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Prepared for on behalf of
EG URBAN PLANNING

Traffic Impact Assessment

Chapman Gardens – Planning Proposal
17-27 Dawes Ave and 16-26 Chapman Avenue, Castle Hill

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1 Introduction

1.1 Overview

Ason Group has been engaged by EG Urban Planning to prepare a Traffic Impact Assessment (TIA) to support a Planning Proposal submission for a site at 17-27 Dawes Avenue and 16-26 Chapman Avenue, Castle Hill (the Site). The site is adjacent to the existing Chapman Reserve. Located within The Hills Shire Council Local Government Area (LGA), the site is subject to the Hills Shire Council controls however, the NSW Government's Sydney Northwest Metro Station presents an opportunity for redevelopment within the area.

The site is located within the Showground Station Precinct (SSP)(see Figure 1) identified by the Department of Planning and Environment (DP&E) and Council for future growth due to its proximity to the planned Sydney Metro Northwest Showground Station. As a result, the DP&E has proposed the SSP be rezoned to maximise the benefits from investment in this key piece of public transport infrastructure. The SSP rezoning is still under assessment by DP&E and Council, however it is proposed to rezone the subject site as follows:

- R4 High Density Residential
- Height limit of up to 6-8 storeys. The site would generally be subject to a height limit of 21 metres (6 storeys), with an increased height limit of 28 metres (8 storeys) applying to 27 Dawes Avenue and 28 Chapman Avenue lots at the western end of the site.

The Planning Proposal seeks further development potential on the site by changing the density and height of buildings controls, as follows:

- R4 High Density Residential
- Floor-space-ratio 3.5 : 1
- Height of buildings up to 19 storeys.

This report assesses the traffic impacts of this Planning Proposal which seeks to amend the future Hills Shire Council LEP controls.

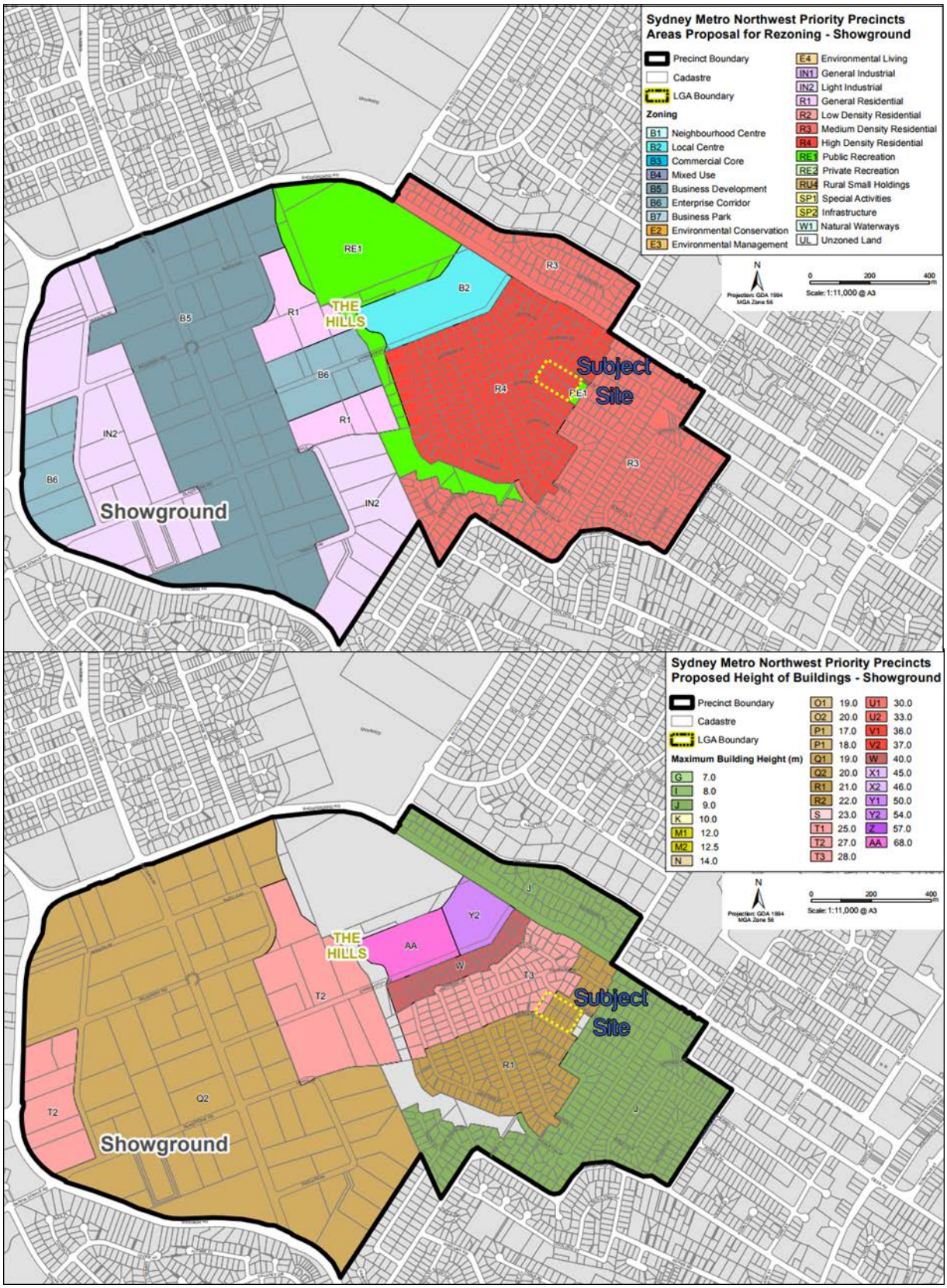

Figure 1: Site Context within the Showground Station Precinct

This TIA report has been prepared to assess the relevant traffic, transport and parking implications of the Proposal. In preparing this TIA, Ason Group has referenced key planning documents, general access, traffic and parking guidelines. These include:

- State Environment Planning Policy No.65 – Design Quality of Residential Apartment Development (SEPP65)
- Transport for New South Wales (TfNSW) – Showground Station Precinct Planning Report, Volume 1 (2015).
- TfNSW – Showground Station Precinct Transport Plan (2015)
- The Hills Shire Council Development Control Plan (2012)
- The Hills Shire Council Local Environmental Plan (2012)
- The Showground Station Precinct DCP (2015)
- The Hills Shire Council Mayoral Minute No.9/2016 – Methodology for Providing Housing Mix and Diversity within the Sydney Metro Northwest Corridor (2016)

This report also references general access, traffic and parking guidelines, including;

- RMS Guide to Traffic Generating Developments (RMS Guide)
- RMS Technical Direction TDT 2013/04a, Guide to Traffic Generating Developments – Updated traffic surveys (the RMS Guide Update).
- Australian Standard 2890.1: Parking Facilities – Off Street Car Parking (AS 2890.1)
- Australian Standard 2890.3: Parking Facilities – Off Street Parking for People with Disabilities (AS 2890.6)

1.2 Report Structure

The report is structured as follows:

- Section 2 provides a summary of the proposal and indicative development potential.
- Section 3 details the existing site context including surrounding road hierarchy, active and public transport services.
- Section 4 discusses the strategic context for the development.
- Section 5 outlines applicable parking requirements applicable to future development.
- Section 6 assesses the traffic impacts of the development including the Site's projected trip generation and forecasted network performance
- Section 7 discusses the site access and internal design considerations
- Section 8 provides a summary of the key conclusions.

2 Overview of Proposal

2.1 Planning Controls

As discussed in Section 1.1, the Showground Station Precinct Planning Proposal seeks to rezone the subject site as follows:

- R4 High Density Residential
- Floor-space-ratio 2.3 : 1
- Height of buildings 6-8 storeys. The site would generally be subject to a height limit of 21 metres (6 storeys), with an increased height limit of 28 metres (8 storeys) applying to 27 Dawes Avenue and 28 Chapman Avenue lots at the western end of the site.

This Planning Proposal seeks to amend the planning controls and permit the following:

- R4 High Density Residential (no change)
- Floor-space-ratio 3.5 : 1
- Height of buildings up to 19 storeys.

2.2 Indicative Development Yield

To assist in assessment of the Proposal, PTW Architects has prepared a concept plan for the site. The resulting plans indicate a residential apartment yield of approximately 380 units, and therefore will be the number of units adopted in this report. In addition, the proposed scheme includes ancillary uses such as a child care and a small café that will activate the ground floor.

Application of similar development assumptions to the planning controls envisaged under the Showground Station Precinct Planning Proposal would be expected to yield up to 250 units. Accordingly, the 'net' effect of the proposed changes would be an uplift of some 130 units as demonstrated in Table 1.

