Traffic Impact Assessment

Proposed Expansion of Rouse Hill Anglican College
Corner of Rouse Road & Worcester Road, Rouse Hill

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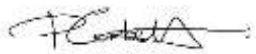
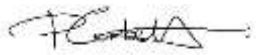
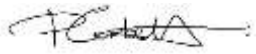
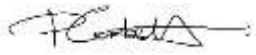
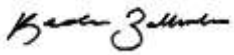
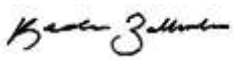
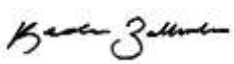
v01	09/12/2015	Paul Corbett	Paul Corbett	
v02	19/01/2016	Paul Corbett	Paul Corbett	
v03	29/02/2016	Paul Corbett	Paul Corbett	
v04	21/06/2016	Paul Corbett	Paul Corbett	
v05	08/03/2017	Kedar Ballurkar	Kedar Ballurkar	
v06	14/03/2017	Kedar Ballurkar	Kedar Ballurkar	
v07	11/08/2017	Kedar Ballurkar	Kedar Ballurkar	

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Contents

Appendices

1. Introduction

TRAFFIX has been commissioned by Anglican Schools Corporation to undertake a Traffic Impact Assessment (TIA) in support of a Development Application (DA) relating to the Rouse Hill Anglican College located on the corner of Worcester Road and Rouse Road, Rouse Hill. This DA proposes an expansion of the existing junior and senior schools to cater for a total of 194 staff and 2,135 students (including 40 FTE Pre-Kindergarten places). This represents an increase of 101 staff and 856 students (including 40 FTE Pre-Kindergarten places) above its current capacity.

This site is at Rouse Hill and forms part of the 'Area 20' Precinct which has been zoned for development as part of the North West Growth Centre established by the NSW Government. In this regard, the development has been assessed under the Blacktown City Council Growth Centre Precincts Development Control Plan 2010 (BCC Growth Centre DCP 2010).

This report documents the findings of our investigations and should be read in the context of the Statement of Environmental Effects (SEE) prepared separately. The report is structured as follows:

- Section 2: Describes the site and its location;
- Section 3: Documents existing traffic conditions and public (and active) transport services;
- Section 4: Describes the proposed development;
- Section 5: Assesses the parking requirements;
- Section 6: Assesses traffic impacts;
- Section 7: Provides an overview of present and future active transport routes;
- Section 8: Discusses access and internal design aspects; and
- Section 9: Presents the overall study conclusions.

2. Location and Site

The site is situated within Area 20 of the Northwest Growth Centre and is bound by Rouse Road to the south, Worcester Road to the east and Cudgegong Road to the west, in the suburb of Rouse Hill. It is located approximately 9 kilometres north of Blacktown Town Centre and 35 kilometres north-west of the Sydney CBD.

The site is irregular in configuration having a total site area of 114,122 m^2. It currently accommodates the Rouse Hill Anglican College, as well as residential property situated at the north-eastern corner of the site.

It has an eastern frontage to Worcester Road of approximately 286 metres, a southern frontage to Rouse Road of approximately 124 metres and a western frontage to Cudgegong Road of approximately 78 metres. The northern property boundary is approximately 560 metres in length and borders existing residential properties (low density).

Access to the site is provided via four (4) vehicular crossings to Worcester Road which serve the on-site car parking and bus drop-off / pick-up area fronting Rouse Road. An additional access is provided onto Rouse Road which serves a small servicing area. A total of 229 car parking spaces are provided throughout the site with most spaces provided along the sites frontage to Rouse Road.

A Location Plan is presented in **Figure 1**, with a Site Plan presented in **Figure 2**.

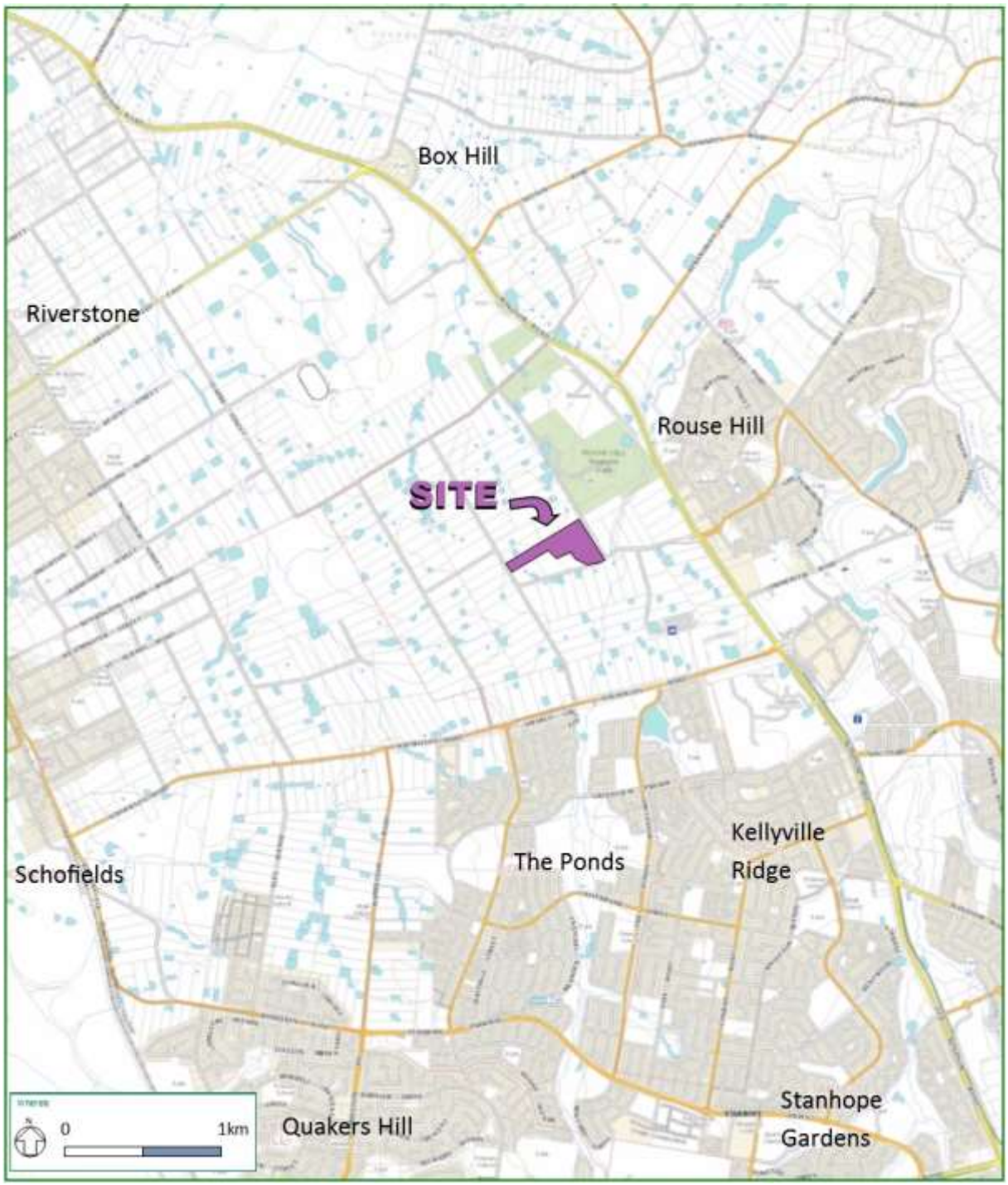

Figure 1: Location Plan

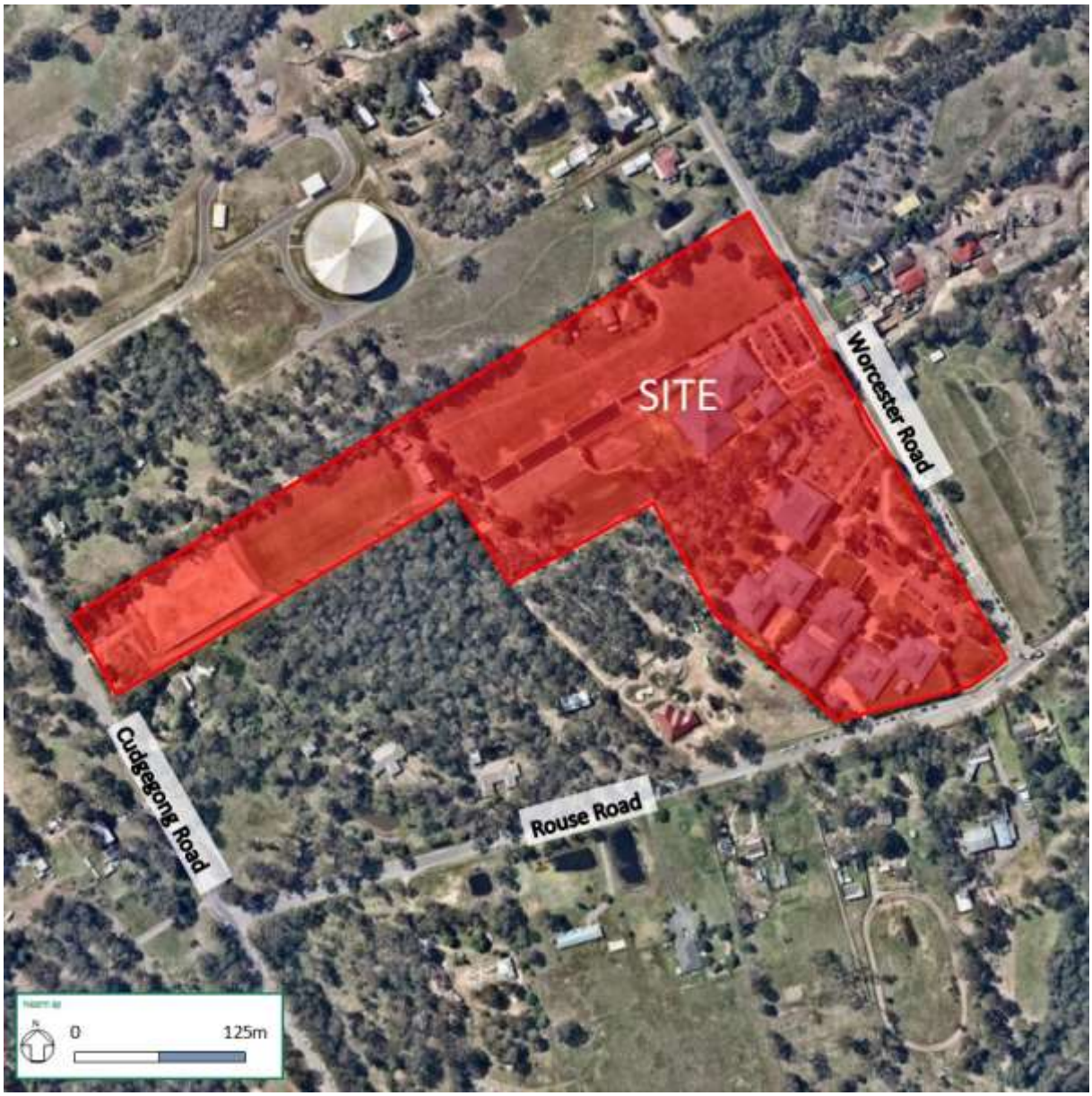

Figure 2: Site Plan

3. Existing & Future Traffic Conditions

3.1 Road Network

The road hierarchy in the vicinity of the site is shown in **Figure 3** with the following of particular interest:

- Windsor Road: an RMS State road (MR 184) to the east of the site that runs in a north-south direction and forms one of the primarily arterial corridors serving the locality and the subject site. Windsor Road carries approximately 31,000 vpd in the vicinity of the site and is constructed with a 30 metre wide divided carriageway, carrying 2 lanes of traffic in both directions. 'No Stopping' restrictions along both sides and it is subject to an 80km/h speed limit.

- Rouse Road: a local road which runs in an east-west direction between Windsor Road in the east and Cudgegong Road in the west. Rouse Road is subject to a 60km/h speed limit however, '40km/h School Zone' speed restrictions apply between 8:00-9:30am and 2:30-4:00pm on school days. Unrestricted parallel parking is permitted along both sides of Rouse Road. It carries a single lane of traffic in each direction along an undivided road of width 8 metres. Rouse Road will however be upgraded to 2 lanes of traffic in each direction as identified by previous studies undertaken by Road Delay Solutions, as the Area 20 Precinct is developed further.

