7 May 2021 181202 TAAB

CTPG
Level 13
333 George Street
Sydney NSW 2000

Attention: Greg Carmichael

LORETO NORMANHURST

P3 Osborn Road Driveway Review

Dear Greg,

Following the recent submission of the Response to Submissions to the Department of Planning, Industry and Environment in late 2020, additional comments were received by various authorities and the public. This letter aims to provide a response to items that were raised during the notification period.

Department of Planning, Industry and Environment

The RTS and Traffic Assessment report did not confirm whether the proposed link road within the site is a one-way or two-way road. Please provide this information, and if it is a one-way road, confirm the direction of one-way travel and why the proposed direction is appropriate.

As stated in the Operational Traffic Management Plan (OTMP), the proposed link road is one-way from Osborn Road to Mount Pleasant Avenue. This direction has been proposed as concerns have been raised previously regarding right turn movements at the intersection of Mount Pleasant Avenue and Pennant Hills Road. By enforcing this one-way movement and restricting use of this drop off to those travelling to and from the west, vehicles associated with this drop off will only exit left onto Pennant Hills Road. As also noted in the OTMP, a quarterly audit will be undertaken of the Mount Pleasant intersection to ensure parents/carers are only turning left onto Pennant Hills Road.

Please confirm

- *The location of the 15 car parking spaces to be dedicated for Early Learning Centre use*
- *The purpose of the layover area outside the front entrance (P4 Primary car park) of the Boarding Accommodation building*
- *How the above space will be managed to prevent casual parking / general student pick up/drop off*
- *Whether bicycle parking and end of trip facilities will be provided in accordance with the Hornsby DCP.*

The 15 spaces required for the Early Learning Centre development application will be located within the spaces shown in Figure 1, once the P1A carpark and through site link is constructed, the parking spaces that will be impacted by the works (at location ‘B’ and ‘D’ in the figure) will be located within the P1A car park. These spaces will be clearly line marked as well as indicated to staff as part of the staff allocation discussed in Section 6.2.1 of the Operational Traffic Management Plan.

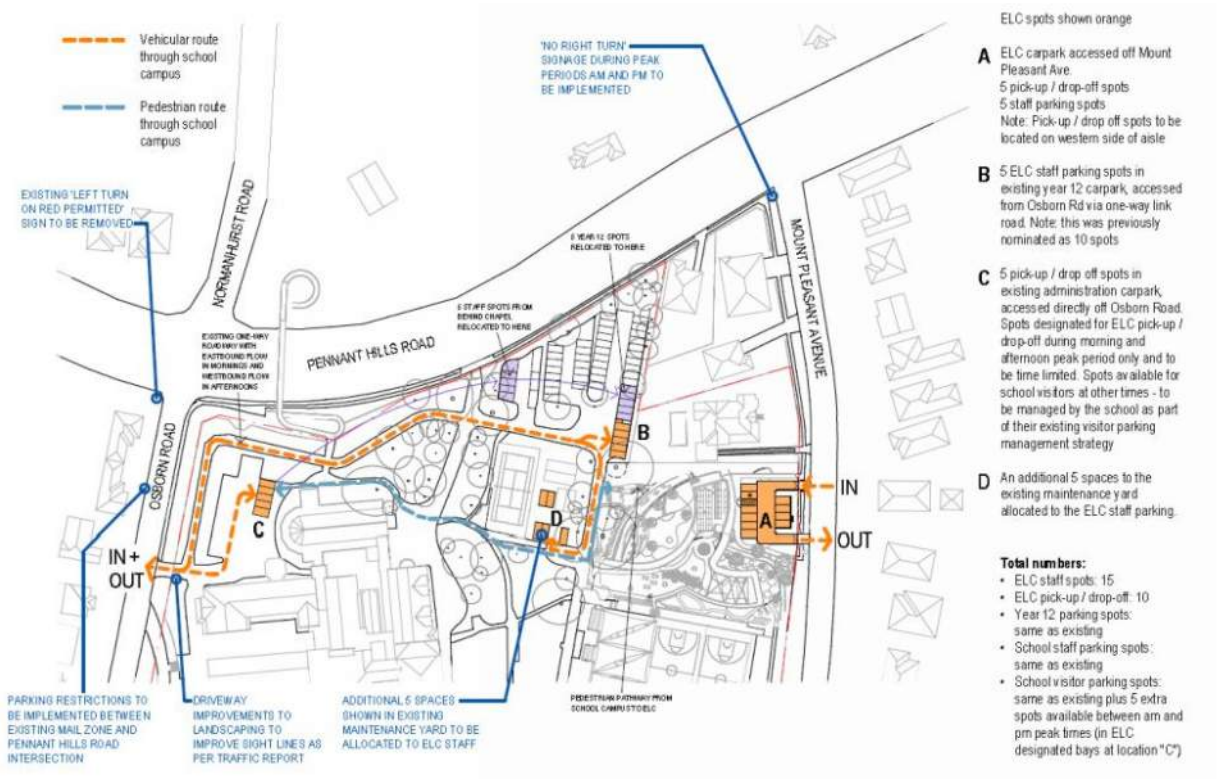

Figure 1: ELC Original Parking Strategy

The layover area outside of the Boarding House will be used for incidental drop off of boarding students (for example parent drop off of a student late on a weeknight or for weekend leave/appointments) which will be a rare occurrence on site. There is a gate to this carpark currently that provides access control through the use of swipe cards. This gate will remain in place restricting the use of this space during typical school days.

Bicycle parking and end of trip facilities will be provided in accordance with Hornsby Shire Council's DCP.

Please provide swept path diagram(s) for the P3A Osborn Road car park pick-up/drop-off area to demonstrate that vehicles have sufficient space to turn around when leaving.

Refer to Appendix A attached for a swept path diagram of the P3A Osborn Road car park.

Please confirm the total number and location(s) of:

- *Existing bicycle parking spaces.*
- *Proposed bicycle parking spaces to be provided within the Boarding Accommodation building and within the Stage 1 works landscaping / car parking areas.*

The School currently has 5 existing bicycle racks located near the Mary Ward Wing in the east of the site.

Council's Development Control Plan requires that bicycle spaces be provided at the following rates for Educational Establishments:

- 1 bicycle rack per 20 full-time staff or part thereof; and
- 5 bicycle racks per class

With the increase in staff and students in the detailed development approval, an additional 14 racks for students and 2 racks for staff are required.

Table 1: Staging of Works and Resultant Bicycle Parking Requirements

	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Increase in Total Student Enrolments	+150	+0	+150	+250	+350
Increase in Full Time Equivalent Staff	+0	+0	+12	+24	+35
Additional Bicycle Parking Requirement	5 racks	0	6 racks	10 racks	14 racks

[1]Note that current student enrolments are below the existing student cap of 1,150 students.

The boarding house has provision for an additional 5 bicycle racks within the basement car park. The P4A car park has also indicated an area for bicycle parking within the car park to accommodate the 6 racks require on its construction.

For Stage 4, as the design is further developed the exact location of bicycle racks will be determined including some external in the landscaping areas. It is recommended that a condition of consent be included that states each development stage must comply with Hornsby Shire Council's bicycle parking requirements as per the above.

Please clarify the following:

- *The exact number of existing school pick-up/drop-off spaces (two or four)?*
- *The proposed number of school bus spaces (one new?)*

The current facility at Osborn Road accommodates 4 pick up and drop off spaces. There will be capacity for 2 additional school buses (total of four spaces) when the existing pick up and drop off is relocated.

Department of Planning, Industry and Environment – Traffic Peer Review Comments

Queuing length resulting from pick-up/drop-off facilities should be included in the volumes of Figure 6.1. Determine if there will be any extensive queues lining up during sharp peak times (8am-8:20am and 3:15pm-3:30pm). Results should also relate to spill back into Osborn Road.

The statement "It was observed on site that some queuing can occur during peak periods as a result of the above geometrical constraints and driver behaviour." In S6.12 needs to be quantified.

The volumes in Figure 6.1 provide movements into and out of the existing pick up and drop off facility and have been used to project future demands of the pick-up and drop-off facility. The proposed pick up and drop off facility will provide through lanes to enable recirculation and will be marshaled to prevent queuing onto adjacent streets. As stated in the Response to Submissions report, the existing pick up and drop off facility is insufficient in terms of length for drop off and has existing geometry that discourages recirculation by drivers. For this reason the relocation of this drop off is proposed as part of the Stage 1 works.

As part of the ELC approval process, drone surveys were undertaken in September 2019 of the intersections of Osborn Road and Mount Pleasant Avenue with Pennant Hills Road to review queue lengths within Osborn Road. These surveys identified a 9 vehicle queue, refer to Appendix B for a copy of this report.

Traffic Report needs to include PM peak results

Reports need to include 95th percentile queues (in metres) and a discussion should be created to identify congested approaches and the extent of queuing as well as potential spill back to adjacent intersections/driveway.

Provide a calibration and validation report for SIDRA modelling and evidence of observed vs. modelled queue length comparisons to ascertain any existing issues, considering site observation was undertaken. The Transport for NSW

Traffic Modelling Guidelines (2013) lists the 95th percentile queue as a core performance element that should be assessed for any intersection modelling using SIDRA intersection. This also ensures that the base models are fit for the purpose of assessing future scenarios.

As part of the ELC approval process, drone surveys were undertaken in September 2019 of the intersections of Osborn Road and Mount Pleasant Avenue with Pennant Hills Road to validate the intersection model. Refer to Appendix B for a copy of this report.

Refer to revised SIDRA model results in Appendix C that include the 95th percentile queue.

Include modelling of a future year scenario to identify impacts on Mount Pleasant Avenue approach, right turn from Osborn Road and the proposed egress route via Normanhurst Road for drivers travelling east due to redistributed traffic. This should be based on Section 5.6.3 of the traffic report which states that there is no timeframe for the installation of the No Right Turn from Mount Pleasant Avenue (south) into Pennant Hills Road (east).

While there is no timeframe for the installation of the No Right Turn, the Operational Traffic Management Plan details how right turns will be restricted for traffic associated with the pick up and drop off:

- Vehicles using the through site link will only be from addresses that are to the west of the School.
- Parents/carers/other drivers will be instructed to only turn left onto Pennant Hills Road.
- An audit of the above instruction will be conducted quarterly to ensure this instruction is followed.

ELC traffic that is required to travel east from Mount Pleasant Avenue has been modelled to travel through the proposed egress route via Normanhurst Road.

Vehicles using the Osborn Road pick up and drop off (those travelling to the east of the School) have been modelled in the future year scenario to turn right onto Pennant Hills Road.

As the through site link is one-way in an east direction only, no vehicles will travel from Mount Pleasant Avenue to Osborn Road.

Include indication of the timing of each stage of the development and modelling to determine progressive impacts and the need for design modifications prior to the full development being realized.

The development seeks approval for the detailed DA for stages 1-4. As such the modelling has been conducted to account for the full stage that is seeking detailed approval and for the full concept stage development.

Any future development applications for building work within the site will have an associated Traffic Impact Assessment that will review the proposal in relation to the overall traffic and assess whether any design modifications will be required.

Including modelling of Pennant Hills Road/Normanhurst Road/Osborn Road and Pennant Hills Road/Mount Pleasant Avenue intersections as the outputs show that westbound queues on Pennant Hills Road at Normanhurst Road/Osborn Road spill back beyond Mount Pleasant Avenue

Existing models should incorporate User-Given Phase Times using the Transport for NSW Intersection Diagnostic Monitor data to reflect actual traffic conditions on the individual approaches. The future models can use Practical or Optimal Cycle Time where necessary.

Refer to revised SIDRA model results in Appendix C with the intersections modelled as a network model. While the westbound queues extend past Mount Pleasant Avenue, this is an existing issue shown in the 2019 existing model and evidenced by the installation of signage to prevent queuing over the intersection. Queues are shown to reduce in the future due to reduced vehicle volumes as a result of Northconnex.

Figure 2: Existing Signage at Mount Pleasant Avenue and Pennant Hills Road Intersection

User given phase times have been applied based on SCATS data received for Thursday the 7th of November 2019.

Surveyed pedestrian volumes should be used for assessing the overall impact, rather than default pedestrian volumes.

The north and south intersection legs on the Pennant Hills Road/Osborn Road/Normanhurst Road intersection provide signalised pedestrian crossings. These crossings experience low volumes of pedestrians during school peak times as train and bus connections are located to the east of Normanhurst Road.

The traffic counts completed as part of the original submission found low pedestrian volumes of 1 pedestrian across Normanhurst Road and 21 pedestrians across Osborn Road. As such, the default of 50 pedestrians across both crossings allows for a more conservative approach than applying the existing pedestrian volumes experienced at the site.

The Operational Traffic Management Plan (OTMP) indicates drivers are instructed to 'recirculate' if spaces are available or children aren't ready. Confirm what is the extent of queuing as a result of circulating and whether it would spill back to the exit driveway and/or impact through vehicles on Osborn Road and parking.

Recirculation of vehicles is to prevent cars from stopping internally and queuing back onto external roads. By having a through lane adjacent to the pick up and drop off areas, vehicles will not be required to stop to wait for a location to pull into a drop off bay. As such vehicles will be moving in free flow without queuing.

Confirm how management measures will ensure that drivers do not stop within the through site link to pick up and drop off to avoid recirculating via Mount Pleasant Avenue, Pennant Hills Road and Osborn Road. Eg. Traffic marshalls, no stopping restrictions.

As stated in the Operational Traffic Management Plan, traffic marshals will be used on site to direct vehicles to continue circulating. No stopping restrictions will also be in place along the internal roadways.

Confirm how management measures will ensure that impacts (if any) of drivers using the Osborn Road pick-up/drop-off facilities requiring to recirculate are not exacerbated by the recirculation arrangements (ie. Point 8 above).

Traffic marshals will be in place to direct vehicles to recirculate and prevent queuing onto Osborn Road.

Traffic Impact Assessment Peer Review (Organised by Residents)

There is no evidence of queuing analysis in the traffic report. A detailed microsimulation analysis or numerical queuing assessment would be required to clarify queuing issues.

Inappropriate modelling platform has been used for the purposes of the assessment. A microsimulation platform would be recommended for further traffic modelling and assessment.

In accordance with Austroads Guide to Traffic Modelling, microsimulation models are generally appropriate for large scale analysis (refer to Section 8.3 of Austroads Guide to Traffic Management art 3 Traffic Study and Analysis Methods). The proposed development is not of a significant scale such as to warrant development of a microsimulation model. Further, this has not been requested during consultation with both Transport for New South Wales and Hornsby Shire Council.

SIDRA traffic model has not been validated in terms of queue length at both intersections, and should be undertaken in a network arrangement rather than isolated intersection modelling.

Drone surveys were undertaken to validate intersection modelling during the preparation of the ELC development approval (refer to Appendix B).

Refer to revised SIDRA model results in Appendix C for modelling results of the site as a network.

A pedestrian survey at the intersection due to numerous students crossing the signalized intersection should be undertaken.

There are no crossings provided across Pennant Hills Road. Previous surveys of the intersection indicated that low pedestrian volumes were experienced at the signalised crossings due to the availability of the pedestrian overpass and the location of bus and train connections.

TTW traffic engineers have not undertaken a site observation to determine the local background traffic issues associated with Loreto.

As stated in the traffic report TTW were on site to observe the current pick up and drop off arrangement and also attended site numerous times during the preparation of the Response to Submissions reporting.

The GTP mode targets are aspirational and impractical and COVID has not been taken into account.

Hornsby Shire Council's Community Plan 2013-2023 provides reference for travel targets within the Hornsby Shire Council Local Government Area for the year 2023. The 10 year goals dictated within the plan provided targets related to sustainable travel that Council aims to achieve (refer to Figure 3). These targets are more aspirational than those detailed in the Green Travel Plan.

MY LIFESTYLE						
	Indicator	Purpose	Measure	Data source	Target /Trend	Frequency
3.1.P	Opportunities for seniors and people with a disability to care for themselves independently are increasing	To track the number of people able to stay comfortably accommodated in their own homes	Number of new residential dwellings approved for seniors and independent living	Hornsby Shire Council's Planning Division	975 dwellings by 2021 (2011 = 675)	4 years
3.2.P	Use of sustainable transport for local trips is increasing	To track the use of local sustainable transport	Percentage of local trips (less than 5 km) by residents using sustainable transport options (walking, riding, public transport)	Statistically valid survey of residents	50% of all trips	4 years
3.3.P.a	Use of sustainable transport options is improving		Percentage of employed residents who travel to work using sustainable transport most days	ABS census data when available. Statistically valid survey of residents at other times	27.1% (2011 ABS Census)	4 years
3.3.P.b			Percentage of car trips on an average weekday is decreasing	Bureau of Transport Statistics, Household Travel Survey	72% of all trips (2010/11)	Annual

Figure 3: Measuring Progress
Source: Hornsby Shire Community Strategic Plan with 4 Year Delivery Program

As part of Hornsby Shire Council's Integrated Land Use Traffic Study, a Car Parking Management Study was developed that addressed parking management within the Shire. Identified within this Car Parking Management Study was a trend away from vehicle usage, with public transport use growing 30% and car driver/passenger modes reducing by 4% over a five-year period from 2011 to 2016. This is also in line with the targets proposed within the Green Travel Plan.

Table 2.13: Travel mode statistics from the 2011 and 2016 Census for the suburbs of Cherrybrook and Normanhurst

Travel Mode	Cherrybrook				Normanhurst			
	2011	2016	% Growth	2019 Forecast	2011	2016	% Growth	2019 Forecast
Public Transport	2,071	2,311	12%	2472	590	769	30%	909
Car Driver or Passenger	5,876	5,380	-8%	5108	1,274	1,218	-4%	1186
Train	716	894	25%	1027	581	750	29%	881
Bus	1,355	1,417	5%	1456	9	19	111%	32
Walked	109	64	-41%	48	57	74	30%	87
Total	**10,127**	**10,066**	**-1%**	**10081**	**2,511**	**2,830**	**13%**	**3091**
Total Car	**5,876**	**5,380**	**-8%**	**5108**	**1,274**	**1,218**	**-4%**	**1186**
Total Other Mode	**4,251**	**4,686**	**10%**	**4974**	**1,237**	**1,612**	**30%**	**1905**

Table 2: Changes in Travel Mode Statistics from 2011 to 2016
Source: Hornsby Shire Council's Car Parking Management Study

At this time, it is unclear what the lasting impact of COVID will be to transport in the future. The Green Travel Plan is a dynamic document that is continually updated per year to adjust to changing travel behaviours and therefore will be able to adjust to changing behaviour that may occur post-COVID.

A holistic Road Safety Audit of the surrounding road network during school time has not been undertaken.

We note that a previous Road Safety Audit was conducted of the pick up and drop off as part of the ELC response to the Sydney Northern Planning Panel and has been attached in Appendix B.

A Road Safety Audit as part of a Condition of Consent has been requested by TfNSW in their response and is likely to form a condition of consent.

Transport for New South Wales

The existing vehicular access on Pennant Hills Road shall be closed to general traffic between Monday and Friday and will be only allowed use on the weekend for ceremonial vehicles accessing the Chapel.

While the majority of ceremonial use would be on the weekends, there may be some occasional use of this access during the week for events such as funerals. We request use of this be extended.

There should be suitable pedestrian paths/facilities within the vehicle accessible areas to corral pedestrians to appropriate crossing locations.

Pedestrian pathways have been considered in the concept design and will be further incorporated in the detailed design.

All vehicles are to enter and exit the site in a forward direction. Provision for vehicles to turn around must be provided within the property boundary.

This has been provided in the original Response to Submissions.

A number of other additional conditions were recommended as part of TfNSW's response that we accept.

Hornsby Shire Council

Traffic and Safety

Council has received representations from some members of the community concerning traffic, parking and drop-off/pick-up arrangements associated with the current operation of Loreto Normanhurst School. A number of residents comment that the proposal to significantly increase student numbers will exacerbate these existing problems. In the Department's assessment of the traffic and parking impacts associated with the proposed increase in student population, the Department should be satisfied the following has been adequately addressed:

Drop-Off/Pick-Up

In the traffic report 6.1.2 it states that 'TTW has collected tube counts of the existing access and egress points into the School and conducted a site visit during a peak morning drop off period to observe current driver behaviour.' The traffic analysis and queuing survey appears to be only conducted during the morning peak, not afternoon peak. It should be noted that drop off behaviour is different from pick up behaviour since in the pick-up, parents often come to the school site early and wait for the children to arrive. Queuing of vehicles on surrounding streets that adjoin the School is an existing issue shared by residents and Council and has been observed to last for a long period of time and is the primary reason for long queues back to Osborn Road during the afternoon peak. The traffic report does not identify or discuss the queuing situation during PM pick up time.

The traffic count survey was also conducted during the afternoon peak as shown in Figure 6.1 of the Response to Submissions report. As evidenced by the tube count survey, afternoon peak movements through the facility are approximately half of those in the morning peak. Nevertheless, traffic modelling has been conducted of the afternoon peak and detailed results are shown in Appendix B.

As part of the ELC development, drone surveys were undertaken in September 2019 of the intersections of Osborn Road and Mount Pleasant Avenue with Pennant Hills Road. These drone surveys indicated a peak queue on Osborn Road of 9 vehicles and showed that queues cleared during each intersection cycle. A summary report has been attached in Appendix B.

In previous conversations with School representatives, it was established that the School does not currently open their access gate until the afternoon pick-up is about to begin. Prior to this, parents who arrive early sit idle in their vehicles on Osborn Road, queuing to access the School through the gates. This appears to start at least 30 minutes prior to pick-up. Currently the afternoon queuing travels down Osborn Road into the intersection with Pennant Hills Road. On Pennant Hills Road the queuing is in the northbound right turn lane (into Osborn Road) and in the southbound lane three queuing to turn left into Osborn Road. The current allowance provided by the school is 4 pick-up spaces and only 3 queuing spaces. The existing queue reaches far beyond this onto the State Road.

Loreto is aware of the current issues with the existing pick up and drop off facility accessed by Osborn Road, as such the relocation of this facility has been prioritised to occur in Stage 1 of the development.

The School proposes that as the development stages, progress and the School population increases, so will the additional requirement for queuing spaces. However, it is evident from the current operation of the School that the number of vehicles queuing is closer to the proposed allowance of 15 to 16 vehicles as estimated for the Stage 4 of the development and the existing capacity is already insufficient for current demand. As the population of the junior school increases, so will the desire for parents to have access to the School to pick-up primary aged children. The Department should consider bringing any proposal for works to reduce traffic queuing for drop off and pick up to Stage 1 or before any increase in student population is approved that would lead to an increase in vehicles to the School occur.

Vehicles queuing are a result of the lack of recirculation that currently occurs due to geometric constraints reducing use of the recirculation. Allowing for this recirculation and providing additional queuing area within the school site will eliminate the need to queue on the surrounding streets.

The relocated Osborn Road pick up and drop off proposed as part of Stage 1 of the works will reduce traffic queuing, which is why it has been prioritised to the beginning of the development works.

The proposed future road link through the site has the potential to create other traffic and safety issues to the Mount Pleasant Avenue intersection which is not signalised. The through link would send traffic out to Mount Pleasant Avenue and the traffic would use the intersection of Mount Pleasant Avenue with Pennant Hills Road. This intersection is subject to many complaints regarding safety and delays and signalisation of the intersection at Mount Pleasant Avenue and Pennant Hills Road should be required should this application be approved as a condition of consent.

Loreto is aware that right turn movements at the intersection of Mount Pleasant Avenue and Pennant Hills Road have associated safety concerns. As discussed with Hornsby Shire Council during the preparation of the Response to Submissions Loreto is supportive of signalisation of this intersection, however TfNSW does not support this due to its proximity with the signalised intersection of Osborn Road and Pennant Hills Road. To reduce safety concerns, the OTMP provides a management solution such that only left turns will be required out of Mount Pleasant Avenue onto Pennant Hills Road as a result of Loreto traffic.

Increasing or relocating the internal queuing area would not address all traffic issues on Osborn Road at present or in the future. It is recommended that Osborn Road be widened to accommodate two traffic lanes along the School side as well as the proposals from traffic report.

Widening of Osborn Road was discussed with the Department of Planning, Industry and Environment. Widening would result in a significant loss to streetscape amenity along Osborn Road due to the required removal of a number of trees.

The traffic issues on Osborn Road are a direct result of the deficiency in queuing area and lack of recirculation currently occurring within the school site. Once vehicles are able to queue internally to the school with the relocated Osborn Road pick up and drop off then improved capacity for the local street traffic will be experienced on Osborn Road.

On Street Parking

The initial development plan states the School has approximately 300 members of staff, but only 179 car parking spaces on site. Council has observed that currently, a high proportion of the School staff and students park on the residential side of Osborn Road and Mount Pleasant Avenue. This observation is further confirmed by the Application in Section 4.3 Parking Supply document (page 12) whereby it is noted that the School currently has an existing shortfall in parking on campus. The Applicant proposes to manage this parking shortfall in the future through a proposed Green Travel Plan. While the Green Travel Plan is welcome, the proposal states that parking onsite will increase in stages in accordance with rising enrolments and staff numbers. In addition, the Staff Travel Surveys conducted for the initial development proposal in 2019, indicated that 89.1% of staff drive to School, but the current proposal does not come close to meeting the need for additional staff parking and would not address existing parking issues on surrounding roads as a result of the school enrolment and staff numbers. Additional parking provision to meet demand should be required prior to any increase in student and staff numbers.