Table 1: Indicative Development Yield Summary

	Existing	Showground Station Precinct	Proposed
FSR	n/a	2.3 : 1	3.5 : 1
No. of Units	12 dwellings	250 units	380 units
Child care	n/a	n/a	100 children
Cafe	n/a	n/a	190m^2

3 Existing Conditions

3.1 Site Description

The Site is in Castle Hill and lies approximately 25km north-west of Sydney CBD and 10km north of Parramatta. It comprises 17-27 Dawes Avenue and 16-26 Chapman Avenue and is currently occupied by 12 detached residential dwellings. A summary of included Lots is provided in Table 2 below.

Table 2: Legally Described Lots

Address	Lot	DP	Approx. Site Area (m^2)
17 Dawes Ave	18	DP255722	944.1
19 Dawes Ave	19	DP255722	946.2
21 Dawes Ave	20	DP255722	965.4
23 Dawes Ave	21	DP255722	946.2
25 Dawes Ave	22	DP255722	960.6
27 Dawes Ave	23	DP255722	933.7
16 Chapman Ave	33	DP246981	934.4
16 Chapman Ave	32	DP246981	933.7
20 Chapman Ave	3	DP583999	934.4
22 Chapman Ave	128	DP250610	933.7
24 Chapman Ave	127	DP250610	944.1
26 Chapman Ave	126	DP250610	946.2
		Total	11,322.7

3.1.1 Site Access

Vehicular access to individual lots is provided from Dawes Avenue and Chapman Avenue, respectively.

3.2 Surrounding Road Network

3.2.1 Road Hierarchy

The road hierarchy within the vicinity of the site is shown in Figure 2, with the roads of interest outlined below:

- Showground Road — a classified RMS Main Road (MR 157) that generally runs in an east-west direction between Windsor Road in the west and Old Northern Road in the east. A general speed limit of 60km/hr is accepted on this main road.
- Carrington Road — an unclassified RMS Regional Road (RR 7471) that generally runs in an east-west direction between Victoria Road and Showground Road.
- Parsonage Road — a local collector road that generally traverses in an east-west direction between Old Northern Road and Windsor Road.
- Middleton Avenue — a local road that generally runs in a north-south direction between Carrington Road and Parsonage Road. It forms the stem of a priority-controlled intersection with Parsonage Road to the south. A roundabout is provided at its intersection with Carrington Road.
- Fishburn Crescent — a local road that circulates to the east of Middleton Avenue.
- Dawes Avenue — a local road that runs in the east-west direction between Fishburn Crescent and forms the southern site frontage.
- Chapman Avenue — a local road that runs in the east-west direction between Fishburn Crescent and Middleton Avenue. It forms the northern site frontage.

Figure 2: Site Location and Road Hierarchy

3.2.2 Network Performance

Traffic surveys were undertaken on Tuesday, 30th May 2017 to determine existing traffic volumes at two key intersections in the vicinity of the site. These two intersections are;

- Dawes Avenue / Middleton Ave; and
- Parsonage Road / Middleton Avenue.

The performance of the above intersection has been analysed using the SIDRA Intersection modelling program. SIDRA modelling outputs a range of performance measures, specifically:

- *Degree of Saturation (DOS) – The DOS is defined as the ratio of demand (arrival) flow to capacity. The DOS is used to measure the performance of intersections where a value of 1.0 represents an intersection at theoretical capacity, above 1.0 represent over-saturated conditions (demand flows exceed capacity) and degrees of saturation below 1.0 represent under-saturated conditions (demand flows are below capacity). As the performance of an intersection approaches DOS of 1.0, queue lengths and delays increase rapidly. It is usual to attempt to keep DOS to less than 0.9, with satisfactory intersection operation generally achieved with a DOS below 0.8.*
- *Average Vehicle Delay (AVD) – Delay represents the difference between interrupted and uninterrupted travel times through an intersection and is measured in seconds per vehicle. Delays include queued vehicles accelerating and decelerating from/to the intersection stop lines, as well as general delays to all vehicles travelling through the intersection. The AVD (or average delay per vehicle in seconds) for intersections also provides a measure of the operational performance of an intersection and is used to determine an intersection's Level of Service (see below). For signalised intersections, the AVD reported relates to the average of all vehicle movements through the intersection. For priority (Give Way, Stop & Roundabout controlled) intersections, the AVD reported is that for the movement with the highest AVD.*
- *Level of Service (LOS) – This is a comparative measure that provides an indication of the operating performance, based on AVD. For signalised and roundabout intersections, LOS is based on the average delay to all vehicles, while at priority controlled intersections LOS is based on the worst approach delay. The following table provides a recommended baseline for assessment as per the RMS Guide.*

Table 3: Traffic Model Performance Criteria

Level of Service	Average Delay per Vehicle (sec/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 & spare capacity	Acceptable delays & spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity & accident study required
E	57 to 70	At capacity; at signals, incidents will cause excessive delays. Roundabouts require other control mode	At capacity, requires other control mode
F	More than 70	Unsatisfactory and requires additional capacity.	Unsatisfactory and requires other control mode or major treatment.

The results of the existing intersection performance for the existing arrangement are outlined below in **Table 4.** The supporting SIDRA outputs and intersection layouts are attached to this report in **Appendix A.**

Table 4: Intersection Performance – Existing

Intersection	Scenario	Period	Degree of Saturation (DOS)	Average Vehicle Delay (AVD) (Sec)	Level of Service (LOS)
Dawes Avenue & Middleton Ave	Existing	AM	0.181	7.1	A
		PM	0.161	7.3	A
Parsonage Road / Middleton Avenue	Existing	AM	0.321	7.1	A
		PM	0.263	6.8	A

It can be seen from Table 4 that both intersections operate within an acceptable Level of Service (LOS) under existing conditions. Nevertheless, the most relevant use of this analysis is for comparison of future traffic conditions as a direct result of the proposed development. Future intersection performance is discussed further in **Section 6**.

3.3 Existing Public Transport Services

3.3.1 Current Mode Share

Below is a summary of various modes of transport used by workers and residents in the selected Travel Zone (TZ 4535). The JTW data also highlighted that most of the residents in the surrounding locality travel to Baulkham Hills for employment. Norwest Business Centre (Norwest Shopping Centre, Lexington Drive and Brookhollow Drive) are the main employment areas within Baulkham Hills, and it can be assumed that most of the resident's travel to and from these areas for work.

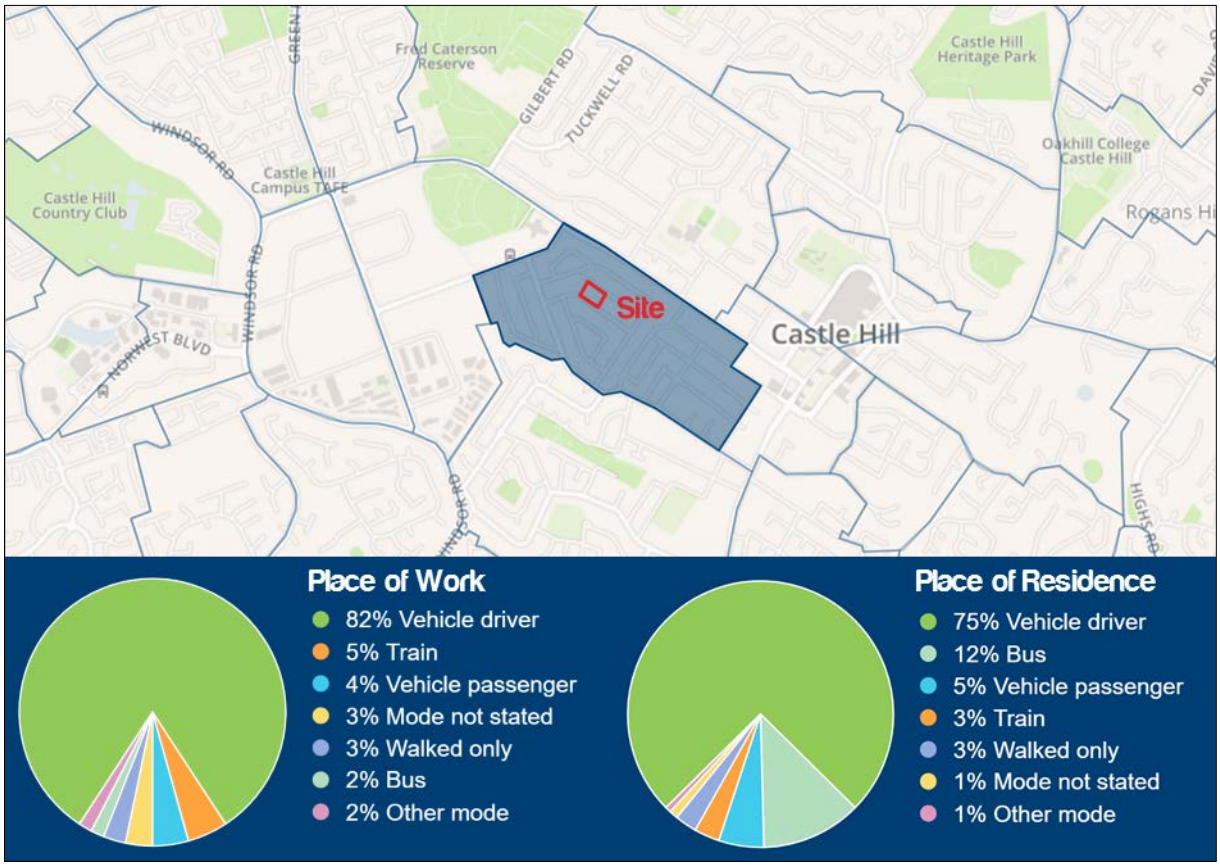

Figure 3: Journey to Work Summary

It is evident from above that a number of residents and employees use train services as part of multi-modal trips. This data also demonstrates a relatively high level of bus use, particularly by residents.