- Worcester Road: a local road which runs in a north-south direction between Guntawong Road in north and Rouse Road in the south. It is subject to a 60km/h speed limit however, '40km/h School Zone' speed restrictions apply between 8:00-9:30am and 2:30-4:00pm on school days. Worcester Road carries a single lane of traffic in either direction with an undivided carriageway of width 10 metres.

- Cudgegong Road: a local road which runs in a north-south direction between Guntawong Road in north and Schofields Road in the south. It is subject to a 60km/h speed limit and carries a single lane of traffic in either direction with an undivided carriageway of width 7 metres.

It should be noted that internal infrastructure located within the NWGC is intended to be upgraded to accommodate the redevelopment of the precinct. Specifically, the *North West Growth Centre Road Framework (2011)* developed a road hierarchy which identifies the future alignment of the Principal Arterial roads, Transit Boulevards, Sub Arterial and Collector roads, based on the existing and future road network. This future network is shown in **Figure 4**, with key upgrades listed below:

- Key priority controlled intersections in the vicinity of the site will be upgraded to roundabout controlled intersections. This includes but is not limited to the following:
  - Rouse Road / Worcester Road
  - Rouse Road / Cudgegong Road
  - Guntawong Road / Worcester Road
  - Guntawong Road / Cudgegong Road
- Rouse Road will be extended beyond its intersection with Cudgegong Road, thereby forming a 4-way roundabout controlled intersection having regard for the above.
- An additional eastbound and westbound traffic lane will be provided for Rouse Road, west of its intersection of Windsor Road. This section of Rouse Road will therefore accommodate a total of two lanes of traffic in each direction.
- Rouse Road, Worcester Road and Cudgegong Road shall be upgraded and classified as 'collector roads'.

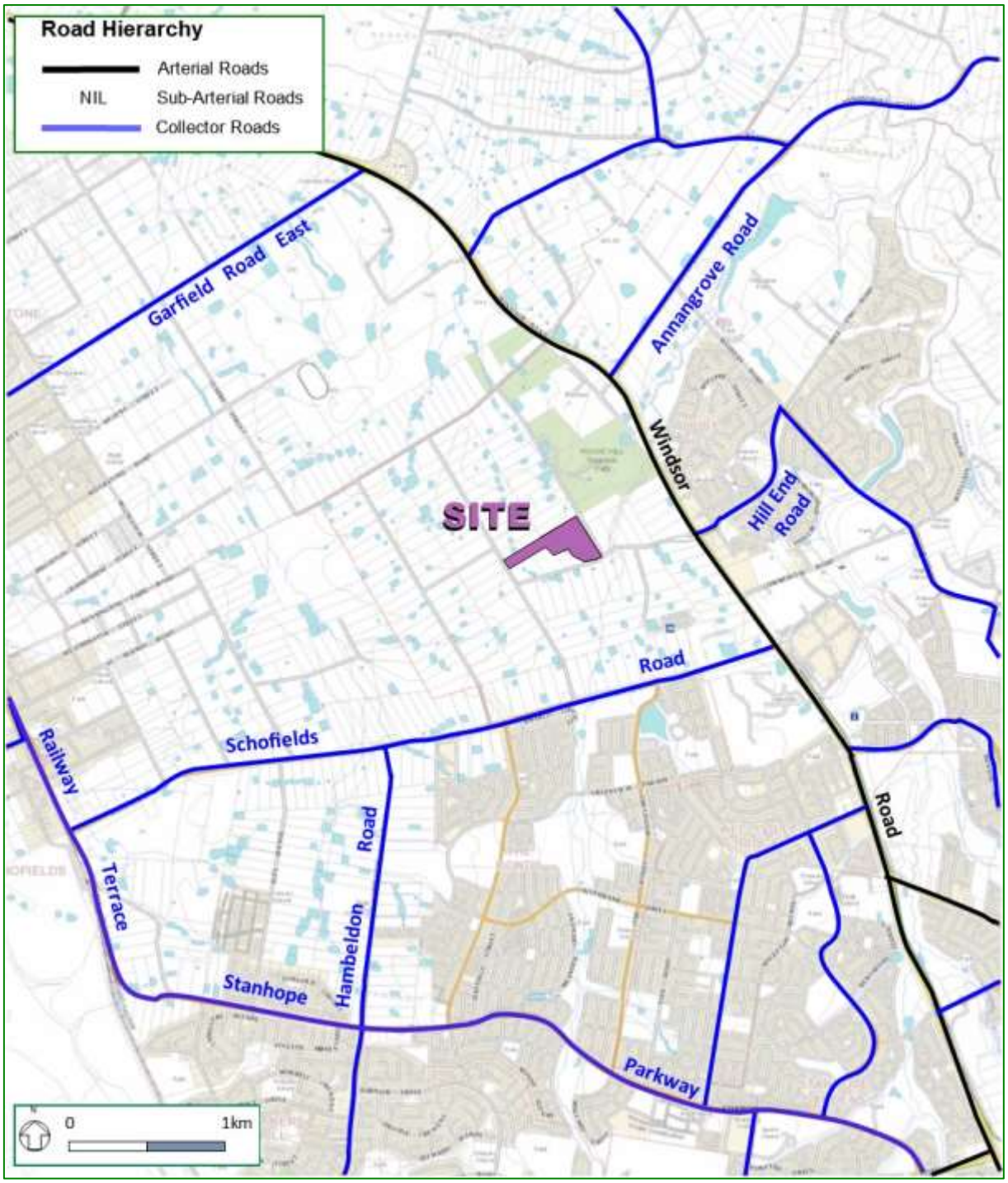

Figure 3: Existing Road Hierarchy

Source: BCC Growth Centre DCP 2010

Figure 4: Future Road Network & Hierarchy of Area 20

3.2 Public Transport

Due to the current low density rural nature of the Area 20 precinct, public transport to the area is presently limited. The site is currently serviced by a single bus route being the Busways Route T75. This existing bus service that operates in the locality is shown in **Figure 5**.

Notwithstanding, as density within the NWGC increases, access to both rail and the local bus network are expected to improve, in response to a demonstrated demand. It is anticipated that new services would be provided and would generally follow collector roads, with strategic bus corridors provided along Transit Boulevards and Principal Arterial roads.

It is also noteworthy that as part of the North West Rail Link project (now known as Sydney Metro Stage 1), two new railway stations will be constructed in the vicinity of the subject site. The Cudgegong Road Station will be located on the corner of Schofields Road and Cudgegong Road, which is approximately 700 metres from the site. The Rouse Hill Station will be located directly outside the Rouse Hill Town Centre, which is approximately 1.5 kilometres from the subject site. The above train lines will connect to Epping, where connections to the T1 North Shore, Northern & Western Line are provided. The North West Rail Link (Sydney Metro Stage 1) is scheduled for completion in 2019.

The future bus and rail network published in the NWGC Road Framework report is shown in Figure 5 for the area adjacent to the subject site. **Figure 6** overleaf also shows the indicative layout for the Cudgegong Road Station

In addition to the above, it is noted that Hillsbus and Busways both operate school bus services for RHAC during the mornings and afternoons. The areas serviced by each company is given below:

- Hillsbus Services: Kellyville, Beaumont Hills, Baulkham Hills, Castle Hill, Annangrove, Box Hill and Kenthurst.
- Busways Services: Rouse Hill, Kellyville Ridge, Stanhope Gardens, Glenwood, Acacia Gardens, Kings Langley, Quakers Hill, Schofields and Riverstone.

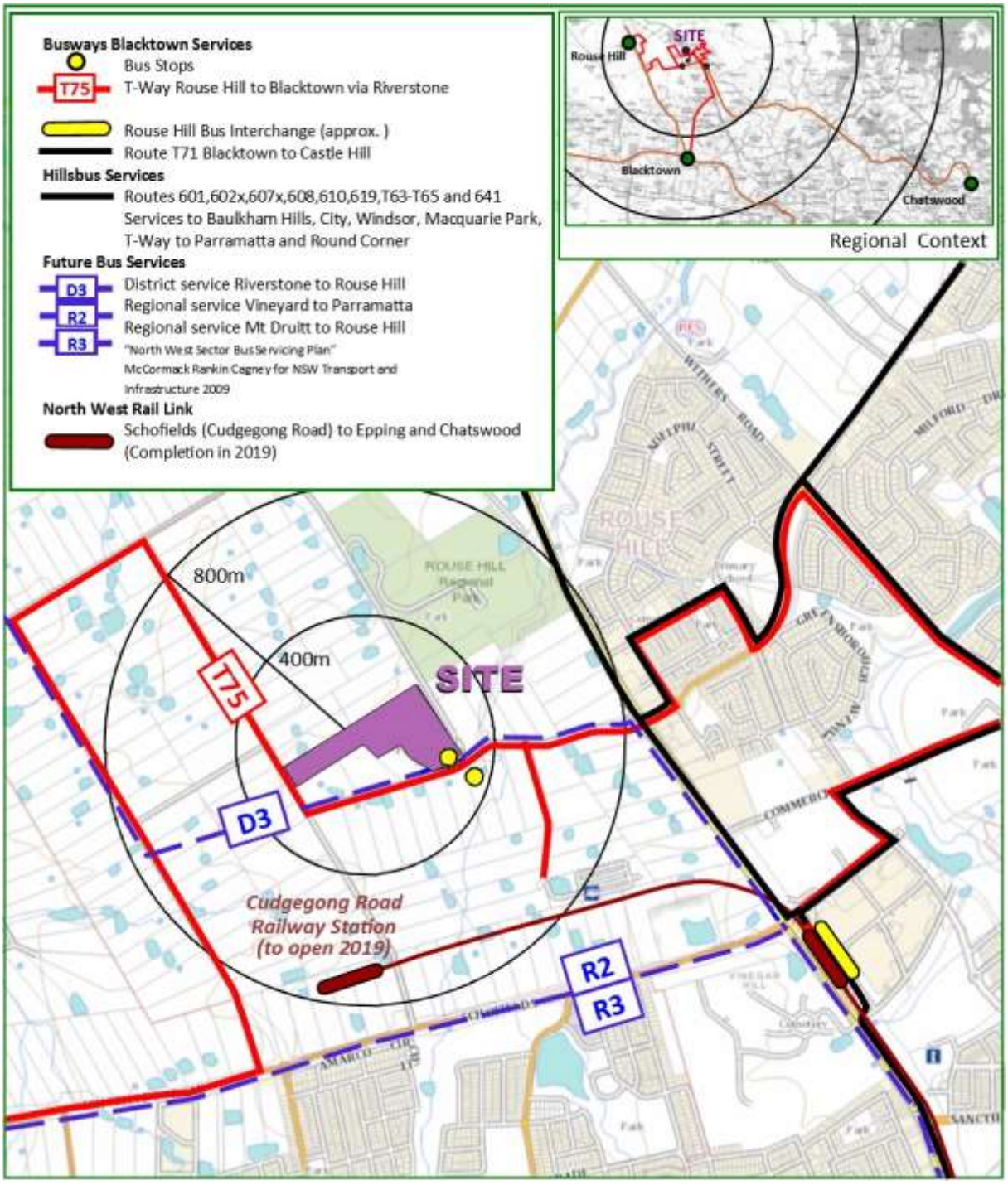

Figure 5: Existing & Future Public Transport Services

Source: www.nwrail.transport.nsw.gov.au

Figure 6: Indicative Layout of Cudgegong Road Railway Station

3.3 Existing Travel Modes & Site Traffic Generation

As a means of assessing the travel modes and traffic generation of the existing (and proposed) school, online travel mode questionnaire surveys were prepared by TRAFFIX and distributed by the school to all staff, parents / carers (with children in Kindergarten to Year 6) and Senior School students. The survey included a range of questions which were primarily aimed to gain an understanding of the following:

- Travel modes in the morning and afternoon
- Average car occupancies

Table 1 below shows the existing travel modes of both staff and students during the AM and PM school peak periods.

Table 1: Existing Travel Modes – AM and PM School Peak Periods

Travel Mode	AM Peak		PM Peak	
	Staff	Student	Staff	Student
Car Driver	99%	4%	99%	4%
Car Passenger	-	73%	-	59%
Public Transport	-	23%	-	37%
Other	1%	-	1%	-

It is evident that 99% of staff drive to / from the school, with the remaining 1% utilising other means of travel. The results also show that 73% of students are dropped-off by private car to the school in the morning, with 59% of students being picked-up by private car in the afternoon. Similarly, 23% of students utilise public transport in the morning, increasing to 37% in the afternoons. A small proportion (4%) of students also drive to / from the school using private cars.

