Traffic Impact Assessment

Rezoning Application & Master Plan for Cherrybrook Village

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1. Introduction

TRAFFIX has been commissioned by Toplace to undertake a traffic impact assessment in support of a rezoning application (Planning Proposal). The site is located within The Hills Shire Council Local Government Area (LGA) and is therefore subject to that Council's controls. It is generally zoned E4 Environmental Living, however a small section of the overall site is currently designated for R2 Low Density Residential uses.

This Planning Proposal relates to the proposed rezoning of the site for a mix of medium – high density residential uses in response to the new Cherrybrook Railway Station, currently under construction immediately to the north of the site. A reduced copy of the proposed Master Plan is included in **Appendix A**. Reference should also be made to the *North West Rail Link Operational Traffic and Transport Report*, prepared on behalf of Transport for NSW (TfNSW) which provides an assessment of the wider precinct as a result of the Cherrybrook Station. TfNSW are currently undertaking further traffic and transport modelling along the Caste Hill Road corridor in support of the future development for various sites along the North West Rail Link more generally, including the current Cherrybrook Station Structure Plan.

This report documents the findings of our investigations and should be read in the context of the Environmental Assessment prepared separately. The development relates to development with potential for well in excess of 200 residential units and is therefore of a size and scale that will require formal referral to the Roads & Maritime Services (RMS) under the provisions of SEPP (Infrastructure) 2007.

The report is structured as follows:

- Section 2: Describes the site and its location
- Section 3: Documents existing traffic conditions
- Section 4: Describes the proposed development
- Section 5: Discusses parking requirements
- Section 6: Assesses traffic impacts
- Section 7: Presents the overall study conclusions.

2. Location and Site

The site is generally situated within 'potential medium density residential development' zone of the Cherrybrook Station Structure Plan, as indicated in **Figure 1** below.

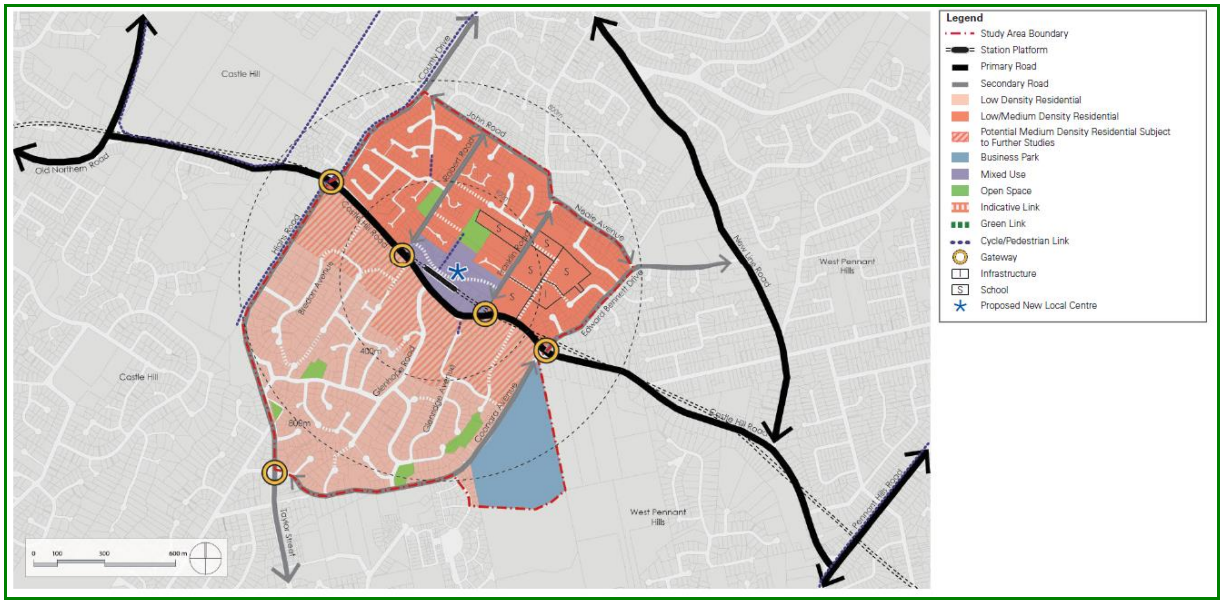


Figure 1: Cherrybrook Station Structure Plan (Source: TfNSW)

Specifically, the overall site that is subject of this rezoning submission presently comprises a total a total of 67 residential dwelling allotments in addition to an existing child care centre located on the corner of Glenhope Road and Castle Hill Road. A site plan is provided in **Figure 2** below.

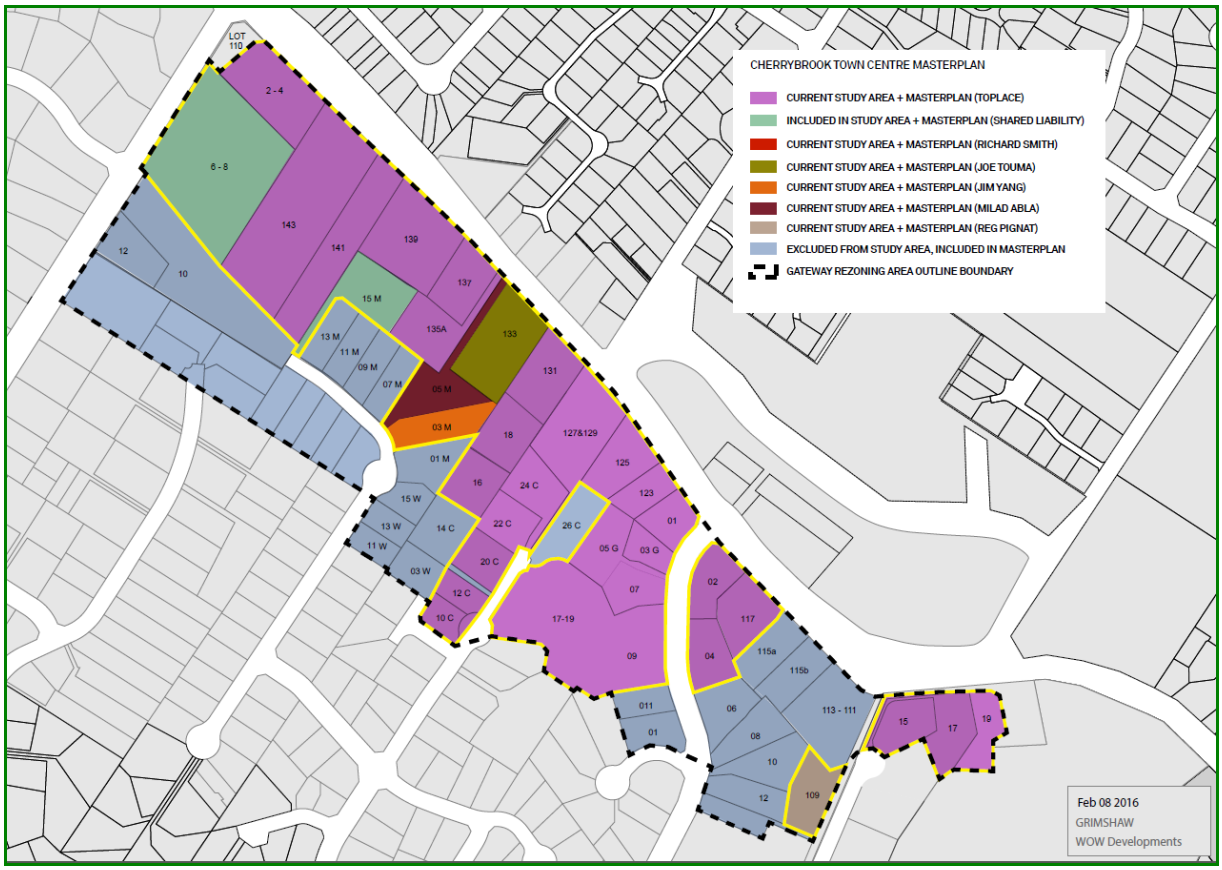


Figure 2: Site Plan - Gateway Rezoning Area

3. Existing Traffic Conditions

3.1 Road Network

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

- Castle Hill Road: an RMS State road (MR 156) that runs in an east-west direction to the north of the site. It carries in the order of 26,700 vehicles per day to the east of Glenhope Road (Station ID 72028) and forms the primary connection to the wider road network.