This data provides an understanding of current travel modes. However, the introduction of the Sydney Metro Northwest line in close proximity to this area would be expected to further increase the proportion of trips made by public transport. Furthermore, improved pedestrian and cyclist connections throughout the local area, including Norwest, as part of the Showground Station Precinct infrastructure would be expected to improve access to the local area. In this regard, Showground Station Precinct Transport Plan identifies a future mode share to private vehicle of 47-48% of trips.

3.3.2 Bus Services

The Site and surrounding network is currently serviced by several bus routes, which can be seen in Figure 4. The local area is currently serviced by the following routes:

- Route 604 (Castle Hill to Parramatta via Windsor Road)
- Route 619 (Rouse Hill to Macquarie Park)
- Route 715 (Castle Hill to Seven Hills)
- Routes 745 (Castle Hill to St Marys via Stanhope Parkway)
- Routes T60 (Castle Hill to Parramatta via Old Windsor Road)
- Route T70 (Castle Hill to Blacktown via Norwest and Bella Vista)
- Route T71 (Castle Hill to Blacktown via Stanhope Parkway)

These bus routes provide connections to major centres including Castle Towers, Rouse Hill, Parramatta, and Macquarie Park. Major bus stops are located less than 400 metres away on Middleton Avenue, Carrington Road and Showground Road with frequent services during peak periods.

The Integrated Public Transport Service Planning Guidelines (2013) states that bus services influence the travel mode choices of sites within 400 metres (approximately 5 minutes) of a bus stop. Accordingly, the Site is considered to be well served by public transport services in the area.

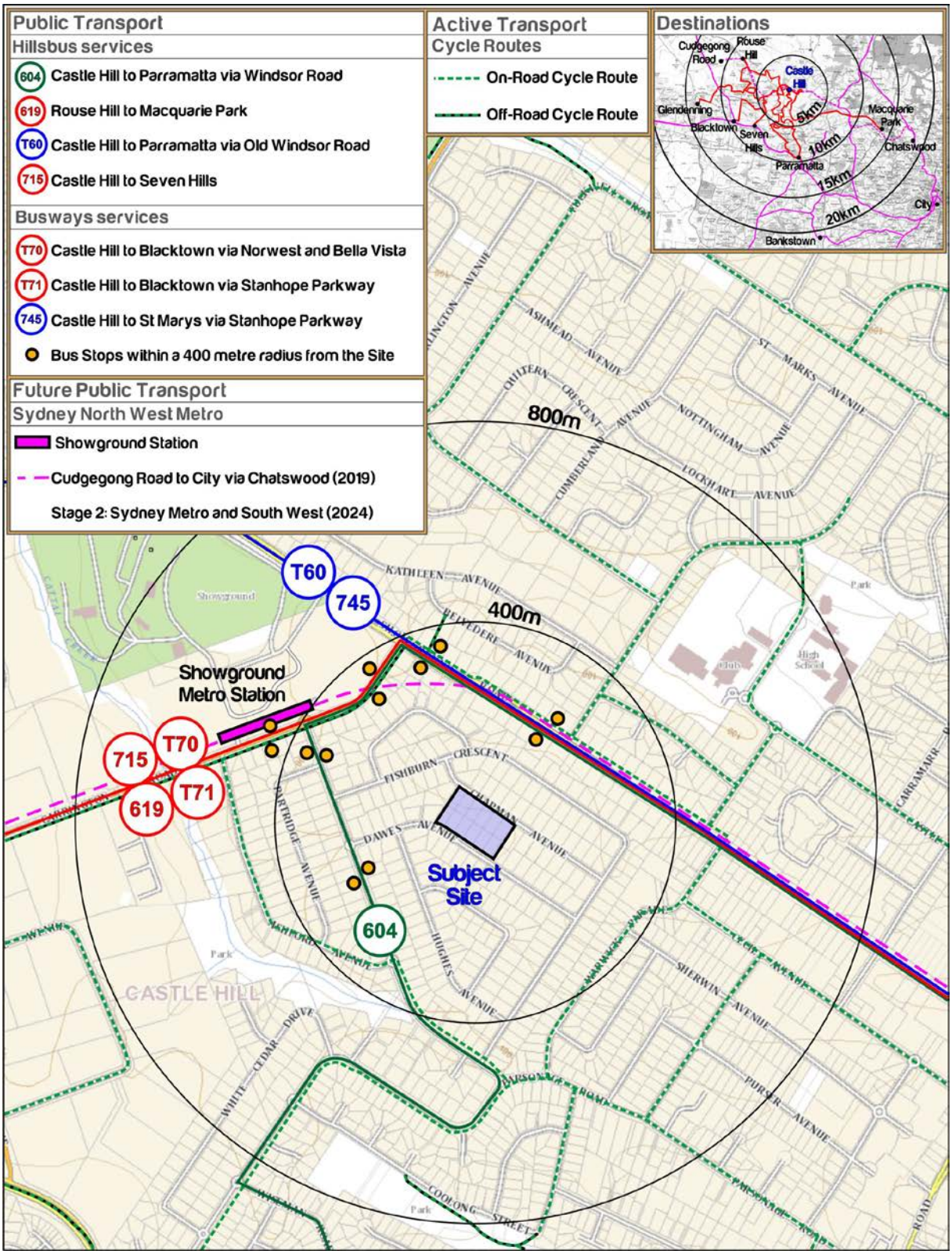

Figure 4: Public Transport Services

3.4 Active Transport Connections

3.4.1 Cycle Network

Cyclists are legal road users entitled to utilise any public road unless otherwise stated (some freeways and motorways prohibit cyclist access), however some roads can be more difficult to safely negotiate than others. In this regard, surrounding roads have been classified by the RMS as either on-road or off-road, and further classified as low, medium, or high difficulty as demonstrated below in Figure 5. Difficulty classes are based on a range of factors, including; traffic volume, speeds and lane width.