In regards to car occupancies, the survey results demonstrate the following averages for staff and students:

- Staff: 1 staff member / car
- Students: 2 students / car

The survey also included a question related to the time staff and students arrive at and depart from the school on a typical day which was used to assess the traffic generation of the existing school during particular periods, in combination with the above survey results. In this regard, it is noted that the traffic generation of the existing school was assessed to be as follows:

- 918 vehicle trips (512 in, 406 out) during the 8:00-9:00am peak hour
- 631 vehicle trips (287 in, 344 out) during the 3:00-4:00pm peak hour

The above generations include both staff and student trips and equate to the below trip rates having regard for the 1,279 students at the existing school:

- 0.72 vehicles per hour per student during the AM peak hour, consisting of:
  - 0.40 veh/hr/student IN
  - 0.32 veh/hr/student OUT
- 0.49 vehicles per hour per student during the PM peak hour, consisting of:
  - 0.22 veh/hr/student IN
  - 0.27 veh/hr/student OUT

The above trip rates are therefore able to be utilised in assessing the traffic generation of the proposed school, which is discussed in further detail in Section 6.

4. Description of Proposed Development

A detailed description of the proposed development is provided in the Statement of Environmental Effects prepared separately. In summary, the development for which approval is now sought comprises the following components:

- Junior School area at north of site expanded via relocation and further student growth with three (3) new classroom modules, new roadway and car parking, and associated landscaped areas.
- Senior School area extended at south of site with demolition and replacement of previous two (2) teaching modules with new teaching spaces including for specialist teaching streams, new roadway and associated landscaped areas.
- New library, multi-purpose building and associated landscaped areas shared between the junior school and senior school.

The above will include the following changes from a traffic and parking perspective:

- Partial minor demolition and reconfiguration of existing car parking areas along the Worcester Road frontage.
- Construction of a new internal road network and car park along the northern property boundary. All entry movements to this car park are to occur via Worcester Road, with all exit movements via Cudgegong Road.
- Construction of a new on-site bus parking area along the Worcester Road frontage, to service the consolidated Junior School area. This area has capacity to accommodate two (2) buses.
- The provision of 56 additional car parking spaces to now provide a total of 285 spaces for the school.

The overall objective of the above development is to increase the student capacity from its current level of 1,279 students to 2,135 students (including 40 FTE Pre-Kindergarten places) and from 93 staff to 194 staff. This represents an increase of 856 students (including 40 FTE Pre-Kindergarten places) and 101 staff.

The parking requirements and traffic impacts arising from the development are discussed in Sections 5 and 6 respectively. Reference should be made to the plans submitted separately to Council which are presented at reduced scale in **Appendix A**.

5. Parking Requirements

5.1 Council Controls

The BCC Growth Centre DCP 2010 requires parking for educational establishments (primary and secondary schools) to be determined at the rates shown in **Table 2**. For the car parking assessment, the FTE Pre-Kindergarten component has been assessed on the basis of parking for childcare centres.

Table 2: Council Parking Rates and Provision

Type	Number	Council Parking Rates	No. Spaces Required	No. Spaces Provided
Junior / Senior School Staff	190	1 space / staff member	190	285
Students (Kindergarten – Year 12)	2,095*	1 space / 100 students	21	
Year 12 Students	138	1 space / 5 Students in Year 12	28	
Childcare Staff	4	1 space / staff member	4	
Children associated with Childcare Centre	40	1 space / 6 children	7	
		Totals	***250***	***285***

* Note: Excludes 40 FTE Pre-Kindergarten places, which are assessed separately in Table 2.

It can be seen from Table 2 that with 194 staff members, 2,095 students (Kindergarten to Year 12) and 40 FTE Pre-Kindergarten students, there is a requirement to provide a total of 250 car parking spaces. In response, the development provides a total of 285 parking spaces (a surplus of 35 spaces), exceeding the requirements of Council's DCP and thereby ensuring that all normal parking demands will be readily accommodated on-site. The proposed car parking provision is therefore considered acceptable.

5.2 Disabled Parking

The BCC Growth Centre DCP 2010 does not provide a rate for the provision of disabled car parking. Accordingly, this has been assessed having regard for the Building Code of Australia (BCA) which recommends that educational establishments (Class 9b Structures) provide disabled parking at a rate of 1 space per 100 parking spaces or part thereof. Therefore, as the development is proposing

285 parking spaces, there is a requirement to provide three (3) disabled parking spaces. In response, the development provides a total of six (6) disabled parking spaces (5 existing and 1 new) throughout the site and therefore exceeds the minimum requirements of the BCA. It is noteworthy that the new disabled parking space has been designed in accordance with AS 2890.6 (2009) *Part 6: Off-street parking for people with disabilities* and that this is situated immediately north-west of the existing hardcourts.

5.3 Bicycle Parking

The BCC Growth Centre DCP 2010 does not provide a rate for the provision of bicycle parking. Notwithstanding, the development provides a bicycle storage shed for the Junior School and utilises the existing gym under croft for the Senior School, with both of these areas accessed via Worcester Road. A total of 66 bicycle spaces are provided comprising 26 bicycle spaces for the Junior School and 40 spaces for the Senior School, with these provisions considered acceptable. It is noted that there is ample area within the site that is available for additional bicycle parking should the demand for bicycle parking increase. Active transport is discussed later in Section 7.

All bicycle spaces provided shall be designed as Class 2 Facilities, thereby satisfying the requirements of AS 2890.3 (2015).

5.4 Bus Parking

The BCC Growth Centre DCP 2010 does not provide a rate for the provision of bus parking or drop-off / pick-up facilities for buses. Notwithstanding, the development proposes an additional two (2) bus parking bays adjacent to Block K and two (2) bus drop-off / pick-up bays, immediately east of the proposed Junior School modules and north of the existing car parking area fronting Worcester Road. These are in addition to the existing bus drop-off / pick-up facility provided along the Worcester Road frontage, which can accommodate in the order of 3-4 buses.

All bus parking and drop-off / pick-up areas have been designed to accommodate vehicles up to 12.5 metres in length. These areas have been assessed using swept path analysis in accordance with AS 2890.2 (2002), with the use of a 12.5 metre heavy rigid vehicle (HRV). These swept paths are provided in **Appendix B** for reference and confirm that satisfactory access will be achieved.

5.5 Servicing and Waste Management

The BCC Growth Centre DCP 2010 does not provide a rate for the provision of service vehicle parking. Notwithstanding, it is noted that courier drivers using cars / vans will be able to utilise spare on-site car parking spaces throughout the site which will be available, noting that the development provides well in excess of the minimum number of spaces required under the DCP.

More importantly, it should be noted that there is not expected to be any substantial changes to the truck servicing / waste collection arrangements of the school. In this regard, all Senior School waste collection will continue to be undertaken from the maintenance area located immediately south of the existing Senior School module building, which is accessed via Rouse Road.

A new Junior School waste holding room will be provided in between the existing and proposed Junior School module buildings, and immediately west of the proposed bus drop-off / pick-up area. Accordingly, waste collection vehicles will be able to access the site using the proposed bus drop-off / pick-up area for waste collection of the Junior School, ensuring that all loading is undertaken on-site.

In addition to the above, the area to the rear of the multi-purpose building is also available for waste collection.

All waste collection areas have been assessed using swept path analysis in accordance with AS 2890.2 (2002), with the use of a 10.6 metre long waste collection vehicle. These swept paths are provided in **Appendix B** for reference and confirm that satisfactory access will be achieved.

6. Traffic Impacts

6.1 Trip Generation

The RMS *Guide to Traffic Generating Developments* does not nominate a specific generation rate for schools, with traffic generation to be assessed using surveys of comparable developments. As discussed in Section 3.3, extensive surveys were undertaken of the existing school to establish appropriate traffic generation rates. The surveys established the following trip rates:

- 0.72 vehicles per hour per student during the AM peak hour period, consisting of:
  - 0.40 veh/hr/student IN
  - 0.32 veh/hr/student OUT
- 0.49 vehicles per hour per student during the PM peak hour period, consisting of:
  - 0.22 veh/hr/student IN
  - 0.27 veh/hr/student OUT

The above rates are considered appropriate for adoption to the proposed increases to both the school and Pre-Kindergarten, given that travel characteristics are expected to be comparable and noting that a proportion of parents / carers would likely have children at both the school and Pre-Kindergarten. Application of these rates to the 2,135 students (including the 40 children in FTE Pre-Kindergarten) proposed results in the following traffic generation:

- 1,537 vehicle trips (854 in, 683 out) during the 8:00-9:00am peak hour
- 1,046 vehicle trips (470 in, 576 out) during the 3:00-4:00pm peak hour

The above generations are not a net increase however, as the generation of the existing school, as discussed in Section 3.3, also needs to be taken into consideration. In this regard, the proposed development is expected to result in the following net increase in traffic generation:

- 619 vehicle trips (342 in, 277 out) during the 8:00-9:00am peak hour
- 415 vehicle trips (183 in, 232 out) during the 3:00-4:00pm peak hour

It is important to note that the above traffic generations are based on existing modes of travel to / from the site. Given that public transport services will greatly improve throughout the area in the near future, as discussed in Section 3.2, it would be expected that there would be a shift in travel modes, with higher utilisation of public transport services and accordingly, a reduction in private car usage. Notwithstanding, for the purposes of a conservative approach to the traffic assessment, no reduction has been taken into consideration. The above traffic generations can therefore be regarded as a 'worst case' scenario.

It is envisaged that with the completion of the new Cudgegong Road Station as part of Northwest Metro Project being 700m away from the school and improvements in accessibility to school for walking and cycling, will further reduce reliance on private car usage to and from the school. This is discussed further in Section 7 – Active Transport.

6.2 Traffic Distribution

All car parking within the existing school is currently accessed via Worcester Road and hence, it is required to accommodate all entry and exit vehicular movements to / from the site. Given that the proposed new internal road network (and car park) will require drivers to enter via Worcester Road and exit via Cudgegong Road, there will be a redistribution of development traffic onto the external road network. This will ease the heavy reliance on Worcester Road and distribute development traffic onto Cudgegong Road, thereby minimising impacts. In this regard, it is noted that the traffic generation associated with the proposed development is assumed to be distributed as follows:

- 60% of development traffic to enter and exit via Worcester Road only. Of these, 70% are expected to arrive from / depart towards Rouse Road, with the remaining 30% to arrive from / depart towards Guntawong Road.
- 40% of development traffic to enter via Worcester Road and exit via Cudgegong Road. Of these, 70% are expected to arrive from / depart towards Rouse Road, with the remaining 30% to arrive from / depart towards Guntawong Road.

With the above in mind, it was therefore considered appropriate that an assessment be undertaken of the following key intersections:

- Rouse Road / Worcester Road
- Rouse Road / Cudgegong Road
- Guntawong Road / Worcester Road
- Guntawong Road / Cudgegong Road

6.3 Peak Period Intersection Performances

Given the planned intensification of the Area 20 Precinct and extensive upgrades to the surrounding road network, it was considered appropriate to base the modelling of the above intersections on the future background traffic volumes and road layouts envisaged in previous traffic studies undertaken of the Area 20 Precinct, by Road Delay Solutions. As such, the traffic assessment and intersection modelling predicted undertaken has been based on Year 2036 intersection turning volumes (provided by Road Delay Solutions), and intersection arrangements which were discussed in Section 3.1.

Modelling of the key intersections identified has focused on the 8:00-9:00am (AM) peak period only. Modelling of the afternoon (3:00-4:00pm) peak hour was not considered necessary, as this will not coincide with the commuter peak hour (generally 5.00-6.00pm). In addition, the traffic generation of the development during this afternoon period is substantially less than the morning period and hence, impacts will be noticeably reduced.

The predicted 2036 intersection turning volumes were analysed using the SIDRA computer program to determine their performance characteristics under the '2036 base' and '2036 base plus development' scenarios. The SIDRA model produces a range of outputs, the most useful of which are the Degree of Saturation (DOS) and Average Vehicle Delay per vehicle (AVD). The AVD is in turn related to a level of service (LOS) criteria. These performance measures can be interpreted using the following explanations:

DOS - the DOS is a measure of the operational performance of individual intersections. As both queue length and delay increase rapidly as DOS approaches 1, it is usual to attempt to keep DOS to less than

0.9. When DOS exceeds 0.9 residual queues can be anticipated, as occurs at many major intersections throughout the metropolitan area during peak periods. For intersections controlled by roundabout or give way/stop control, satisfactory intersection operation is generally indicated by a DOS of 0.8 or less.