- Highs Road: a local collector road that runs in a north-south direction, to the west of the site. It forms an alternative access route to Pennant Hills Road (Cumberland Highway) via Taylor Street and Aiken Road. However, left turn only restrictions at the intersection of Aiken Road / Pennant Hills Road are considered to discourage the use of this route to access the M2 Motorway. Highs Road forms an off-set signalised intersection with Castle Hill Road and Country Drive at the western gateway to the Cherrybrook Station Precinct.

- Glenhope Road: a local road that generally runs in a north-south direction from Castle Hill Road and primarily serves the low density residential area to the south of the site. Traffic signals have recently been constructed at the intersection of Glenhope Road with Castle Hill Road.

- Other local roads: Matthew Way, Willunga Place, Tall Ships Avenue, Carioca Circuit, Yarra Burn Avenue and Salisbury Downs Drive are all local roads to the south of the site which connect with Highs Road and Glenhope Road. These roads primarily provide local access to individual dwellings and do not have significant status in the context of the wider road hierarchy serving the region.

It can be seen from Figure 3 that the site is conveniently located with respect to the arterial and local road systems serving the region. It is therefore able to effectively distribute traffic onto the wider road network, minimising traffic impacts.

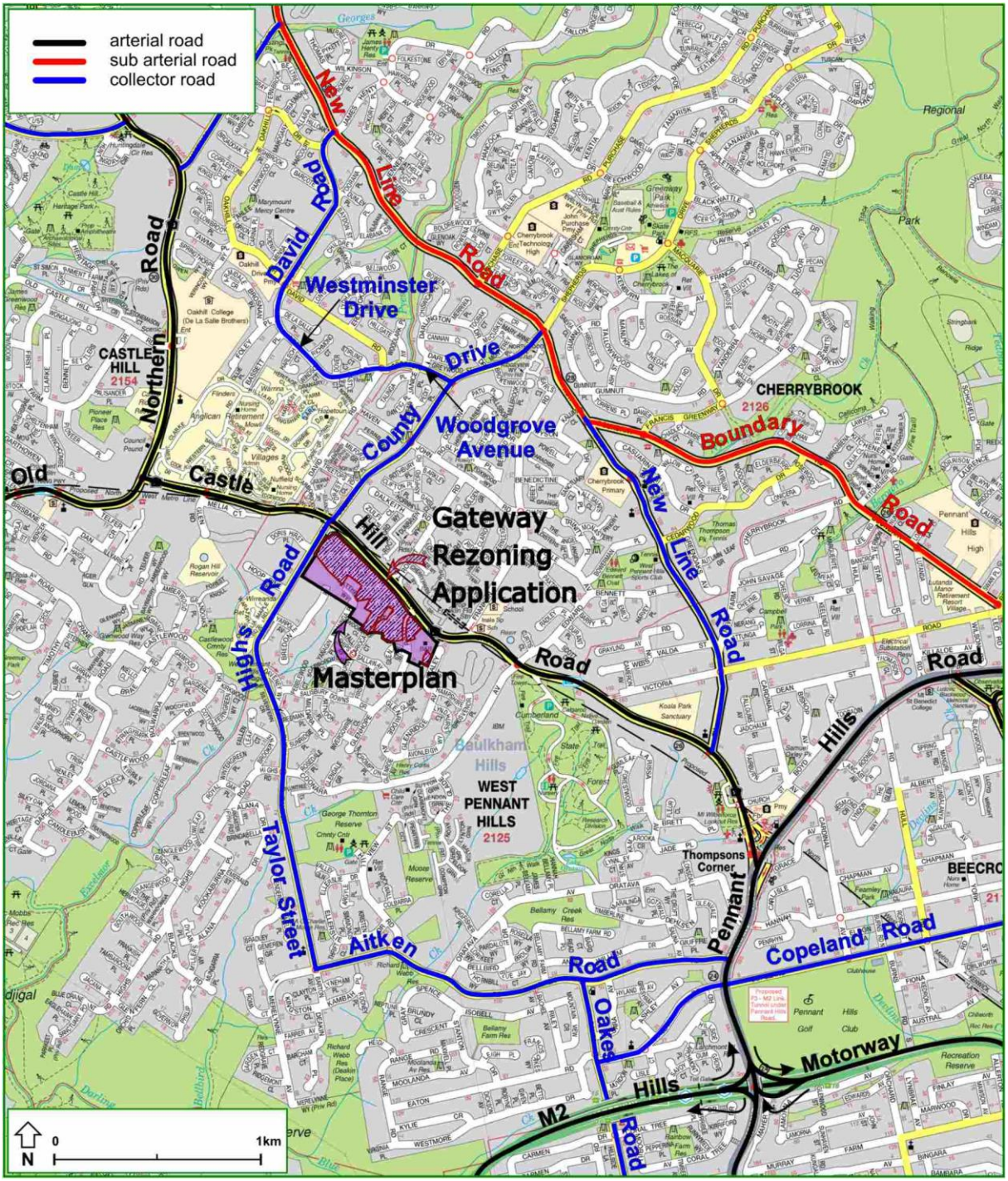


Figure 3: Surrounding Road Hierarchy

3.2 Key Intersections

The key intersections in the vicinity of the site are shown below and provide an understanding of the existing road geometry and alignment.

Figure 4: Intersection of Castle Hill Road / Highs Road / Country Drive (Source: NearMap)

It can be seen from **Figure 4** above that Highs Road and Country Drive form a staggered signalised intersection with Castle Hill Road. These signals are subject to a 'split phase' signal arrangement as a result of the offset alignment between Highs Road (south approach) and Country Drive (north approach), in addition to the RMS requirements for dual right turn lanes as provided on the northern approach.

The existing configuration of the Glenhope Road / Castle Hill Road signals is show in **Figure 5** below. However, it is noted that the northern leg of this intersection is a temporary site access for the Cherrybrook Station construction works and this intersection will be reinstated as a signalised T-junction in the future once these works are complete.

Figure 5: Intersection of Castle Hill Road / Glenhope Road (Source: NearMap)

Figure 6: Intersection of Castle Hill Road / Coonara Avenue (Source: NearMap)

3.3 Public Transport

A review of Journey-to-Work data for the locality (TZ 4575) indicates a relatively moderate use of public transport services, as summarised in **Figure 7** below. The existing bus services that operate in the locality are shown in **Figure 8**. It is evident that Route 631 in particular operates within close proximity to the subject site.