To achieve long term Green Travel Plan objectives, other modes of transport need to be made more efficient and attractive. By providing full capacity for staff internal to the site, there is reduced incentive for staff to adopt the principles introduced in the Green Travel Plan.

This aligns with the principles detailed in Hornsby Shire Council's Car Parking Management Strategy (detailed in the extract shown in Figure 4), specifically that the provision of parking is to be undertaken through a "*demand management, not a demand satisfaction approach*".

This approach is also in line with Council's Draft Sustainable Hornsby Policy 2040, including item C2.4 to "*advocate for the reduction in use of private vehicles and increased use of public transport*" which is given a high to medium priority within the Policy. The provision of the full car parking on site would encourage the use of private vehicles by staff and discourage uptake of public transport.

The proposed concept plan has the ability to provide parking for the full staff parking demand through the future underground car park subject to future travel demand studies to be undertaken during Stage 5 of the concept plan. This allows for travel demand management measures to be put in place to reduce car parking requirements, however if they are unsuccessful a higher car parking rate can be provided for within the site.

Unresponsive to Demand Management: There are numerous examples of cost-effective parking management measures that do not require increasing the supply of parking. Examples include shower and locker facilities for employees who walk or cycle, unbundling employee parking from salary packages, providing free passenger transport passes for employees, and developing workplace travel plans. Minimum parking ratios fail to account for demand management strategies and therefore provide no incentive for consideration of alternative transport modes.

For these reasons, minimum parking ratios are considered to be inaccurate and inefficient. It is also significant that the costs associated with minimum parking ratios have become disproportionately high in relation to their advantages.

With the benefit of overseas studies[16], it is apparent that the unintended negative consequences of minimum parking requirements outweigh their benefits in urban areas. These detrimental impacts have, to a large extent, been self-reinforcing and have created a cycle of motor vehicle dependence. This cycle occurs as a result of the following processes:

- Increased vehicle use creates additional demand for parking.
- This increased demand is then reflected in increased minimum parking ratios.
- These increased parking ratios then result in reduced urban density.
- Reduced urban density then stimulates increased vehicle use, repeating the cycle.

The net effect of free or subsidised parking is reduced urban density, increased sprawl, high rates of vehicle ownership and use, more expensive goods and services, as well as increased congestion, air pollution, and noise. This is an eventual scenario for the Town Centres if no action is taken. In short, current parking management practices contribute towards a host of expensive and undesirable consequences. This approach is unsustainable, especially with the anticipated growth of development in the Shire.

Coordinate the parking study for the Shire with an integrated transport strategy. The integrated transport strategy is to incorporate five sustainable parking principles:

- Focus on people movement rather than vehicle access.
- Provide efficient and effective alternatives to car access.
- Parking policy and strategy must support sustainable transport.
- The appropriate amount of parking for a centre will be well below the unconstrained demand for parking.
- The provision of parking requires a demand management, not a demand satisfaction approach.

Figure 4: Extracts from Draft Car Parking Management Strategy
Source: Hornsby Shire Council

Footpath capacity

The increased pedestrian movements will create a situation where the existing 1.2m wide footpath cannot safety accommodate pedestrians. In the Department's Assessment, consideration should be given to upgrading the footpaths adjoining the site to 2m width along the pedestrian desired lines. It is acknowledged

that a plan should be submitted to demonstrate how a widened footpath in addition to an extra lane along the Osborn Road frontage of the site could be accommodated within the building setbacks. A plan showing the dedication of part of the site for the purposes of road widening to accommodate the proposal may be required.

No pedestrian entries to the school on Osborn Road currently exist and no new entries are proposed as part of the Concept Plan. The proposed main entry to the school site is from Pennant Hills Road, with additional pedestrian entries provided along Mount Pleasant Avenue. By reducing pedestrian entry points, potential pedestrian-vehicle conflict points are able to be controlled and monitored by Loreto during peak times.

Prepared by
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in its capacity as trustee for the
TAYLOR THOMSON WHITTING NSW TRUST

GRACE CARPP
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PAUL YANNOULATOS
Technical Director

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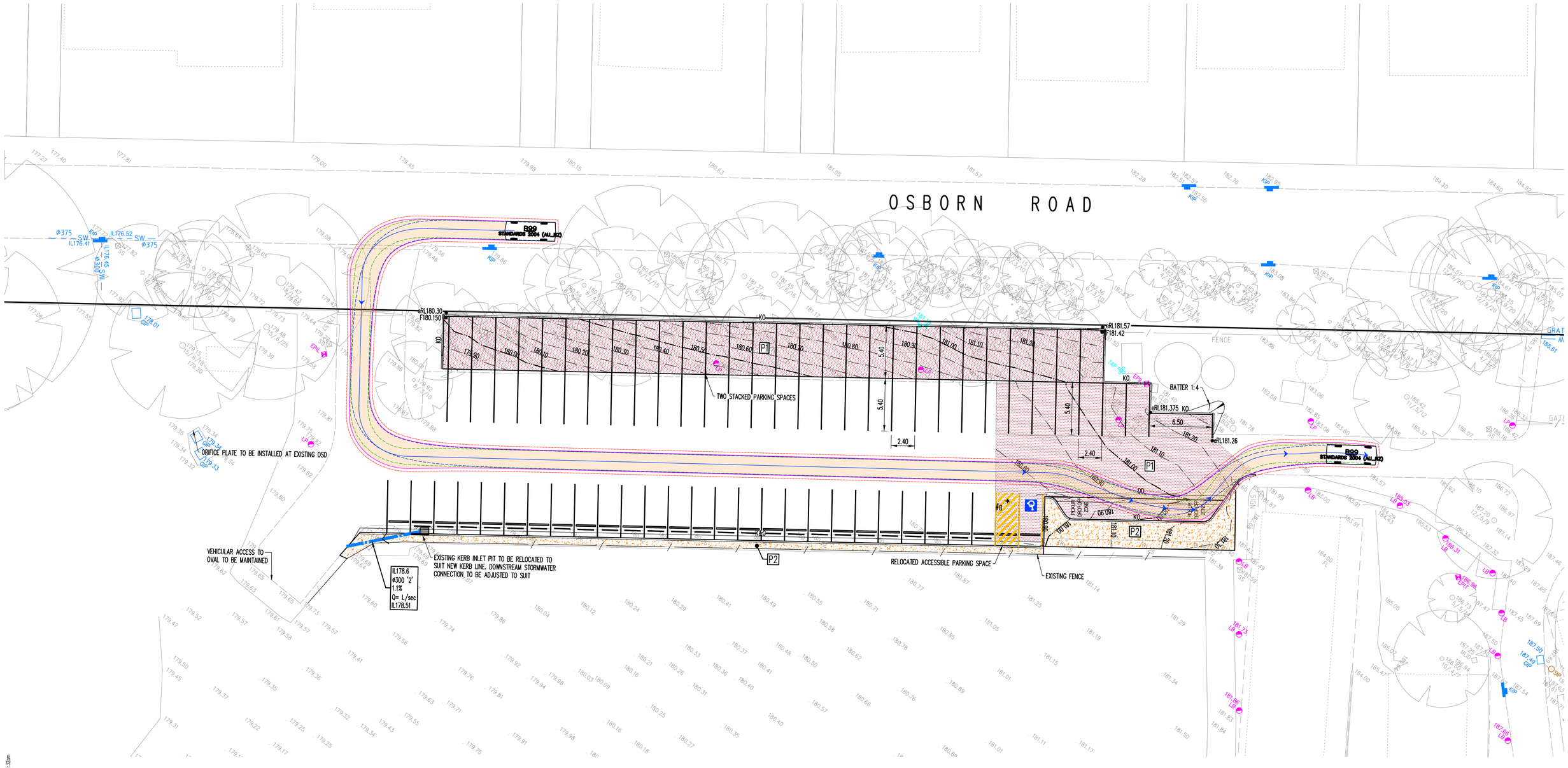
Appendix A – Swept Path Analysis for P3A Pick Up and Drop Off

THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL RELEVANT NOTES ON DRAWING C101



P3A CAR PARK – B99 SWEPT PATH

FileName: SKT03.dwg - USER: grosic - Plot File Created: Apr 23, 2021 - 11:32am

A1 0 1 2 3 4 5 6 7 8 9 10

Rev	Description	Eng	Draft	Date
P1	ISSUE FOR SSDA	GC	GC	23.04.21

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Project
LORETO NORMANHURST,
91-93 PENNANT HILLS ROAD
SITE A, BOARDING HOUSE

Sheet Subject
TURNING PATH ANALYSIS
SHEET 3

Scale : A1	Drawn	Authorised
1:250	GC	PY

Job No	Drawing No	Revision
181202	SKT03	P1

Plot File Created: Apr 23, 2021 - 11:32am

Appendix B – Loreto Normanhurst Early Learning Centre (ELC) Response to Deferral Decision prepared by Ason Group 11 November 2019

Reference: 0731l06v4

11 November 2019

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Attention: Matthew Miles – Senior Town Planner

Re: Loreto Normanhurst – Early Learning Centre (ELC)
Response to Deferral Decision; Traffic and Transport

Dear Matthew,

The below provides Ason Group's response to the request for further information following the Sydney North Planning Panel (the Panel) meeting held on Wednesday 11th September 2019. The Panel Deferred the Development Application (DA) decision for the proposed Early Learning Centre (ELC) in Mount Pleasant Avenue, Normanhurst (the Site) (reference: 1227/2018), while further investigation into the traffic impacts of the ELC were undertaken.

Our approach to the additional investigation was discussed with the Development Assessment Team at Hornsby Council (Council), and the findings of this additional investigation are summarised below.

Executive Summary

The key issues raised at the Panel related to network operation and safety alongside parking demands of the Loreto Normanhurst School (the School).

With regard for network operation and safety, drone surveys were undertaken in September 2019. These surveys provided valuable insight and further validation to the analysis already undertaken by Ason Group as part of the DA traffic and transport assessment. The key findings and conclusions from this assessment are:

- Osborn Road
  - SIDRA intersection analysis indicates that the Pennant Hills Road (PHR) and Osborn Road intersection currently operates with good Level of Service (LOS B), with acceptable delays and spare capacity.
  - This has been confirmed by drone surveys which demonstrated only minor queueing in both the AM and PM peak periods. Further, the drone footage demonstrates that these queues clear under each intersection cycle.
  - With regard to the ELC Proposal, the addition of 20-25 vehicles during the peak periods would have a negligible impact on the operation of this intersection. This is particularly notable when considering that the ELC would be operational between 7:00am-6:00pm, and therefore the peak PUDO for the ELC would not correspond with the School peak periods.
- Mount Pleasant Avenue (MPA):
  - The drone footage has demonstrated that MPA is not highly trafficked and that any delay to vehicles turning right into / out of MPA relates to vehicles having to cross 3 lanes on PHR. Therefore, the signage banning this movement to be implemented as part of the ELC development is appropriate and supportable.
  - The drone surveys also demonstrated very minor queues within the MPA / PHR intersection. Queues generally were associated with left turning vehicles (maximum of 3 vehicles) and only small percentages of right turning vehicles were observed during the peak periods.

The drone footage and SIDRA analysis to date has demonstrated that the 2 key intersections assessed currently operate with good LOS and spare capacity, with the exception of the right-turn from MPA, which is to be banned as part of the ELC DA. Therefore, the net increase in traffic generation expected as a result of the ELC (which equates to 20-25 vehicles on MPA and Osborn Road) can be accommodated by the existing road network.

Parking will be provided for the ELC in accordance with Council's DCP. This consists of 10 new parking spaces to be provided with the ELC car park and repurposing spaces which are not currently utilised within the School Grounds. Nevertheless, following comments received during the Panel, a further 5 spaces are to be provided within School Grounds to alleviate residents' concerns with regard to the School demands on on-street parking.

Key Issues

The key issue raised by the Panel (alongside the residents in the local area) of which Ason Group are responding generally related to network operation and safety. More specifically, intersection delay resulting from the traffic generated by the existing Loreto Normanhurst School (the School).

The second key issue, which was a concern mainly raised by residents, was in relation to there being insufficient parking for the ELC and that currently the School relies heavily on on-street parking during the day.

Network Operations and Safety

So as to record the current operation of the network, with specific reference to Osborn Road and Mount Pleasant Avenue (MPA), drone surveys were conducted between 25th September and 27th September 2019. The surveys included the following:

- Wednesday 25th September – AM and PM peak hour operation of the Pennant Hills Road (PHR) / MPA intersection (7:30-9:00am and 2:55-3:50pm) and PHR / Osborn Road intersection (7:30-9:00am and 2:45-4:45pm);
- Thursday 26th September – PM peak hour operation of PHR / Osborn Road Intersection (2:50-4:30pm); and
- Friday 27th September – AM peak hour operation of PHR / Osborn Road Intersection (7:55-8:55am).

The footage of these videos can be found at the below link, with screenshots of typical and peak queuing observed (found during the drone surveys undertaken on Wednesday 25th September) provided by **Figure 1**, **Figure 2** and **Figure 3**:

https://www.dropbox.com/sh/7kix816gxvlmszj/AADRSUOgrq5HQJ4wJSAexg_0a?dl=0

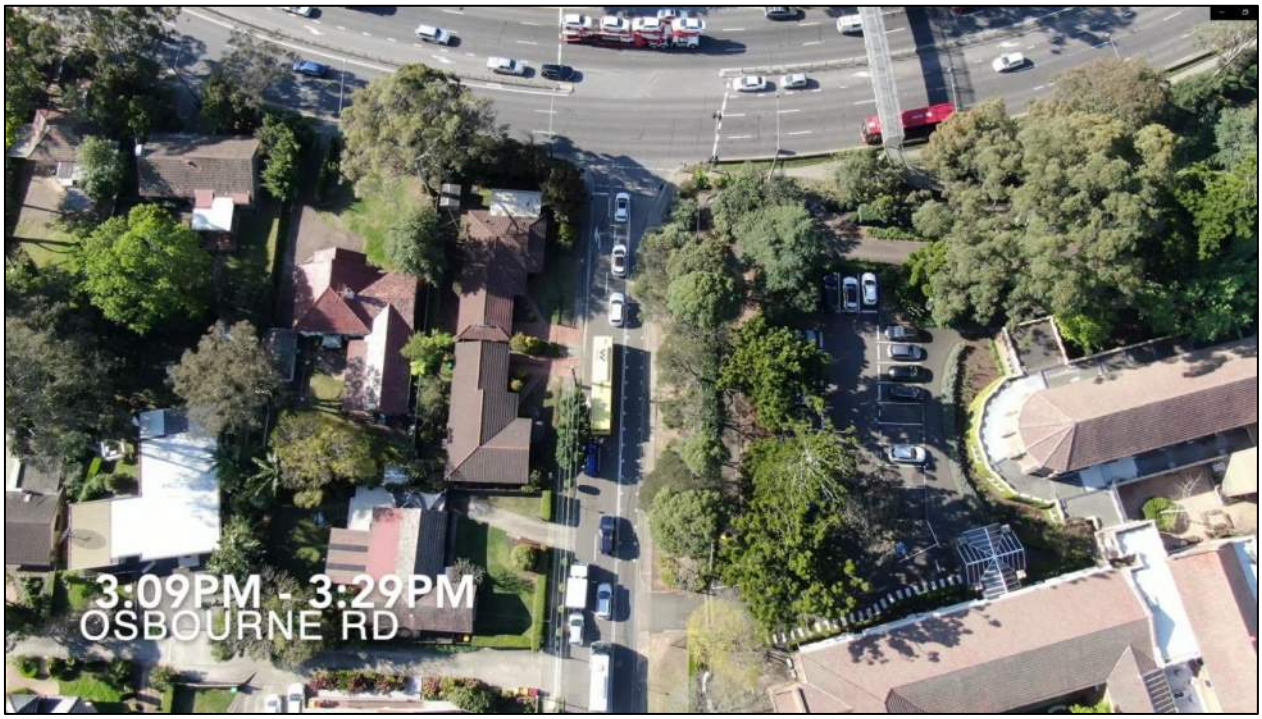


Figure 1: Peak Queuing Observed on Osborn Road

Figure 2: Typical Queuing Observed on Osborn Road

Figure 3: Typical Queuing Observed on Mount Pleasant Avenue

With the exception of Year 12 students, the attendance at the School during the survey period was as follows:

- 92% attendance on Wednesday 25th September
- 90% attendance on Thursday 26th September

Only staff attended the School during the AM peak hour survey of the PHR / Osborn Road intersection undertaken on Friday 27th September, providing insight into the changes in operation of this intersection when students are not in attendance at the School.

As noted, Year 12 students were not in attendance during the survey period. The School's current student population includes a total of 1,096 students; of this 14% (157) are Year 12 students. Questionnaire travel surveys were undertaken of staff and student travel for the purposes of Master planning for the wider School. These surveys found that, on a typical day, 44% (69) of Year 12 students drive to School.

An average car occupancy of 1.2 students per vehicle was found by the travel surveys, which includes Year 12 students driving younger siblings to School. Therefore, of the School population Year 12 students represent a total of 58 independent car trips.

The surveys found that:

- Approximately 88% (51) of students parked within School Grounds with access via Osborn Road,
- The remainder of Year 12 students reported utilising on-street car parking elsewhere in the area,
- Notably no Year 12 students reported parking on-street in Osborn Road.

Therefore, the Year 12 traffic generation represents an additional vehicle on Osborn Road every 1-2 minutes, which would not materially impact the traffic conditions which were recorded by the drone surveys.

Results of surveys

Osborn Road

The drone surveys demonstrated only minor queueing in both the AM and PM peak periods. Whilst some queuing was observed during the peak morning and evening pick-up times, the videos demonstrate that these queues clear under each intersection cycle. The maximum number of vehicles observed existing at any time from Osborn Road under each cycle was some 9 vehicles (Figure 1). The peak observed times were between 8:17-8:33am in the morning peak and 3:10-3:25pm in the afternoon peak. Please refer to the link above to view these.

This validates the SIDRA analysis undertaken by Ason Group, which found that the intersection was operating with a good Level of Service (LOS B), with acceptable delays and spare capacity. The potential to widen Osborn Road in the vicinity of its intersection with PHR was a suggestion raised at the Panel to create additional capacity for vehicles leaving Osborn Road (i.e. additional left / right / through lanes from Osborn Road). However, the SIDRA analysis, which has been confirmed and validated by the drone surveys, illustrates that this is not required.

Notwithstanding the above, it was observed during the surveys that parking within Osborn Road on the eastern side does impact the ability of vehicles (notably for buses) to merge into the left-hand lane during peak periods (**Figure 4** and **Figure 5**). Based on the observed surveys, it is our recommendation that the spaces north of the Post Box, as illustrated by **Figure 6**, either be removed or be limited to times outside of School peak to improve the traffic flow in Osborn Road.

Finally, it is worthy of note that, while there were less vehicles observed on Osborn Road during the Friday AM survey period, there was still queuing observed when students were not in attendance at School, with a peak of 5 queued vehicles recorded.

Figure 4: Osborn Road On-street Parking

Figure 5: Osborn Road On-street Parking

Figure 6: Osborn Road On-street Parking to be Restricted

Critically, in terms of the ELC, the surveys clearly demonstrate that there is minimal if any queueing during the corresponding pick-up / drop-off (PUDO) times (generally 7:00-8:00am and 4:00-5:30pm), thereby confirming the conclusions found in the original traffic report by Ason Group and agreed by both Council and RMS that sufficient capacity exists in the network to accommodate the Proposal.

Mount Pleasant Avenue

As reported by the travel behaviour surveys undertaken for the Master Plan, an insignificant portion of Year 12 students utlise MPA to access the School (4 in total). Therefore, the drone surveys have provided an excellent insight into the operation of MPA and its intersection with PHR.

The drone surveys also demonstrated very minor queues within the MPA / PHR intersection. Queues generally were associated with left turning vehicles (maximum of 3 vehicles) and only small percentages of right turning vehicles were observed during the peak periods. A review of the drone footage demonstrated a maximum queue of 3 vehicles during the survey period, again confirming the conclusions reached by Ason Group, RMS and Council.

Road Safety Audits

Road Safety Audits (RSA) of the existing conditions on Osborn Road and MPA were undertaken by DC Traffic Engineering to highlight any existing potential road safety concerns. These RSAs are provided as **Attachment 1**, with the key outcomes of the RSAs summarised below

Osborn Road

The Osborn Road RSA included a number of suggestions which should be considered by Council and RMS, such as footpath improvements works, tree pruning, relocating traffic signs, re-instalment of pavement markings and review of the permitted left-turn on red. The School would work with both agencies to accommodate the recommendations where possible.

With regard to RSA ref 6 (*Osborn Road in its immediate departure from Pennant Hills Road*), concern has been raised with the narrow departure from PHR into Osborn Road. The key concerned with the width of the southbound lane included limited space for vehicles to negotiate the departure as well as a kinked travel path from Normanhurst Road straight into Osborn Road, resulting in excessive slowing of vehicles.

It is noted that there *are very few easy solutions to addressing these issues*. It was suggested by the RSA that larger scale improvements would be required to resolve these identified issues such as road widening. However, the drone surveys have illustrated that the signalised intersection currently operates efficiently and safely. This in part, due to low volumes of traffic which are required to make these manoeuvres.

Therefore, for a Proposal such as the ELC, which would increase traffic generation on Osborn Road by 20-25 vehicles during the peak period, a large-scale measure such as road widening would not be warranted. This is particularly notable when considering that the ELC would be operational between 7:00am-6:00pm, and therefore the peak PUDO for the ELC would not correspond with the School peak periods.

In terms of items which the School can address, such as tree pruning, these would be implemented by the School where possible.

Mount Pleasant Avenue

The key issue identified by the RSA for MPA was the concern with the permitted right-turns. Signage banning the right-turn will be implemented as part of the ELC development (already suggested by Council as a Condition of Consent) and therefore would resolve this key issue.

Tree pruning works, where possible would be undertaken by the School. Many of the other items suggested are recommended to be considered by Council / RMS, such repairing pot holes, tree pruning on public land, relocation of traffic signs and installation of pavement markings.

Further detail on each of the items provided within the RSAs, alongside who is responsible / Ason Group's recommendations, is provided in **Table 1** and **Table 2**.

Table 1: RSA Summary Table – Osborn Road

Ref.	Comment	Responsibility / Recommendation
1.	**Comment:** the combined effect of the curvature of this road, and overhanging tree foliage on the inside (northern) side of the curve have affected the sight distance **Suggestion:** Driver visibility to the primary signals could be improved by pruning the tree foliage and relocating the parking restriction signs.	Any works to foliage and signage on the public roadway need to be undertaken by the asset owner (RMS and / or Council). The School will place maintenance requests for tree pruning works.
2.	**Comment:** A dynamic flashing light unit has been provided to alert westbound drivers of the traffic signals in the road ahead… the flashing light unit is not optimally positioned. **Suggestion: i**f the flashing light unit was relocated…As such, the flashing light unit would be more meaningful as the driver would receive both advanced warning messages at the same time.	As above, any works to the public roadway need to be undertaken by RMS and / or Council. The RSAs will be provided to RMS for their review.
3.	**Comment:** The northbound left-turn movement from Osborn Road to Pennant Hills Road contains LEFT TURN ON RED PERMITTED AFTER STOPPING signs (LTOR rule). This does not appear to be appropriate for a left-turn onto Pennant Hills Road, as a major and high-volume arterial route. **Suggestion:** With minor adjustment works to include red arrow aspects, the left-turn movement to Pennant Hills Road West could easily become fully controllable, and adaptive to differing traffic conditions of the day. The adjusted signal hardware and phasing may also be able to replace the LTOR rule such that there are no longer any uncontrolled left-turn movements.	Any alterations to the phasing of the signals are the responsibility of RMS. However, it is noted that the safety concern raised has regard for uncontrolled left-turns onto the high-volume PHR. As recorded by the drone survey, this intersection is operating safely and efficiently and therefore, Ason Group does not deem the suggestion to change the phasing of the signals to be required at this stage.
4.	**Comment:** In the westbound direction of Pennant Hills Road…is also a pedestrian fence on the median which obstructs the sight bench available across the median. This restricts the stopping sight distance (SDD) from westbound drivers to the right-turn lane to Normanhurst Road. **Suggestion:** As the pedestrian fence is a major contributor to the loss of sight line to this right-turn lane, and this is also a critical safety amenity itself, the audit team does not recommend any adjustment or removal of this fence. Without increasing the length of the right-turn lane, there is little that could be done to improve driver advanced visibility and awareness of conditions in this lane.	N/A – Requires RMS review.
5.	**Comment:** In the eastbound direction of Pennant Hills Road…also a pedestrian fence on the median which obstructs the sight bench available across the median. This restricts the stopping sight distance (SDD) from eastbound drivers to the right-turn lane to Osborn Road.	N/A – Requires RMS review. It is critical to note that this is a sightline issue caused by the pedestrian fencing along PHR (i.e. a physical issue) and not an issue that relates to the traffic generation in the area. As

Ref.	Comment	Responsibility / Recommendation
	Suggestion: As the pedestrian fence is a major contributor to the loss of sight line to this right-turn lane, and this is also a critical safety amenity itself, the audit team does not recommend any adjustment or removal of this fence.	noted by the RSA, this fence is an important safety amenity in itself and therefore it is not recommended to remove it
6.	**Comment:** The Osborn Road southbound departure from Pennant Hills Road is narrow. **Suggestion:** There are very few easy solutions to addressing these issues. However, if larger scale improvements are considered along Osborn Road, then consideration could also be given to widening works to improve lane and road widths, as well as safety on footpaths.	As noted, the only way to overcome this issue is to widen Osborn Road, which would require significant works. With regard to the ELC DA, these works are not justified at this stage (as already discussed).
7.	**Comment:** There are several signs along the audited length of Osborn Road which are visually obscured by tree foliage. **Suggestion:** These are generally mitigatable by tree pruning works.	Pruning works on trees which overhang the School property boundary are to be undertaken by the School. As noted above, any works to public land are the responsibility of the asset owner, so a request will be made to Council to prune the trees on public land.
8.	**Comment:** Outbound drivers from Gate O4 of Loreto Normanhurst would need to check for gaps in the northbound and southbound traffic streams of Osborn Road…As seen, there is limited minimum gap sight distance (MGSD) to the south due to a cluster of trees **Suggestion:** The MGSD sight lines could be improved through tree pruning works.	As above, the School will undertake tree pruning works on their property. A maintenance request would be submitted to Council to prune vegetation on public land.
9.	**Comment:** Outbound drivers from Gate O3 of Loreto Normanhurst would need to check for gaps in the northbound and southbound traffic streams of Osborn Road…there is limited minimum gap sight distance (MGSD) to the south due to a large tree. **Suggestion:** As the sight-limiting feature is a tree trunk and not the foliage, it is unreasonable to remove this tree on account of the affected sight line (unless other large-scale development changes were proposed at the School or along Osborn Road).	The location of this Gate and the identified limited sightline would be reviewed as part of the Master Plan. The ELC DA would have no impact to the current operation of this Gate.
10.	**Comment:** Gate O1 appear to function as a joint inbound and outbound gate to the School. Outbound drivers would have limited visibility to pedestrians on the eastern footpath of Osborn Road. This is due to the vegetation either side of the driveway**.** **Suggestion:** Some mitigation measures would include: • Clearing the vegetation altogether. • Trimming the vegetation to achieve a wider outbound vista. • Trimming the vegetation to a lower height. This would work with respects to the shaped hedges. The un-shape-able trees. • could be “thinned out” to improve see through visibility. • Provision of STOP signs and a stop hold line. • Provision of convex mirrors. However, this is generally not failsafe since it does not entirely compensate for the lack of	The School Gates are being reviewed as part of the Master Plan works. However, the vegetation works identified would be undertaken by the School in the interim period.