AVD - the AVD for individual intersections provides a measure of the operational performance of an intersection. In general, levels of acceptability of AVD for individual intersections depend on the time of day (motorists generally accept higher delays during peak commuter periods) and the road system being modelled (motorists are more likely to accept longer delays on side streets than on the main road system).

LOS - this is a comparative measure which provides an indication of the operating performance of an intersection as shown below:

Level of Service	Average Delay per Vehicle (secs/veh)	Traffic Signals, Roundabout	Give Way and Stop Signs
A	less than 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity; at signals incidents will cause excessive delays. Roundabouts require other control mode	At capacity and requires other control mode
F	More than 70	Unsatisfactory and requires additional capacity.	Unsatisfactory and requires other control mode or major treatment.

A summary of the modelled results are provided in **Table 3** below. Reference should also be made to the SIDRA outputs included in **Appendix C** which provide detailed results for individual lanes and approaches.

Table 3: AM Peak Hour Intersection Performances

Intersection Description	Control Type	Model	Degree of Saturation	Intersection Delay (sec)	Level of Service
Rouse Road / Worcester Road	Roundabout*	2036 Base	0.467	7.5	A
	Roundabout*	2036 Base + Development	0.519	8.7	A
Rouse Road / Cudgegong Road	Roundabout*	2036 Base	0.410	11.9	A
	Roundabout*	2036 Base + Development	0.706	16.2	B
Guntawong Road / Worcester Road	Roundabout*	2036 Base	0.300	12.1	A
	Roundabout*	2036 Base + Development	0.309	12.1	A
Guntawong Road / Cudgegong Road	Roundabout*	2036 Base	0.241	12.5	A
	Roundabout*	2036 Base + Development	0.358	12.9	A

* Note: All SIDRA results reported above relate to the movement with the highest delay, in accordance with the RMS Guide to Traffic Generating Developments.

It can be seen from Table 3 that all key intersections are expected to operate satisfactorily under the 2036 'base-case' scenario, with acceptable delays and a Level of Service of A during the critical AM peak period.

Table 3 also shows that the proposed development would have only minor impacts on the operation of these key intersections during the AM peak period, which will continue to operate with a Level of Service A excluding the Rouse Road / Cudgegong Road intersection, which will operate with a Level of Service B. All key intersections will therefore continue to operate with acceptable delays and spare capacity.

It is therefore evident that the additional traffic volumes generated by the proposed development will be accommodated by the future road network, with no additional upgrades required. The traffic impacts of the development on the external road network are therefore considered acceptable.

7. Active Transport

7.1 Existing Network

Active transport refers to non-motorised modes of transport such as walking and cycling. This would fall under the broader category of public transport and also specifically include the leg of a journey made to a bus stop or train station.

Presently there are limited facilities provided for pedestrians and cyclists in the vicinity of the site. Whilst footpaths have been constructed along the school frontages, it is noted that they do not extend on Rouse Road, to the east and west, and on Worcester Road, to the north. As such, they offer limited utility other than for pick-up and drop-off for school children.

The lack of footpaths in the surrounding areas provide no safe method for students to walk to school, forcing them on certain sections to share the road carriageway with vehicles at particular locations. This is particularly the case where unsurfaced road shoulders are uneven and do not provide any traction in wet weather.

These roads provide access to walkable catchments and presumably students whom can otherwise walk to school may be driven to in lieu of suitable pedestrian facilities. Furthermore, the lack of safe pedestrian footpaths will make walking to future public transport amenities unfeasible, with danger compounded by expected increases in traffic volumes.

These concerns have also been raised by the school during an intensive workshop session. The need for crossings was also identified in response to the future railway station and increased road volumes, particularly at intersections where no footpaths are available as refuge for pedestrians.

7.2 Future Network

In order to increase the uptake of active transport, road networks should be designed to offer convenient routes that are also safe for pedestrian and cyclist use. For the proposed development, this would be promoted for students whom either live in a walkable distance from the school or those walking to the future Cudgegong Road Station or bus terminal on Windsor Road at the intersection of Schofields Road.

Using knowledge from student enrolments, the school has nominated the following routes in **Figure 7**. These routes connect to the major established residential catchments as well as the above public transport destinations. It can be seen that the school envisages pedestrian movements on Rouse Road/Mile End Road, Windsor Road and Cudgegong Road. These flows are notwithstanding background growth associated with other users of the train station and emanating from surrounding residential development.

From studying the future road network illustrated in **Figure 4** for Area 20, it is evident that the intersection of all these roads will benefit from upgrades, either being controlled by roundabouts or signals. It is assumed that pedestrian crossing facilities will be incorporated into the design at all approaches, either by way of refuge islands or signalised crossings. As such, these nominated routes are considered supportable both in terms of amenity and safety, accounting for any increase in traffic volumes.

The school has performed a preliminary audit on these roads and has identified missing footpaths that are needed to ensure a safe passage for pedestrians that is separate from the road carriageway. It is anticipated that future residential development in close proximity of the site, notwithstanding the proposed increase in student numbers, will warrant these civil improvements to be overseen by Council.

In this regard, the planned upgrade of the Rouse Road Bridge, as announced by Council in partnership with the federal government, presents an ideal opportunity to implement dedicated pedestrian and cyclist paths on conjunction with carriageway widening. Forward planning will ensure that a complete active transport network will be available and support mode shifts away from private vehicle transportation.

It is noteworthy that the internal school bus bay and pick-up and drop-off areas have been designed to be pedestrian friendly. It is inherently safer for students to arrive or depart from the school within the site, whilst provision for internal footpaths and crossings is evidenced on the plans. As detailed earlier, bicycle parking for students on-site will also provide incentive for cycling as a means of transport to the site.

Finally, it is noteworthy that the school is already committed to promoting public transport and publishes information on bus services on its website. It is envisaged that as civil improvements are made, active transport routes can be also posted for the benefit of current and prospective students. This information can also be presented in the form of a green travel plan as part of an overall wayfinding strategy for the school.

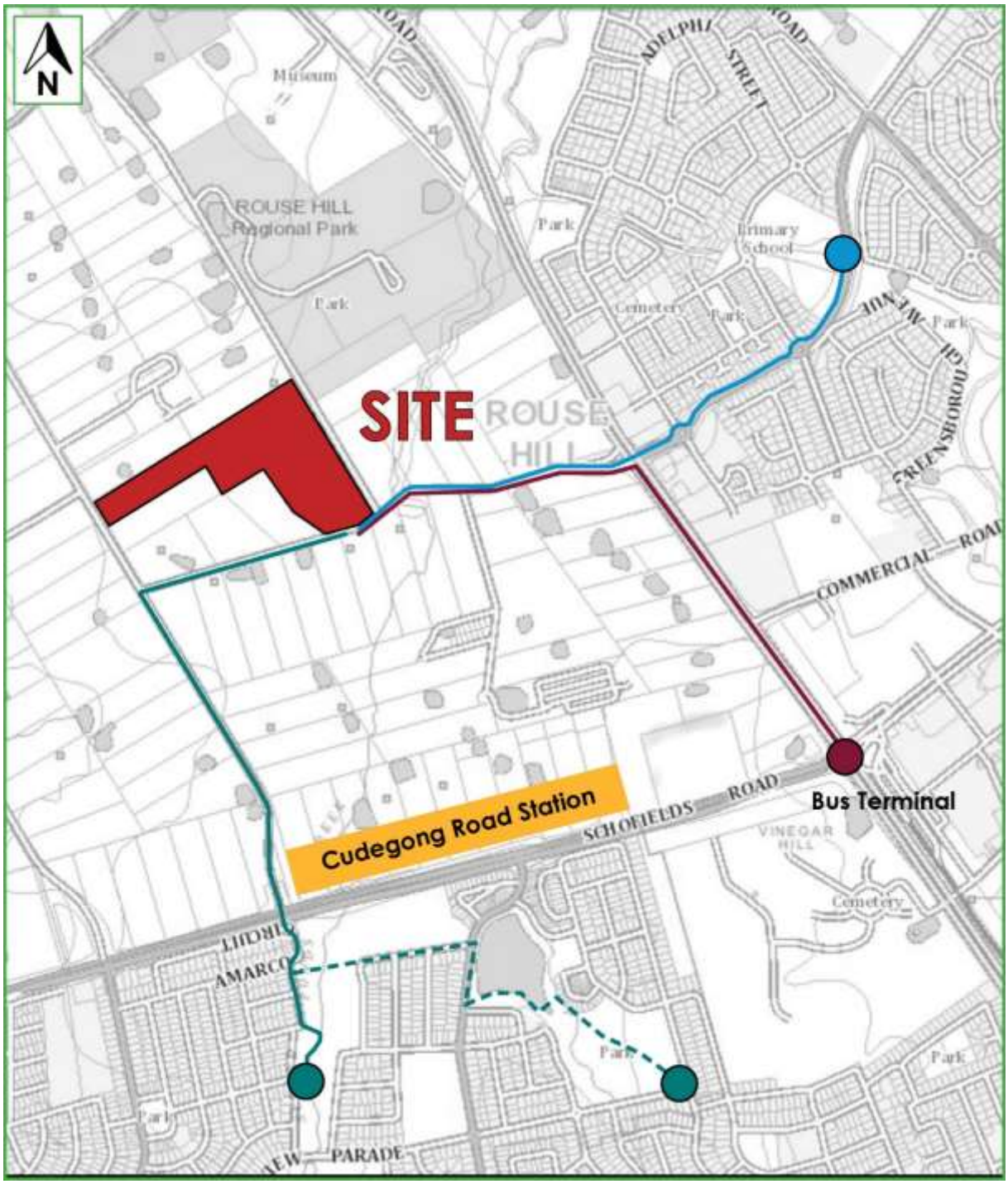

Figure 7: Catchment Routes

8. Access & Internal Design Aspects

8.1 Access

8.1.1 Design

The development proposes three (3) additional access driveways to serve the proposed internal road network, car park and bus drop-off / pick-up area. This includes:

- An 8.0 metre wide (2 lane) entry-only driveway onto Worcester Road, at the north-eastern corner of the site, primarily serving the proposed Junior School car park.
- A 6.0 metre wide (2 lane) exit-only driveway onto Cudgegong Road, at the western end of the site, primarily serving the proposed Junior School car park.
- An 8.5 metre wide entry-only driveway onto Worcester Road, immediately north-east of the proposed bus shelter, which shall accommodate buses.

The proposed arrangements satisfy the Category 3 Driveway requirements of AS 2890.1 (2004) (i.e. for car parking) and AS 2890.2 (2002), and are considered acceptable.

The proposed one-way traffic flow serving the new car park will also ensure that the driveways and car park operate safely and efficiently. There will also be minimal potential for queuing to extend onto Worcester Road, having regard for the extensive queuing area available within the site on approach to the proposed car park. In addition, it is noted that the 2 lane exit-only driveway onto Cudgegong Road includes separate left-turn and right-turn lanes to improve efficiency of this egress.

Swept path analysis has been undertaken of the proposed arrangements with the use of a B99 vehicle, 10.6 metre waste collection vehicle and 12.5 metre heavy rigid vehicle (HRV), in accordance with AS 2890.1 (2004) and AS 2890.2 (2002). This analysis confirms satisfactory access and compliance with the above standards, with relevant swept paths provided in Appendix B for reference.

An assessment of available sight distances at the proposed Cudgegong Road exit-only driveway has also been undertaken with respect to the requirements of AS 2890.1 (2004). Site investigations demonstrate that sight distances in excess of 100 metres are achieved to both the north and south of

the proposed driveway, thereby satisfying the minimum 65 metres required under AS 2890.1 (2004) for the signposted speed limit of 60km/h.

8.1.2 Performance of Driveways

Whilst the proposed entry-only and exit-only (car parking) driveways comply with AS 2890.1 (2004) and are expected to operate safely and efficiently, additional SIDRA modelling has been undertaken of these driveways to assess their performance under the Year 2036 traffic conditions. The results of this modelling are presented in **Table 4** below, with detailed SIDRA outputs included in Appendix C for reference.

Table 4: AM Peak Hour - Performance of Proposed Driveways

Intersection Description	Control Type	Model	Degree of Saturation	Intersection Delay (sec)	Level of Service
Worcester Road Entry-Only Driveway	Priority*	2036 Base + Development	0.573	14.2	A
Cudgegong Road Exit-Only Driveway	Priority*	2036 Base + Development	0.105	2.1	A

* Note: All SIDRA results reported above relate to the movement with the highest delay, in accordance with the RMS Guide to Traffic Generating Developments.