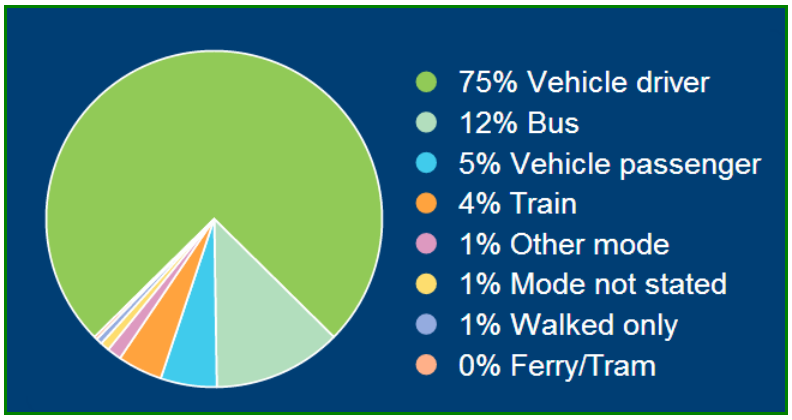


Figure 7: Journey-to-Work Travel Modes (Source: NSW Bureau of Transport Statistics)

Notwithstanding these current usage patterns, public transport opportunities for residents in the locality will improve significantly following completion of the Cherrybrook Station and North West Rail Link. In addition to rail services within 400m of the site, Cherrybrook Station will attract a range of other bus service connections as discussed within the *North West Rail Link Operational Traffic and Transport Report*, prepared on behalf of TfNSW.

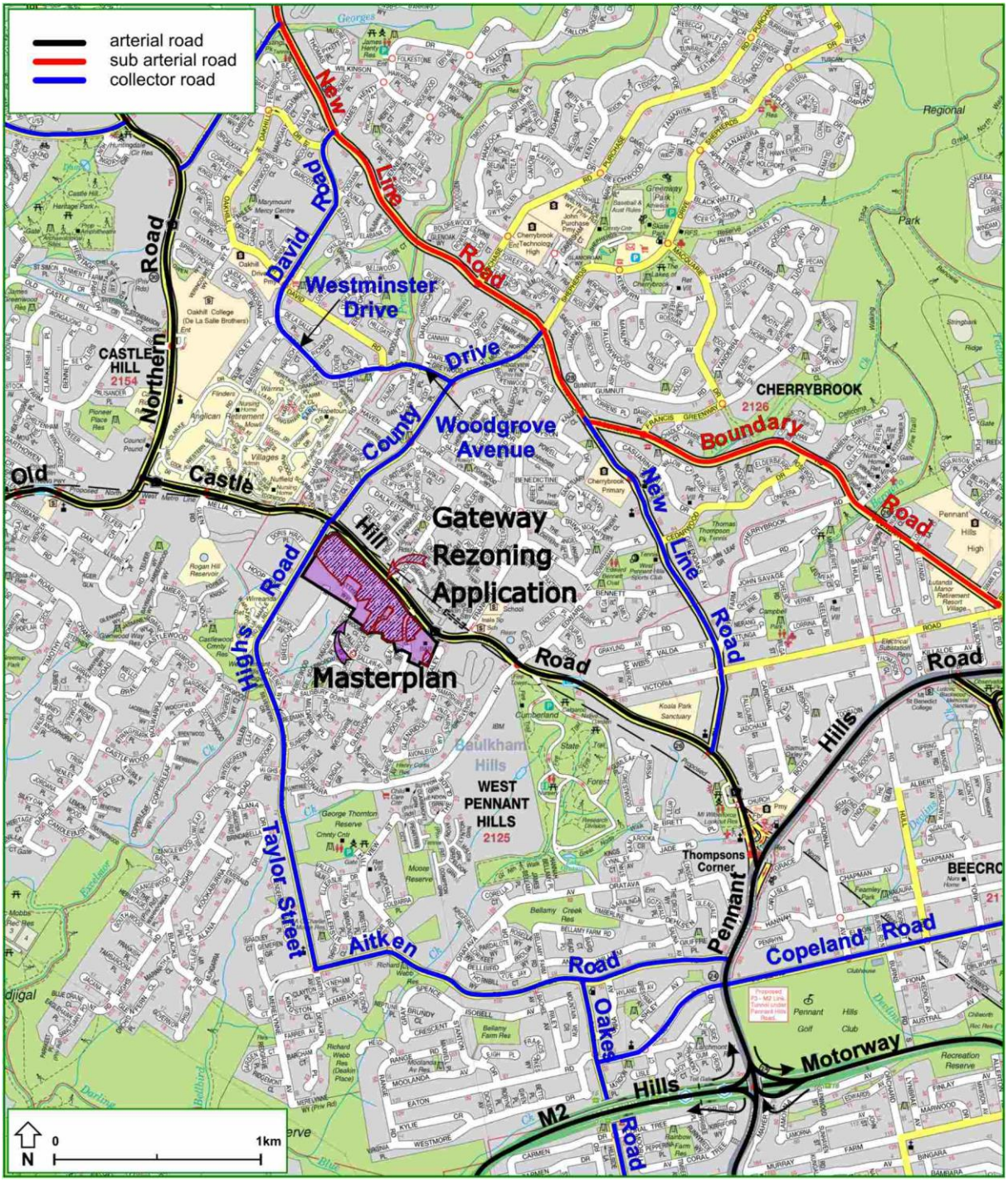


Figure 8: Existing Public Transport Routes

3.4 Existing Site Generation

The subject site accommodates 17 residential dwellings in additional to a 58 place child care centre located at 1 Glenhope Road.

The RMS *Guide to Traffic Generating Developments*, including the Updated traffic surveys (TDT 2013/04a) recommends the following traffic generation rates for low density residential dwellings and child care centres, as summarised in **Table 1** below.

Table 1: Existing Site Traffic Generation

Use	No.	Traffic Generation Rate		Traffic Generation	
		AM	PM	AM	PM
Residential	67 Dwellings	0.95 veh/hr/unit	0.99 veh/hr/unit	64	66
Child Care	58 Children	0.8 veh/hr/child	0.7 veh/hr/unit	46	41
TOTAL				110	107

It can be seen from **Table 1** that the existing uses result in a traffic generation of approximately 105-110 vehicles per hour associated with the current use of the site during both peak periods.

4. Description of Proposal

A detailed description of the proposed development is provided in the Environmental Assessment prepared separately by Mecone. In summary, the development seeks to rezone the site for the purposes of:

- High density residential development along Castle Hill Road, with a height of between 6-14 stories, and
- Medium density development with a height of between 3-6 storeys as a transition zone to the existing low-density residential areas to the south.
- 400 space commuter carpark and end of trip facility to be constructed under Station Civic Plaza

The parking requirements and traffic impacts arising from the development are discussed in Sections 5 and 6, respectively. Reference should also be made to the plans submitted separately to Council.

Separate development application submissions will be required for specific buildings on the site at some stage in the future following gazettal of the land zonings sought and further detailed assessment. Notwithstanding, preliminary analysis on the basis of the proposed increased density, indicates that the overall master plan area could yield the following indicative apartment mix:

Table 2: Proposed Apartment Mix

Council Apartment Mix and Size Controls	1 Bedroom	2 Bedrooms	3 Bedrooms	Total
Type 1	331	331	279	941
Type 2	332	336	288	956
Type 3	451	431	401	1283
	1114	1098	968	3,180

5. Parking Requirements

5.1 Car Parking

The *Hills Development Control Plan 2012* (DCP) – Part C – Section 1 nominally requires Residential Flat Buildings to provide car parking at the following rates:

- 1 space per one (1) bedroom unit, plus
- 2 spaces per two (2) OR three (3) bedroom units, plus
- 2 visitor spaces per five (5) residential units.