Ref.	Comment	Responsibility / Recommendation
	clear and unassisted visibility. Also, as the image is distorted, it is difficult to judge distances and speeds of pedestrians.	
11.	**Comment:** Pennant Hills Road/Osborn Road intersection – opposing right-turns…visibility constraints. **Suggestion:** Increased controls on the right-turn movements could be considered including full control (non-filtered turns), part-day controls, or leading right-turn phases.	The concerns raised are with regard to opposing right turns at the PHR / Osborn Road signals. As discussed under Ref 3. the drone surveys and modelling analysis to date has illustrated that these signals operate efficiently and safely and therefore it is not Ason Group's recommendation to review the phasing at this time. Nevertheless, the RSA will be made available for RMS review and consideration.
12.	**Comment:** The 40k pavement patches associated with the start of the school zone have faded. **Suggestion:** The pavement markings should be re-instated to improve the prominence of the western gateway to the school zone.	This is the responsibility of RMS; as above, the RSA will be made available for RMS review and consideration.
13.	**Comment:** In general, the audit team noted that there was a substantial volume of loose gravel and debris at the Pennant Hills Road/Osborn Road/ Normanhurst Road intersection. **Suggestion:** There is no immediately obvious source of this loose material. As such, the mitigations would tend to be reactive, such as street sweeping and maintenance.	As above, this is an issue for RMS to review.
14.	**Comment:** the continued single southbound lane of Osborn Road presents several other movement restrictions along its length, particularly for the section that contains a BB double barrier centreline. As shown below, at gate O1, the limited width between the eastern kerbline of Osborn Road and the BB double barrier centreline constrains the left-turn movement into the driveway. **Suggestion:** N/A	This was not observed to be an issue during on-site investigations nor the drone surveys. Nevertheless, the access points into the School are all being reviewed as part of the Master Plan. As part of these works, the left-turns into the site would be reviewed.
15.	**Comment:** A portion of the eastern kerbline between Gates O2 and O3 is signposted as a NO PARKING zone…drivers are permitted to stop along a kerbline signposted with NO PARKING signs provided that they are dropping off or picking up passengers…the audit team envisages that this kerbline would still be used in less formal situations. **Suggestion:** Consideration could be given to extending the NO STOPPING designation to cover this zone.	As above, this was not observed to be an issue during on-site investigations nor the drone surveys. Further, it is noted that PUDO arrangements are currently being reviewed as part of the Master Plan, with the PUDO location to be moved to the southern part of School Grounds on Osborn Road, under the Oval. However, this will be monitored and if required, a request would be made to Council's Traffic Committee to install NO STOPPING signs.
16.	**Comment:** In general, the footpaths throughout the study length contained many uneven surfaces due to vertical movement in the slabs, non-flush interfaces between asphalt in-fills and concrete slabs, and loose litter and debris. **Suggestion:** N/A	Maintenance of footpaths is the responsibility of the asset owner (Council). Therefore, a request will be made to Council to review and repair the footpaths.

Table 2: RSA Summary Table – Mount Pleasant Avenue

Ref.	Comment	Ason Group Response
1.	**Comment:** Under existing conditions, eastbound right-turn movements are permitted from Pennant Hills Road to Mt. Pleasant Avenue. **Suggestion:** Consideration should be given to banning or part-day banning this movement.	Signage banning the right is to be installed as part of the ELC DA.
2.	**Comment:** The Mt. Pleasant Avenue approach to its intersection with Pennant Hills Road is STOP controlled. As such, all outbound drivers are required to stop… Further to the above, right-turn movements are permitted from Mt. Pleasant Avenue to Pennant Hills Road North. **Suggestion**: Consideration should be given to banning the outbound right-turn from Mt. Pleasant Avenue, or at least implementing a part-day ban.	Signage banning the right is to be installed as part of the ELC DA.
3.	**Comment:** In the westbound travel direction of Pennant Hills Road, the school zone commences…However, the right-hand SCHOOL ZONE sign is placed on the northern side of the road which is well outside the forward field of view of westbound drivers… The audit team also notes that the 40k pavement patches have faded which reduces the effectiveness of these as regulatory and advisory devices. **Suggestion:** This sign would be more appropriately placed on the median…to improve its visual prominence.	Any works to foliage and signage on the public roadway need to be undertaken by the asset owner (RMS). The School will provide the results of this RSA to RMS for consideration of suggestions made in relation to PHR which requires their maintenance.
4.	**Comment:** On the eastern side of Mt. Pleasant Avenue to the south of Pennant Hills Road, there is a NO STOPPING sign with a single-sided, north-facing arrow. As such, this allows vehicles to stop/ park along the eastern kerbline to the south of this point. **Suggestion:** the NO STOPPING sign should be relocated further south.	As above, any works to signage on the public roadway need to be undertaken by the asset owner (Council). It is noted that due to the low traffic volumes on MPA, this was not observed to be a concern (as shown by the drone surveys). Nevertheless, the RSA is provided as Attachment 1 for Council's review.
5.	**Comment:** There are several signs along the audited length of Mt. Pleasant Avenue which are visually obscured by tree foliage. **Suggestion:** These are generally mitigatable by tree pruning works.	Any works to foliage on the public roadway need to be undertaken by the asset owner (Council). Any foliage on School property will be pruned following the outcome of this RSA.
6.	**Comment:** From the night time inspection of the site, the audit team noted that there is a relative dark patch along Pennant Hills Road at its intersection with Mt. Pleasant Avenue. This appears to be a result of missing or malfunctioning street light luminaires…The poor lighting at this location could increase the risk of night time crashes. **Suggestion:** N/A	With regard to the School and the proposed ELC, this is not applicable. However, as noted the results of the RSA will be provided to RMS for their review and consideration.
7.	**Comment:** There is a pair of right-left reverse curves in combination with a crest vertical curve. The combined effect of the horizontal curves and the crest has reduced driver visibility	Any works to the public roadway need to be undertaken by the asset owner (Council). The results of this RSA will be provided to Council for their consideration and review.

Ref.	Comment	Ason Group Response
	to the road ahead… is particularly critical if drivers in either direction drift towards the midline of the road... **Suggestion:** Consideration should be given to providing a centreline to define and separate opposing traffic streams.	
8.	**Comment:** At the time of the inspections, there were numerous potholes and pavement failures in the westbound carriageway of Pennant Hills Road. **Suggestion:** N/A	As above, any works to PHR need to be undertaken by the asset owner (RMS).
9.	**Comment:** There is no footpath on the western side of the road along the School frontage (left-hand image). As such, any pedestrian traffic generated from the School would be forced to walk on the unpaved portions of the verge…or crossing the road to access the eastern footpath. **Suggestion:** Consideration should be given to providing a footpath on the western side of Mt. Pleasant Avenue to link into the pre-existing footpath further north.	With regard to the ELC, the Site is connected to the external footpath along MPA. This would assist with improving connectivity of the main School, as a pedestrian connection will be provided between the School and the ELC. The pedestrian connectivity of the School itself is being reviewed as part of the Master Plan. It is worthy of note again that any works to public land, such as provision of a footpath, would need to be considered by the asset owner, being Council.
10.	**Comment:** At the southern end of the audited length of Mt. Pleasant Avenue, the kerb-bounded section of this road transitions to an un-kerbed section with an unpaved verge. **Suggestion:** N/A	Any works to the public roadway need to be undertaken by the asset owner (Council).
11.	**Comment:** The kerb ramps at both of these corners of the intersection are poorly aligned and direct pedestrians towards Pennant Hills Road. **Suggestion:** N/A	As above, any works to the public road need to be undertaken by the asset owner (RMS / Council).
12.	**Comment:** In general, many driveways along this road contain trees/ shrubs either side of them and in the roadside verges of Mt Pleasant Road. The sight lines to and from several driveways were restricted due to these trees. **Suggestion:** Tree pruning/ thinning works would generally improve sight lines in these respects.	As above, any works to the public road need to be undertaken by the asset owner (Council). However, the foliage along the School frontage which could impede sightlines will be pruned following the outcome of the RSA.

Parking

Parking will be provided in accordance Council controls. Therefore, the previous conclusions by Ason Group and Council, that the proposed parking provision is appropriate and the ELC would not have an impact on on-street parking capacities remain valid.

Nevertheless, to address concerns raised by residents, an additional 5 staff parking spaces are to be provided within School Grounds, to the east of the tennis courts. A reduced copy of the updated plan illustrating these spaces is provided as **Attachment 2**.

General Issues

In regard to the other issues raised at the Panel, please see our responses provided below.

Issue Raised at the Meeting	Response
1. Timing of traffic lights on Pennant Hills Road/Osborn Road could be extended	The drone surveys demonstrated that there is no need to review cycle times, however, opportunity may exist to revisit this post opening of NorthConnex.
2. Signalise MPA / PHR intersection	N/A
3. The Mount Pleasant Avenue intersection is already at capacity	Drone surveys confirm that there is sufficient capacity to accommodate future development with only a minor increase in delays expected. Issues raised by residents in the Panel meeting do not appear to have been found and in fact, appear to have been over exaggerated. Accordingly, findings of Ason Group remain valid.
4. Education of parents not parking in certain areas is not an acceptable solution to parking issues	5 additional staff spaces are to be provided to the east of the tennis courts, within School grounds.
5. Management of pick up and drop off is insufficient by the School	The issue of management of the PUDO for the School does not form part of the is application. Notwithstanding, again the drone surveys demonstrate the operation of Osborn Road is acceptable (as found by the SIDRA modelling analysis undertaken for the Development Application) and operates with expected delays during the peak 15 minutes school PUDO.
6. Existing traffic conditions are being ignored and nothing is being done about it	The drone surveys have illustrated that the road network in the vicinity of the School operates with acceptable delays and queuing. The RSAs have identified a number of opportunities to improve safety, with the main recommendation that can be implemented by the School relating to pruning of vegetation. This pruning will be undertaken by the School.
7. The ELC will create additional impact on Osborn Road. The application should consider widening Osborn Road.	The surveys demonstrate satisfactory operation of Osborn Road and the addition of 20-25 vehicles would not warrant the need for any additional widening.
8. The proposed development will create too much traffic. The community is not being listened to in terms of the traffic congestion and safety issues.	Drone surveys confirm the previous findings of Ason Group, Council and RMS are valid and that the addition of the ELC will have no meaningful impact on the surrounding road network.
9. Other schools and pre-schools in the area will be impacted by additional traffic	As already discussed, and concluded by Ason Group and Council, once distributed across the network, the traffic generated by the ELC is of a sufficiently low order that the impact would be negligible.
10. Source of frustration of parents not being able to park in Osborn Road	Parking, and importantly PUDO spaces, are being provided in accordance with Council controls and is therefore acceptable.

Issue Raised at the Meeting	Response
11. Panel concerned additional impact, if only minimal and may be unacceptable – cumulative impact of any proposal. There may be works that could be undertaken	The quantitative analysis undertaken by Ason Group clearly demonstrates that the ELC can clearly be accommodated as per the previous conclusions of Ason Group, Council and RMS. The surveys provide content to the issues raised by the community and demonstrate that these issues have been overexaggerated in terms of network capacity and operation. On this basis, it is unclear how the Panel could have concerns given the substantial evidence demonstrating the application would be acceptable.
12. Defer determination – • Further information provided to Council regarding: ○ Consideration of widening Osborn Road intersection ○ Widening Access points to the School ○ Bringing forward masterplan solutions in subject proposal ○ Any other matters the School can undertake	Drone surveys have been undertaken to capture the existing operation of the road network. Although Year 12 students were not in attendance during the time of survey the traffic generated by this year group is minimal when compared to the remainder of the School. Noting attendance at the School was 90-92%, the drone surveys provide an excellent insight into the operation of the road network during the peak hour. The drone surveys confirm that there is sufficient capacity to accommodate the ELC development with only a minor increase in delays expected. Issues raised by residents in the Panel meeting do not appear to have been found and in fact, appear to have been over exaggerated. With a specific reference to the ELC Proposal, the drone surveys clearly demonstrate that there is minimal if any queueing during the corresponding PUDO times (generally 7:30-8:30am and 4:00-5:30pm). The tree pruning identified by the RSAs would be undertaken by the School, where appropriate. Further the School will work with Council and RMS to accommodate any of the proposed measures if possible (such as accommodating relocated traffic signs). Accordingly, the findings of Ason Group that the ELC is acceptable from a traffic and transport planning perspective, remain valid.

As noted, the above will be turned to into a formal response once all the information is available (i.e. updated plans and road safety audit). Should you have any queries, please do not hesitate to contact the undersigned.

Yours sincerely,

Andrew Johnson
Director – Ason Group
Email: andrew.johnson@asongroup.com.au

Attachment 1

Independent Road Safety Audits

TRAFFIC ENGINEERING

Ason Group

Osborn Road, Normanhurst

Existing stage road safety audit

DC Traffic Engineering Pty Ltd
ABN 50 148 960 632
www.dctrafficengineering.com.au

Ason Group

Osborn Road, Normanhurst

Existing stage road safety audit

Authors Damien Chee

Report No ASON-PROJ-0007-01 ES RSA OSBORN ROAD REV 3

Date 24/10/2019

This report has been prepared for Ason Group.

CONTENTS

Appendices

1 Introduction

1.1 Project and audit details

Details of the audit have been summarised in Table 1.

Table 1 Details of the road safety audit.

Audited project	Osborn Road, between and including its intersection with Pennant Hills Road-Normanhurst Road, and the southern-most extent of the Loreto Normanhurst School frontage, Normanhurst.
Client/ contact	Rebecca Butler-Madden Senior Transport Planner Ason Group Ph: (02) 9083 6601 / 0406 421 154 E: Rebecca.BMadden@asongroup.com.au
Audit type	*Existing stage* road safety audit.
Purpose	Loreto Normanhurst is proposing to develop an early learning centre on Mount Pleasant Avenue. As part of the planning for this development, an *existing stage* road safety audit has been requested of Osborn Road, which is the access road to the school along its western frontage.
Scope of project/ audit	Spatial scope The following roads were formally reviewed as part of this road safety audit: ▪ Pennant Hills Road, from the western-commencement of the school zone (approximately in line with the Buckingham Avenue intersection) to 75m east of Osborn Road (to capture the full length of the right-turn lane to Normanhurst Road). ▪ Normanhurst Road, for a length of 30m to the north of Pennant Hills Road, to capture the lane status advice for the two southbound approach lanes. ▪ Osborn Road, from 0-350m south of Pennant Hills Road to capture the entire length of the western school frontage. Temporal scope As an *existing stage* road safety audit, the audit and its findings were associated with the site conditions ("version") as inspected at the following dates/ times: ▪ 1300-1400h on 9/10/2019 – day time inspection. ▪ 2200-2300h on 13/10/2019 – night time inspection.
Audit team details	Damien Chee, DC Traffic Engineering (level 3 and lead auditor – RSA-02-0094). Linda Chee, DC Traffic Engineering (Level 2 road safety auditor - RSA-02-1069). Tim Lewis, Ason Group (Level 2 road safety auditor – RSA-02-0809). James Laidler, Ason Group.
Audit methodology	The audit was undertaken using the following methodology: ▪ A day time inspection of the site was carried out between 1300-1400h on 9/10/2019. ▪ A night time inspection was carried out between 2200-2300h on 13/10/2019. ▪ The road safety audit findings have been documented in this report in accordance with the NSW Centre for Road Safety's *Guidelines for Road Safety Audit Practices* (2011). ▪ This report includes completed *checklist 6 –existing stage audit* as sourced from the Austroads *Guide to Road Safety Part 6: Road Safety Audit*.
Material supplied	Not applicable.

1.2 Responding to the audit report

Road safety audits provide the opportunity to highlight potential road safety problems and have them formally considered by the project manager in conjunction with all other project considerations.

The responsibility for the project rests with the project manager, not with the auditor. The project manager is under no obligation to accept the audit findings. Also, it is not the role of the auditor to agree to, or approve the project manager's responses to the audit.

1.3 Previous audits

There were no previous road safety audit reports issued to the audit team of direct relevance to this road.

2 Safety audit findings

The road safety audit findings are presented in Table 2.

Table 2 Road safety audit findings.

Ref	Theme/ location	Road safety audit finding	Priority
1	Eastbound travel direction of Pennant Hills Road in approach to Osborn Road.	The Pennant Hills Road/ Osborn Road/ Normanhurst Road intersection is traffic signal controlled. However, the combined effect of the curvature of this road, and overhanging tree foliage on the inside (northern) side of the curve have affected the *approach sight distance* (ASD) available between eastbound drivers and the primary signal lanterns. These are the lanterns on the north-western corner of the intersection. With reduced ASD, drivers may not be aware of the prevailing signal phasing which may lead to red-light breaches and associated crashes with cross traffic streams. Furthermore, as the primary signals are typically placed in line with the hold line of the approach, they also advise drivers *where* to stop. As such, the restricted view of the signals may lead to drivers over-shooting the hold line and encroaching into the controlled area of the intersection. The left-hand image shows the view from a driver in lane 2 towards the primary signals when approximately 50m upstream of the intersection. The signals on the vertical portion of the mast-arm post are obscured by the tree foliage in the yellow oval. The foliage in the yellow box is starting to visually obscure the street name sign to Normanhurst Road. With further growth, it is likely that this street name sign could become blocked as well. The sight line from lane 1 would be even worse since this is further inside the curve. The right-hand image shows a view from approximately 25m upstream of the intersection where the primary signals are no longer visually blocked by the overhanging tree foliage. However, the signals are partially and momentarily blocked by the parking restriction signs. Driver visibility to the primary signals could be improved by pruning the tree foliage and relocating the parking restriction signs. The restored visibility to the primary signals would also improve pedestrian safety, especially if red signal holds/ delays are in place to safeguard pedestrians on the northern crossing.  ***Left:*** *Looking eastbound along Pennant Hills Road towards the intersection with Osborn Road-Normanhurst Road from approximately 50m upstream.* ***Right:*** *Looking eastbound towards the signals from approximately 25m upstream.*	High

Ref	Theme/ location	Road safety audit finding	Priority
2	Westbound travel direction of Pennant Hills Road in approach to Osborn Road.	Due to the curvature of Pennant Hills Road and the potentially sight-obstructing pedestrian bridge, a dynamic flashing light unit has been provided to alert westbound drivers of the traffic signals in the road ahead. These appear to flash when the downstream signals (at Osborn Road) are on red signal display. This is a compensatory measure for the reduced *approach sight distance* to the traffic signals. However, the flashing light unit is not optimally positioned. As shown in the images below, the flashing light unit is mounted to the pedestrian bridge above lane 2 (middle lane). When the driver is on the straight line (tangential) portion of the curve (see left-hand image), the flashing light unit is well outside the forward field of view. Some drivers may not have a clear sight line to the flashing lights if they cannot see over the median pedestrian fence. Also, since the road contains a curve-crest combination, any tall vehicles in the road ahead may also block this sight line. If drivers lack clear visibility to the flashing light unit, it renders the device ineffective as an advanced warning system. By the time the driver can see the flashing light unit, they would be able to see the actual signals anyway and would no longer need advanced warning. Using the left-hand image, the flashing light assembly would be more effectively relocated to the projection of the straight line (tangential) portion of the curve. An indicative location is depicted by the white rectangle. This puts the flashing lights in clear view of approaching drivers when they are well upstream of the sight-limiting curve and crest. Also, by being placed further upstream, this would more effectively warn drivers and allow them to control speeds with respects to approaching the back-of-queue. Typically, the back-of-queue would be well upstream of the signals themselves. Also, evident in the left-hand image, if the flashing light unit was relocated, it would also be visible in the same “picture frame” as the TRAFFIC SIGNALS + PREPARE TO STOP signage combination. As such, the flashing light unit would be more meaningful as the driver would receive both advanced warning messages at the same time.  ***Left:*** *Looking westbound along Pennant Hills Road towards the curve and crest in approach to the traffic signals at Osborn Road. The advanced warning flashing light unit could be better placed on the projection to this straight line (tangential) portion of the curve.* ***Right:*** *Further downstream from the first photo. As shown, by the time the flashing light unit is visible to the driver, they would already be able to see the signals themselves.*	High

Ref	Theme/ location	Road safety audit finding	Priority
3	Northbound left-turn movement from Osborn Road to Pennant Hills Road.	The northbound left-turn movement from Osborn Road to Pennant Hills Road contains LEFT TURN ON RED PERMITTED AFTER STOPPING signs (LTOR rule). This does not appear to be appropriate for a left-turn onto Pennant Hills Road, as a major and high-volume arterial route. This is especially in light of its function as a major feeder and receiver route to/from the M1 motorway, less than 1km to the north-east. Uncontrolled left-turn movements would require gap detection and selection in a high-volume receiving road. Furthermore, as Pennant Hills Road contains a sight-limiting horizontal curve to the south, this could also limit the ability to see and select safe gaps to perform this left-turn manoeuvre. There may be *cross traffic* crashes as a result. The audit team notes that the primary and tertiary signal lanterns contain five signal aspects – (i) the red, amber and green full circle aspects which control general outbound movements from Osborn Road, and (ii) amber and green left-turn arrow aspects. With minor adjustment works to include red arrow aspects, the left-turn movement to Pennant Hills Road West could easily become fully controllable, and adaptive to differing traffic conditions of the day. The adjusted signal hardware and phasing may also be able to replace the LTOR rule such that there are no longer any uncontrolled left-turn movements.  ***Above:*** *Looking northbound from Osborn Road to Pennant Hills Road showing the LEFT TURN ON RED PERMITTED AFTER STOPPING signs in place.*	High

Ref	Theme/ location	Road safety audit finding	Priority
4	Westbound travel direction of Pennant Hills Road in approach to Osborn Road-Normanhurst Road – Visibility to the right-turn lane to Normanhurst Road.	In the westbound direction of Pennant Hills Road, there is a curve-crest combination in approach to the Osborn Road-Normanhurst Road intersection. There is also a pedestrian fence on the median which obstructs the sight bench available across the median. This restricts the *stopping sight distance* (SDD) from westbound drivers to the right-turn lane to Normanhurst Road. The sight line is most affected in lane 3 (median-side lane) since (i) this is the westbound lane that is furthest on the inside of the curve, and (ii) this the westbound lane that would be most critically affected by conditions in the right-turn lane. The left-hand image shows the view from a westbound driver when approximately 35m upstream of the right-turn lane. At this point, the driver has limited view of the conditions in the right-turn lane including the kerb alignment and pavement conditions. They may also lack full visibility of any vehicles stopped in the right-turn lane, including their brake and indicator lights. The full detail of the right-turn lane only becomes visible a further 20m downstream (see right-hand image) which is only 15m upstream of the start of the right-turn lane. The driver may lack awareness to the conditions in the right-turn lane, and may not have enough time or space to react, such as adjusting their approach speed or even aborting the right-turn altogether. As the pedestrian fence is a major contributor to the loss of sight line to this right-turn lane, and this is also a critical safety amenity itself, the audit team does not recommend any adjustment or removal of this fence. Without increasing the length of the right-turn lane, there is little that could be done to improve driver advanced visibility and awareness of conditions in this lane. As such, consideration should be given to relocating the dynamic flashing light unit as described in item 2. This would at least help to control approach speeds and give drivers real-time advice of the prevailing signal phasing.  ***Left:*** *Looking westbound along Pennant Hills Road from approximately 35m upstream of the right-turn lane. There is limited visibility to the conditions in the right-turn lane to Normanhurst Road due to the curvature of the road and the median pedestrian fence.* ***Right:*** *Looking westbound from approximately 15m upstream, where the alignment and pavement condition in the right-turn lane are more visible.*	Medium