It can be seen from Table 4 that the proposed Worcester Road car parking entry-only driveway will operate satisfactorily under the 2036 base plus development scenario with acceptable delays and degree of saturation. In addition, it is evident that this driveway will operate with Level of Service A. The extensive queuing area provided within the site on approach to the proposed car park will also ensure that there is minimal potential for vehicles to queue back from this car park to the subject driveway.

Table 4 also shows that the proposed Cudgegong Road exit-only driveway will operate satisfactorily under the 2036 base plus development scenario with minimal delays and degree of saturation, whilst also operating with a Level of Service A.

The above modelling results therefore confirm that the proposed car parking entry-only and exit-only driveways will operate very efficiently, with acceptable delays and Levels of Service A. As such, there

is expected to be minimal delays experienced at either driveway when entering or exiting the site for development and through vehicular traffic.

8.2 Internal Design

The proposed changes to the internal parking arrangements comply with relevant sections of AS 2890.1 (2004), AS 2890.2 (2002), AS 2890.3 (2015) and AS 2890.6 (2009), with the following considered noteworthy:

8.2.1 Parking Modules

- All staff parking spaces shall be designed in accordance with a Class 1A User and provided with a minimum space length of 5.4m, a minimum width of 2.4m and a minimum aisle width of 5.8m.
- All drop-off / pick-up parking spaces shall be designed in accordance with a Class 3A User and provided with a minimum space length of 5.4m, a minimum width of 2.7m and a minimum aisle width of 6.2m or a minimum width of 2.6m and a minimum aisle width of 6.6m.
- All parallel spaces shall be designed in accordance with Figure 2.5 of AS 2890.1 (2004).
- The single new disabled parking space proposed is designed in accordance with AS 2890.6 (2009). The space is provided with a clear width of 2.4m and located adjacent to a minimum shared area of 2.4m.
- All spaces located adjacent to obstructions of greater than 150mm in height are provided with an additional width of 300mm.
- Dead-end aisles are provided with the required 1.0m aisle extension in accordance with Figure 2.3 of AS 2890.1 (2004).

8.2.2 Clear Head heights

- A minimum clear head height of 2.2m is provided for all areas within the site as required by AS 2890.1 (2004). An additional clear head height of 2.5m is to be provided above the disabled space as required by AS 2890.6 (2009).
- A minimum clear head height of 4.5m is provided above all areas to be traversed by service vehicles and buses.

8.2.3 Other Considerations

- Appropriate visual splays are to be provided at the exit-only driveway onto Cudgegong Road in accordance with the requirements of Figure 3.3 of AS 2890.1 (2004).

- The proposed internal road network has extensive queuing area available on approach to the new car park, thereby ensuring compliance with Section 3.4 of AS 2890.1 (2004) is achieved.

8.2.4 Servicing Areas

- The internal bus parking / drop-off / pick-up area and internal connecting road have been designed in accordance with the requirements of AS 2890.2 (2002) for the maximum length vehicle permissible on-site being a 12.5m HRV.

- All waste collection areas have been assessed using swept path analysis, with the use of a 10.6 metre long waste collection truck which confirms that satisfactory will be achieved.

- A swept path analysis has been undertaken as permissible under AS 2890.2 (2002) and confirms the internal design. The swept path assessment is included in Appendix B.

In summary, the proposed changes to the internal parking arrangements comply with relevant sections of AS 2890.1 (2004), AS 2890.2 (2002), AS 2890.3 (2015) and AS 2890.6 (2009). It is however envisaged that a condition of consent would be imposed requiring compliance with these standards and as such any minor amendments considered necessary (if any) can be dealt with prior to the release of a Construction Certificate.

9. Conclusions

In summary:

- The proposed development is expected to generate a total of 1,537 vehicle trips (854 in, 683 out) during the 8:00-9:00am peak hour and 1,046 vehicle trips (470 in, 576 out) during the 3:00-4:00pm peak hour. This is however a net increase of only 619 vehicle trips (342 in, 277 out) during the 8:00-9:00am peak hour and 415 vehicle trips (183 in, 232 out) during the 3:00-4:00pm peak hour, when the generation of the existing development is taken into consideration.

- SIDRA modelling has been undertaken of four (4) key intersections in the vicinity of the site and the proposed car parking entry-only and exit-only driveways, using Year 2036 traffic volumes as the base for purposes of assessment. Use of 2036 volumes was considered appropriate given the planned intensification of the Area 20 Precinct and extensive upgrades to the surrounding road network. All modelling focused on the 8:00-9:00am morning peak period only. Modelling of the afternoon (3:00-4:00pm) peak hour was not considered necessary, as the traffic generation during this period is substantially less than the morning peak and noting that this will not coincide with the commuter peak hour (generally 5.00-6.00pm).

- The results of the SIDRA modelling demonstrate that the additional traffic volumes generated by the proposed development will be accommodated by the existing road network with only minor impacts and that no additional upgrades are required. Indeed, all intersections (excluding Rouse Road / Cudgegong Road) are expected to operate with a Level of Service A during the critical AM peak period, based on 2036 volumes. The intersection of Rouse Road / Cudgegong Road will also operate satisfactorily with acceptable delays, albeit with a Level of Service B.

- The results of the SIDRA modelling also demonstrate that both the proposed entry-only and exit-only driveways will operate satisfactorily with Levels of Service A, based on 2036 volumes. As such, there is expected to be minimal delays experienced at either driveway for drivers entering or exiting the site and for through vehicular traffic.

- The proposed development is required to provide a total of 250 car parking spaces under the Blacktown Growth Centre Precincts Development Control Plan 2010. In response, the development provides a total of 285 parking spaces (i.e. a surplus of 35 spaces), exceeding the requirements of Council and thereby ensuring that all normal parking demands will be readily accommodated on-site. The proposed car parking provision is therefore considered acceptable.

- A desktop review of the active transport network reveals a lack of footpaths within vicinity of the site which severely limits pedestrian connectivity to the site. As such, several routes have been flagged for improvements, which would enable students to walk from residential catchments and to take advantage of future rail and bus connections. This upgrades would involve construction of new footpaths, pedestrian crossing facilities as well as cycle paths.

- The proposed access and parking arrangements comply with the relevant sections of AS 2890.1 (2004), AS 2890.2 (2002), AS 2890.3 (2015) and AS 2890.6 (2009). The proposed arrangements have also been assessed using AutoTrack, which confirms satisfactory operation.

- The proposed development will create moderate impacts that can be accommodated, while embracing the policies of the Blacktown Growth Centre Precincts Development Control Plan 2010.

It is therefore concluded that the proposed development is supportable on traffic planning grounds and will operate satisfactorily.

Appendix A

Architectural Plans

GENERAL NOTES

DO NOT SCALE FROM THIS DRAWING

CONFIRM ALL DIMENSIONS AND SETOUTS ON SITE PRIOR TO MANUFACTURE & INSTALLATION

ALL WORK IN ACCORDANCE WITH RELEVANT AUSTRALIAN STANDARDS

TO BE READ IN CONJUNCTION WITH ENGINEERS DOCUMENTS

LEGEND

0 50m

- EXISTING TURF & SOFT LANDSCAPING ZONES
- PROPOSED TURF
- PROPOSED SOFT LANDSCAPING
- PROPOSED SOFTFALL
- PROPOSED HARD LANDSCAPING
- EXISTING BUILT FORM AND ROADS
- EXISTING BUILDINGS
- EXISTING GRAVEL ROAD
- PROPOSED ROADWAY
- METAL DECK ROOFING
- POLYCARBONATE ROOFING
- LIGHTWEIGHT
- GLAZING
- BRICK FACE
- EXISTING TREES
- PROPOSED TREES
- AREA 20 ROAD NETWORK

01 SITE PLAN
1:1000

Rev	Date	Description
01	25.07.17	SSDA SUBMISSION

sydney
Level 2, 79 Myrtle St
Chippendale 2008
Nominated Architect: Gerard Reinmuth 6629
T 02 9279 2226
F 02 9279 2227

hobart
181 Elizabeth St
Hobart 7000
Nominated Architect: Scott Balmforth 564
T 03 6234 6372
F 03 6231 4939

TERROIR

Project:
ROUSE HILL ANGLICAN COLLEGE
MASTERPLAN 2016

Drawing Description:
PROPOSED SITE PLAN

Drawn by: AM Checked by: TD Scale:1:1000@A1

PROJECT NO:	DWG NO:	REV NO:
14301	MP-10-00	01

Drawing Status: SSDA

Appendix B

Swept Path Analysis

GENERAL NOTES

DO NOT SCALE FROM THIS DRAWING

CONFIRM ALL DIMENSIONS AND SETOUTS ON SITE PRIOR TO MANUFACTURE & INSTALLATION

ALL WORK IN ACCORDANCE WITH RELEVANT AUSTRALIAN STANDARDS

TO BE READ IN CONJUNCTION WITH ENGINEERS DOCUMENTS

LEGEND

0 50m

- EXISTING TURF & SOFT LANDSCAPING ZONES
- PROPOSED TURF
- PROPOSED SOFT LANDSCAPING
- PROPOSED SOFTFALL
- PROPOSED HARD LANDSCAPING
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- EXISTING BUILDINGS
- EXISTING GRAVEL ROAD
- PROPOSED ROADWAY
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Nominated Architect: Scott Balmforth 564
T 03 6234 6372
F 03 6231 4939

TERROIR

Project:
ROUSE HILL ANGLICAN COLLEGE
MASTERPLAN 2016

Drawing Description:
PROPOSED SITE PLAN

Drawn by: AM Checked by: TD Scale:1:1000@A1

PROJECT NO:	DWG NO:	REV NO:
14301	MP-10-00	01

Drawing Status: SSDA

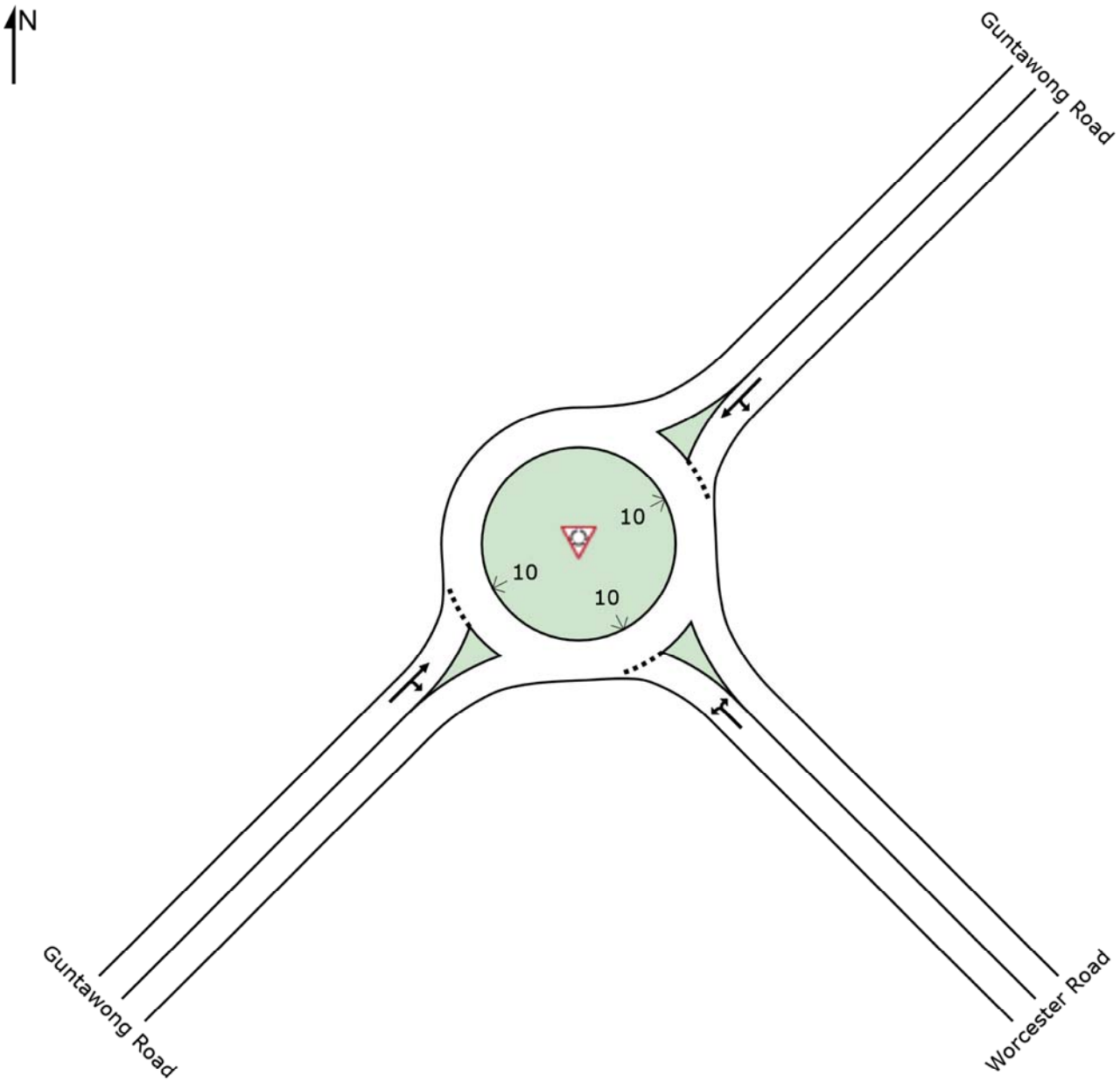
Appendix C

SIDRA Outputs

SITE LAYOUT

Site: 1 [J01 - Worcester Rd x Guntawong Rd - AM - 2036 Base]