However, the above rates apply to the entire LGA and are not therefore considered representative of high density residential development within 400 metres of a railway station. Indeed, even the reduced parking rates applicable to the Caste Hill Centre are substantially higher than apply to developments adjacent to railway stations in many other areas throughout the Greater Sydney Metropolitan Area. For example, future residential development on the northern side of Caste Hill Road would be subject to the minimum parking requirements of the *Hornsby Development Control Plan 2013*, as follows:

- 0.75 spaces per one (1) bedroom unit, plus
- 1.0 space per two (2) bedroom unit, plus
- 1.5 space per three (3) bedroom unit, plus
- 1 visitor space per seven (7) units.

The above controls relate to all development within 800 metres of a railway station, whereas the subject site is generally located within 400 metres of the future Cherrybrook Station. As such, further reductions to these parking requirements could be considered for the purposes of a site specific DCP. Reduced on-site parking, where supplemented with complimentary on-street parking restrictions, has the potential to reduce car usage, particularly during weekday peak (commuter) periods. This will enhance the feasibility for higher frequency public transport services to benefit the wider community and is encouraged for the proposed 'transit oriented' development that is essentially a direct response to the new train station being constructed.

It is also noted the planning proposal includes a 400 space commuter car park within the subject site.Commuter use of this car will generally occur during weekday business hours, with reduced usage in the evenings and on weekends. As such, there is scope for some shared use of this car parking by residential visitors that will not coincide with commuter peak demands.

In this regard, any future site specific DCP would be encouraged to promote reduced levels of car parking, say on the basis of the RMS Guide regional centre rates as a minimum parking requirement, as outlined in the SEPP 65 amendment which promotes the adoption of reduced minimum parking provision rates within 800 metres of a railway station. Notwithstanding, to protect the commercial feasibility of future developments, Council is encouraged to provide some level of flexibility by maintaining existing parking controls, as outlined in **Table 3** below.

Table 3: Car Parking Rates

Unit Type	Minimum Parking Rate[1]	Maximum Parking Rate[2]
1 bedroom (& studio)	0.4 spaces per unit	1.0 space per unit
2 bedroom	0.7 spaces per unit	1.5 spaces per unit
3 bedroom	1.2 spaces per unit	2.0 spaces per unit
Visitor	1.0 space per 7 units	2 spaces per 5 units
Car Wash Bay	1 bay per Building (can be shared with a visitor space)	1 bay per Building (can be shared with a visitor space)

Notes: 1) Rates based on RMS Guide to Traffic Generating Developments for Regional Centre

2) Rate based on The Hills DCP for Castle Hill Centre

Preliminary spatial planning indicates that sufficient basement area can be provided to achieve approximately 0.95 car parking spaces per unit currently under consideration. Additional car parking will also be available on new internal roads. As such, it is anticipated that a suitable level of car parking can be provided by future development noting that reduced car parking will encourage the use of the available public transport, including future rail services.

To support a minimalistic approach to on-site car parking provisions, Council would need to consider implementation of period parking restriction on surrounding roads to prevent spill over of unwanted

parking demands onto existing surrounding residential areas. However, it is expected that ongoing review of on-street parking restrictions may be required in any event, following completion of Cherrybrook Station, to prevent excessive commuter parking in surrounding residential areas.

Nevertheless, car parking requirements and provision will ultimately be subject to Council adoption of the above rates (or others) as part of any site specific DCP, with further detailed assessment as part of any future development application(s). In the event that developments are to provide car parking in accordance with the above minimum rates, then developers would be encouraged to engage with car share operators to investigate options for Car Share parking spaces within basement and/or throughout the precinct more generally.

5.2 Disabled Parking

Each adaptable unit will need to be provided with an accessible parking space. Visitor and any non-residential car parking should provide accessible car parking in accordance with the *Disability (Access to Premises - Buildings) Standards 2010*, which generally requires accessible parking at a rate of between 1-2% of total spaces for most uses.

All accessible spaces will need to be designed in accordance with AS2890.6, except for resident accessible spaces associated with adaptable units which should be designed to AS4299 with a width of 3.8 metres as recommended by the Practice Note (PN: 01 – August 2012) prepared by the Association of Consultants in Access, Australia.

5.3 Bicycle & Motorcycle Facilities

All bicycle and motorcycle parking will need to comply with the provisions of The Hills DCP Part C Section 1.

5.4 Servicing

Where possible, subject to individual site constraints, provision should be made for on-site waste collection and servicing, particularly in buildings in excess of 50 units. Notwithstanding, this is a detailed matter for assessment during subsequent development applications.

6. Traffic Assessment

6.1 Assumptions

6.1.1 Traffic Generation

6.1.1.1 Residential

Having regard for the 'transit-oriented' nature of future development immediately adjacent to the new Cherrybrook Station Precinct, which includes commercial areas on the northern side of Castle Hill Road, this assessment adopts the high density traffic generation rate of 0.19 and 0.15 veh/hr/unit during the AM and PM peak periods, respectively, as outlined by the RMS *Technical Direction 04a*. These rates supersede the previous rates of the RMS *Guide to Traffic Generating Developments* (RMS Guide).

Traffic generation rates for medium density units are based on the RMS Guide, as follows:

- 0.4 trips per studio or one (1) bedroom unit
- 0.5 trips per two (2) bedroom unit
- 0.575 trips per three (3) bedroom unit

The traffic generation rate adopted for three (3) bedroom units is the average of the range provided within the RMS Guide.

6.1.1.2 Commuter Carpark

The RMS Guide recommends surveys be undertaken of similar carparks to gain understanding of the traffic generating potential, due to the varying nature of each carpark. Surveys of the existing Thornleigh Station Commuter Carpark were undertaken to gain an understanding of the traffic generating potential of the proposed 400 space commuter carpark. The trip rates obtained from the above-mentioned surveys were used to calculate the morning (7:30am-9:30am) and evening (4:00pm-6:00pm) peak commuter trip rates of the commuter carpark, the results of which are as follows:

AM Peak

- 0.15 trips / parking space

PM Peak

- 0.25 trips / parking space

6.1.2 Traffic Distribution

6.1.2.1 Residential

To better ascertain the likely future travel behaviour of future residents, the Journey-to-Work (JTW) data for the following localities were reviewed to inform the future distribution of residential traffic onto the surrounding road network. Similar localities included areas adjacent to other existing train stations in the north-west of Sydney Travel Zones (TZ), including Waitara (TZ 1631, 1633 & 1634), Normanhurst (TZ 1640, 1642, 1644) and Pennant Hills (TZ 1414, 1417, 1643, 1645). From review of current Journey-to-Work data for these areas and with consideration to the available traffic routes that would be applied to the Cherrybrook site, the traffic distribution outlined in **Table 4** has been assumed for the purposes of this study.

It is noted that Journey-to-Work and related trip purposes only account for approximately 60% of peak hourly trips, with the balance typically comprising non work related trip purposes such as local shopping and other recreational purposes. These 'other trip' purposes have been more evenly distributed onto the surrounding road network having to better represent the mix of travel purpose and destinations of future residents.