Ref	Theme/ location	Road safety audit finding	Priority
5	Eastbound travel direction of Pennant Hills Road in approach to Osborn Road-Normanhurst Road – Visibility to the right-turn lane to Osborn Road.	In the eastbound direction of Pennant Hills Road, there is a right-hand curve in the immediate approach to the right-turn lane to Osborn Road. There is also a pedestrian fence on the median which obstructs the sight bench available across the median. This restricts the *stopping sight distance* (SDD) from eastbound drivers to the right-turn lane to Osborn Road. The sight line is most affected in lane 3 (median-side lane) since (i) this is the eastbound lane that is furthest on the inside of the curve, and (ii) this the eastbound lane that would be most critically affected by conditions in the right-turn lane. The left-hand image shows the view from an eastbound driver when approximately 50m upstream of the right-turn lane. At this point, the driver has limited view of the conditions in the right-turn lane including the kerb alignment and pavement condition. They may also lack full visibility of any vehicles stopped in the right-turn lane, including their brake and indicator lights. The full detail of the right-turn lane only becomes visible a further 20m downstream (see right-hand image) which is only 30m upstream of the start of the right-turn lane. The driver may lack awareness to the conditions in the right-turn lane, and may not have enough time or space to react such as adjusting their approach speed or even aborting the right-turn altogether. As the pedestrian fence is a major contributor to the loss of sight line to this right-turn lane, and this is also a critical safety amenity itself, the audit team does not recommend any adjustment or removal of this fence.  ***Left:*** *Looking eastbound along Pennant Hills Road from approximately 50m upstream of the right-turn lane to Osborn Road.* ***Right:*** *Looking eastbound from approximately 30m upstream of the right-turn lane.*	Medium

Ref	Theme/ location	Road safety audit finding	Priority
6	Osborn Road in its immediate departure from Pennant Hills Road.	The Osborn Road southbound departure from Pennant Hills Road is narrow (see left-hand image). This is due to the lack of shoulder, limited flaring of the kerblines, and the BB double barrier centreline which appears to have been shifted as far east as possible. The limited departure width would have several road safety implications including: ▪ There is limited space for vehicles to negotiate this departure. Any vehicles that turn left from Pennant Hills Road East could cross the BB double barrier centreline and increase the risk of *head-on* crashes with northbound vehicles. Any right-turning vehicle from Pennant Hills Road West could also be at risk of striking the south-eastern kerb return, or tracking across the lane 2 of the northbound direction. ▪ Normanhurst Road contains two lanes in the southbound direction approaching Pennant Hills Road. Lane 1 (left-hand lane) is a shared *left-through* lane. Lane 2 is a dedicated right-turn lane. As such, the southbound straight through movement from Normanhurst Road to Osborn Road would need to commence from lane 1, negotiate a kinked travel path in the control area of the intersection to then enter the narrow departure lane in Osborn Road. The right-hand image shows the view from a driver negotiating this path and illustrates the extreme kinked travel path involved. This kinked travel path could lead to wheel-strikes on the south-eastern kerb return (including pedestrians standing at this location. Alternatively, if the driver avoids impacts with this kerb, they could be at risk of *side-swipe* crashes with the adjacent right-turn lane. ▪ Even if southbound vehicles are able to negotiate this narrow departure channel without striking kerbs or causing a *head-on* crash, the driver may be required to slow down excessively to successfully negotiate this channel. This could introduce *rear-end* crash risks in this departure. Alternatively, drivers that hesitate/ baulk could cause “shockwaves” which may also cause *rear-end* crash risks and queue spillback into the control area of the Pennant Hills Road/ Osborn Road/ Normanhurst Road intersection. Also evident in the images below, the eastern footpath of Osborn Road is narrow and is bounded by a batter slope. This increases the risk of *vehicle-pedestrian* crashes, especially in light of the wheel-strike risks described above. Pedestrians would be unwilling to walk on the batter slopes due to its slippery surface. The batter slope could also increase risks of debris spillage onto the footpath. There are very few easy solutions to addressing these issues. However, if larger scale improvements are considered along Osborn Road, then consideration could also be given to widening works to improve lane and road widths, as well as safety on footpaths.   ***Left:*** *Looking southbound into Osborn Road at the narrow departure channel.* ***Right:*** *The view of a southbound driver entering Osborn Road from Normanhurst Road – due to the kinked travel path from the southbound through lane of Normanhurst Road.*	Medium

Ref	Theme/ location	Road safety audit finding	Priority
7a	General – Visually obscured signs.	There are several signs along the audited length of Osborn Road which are visually obscured by tree foliage. The signs therefore lack effectiveness in conveying the regulatory and speed zoning advice. Many of these signs also contain time-based information, such as when the school zone (and hence variable speed limit of 40km/h) is in operation. The visually obscured signs are depicted below as well as in item 7b, with descriptions in the captions. These are generally mitigatable by tree pruning works.   ***Left:*** *Looking southbound along Osborn Road towards the END SCHOOL ZONE sign. The sign is visually obscured by tree foliage.* ***Right:*** *Looking northbound along Osborn Road at the southern gateway (entry point) to the school zone. The left-hand SCHOOL ZONE sign (circled in yellow) is partially obscured by tree foliage. The right-hand sign (marked by the white arrow) is totally obscured and rendered ineffective.*	Medium

Ref	Theme/ location	Road safety audit finding	Priority
7b	General – Visually obscured signs. Continued from item 7a…	Continued from item 7a…   ***Left:*** *Looking southbound into Osborn Road from the Pennant Hills Road intersection. This is the view that southbound drivers from Normanhurst Road would have as they track towards the Osborn Road departure. The SCHOOL ZONE sign is partially obscured by overhanging tree foliage.* ***Right:*** *Looking northbound along Osborn Road towards the paired SCHOOL ZONE signs. The left-hand sign (marked by the white arrow) is visually obscured by tree foliage. The right-hand sign (marked by the yellow arrow) is likely to be visually obscured in future.*	Medium

Ref	Theme/ location	Road safety audit finding	Priority
8	Gate O4 – Visibility conditions for outbound drivers.	Outbound drivers from Gate O4 of Loreto Normanhurst would need to check for gaps in the northbound and southbound traffic streams of Osborn Road. This requires them to look to the left (south) and right (north). The driver views in these directions are shown below in the left and right-hand images respectively. As seen, there is limited *minimum gap sight distance* (MGSD) to the south due to a cluster of trees (left-hand image). The driver is unlikely to have a clear view to northbound traffic and may not be able to judge suitable gaps. This could lead to poor gap selection and consequential cross traffic crashes. Alternatively, a common response is for drivers to "creep" out into the roadway to improve their sightline. This would leave them exposed to impacts by southbound vehicles when stopped in such a position. The right-hand image shows the MGSD sightline to the north. This also shows a southbound vehicle that has just come into the driver's view. The southbound vehicle would not have been visible from upstream of this point which also increases the risk of poor gap detection and selection by the outbound driver, and consequential *cross traffic* crashes. On-site observations revealed an approximate four-second gap between the southbound vehicle at this point (where it has just come into the view of the outbound driver) and the driveway where the *cross traffic* crash conflict would occur. The MGSD sight lines could be improved through tree pruning works.   ***Left:*** *The view from Gate O4 to the south (left).* ***Right:*** *The view from Gate 04 to the north (right).*	Medium

Ref	Theme/ location	Road safety audit finding	Priority
9	Gate O3 – Visibility conditions for outbound drivers.	Outbound drivers from Gate O3 of Loreto Normanhurst would need to check for gaps in the northbound and southbound traffic streams of Osborn Road. This requires them to look to the left (south) and right (north). The driver view to the left (south) is shown in the left-hand image. As seen, there is limited *minimum gap sight distance* (MGSD) to the south due to a large tree (left-hand image). The driver is unlikely to have a clear view to northbound traffic and may not be able to judge suitable gaps. This could lead to poor gap selection and consequential *cross traffic* crashes. Alternatively, a common response is for drivers to "creep" out into the roadway to improve their sightline. This would leave them exposed to impacts by southbound vehicles when stopped in such a position. As the sight-limiting feature is a tree trunk and not the foliage, it is unreasonable to remove this tree on account of the affected sight line (unless other large-scale development changes were proposed at the school or along Osborn Road). As such, outbound drivers could be encouraged to use Gate O4 instead (provided that its MGSD sight lines are improved as described in item 8). Some degree of sight line improvement could be achieved by clearing out the understorey layer of low-level trees and plants. This would allow some "see-through" visibility between the large tree trunks. However, the resulting sight lines would not be totally failsafe.   ***Left:*** *The view from Gate O3 to the south which is affected by the large tree trunk.* ***Right:*** *Looking northbound along Osborn Road showing the limited view to the driveway (behind the trees).*	Medium

Ref	Theme/ location	Road safety audit finding	Priority
10	Gate O1 – Visibility of outbound drivers to pedestrians on the eastern footpath of Osborn Road.	Gate O1 appears functions as a joint inbound and outbound gate to the school. Outbound drivers would have limited visibility to pedestrians on the eastern footpath of Osborn Road. This is due to the vegetation either side of the driveway. The limited visibility may increase the risk of *vehicle-pedestrian* crashes, particularly since the footpath is likely to be used by school children, including persons of shorter stature. Some mitigation measures would include: ▪ Clearing the vegetation altogether. ▪ Trimming the vegetation to achieve a wider outbound vista. ▪ Trimming the vegetation to a lower height. This would work with respects to the shaped hedges. The un-shape-able trees could be “thinned out” to improve see through visibility. ▪ Provision of STOP signs and a stop hold line. ▪ Provision of convex mirrors. However, this is generally not failsafe since it does not entirely compensate for the lack of clear and unassisted visibility. Also, as the image is distorted, it is difficult to judge distances and speeds of pedestrians.  ***Above:*** *Looking outbound from Gate O1 showing the limited visibility to the footpath area either side of the gate.*	Medium

Ref	Theme/ location	Road safety audit finding	Priority
11	Pennant Hills Road/ Osborn Road intersection – Opposing right-turns.	The northbound and southbound right-turns from Osborn Road and Normanhurst Road respectively, are both filtered right-turn movements. As such, the northbound right-turn is required to filter through the opposing (southbound) *through* movement, and left-turn movements from the Normanhurst Road leg. Similarly, the southbound right-turn is required to filter through the opposing (northbound) *through* and left-turn movements. Furthermore, both legs have two approach lanes, and hence two separate approach streams of traffic. The audit team notes the following visibility constraints: ▪ Northbound right-turning drivers could have restricted visibility to the southbound *through* and left-turn movements due to the crest vertical curve and downhill grade in Normanhurst Road (see left-hand image). ▪ Northbound right-turning drivers could also have restricted visibility due to southbound right-turning traffic, who are often in queue whilst waiting to filter through the intersection as well. ▪ Southbound right-turning drivers could have restricted visibility to the northbound left-turn movements due to the northbound right-turning traffic, who are often in queue whilst waiting to filter through the intersection as well. Increased controls on the right-turn movements could be considered including full control (non-filtered turns), part-day controls, or leading right-turn phases.   ***Left:*** *Looking northbound from Osborn Road into the intersection with Pennant Hills Road. Note the crest vertical curve in Normanhurst Road which limits drivers' visibility to the opposing (southbound) through and left-turning traffic streams. The stopped southbound right-turning vehicle also blocks the sightline to any vehicles that may be moving up in the adjacent traffic lane.* ***Right:*** *Looking southbound into the intersection from Normanhurst Road. The driver's view to northbound left-turning traffic (there are no such vehicles performing this manoeuvre in this picture) could be blocked by the opposing (northbound) right-turning vehicle which has stopped at the hold line.*	Medium

Ref	Theme/ location	Road safety audit finding	Priority
12	Pennant Hills Road to the west of Osborn Road.	The 40k pavement patches associated with the start of the school zone have faded. These are critical features of the school zone signifying (i) the start of the school zone and (ii) the prevailing speed limit during school zone hours. As such, with the faded condition of the markings, drivers may lack awareness of the school zone and speed zoning conditions. Drivers may also use this as a legal excuse for non-compliance as well. Pennant Hills Road carries a high volume of traffic as one of the principle access routes to the M1 Motorway. Under heavy traffic conditions, pavement markings are especially beneficial to drivers since they need to maintain focus on the road ahead, and could be more likely to overlook signs on each side of the road. Also, as there are many school zones along Pennant Hills Road, it is important that drivers are aware of the start and end points of these zones. The pavement markings should be re-instated to improve the prominence of the western gateway to the school zone.  ***Above:*** *Looking eastbound along Pennant Hills Road with a view of the faded 40k pavement patches to the west of Osborn Road.*	Low

Ref	Theme/ location	Road safety audit finding	Priority
13	Pennant Hills Road, eastbound right-turn lane to Osborn Road and control area of the intersection.	In general, the audit team noted that there was a substantial volume of loose gravel and debris at the Pennant Hills Road/ Osborn Road/ Normanhurst Road intersection. This included the eastbound right-turn lane to Osborn Road and the control area of the intersection. Loose gravel and debris tend to compromise skid resistance and tyre-to-pavement friction. This could affect braking performance and braking distance. It could also affect the stability of the vehicle as it negotiates turns. As such, the reduced skid resistance could increase the risk of *loss of control* crashes, *rear-end* crashes and even *cross traffic* crashes since some vehicles may not stop clear of the control area of the intersection. There is no immediately obvious source of this loose material. As such, the mitigations would tend to be reactive, such as street sweeping and maintenance.  ***Above:*** *Evidence of loose gravel along the midline of the eastbound right-turn lane to Osborn Road. Note also the loose debris along the fringe of the median SF kerb.*	Low

Ref	Theme/ location	Road safety audit finding	Priority
14	Osborn Road – Impact of single southbound lane and centreline alignment.	Item 6 described the narrow width of the southbound departure lane in Osborn Road from its intersection with Pennant Hills Road. Further to that issue, the continued single southbound lane of Osborn Road presents several other movement restrictions along its length, particularly for the section that contains a BB double barrier centreline. As shown below, at gate O1, the limited width between the eastern kerbline of Osborn Road and the BB double barrier centreline constrains the left-turn movement into the driveway. Left-turning vehicles are likely to encroach over the centreline when entering the school. This would present exposure to *head-on* crashes with northbound vehicles. Alternatively, if they remain within the southbound traffic lane, they may be at risk of impacting the kerbs either side of the driveway. This is particularly the case for long vehicles. Similarly, any outbound left-turn movement from the driveway (although not anticipated to be a large volume movement) would also have risks of crossing the centreline or dropping over the full-height kerb.  ***Above:*** *Looking southbound along Osborn Road showing the limited width between the eastern (left-hand) kerbline and the BB double barrier centreline. Gate O1 is on the left-hand side of the photo.*	Low

Ref	Theme/ location	Road safety audit finding	Priority
15	Eastern kerbline of Osborn Road between Gates O2 and O3.	A portion of the eastern kerbline between Gates O2 and O3 is signposted as a NO PARKING zone (see below). NSW Road Rule 168 stipulates that drivers are permitted to stop along a kerbline signposted with NO PARKING signs provided that they are dropping off or picking up passengers, remain attending the vehicle, and do not layover for more than two minutes. The audit team acknowledges that the logical management method for formal pickup and drop off of students, and delivery of goods to the school, would be via the internal roadway. However, the audit team envisages that this kerbline would still be used in less formal situations. This could include: ▪ Drop off and pick up of students outside the typical peak period such as for before-school or after-school activities. ▪ Buses and other long vehicles that are unwilling to enter the school grounds. If this kerbline is to remain as a NO PARKING zone, it would need to be managed to minimise risks of congestion at this point. The audit team highlights a number of risky scenarios, as follows: ▪ If the kerbline is mis-used by parents/ carers that are too impatient to enter the school grounds, it could lead to congestion and potential queue spill back to the north. The audit team noted that there is only 50m of kerb length available which is signposted as a NO PARKING zone. This could lead to upstream congestion if the kerbline is fully occupied (approximately seven passenger cars), or if vehicles stop midway along its length or towards the northern end of this zone. If the queue spills back to the BB double barrier centreline, it may also force trailing southbound drivers to cross this line to pass around the queue. ▪ Any vehicles stopped along this kerbline, or moving slowing into or out of a stopped position could also be exposed to *rear-end* crashes by trailing southbound vehicles. This kerbline is also located on the departure side of a sight-limited crest vertical curve. Trailing drivers may not see or expect slow-moving or stopped vehicles at this point. Consideration could be given to extending the NO STOPPING designation to cover this zone. Alternatively, the risks described above would need to be “managed out” by the school and its policies and traffic management plan.  ***Left:*** *Looking southbound along Osborn Road towards the NO PARKING zone on the eastern kerbline.*	Low

Ref	Theme/ location	Road safety audit finding	Priority
16	General – Condition of the footpaths.	In general, the footpaths throughout the study length contained many uneven surfaces due to vertical movement in the slabs, non-flush interfaces between asphalt in-fills and concrete slabs, and loose litter and debris. These may all pose as trip and slip hazards for pedestrians. This is especially concerning since the footpaths may be used by school children. Also, any slip/ trip events may result in pedestrians falling onto the roadway with subsequent risks of impacts by passing vehicles.    ***Above:*** *Examples of uneven and slippery footpaths throughout the study length. The top left-hand photo shows an asphalt in-fill following a utility trench. This has resulted in exposed slab edges and vertical lips. The top right-hand photo shows a high degree of leaf and dirt litter. The bottom image shows a pronounced vertical lip at a slab-joint.*	

3 Concluding statement

DC Traffic Engineering has undertaken an *existing stage* road safety audit of this project in accordance with the methodology outlined in Section 1 of this report.

Issues identified have been noted in this report for the Project Manager to review, assess, and where appropriate, make the necessary recommendations to improve safety.

Damien Chee
Audit Team Leader
DC Traffic Engineering Pty Ltd

Appendix A

Road Safety Audit Checklist

Checklist questions	Comments
6.1 Road alignment and cross section	
1 Visibility ▪ sight distance Is sight distance adequate for the speed of traffic using the route? ▪ Is adequate sight distance provided for intersections and crossings? (eg. pedestrian, cyclist, cattle, railway) ▪ Is adequate sight distance provided at all private driveways and property entrances?	MGSD issues noted from driveways. Restricted SSD to right-turn lanes identified.
2 Design speed ▪ Is the horizontal and vertical alignment suitable for the (85th percentile) traffic speed? ▪ If not are: o Warning signs installed? Advisory speed signs installed? o Are the posted advisory speeds for curves appropriate?	Yes.
3 Speed limit/speed zoning ▪ Is the speed limit compatible with the function, road geometry, land use and sight distance?	Faded 40k patches identified. Many school zone signs (which contain speed limit information) were also blocked by overhanging tree foliage.
4 Overtaking ▪ Are safe overtaking opportunities provided?	Limited passing opportunity if there is excessive use of NO PARKING ZONE as a pick up/ drop off area.
5 Readability by drivers ▪ Is the road free of elements which may cause confusion? For example: o Is alignment of the roadway clearly defined? o Has disused pavement (if any) been removed or treated? o Have old pavement markings been removed properly? o Do tree lines follow the road alignment? o Does the line of street lights or the poles follow the road alignment? ▪ Is the road free of misleading curves or combinations of curves?	Yes.
6 Widths ▪ Are medians and islands of adequate width for the likely users? ▪ Are traffic lane and carriageway widths adequate for the traffic volume and mix? ▪ Are bridge widths adequate?	Yes.
7 Shoulders ▪ Are shoulders wide enough to allow drivers to regain control of errant vehicles? ▪ Are shoulders wide enough for broken down or emergency vehicles to stop safely? ▪ Are shoulders sealed? ▪ Are shoulders trafficable for all vehicles and road users? (I.e. are shoulders in good condition) ▪ Is the transition from road to shoulder safe? (no drop-offs)	Lack of lane width in southbound direction of Osborn Road.

Checklist questions	Comments
8 Crossfalls ▪ Is appropriate superelevation provided on curves? ▪ Is any adverse crossfall safely managed (for cars, trucks, etc.)? ▪ Do crossfalls (carriageway and shoulder) provide adequate drainage?	NA.
9 Batter slopes ▪ Are batter slopes traversable by cars and trucks which run off the road?	Batter slopes adjacent to eastern footpath of Osborn Road which pedestrians would be reluctant to use. This puts pedestrians closer to the roadway.
10 Drains ▪ Are roadside drains and culvert end walls traversable?	Yes.
6.2 Auxiliary lanes	
1 Tapers ▪ Are starting and finishing tapers located and aligned correctly? ▪ Is there sufficient sight distance to the end of the auxiliary lane?	NA.
2 Shoulders ▪ Are appropriate shoulder widths provided at merges? ▪ Have shoulder widths been maintained beside the auxiliary lane?	NA.
3 Signs and markings ▪ Have all signs been installed in accordance with the appropriate guidelines? ▪ Are all signs conspicuous and clear? ▪ Does all linemarking conform to these guidelines (particularly three merge arrows)? ▪ Is there advance warning of approaching auxiliary lanes?	NA.
4 Turning ▪ Have right turns from the through lane been avoided? ▪ Is there advance warning of turn lanes?	NA.
6.3 Intersections	
1 Location ▪ Are all intersections located safely with respect to the horizontal and vertical alignment? ▪ Where intersections occur at the end of high speed environments (eg. at approaches to towns), are there traffic control devices to alert drivers?	ASD issues noted due to the curvature of Pennant Hills Road and obstructions in the sight bench such as fences and tree foliage. SSD limitations to right-turn lanes.

2 Visibility
▪ sight distance
  ○ Is the presence of each intersection obvious to all road users?
  ○ Is the sight distance appropriate for all movements and all users?
  ○ Is there stopping sight distance to the rear of any queue or slow moving turning vehicles?
  ○ Has the appropriate sight distance been provided for entering and leaving vehicles?
	See above comment.

Checklist questions	Comments
3 Controls and delineation ▪ Are pavement markings and intersection control signs satisfactory? ▪ Are vehicle paths through intersections delineated satisfactorily? ▪ Are all lanes properly marked (including any arrows)?	Faded 40k patches noted.
4 Layout ▪ Are all conflict points between vehicles safely managed? ▪ Is the intersection layout obvious to all road users? ▪ Is the alignment of kerbs obvious and appropriate? ▪ Is the alignment of traffic islands obvious and appropriate? ▪ Is the alignment of medians obvious and appropriate? ▪ Can all likely vehicle types be accommodated? ▪ Are merge tapers long enough? ▪ Is the intersection free of capacity problems which may produce safety problems?	Uncontrolled left-turns allowed from Osborn Road to Pennant Hills Road.
5 Miscellaneous ▪ Particularly at rural sites, are all intersections free of loose gravel?	Loose gravel and debris noted.
6.4 Signs and lighting	
1 Lighting ▪ Is lighting required and if so, has it been adequately provided? ▪ Is the road free of features which interrupt illumination (eg. trees or overbridges)? ▪ Is the road free of lighting poles which are a fixed roadside hazard? ▪ Are frangible or slip-base poles provided? ▪ Ambient lighting: if it creates special lighting needs, have these been satisfied? ▪ Is the lighting scheme free of confusing or misleading effects on signals or signs? ▪ Is the scheme free of any lighting black patches?	Yes.
2 General signs issues ▪ Are all necessary regulatory, warning and direction signs in place? Are they conspicuous and clear? ▪ Are the correct signs used for each situation, and is each sign necessary? ▪ Are all signs effective for all likely conditions (eg. day, night, rain, fog, rising or setting sun, oncoming headlights, poor lighting)? ▪ If restrictions apply for any class of vehicle, are drivers adequately advised? ▪ If restrictions apply for any class of vehicle, are drivers advised of alternative routes?	Several signage issues noted.

Checklist questions	Comments
3 Sign legibility ▪ In daylight and darkness, are signs satisfactory regarding: o visibility: Clarity of message? Readability/legibility at the required distance? ▪ Is sign retroreflectivity or illumination satisfactory? ▪ Are signs able to be seen without being hidden by their background or adjacent distractions? ▪ Is driver confusion due to too many signs avoided?	Several visually obscured signs noted.
4 Sign supports ▪ Are sign supports out of the clear zone? ▪ If not, are they: o Frangible? o Shielded by barriers (eg. guard fence, crash cushions)?	Yes.
6.5 Markings and delineation	
1 General Issues ▪ Is the line marking and delineation: o Appropriate for the function of the road? o Consistent along the route? o Likely to be effective under all expected conditions? (day, night, wet, dry, fog, rising and setting sun position, oncoming headlights, etc) ▪ Is the pavement free of excessive markings? (eg. unnecessary turn arrows, unnecessary barrier lines, etc.)	Faded 40k patches.
2 Centrelines, edgelines, lane lines ▪ Are centrelines, edgelines, and lane lines provided? If not, do drivers have adequate guidance? ▪ Are RRPM's required? ▪ If RRPM's are installed, are they correctly placed, correct colours, in good condition? ▪ Are profiled (audible) edgelines provided where required? ▪ Is the linemarking in good condition? ▪ Is there sufficient contrast between linemarking and pavement colour?	Yes.
3 Guideposts and reflectors ▪ Are guideposts appropriately installed? ▪ Are delineators clearly visible? ▪ Are the correct colours used for the delineators? ▪ Are the delineators on guard fences, crash barriers and bridge railings consistent with those on guideposts?	This is an urban location with kerb and gutter and streetlighting.