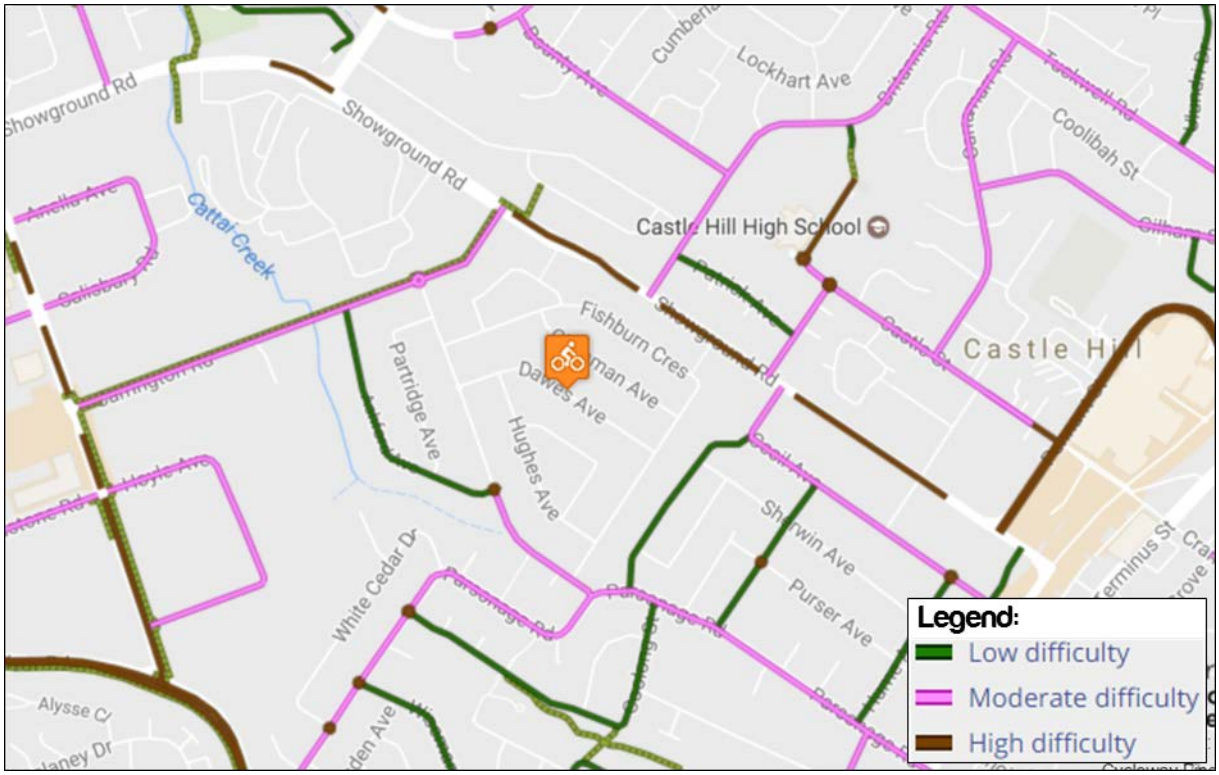

Figure 5: Cycleway Routes

The Hills Shire Council, in an effort to reduce dependence on vehicles within the locality, has focused on providing high quality pedestrian and cycle routes to connect key infrastructure over recent years. Carrington Road and Victoria Avenue have 2.4 metre cycleways built on at least one side of the road. The upgrade of Showground Road from Carrington Road to Old Northern Road will also provide a 2.4 metres cycleway to promote vibrant communities and encourage a trend away from single occupancy vehicle trips.

3.4.2 Pedestrian Connectivity

3.42.1

The prevalence of footpaths allows for an increased accessibility for the public to and from the Site, promoting an active lifestyle and reducing the dependence on vehicles as the sole mode of transportation throughout the network. In recent years, The Hills Shire Council has been building a network of footpaths and cycleways throughout the Shire on at least one side of road, with the aim to build footpath or cycleway on every road within The Shire.

Built concrete footpaths are located in the streets surrounding the Site except for Chapman Avenue and Fishburn Crescent.

There is a direct route for residents of the Site to the planned Showground Station.

3.4.3

Within site, through-site links have been proposed to increase accessibility to residents and pedestrians alike. It is proposed that links will be provided within site that will be accessible to public and private users, providing a pedestrian and cycle connection between Dawes Avenue and Chapman Avenue.

4 Strategic Context

4.1 North West Rail Link Corridor Strategy

As part of the planning for future growth in the area, the NSW Government is investing $8.3 Billion to deliver Australia's largest public transport infrastructure project – the Sydney Metro Northwest. The project will provide access to employment centres, retail and educational facilities across Sydney. To support the project, DP&E has identified a number of Priority Precincts, including the Showground Station Precinct, with the aim to provide housing and jobs in centres with good existing or planned transport services. This will be supported by traffic and road improvements, commuter car parks, bus priorities and introduction of pedestrian and cycle paths. Major road improvements to reduce congestion and improve travel times include:

- Priority bus lanes;
- Improved Connections for cyclists and pedestrians throughout the precinct;
- Provision for improved public transport connections to the station and employment areas.

Investment in the Sydney Metro - Northwest will help drive a more diverse, competitive and sustainable economy and generate substantial and lasting economic, social and environmental benefits.

4.2 Showground Station Structure Plan

This plan addresses the objective, that a 20-year plan for traffic and transport in The Hills Shire Councils LGA be developed. By 2036, it is expected that the Showground Station Precinct will be transformed into a vibrant, connected and walkable centre which is attractive to live, work and spend time.

The construction of the Showground Station, and the subsequent changes in land-use will result in approximately 5,000 new homes over the next 20 years. These new homes will have convenient access to the Showground Station, jobs, shops, cafés and open spaces.

A varied built form is planned for the Precinct to reflect the new opportunities. The built form ranges from 4 -20 stories of residential buildings, and 4-6 stories for commercial and light-industrial areas. Within the local centre, there is a plan to accommodate shops, cafes, and restaurants, with "shop-top" residential buildings above.

Work will be undertaken before the new Showground Station opens in the first half of 2019 and will provide immediate actions to cater for growth in the area and deliver longer term planning solutions to meet the needs of the future. A number of transport initiatives are currently proposed for the Showground Station Precinct area.

4.3 The Showground Station Precinct DCP Amendments

Draft amendments to Council's DCP in relation to the Showground Station Precinct have been prepared by the Department of Planning and Environment (DP&E) with the aim to establish a framework to guide the future development of the Showground Station Precinct. The Showground Station DCP amendments aims to:

- Provide a mix of housing, retail, employment and services;
- Ensure that development occurs in a coordinated manner consistent with the vision and development principles of the Precinct;
- Ensure the key elements of the Precinct are delivered whilst providing a degree of flexibility in the final layout and design of the Precinct;
- Locate higher scale residential and commercial uses close to station, Castle Hill Showground and Cattai Creek corridor to optimise access to the station's amenities.
- Develop a local centre in the area surrounding the station; and
- Maintain and enhance the range of light industrial, business, bulky goods retail and other employment uses.
- Development within the precinct will need to have regard to The Hills Shire Council DCP, however in the event of any inconsistency between DCP's, the Showground Station Precinct DCP will prevail to the extent of the inconsistency.

4.4 State Environmental Planning Policy No 65

The State Environmental Planning Policy No 65 - Design Quality of Residential Apartment Development (SEPP 65) states the following:

"Parking requirements should be determined in relation to the availability, frequency and convenience of public transport or proximity to a centre in regional areas. Reduced requirements promote a reduction in car dependency and encourage walking, cycling and use of public transport. Provision of parking for alternative forms of transport such as car share vehicles, motorcycles and bicycles should also be considered. Where less car parking is provided, councils should not provide on street resident parking permits."

Having regard for the above, SEPP 65 stipulates that minimum car parking shall be based on either the RMS *Guide to Traffic Generating Developments* or the relevant Council codes, whichever is less. This control applies:

- on sites that are within 800 metres of a railway station or light rail stop in the Sydney Metropolitan Area; or
- on land zoned, and sites within 400 metres of land zoned, B3 Commercial Core, B4 Mixed Use or equivalent in a nominated regional centre.

4.5 Mayoral Minute No.9/2016

The Mayoral Minute No.9/2016 – Methodology for Providing Housing Mix and Diversity within the Sydney Metro Northwest Corridor proposes amendment to development strategies so they are specific to The Hills Shire Council. The proposed strategy stipulates the following;

- Land within a Sydney Metro Northwest Corridor station precinct is assigned a "base" floor space ratio, calculated based on the walking distance of that land from the station. The "base" floor space ratio for the proposal would be 1.1:1 for land within 400 metres walking distance) from a Station. These "base" floor space ratios reflect suitable dwelling densities for Transit Oriented Development within a 400 metre walking catchments of 120 dwellings per hectare.
- Land within a Sydney Metro Northwest Corridor station precinct is also assigned with an "incentivised" floor space ratio through either the planning proposal or precinct planning process. The "incentivised" floor space ratio would be determined by Council on a site-by-site basis and would represent the maximum development scenario permissible on the land.
- Alternatively, a higher "incentivised" floor space ratio could be achieved if the following requirements are met:
    - Maximum of 25% of all dwellings to be studio or one bedroom apartments;
    - Minimum of 20% of all dwellings to be three or more bedroom apartments;
    - 40% of all two and three bedroom apartments to comply with a minimum apartment size set by Council (110m^2 for two bedrooms and 135m^2 for three bedrooms);
    - Parking rates to be 1 space per apartment and 1 visitor space per 5 apartments.

5 Parking Requirements

5.1 Car Parking

Car parking provisions are a detailed matter to be addressed during subsequent Development Application submissions.

A summary of relevant parking controls is provided in Table 5 below.