Intersection of Worcester Road and Guntawong Road
Scenario: 2036 Base
Period: AM Peak
Roundabout



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Project: \\traffixserver\TDATA\Synergy\Projects\15\15.266\Modelling\15.266s02v4 TRAFFIX SIDRA Modelling_2135 Students_SIDRA 7.sip7

MOVEMENT SUMMARY

Site: 1 [J01 - Worcester Rd x Guntawong Rd - AM - 2036 Base]

Intersection of Worcester Road and Guntawong Road
Scenario: 2036 Base
Period: AM Peak
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Worcester Road											
4	L2	64	5.0	0.300	8.6	LOS A	1.8	13.2	0.70	0.82	53.8
6	R2	157	5.0	0.300	12.1	LOS A	1.8	13.2	0.70	0.82	53.8
Approach		221	5.0	0.300	11.1	LOS A	1.8	13.2	0.70	0.82	53.8
NorthEast: Guntawong Road											
7	L2	153	5.0	0.521	5.2	LOS A	4.8	35.2	0.39	0.49	55.5
8	T1	522	5.0	0.521	5.4	LOS A	4.8	35.2	0.39	0.49	53.7
Approach		675	5.0	0.521	5.4	LOS A	4.8	35.2	0.39	0.49	54.3
SouthWest: Guntawong Road											
2	T1	607	5.0	0.607	6.4	LOS A	5.8	42.7	0.63	0.60	52.5
3	R2	73	5.0	0.607	9.7	LOS A	5.8	42.7	0.63	0.60	55.4
Approach		680	5.0	0.607	6.8	LOS A	5.8	42.7	0.63	0.60	53.0
All Vehicles		1576	5.0	0.607	6.8	LOS A	5.8	42.7	0.53	0.58	53.7

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

MOVEMENT SUMMARY

Site: 1 [J01 - Worcester Rd x Guntawong Rd - AM - 2036 Base + Dev]

Intersection of Worcester Road and Guntawong Road
Scenario: 2036 Base + Development
Period: AM Peak
Roundabout

Movement Performance - Vehicles

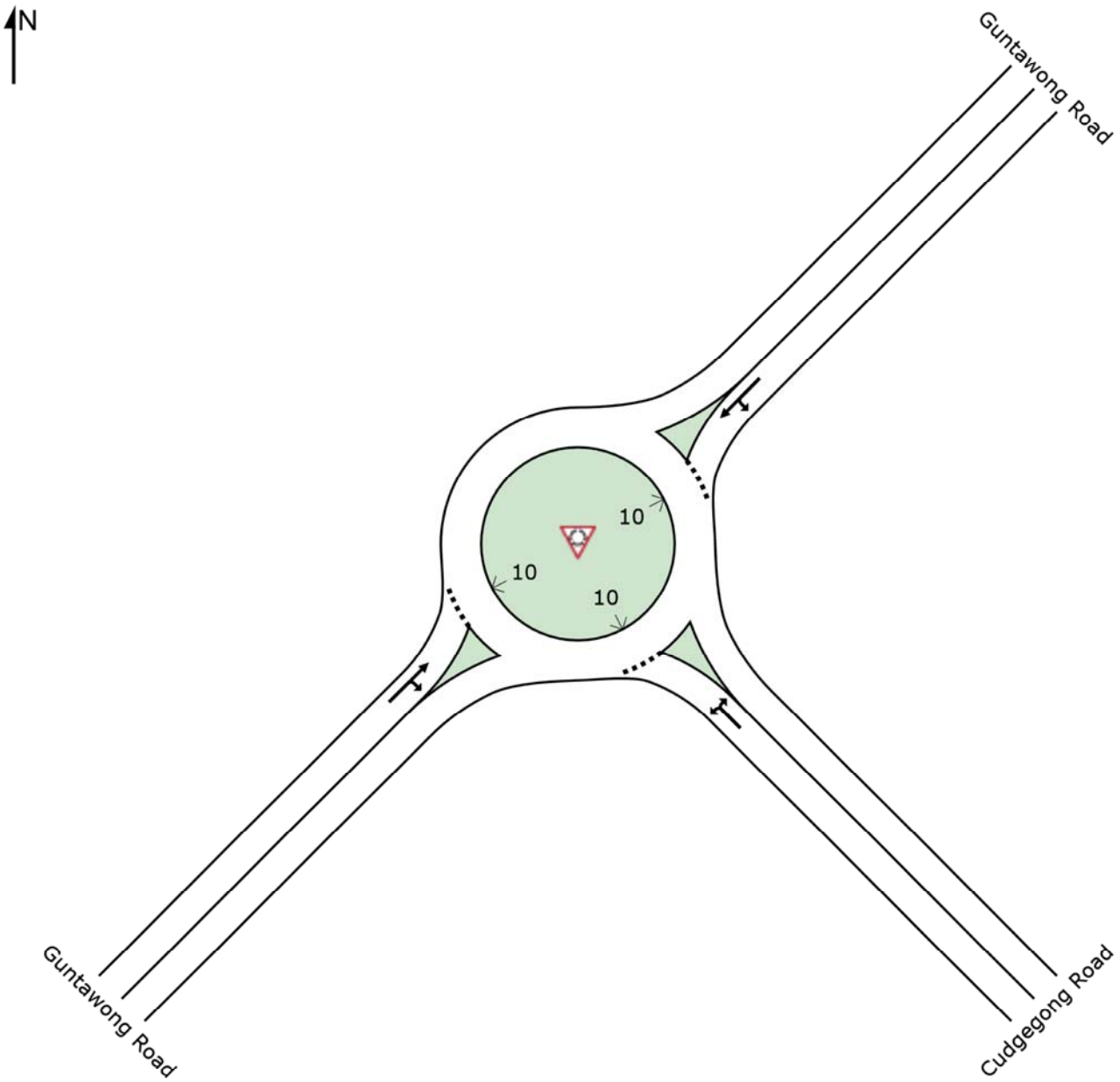
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Worcester Road											
4	L2	64	4.9	0.309	8.6	LOS A	1.9	14.0	0.72	0.82	55.1
6	R2	158	4.7	0.309	12.1	LOS A	1.9	14.0	0.72	0.82	53.8
Approach		222	4.7	0.309	11.1	LOS A	1.9	14.0	0.72	0.82	54.3
NorthEast: Guntawong Road											
7	L2	218	3.4	0.612	5.7	LOS A	6.3	45.9	0.56	0.54	55.2
8	T1	522	5.0	0.612	6.0	LOS A	6.3	45.9	0.56	0.54	55.3
Approach		740	4.6	0.612	5.9	LOS A	6.3	45.9	0.56	0.54	55.3
SouthWest: Guntawong Road											
2	T1	659	4.6	0.684	6.6	LOS A	7.5	54.2	0.70	0.62	54.7
3	R2	115	2.8	0.684	9.9	LOS A	7.5	54.2	0.70	0.62	56.3
Approach		774	4.4	0.684	7.1	LOS A	7.5	54.2	0.70	0.62	55.0
All Vehicles		1736	4.5	0.684	7.1	LOS A	7.5	54.2	0.64	0.61	55.0

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

SITE LAYOUT

Site: 1 [J02 - Cudgegong Rd x Guntawong Rd - AM - 2036 Base]

Intersection of Cudgegong Road and Guntawong Road
Scenario: 2036 Base
Period: AM Peak
Roundabout



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MOVEMENT SUMMARY

Site: 1 [J02 - Cudgegong Rd x Guntawong Rd - AM - 2036 Base]

Intersection of Cudgegong Road and Guntawong Road
Scenario: 2036 Base
Period: AM Peak
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Cudgegong Road											
4	L2	36	5.0	0.241	9.0	LOS A	1.4	10.0	0.69	0.82	52.8
6	R2	136	5.0	0.241	12.5	LOS A	1.4	10.0	0.69	0.82	53.2
Approach		172	5.0	0.241	11.8	LOS A	1.4	10.0	0.69	0.82	53.1
NorthEast: Guntawong Road											
7	L2	113	5.0	0.494	4.9	LOS A	4.3	31.7	0.25	0.46	55.6
8	T1	585	5.0	0.494	5.1	LOS A	4.3	31.7	0.25	0.46	54.7
Approach		698	5.0	0.494	5.1	LOS A	4.3	31.7	0.25	0.46	54.9
SouthWest: Guntawong Road											
2	T1	343	5.0	0.343	5.8	LOS A	2.4	17.5	0.43	0.54	53.8
3	R2	38	5.0	0.343	9.1	LOS A	2.4	17.5	0.43	0.54	55.4
Approach		381	5.0	0.343	6.1	LOS A	2.4	17.5	0.43	0.54	54.0
All Vehicles		1251	5.0	0.494	6.3	LOS A	4.3	31.7	0.37	0.53	54.3

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

MOVEMENT SUMMARY

Site: 1 [J02 - Cudgegong Rd x Guntawong Rd - AM - 2036 Base + Dev]

Intersection of Cudgegong Road and Guntawong Road
Scenario: 2036 Base + Development
Period: AM Peak
Roundabout