Checklist questions	Comments
4 Curve warning and delineation ▪ Are curve warning signs and advisory speed signs installed where required? ▪ Are advisory speed signs consistent along the route? ▪ Are the signs correctly located in relation to the curve? (ie. not too far in advance) ▪ Are the signs large enough? ▪ Are chevron alignment markers (CAMs) installed where required? ▪ Is the positioning of CAMs satisfactory to provide guidance around the curve? ▪ Are the CAMs the correct size? ▪ Are CAMs confined to curves (not used to delineate islands, etc)?	This is an urban environment.
6.6 Crash barriers and clear zones	
1 Clear zones ▪ Is the clear zone width traversable (i.e. drivable)? ▪ Is the clear zone width free of rigid fixtures? (if not, can all of these rigid fixtures be removed or shielded?) ▪ Are all power poles, trees, etc., at a safe distance from the traffic paths? ▪ Is the appropriate treatment or shielding provided for any objects within the clear zone?	Generally, as the speed environment of Osborn Road is low, clear zone crash hazards were not a focal point of the audit.
2 Crash barriers ▪ Are crash barriers installed where necessary? ▪ Are crash barriers installed at all necessary locations in accordance with the relevant guidelines? ▪ Are the barrier systems suitable for the purpose? ▪ Are the crash barriers correctly installed? ▪ Is the length of crash barrier at each installation adequate? ▪ Is guard fence attached correctly to bridge railings? ▪ Is there sufficient width between the barrier and the edge line to contain a broken down vehicle?	Generally, as the speed environment of Osborn Road is low, clear zone crash hazards were not a focal point of the audit.
3 End treatments ▪ Are end treatments constructed correctly? ▪ Is there a safe run off area behind breakaway terminals?	NA.
4 Fences ▪ Are pedestrian fences frangible? ▪ Are vehicles safe from being "speared" by horizontal fence railings located within the clear zone?	Yes.
5 Visibility of barriers and fences ▪ Is there adequate delineation and visibility of crash barriers and fences at night?	Yes.
6.7 Traffic signals	

Checklist questions	Comments
1 Operations ▪ Are traffic signals operating correctly? ▪ Are the number, location and type of signal displays appropriate for the traffic mix and traffic environment? ▪ Where necessary, are there provisions for visually impaired pedestrians (eg. audio-tactile push buttons, tactile markings)? ▪ Where necessary, are there provisions for elderly or disabled pedestrians (eg. extended green or clearance phase)? ▪ Is the controller located in a safe position? (i.e. where it is unlikely to be hit, but maintenance access is safe) ▪ Is the condition (especially skid resistance) of the road surface on the approaches satisfactory?	The signals allow for uncontrolled left-turns from Osborn Road to Pennant Hills Road.
2 Visibility ▪ Are traffic signals clearly visible to approaching motorists? ▪ Is there adequate stopping sight distance to the ends of possible vehicle queues? ▪ Have any visibility problems that could be caused by the rising or setting sun been addressed? ▪ Are signal displays shielded so that they can be seen only by the motorists for whom they are intended? ▪ Where signal displays are not visible from an adequate distance, are signal warning signs and/or flashing lights installed? ▪ Where signals are mounted high for visibility over crests, is there adequate stopping sight distance to the ends of traffic queues? ▪ Is the primary signal free from obstructions on the nearside footway to approaching drivers? (trees, light poles, signs, bus stops, etc)	No. Furthermore, the advanced warning system for westbound drivers is poorly placed being around the sight-limited horizontal curve.
6.8 Pedestrians and cyclists	
1 General issues ▪ Are there appropriate travel paths and crossing points for pedestrians and cyclists? ▪ Are safety fences installed where necessary to guide pedestrians and cyclists to crossings or overpasses? ▪ Are safety barriers installed where necessary to separate vehicle, pedestrian and cyclist flows? ▪ Are pedestrian and bicycle facilities suitable for night use?	Yes.

Checklist questions	Comments
2 Pedestrians ▪ Is there adequate separation distance between vehicular traffic and pedestrians on footways? ▪ Is there an adequate number of pedestrian crossings along the route? ▪ At crossing points is fencing oriented so pedestrians face oncoming traffic? ▪ Is there adequate provision for the elderly, the disabled, children, wheelchairs and baby carriages (eg. holding rails, kerb and median crossings, ramps)? ▪ Are adequate hand rails provided where necessary (eg. on bridges, ramps)? ▪ Is signing about pedestrians near schools adequate and effective? ▪ Is signing about pedestrians near any hospital adequate and effective? ▪ Is the distance from the stop line to a cross walk sufficient for truck drivers to see pedestrians?	The eastern footpath of Osborn Road is narrow and forces pedestrians (including school children) to walk close to the road. The batter slopes on the eastern side of the path would discourage pedestrians from walking on this area.
3 Cyclists ▪ Is the pavement width adequate for the number of cyclists using the route? ▪ Is the bicycle route continuous (i.e. free of squeeze points or gaps)? ▪ Are drainage pit grates 'bicycle safe'?	No.
4 Public transport ▪ Are bus stops safely located with adequate visibility and clearance to the traffic lane? ▪ Are bus stops in rural areas sign posted in advance? ▪ Are shelters and seats located safely to ensure that sight lines are not impeded? Is clearance to the road adequate? ▪ Is the height and shape of the kerb at bus stops suitable for pedestrians and bus drivers?	Yes.
6.9 Bridges and culverts	
1 Design features ▪ Are bridges and culverts the full formation width? ▪ Are bridge and culvert carriageway widths consistent with approach conditions? ▪ Is the approach alignment compatible with the 85th percentile travel speed? ▪ Have warning signs been erected if either of the above two conditions (I.e. width and speed) are not met?	NA.
2 Crash barriers ▪ Are there suitable traffic barriers on bridges and culverts and their approaches to shield errant vehicles? ▪ Is the connection between barrier and bridge safe? ▪ Is the bridge free of kerbing which would reduce the effectiveness of barriers or rails?	The bridge is a pedestrian bridge over the carriageways of Pennant Hills Road.
3 Miscellaneous ▪ Are pedestrian facilities on the bridge appropriate and safe? ▪ Is fishing from the bridge prohibited? If not, has provision been made for "safe" fishing? ▪ Does delineation continue over the bridge?	Yes. The bridge is not accessible by road vehicles.

Checklist questions	Comments
6.10 Pavement	
1 Pavement defects ▪ Is the pavement free of defects (eg. excessive roughness or rutting, potholes, loose material, etc) which could result in safety problems (eg. loss of steering control)? ▪ Is the condition of the pavement edges satisfactory? ▪ Is the transition from pavement to shoulder free of dangerous edge drop offs?	Loose gravel noted.
2 Skid resistance ▪ Does the pavement appear to have adequate skid resistance, particularly on curves, steep grades and approaches to intersections? ▪ Has skid resistance testing been carried out where necessary?	Loose gravel noted.
3 Ponding ▪ Is the pavement free of areas where ponding or sheet flow of water could contribute to safety problems?	Yes.
4 Loose stones/material ▪ Is the pavement free of loose stones and other material?	No.
6.11 Parking	
1 General issues ▪ Are the provisions for or restrictions on parking satisfactory in relation to traffic safety? ▪ Is the frequency of the parking turnover compatible with the safety of the route? ▪ Is there sufficient parking for delivery vehicles so that safety problems due to double parking do not occur? ▪ Are parking manoeuvres along the route possible without causing safety problems? (eg. angle parking) ▪ Is the sight distance at intersections and along the route, unaffected by parked vehicles?	Stopping is permitted along a section of the western frontage of the school. This may lead to congestion and queue development.
6.12 Provision for heavy vehicles	
1 Design issues ▪ Are overtaking opportunities available for heavy vehicles where volumes are high? ▪ Does the route generally cater for the size of vehicle likely to use it? ▪ Is there adequate manoeuvring room for large vehicles along the route, at intersections, roundabouts, etc.? ▪ Is access to rest areas and truck parking areas adequate for the size of vehicle expected? (Consider acceleration, deceleration, shoulder widths, etc.)	Pennant Hill Road contains a significant proportion of heavy vehicles. There would be limited heavy vehicle access needs in Osborn Road.

Checklist questions	Comments
2 Pavement/shoulder quality ▪ Are shoulders sealed at bends to provide additional pavement for long vehicles? ▪ Is the pavement width adequate for heavy vehicles? ▪ In general, is the pavement quality sufficient for the safe travel of heavy and oversized vehicles? ▪ On truck routes, are reflective devices appropriate for truck drivers' eye heights?	No.
6.13 Floodways and causeways	
1 Ponding, flooding ▪ Are all sections of the route free from ponding or flow across the road during wet weather? ▪ If there is ponding or flow across the road during wet weather, is there appropriate signposting? ▪ Are floodways and causeways correctly signposted?	Yes.
2 Safety of devices ▪ Are all culverts or drainage structures located outside the clear roadside recovery area? ▪ If not, are they shielded from the possibility of vehicle collision?	Yes.
6.14 Miscellaneous	
1 Landscaping ▪ Is landscaping in accordance with guidelines (eg. clearances, sight distance)? ▪ Will existing clearances and sight distances be maintained following future plant growth? ▪ Does the landscaping at roundabouts avoid visibility problems?	Several sight-obstructing trees noted.
2 Temporary works ▪ Are all locations free of construction or maintenance equipment that is no longer required? ▪ Are all locations free of signs or temporary traffic control devices that are no longer required?	Yes.
3 Headlight glare ▪ Have any problems that could be caused by headlight glare been addressed (eg. a two-way service road close to main traffic lanes, the use of glare fencing or screening)?	Yes.
4 Roadside activities ▪ Are the road boundaries free of any activities that are likely to distract drivers? ▪ Are all advertising signs installed so that they do not constitute a hazard?	Yes.
5 Errant vehicles ▪ Is the roadside furniture on the verges and footways free of damage from errant vehicles which could indicate a possible problem, hazard or conflict at the site?	Osborn Road is a low-speed environment.

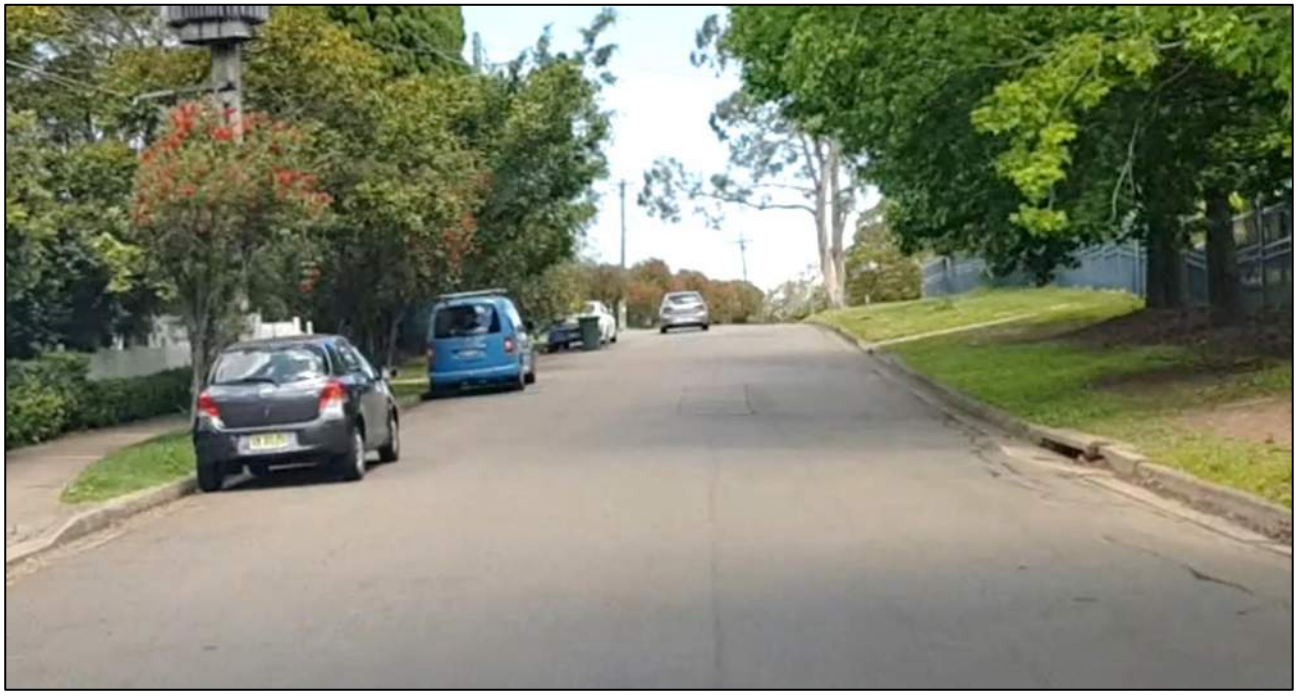
Checklist questions	Comments
6 Other safety issues ▪ Is the embankment stability safe? ▪ Is the route free of unsafe overhanging branches? ▪ Is the route free of visibility obstructions caused by long grass? ▪ Are any high wind areas safely dealt with? ▪ If back to back median kerbing is used is it: o Adequately delineated? o Obvious where it starts? o Obvious at intersections? o Unlikely to be a hazard to pedestrians?	Sight-obstructing vegetation noted.
7 Rest Areas ▪ Is the location of rest areas and truck parking areas along the route appropriate? ▪ Is there adequate sight distance to the exit and entry points from rest areas and truck parking areas at all times of the day?	NA.
8 Animals ▪ Is the route free from large numbers of animals (eg. cattle, sheep, kangaroos, koalas, wombats, etc.)? ▪ If not, is it protected by animal-proof fencing?	Yes.

TRAFFIC ENGINEERING

Ason Group

Mt Pleasant Avenue, Normanhurst

Existing stage road safety audit



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Mt Pleasant Avenue, Normanhurst

Existing stage road safety audit

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Report No ASON-PROJ-0007-02 ES RSA MT PLEASANT AVENUE Rev 2

Date 21/10/2019

This report has been prepared for Ason Group.

CONTENTS

Appendices

1 Introduction

1.1 Project and audit details

Details of the audit have been summarised in Table 1.

Table 1 Details of the road safety audit.

Audited project	Mt Pleasant Avenue, between and including its intersection with Pennant Hills Road, and the southern-most extent of the Loreto Normanhurst School frontage, Normanhurst.
Client/ contact	Rebecca Butler-Madden Senior Transport Planner Ason Group Ph: (02) 9083 6601 / 0406 421 154 E: Rebecca.BMadden@asongroup.com.au
Audit type	*Existing stage* road safety audit.
Purpose	Loreto Normanhurst are proposing to develop an early learning centre on Mount Pleasant Avenue. As part of the planning for this development, an *existing stage* road safety audit has been requested of Mt Pleasant Avenue, which is the access road to the school along its eastern frontage.
Scope of project/ audit	Spatial scope The following roads were formally reviewed as part of this road safety audit: ▪ Pennant Hills Road, from Redgrave Road (to capture the length of the school zone) to 70m west of Mt. Pleasant Avenue (to capture the full length of the right-turn lane to Mt. Pleasant Avenue). ▪ Mt. Pleasant Avenue, from 0-700m south of Pennant Hills Road to capture the entire length of the eastern school frontage. Temporal scope As an *existing stage* road safety audit, the audit and its findings were associated with the site conditions ("version") as inspected at the following dates/ times: ▪ 1300-1400h on 9/10/2019 – day time inspection. ▪ 2200-2300h on 13/10/2019 – night time inspection.
Audit team details	Damien Chee, DC Traffic Engineering (level 3 and lead auditor – RSA-02-0094). Linda Chee, DC Traffic Engineering (Level 2 road safety auditor - RSA-02-1069). Tim Lewis, Ason Group (Level 2 road safety auditor – RSA-02-0809). James Laidler, Ason Group.
Audit methodology	The audit was undertaken using the following methodology: ▪ A day time inspection of the site was carried out between 1300-1400h on 9/10/2019. ▪ A night time inspection was carried out between 2200-2300h on 13/10/2019. ▪ The road safety audit findings have been documented in this report in accordance with the NSW Centre for Road Safety's *Guidelines for Road Safety Audit Practices* (2011). ▪ This report includes completed *checklist 6 –existing stage audit* as sourced from the Austroads *Guide to Road Safety Part 6: Road Safety Audit*.
Material supplied	Not applicable.

1.2 Responding to the audit report

Road safety audits provide the opportunity to highlight potential road safety problems and have them formally considered by the project manager in conjunction with all other project considerations.

The responsibility for the project rests with the project manager, not with the auditor. The project manager is under no obligation to accept the audit findings. Also, it is not the role of the auditor to agree to, or approve the project manager's responses to the audit.

1.3 Previous audits

There were no previous road safety audit reports issued to the audit team of direct relevance to this road.

2 Safety audit findings

The road safety audit findings are presented in Table 2.

Table 2 Road safety audit findings.

Ref	Theme/ location	Road safety audit finding	Priority
1	Eastbound right-turn movement from Pennant Hills Road to Mt. Pleasant Avenue.	Under existing conditions, eastbound right-turn movements are permitted from Pennant Hills Road to Mt. Pleasant Avenue. This is an uncontrolled turn where the right-turning driver needs to filter across three westbound lanes (and hence three separate traffic streams). As Pennant Hills Road is a major arterial road and one of the primary feeders/ receivers of traffic to/ from the M1 Motorway (less than 1km to the north-east), this route experiences high volumes of traffic. Furthermore, there is also a significant volume of trucks on this route. The high traffic volumes mean that there are few gaps presented in the traffic streams. As a three-lane crossing, the right-turning driver also needs to judge *coinciding gaps* in all three lanes. The likelihood of gaps in all three lanes coinciding is substantially less than an individual gap in any one of those lanes. In these respects, the filtered right-turn movement would be extremely complex and prone to driver error. This includes poor gap judgement, and deliberate selection of substandard gaps (due to impatience and frustration). Also, another dangerous practice often used by drivers is to "creep out" into initial gaps in lane 3 to then "thread" through gaps in lanes 1 and 2. This method of incremental/ staggered crossing is risky since the driver heavily relies on a gap presenting itself in lanes 1 and 2. Also, if gaps do not present themselves, the driver could be left stranded and exposed to a *head on*-impact with traffic in westbound lane 3. Also, this method of gap acceptance assumes that vehicles in each respective westbound lane will continue to remain in their lanes. If any vehicle changes lanes, this could also make the gap conditions less predictable. The filtered right-turn movements across three opposing lanes is not ideal for the safety of school-related traffic (particularly due to the more vulnerable road user age groups involved). Also, during non-school zone periods, the opposing traffic is legally allowed to travel up to 70km/h. The audit team also scarring on the palm tree and broken glass at the base of the utility pole on the south-eastern corner of the intersection (see right-hand image). This is possible evidence of crashes involving rushed right-turn movements. Consideration should be given to banning or part-day banning this movement.    ***Left:*** *Looking eastbound along Pennant Hills Road from the head of the right-turn lane (to Mt. Pleasant Avenue). This is a situation where there are coinciding gaps in all three westbound lanes.* ***Middle:*** *More heavily congested conditions with a lack of gaps.* ***Right:*** *Evidence of previous crashes with scarring on the tree trunk and broken glass at the base of the utility pole.*	High

Ref	Theme/ location	Road safety audit finding	Priority
2	Sight line from the hold line of Mt. Pleasant Avenue to Pennant Hills Road North.	The Mt. Pleasant Avenue approach to its intersection with Pennant Hills Road is STOP controlled. As such, all outbound drivers are required to stop, and then assess gaps and traffic conditions in Pennant Hills Road before turning left or right. There is limited *minimum gap sight distance* (MGSD) from this hold line to the north. The sight constraining features include (i) a brick property wall on the south-eastern corner of the intersection, and (ii) overhanging hedges and tree foliage from properties along the southern side of Pennant Hills Road. The limited MGSD sight line may result in poor gap detection and selection and consequential *cross traffic* crashes. This is also since there are three southbound approach lanes which makes the gap detection process very complicated. As an initial measure, the overhanging tree foliage from the southern properties could be pruned back to improve the MGSD sight line. Further to the above, right-turn movements are permitted from Mt. Pleasant Avenue to Pennant Hills Road North. This is a high-risk manoeuvre due to several constraining factors, as follows: ▪ The MGSD sight line to the north is restricted as discussed above. ▪ The MGSD sight line to the south is also restricted due to the median pedestrian fence and the limited “see through” visibility as a result of the fence balusters and posts. ▪ The right-turn movement requires gap detection and selection, and then crossing of three individual westbound traffic lanes. It also requires gap detection and selection in the eastbound carriageway (up to six lanes altogether). Ideally, the driver should make the right-turn when there are gaps in all three eastbound lanes. However, in reality, many drivers may resort to using gaps in lanes 2 and 3, knowing that vehicles in lane 1 eastbound (kerbside lane) are less of a collision threat. The gap checking process is extremely complicated, and many drivers may also attempt a staggered crossing method, where they accept a gap in the westbound carriageway and then drift forwards slowly in the hope that a gap presents itself in the eastbound carriageway. This is a risky method of entry. If gaps do not present themselves in the eastbound carriageway, the right-turning vehicle would be left stranded and exposed to collisions by westbound vehicles. Consideration should be given to banning the outbound right-turn from Mt. Pleasant Avenue, or at least implementing a part-day ban.  ***Left-hand image:*** *Looking westbound along Pennant Hills Road towards Mt. Pleasant Avenue from lane 1. Note the restricted sight line between this traffic lane and the outbound vehicle from Mt. Pleasant Avenue. The sight-constraining features are the overhanging tree foliage from the southern properties. Note also how the outbound vehicle has advanced forwards into the westbound carriageway, to establish a better MGSD sight line.*  ***Right-hand image:*** *The view from the hold line of Mt. Pleasant Avenue to the north. Note the impact of the brick property wall on the MGSD sight line. To establish a better sight line, the driver would need to advance further out and possibly into the westbound carriageway of Pennant Hills Road. This would increase the risk of cross traffic crashes.*	High

Ref	Theme/ location	Road safety audit finding	Priority
3	Westbound travel direction of Pennant Hills Road in approach to Mt. Pleasant Avenue.	In the westbound travel direction of Pennant Hills Road, the school zone commences to the immediate east of Mt. Pleasant Avenue. This consists of a pair of SCHOOL ZONE signs, and 40k patches and dragon's teeth markings in each travel lane. However, the right-hand SCHOOL ZONE sign (circled in yellow) is placed on the northern side of the road which is well outside the forward field of view of westbound drivers. This sign would be more appropriately placed on the median (marked by the white star) to improve its visual prominence. If relocated to the median, the sign face should be mounted sufficiently high to maintain the sight lines between eastbound right-turners (in the right-turn lane to Mt. Pleasant Avenue) and westbound traffic that are approaching this point. The audit team also notes that whilst the eastbound travel direction of Pennant Hills Road contains a flashing light unit on the SCHOOL ZONE sign, there is no corresponding flashing light unit provided in the westbound direction (at the location shown below). This is a point of inconsistency. Whilst the flashing light assembly is not a mandatory requirement, it greatly enhances compliance with the 40km/h school zone speed limit since drivers are more certain as to when the school zone conditions are in effect. That is, there is less ambiguity as to whether the road is under a 40km/h school zone speed limit, or operating to the default 70km/h speed limit. In these respects, consideration should also be given to retrofitting a flashing light assembly at this point. The audit team also notes that the 40k pavement patches have faded which reduces the effectiveness of these as regulatory and advisory devices.  ***Above:*** *Looking westbound along Pennant Hills Road showing the large lateral offset of the right-hand SCHOOL ZONE sign and the lack of flashing light units on either sign.*	Medium

Ref	Theme/ location	Road safety audit finding	Priority
4	Eastern kerb line of Mt. Pleasant Avenue to the south of Pennant Hills Road.	On the eastern side of Mt. Pleasant Avenue to the south of Pennant Hills Road, there is a NO STOPPING sign with a single-sided, north-facing arrow. As such, this allows vehicles to stop/ park along the eastern kerbline to the south of this point. As shown in the left-hand image, any vehicles parked along this kerb, would severely limit the space available for other southbound vehicles. The silver southbound vehicle has encroached well into the space of the opposing traffic stream. Furthermore, to take this travel path, it also crossed over the BB double barrier centreline. This presents *head-on* crash risks with the opposing (northbound traffic stream). The blue vehicle approaching this point would either need to stop to allow the southbound vehicle to clear through this squeeze point, or else they would be exposed to this *head-on* crash risk. Another risk scenario would be when there are queues in the northbound travel direction such that there is insufficient space/width for the southbound vehicle to pass (due to the parked vehicle on one side and a queued vehicle on the other). The southbound vehicle would be forced to stop until the queue dissipates. This is in the immediate departure from the intersection where they could be exposed to a rear-end impact by other trailing traffic. To reduce the risk of cross centreline breaches and *head-on* crashes, the NO STOPPING sign should be relocated further south.   ***Left:*** *Looking southbound along Mt. Pleasant Avenue showing the impact of vehicles (legally) parked on the eastern kerbline, on the residual passing clearance for other southbound traffic.* ***Right:*** *Another example where a southbound vehicle was forced to cross the BB centreline due to a vehicle parked on the eastern kerbline. Note also the potential risk to queued vehicles in the northbound direction. If there were more vehicles in this queue, there would have either been (i) a crash risk between the cross centreline southbound vehicle and the queued vehicle or (ii) the southbound vehicle would be forced to stop in the immediate departure from the intersection where it would be exposed to rear-end crash by other trailing southbound vehicles.*	Medium