Table 4: Adopted Future Traffic Distribution

Distribution Zone	Journey-to-Work (60% of peak hourly trips)	Other Trip Purposes (40% of peak hourly trips)
Castle Hill Rd (east)	88%	20%
Castle Hills Rd (west)	8%	20%
County Dr	2%	20%
Highs Rd	0%	20%
Edward Bennett Dr	0%	5%

Coonara Ave	**2%**	**15%**
TOTAL	**100%**	**100%**

6.1.2.2 Commuter Carpark:

The following assumptions were made with regard to the travel behaviour of commuters driving to and from the commuter carpark:

- 80% of commuters are expected to arrive from the north, the direction of Cherrybrook, which is where the majority of residential dwellings are located within the locality. Residential dwellings to the west are located closer to the proposed Castle Hill Railway Station, dwellings to the east are located closer to the existing T1 line and a large proportion of developments to the south are within walking distance of the site.
- Of the 80% of commuters arriving from the north, 80% are expected to arrive from the northern leg (County Drive) of the intersection of Castle Hill Road/County Road/Highs Road, accessing the site's internal road network from High's Road. 20% of commuters are expected to arrive from the eastern leg (Castle Hill Road) of the intersection of Castle Hill Road and Glenhope Road, accessing the site's internal road network from Glenhope Road.

6.1.3 Structure Plan Development Yield

As part of the future planning for the Cherrybrook Station Precinct generally, TfNSW prepared a traffic report (*North West Rail Link Operational Traffic and Transport Report*) which provides an assessment of future traffic conditions as a result of the Cherrybrook Station and associated Cherrybrook Structure Plan. Relevant extracts from the Structure Plan are included in **Appendix B**.

The Cherrybrook Structure Plan identifies a development potential of up to 3,150 medium density units. Spatial analysis indicates that up to 65% of the 'medium density apartments' (approximately 2,000 units) is provided within the area to the south of Castle Hill Road, as depicted by **Figure 9** below.

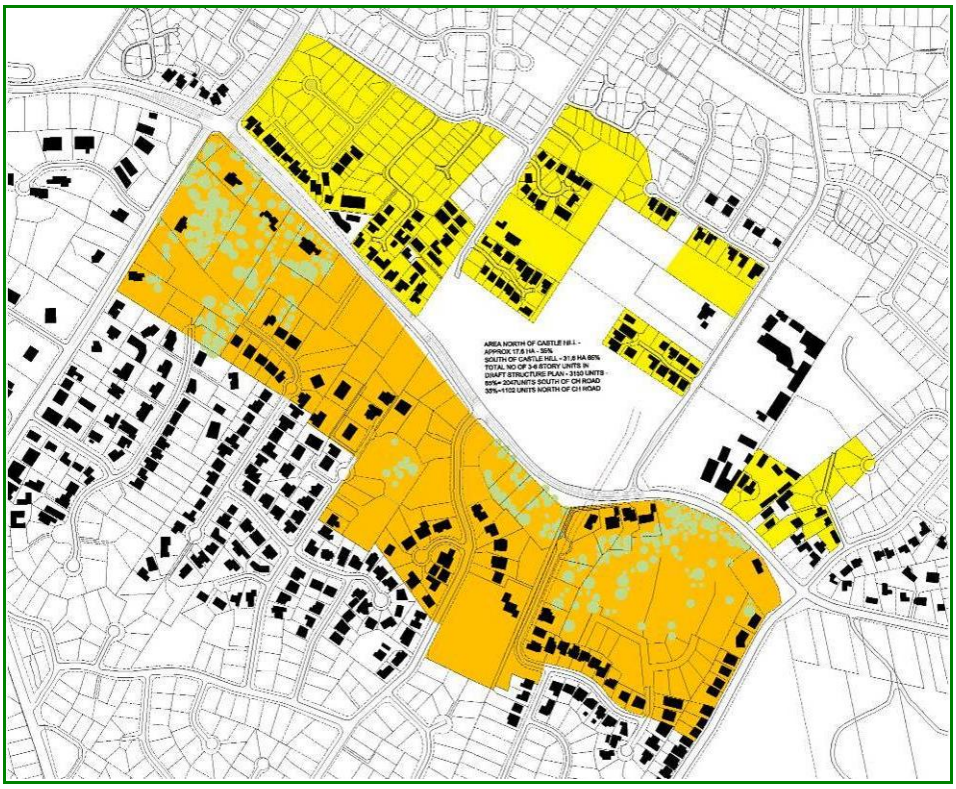


Figure 9: Structure Plan Assumed Density Analysis (Source: Grimshaw Architects)

The subject site relates to a large proportion of this overall area, to the south of Castle Hill Road.

6.2 Traffic Generation Assessment

6.2.1 Proposed Master Plan Traffic Generation

The proposed rezoning and floor space ratio are expected to yield a total of approximately 3,200 residential units. At this stage, the mix of bedrooms is unknown and, on that basis, an average traffic generation rate of 0.5 veh/hr/unit has been adopted for the medium density residential units which are expected to comprise approximately 315 of the total unit yield.

Application of the rates outlined in Section 6.1 to the 2,962 high density, 254 medium density units and the commuter carpark results in a total traffic generation of 743 veh/hr and 666 veh/hr during the AM and PM peak periods, respectively, as summarised in **Table 5** below.

Table 5: Traffic Generation – Proposed Rezoning

Type of Unit	No.	Traffic Generation Rate		Traffic Volumes (two-way)	
		AM	PM	AM	PM
Medium Density	254	0.5 / unit		127	127
High Density	2,926	0.19 / unit	0.15 / unit	556	439
TOTAL RES	3180			683	566
Commuter Carpark	400 spaces	0.15 / space	0.25 / space	60	100
			TOTAL	743	666

This represents a net increase of 663 and 559 veh/hr above that of the existing use of the site, as assessed in Section 3, which will be distributed onto all available routes. This is considered a moderate traffic volume increase in light of the scale of the development and this outcome reflects the fact that high density residential development in particular is a low traffic-generating use where it is located close to public transport.

6.2.2 Structure Plan Inherent Traffic Volumes

Similarly, the inherent traffic generation associated with the over-arching Structure Plan is summarised in **Table 6** below, assuming a similar traffic generation rate is applied to a total of 2,000 medium density residential units.

Table 6: Traffic Generation - Structure Plan Yield

Type of Unit	No.	Traffic Generation Rate		Traffic Volumes (two-way)	
		AM	PM	AM	PM
Two Bed	2,000	0.5 / unit		1,000	1,000
TOTAL	2,000			1,000	1,000

6.2.3 Comparison of Traffic Volumes

From comparison of the traffic volumes outlined in **Tables 5 and 6** above, it is evident that the total traffic volumes generated by future development to the south of the Castle Hill Road corridor will remain less than previously adopted under the Structure Plan for the Cherrybrook South sub-precinct by 119 veh/hr during the morning peak and 218 veh/hr during evening peak periods, as summarised in **Table 7** below.

Table 7: Traffic Generation Comparison for Structure Plan Area, South of Castle Hill Rd

Land Use Scenario	No. of Dwellings / Spaces Assumed for Subject Site	AM Traffic Volumes	PM Traffic Volumes
Structure Plan	**2,000**	**1,000**	**1,000**
Current Master Plan	**3,180**	**743**	**666**
Net Change	**+1,180**	**-257**	**-334**

In this regard, it is expected that the traffic volumes associated with the proposed highdensity residential development and commuter car park to the south of Castle Hill Road will be sufficiently catered for in the TfNSW traffic modelling being undertaken in support of the Cherrybrook Structure Plan.

Furthermore, traffic impacts associated with future development will also be assessed in relation to Development Applications for all sites (including the subject site) as they are rolled out over an extended timeframe, with on-going updates expected to all subsequent traffic assessments so that Council, RMS and TfNSW can monitor changes to the traffic conditions as the development potential identified under this Planning Proposal and the Structure Plan is realised.