Table 5: Car Parking Requirements Summary

Land Use	Type	SEPP 65 (RMS Guide)	Showground Station Precinct Plan	The Hills DCP 2012	Mayoral Minute No.9/2016
Residential	1 Bedroom Unit	0.6 spaces / unit	1 space / unit	1 space / unit	1 space / unit
	2 Bedroom Unit	0.9 spaces / unit	1 space / unit	2 spaces / unit	1 space / unit
	3 Bedroom Unit	1.4 spaces / unit	1.5 spaces / unit	2 spaces / unit	1 space / unit
	4 Bedroom units	n/a (adopt 3-bedroom rate)	2.0 spaces / unit	n/a (adopt 3-bedroom rate)	1 space / unit
	Visitors	1 space / 5 units	1 space / 10 dwellings	1 spaces / 2.5 units (rounded up to the nearest whole number)	1 space / 5 unit
Non-residential	Cafe	n/a	n/a	1 space / 5 seats; PLUS 12 spaces per 100m^2 GFA	n/a
	Child Care	n/a	n/a	1 space / employee; PLUS 1 space / 6 children	n/a

Application of the above rates to the indicative development yield, PTW has identified a car park of approximately 698 spaces to satisfactorily accommodate the minimum number of parking spaces required under SEPP65, draft Showground Station Precinct controls and the Mayoral Minute No.9/2016.

For market purposes, it is understood that a minimum of 1 space per unit is expected to be provided. In this regard, the future car parking provision (subject to detailed design) is expected to be in the order of 698 spaces. A breakdown of the indicative parking numbers, based on the proposed rates, is outlined below in Table 6.

Table 6: Proposed Parking Rates and Indicative Requirement

Land-use	No.	Parking Rate	Parking Proposed
1 Bedroom	57	1 space / unit	57
2 Bedroom (small)	133	1 space / unit	133
2 Bedroom (large)	95	2 spaces / unit	190
3 Bedroom (small)	57	2 spaces / unit	114
3 Bedroom (large)	38	2 spaces / unit	76
Visitors	380	1 spaces / 10 units[1]	38
Child care	95 children	1 space / 6 children	16
	10 staff	1 space / employee	10
Cafe	190m^2	15 spaces / 100m^2 GFA	29
		TOTAL	**663[1]**

Note: 1) Visitor car parking rates outlined in the Showground Station DCP Draft have been adopted in this report. It is noted that outside of peak business hours, the childcare and café parking spaces will be adapted to visitor spaces in accordance with Council rates.

2) Indicative size of café only, therefore seating arrangement has not been assessed. As seating is unknown, Council DCP rates cannot be adopted, therefore the RMS guide referring to parking rates for restaurants has been used at a rate of 15 spaces / 100m^2 GFA

The following is considered noteworthy with regard to future parking provisions:

- There may be an opportunity for shared use of child care centre and café parking by residential visitors outside of business hours. Thus, the effective residential visitor parking rate would be more than the minimum 1 space per 10 units proposed.
- Subject to Council approval, there may be an opportunity to designate a length of the site frontage or other nearby kerb area as drop-off parking for the child care centre.

Notwithstanding, as discussed above, car parking provisions is a detailed matter for assessment during Development Application.

5.2 Servicing

Having regard for the number of units envisaged, it is anticipated that an on-site service area will be provided. Again, this is a detailed matter for consideration as part of a subsequent Development Application.

6 Traffic Assessment

6.1 Traffic Generation

6.1.1 Adopted Generation Rates

For the purposes of this assessment, traffic generation rates from the RMS Guide Update have been adopted as follows:

- Low density housing (applying to the existing dwellings, prior to completion of the Sydney Metro Northwest)
  - AM peak 0.95 veh/hr/dwelling
  - PM peak 0.99 veh/hr/dwelling
- High-density residential flat buildings (applying to future development, post completion of the Metro)
  - AM peak 0.19 veh/hr/unit (or 0.15 veh/hr/car space)
  - PM peak 0.15 veh/hr/unit (or 0.12 veh/hr/ car space)
- Childcare centres
  - AM peak 0.8 trips/child (7:00am – 9:00am)
  - PM peak 0.7 trips/child (4:00pm – 6:00pm)
- Cafe
  - Peak 5 veh/hr/100m^2 GFA

It is noted that the café (and to a considerable extent the child care centre) will primarily serve the local community including the subject site and therefore not generate a large number of vehicular trips on the surrounding road network. Notwithstanding, the future traffic associated with café has been assessed having regard for the RMS *Guide to Traffic Generating Developments*, as a worst-case scenario. Similarly, the adopted yields are slightly higher than identified by PTW to ensure the analysis is sufficiently robust to encompass traffic implication that could result from changes to the scheme as part of DA design development and coordination.

It should be noted that a traffic generation based on number of parking spaces will be dependent on the final number of parking spaces provided at DA stage. Furthermore, it is difficult to compare traffic impacts under this scenario with that of a future baseline scenario based on a unit based analysis. Accordingly, analysis in relation to 'trips per space' is presented for sensitivity purposes only.

6.1.2 Existing Traffic Generation

As discussed in Section 3.1, the Site is currently occupied by 12 low-density residential dwellings. Based on the above trip rates, these dwellings are expected to generate in the order of 11-12 vehicle trips during weekday peak periods.

6.1.3 Future Traffic Generation

There are 2 future scenarios under consideration. The first being a future baseline scenario being the level of traffic generated by a development in accordance with the future Showground Station Precinct planning proposal controls (250 units), with the second being that generated by the development intensity now proposed (380 units). Both scenarios also include the childcare centre and café running at full capacity (100 children).

A comparison of peak hourly vehicle movements under these future scenarios is provided in Table 7 below.

Table 7: Traffic Generation Comparison

Scenario		AM Peak (veh/hr)	PM Peak (veh/hr)
Existing	12 dwellings	12	11
Future – Baseline (Showground Station Precinct Controls)	250 units	138[1]	118[2]
Future - Proposed	380 units	162[1]	137[2]

Note: 1) AM peak includes 90 veh/hr associated with the childcare centre (80veh/hr) and café (10 veh/hr) uses, common between future scenarios

2) PM peak includes 80 veh/hr associated with the childcare centre (70veh/hr) and café (10 veh/hr) uses, common between future scenarios

It can be seen from above that the increased development potential now sought could result in an increase of up to 24 and 19 vehicle trips per hour during weekday morning and evening peak periods.

This is a moderate increase and will not have a significant impact on the regional road network. Accordingly, a localised assessment of traffic impacts is expected to be required.

6.1.4 Sensitivity Analysis for Future Traffic Generation

A sensitivity test assessment of the proposal has been undertaken using trip generation from the RMS Guide Update with respect to the number of car spaces proposed. Table 8 below outlines an increase of up to 28 and 23 vehicle trips per hour during weekday morning and evening peak periods.

Table 8: Sensitivity Analysis

Scenario		AM Peak (veh/hr)	PM Peak (veh/hr)
Existing	12 dwellings	12	11
Future – Proposed (Showground Station Precinct Controls)	380 units	162[1]	137[2]
Future – Proposed (Sensitivity)	667 spaces	190[1]	160[2]

Note: 1) AM peak includes 90 veh/hr associated with the childcare centre (80veh/hr) and café (10 veh/hr) uses, common between future scenarios

2) PM peak includes 80 veh/hr associated with the childcare centre (70veh/hr) and café (10 veh/hr) uses, common between future scenarios

6.2 Traffic Distribution & Assignment

A review of current Journey-to-Work data indicates the following distribution of traffic onto the surrounding road network approximately as follows:

- North 5% (via Windsor Road, Green Road and Gilbert Road)
- East 7% (via Showground Road
- South 48% (via Parsonage Road to Windsor Road)
- West 40% (via Norwest Boulevarde)

However, the future Sydney Metro Northwest is expected to alter current mode share patterns, particularly to key destinations such as Norwest and the Sydney CBD. Accordingly, this assessment adopts the trip distribution outlined in the Showground Station Precinct Transport Plan, as presented in Figure 6.