Ref	Theme/ location	Road safety audit finding	Priority
5a	General – Visually obscured signs along Mt. Pleasant Avenue.	There are several signs along the audited length of Mt. Pleasant Avenue which are visually obscured by tree foliage. The signs therefore lack effectiveness in conveying the regulatory and speed zoning advice. Many of these signs also contain time-based information, such as when the school zone (and hence variable speed limit of 40km/h) is in operation. The visually obscured signs are depicted below as well as in item 5b, with descriptions in the captions. These are generally mitigatable by tree pruning works.   ***Left:*** *Looking southbound along Mt. Pleasant Avenue with a view of the partially obscured SCHOOL ZONE sign.* ***Right:*** *Looking northbound at the reverse side of the first sign. The SCHOOL ZONE sign in this direction is also partially obscured by tree foliage.*	Medium

Ref	Theme/ location	Road safety audit finding	Priority
5b	General – Visually obscured signs. Continued from item 5a…	Continued from item 5a…  ***Above:*** *Looking northbound along Mt. Pleasant Avenue towards its intersection with Pennant Hills Road. The right-hand STOP sign is almost entirely obscured by tree foliage. This is critical since there is also limited viewing time to the left-hand STOP sign due to trees and foliage on the western side of the road.*	Medium

Ref	Theme/ location	Road safety audit finding	Priority
6	Pennant Hills Road, at its intersection with Mt. Pleasant Avenue.	From the night time inspection of the site, the audit team noted that there is a relative dark patch along Pennant Hills Road at its intersection with Mt. Pleasant Avenue. This appears to be a result of missing or malfunctioning street light luminaires. The impact of the poor lighting is evident in the image below, showing the contrast between the poorly lit roadway in the foreground and the much better lighting performance further downstream (east). The poor lighting at this location could increase the risk of night time crashes. Especially if the object being struck is non-reflective or non-illuminated. Eg. a fallen load, damaged tyre etc. The poor lighting also means drivers would have less awareness of pavement conditions.  ***Above:*** *Looking eastbound along Pennant Hills Road during the night time inspection, showing the poor lighting standard at the Mt. Pleasant Avenue intersection.*	Medium

Ref	Theme/ location	Road safety audit finding	Priority
7	Section of Mt Pleasant Avenue at the main entrance to Loreto Normanhurst.	There is a pair of right-left reverse curves in combination with a crest vertical curve. The combined effect of the horizontal curves and the crest has reduced driver visibility to the road ahead. As such, drivers may not be aware of the road alignment in the road ahead. This is particularly critical if drivers in either direction drift towards the midline of the road where there could be corresponding *head-on* crash risks with opposing vehicles. Consideration should be given to providing a centreline to define and separate opposing traffic streams.  ***Above:*** *Looking southbound along Mt Pleasant Avenue towards the crest-curve combination.*	Medium

Ref	Theme/ location	Road safety audit finding	Priority
8	Pennant Hills Road, westbound carriageway between the start of the school zone and the pedestrian bridge.	At the time of the inspections, there were numerous potholes and pavement failures in the westbound carriageway of Pennant Hills Road. These may destabilise vehicles and increase the risk of *loss of control* events. The potholes may also lead to progressive damage to the pavement and its sub-base. This is especially if water is able to seep in these voids. As such, without intervention, the potholes are likely to become larger and deeper. Many of these potholes are also in the wheelpaths of vehicles. The frequent wheel loading on these failures may also exacerbate the damage, and may also limit the effectiveness of any patchwork.   ***Left:*** *Looking westbound along Pennant Hills Road with a view of pavement failures in lanes 1 and 2 of the westbound carriageway.* ***Right:*** *More potholes along the left-wheel path in lane 2, to the west of Mt. Pleasant Avenue.*	Low

Ref	Theme/ location	Road safety audit finding	Priority
9	Western side of Mt. Pleasant Avenue.	There is no footpath on the western side of the road along the school frontage (left-hand image). As such, any pedestrian traffic generated from the school would be forced to walk on the unpaved portions of the verge with increased risks of trips and falls. Alternatively, these pedestrians may resort to walking on the roadway, or crossing the road to access the eastern footpath. The steep cross fall of the verge (also evident in the left-hand image) would also discourage pedestrians from using this verge area. As such, any movements along or across the road would present risks of *vehicle-pedestrian* crashes including events that may involve school students and staff. Consideration should be given to providing a footpath on the western side of Mt. Pleasant Avenue to link into the pre-existing footpath further north. This would also allow greater flexibilities since any walk-based trips to/ from the east would be more conveniently catered for along this road, rather than using the Osborne Road gates and circuiting around (a much longer trip). Also, with the pre-existing footpath further north, there are several sections which have limited effective width due to overhanging bushes and trees (middle image). These should be cleared back to re-instate the full width of the footpath. Many sections of this path are also uneven and could present as current or future trip hazards (see right-hand image).    ***Left:*** *There are no footpaths on the western side of Mt Pleasant Avenue along the school frontage.* ***Middle:*** *the effective width of the footpath (further north) is reduced due to overhanging trees/ bushes.* ***Right:*** *An example of uneven path levels at this utility lid and backfilled trench.*	Low

Ref	Theme/ location	Road safety audit finding	Priority
10	Western verge of Mt. Pleasant Avenue at the southern end of the school frontage.	At the southern end of the audited length of Mt. Pleasant Avenue, the kerb-bounded section of this road transitions to an un-kerbed section with an unpaved verge. This is a rather informal road-verge interface for an urban and residential area. As such, the following issues were present: ▪ With no continuing kerbline in place, there is a jagged pavement edge which forms a vertical lip. This could destabilise vehicles and also inhibit re-entry of vehicles to the roadway if they stray outside the traffic lanes. Pronounced vertical lips typically result in *tyre scrubbing* where the inside and vertical wall of the tyre scrubs along the vertical edge of the pavement. This can lead to tyre damage and also contribute to *loss of control* events. ▪ The lack of kerb and gutter, also presents an abrupt reduction in sealed and trafficable width. This is evident in the left-hand image where the kerbline suddenly terminates and the pavement boundary juts into the roadway. This would increase the risk of wheel tracking on the soft verge as well as across the pavement boundary where the frequent wheel contact and loading may also lead to progressive damage to the edge of pavement. ▪ The lack of a lined gutter also means that water accumulation along the informal interface is likely to ingress to the sub-base levels of the pavement. This could lead to structural weakening of the sub-base with consequential collapse of the overlying pavement. The deteriorating edges are evidence of this. ▪ The informal verge area is used as a parking area. The frequent trafficking of this area would lead to progressive damage to the edge of pavement. As the sealed and trafficable portion of road is narrower along this area, this also means vehicles parked at this location are able to be parked closer to road traffic with risks of impacts by passing traffic (see right-hand image).   ***Left:*** *Looking northbound along Mt. Pleasant Avenue at the point where the road transitions from kerb-bounded to an informal road-verge interface with variable edge conditions.* ***Right:*** *The narrower width of sealed and trafficable roadway allows parked cars to be positioned much closer to traffic with risks of impacts.*	Low

Ref	Theme/ location	Road safety audit finding	Priority
11	South-eastern and south-western kerb returns of the Pennant Hills Road/ Mt Pleasant Avenue intersection.	The kerb ramps at both of these corners of the intersection are poorly aligned and direct pedestrians towards Pennant Hills Road. This is especially the case for vision impaired pedestrians who rely on the alignment of the ramp to interpret the crossing direction. Mobility-impaired pedestrians may also be affected, especially if using a wheeled device, since there is a natural tendency to roll down or up the ramp in a perpendicular trajectory to the ramp.  ***Above:*** *The kerb ramp on the south-eastern corner of the intersection.*	Low

Ref	Theme/ location	Road safety audit finding	Priority
12	General – Driveways and the impact of sight-obstructing vegetation.	In general, many driveways along this road contain trees/ shrubs either side of them and in the roadside verges of Mt Pleasant Road. The sight lines to and from several driveways were restricted due to these trees. This could affect the safety of vehicles using these driveways, especially those egressing and where the drivers need clear visibility to conflicting traffic streams on Mt Pleasant Avenue. With reduced visibility, there may be increased risks of *cross traffic* crashes. Also, some trees also blocked the sight lines from egressing drivers to the footpaths where pedestrians may be standing/ walking. Tree pruning/ thinning works would generally improve sight lines in these respects.  ***Above:*** *The view from one driveway on the eastern side of Mt Pleasant Avenue towards the north. The sight lines were obscured by trees in the eastern verge.*	Low

3 Concluding statement

DC Traffic Engineering has undertaken an *existing stage* road safety audit of this project in accordance with the methodology outlined in Section 1 of this report.

Issues identified have been noted in this report for the Project Manager to review, assess, and where appropriate, make the necessary recommendations to improve safety.

Damien Chee
Audit Team Leader
DC Traffic Engineering Pty Ltd

Appendix A

Road Safety Audit Checklist

Checklist questions	Comments
6.1 Road alignment and cross section	
1 Visibility ▪ sight distance Is sight distance adequate for the speed of traffic using the route? ▪ Is adequate sight distance provided for intersections and crossings? (eg. pedestrian, cyclist, cattle, railway) ▪ Is adequate sight distance provided at all private driveways and property entrances?	MGSD issues noted from Mt Pleasant Avenue to east and west on Pennant Hills Road. Visibility constraints noted due to trees in verges and drivers from driveways being visually obscured.
2 Design speed ▪ Is the horizontal and vertical alignment suitable for the (85th percentile) traffic speed? ▪ If not are: o Warning signs installed? Advisory speed signs installed? o Are the posted advisory speeds for curves appropriate?	Yes.
3 Speed limit/speed zoning ▪ Is the speed limit compatible with the function, road geometry, land use and sight distance?	Schools zone signs are obscured. 40k pavement patches have faded.
4 Overtaking ▪ Are safe overtaking opportunities provided?	Lack of passing clearance in southbound departure of Mt. Pleasant Avenue from its intersection with Pennant Hills Road, due to parked cars on one side and queued cars on the other.
5 Readability by drivers ▪ Is the road free of elements which may cause confusion? For example: o Is alignment of the roadway clearly defined? o Has disused pavement (if any) been removed or treated? o Have old pavement markings been removed properly? o Do tree lines follow the road alignment? o Does the line of street lights or the poles follow the road alignment? ▪ Is the road free of misleading curves or combinations of curves?	Yes.
6 Widths ▪ Are medians and islands of adequate width for the likely users? ▪ Are traffic lane and carriageway widths adequate for the traffic volume and mix? ▪ Are bridge widths adequate?	Width restriction noted in Mt. Pleasant Avenue at southern end. Lack of passing clearance at northern end due to parked cars.

Checklist questions	Comments
7 Shoulders ▪ Are shoulders wide enough to allow drivers to regain control of errant vehicles? ▪ Are shoulders wide enough for broken down or emergency vehicles to stop safely? ▪ Are shoulders sealed? ▪ Are shoulders trafficable for all vehicles and road users? (I.e. are shoulders in good condition) ▪ Is the transition from road to shoulder safe? (no drop-offs)	Unsealed verge area noted at southern end.
8 Crossfalls ▪ Is appropriate superelevation provided on curves? ▪ Is any adverse crossfall safely managed (for cars, trucks, etc.)? ▪ Do crossfalls (carriageway and shoulder) provide adequate drainage?	Yes.
9 Batter slopes ▪ Are batter slopes traversable by cars and trucks which run off the road?	Yes. Steep verge on western side would be unattractive to pedestrians.
10 Drains ▪ Are roadside drains and culvert end walls traversable?	Yes.
6.2 Auxiliary lanes	
1 Tapers ▪ Are starting and finishing tapers located and aligned correctly? ▪ Is there sufficient sight distance to the end of the auxiliary lane?	NA.
2 Shoulders ▪ Are appropriate shoulder widths provided at merges? ▪ Have shoulder widths been maintained beside the auxiliary lane?	NA.
3 Signs and markings ▪ Have all signs been installed in accordance with the appropriate guidelines? ▪ Are all signs conspicuous and clear? ▪ Does all linemarking conform to these guidelines (particularly three merge arrows)? ▪ Is there advance warning of approaching auxiliary lanes?	NA.
4 Turning ▪ Have right turns from the through lane been avoided? ▪ Is there advance warning of turn lanes?	Yes.
6.3 Intersections	
1 Location ▪ Are all intersections located safely with respect to the horizontal and vertical alignment? ▪ Where intersections occur at the end of high speed environments (eg. at approaches to towns), are there traffic control devices to alert drivers?	Poor MGSD from Mt. Pleasant Avenue to the east and west on Pennant Hills Road.

Checklist questions	Comments

2 Visibility
▪ sight distance
  ○ Is the presence of each intersection obvious to all road users?
  ○ Is the sight distance appropriate for all movements and all users?
  ○ Is there stopping sight distance to the rear of any queue or slow moving turning vehicles?
  ○ Has the appropriate sight distance been provided for entering and leaving vehicles?
	See above comment.

3 Controls and delineation ▪ Are pavement markings and intersection control signs satisfactory? ▪ Are vehicle paths through intersections delineated satisfactorily? ▪ Are all lanes properly marked (including any arrows)?	STOP sign obscured by overhanging foliage.
4 Layout ▪ Are all conflict points between vehicles safely managed? ▪ Is the intersection layout obvious to all road users? ▪ Is the alignment of kerbs obvious and appropriate? ▪ Is the alignment of traffic islands obvious and appropriate? ▪ Is the alignment of medians obvious and appropriate? ▪ Can all likely vehicle types be accommodated? ▪ Are merge tapers long enough? ▪ Is the intersection free of capacity problems which may produce safety problems?	Poor MGSD from Mt. Pleasant Avenue to the east and west on Pennant Hills Road.
5 Miscellaneous ▪ Particularly at rural sites, are all intersections free of loose gravel?	Yes.
6.4 Signs and lighting	
1 Lighting ▪ Is lighting required and if so, has it been adequately provided? ▪ Is the road free of features which interrupt illumination (eg. trees or overbridges)? ▪ Is the road free of lighting poles which are a fixed roadside hazard? ▪ Are frangible or slip-base poles provided? ▪ Ambient lighting: if it creates special lighting needs, have these been satisfied? ▪ Is the lighting scheme free of confusing or misleading effects on signals or signs? ▪ Is the scheme free of any lighting black patches?	Dark patch noted on Pennant Hills Road.

Checklist questions	Comments
2 General signs issues ▪ Are all necessary regulatory, warning and direction signs in place? Are they conspicuous and clear? ▪ Are the correct signs used for each situation, and is each sign necessary? ▪ Are all signs effective for all likely conditions (eg. day, night, rain, fog, rising or setting sun, oncoming headlights, poor lighting)? ▪ If restrictions apply for any class of vehicle, are drivers adequately advised? ▪ If restrictions apply for any class of vehicle, are drivers advised of alternative routes?	Many signs are visually obscured.
3 Sign legibility ▪ In daylight and darkness, are signs satisfactory regarding: o visibility: Clarity of message? Readability/legibility at the required distance? ▪ Is sign retroreflectivity or illumination satisfactory? ▪ Are signs able to be seen without being hidden by their background or adjacent distractions? ▪ Is driver confusion due to too many signs avoided?	See above.
4 Sign supports ▪ Are sign supports out of the clear zone? ▪ If not, are they: o Frangible? o Shielded by barriers (eg. guard fence, crash cushions)?	Yes. Generally, this is a low-speed urban environment. As such, signs as potential clear zone crash hazards were not a focal aspect of the audit.
6.5 Markings and delineation	
1 General Issues ▪ Is the line marking and delineation: o Appropriate for the function of the road? o Consistent along the route? o Likely to be effective under all expected conditions? (day, night, wet, dry, fog, rising and setting sun position, oncoming headlights, etc) ▪ Is the pavement free of excessive markings? (eg. unnecessary turn arrows, unnecessary barrier lines, etc.)	Yes.
2 Centrelines, edgelines, lane lines ▪ Are centrelines, edgelines, and lane lines provided? If not, do drivers have adequate guidance? ▪ Are RRPM's required? ▪ If RRPM's are installed, are they correctly placed, correct colours, in good condition? ▪ Are profiled (audible) edgelines provided where required? ▪ Is the linemarking in good condition? ▪ Is there sufficient contrast between linemarking and pavement colour?	Lack of width between cars parked on eastern kerbline of Mt. Pleasant Avenue and BB centreline. Risks of centreline breaches noted.

Checklist questions	Comments
3 Guideposts and reflectors ▪ Are guideposts appropriately installed? ▪ Are delineators clearly visible? ▪ Are the correct colours used for the delineators? ▪ Are the delineators on guard fences, crash barriers and bridge railings consistent with those on guideposts?	NA. Urban and residential site.
4 Curve warning and delineation ▪ Are curve warning signs and advisory speed signs installed where required? ▪ Are advisory speed signs consistent along the route? ▪ Are the signs correctly located in relation to the curve? (ie. not too far in advance) ▪ Are the signs large enough? ▪ Are chevron alignment markers (CAMs) installed where required? ▪ Is the positioning of CAMs satisfactory to provide guidance around the curve? ▪ Are the CAMs the correct size? ▪ Are CAMs confined to curves (not used to delineate islands, etc)?	NA.
6.6 Crash barriers and clear zones	
1 Clear zones ▪ Is the clear zone width traversable (i.e. drivable)? ▪ Is the clear zone width free of rigid fixtures? (if not, can all of these rigid fixtures be removed or shielded?) ▪ Are all power poles, trees, etc., at a safe distance from the traffic paths? ▪ Is the appropriate treatment or shielding provided for any objects within the clear zone?	This is generally a low-speed, urban road. As such, clear zone crash hazards were not a focal aspect of this audit.
2 Crash barriers ▪ Are crash barriers installed where necessary? ▪ Are crash barriers installed at all necessary locations in accordance with the relevant guidelines? ▪ Are the barrier systems suitable for the purpose? ▪ Are the crash barriers correctly installed? ▪ Is the length of crash barrier at each installation adequate? ▪ Is guard fence attached correctly to bridge railings? ▪ Is there sufficient width between the barrier and the edge line to contain a broken down vehicle?	NA.
3 End treatments ▪ Are end treatments constructed correctly? ▪ Is there a safe run off area behind breakaway terminals?	NA.
4 Fences ▪ Are pedestrian fences frangible? ▪ Are vehicles safe from being "speared" by horizontal fence railings located within the clear zone?	NA.

Checklist questions	Comments
5 Visibility of barriers and fences ▪ Is there adequate delineation and visibility of crash barriers and fences at night?	Yes.
6.7 Traffic signals	
1 Operations ▪ Are traffic signals operating correctly? ▪ Are the number, location and type of signal displays appropriate for the traffic mix and traffic environment? ▪ Where necessary, are there provisions for visually impaired pedestrians (eg. audio-tactile push buttons, tactile markings)? ▪ Where necessary, are there provisions for elderly or disabled pedestrians (eg. extended green or clearance phase)? ▪ Is the controller located in a safe position? (i.e. where it is unlikely to be hit, but maintenance access is safe) ▪ Is the condition (especially skid resistance) of the road surface on the approaches satisfactory?	NA. No traffic signals throughout the audited length.
2 Visibility ▪ Are traffic signals clearly visible to approaching motorists? ▪ Is there adequate stopping sight distance to the ends of possible vehicle queues? ▪ Have any visibility problems that could be caused by the rising or setting sun been addressed? ▪ Are signal displays shielded so that they can be seen only by the motorists for whom they are intended? ▪ Where signal displays are not visible from an adequate distance, are signal warning signs and/or flashing lights installed? ▪ Where signals are mounted high for visibility over crests, is there adequate stopping sight distance to the ends of traffic queues? ▪ Is the primary signal free from obstructions on the nearside footway to approaching drivers? (trees, light poles, signs, bus stops, etc)	NA. No traffic signals throughout the audited length.
6.8 Pedestrians and cyclists	
1 General issues ▪ Are there appropriate travel paths and crossing points for pedestrians and cyclists? ▪ Are safety fences installed where necessary to guide pedestrians and cyclists to crossings or overpasses? ▪ Are safety barriers installed where necessary to separate vehicle, pedestrian and cyclist flows? ▪ Are pedestrian and bicycle facilities suitable for night use?	There are no footpaths on the western side of Mt. Pleasant Avenue along the school frontage.

Checklist questions	Comments
2 Pedestrians ▪ Is there adequate separation distance between vehicular traffic and pedestrians on footways? ▪ Is there an adequate number of pedestrian crossings along the route? ▪ At crossing points is fencing oriented so pedestrians face oncoming traffic? ▪ Is there adequate provision for the elderly, the disabled, children, wheelchairs and baby carriages (eg. holding rails, kerb and median crossings, ramps)? ▪ Are adequate hand rails provided where necessary (eg. on bridges, ramps)? ▪ Is signing about pedestrians near schools adequate and effective? ▪ Is signing about pedestrians near any hospital adequate and effective? ▪ Is the distance from the stop line to a cross walk sufficient for truck drivers to see pedestrians?	See previous item.
3 Cyclists ▪ Is the pavement width adequate for the number of cyclists using the route? ▪ Is the bicycle route continuous (i.e. free of squeeze points or gaps)? ▪ Are drainage pit grates 'bicycle safe'?	Squeeze point at southern end.
4 Public transport ▪ Are bus stops safely located with adequate visibility and clearance to the traffic lane? ▪ Are bus stops in rural areas sign posted in advance? ▪ Are shelters and seats located safely to ensure that sight lines are not impeded? Is clearance to the road adequate? ▪ Is the height and shape of the kerb at bus stops suitable for pedestrians and bus drivers?	NA.
6.9 Bridges and culverts	
1 Design features ▪ Are bridges and culverts the full formation width? ▪ Are bridge and culvert carriageway widths consistent with approach conditions? ▪ Is the approach alignment compatible with the 85th percentile travel speed? ▪ Have warning signs been erected if either of the above two conditions (I.e. width and speed) are not met?	NA.
2 Crash barriers ▪ Are there suitable traffic barriers on bridges and culverts and their approaches to shield errant vehicles? ▪ Is the connection between barrier and bridge safe? ▪ Is the bridge free of kerbing which would reduce the effectiveness of barriers or rails?	NA.
3 Miscellaneous ▪ Are pedestrian facilities on the bridge appropriate and safe? ▪ Is fishing from the bridge prohibited? If not, has provision been made for "safe" fishing? ▪ Does delineation continue over the bridge?	NA.

Checklist questions	Comments
6.10 Pavement	
1 Pavement defects ▪ Is the pavement free of defects (eg. excessive roughness or rutting, potholes, loose material, etc) which could result in safety problems (eg. loss of steering control)? ▪ Is the condition of the pavement edges satisfactory? ▪ Is the transition from pavement to shoulder free of dangerous edge drop offs?	Potholes noted in Pennant Hills Road.
2 Skid resistance ▪ Does the pavement appear to have adequate skid resistance, particularly on curves, steep grades and approaches to intersections? ▪ Has skid resistance testing been carried out where necessary?	Yes.
3 Ponding ▪ Is the pavement free of areas where ponding or sheet flow of water could contribute to safety problems?	Yes.
4 Loose stones/material ▪ Is the pavement free of loose stones and other material?	Yes.
6.11 Parking	
1 General issues ▪ Are the provisions for or restrictions on parking satisfactory in relation to traffic safety? ▪ Is the frequency of the parking turnover compatible with the safety of the route? ▪ Is there sufficient parking for delivery vehicles so that safety problems due to double parking do not occur? ▪ Are parking manoeuvres along the route possible without causing safety problems? (eg. angle parking) ▪ Is the sight distance at intersections and along the route, unaffected by parked vehicles?	Informal verge area used for parking at the southern end of the audited length.
6.12 Provision for heavy vehicles	
1 Design issues ▪ Are overtaking opportunities available for heavy vehicles where volumes are high? ▪ Does the route generally cater for the size of vehicle likely to use it? ▪ Is there adequate manoeuvring room for large vehicles along the route, at intersections, roundabouts, etc.? ▪ Is access to rest areas and truck parking areas adequate for the size of vehicle expected? (Consider acceleration, deceleration, shoulder widths, etc.)	Yes.

Checklist questions	Comments
2 Pavement/shoulder quality ▪ Are shoulders sealed at bends to provide additional pavement for long vehicles? ▪ Is the pavement width adequate for heavy vehicles? ▪ In general, is the pavement quality sufficient for the safe travel of heavy and oversized vehicles? ▪ On truck routes, are reflective devices appropriate for truck drivers' eye heights?	Yes – on Pennant Hills Road.
6.13 Floodways and causeways	
1 Ponding, flooding ▪ Are all sections of the route free from ponding or flow across the road during wet weather? ▪ If there is ponding or flow across the road during wet weather, is there appropriate signposting? ▪ Are floodways and causeways correctly signposted?	Yes.
2 Safety of devices ▪ Are all culverts or drainage structures located outside the clear roadside recovery area? ▪ If not, are they shielded from the possibility of vehicle collision?	NA.
6.14 Miscellaneous	
1 Landscaping ▪ Is landscaping in accordance with guidelines (eg. clearances, sight distance)? ▪ Will existing clearances and sight distances be maintained following future plant growth? ▪ Does the landscaping at roundabouts avoid visibility problems?	Several sight-obstructing trees noted.
2 Temporary works ▪ Are all locations free of construction or maintenance equipment that is no longer required? ▪ Are all locations free of signs or temporary traffic control devices that are no longer required?	Yes.
3 Headlight glare ▪ Have any problems that could be caused by headlight glare been addressed (eg. a two-way service road close to main traffic lanes, the use of glare fencing or screening)?	This is an urban road environment.
4 Roadside activities ▪ Are the road boundaries free of any activities that are likely to distract drivers? ▪ Are all advertising signs installed so that they do not constitute a hazard?	Yes.
5 Errant vehicles ▪ Is the roadside furniture on the verges and footways free of damage from errant vehicles which could indicate a possible problem, hazard or conflict at the site?	Damaged guardrail noted.