However, given the uncertainty in relation to timing for that wider Castle Hill Road corridor study, the impacts of the additional traffic generated by the subject Planning Proposal is assessed in the following section, noting that some localised improvements may be required and so that assessment of this particular Planning Proposal may progress.

6.3 Traffic Impact Assessment

6.3.1 Planned Intersection Performance

This TfNSW strategic assessment identifies the following intersection performances during the critical morning peak period under a future (2021) development scenario, presumably including traffic associated with the Cherrybrook Structure Plan, in addition to changes to regional traffic flows as a result of the North West Rail Link.

Table 8: Future 2021 Intersection Performance (Cherrybrook Station Structure Plan)

Intersection Description	Control Type	Period	Degree of Saturation	Level of Service
Castle Hill Rd / Highs Rd	**Signals**	**AM**	**1.02**	**F**
Castle Hill Rd / Glenhope Rd	**Signals**	**AM**	**0.42**	**A**
Castle Hill Rd / Edward Bennett Dr	**Signals**	**AM**	**0.85**	**D**

The *North West Rail Link Operational Traffic and Transport Report* identifies an additional through lane and/or increased turning bay lengths to ameliorate traffic impacts at the Castle Hill Road / Country Drive / Highs Road intersection. However, it is expected that the full range of improvements required as a result of the Structure Plan development impacts will be identified separately as part of the TfNSW corridor study being undertaken separately.

6.3.2 Existing Conditions

Surveys of the following key intersections were conducted on Tuesday 20th November 2018:

- Castle Hill Road / Highs Road / County Drive
- Castle Hill Road / Glenhope Road
- Castle Hill Road / Coonara Avenue / Edward Bennett Drive

The results of these surveys were analysed using the SIDRA computer program to determine their performance characteristics under existing traffic conditions. 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. In this regard, a practical limit at 1.1 can be assumed. 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 is provided in **Table 9** below. Reference should also be made to the SIDRA outputs provided in **Appendix C** which provide detailed results for individual movements and approaches.

Table 9: Intersection Performance Summary – Existing Volumes

Intersection Description	Control	Period	DOS	Average Delay	Level of Service
Castle Hill Rd / Highs Rd / County Dr	Signals	AM	0.919	48.4	D
		PM	0.975	61.5	E
Castle Hill Rd / Glenhope Rd	Signals	AM	0.486	8.4	A
		PM	0.525	3.6	A
Castle Hill Rd / Coonara Ave / Edward Bennett Dr	Signals	AM	0.976	53.5	D
		PM	0.890	36.5	C

It can be seen from Table 9 above that the surveyed intersections operate satisfactorily under existing conditions with the worst performing intersections operating at a LOS D during the AM peak period.

It is stressed that the most relevant use of this analysis is to compare the relative change in the performance parameters as a result of this Planning Proposal. This is discussed further below.

6.3.3 Development Impacts

As discussed in Section 6.2.1 the indicative development yield plus commuter carpark will generate 743 veh/hr and 666 veh/hr during the AM and PM peak periods. These volumes reduce by approximately 110 veh/hr when the existing site traffic is taken into account.

However, it should be noted the proposed Cherrybrook Railway Station forms part of the proposed northwest rail network and will encourage commuters currently driving to and from work through this precinct to use alternative modes of transport. This change in existing road users' travel behaviour will result in a reduction of existing vehicle-based trips on the local road network, thereby reducing vehicle volumes at the surveyed intersections. This has not ben taken into consideration with regard to the

below intersection performance results. In addition, it is emphasized the below intersection performance results are based on a development yield of 3,800 units plus the proposed 400 space commuter carpark, in order to adopt a conservative approach. Therefore, the below should be considered a 'worst case scenario' with regard to the developments impact on the surrounding road network.

Having regard for the above, the future performance of key intersections with the addition of this development traffic and commuter carpark is summarised in **Table 10** below (including the proposed new precinct access intersection on Castle Hill Road).

Table 10: Intersection Performance Summary – Existing + Development

Intersection Description	Control	Period	DOS	Average Delay	Level of Service
Castle Hill Rd / Highs Rd / County Dr	Signals	AM	1.023	79.8	F
		PM	1.014	78.6	F
Castle Hill Rd / New Village Access Rd	Priority (Left-in, left-out)	AM	0.037	7.2	A
		PM	0.462	0.5	A
Castle Hill Rd / Glenhope Rd	Signals	AM	0.869	20.6	B
		PM	0.023	8.5	A
Castle Hill Rd / Coonara Ave / Edward Bennett Dr	Signals	AM	1.000	48.1	D
		PM	0.899	34.3	C

This preliminary modelling indicates the key intersection of Castle Hill Road / Highs Road / County Drive will 'fail' as a result of the increased traffic generated by development to the south of Castle Hill Road.

To address this, a range of improvements are expected to be required as a result of the development, as follows:

- Provide an additional lane to Castle Hill Road (westbound) locally through the intersection. Given the steep change of grade to the south of Castle Hills Road, it is recommended that additional width be recovered from the northern side of Castle Hill Road.

- Provide a left turn slip lane on the east approach of Castle Hill Road (to Highs Road)
- Increase the length of left turn short lane on southern approach to intersection by road widening along the eastern side of Highs Road. This widening will improve the alignment of northern and southern approaches to the intersection and allow for additional turning lanes on the southern approach.

In addition, an opportunity for an improvement has been identified at the intersection of Castle Hill Road / Coonara Avenue / Edward Bennett Drive by providing turn slip lanes on both eastern and southern approach to the intersection.

The performance of the key intersections, incorporating the above improvements, is summarised in Table 11 below.

Table 11: Intersection Performance Summary – Existing + Development (with Improvements)

Intersection Description	Control	Period	DOS	Average Delay	Level of Service
Castle Hill Rd / Highs Rd / County Dr	Signals	AM	0.912	47.6	D
		PM	0.978	65.4	E
Castle Hill Rd / New Village Access Rd	Priority (Left-in, left-out)	AM	0.037	7.2	A
		PM	0.023	8.5	A
Castle Hill Rd / Glenhope Rd	Signals	AM	0.869	20.6	B
		PM	0.847	7.2	A
Castle Hill Rd / Coonara Ave / Edward Bennett Dr	Signals	AM	0.897	28.9	C
		PM	0.899	34.3	C

It can be seen that all intersections will operate with acceptable delays with the additional traffic generated by the Cherrybrook South Precinct generally based on a development yield of 3,600 units, including the proposed commuter carpark, subject to the intersection improvements outlined above. **Table 11** also shows that the critical intersections operate at LoS E or better during the AM and PM peak periods. It is anticipated that these intersections should be able to accommodate the additional

99 veh/hr and 131 veh/hr in the AM and PM peak periods without operating at an unacceptable level of service.

6.4 Construction Traffic Impacts

Assessment of construction impacts will be undertaken separately as part of the detailed Development Application assessment process for individual developments, or as a Construction Certificate requirement.

7. Conclusions

In summary:

- The proposal seeks to increase residential density and introduce a commuter carpark in close proximity to the new Cherrybrook Railway Station which is a desirable transport planning outcome generally in the context of metropolitan strategies. Roads in the vicinity of the site and north-western Sydney generally are approaching (or exceeding) capacity and promotion of alternatives methods of travel is a desirable outcome for any future 'transit-oriented' development seeking to benefit from the improvements to public transport accessibility afforded by the new station and connecting bus services.