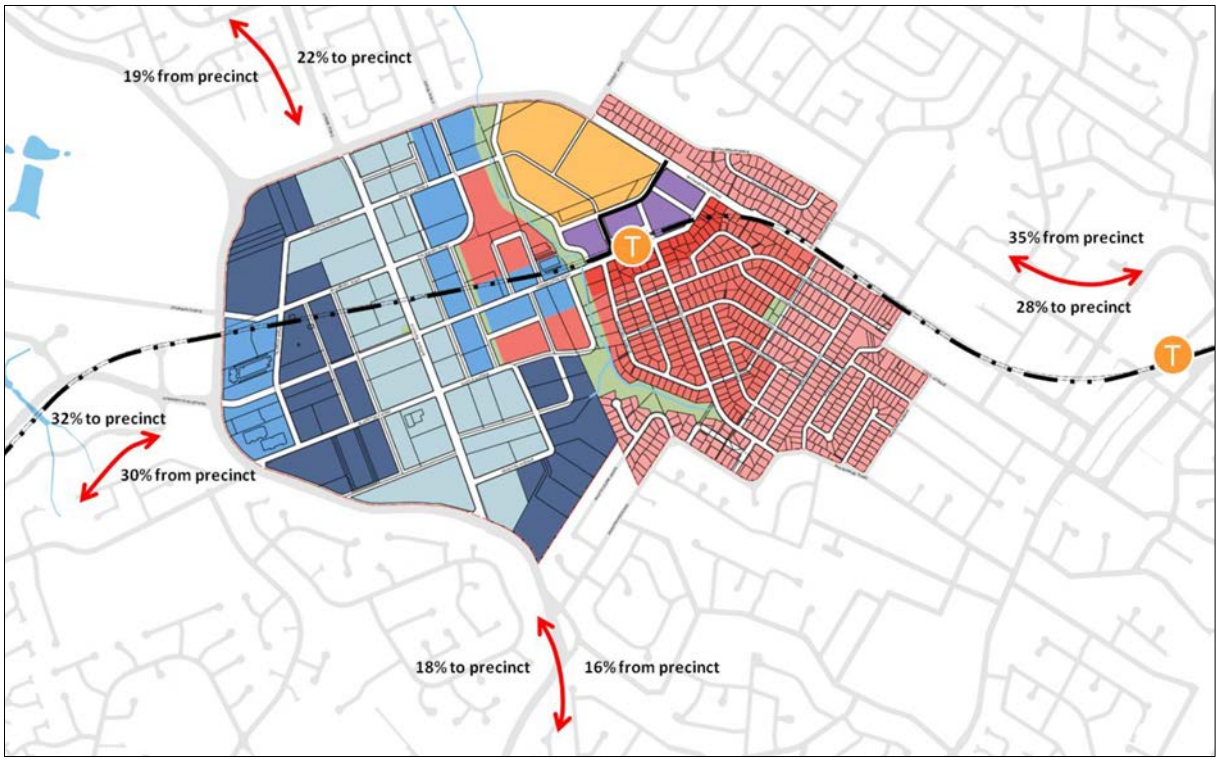

Figure 6: Trip Distribution

6.3 Network Performance

For the purpose of this TIA report, an assessment of the Proposal has been undertaken, including the combination of:

- Baseline traffic – which consists of 2017 existing (surveyed),
- 250 Unit Scenario – which consists of 2017 existing (surveyed), plus 10-year background growth (2% p.a.), plus forecast development traffic (250 units based on a compliant development, with a childcare centre and café) associated with the Proposal.
- 380 Unit Scenario – which consists of 2017 existing (surveyed), plus 10-year background growth (2% p.a.), plus forecast development traffic (380 units based on a compliant development, with a childcare centre and café) associated with the Proposal.

Having regard for the moderate increase in traffic, an assessment of two key local intersections has been adopted as the study area for this assessment. These intersections have been assessed using SIDRA Intersection, with the results summarised in Table 9.

Table 9: Intersection Operation Summary – Standard Assessment

Intersection		Period	Design Scenario	Degree of Saturation (DOS)	Average Vehicle Delay (AVD)	Level of Service (LOS)
1	Dawes Avenue and Middleton Avenue	AM	Existing Scenario	0.181	7.1	A
			Compliant Development Scenario	0.239	7.4	A
			Increased Yield Scenario	0.243	7.4	A
		PM	Existing Scenario	0.161	7.3	A
			Compliant Development Scenario	0.212	7.5	A
			Increased Yield Scenario	0.214	7.6	A
2	Middleton Avenue and Parsonage Road	AM	Existing Scenario	0.321	7.1	A
			Compliant Development Scenario	0.521	10.5	A
			Increased Yield Scenario	0.538	10.7	A
		PM	Existing Scenario	0.263	6.8	A
			Compliant Development Scenario	0.390	8.8	A
			Increased Yield Scenario	0.397	8.8	A

The results summarised in the table above demonstrate that all intersections will perform within acceptable limits (at LOS A) with minimal delays. It is also noteworthy that the relative change as a result of this proposal is negligible, with a maximum increased average delay of only 0.2 seconds between the 250 unit and 380 unit scenarios. Accordingly, the uplift in development now sought is considered to have negligible traffic impact on the surrounding road network.

6.3.1 Sensitivity Network Performance

In addition to the above, further sensitivity analysis was undertaken to assess the impact of the future development providing additional car parking above that of other high density residential units to account for the more conservative parking rates applied by The Hills Shire Council.

This scenario adopts the 2017 existing (surveyed), plus 10-year background growth (2% p.a.), plus forecast development traffic (667 spaces based on a compliant development, in addition to ancillary childcare centre and café uses) associated with the Proposal.

A summary of the modelled results is provided in Table 10.

Table 10: Intersection Operation Summary – Sensitivity Analysis

	Intersection	Period	Design Scenario	Degree of Saturation (DOS)	Average Vehicle Delay (AVD)	Level of Service (LOS)
1	Dawes Avenue and Middleton Avenue	AM	Increased Yield Scenario	0.243	7.4	A
			Sensitivity Scenario	0.246	7.4	A
		PM	Increased Yield Scenario	0.214	7.6	A
			Sensitivity Scenario	0.216	7.6	A
2	Middleton Avenue and Parsonage Road	AM	Increased Yield Scenario	0.538	10.7	A
			Sensitivity Scenario	0.560	11.1	A
		PM	Increased Yield Scenario	0.397	8.8	A
			Sensitivity Scenario	0.407	9.0	A

It can be seen from above that the intersections shall continue to operate well with a Level of Service A during both peak periods with the largest increase in delay of 0.4 seconds. Accordingly, it is determined that the development will have no material impact on the local road network.

Furthermore, it is noted that regional road connections such as Showground Road with Carrington Road are forecast to operate at a Level of Service B with spare capacity under a 2036 scenario. Accordingly, the minor increase in traffic resulting from the Proposal is unlikely to impact on the operation of the wider regional road network.

6.4 Improvement Works

There is satisfactory road width to accommodate the increase in traffic and the current network has sufficient capacity to accommodate the net increase in traffic – both the conforming design and the proposed uplift scenario, without further improvements or upgrades.

7 Site Access & Internal Design

7.1 Relevant Design Standards

The site access, car park and loading areas (and access thereto) shall be designed to comply with the following relevant Australian Standards:

- AS2890.1 for car parking areas;
- AS2890.2 for commercial vehicle loading areas;
- AS2890.3 for bicycle parking; and
- AS2890.6 for accessible (disabled) parking.

It is expected that any detailed construction drawings in relation to any modified areas of the car park or site access would comply with these Standards.

7.2 Site Access Arrangements

Based on AS2890.1 and the number car parking spaces to be provided (>600 spaces), it is anticipated that a Category 4 driveway shall be required. This comprises an entry width of 6.0-8.0m and an exit width of 6.0-8.0m with a minimum separation between driveways of 1.0m.

7.3 Internal Design

The site access, internal car park and loading areas shall be designed having regard for the above Standards. Further detailed assessment internal design will be undertaken during the future DA stage(s).

7.4 Internal Pedestrian Connectivity

Within site, through-site links have been proposed to increase accessibility to residents and pedestrians alike. It is proposed that links will be provided within site that will be accessible to public and private users, providing a pedestrian and cycle connection between Dawes Avenue and Chapman Avenue. The proposed links will provide an additional 777m^2 for the community to utilise the increased amenity. A breakdown of the through-links are as follows;

1. Through site link one = 400 m^2
2. Through site link two = 377 m^2

8 Conclusions

The key findings of this Traffic Impact Assessment are:

- The Site lies within the Showground Station Precinct which is planned for significant uplift in development in response to the Sydney Metro Northwest Showground Station approximately 400 metres to the northwest of the site.
- Furthermore, the Site is midway between two key centres being the Norwest strategic centre and the Castle Hill centre which are both located within suitable cycle catchments of the subject site.
- In this regard, increased residential development on the site seeks to capitalise on this proximity and maximise the benefits arising from the Governments investment in infrastructure in the locality.
- Car parking provisions will ultimately be subject to further consideration during Development Application design development. However, it is understood that car parking will be provided between the upper and lower ranges specified by The Hills DCP and SEPP 65, respectively (498-898 spaces). In this regard, an indicative figure of 698 parking spaces has been provided.
- It is envisaged that all car parking will be provided via a single access driveway to Dawes Avenue (a local road). This access and internal car parking shall be designed to comply with relevant Standards (AS2890 series) and be subject to further detailed assessment during subsequent Development Application submissions. Having regard for the size of car park proposed, it is anticipated that the Category 4 driveway shall be required.
- The traffic generation arising from the existing, planned and proposed development scenarios has been assessed in accordance with the RMS *Guide to Traffic Generating Developments* with the resulting traffic generation for existing, planned under the Showground Station Precinct and proposed controls summarised below.