Movement Performance - Vehicles

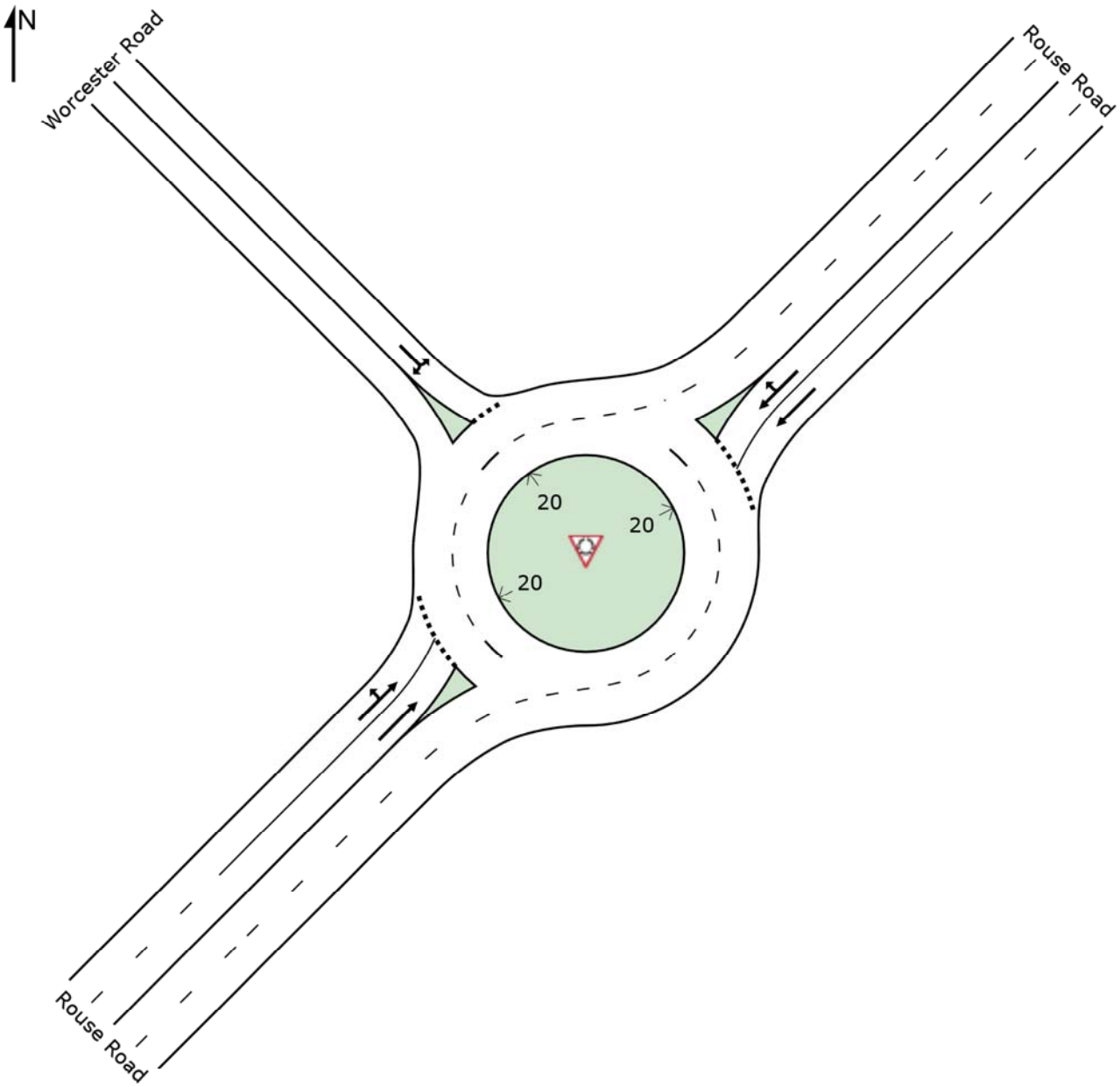
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Cudgegong Road											
4	L2	71	3.0	0.358	9.3	LOS A	2.2	15.8	0.73	0.85	52.8
6	R2	187	3.4	0.358	12.9	LOS A	2.2	15.8	0.73	0.85	53.2
Approach		258	3.3	0.358	11.9	LOS A	2.2	15.8	0.73	0.85	53.1
NorthEast: Guntawong Road											
7	L2	113	4.7	0.495	4.8	LOS A	4.5	32.7	0.26	0.46	55.6
8	T1	585	5.0	0.495	5.1	LOS A	4.5	32.7	0.26	0.46	54.6
Approach		698	5.0	0.495	5.1	LOS A	4.5	32.7	0.26	0.46	54.9
SouthWest: Guntawong Road											
2	T1	385	4.4	0.407	6.3	LOS A	3.0	21.7	0.53	0.59	53.4
3	R2	38	5.6	0.407	9.6	LOS A	3.0	21.7	0.53	0.59	55.1
Approach		423	4.5	0.407	6.6	LOS A	3.0	21.7	0.53	0.59	53.6
All Vehicles		1379	4.5	0.495	6.8	LOS A	4.5	32.7	0.43	0.57	54.1

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

SITE LAYOUT

Site: 1 [J03 - Worcester Rd x Rouse Rd - AM - 2036 Base]

Intersection of Worcester Road and Rouse Road
Scenario: 2036 Base
Period: AM Peak
Roundabout



MOVEMENT SUMMARY

Site: 1 [J03 - Worcester Rd x Rouse Rd - AM - 2036 Base]

Intersection of Worcester Road and Rouse Road
Scenario: 2036 Base
Period: AM Peak
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
NorthEast: Rouse Road											
5	T1	321	5.0	0.229	1.7	LOS A	1.2	8.9	0.32	0.26	39.9
6	R2	247	5.0	0.229	6.1	LOS A	1.2	8.8	0.33	0.53	39.5
Approach		568	5.0	0.229	3.6	LOS A	1.2	8.9	0.33	0.38	39.7
NorthWest: Worcester Road											
7	L2	296	5.0	0.467	3.6	LOS A	2.6	19.2	0.57	0.65	39.1
9	R2	145	5.0	0.467	7.5	LOS A	2.6	19.2	0.57	0.65	39.8
Approach		441	5.0	0.467	4.9	LOS A	2.6	19.2	0.57	0.65	39.3
SouthWest: Rouse Road											
10	L2	194	5.0	0.234	2.9	LOS A	1.2	8.6	0.40	0.41	39.4
11	T1	341	5.0	0.234	2.3	LOS A	1.2	8.6	0.41	0.34	39.9
Approach		535	5.0	0.234	2.5	LOS A	1.2	8.6	0.40	0.36	39.6
All Vehicles		1544	5.0	0.467	3.6	LOS A	2.6	19.2	0.42	0.45	39.5

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

MOVEMENT SUMMARY

Site: 1 [J03 - Worcester Rd x Rouse Rd - AM - 2036 Base + Dev]

Intersection of Worcester Road and Rouse Road
Scenario: 2036 Base + Development
Period: AM Peak
Roundabout

Movement Performance - Vehicles

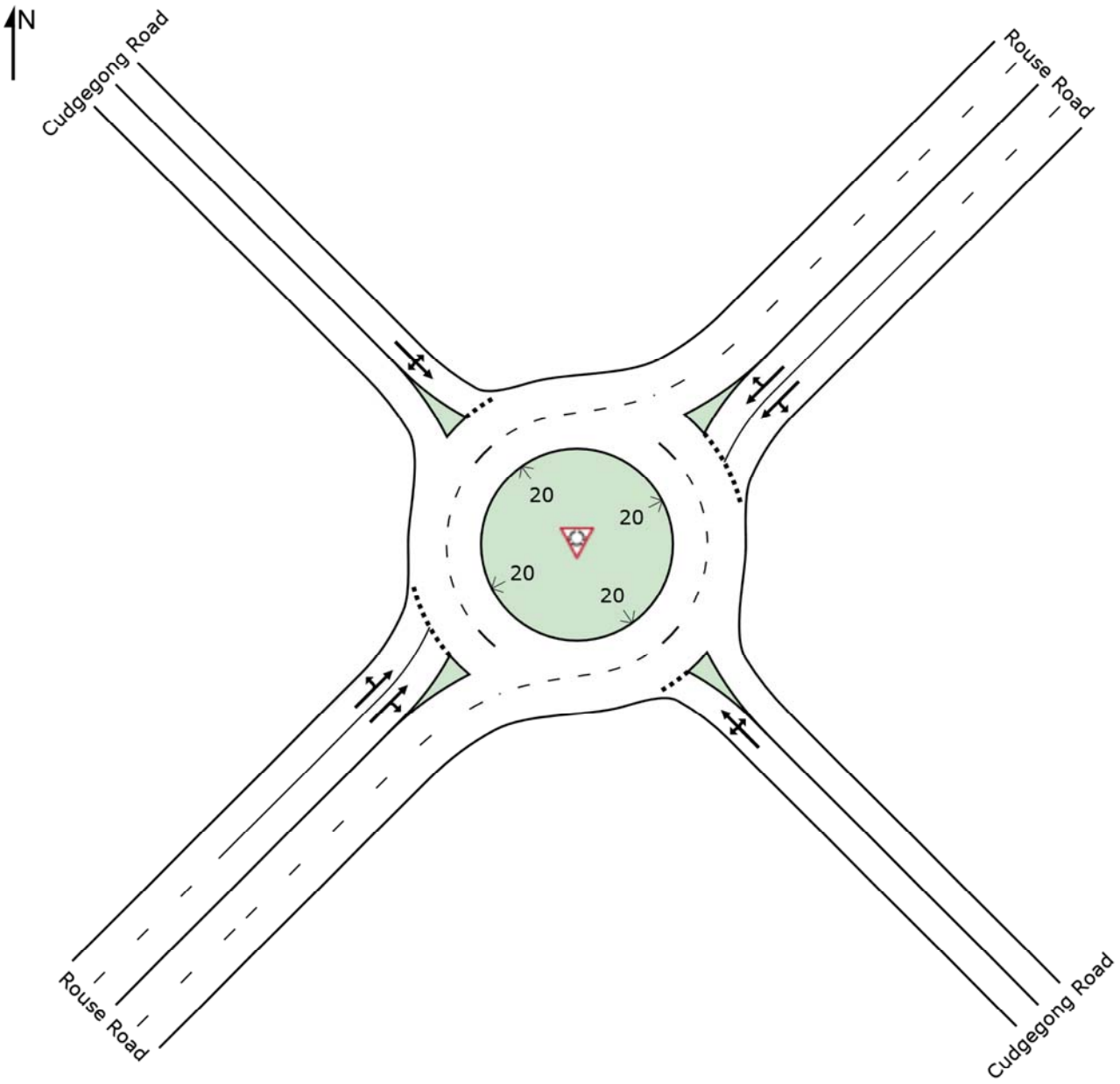
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
NorthEast: Rouse Road											
5	T1	321	4.9	0.274	1.9	LOS A	1.5	11.3	0.36	0.26	40.0
6	R2	399	3.2	0.305	6.1	LOS A	1.8	13.1	0.36	0.55	39.4
Approach		720	3.9	0.305	4.2	LOS A	1.8	13.1	0.36	0.42	39.6
NorthWest: Worcester Road											
7	L2	298	4.9	0.519	4.9	LOS A	3.3	24.3	0.66	0.79	38.9
9	R2	146	5.0	0.519	8.7	LOS A	3.3	24.3	0.66	0.79	39.5
Approach		444	5.0	0.519	6.1	LOS A	3.3	24.3	0.66	0.79	39.1
SouthWest: Rouse Road											
10	L2	295	3.2	0.384	3.9	LOS A	2.3	16.4	0.57	0.54	39.2
11	T1	462	3.6	0.384	3.3	LOS A	2.3	16.4	0.57	0.49	39.5
Approach		757	3.5	0.384	3.5	LOS A	2.3	16.4	0.57	0.51	39.4
All Vehicles		1921	4.0	0.519	4.4	LOS A	3.3	24.3	0.51	0.54	39.4

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

SITE LAYOUT

Site: 1 [J04 - Cudgegong Road x Rouse Rd - AM - 2036 Base]

Intersection of Cudgegong Road and Rouse Road
Scenario: 2036 Base
Period: AM Peak
Roundabout



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MOVEMENT SUMMARY

Site: 1 [J04 - Cudgegong Road x Rouse Rd - AM - 2036 Base]

Intersection of Cudgegong Road and Rouse Road
Scenario: 2036 Base
Period: AM Peak
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Cudgegong Road											
21	L2	16	5.0	0.435	5.6	LOS A	2.4	17.9	0.51	0.69	53.3
2	T1	105	5.0	0.435	5.9	LOS A	2.4	17.9	0.51	0.69	55.9
3	R2	316	5.0	0.435	10.5	LOS A	2.4	17.9	0.51	0.69	56.0
Approach		437	5.0	0.435	9.2	LOS A	2.4	17.9	0.51	0.69	55.9
NorthEast: Rouse Road											
4	L2	200	5.0	0.184	5.0	LOS A	0.9	6.9	0.37	0.53	56.8
25	T1	179	5.0	0.184	5.0	LOS A	0.9	6.9	0.37	0.54	56.6
6	R2	53	5.0	0.184	9.7	LOS A	0.9	6.8	0.37	0.54	57.3
Approach		432	5.0	0.184	5.6	LOS A	0.9	6.9	0.37	0.54	56.8
NorthWest: Cudgegong Road											
7	L2	158	5.0	0.410	7.0	LOS A	2.1	15.6	0.62	0.77	56.4
8	T1	140	5.0	0.410	7.2	LOS A	2.1	15.6	0.62	0.77	56.6
29	R2	42	5.0	0.410	11.9	LOS A	2.1	15.6	0.62	0.77	55.9
Approach		340	5.0	0.410	7.7	LOS A	2.1	15.6	0.62	0.77	56.5
SouthWest: Rouse Road											
30	L2	16	5.0	0.133	6.1	LOS A	0.7	5.0	0.54	0.60	55.3
31	T1	220	5.0	0.133	6.2	LOS A	0.7	5.0	0.54	0.62	56.4
32	R2	16	5.0	0.133	11.0	LOS A	0.7	4.9	0.54	0.63	55.2
Approach		252	5.0	0.133	6.5	LOS A	0.7	5.0	0.54	0.62	56.2
All Vehicles		1460	5.0	0.435	7.3	LOS A	2.4	17.9	0.50	0.65	56.4

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

MOVEMENT SUMMARY

Site: 1 [J04 - Cudgegong Road x Rouse Rd - AM - 2036 Base + Dev]

Intersection of Cudgegong Road and Rouse Roasd
Scenario: 2036 Base + Development
Period: AM Peak
Roundabout