- Having regard for the above and other site planning constraints, reduced on-site parking provisions, consistent with the RMS *Guide to Traffic Generating Developments* for high density developments, are to be encouraged as discussed in Section 5, with adoption of minimum rates. However, to preserve flexibility to respond to the commercial viability of development, it is recommended that Council consider establishment of both minimum and maximum rates for the Precinct as part of a site specific DCP.

- The Cherrybrook Station Structure Plan identifies a potential for 3,150 medium density units, with approximately 65% of these units located within the Cherrybrook South Precinct, to the south of Castle Hill Road (approximately 2,000 units). This has an inherent traffic generation of 1,000 vehicles per hour (veh/hr) during both morning and evening peak periods.

- The proposed rezoning seeks to increase the yield on the subject site in recognition of the transport planning benefits of achieving higher yields in close proximity to Cherrybrook Station and the Castle Hill Road corridor.

- Development of the site (~3,180 units + commuter carpark) will generate in the order of 743 and 666 veh/hr during morning and evening peak periods, having regard for the higher density units now proposed. This represents an increase of 633 and 636 veh/hr above that of the existing uses of the site as residential dwellings (with no rail station) and a child care centre.

- However, the indicative development yield now under consideration will actually result in a reduced traffic volume in comparison to that which would occur under the existing Structure Plan development yield. This takes into consideration the increased proportion of high density apartments which is expected to encourage a different demographic of future

residents. In this regard, the increased number of apartments now proposed is offset by the reduced effective traffic generating nature of residents within high density apartment buildings as opposed to the larger family groups that may otherwise occupy less intense, medium density housing.

- The traffic impacts associated with the proposed rezoning will be more than adequately catered for by the future traffic planning for the wider area being undertaken by TfNSW in relation to the Castle Hill Road corridor based on the current Structure Plan.

- The proposed Master Plan also provides a through site connection between Glenhope Road and Highs Road. TfNSW have expressed interest in this connection which could be of benefit for bus route planning at some stage in the future, particularly to alleviate the need for the planned West Pennant Hills Valley Shuttle bus service, identified in the NWRL EIS, to access Castle Hill Road. In the event that a bus stop is to be considered on internal roads within the proposed Cherrybrook Village, then a direct pedestrian connection to the Station is provided via a pedestrian tunnel from the main east-west village road.

- Furthermore, Council and RMS will no doubt review traffic conditions following completion of the North West Rail Link and also as part of the ongoing planning proposals and development applications for individual land parcels within the Precinct. Hence, the staged and ultimate design of future road improvements can be determined more precisely over time and it is expected that these will be funded by way of Section 94 contributions at Development Application stage.

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

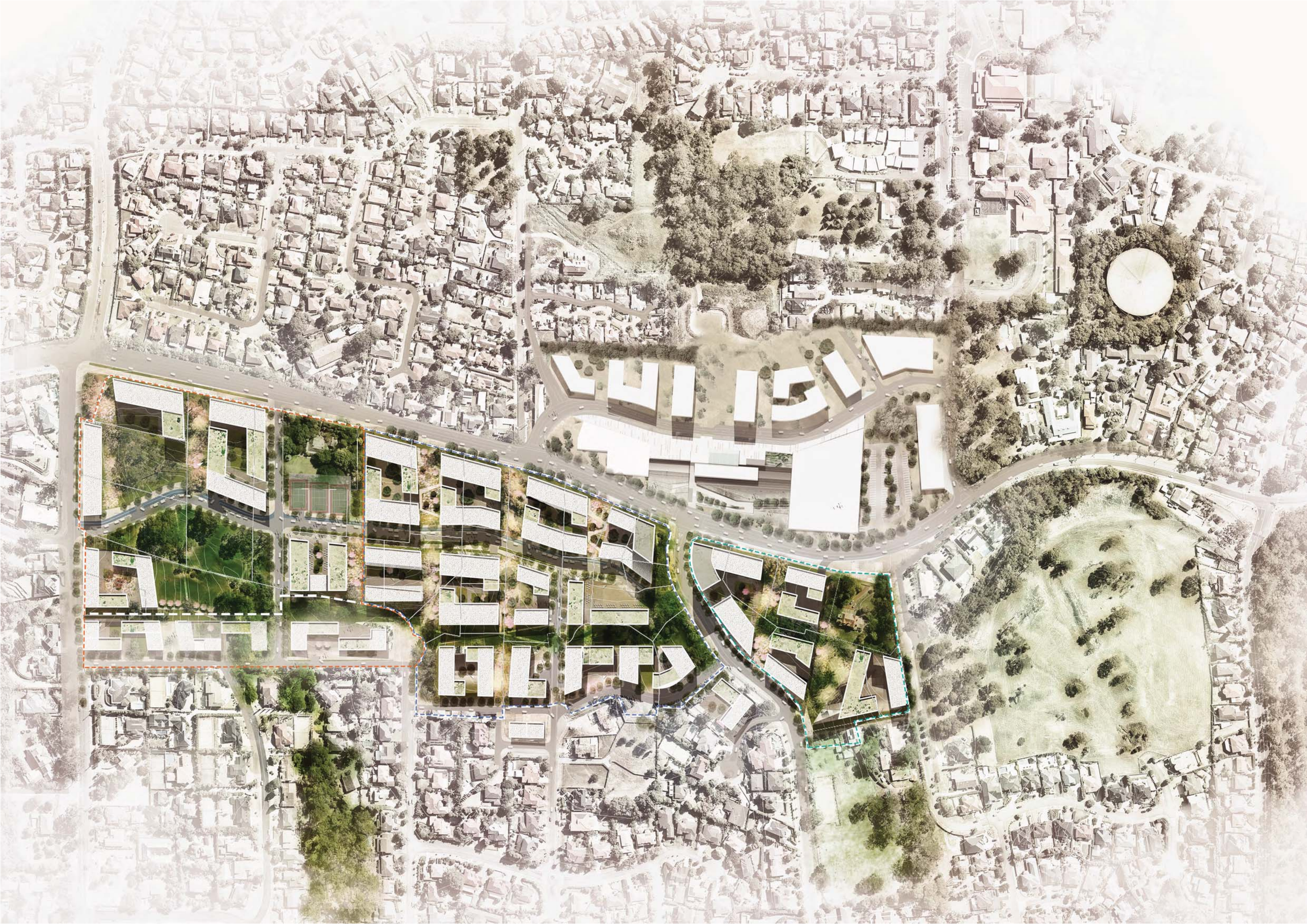
Appendix A

Reduced Plans

LOT 110
2 - 4
6 - 8
143
141
139
137
135A
133
131
127&129
125
123
01
03 G
05 G
07
17-19
09
18
16
24 C
22 C
20 C
12 C
10 C
26 C
14 C
15 W
13 W
11 W
03 W
01 M
03 M
05 M
07 M
09 M
11 M
13 M
15 M
12
10
02
117
04
115a
115b
113 - 111
06
08
10
12
109