Scenario	Indicative No. of Dwellings	AM Peak (veh/hr)	PM Peak (veh/hr)
Existing	12 dwellings	12	11
Future – Baseline (Showground Station Precinct Controls)	250 units	138	118
Future - Proposed	380 units	162	137

Note: 1) AM peak includes 90 veh/hr associated with the childcare centre (80veh/hr) and café (10 veh/hr) uses, common between future scenarios

2) PM peak includes 80 veh/hr associated with the childcare centre (70veh/hr) and café (10 veh/hr) uses, common between future scenarios

- It is evident from above that the proposed uplift of approximately 130 units will increase traffic in the order of 24 and 19 vehicles per hour, respectively, during weekday morning and evening peak periods.

- A sensitivity test, basing the traffic generation assessment on an indicative number of parking spaces, resulted in a higher future traffic generation 180 and 150 vehicles per hour, respectively.
- Key surrounding intersections of Middleton Avenue with Dawes Road and Parsonage Avenue will operate with a Level of Service A under all scenarios assessed. This includes under the conservative 'sensitivity test' analysis referred to above. Of particular note is that the average delays at these intersections will experience negligible increase as a result of the proposed uplift.

It is therefore concluded that the Proposal is supportable on traffic planning grounds.

Appendix A

SIDRA Modelling Results

LANE SUMMARY

Site: 101 [Middleton Ave / Dawes Ave - AM]

Middleton Ave / Dawes Ave
Period: AM Peak
Case: 2017 Base Case
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Middleton Ave (580m)													
Lane 1[d]	253	1.3	1395	0.181	100	4.0	LOS A	1.0	7.4	Full	580	0.0	0.0
Approach	253	1.3		0.181		4.0	LOS A	1.0	7.4				
East: Dawes Ave (500m)													
Lane 1[d]	29	0.0	1057	0.028	100	7.1	LOS A	0.1	0.9	Full	500	0.0	0.0
Approach	29	0.0		0.028		7.1	LOS A	0.1	0.9				
North: Middleton Ave (240m)													
Lane 1[d]	182	1.2	1637	0.111	100	3.9	LOS A	0.6	4.0	Full	240	0.0	0.0
Approach	182	1.2		0.111		3.9	LOS A	0.6	4.0				
Intersection	464	1.1		0.181		4.2	LOS A	1.0	7.4				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
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.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 101 [Middleton Ave / Dawes Ave - AM Compliant Yield]

Middleton Ave / Dawes Ave
Period: AM Peak
Case: Compliant Yield
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Middleton Ave (580m)													
Lane 1[d]	309	1.4	1292	0.239	100	4.3	LOS A	1.5	10.4	Full	580	0.0	0.0
Approach	309	1.4		0.239		4.3	LOS A	1.5	10.4				
East: Dawes Ave (500m)													
Lane 1[d]	66	0.0	1021	0.065	100	7.4	LOS A	0.3	2.1	Full	500	0.0	0.0
Approach	66	0.0		0.065		7.4	LOS A	0.3	2.1				
North: Middleton Ave (240m)													
Lane 1[d]	244	0.9	1603	0.152	100	4.0	LOS A	0.8	5.9	Full	240	0.0	0.0
Approach	244	0.9		0.152		4.0	LOS A	0.8	5.9				
Intersection	620	1.0		0.239		4.5	LOS A	1.5	10.4				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
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.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 101 [Middleton Ave / Dawes Ave - AM Increased Yield]

Middleton Ave / Dawes Ave
Period: AM Peak
Case: Increased Yield
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Middleton Ave (580m)													
Lane 1[d]	311	1.4	1278	0.243	100	4.3	LOS A	1.5	10.6	Full	580	0.0	0.0
Approach	311	1.4		0.243		4.3	LOS A	1.5	10.6				
East: Dawes Ave (500m)													
Lane 1[d]	73	0.0	1021	0.071	100	7.4	LOS A	0.3	2.4	Full	500	0.0	0.0
Approach	73	0.0		0.071		7.4	LOS A	0.3	2.4				
North: Middleton Ave (240m)													
Lane 1[d]	246	0.9	1584	0.155	100	4.0	LOS A	0.9	6.1	Full	240	0.0	0.0
Approach	246	0.9		0.155		4.0	LOS A	0.9	6.1				
Intersection	629	1.0		0.243		4.5	LOS A	1.5	10.6				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
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.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 101 [Middleton Ave / Dawes Ave - AM Sensitivity Test]

Middleton Ave / Dawes Ave
Period: AM Peak
Case: Sensitivity Test
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Middleton Ave (580m)													
Lane 1[d]	311	1.4	1261	0.246	100	4.4	LOS A	1.5	10.7	Full	580	0.0	0.0
Approach	311	1.4		0.246		4.4	LOS A	1.5	10.7				
East: Dawes Ave (500m)													
Lane 1[d]	80	0.0	1021	0.078	100	7.4	LOS A	0.4	2.6	Full	500	0.0	0.0
Approach	80	0.0		0.078		7.4	LOS A	0.4	2.6				
North: Middleton Ave (240m)													
Lane 1[d]	249	0.8	1585	0.157	100	4.0	LOS A	0.9	6.2	Full	240	0.0	0.0
Approach	249	0.8		0.157		4.0	LOS A	0.9	6.2				
Intersection	640	1.0		0.246		4.6	LOS A	1.5	10.7				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
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.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 101 [Middleton Ave / Dawes Ave - PM]

Middleton Ave / Dawes Ave
Period: PM Peak
Case: 2017 Base Case
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Middleton Ave (580m)													
Lane 1[d]	239	0.9	1487	0.161	100	4.0	LOS A	0.9	6.5	Full	580	0.0	0.0
Approach	239	0.9		0.161		4.0	LOS A	0.9	6.5				
East: Dawes Ave (500m)													
Lane 1[d]	13	0.0	1031	0.012	100	7.3	LOS A	0.1	0.4	Full	500	0.0	0.0
Approach	13	0.0		0.012		7.3	LOS A	0.1	0.4				
North: Middleton Ave (240m)													
Lane 1[d]	222	0.5	1601	0.139	100	4.0	LOS A	0.7	5.0	Full	240	0.0	0.0
Approach	222	0.5		0.139		4.0	LOS A	0.7	5.0				
Intersection	474	0.7		0.161		4.1	LOS A	0.9	6.5				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
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.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 101 [Middleton Ave / Dawes Ave - PM Compliant Yield]

Middleton Ave / Dawes Ave
Period: PM Peak
Case: Compliant Yield
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Middleton Ave (580m)													
Lane 1[d]	294	0.7	1386	0.212	100	4.1	LOS A	1.3	9.1	Full	580	0.0	0.0
Approach	294	0.7		0.212		4.1	LOS A	1.3	9.1				
East: Dawes Ave (500m)													
Lane 1[d]	35	0.0	992	0.035	100	7.5	LOS A	0.2	1.1	Full	500	0.0	0.0
Approach	35	0.0		0.035		7.5	LOS A	0.2	1.1				
North: Middleton Ave (240m)													
Lane 1[d]	296	0.4	1569	0.188	100	4.0	LOS A	1.0	7.3	Full	240	0.0	0.0
Approach	296	0.4		0.188		4.0	LOS A	1.0	7.3				
Intersection	624	0.5		0.212		4.3	LOS A	1.3	9.1				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
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.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 101 [Middleton Ave / Dawes Ave - PM Increased Yield]

Middleton Ave / Dawes Ave
Period: PM Peak
Case: Increased Yield
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Middleton Ave (580m)													
Lane 1[d]	294	0.7	1372	0.214	100	4.1	LOS A	1.3	9.2	Full	580	0.0	0.0
Approach	294	0.7		0.214		4.1	LOS A	1.3	9.2				
East: Dawes Ave (500m)													
Lane 1[d]	38	0.0	992	0.038	100	7.6	LOS A	0.2	1.2	Full	500	0.0	0.0
Approach	38	0.0		0.038		7.6	LOS A	0.2	1.2				
North: Middleton Ave (240m)													
Lane 1[d]	311	0.3	1573	0.197	100	4.0	LOS A	1.1	7.8	Full	240	0.0	0.0
Approach	311	0.3		0.197		4.0	LOS A	1.1	7.8				
Intersection	642	0.5		0.214		4.3	LOS A	1.3	9.2				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
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.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 101 [Middleton Ave / Dawes Ave - PM Sensitivity Test]