Checklist questions	Comments
6 Other safety issues ▪ Is the embankment stability safe? ▪ Is the route free of unsafe overhanging branches? ▪ Is the route free of visibility obstructions caused by long grass? ▪ Are any high wind areas safely dealt with? ▪ If back to back median kerbing is used is it: o Adequately delineated? o Obvious where it starts? o Obvious at intersections? o Unlikely to be a hazard to pedestrians?	Sight-obstructing vegetation noted.
7 Rest Areas ▪ Is the location of rest areas and truck parking areas along the route appropriate? ▪ Is there adequate sight distance to the exit and entry points from rest areas and truck parking areas at all times of the day?	Parking on the informal verge area noted at the southern end of the audited length.
8 Animals ▪ Is the route free from large numbers of animals (eg. cattle, sheep, kangaroos, koalas, wombats, etc.)? ▪ If not, is it protected by animal-proof fencing?	Yes.

Attachment 2

Updated Plans (Reduced)

9 CARPARKING STRATEGY REVISED. NEW PEDESTRIAN ACCESS PATH FROM WEST OF SITE

9 PARKING STRATEGY REVISED

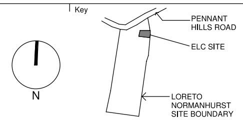
LORETO NORMANHURST CAMPUS

CAMPUS TOTAL AREA	=	130,248.5m^2
ELC SUBJECT SITE AREA	=	3,913.9m^2
ELC PICK-UP/DROP-OFF BAYS	=	10 Total (incl. 1 accessible). 5 bays in Carpark behind Chapel and 5 in car park fronting Mount Pleasant Avenue
ELC STAFF PARKING BAYS	=	10 Total. 5 bays in current year 12 carpark and 5 in car park fronting Mount Pleasant Avenue + 1 motorcycle bay (in current year 12 carpark)
YEAR 12 PARKING BAYS	=	No Change to Total - As per Existing
SCHOOL STAFF PARKING BAYS	=	No Change to Total - As per Existing
SCHOOL VISITOR PARKING BAYS	=	As per Existing - with an additional 5 bays outside of peak AM and PM ELC pick-up / drop-off times. Located in carpark behind chapel.

Revisions

No.	Date	Description	Ver	App'd
1	27/09/2018	ISSUED FOR PRE-LODGEMENT MEETING		
2	27/09/2018	PRELIMINARY ISSUE TO CONSULTANTS		
3	5/10/2018	ISSUED FOR COST PLAN		
4	9/10/2018	ISSUED FOR COORDINATION		
5	23/10/2018	ISSUED FOR COORDINATION		
6	8/11/2018	ISSUED FOR COORDINATION AND INTERNAL REVIEW		
7	20/11/2018	ISSUED FOR DA	MJ	ML
8	22/11/2018	ISSUED FOR DA	MJ	ML
9	11/07/2019	CARPARKING STRATEGY AMENDED AND NEW SITE ACCESS FROM WEST	MJ	ML

Key



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Project

LORETO NORMANHURST ELC
91-93 PENNANT HILLS ROAD
NORMANHURST NSW 2076

Proj. No. 18011

Drawing Title

PROPOSED SITE PLAN

Sheet Status

NOT FOR CONSTRUCTION

Scale

1:1000 @ A1

0 10 20 40 80 m

Drawing No.

DA1002

Issue

9

Appendix C – SIDRA Modelling Outputs

MOVEMENT SUMMARY

Site: 101 [Pennant Hills Road-Mount Pleasant Avenue AM-Base-2019 (Site Folder: General)]

Network: N101 [AM Base 2019 (Network Folder: General)]

New Site
Site Category: Existing Design
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Mount Pleasant Avenue														
1	L2	21	0.0	21	0.0	0.042	11.0	LOS A	0.1	0.9	0.57	0.96	0.57	33.0
3	R2	26	0.0	26	0.0	1.305	611.0	LOS F	7.2	50.4	1.00	1.49	2.73	4.5
Approach		47	0.0	47	0.0	1.305	344.4	LOS F	7.2	50.4	0.81	1.25	1.77	6.2
East: Pennant Hills Road														
4	L2	35	0.0	35	0.0	0.430	3.6	LOS A	0.0	0.0	0.00	0.02	0.00	39.9
5	T1	2049	15.2	2049	15.2	0.430	0.2	LOS A	0.0	0.0	0.00	0.01	0.00	39.7
Approach		2084	14.9	2084	14.9	0.430	0.3	NA	0.0	0.0	0.00	0.01	0.00	39.7
West: Pennant Hills Road														
11	T1	2102	15.7	2051	16.0	0.387	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	39.8
12	R2	44	0.0	43	0.0	0.436	46.9	LOS D	1.1	7.8	0.96	1.02	1.11	23.2
Approach		2146	15.4	2093 N1	15.7	0.436	1.0	NA	1.1	7.8	0.02	0.02	0.02	39.2
All Vehicles		4278	15.0	4225 N1	15.1	1.305	4.5	NA	7.2	50.4	0.02	0.03	0.03	36.3

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.
Delay Model: SIDRA Standard (Geometric Delay is included).
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: 101 [Pennant Hills Road-Mount Pleasant Avenue AM-Base-2026 (Site Folder: General)]

Network: N101 [AM Base 2026 (Network Folder: General)]

New Site
Site Category: 2026 Base Case
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Mount Pleasant Avenue														
1	L2	21	0.0	21	0.0	0.043	10.3	LOS A	0.1	0.8	0.53	0.94	0.53	33.4
3	R2	26	0.0	26	0.0	0.846	258.4	LOS F	2.5	17.5	1.00	1.12	1.43	9.8
Approach		47	0.0	47	0.0	0.846	148.1	LOS F	2.5	17.5	0.79	1.04	1.03	12.5
East: Pennant Hills Road														
4	L2	35	0.0	35	0.0	0.430	3.6	LOS A	0.0	0.0	0.00	0.03	0.00	39.8
5	T1	1832	15.2	1832	15.2	0.430	0.2	LOS A	0.0	0.0	0.00	0.01	0.00	39.7
Approach		1866	14.9	1866	14.9	0.430	0.3	NA	0.0	0.0	0.00	0.01	0.00	39.7
West: Pennant Hills Road														
11	T1	1805	15.7	1805	15.7	0.341	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	39.9
12	R2	44	0.0	44	0.0	0.348	34.7	LOS C	0.9	6.1	0.94	1.00	1.05	26.1
Approach		1849	15.3	1849	15.3	0.348	0.9	NA	0.9	6.1	0.02	0.02	0.03	39.3
All Vehicles		3763	14.9	3763	14.9	0.846	2.4	NA	2.5	17.5	0.02	0.03	0.03	38.0

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.
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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Pennant Hills Road-Mount Pleasant Avenue AM-Base-2036 (Site Folder: General)]

Network: N101 [AM Base 2036 (Network Folder: General)]

New Site
Site Category: 2036 Base Case
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Mount Pleasant Avenue														
1	L2	107	0.0	107	0.0	0.174	9.8	LOS A	0.5	3.8	0.52	0.98	0.52	33.6
3	R2	26	0.0	26	0.0	0.641	147.7	LOS F	1.8	12.4	0.99	1.07	1.22	14.5
Approach		134	0.0	134	0.0	0.641	37.0	LOS C	1.8	12.4	0.61	0.99	0.66	24.0
East: Pennant Hills Road														
4	L2	63	0.0	63	0.0	0.346	3.5	LOS A	0.0	0.0	0.00	0.05	0.00	39.8
5	T1	1613	14.6	1613	14.6	0.346	0.1	LOS A	0.0	0.0	0.00	0.02	0.00	39.7
Approach		1676	14.1	1676	14.1	0.346	0.3	NA	0.0	0.0	0.00	0.02	0.00	39.7
West: Pennant Hills Road														
11	T1	1521	14.9	1521	14.9	0.286	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	39.9
12	R2	71	0.0	71	0.0	0.443	30.5	LOS C	1.2	8.6	0.93	1.02	1.12	27.2
Approach		1592	14.3	1592	14.3	0.443	1.4	NA	1.2	8.6	0.04	0.05	0.05	39.0
All Vehicles		3401	13.6	3401	13.6	0.641	2.2	NA	1.8	12.4	0.04	0.07	0.05	38.2

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.
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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Pennant Hills Road-Mount Pleasant Avenue AM-WD-2026 (Site Folder: General)]

Network: N101 [AM WD 2026 (Network Folder: General)]

New Site
Site Category: 2026 Post Development
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Mount Pleasant Avenue														
1	L2	156	0.0	156	0.0	0.612	17.1	LOS B	1.5	10.7	0.70	1.18	1.14	29.9
3	R2	26	0.0	26	0.0	0.852	266.3	LOS F	2.5	17.8	1.00	1.12	1.43	9.5
Approach		182	0.0	182	0.0	0.852	53.1	LOS D	2.5	17.8	0.74	1.17	1.19	20.0
East: Pennant Hills Road														
4	L2	43	0.0	43	0.0	0.427	3.6	LOS A	1.3	10.2	0.00	0.03	0.00	39.9
5	T1	1907	14.6	1907	14.6	0.427	0.2	LOS A	2.2	17.6	0.00	0.01	0.00	39.7
Approach		1951	14.2	1951	14.2	0.427	0.3	NA	2.2	17.6	0.00	0.01	0.00	39.7
West: Pennant Hills Road														
11	T1	1926	14.7	1926	14.7	0.362	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	39.9
12	R2	52	0.0	52	0.0	0.491	45.4	LOS D	1.3	8.8	0.96	1.03	1.14	23.5
Approach		1978	14.3	1978	14.3	0.491	1.2	NA	1.3	8.8	0.03	0.03	0.03	39.0
All Vehicles		4111	13.6	4111	13.6	0.852	3.1	NA	2.5	17.8	0.04	0.07	0.07	37.5

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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Pennant Hills Road-Mount Pleasant Avenue AM-WD-2036 (Site Folder: General)]

Network: N101 [AM WD 2036 (Network Folder: General)]

New Site
Site Category: 2036 Post Development
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Mount Pleasant Avenue														
1	L2	200	0.0	200	0.0	0.487	11.9	LOS A	1.5	10.2	0.57	1.11	0.80	32.5
3	R2	26	0.0	26	0.0	0.716	182.7	LOS F	2.0	14.1	0.99	1.08	1.27	12.6
Approach		226	0.0	226	0.0	0.716	31.8	LOS C	2.0	14.1	0.62	1.11	0.86	25.0
East: Pennant Hills Road														
4	L2	75	0.0	75	0.0	0.513	3.8	LOS A	0.0	0.0	0.00	0.06	0.00	39.5
5	T1	1687	14.0	1687	14.0	0.513	0.4	LOS A	0.0	0.0	0.00	0.02	0.00	39.4
Approach		1762	13.4	1762	13.4	0.513	0.5	NA	0.0	0.0	0.00	0.02	0.00	39.4
West: Pennant Hills Road														
11	T1	1632	13.9	1632	13.9	0.305	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	39.9
12	R2	80	0.0	80	0.0	0.566	37.4	LOS C	1.6	11.3	0.95	1.06	1.23	25.4
Approach		1712	13.3	1712	13.3	0.566	1.8	NA	1.6	11.3	0.04	0.05	0.06	38.7
All Vehicles		3700	12.5	3700	12.5	0.716	3.0	NA	2.0	14.1	0.06	0.10	0.08	37.6

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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Pennant Hills Road-Mount Pleasant Avenue PM-Base-2019 (Site Folder: General)]

Network: N101 [PM Base 2019 (Network Folder: General)]

New Site
Site Category: Existing Design
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Mount Pleasant Avenue														
1	L2	65	0.0	65	0.0	0.151	11.0	LOS A	0.4	2.6	0.57	1.00	0.57	33.0
3	R2	29	0.0	29	0.0	1.288	568.5	LOS F	7.5	52.4	1.00	1.53	2.88	4.9
Approach		95	0.0	95	0.0	1.288	184.5	LOS F	7.5	52.4	0.70	1.17	1.29	9.2
East: Pennant Hills Road														
4	L2	26	0.0	26	0.0	0.491	3.7	LOS A	0.0	0.0	0.00	0.02	0.00	39.7
5	T1	1924	19.1	1924	19.1	0.491	0.3	LOS A	0.0	0.0	0.00	0.01	0.00	39.6
Approach		1951	18.8	1951	18.8	0.491	0.4	NA	0.0	0.0	0.00	0.01	0.00	39.6
West: Pennant Hills Road														
11	T1	2481	11.2	2481	11.2	0.455	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	39.8
12	R2	17	0.0	17	0.0	0.154	34.3	LOS C	0.4	2.5	0.93	0.96	0.94	26.2
Approach		2498	11.2	2498	11.2	0.455	0.3	NA	0.4	2.5	0.01	0.01	0.01	39.6
All Vehicles		4543	14.2	4543	14.2	1.288	4.2	NA	7.5	52.4	0.02	0.03	0.03	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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Pennant Hills Road-Mount Pleasant Avenue PM-Base-2026 (Site Folder: General)]

Network: N101 [PM Base 2026 (Network Folder: General)]

New Site
Site Category: 2026 Base Case
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Mount Pleasant Avenue														
1	L2	65	0.0	65	0.0	0.130	10.6	LOS A	0.4	2.5	0.55	0.99	0.55	33.3
3	R2	29	0.0	29	0.0	1.159	456.3	LOS F	5.8	40.5	1.00	1.43	2.51	6.0
Approach		95	0.0	95	0.0	1.159	149.2	LOS F	5.8	40.5	0.69	1.13	1.16	11.0
East: Pennant Hills Road														
4	L2	26	0.0	26	0.0	0.421	3.6	LOS A	0.0	0.0	0.00	0.02	0.00	39.8
5	T1	1794	19.1	1794	19.1	0.421	0.2	LOS A	0.0	0.0	0.00	0.01	0.00	39.7
Approach		1820	18.8	1820	18.8	0.421	0.3	NA	0.0	0.0	0.00	0.01	0.00	39.7
West: Pennant Hills Road														
11	T1	2151	13.0	2151	13.0	0.399	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	39.8
12	R2	17	0.0	17	0.0	0.131	29.3	LOS C	0.3	2.2	0.92	0.95	0.92	27.6
Approach		2167	12.9	2167	12.9	0.399	0.3	NA	0.3	2.2	0.01	0.01	0.01	39.7
All Vehicles		4082	15.2	4082	15.2	1.159	3.7	NA	5.8	40.5	0.02	0.03	0.03	36.9

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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Pennant Hills Road-Mount Pleasant Avenue PM-Base-2036 (Site Folder: General)]

Network: N101 [PM Base 2036 (Network Folder: General)]

New Site
Site Category: 2026 Base Case
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Mount Pleasant Avenue														
1	L2	65	0.0	65	0.0	0.107	10.0	LOS A	0.3	2.3	0.52	0.97	0.52	33.5
3	R2	29	0.0	29	0.0	0.804	207.0	LOS F	2.4	16.6	1.00	1.12	1.40	11.5
Approach		95	0.0	95	0.0	0.804	71.3	LOS F	2.4	16.6	0.67	1.01	0.79	18.1
East: Pennant Hills Road														
4	L2	27	3.8	27	3.8	0.340	3.6	LOS A	0.0	0.0	0.00	0.02	0.00	39.9
5	T1	1622	19.1	1622	19.1	0.340	0.1	LOS A	0.0	0.0	0.00	0.01	0.00	39.8
Approach		1649	18.8	1649	18.8	0.340	0.2	NA	0.0	0.0	0.00	0.01	0.00	39.8
West: Pennant Hills Road														
11	T1	1672	11.3	1672	11.3	0.308	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	39.9
12	R2	17	0.0	17	0.0	0.106	24.2	LOS B	0.3	1.8	0.89	0.94	0.89	29.2
Approach		1688	11.2	1688	11.2	0.308	0.3	NA	0.3	1.8	0.01	0.01	0.01	39.7
All Vehicles		3433	14.5	3433	14.5	0.804	2.2	NA	2.4	16.6	0.02	0.04	0.03	38.2

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.
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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Pennant Hills Road-Mount Pleasant Avenue PM-WD-2026 (Site Folder: General)]

Network: N101 [PM WD 2026 (Network Folder: General)]

New Site
Site Category: 2026 Base Case
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Mount Pleasant Avenue														
1	L2	114	0.0	114	0.0	0.279	11.3	LOS A	0.7	4.9	0.57	1.03	0.63	32.9
3	R2	29	0.0	29	0.0	1.142	444.4	LOS F	5.5	38.8	1.00	1.41	2.45	6.1
Approach		143	0.0	143	0.0	1.142	100.4	LOS F	5.5	38.8	0.66	1.11	1.01	13.8
East: Pennant Hills Road														
4	L2	51	0.0	51	0.0	0.529	3.8	LOS A	0.0	0.0	0.00	0.04	0.00	39.6
5	T1	1852	18.5	1852	18.5	0.529	0.4	LOS A	0.0	0.0	0.00	0.01	0.00	39.5
Approach		1902	18.0	1902	18.0	0.529	0.5	NA	0.0	0.0	0.00	0.01	0.00	39.5
West: Pennant Hills Road														
11	T1	2185	10.8	2185	10.8	0.400	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	39.8
12	R2	40	0.0	40	0.0	0.342	37.4	LOS C	0.9	6.0	0.94	1.00	1.05	25.4
Approach		2225	10.6	2225	10.6	0.400	0.7	NA	0.9	6.0	0.02	0.02	0.02	39.4
All Vehicles		4271	13.6	4271	13.6	1.142	4.0	NA	5.5	38.8	0.03	0.05	0.04	36.8

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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Pennant Hills Road-Mount Pleasant Avenue PM-WD-2036 (Site Folder: General)]

Network: N101 [PM WD 2036 (Network Folder: General)]

New Site
Site Category: 2026 Base Case
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Mount Pleasant Avenue														
1	L2	160	0.0	160	0.0	0.322	10.7	LOS A	1.0	6.7	0.55	1.04	0.64	33.2
3	R2	29	0.0	29	0.0	0.868	246.7	LOS F	2.7	18.8	1.00	1.15	1.52	10.1
Approach		189	0.0	189	0.0	0.868	47.4	LOS D	2.7	18.8	0.62	1.06	0.77	21.2
East: Pennant Hills Road														
4	L2	52	2.0	52	2.0	0.422	3.6	LOS A	0.0	0.0	0.00	0.04	0.00	39.7
5	T1	1642	18.8	1642	18.8	0.422	0.2	LOS A	0.0	0.0	0.00	0.01	0.00	39.6
Approach		1694	18.3	1694	18.3	0.422	0.3	NA	0.0	0.0	0.00	0.01	0.00	39.6
West: Pennant Hills Road														
11	T1	1731	10.8	1731	10.8	0.317	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	39.9
12	R2	40	0.0	40	0.0	0.272	28.9	LOS C	0.7	4.8	0.92	0.98	1.00	27.7
Approach		1771	10.6	1771	10.6	0.317	0.7	NA	0.7	4.8	0.02	0.02	0.02	39.4
All Vehicles		3654	13.6	3654	13.6	0.868	3.0	NA	2.7	18.8	0.04	0.07	0.05	37.6

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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 1 [Pennant Hills Road-Normanhurst Road-Osborn Road PM-Base-2019 (Site Folder: General)]

Network: N101 [PM Base 2019 (Network Folder: General)]

Penant Hills Road-Normanhurst Road-Osbourne Road
Site Category: Existing Design
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 139 seconds (Site User-Given Phase Times)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Osborn Road														
1	L2	65	9.7	65	9.7	0.154	47.6	LOS D	3.5	26.2	0.82	0.72	0.82	21.6
2	T1	29	0.0	29	0.0	0.823	76.8	LOS F	7.6	54.9	1.00	0.97	1.29	13.7
3	R2	74	4.3	74	4.3	0.823	80.1	LOS F	7.6	54.9	1.00	0.97	1.29	3.7
Approach		168	5.6	168	5.6	0.823	66.9	LOS E	7.6	54.9	0.93	0.87	1.11	13.1
East: Pennant Hills Road														
4	L2	60	1.8	60	1.8	0.650	17.6	LOS B	29.8	237.1	0.64	0.60	0.64	25.1
5	T1	2178	17.2	2178	17.2	0.650	14.0	LOS A	29.8	237.1	0.63	0.58	0.63	33.0
6	R2	69	4.5	69	4.5	* 0.328	20.0	LOS B	2.7	19.9	0.77	0.75	0.77	29.1
Approach		2307	16.4	2307	16.4	0.650	14.2	LOS A	29.8	238.4	0.63	0.59	0.63	32.8
North: Normanhurst Road														
7	L2	72	7.4	72	7.4	0.367	60.5	LOS E	6.3	46.3	0.94	0.77	0.94	14.8
8	T1	31	3.4	31	3.4	0.367	57.1	LOS E	6.3	46.3	0.94	0.77	0.94	16.4
9	R2	112	5.7	112	5.7	* 1.030	131.6	LOS F	11.0	80.9	1.00	1.31	1.87	15.4
Approach		214	5.9	214	5.9	1.030	97.1	LOS F	11.0	80.9	0.97	1.05	1.43	15.4
West: Pennant Hills Road														
10	L2	32	3.3	32	3.3	0.659	17.8	LOS B	31.5	241.2	0.64	0.60	0.64	34.1
11	T1	2331	11.4	2331	11.4	* 0.659	14.2	LOS A	31.5	241.8	0.64	0.59	0.64	31.1
12	R2	46	6.8	46	6.8	0.220	16.9	LOS B	1.4	10.6	0.65	0.68	0.65	30.9
Approach		2408	11.2	2408	11.2	0.659	14.3	LOS A	31.5	241.8	0.64	0.59	0.64	31.1
All Vehicles		5098	13.2	5098	13.2	1.030	19.5	LOS B	31.5	241.8	0.66	0.62	0.68	29.7

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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Effective Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Osborn Road											
P1	Full	53	63.8	LOS F	0.2	0.2	0.96	0.96	227.2	212.4	0.94
North: Normanhurst Road											
P3	Full	53	63.8	LOS F	0.2	0.2	0.96	0.96	227.2	212.4	0.94
All Pedestrians		105	63.8	LOS F	0.2	0.2	0.96	0.96	227.2	212.4	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: 1 [Pennant Hills Road-Normanhurst Road-Osborn Road PM-Base-2026 (Site Folder: General)]

Network: N101 [PM Base 2026 (Network Folder: General)]

Penant Hills Road-Normanhurst Road-Osbourne Road PM-Existing Scenario
Site Category: 2026 Base Case
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Osborn Road														
1	L2	65	9.7	65	9.7	0.146	46.4	LOS D	3.4	25.9	0.81	0.72	0.81	21.9
2	T1	29	0.0	29	0.0	0.521	62.5	LOS E	6.8	48.6	0.98	0.79	0.98	15.6
3	R2	74	4.3	74	4.3	0.521	65.8	LOS E	6.8	48.6	0.98	0.79	0.98	4.4
Approach		168	5.6	168	5.6	0.521	57.7	LOS E	6.8	48.6	0.91	0.76	0.91	14.4
East: Pennant Hills Road														
4	L2	60	1.8	60	1.8	0.619	18.0	LOS B	27.7	220.4	0.63	0.59	0.63	24.8
5	T1	2031	17.2	2031	17.2	* 0.619	14.4	LOS A	27.7	220.4	0.62	0.57	0.62	32.8
6	R2	69	4.5	69	4.5	* 0.420	16.7	LOS B	2.0	14.5	0.68	0.70	0.68	30.5
Approach		2160	16.3	2160	16.3	0.619	14.6	LOS B	27.7	221.8	0.62	0.58	0.62	32.6
North: Normanhurst Road														
7	L2	72	7.4	72	7.4	0.282	53.9	LOS D	5.9	43.4	0.89	0.75	0.89	15.9
8	T1	31	3.4	31	3.4	0.282	50.5	LOS D	5.9	43.4	0.89	0.75	0.89	17.5
9	R2	112	5.7	112	5.7	* 0.625	68.3	LOS E	7.5	55.3	1.00	0.82	1.02	22.1
Approach		214	5.9	214	5.9	0.625	60.9	LOS E	7.5	55.3	0.94	0.78	0.96	20.1
West: Pennant Hills Road														
10	L2	32	3.3	32	3.3	0.573	17.3	LOS B	25.1	192.6	0.60	0.56	0.60	34.3
11	T1	1980	11.4	1980	11.4	0.573	13.7	LOS A	25.1	193.1	0.59	0.54	0.59	31.3
12	R2	46	6.8	46	6.8	0.303	17.2	LOS B	1.3	9.6	0.66	0.68	0.66	30.8
Approach		2058	11.2	2058	11.2	0.573	13.9	LOS A	25.1	193.1	0.59	0.55	0.59	31.3
All Vehicles		4600	13.2	4600	13.2	0.625	18.0	LOS B	27.7	221.8	0.63	0.58	0.63	30.4