Movement Performance - Vehicles

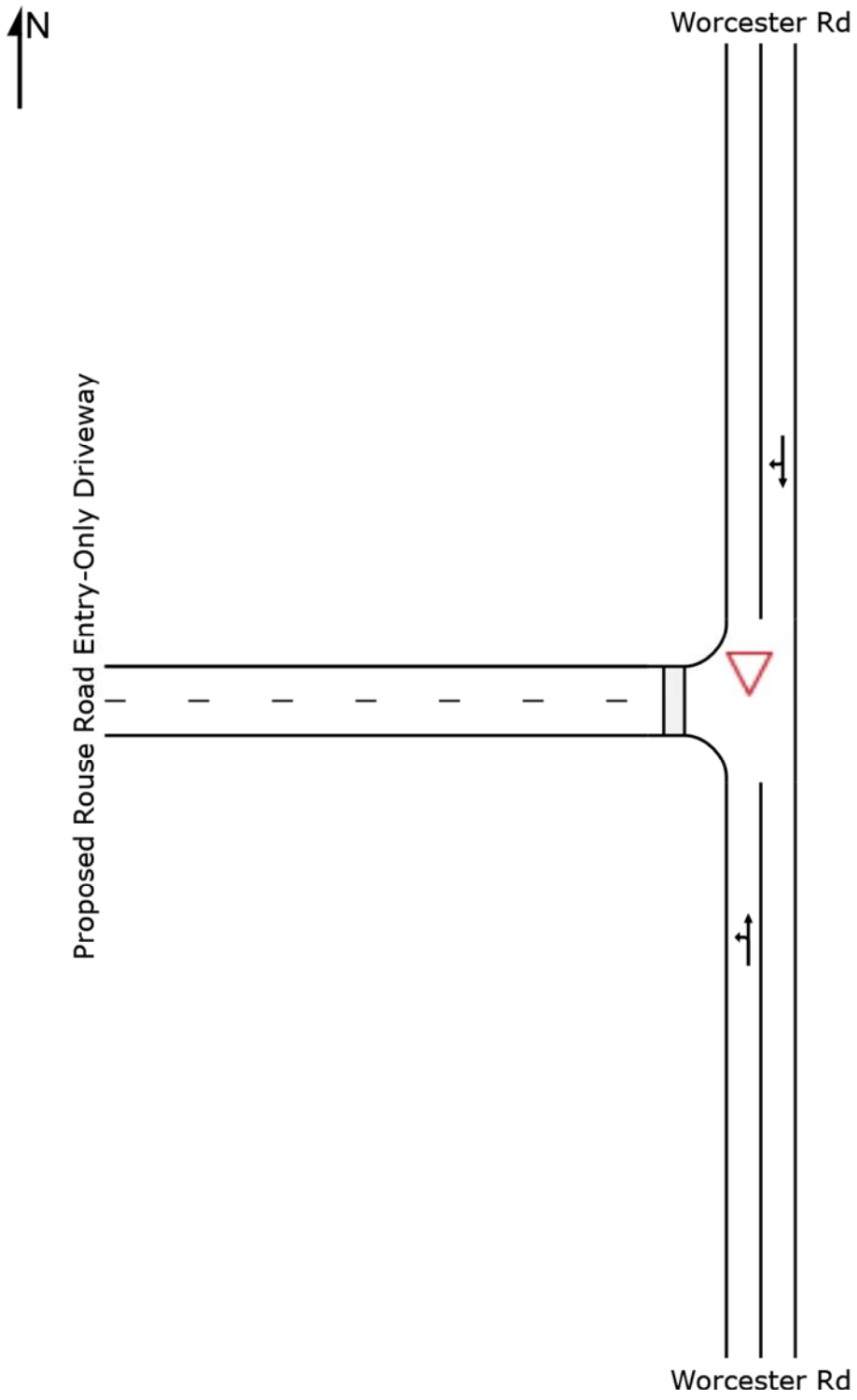
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Cudgegong Road											
21	L2	16	6.7	0.545	6.4	LOS A	3.8	27.8	0.61	0.74	52.8
2	T1	105	5.0	0.545	6.6	LOS A	3.8	27.8	0.61	0.74	55.6
3	R2	417	3.8	0.545	11.2	LOS A	3.8	27.8	0.61	0.74	55.7
Approach		538	4.1	0.545	10.2	LOS A	3.8	27.8	0.61	0.74	55.6
NorthEast: Rouse Road											
4	L2	312	3.4	0.276	5.4	LOS A	1.6	11.7	0.49	0.59	56.7
25	T1	191	5.0	0.242	5.5	LOS A	1.3	9.8	0.48	0.58	56.3
6	R2	54	5.9	0.242	10.2	LOS A	1.3	9.8	0.48	0.58	57.1
Approach		556	4.2	0.276	5.9	LOS A	1.6	11.7	0.49	0.59	56.6
NorthWest: Cudgegong Road											
7	L2	280	3.0	0.706	11.2	LOS A	6.2	44.8	0.83	1.04	55.0
8	T1	209	3.5	0.706	11.5	LOS A	6.2	44.8	0.83	1.04	55.0
29	R2	53	4.0	0.706	16.2	LOS B	6.2	44.8	0.83	1.04	53.9
Approach		542	3.3	0.706	11.8	LOS A	6.2	44.8	0.83	1.04	54.9
SouthWest: Rouse Road											
30	L2	16	6.7	0.153	6.8	LOS A	0.9	6.3	0.62	0.66	55.0
31	T1	231	4.6	0.153	6.9	LOS A	0.9	6.3	0.62	0.67	56.1
32	R2	16	6.7	0.153	11.7	LOS A	0.8	6.1	0.63	0.69	54.9
Approach		262	4.8	0.153	7.2	LOS A	0.9	6.3	0.62	0.67	56.0
All Vehicles		1898	4.0	0.706	9.0	LOS A	6.2	44.8	0.64	0.77	55.7

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

SITE LAYOUT

Site: 101 [J05 - Worcester Rd Entry-Only Driveway - AM - 2036 Base + Dev]

Worcester Rd Entry-Only Driveway
Scenario: 2036 Base + Development
Period: AM Peak
Giveway / Yield (Two-Way)



MOVEMENT SUMMARY

Site: 101 [J05 - Worcester Rd Entry-Only Driveway - AM - 2036 Base + Dev]

Worcester Rd Entry-Only Driveway
Scenario: 2036 Base + Development
Period: AM Peak
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

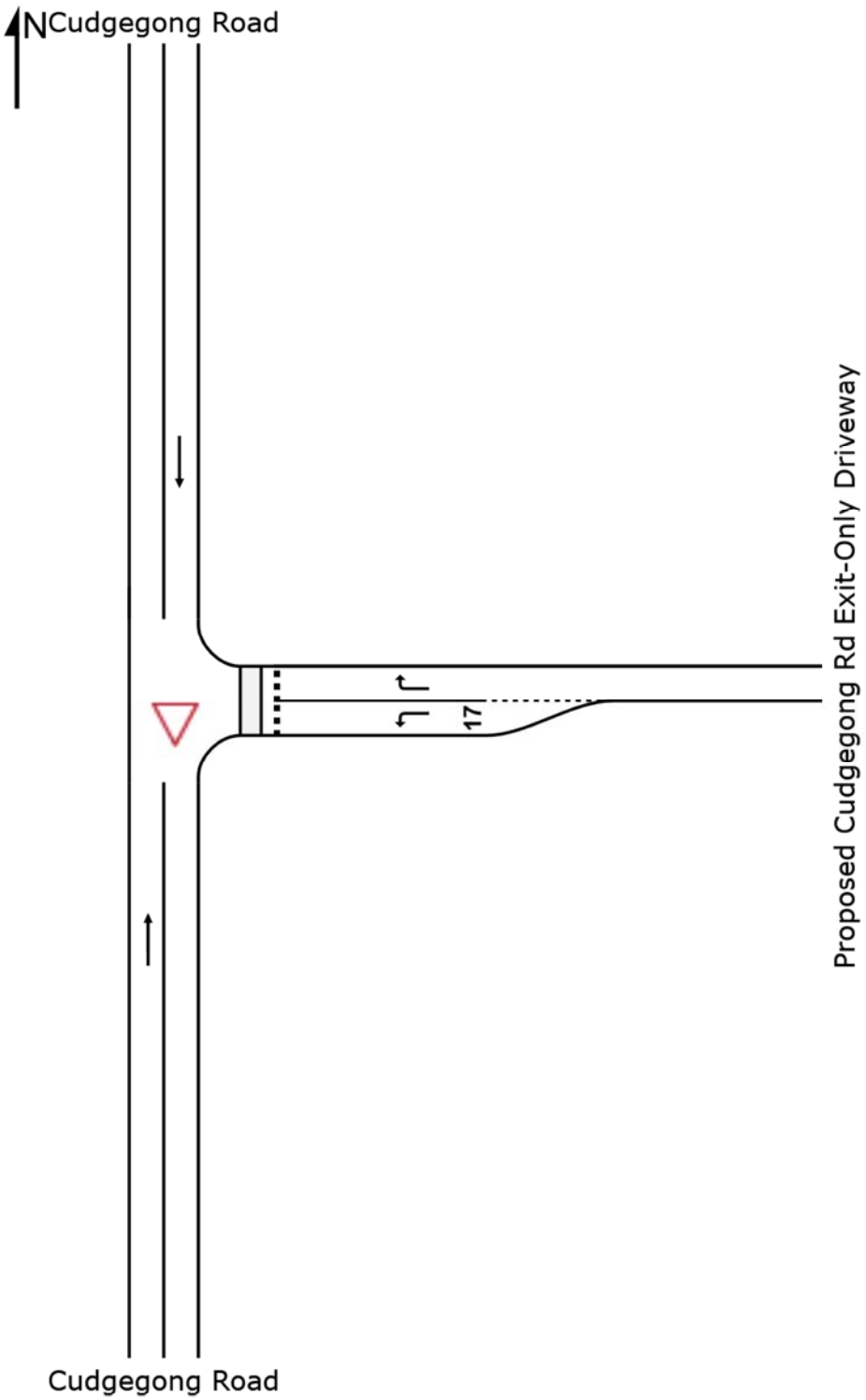
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Worcester Rd											
1	L2	629	0.0	0.571	5.3	LOS A	4.7	33.0	0.25	0.44	19.2
2	T1	211	5.0	0.571	0.4	LOS A	4.7	33.0	0.25	0.44	38.5
Approach		840	1.3	0.571	4.1	NA	4.7	33.0	0.25	0.44	23.3
North: Worcester Rd											
8	T1	211	5.0	0.573	9.5	LOS A	5.2	36.9	0.88	0.69	36.3
9	R2	269	0.0	0.573	14.2	LOS B	5.2	36.9	0.88	0.69	24.4
Approach		480	2.2	0.573	12.1	NA	5.2	36.9	0.88	0.69	28.1
All Vehicles		1320	1.6	0.573	7.0	NA	5.2	36.9	0.48	0.53	25.3

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

SITE LAYOUT

Site: 101 [J06 - Cudgegong Rd Exit-Only Driveway - AM - 2036 Base + Dev]

Cudgegong Rd Exit-Only Driveway
Scenario: 2036 Base + Development
Period: AM Peak
Giveway / Yield (Two-Way)



MOVEMENT SUMMARY

Site: 101 [J06 - Cudgegong Rd Exit-Only Driveway - AM - 2036 Base + Dev]

Cudgegong Rd Exit-Only Driveway
Scenario: 2036 Base + Development
Period: AM Peak
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Cudgegong Road											
2	T1	211	5.0	0.111	0.0	LOS A	0.0	0.0	0.00	0.00	40.0
Approach		211	5.0	0.111	0.0	NA	0.0	0.0	0.00	0.00	40.0
East: Proposed Cudgegong Rd Exit-Only Driveway											
4	L2	201	0.0	0.156	1.0	LOS A	0.7	4.6	0.36	0.24	18.0
6	R2	86	0.0	0.105	2.1	LOS A	0.3	2.4	0.44	0.38	24.6
Approach		287	0.0	0.156	1.3	LOS A	0.7	4.6	0.39	0.28	20.5
North: Cudgegong Road											
8	T1	211	5.0	0.111	0.0	LOS A	0.0	0.0	0.00	0.00	40.0
Approach		211	5.0	0.111	0.0	NA	0.0	0.0	0.00	0.00	40.0
All Vehicles		708	3.0	0.156	0.5	NA	0.7	4.6	0.16	0.12	29.8

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