Middleton Ave / Dawes Ave
Period: PM Peak
Case: Sensitivity Test
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Middleton Ave (580m)													
Lane 1[d]	295	0.7	1363	0.216	100	4.2	LOS A	1.3	9.3	Full	580	0.0	0.0
Approach	295	0.7		0.216		4.2	LOS A	1.3	9.3				
East: Dawes Ave (500m)													
Lane 1[d]	40	0.0	992	0.040	100	7.6	LOS A	0.2	1.3	Full	500	0.0	0.0
Approach	40	0.0		0.040		7.6	LOS A	0.2	1.3				
North: Middleton Ave (240m)													
Lane 1[d]	304	0.3	1558	0.195	100	4.0	LOS A	1.1	7.7	Full	240	0.0	0.0
Approach	304	0.3		0.195		4.0	LOS A	1.1	7.7				
Intersection	639	0.5		0.216		4.3	LOS A	1.3	9.3				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
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.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 102 [Parsonage Rd / Middleton Ave - AM]

Parsonage Rd / Middleton Ave
Period: AM Peak
Case: 2017 Base Case
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: Parsonage Rd (140m)													
Lane 1	525	1.0	1635	0.321	100	2.9	LOS A	1.7	11.8	Full	140	0.0	0.0
Approach	525	1.0		0.321		2.9	NA	1.7	11.8				
North: Middleton Ave (580m)													
Lane 1	267	1.6	906	0.295	100	7.1	LOS A	1.2	8.7	Full	580	0.0	0.0
Approach	267	1.6		0.295		7.1	LOS A	1.2	8.7				
West: Parsonage Rd (115m)													
Lane 1	301	2.8	1893	0.159	100	1.0	LOS A	0.0	0.0	Full	115	0.0	0.0
Approach	301	2.8		0.159		1.0	NA	0.0	0.0				
Intersection	1094	1.6		0.321		3.4	NA	1.7	11.8				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
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 lanes.
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.

LANE SUMMARY

Site: 102 [Parsonage Rd / Middleton Ave - AM Compliant Yield]

Parsonage Rd / Middleton Ave
Period: AM Peak
Case: Compliant Yield
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: Parsonage Rd (140m)													
Lane 1	655	1.0	1536	0.426	100	4.1	LOS A	3.2	22.9	Full	140	0.0	0.0
Approach	655	1.0		0.426		4.1	NA	3.2	22.9				
North: Middleton Ave (580m)													
Lane 1	383	1.4	735	0.521	100	10.5	LOS A	3.3	23.2	Full	580	0.0	0.0
Approach	383	1.4		0.521		10.5	LOS A	3.3	23.2				
West: Parsonage Rd (115m)													
Lane 1	403	2.6	1895	0.213	100	1.0	LOS A	0.0	0.0	Full	115	0.0	0.0
Approach	403	2.6		0.213		1.0	NA	0.0	0.0				
Intersection	1441	1.5		0.521		4.9	NA	3.3	23.2				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
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 lanes.
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.

LANE SUMMARY

Site: 102 [Parsonage Rd / Middleton Ave - AM Increased Yield]

Parsonage Rd / Middleton Ave
Period: AM Peak
Case: Increased Yield
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: Parsonage Rd (140m)													
Lane 1	656	1.0	1534	0.428	100	4.1	LOS A	3.3	23.1	Full	140	0.0	0.0
Approach	656	1.0		0.428		4.1	NA	3.3	23.1				
North: Middleton Ave (580m)													
Lane 1	395	1.3	733	0.538	100	10.7	LOS A	3.5	24.7	Full	580	0.0	0.0
Approach	395	1.3		0.538		10.7	LOS A	3.5	24.7				
West: Parsonage Rd (115m)													
Lane 1	404	2.6	1895	0.213	100	1.0	LOS A	0.0	0.0	Full	115	0.0	0.0
Approach	404	2.6		0.213		1.0	NA	0.0	0.0				
Intersection	1455	1.5		0.538		5.1	NA	3.5	24.7				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
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 lanes.
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.

LANE SUMMARY

Site: 102 [Parsonage Rd / Middleton Ave - AM Sensitivity Test]

Parsonage Rd / Middleton Ave
Period: AM Peak
Case: Sensitivity Test
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: Parsonage Rd (140m)													
Lane 1	658	1.0	1532	0.430	100	4.1	LOS A	3.3	23.3	Full	140	0.0	0.0
Approach	658	1.0		0.430		4.1	NA	3.3	23.3				
North: Middleton Ave (580m)													
Lane 1	409	1.3	731	0.560	100	11.1	LOS A	3.8	26.7	Full	580	0.0	0.0
Approach	409	1.3		0.560		11.1	LOS A	3.8	26.7				
West: Parsonage Rd (115m)													
Lane 1	405	2.6	1894	0.214	100	1.1	LOS A	0.0	0.0	Full	115	0.0	0.0
Approach	405	2.6		0.214		1.1	NA	0.0	0.0				
Intersection	1473	1.5		0.560		5.2	NA	3.8	26.7				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
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 lanes.
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.

LANE SUMMARY

Site: 102 [Parsonage Rd / Middleton Ave - PM]

Parsonage Rd / Middleton Ave
Period: PM Peak
Case: 2017 Base Case
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: Parsonage Rd (140m)													
Lane 1	378	0.3	1438	0.263	100	4.1	LOS A	1.4	10.1	Full	140	0.0	0.0
Approach	378	0.3		0.263		4.1	NA	1.4	10.1				
North: Middleton Ave (580m)													
Lane 1	224	0.5	945	0.237	100	6.8	LOS A	0.9	6.6	Full	580	0.0	0.0
Approach	224	0.5		0.237		6.8	LOS A	0.9	6.6				
West: Parsonage Rd (115m)													
Lane 1	462	0.7	1913	0.242	100	1.3	LOS A	0.0	0.0	Full	115	0.0	0.0
Approach	462	0.7		0.242		1.3	NA	0.0	0.0				
Intersection	1064	0.5		0.263		3.5	NA	1.4	10.1				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
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 lanes.
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.

LANE SUMMARY

Site: 102 [Parsonage Rd / Middleton Ave - PM Compliant Yield]

Parsonage Rd / Middleton Ave
Period: PM Peak
Case: Compliant Yield
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: Parsonage Rd (140m)													
Lane 1	484	0.2	1283	0.377	100	5.9	LOS A	2.8	19.7	Full	140	0.0	0.0
Approach	484	0.2		0.377		5.9	NA	2.8	19.7				
North: Middleton Ave (580m)													
Lane 1	312	0.3	798	0.390	100	8.8	LOS A	2.0	14.0	Full	580	0.0	0.0
Approach	312	0.3		0.390		8.8	LOS A	2.0	14.0				
West: Parsonage Rd (115m)													
Lane 1	582	0.7	1910	0.305	100	1.4	LOS A	0.0	0.0	Full	115	0.0	0.0
Approach	582	0.7		0.305		1.4	NA	0.0	0.0				
Intersection	1378	0.5		0.390		4.6	NA	2.8	19.7				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
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 lanes.
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.

LANE SUMMARY

Site: 102 [Parsonage Rd / Middleton Ave - PM Increased Yield]

Parsonage Rd / Middleton Ave
Period: PM Peak
Case: Increased Yield
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: Parsonage Rd (140m)													
Lane 1	489	0.2	1275	0.384	100	6.0	LOS A	2.9	20.3	Full	140	0.0	0.0
Approach	489	0.2		0.384		6.0	NA	2.9	20.3				
North: Middleton Ave (580m)													
Lane 1	316	0.3	795	0.397	100	8.8	LOS A	2.1	14.4	Full	580	0.0	0.0
Approach	316	0.3		0.397		8.8	LOS A	2.1	14.4				
West: Parsonage Rd (115m)													
Lane 1	585	0.7	1910	0.306	100	1.4	LOS A	0.0	0.0	Full	115	0.0	0.0
Approach	585	0.7		0.306		1.4	NA	0.0	0.0				
Intersection	1391	0.5		0.397		4.7	NA	2.9	20.3				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
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 lanes.
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.

LANE SUMMARY

Site: 102 [Parsonage Rd / Middleton Ave - PM Sensitivity Test]

Parsonage Rd / Middleton Ave
Period: PM Peak
Case: Sensitivity Test
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: Parsonage Rd (140m)													
Lane 1	496	0.2	1265	0.392	100	6.1	LOS A	3.0	21.0	Full	140	0.0	0.0
Approach	496	0.2		0.392		6.1	NA	3.0	21.0				
North: Middleton Ave (580m)													
Lane 1	321	0.3	789	0.407	100	9.0	LOS A	2.1	15.0	Full	580	0.0	0.0
Approach	321	0.3		0.407		9.0	LOS A	2.1	15.0				
West: Parsonage Rd (115m)													
Lane 1	589	0.7	1909	0.309	100	1.5	LOS A	0.0	0.0	Full	115	0.0	0.0
Approach	589	0.7		0.309		1.5	NA	0.0	0.0				
Intersection	1406	0.4		0.407		4.8	NA	3.0	21.0				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
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 lanes.
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.