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.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Effective Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Osborn Road											
P1	Full	53	64.3	LOS F	0.2	0.2	0.96	0.96	227.7	212.4	0.93
North: Normanhurst Road											
P3	Full	53	64.3	LOS F	0.2	0.2	0.96	0.96	227.7	212.4	0.93
All Pedestrians		105	64.3	LOS F	0.2	0.2	0.96	0.96	227.7	212.4	0.93

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: 1 [Pennant Hills Road-Normanhurst Road-Osborn Road PM-Base-2036 (Site Folder: General)]

Network: N101 [PM Base 2036 (Network Folder: General)]

Penant Hills Road-Normanhurst Road-Osbourne Road PM-Existing Scenario
Site Category: 2026 Base Case
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Osborn Road														
1	L2	65	9.7	65	9.7	0.138	44.7	LOS D	3.3	25.4	0.79	0.72	0.79	22.3
2	T1	29	0.0	29	0.0	0.472	60.2	LOS E	6.6	47.5	0.96	0.78	0.96	15.9
3	R2	74	4.3	74	4.3	0.472	63.5	LOS E	6.6	47.5	0.96	0.78	0.96	4.6
Approach		168	5.6	168	5.6	0.472	55.6	LOS D	6.6	47.5	0.90	0.76	0.90	14.7
East: Pennant Hills Road														
4	L2	60	1.8	60	1.8	0.574	18.3	LOS B	24.7	195.8	0.61	0.58	0.61	24.6
5	T1	1836	17.1	1836	17.1	* 0.574	14.7	LOS B	24.7	195.8	0.60	0.56	0.60	32.7
6	R2	67	1.6	67	1.6	* 0.312	13.5	LOS A	1.4	9.9	0.56	0.64	0.56	32.0
Approach		1963	16.1	1963	16.1	0.574	14.8	LOS B	24.7	197.2	0.60	0.56	0.60	32.5
North: Normanhurst Road														
7	L2	72	7.4	72	7.4	0.263	52.0	LOS D	5.8	42.6	0.87	0.74	0.87	16.3
8	T1	31	3.4	31	3.4	0.263	48.5	LOS D	5.8	42.6	0.87	0.74	0.87	17.9
9	R2	112	5.7	112	5.7	* 0.568	65.6	LOS E	7.3	53.9	0.98	0.80	0.98	22.5
Approach		214	5.9	214	5.9	0.568	58.6	LOS E	7.3	53.9	0.93	0.77	0.93	20.5
West: Pennant Hills Road														
10	L2	32	3.3	32	3.3	0.468	16.9	LOS B	18.6	142.7	0.55	0.51	0.55	34.4
11	T1	1568	11.4	1568	11.4	0.468	13.3	LOS A	18.6	143.3	0.55	0.50	0.55	31.5
12	R2	46	6.8	46	6.8	0.280	16.2	LOS B	1.1	8.3	0.63	0.66	0.63	31.2
Approach		1646	11.1	1646	11.1	0.468	13.5	LOS A	18.6	143.3	0.55	0.50	0.55	31.5
All Vehicles		3992	13.1	3992	13.1	0.574	18.3	LOS B	24.7	197.2	0.61	0.56	0.61	30.3

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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Effective Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Osborn Road											
P1	Full	53	64.3	LOS F	0.2	0.2	0.96	0.96	227.7	212.4	0.93
North: Normanhurst Road											
P3	Full	53	64.3	LOS F	0.2	0.2	0.96	0.96	227.7	212.4	0.93
All Pedestrians		105	64.3	LOS F	0.2	0.2	0.96	0.96	227.7	212.4	0.93

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: 1 [Pennant Hills Road-Normanhurst Road-Osborn Road PM-WD-2026 (Site Folder: General)]

Network: N101 [PM WD 2026 (Network Folder: General)]

Penant Hills Road-Normanhurst Road-Osbourne Road PM-Existing Scenario
Site Category: 2026 Base Case
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Osborn Road														
1	L2	52	12.2	52	12.2	0.106	42.7	LOS D	2.6	19.9	0.77	0.70	0.77	22.7
2	T1	29	0.0	29	0.0	0.668	61.4	LOS E	10.4	73.8	0.99	0.84	1.02	15.7
3	R2	126	2.5	126	2.5	* 0.668	64.7	LOS E	10.4	73.8	0.99	0.84	1.02	4.4
Approach		207	4.6	207	4.6	0.668	58.8	LOS E	10.4	73.8	0.94	0.81	0.96	11.8
East: Pennant Hills Road														
4	L2	118	0.9	118	0.9	0.677	21.2	LOS B	32.7	256.7	0.70	0.67	0.70	22.8
5	T1	2082	16.7	2082	16.7	* 0.677	17.5	LOS B	32.7	256.7	0.69	0.64	0.69	31.6
6	R2	67	4.7	67	4.7	0.424	19.5	LOS B	2.1	15.1	0.74	0.72	0.74	29.3
Approach		2267	15.6	2267	15.6	0.677	17.7	LOS B	32.7	259.7	0.69	0.65	0.69	31.3
North: Normanhurst Road														
7	L2	69	7.6	69	7.6	0.242	50.1	LOS D	5.5	40.8	0.85	0.73	0.85	16.7
8	T1	31	3.4	31	3.4	0.242	46.6	LOS D	5.5	40.8	0.85	0.73	0.85	18.3
9	R2	112	5.7	112	5.7	0.518	64.0	LOS E	7.2	53.0	0.97	0.79	0.97	22.7
Approach		212	6.0	212	6.0	0.518	56.9	LOS E	7.2	53.0	0.91	0.76	0.91	20.8
West: Pennant Hills Road														
10	L2	32	3.3	32	3.3	0.617	20.1	LOS B	28.6	219.3	0.66	0.61	0.66	33.3
11	T1	2003	11.3	2003	11.3	0.617	16.3	LOS B	28.6	219.9	0.64	0.59	0.64	30.0
12	R2	100	3.2	100	3.2	* 0.669	31.3	LOS C	5.2	37.6	0.99	0.89	1.09	25.8
Approach		2135	10.8	2135	10.8	0.669	17.1	LOS B	28.6	219.9	0.66	0.61	0.67	29.9
All Vehicles		4821	12.6	4821	12.6	0.677	20.9	LOS B	32.7	259.7	0.70	0.64	0.70	29.1

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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Effective Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Osborn Road											
P1	Full	53	64.3	LOS F	0.2	0.2	0.96	0.96	227.7	212.4	0.93
North: Normanhurst Road											
P3	Full	53	64.3	LOS F	0.2	0.2	0.96	0.96	227.7	212.4	0.93
All Pedestrians		105	64.3	LOS F	0.2	0.2	0.96	0.96	227.7	212.4	0.93

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: 1 [Pennant Hills Road-Normanhurst Road-Osborn Road PM-WD-2036 (Site Folder: General)]

Network: N101 [PM WD 2036 (Network Folder: General)]

Penant Hills Road-Normanhurst Road-Osbourne Road PM-Existing Scenario
Site Category: 2026 Base Case
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Osborn Road														
1	L2	77	8.2	77	8.2	0.136	39.3	LOS C	3.7	27.6	0.75	0.71	0.75	23.5
2	T1	29	0.0	29	0.0	0.617	64.6	LOS E	7.8	55.7	1.00	0.81	1.01	15.3
3	R2	86	3.7	86	3.7	0.617	67.9	LOS E	7.8	55.7	1.00	0.81	1.01	4.3
Approach		193	4.9	193	4.9	0.617	56.0	LOS D	7.8	55.7	0.90	0.77	0.90	14.6
East: Pennant Hills Road														
4	L2	80	1.3	80	1.3	0.654	23.4	LOS B	30.6	241.3	0.72	0.68	0.72	21.7
5	T1	1891	16.6	1891	16.6	* 0.654	19.6	LOS B	30.6	241.3	0.70	0.65	0.70	30.8
6	R2	108	2.9	108	2.9	* 0.376	15.9	LOS B	2.9	20.5	0.68	0.71	0.68	30.9
Approach		2079	15.3	2079	15.3	0.654	19.5	LOS B	30.6	243.4	0.70	0.65	0.70	30.6
North: Normanhurst Road														
7	L2	111	4.8	111	4.8	0.334	51.2	LOS D	8.0	58.1	0.88	0.76	0.88	16.4
8	T1	31	3.4	31	3.4	0.334	47.8	LOS D	8.0	58.1	0.88	0.76	0.88	17.9
9	R2	112	5.7	112	5.7	* 0.664	70.8	LOS F	7.7	56.5	1.00	0.84	1.06	21.7
Approach		253	5.0	253	5.0	0.664	59.5	LOS E	8.0	58.1	0.93	0.79	0.96	19.6
West: Pennant Hills Road														
10	L2	32	3.3	32	3.3	0.518	21.1	LOS B	22.0	168.1	0.64	0.58	0.64	33.0
11	T1	1592	11.2	1592	11.2	0.518	17.4	LOS B	22.0	168.7	0.63	0.57	0.63	29.5
12	R2	65	4.8	65	4.8	0.266	19.8	LOS B	2.1	15.1	0.74	0.72	0.74	29.8
Approach		1688	10.8	1688	10.8	0.518	17.6	LOS B	22.0	168.7	0.63	0.57	0.63	29.6
All Vehicles		4213	12.4	4213	12.4	0.664	22.8	LOS B	30.6	243.4	0.70	0.63	0.70	28.5

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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Effective Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Osborn Road											
P1	Full	53	64.3	LOS F	0.2	0.2	0.96	0.96	227.7	212.4	0.93
North: Normanhurst Road											
P3	Full	53	64.3	LOS F	0.2	0.2	0.96	0.96	227.7	212.4	0.93
All Pedestrians		105	64.3	LOS F	0.2	0.2	0.96	0.96	227.7	212.4	0.93

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: 1 [Pennant Hills Road-Normanhurst Road-OsbornRoad AM-Base-2019 (Site Folder: General)]

Network: N101 [AM Base 2019 (Network Folder: General)]

Penant Hills Road-Normanhurst Road-Osbourne Road
Site Category: Existing Design
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 139 seconds (Site User-Given Phase Times)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Osborn Road														
1	L2	74	11.4	74	11.4	0.166	46.2	LOS D	3.8	29.6	0.81	0.73	0.81	21.9
2	T1	52	2.0	52	2.0	* 2.072	1010.0	LOS F	44.1	314.1	1.00	2.56	4.51	1.5
3	R2	102	2.1	102	2.1	2.072	1013.3	LOS F	44.1	314.1	1.00	2.56	4.51	0.3
Approach		227	5.1	227	5.1	2.072	699.2	LOS F	44.1	314.1	0.94	1.96	3.31	1.6
East: Pennant Hills Road														
4	L2	74	2.9	74	2.9	0.588	17.6	LOS B	25.5	200.6	0.61	0.58	0.61	25.0
5	T1	1922	16.0	1922	16.0	0.588	14.0	LOS A	25.5	200.6	0.60	0.56	0.60	32.9
6	R2	63	1.7	63	1.7	0.243	14.9	LOS B	1.8	12.7	0.63	0.68	0.63	31.3
Approach		2059	15.1	2059	15.1	0.588	14.2	LOS A	25.5	202.2	0.60	0.56	0.60	32.8
North: Normanhurst Road														
7	L2	94	2.2	94	2.2	0.667	65.8	LOS E	11.5	81.1	1.00	0.83	1.02	14.2
8	T1	80	0.0	80	0.0	0.667	62.4	LOS E	11.5	81.1	1.00	0.83	1.02	15.7
9	R2	120	3.5	120	3.5	1.791	766.0	LOS F	30.8	221.8	1.00	2.26	4.06	3.8
Approach		294	2.2	294	2.2	1.791	351.0	LOS F	30.8	221.8	1.00	1.41	2.26	5.4
West: Pennant Hills Road														
10	L2	34	0.0	34	0.0	0.594	17.7	LOS B	25.8	205.1	0.61	0.57	0.61	34.1
11	T1	1947	16.7	1947	16.7	* 0.594	14.0	LOS A	25.8	205.1	0.60	0.55	0.60	31.1
12	R2	93	6.8	93	6.8	* 0.371	17.8	LOS B	3.5	26.1	0.77	0.75	0.77	30.5
Approach		2074	16.0	2074	16.0	0.594	14.2	LOS A	25.8	205.8	0.61	0.56	0.61	31.2
All Vehicles		4654	14.2	4654	14.2	2.072	68.9	LOS E	44.1	314.1	0.65	0.68	0.84	17.6

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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Effective Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Osborn Road											
P1	Full	53	63.8	LOS F	0.2	0.2	0.96	0.96	227.2	212.4	0.94
North: Normanhurst Road											
P3	Full	53	63.8	LOS F	0.2	0.2	0.96	0.96	227.2	212.4	0.94
All Pedestrians		105	63.8	LOS F	0.2	0.2	0.96	0.96	227.2	212.4	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: 1 [Pennant Hills Road-Normanhurst Road-OsbornRoad AM-Base-2026 (Site Folder: General)]

Network: N101 [AM Base 2026 (Network Folder: General)]

Penant Hills Road-Normanhurst Road-Osbourne Road
Site Category: 2026 Base Case
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Osborn Road														
1	L2	74	11.4	74	11.4	0.118	34.8	LOS C	3.3	25.3	0.70	0.69	0.70	24.7
2	T1	52	2.0	52	2.0	0.627	59.4	LOS E	10.0	71.2	0.98	0.81	0.98	16.1
3	R2	102	2.1	102	2.1	* 0.627	62.7	LOS E	10.0	71.2	0.98	0.81	0.98	4.6
Approach		227	5.1	227	5.1	0.627	52.9	LOS D	10.0	71.2	0.89	0.77	0.89	14.8
East: Pennant Hills Road														
4	L2	74	2.9	74	2.9	0.629	26.4	LOS B	28.4	223.0	0.74	0.69	0.74	20.3
5	T1	1717	16.0	1717	16.0	* 0.629	22.7	LOS B	28.4	223.0	0.73	0.67	0.73	29.7
6	R2	63	1.7	63	1.7	0.250	19.1	LOS B	1.6	11.3	0.70	0.70	0.70	29.5
Approach		1854	15.0	1854	15.0	0.629	22.7	LOS B	28.4	225.0	0.73	0.67	0.73	29.5
North: Normanhurst Road														
7	L2	94	2.2	94	2.2	0.367	49.2	LOS D	9.7	68.6	0.87	0.75	0.87	17.0
8	T1	80	0.0	80	0.0	0.367	45.8	LOS D	9.7	68.6	0.87	0.75	0.87	18.6
9	R2	120	3.5	120	3.5	0.580	64.8	LOS E	7.9	56.8	0.98	0.80	0.98	22.6
Approach		294	2.2	294	2.2	0.580	54.7	LOS D	9.7	68.6	0.91	0.77	0.91	20.4
West: Pennant Hills Road														
10	L2	34	0.0	34	0.0	0.612	26.0	LOS B	27.0	214.8	0.73	0.67	0.73	31.4
11	T1	1673	16.7	1673	16.7	0.612	22.2	LOS B	27.0	214.8	0.72	0.65	0.72	27.6
12	R2	93	6.8	93	6.8	* 0.390	21.8	LOS B	3.0	22.0	0.80	0.75	0.80	29.0
Approach		1799	15.9	1799	15.9	0.612	22.3	LOS B	27.0	215.7	0.72	0.66	0.72	27.7
All Vehicles		4174	13.9	4174	13.9	0.629	26.4	LOS B	28.4	225.0	0.75	0.68	0.75	27.2

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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Effective Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Osborn Road											
P1	Full	53	64.3	LOS F	0.2	0.2	0.96	0.96	227.7	212.4	0.93
North: Normanhurst Road											
P3	Full	53	64.3	LOS F	0.2	0.2	0.96	0.96	227.7	212.4	0.93
All Pedestrians		105	64.3	LOS F	0.2	0.2	0.96	0.96	227.7	212.4	0.93

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: 1 [Pennant Hills Road-Normanhurst Road-OsbornRoad AM-Base-2036 (Site Folder: General)]

Network: N101 [AM Base 2036 (Network Folder: General)]

Penant Hills Road-Normanhurst Road-Osbourne Road AM-Existing Scenario
Site Category: 2036 Base Case
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Osborn Road														
1	L2	74	11.4	74	11.4	0.113	33.4	LOS C	3.2	24.7	0.68	0.69	0.68	25.1
2	T1	52	2.0	52	2.0	0.591	57.4	LOS E	9.8	70.0	0.97	0.81	0.97	16.4
3	R2	102	2.1	102	2.1	* 0.591	60.7	LOS E	9.8	70.0	0.97	0.81	0.97	4.8
Approach		227	5.1	227	5.1	0.591	51.1	LOS D	9.8	70.0	0.87	0.77	0.87	15.1
East: Pennant Hills Road														
4	L2	128	1.6	128	1.6	0.600	26.9	LOS B	26.4	204.1	0.74	0.69	0.74	20.0
5	T1	1524	15.3	1524	15.3	* 0.600	23.2	LOS B	26.4	204.1	0.73	0.66	0.73	29.5
6	R2	86	1.2	86	1.2	0.315	18.2	LOS B	2.2	15.7	0.68	0.69	0.68	29.8
Approach		1739	13.6	1739	13.6	0.600	23.2	LOS B	26.4	207.4	0.73	0.67	0.73	29.1
North: Normanhurst Road														
7	L2	117	1.8	117	1.8	0.378	47.0	LOS D	10.8	76.2	0.86	0.75	0.86	17.4
8	T1	80	0.0	80	0.0	0.378	43.6	LOS D	10.8	76.2	0.86	0.75	0.86	19.0
9	R2	120	3.5	120	3.5	0.534	62.6	LOS E	7.7	55.6	0.97	0.80	0.97	23.0
Approach		317	2.0	317	2.0	0.534	52.1	LOS D	10.8	76.2	0.90	0.77	0.90	20.6
West: Pennant Hills Road														
10	L2	34	0.0	34	0.0	0.533	25.7	LOS B	22.0	174.3	0.70	0.64	0.70	31.5
11	T1	1373	16.4	1373	16.4	0.533	21.8	LOS B	22.0	174.3	0.68	0.61	0.68	27.7
12	R2	143	4.4	143	4.4	* 0.598	23.9	LOS B	5.3	38.2	0.91	0.81	0.91	28.2
Approach		1549	14.9	1549	14.9	0.598	22.1	LOS B	22.0	175.2	0.71	0.63	0.71	27.9
All Vehicles		3833	12.7	3833	12.7	0.600	26.8	LOS B	26.4	207.4	0.74	0.67	0.74	26.9

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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Effective Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Osborn Road											
P1	Full	53	64.3	LOS F	0.2	0.2	0.96	0.96	227.7	212.4	0.93
North: Normanhurst Road											
P3	Full	53	64.3	LOS F	0.2	0.2	0.96	0.96	227.7	212.4	0.93
All Pedestrians		105	64.3	LOS F	0.2	0.2	0.96	0.96	227.7	212.4	0.93

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: 1 [Pennant Hills Road-Normanhurst Road-OsbornRoad AM-WD-2026 (Site Folder: General)]

Network: N101 [AM WD 2026 (Network Folder: General)]

Penant Hills Road-Normanhurst Road-Osbourne Road AM-Existing Scenario
Site Category: 2026 Post Development
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Osborn Road														
1	L2	74	11.4	74	11.4	0.095	26.8	LOS B	2.8	21.8	0.60	0.66	0.60	27.1
2	T1	52	2.0	52	2.0	0.827	63.8	LOS E	18.1	128.3	1.00	0.97	1.17	15.3
3	R2	200	1.1	200	1.1	* 0.827	67.1	LOS E	18.1	128.3	1.00	0.97	1.17	4.3
Approach		325	3.6	325	3.6	0.827	57.5	LOS E	18.1	128.3	0.91	0.90	1.04	11.8
East: Pennant Hills Road														
4	L2	149	1.4	149	1.4	0.821	39.3	LOS C	39.1	301.9	0.94	0.87	0.95	15.9
5	T1	1828	15.0	1828	15.0	* 0.821	35.7	LOS C	39.1	301.9	0.92	0.85	0.94	25.9
6	R2	86	1.2	86	1.2	0.315	26.4	LOS B	2.7	18.8	0.85	0.75	0.85	26.7
Approach		2064	13.5	2064	13.5	0.821	35.5	LOS C	39.1	301.9	0.92	0.85	0.94	25.5
North: Normanhurst Road														
7	L2	117	1.8	117	1.8	0.327	41.8	LOS C	10.1	71.3	0.80	0.73	0.80	18.6
8	T1	80	0.0	80	0.0	0.327	38.4	LOS C	10.1	71.3	0.80	0.73	0.80	20.2
9	R2	120	3.5	120	3.5	0.437	56.4	LOS D	7.3	52.5	0.92	0.79	0.92	24.0
Approach		317	2.0	317	2.0	0.437	46.5	LOS D	10.1	71.3	0.85	0.75	0.85	21.7
West: Pennant Hills Road														
10	L2	34	0.0	34	0.0	0.744	36.1	LOS C	33.7	267.6	0.88	0.80	0.88	28.7
11	T1	1680	16.6	1680	16.6	0.744	31.8	LOS C	33.7	267.6	0.86	0.78	0.86	24.3
12	R2	162	3.9	162	3.9	* 0.628	40.8	LOS C	6.4	46.3	0.99	0.88	0.99	23.3
Approach		1876	15.2	1876	15.2	0.744	32.6	LOS C	33.7	268.7	0.87	0.79	0.87	24.3
All Vehicles		4582	12.7	4582	12.7	0.827	36.7	LOS C	39.1	301.9	0.89	0.82	0.91	23.9

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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Effective Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Osborn Road											
P1	Full	53	64.3	LOS F	0.2	0.2	0.96	0.96	227.7	212.4	0.93
North: Normanhurst Road											
P3	Full	53	64.3	LOS F	0.2	0.2	0.96	0.96	227.7	212.4	0.93
All Pedestrians		105	64.3	LOS F	0.2	0.2	0.96	0.96	227.7	212.4	0.93

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: 1 [Pennant Hills Road-Normanhurst Road-OsbornRoad AM-WD-2036 (Site Folder: General)]

Network: N101 [AM WD 2036 (Network Folder: General)]

Penant Hills Road-Normanhurst Road-Osbourne Road AM-Existing Scenario
Site Category: 2036 Post Development
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Osborn Road														
1	L2	74	11.4	74	11.4	0.094	26.2	LOS B	2.8	21.5	0.60	0.66	0.60	27.3
2	T1	52	2.0	52	2.0	0.773	64.5	LOS E	13.2	93.7	1.00	0.92	1.13	15.3
3	R2	137	1.5	137	1.5	* 0.773	67.8	LOS E	13.2	93.7	1.00	0.92	1.13	4.3
Approach		262	4.4	262	4.4	0.773	55.4	LOS D	13.2	93.7	0.89	0.85	0.98	13.4
East: Pennant Hills Road														
4	L2	203	1.0	203	1.0	0.774	37.4	LOS C	36.2	275.2	0.91	0.84	0.91	16.3
5	T1	1625	14.4	1625	14.4	* 0.774	33.3	LOS C	36.2	275.2	0.89	0.81	0.89	26.5
6	R2	108	1.0	108	1.0	0.286	20.9	LOS B	2.8	20.1	0.76	0.73	0.76	28.7
Approach		1937	12.2	1937	12.2	0.774	33.0	LOS C	36.2	281.6	0.88	0.81	0.88	25.9
North: Normanhurst Road														
7	L2	140	1.5	140	1.5	0.407	46.0	LOS D	12.0	84.7	0.85	0.76	0.85	17.6
8	T1	80	0.0	80	0.0	0.407	42.5	LOS D	12.0	84.7	0.85	0.76	0.85	19.2
9	R2	120	3.5	120	3.5	0.560	63.8	LOS E	7.8	56.3	0.97	0.80	0.97	22.8
Approach		340	1.9	340	1.9	0.560	51.4	LOS D	12.0	84.7	0.90	0.78	0.90	20.5
West: Pennant Hills Road														
10	L2	34	0.0	34	0.0	0.642	34.4	LOS C	26.9	213.0	0.83	0.75	0.83	29.1
11	T1	1382	16.3	1382	16.3	0.642	30.2	LOS C	26.9	213.0	0.80	0.72	0.80	24.8
12	R2	212	3.0	212	3.0	* 0.616	41.1	LOS C	8.6	61.8	0.97	0.92	0.97	23.2
Approach		1627	14.2	1627	14.2	0.642	31.7	LOS C	26.9	214.0	0.83	0.74	0.83	24.7
All Vehicles		4166	11.7	4166	11.7	0.774	35.4	LOS C	36.2	281.6	0.86	0.78	0.87	24.2

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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Effective Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Osborn Road											
P1	Full	53	64.3	LOS F	0.2	0.2	0.96	0.96	227.7	212.4	0.93
North: Normanhurst Road											
P3	Full	53	64.3	LOS F	0.2	0.2	0.96	0.96	227.7	212.4	0.93
All Pedestrians		105	64.3	LOS F	0.2	0.2	0.96	0.96	227.7	212.4	0.93

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.