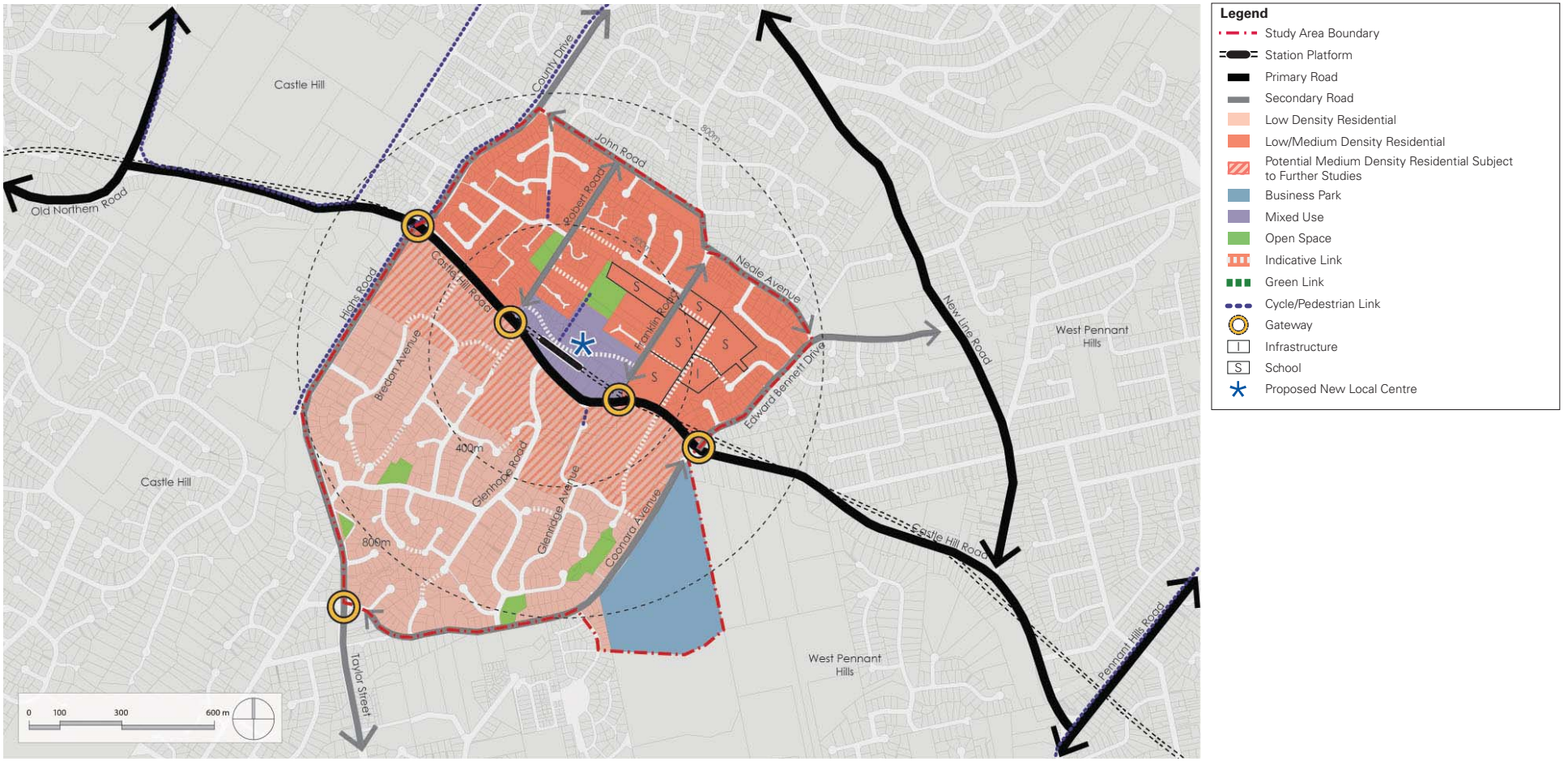
CHERRYBROOK TOWN CENTRE MASTERPLAN

- CURRENT STUDY AREA + MASTERPLAN (TOPLACE)
- INCLUDED IN STUDY AREA + MASTERPLAN (SHARED LIABILITY)
- CURRENT STUDY AREA + MASTERPLAN (RICHARD SMITH)
- CURRENT STUDY AREA + MASTERPLAN (JOE TOUMA)
- CURRENT STUDY AREA + MASTERPLAN (JIM YANG)
- CURRENT STUDY AREA + MASTERPLAN (ALAN BALOUT)
- CURRENT STUDY AREA + MASTERPLAN (TED DAVIS)
- CURRENT STUDY AREA + MASTERPLAN (CRAIG STUBBS)
- CURRENT STUDY AREA + MASTERPLAN (JIM PIGNAT)
- CURRENT STUDY AREA + MASTERPLAN (MILAD ABLA)
- CURRENT STUDY AREA + MASTERPLAN (REG PIGNAT)
- EXCLUDED FROM STUDY AREA, INCLUDED IN MASTERPLAN
- BOUNDARY OF SITES INCLUDED IN GATEWAY REZONING APPLICATION
- BOUNDARY OF SITES INCLUDED IN MASTERPLAN - EXCLUDED FROM REZONING APPLICATION



Appendix B

Extracts from the Cherrybrook Structure Plan



Legend

- Study Area Boundary
- Station Platform
- Primary Road
- Secondary Road
- Low Density Residential
- Low/Medium Density Residential
- Potential Medium Density Residential Subject to Further Studies
- Business Park
- Mixed Use
- Open Space
- Indicative Link
- Green Link
- Cycle/Pedestrian Link
- Gateway
- Infrastructure
- School
- Proposed New Local Centre

Figure 19: Structure Plan for the Cherrybrook Study Area

5.3 FUTURE PRECINCT CHARACTER

The following diagrams and images demonstrate the desired future character for the sites which may contribute to the growth of Cherrybrook in the future.

Centre

Objectives: To provide a precinct that contains a mix of local retail and residential uses to provide activation within the station and interchange areas, and attractive public spaces that are a focal point for the local community. To provide a public domain that ensures safety and accessibility for all modes of transport, particularly cycling and walking, within the station precinct and between the station and adjoining uses. It is anticipated that the Precinct will contain a bus, taxi, kiss and ride interchange, which is integrated with the station.

Character: It is anticipated that under the vision and Structure Plan this precinct could accommodate a mix of local retail and residential uses that would complement the character of the local area and carefully designed to integrate into the surrounding streetscape. The precinct will also contain a local transport interchange and commuter car parking. New public spaces will seek to enhance the landscape character of the area.

Public Domain and Open Space

Objectives: To provide attractive open spaces of high amenity for the public, as well as an accessible and safe public domain.

Character: The Structure Plan identifies green open spaces for residents that are accessible and safe. They should be landscaped appropriately to integrate with the existing character of the area.

Figure 20: Proposed Location of Station Precinct

Figure 21: Proposed Location of Public Domain and Open Space

Low/Medium Density Townhouses

Objectives: To provide for the housing needs of a growing community and to provide a variety of housing types within close proximity of the station and associated uses. As well as a well-developed public domain which ensures the safety and accessibility of pedestrians and cyclists, and the provision of open space and civic spaces.

Character: It is anticipated that under the vision and Structure Plan that this precinct will evolve to become a mixture of single detached dwellings and townhouses. This precinct will serve as a transition between the lower density residential areas beyond the Study Area and the station precinct.

Figure 22: Proposed Location of Low/Medium Density Townhouses

Medium Density Apartment Living

Objectives: To provide for the housing needs of a growing community and to encourage an increased residential density in areas with direct access to the new rail link and station, as well as an enhanced public domain.

Character: It is anticipated that under the vision and Structure Plan that this precinct could accommodate multi-dwelling housing only where the site is an appropriate size to deliver a high level of amenity for the existing and future residents. This could comprise of 3-6 storey apartment buildings, carefully master planned around communal open spaces and incorporating landscaped setbacks to existing streetscapes. Land to the south of Castle Hill Road may potentially be redeveloped for Medium Density Apartment living, subject to further investigation and studies.

Figure 23: Proposed Location of Medium Density Apartments

Areas Expected to Remain Unchanged

Within the Study Area there are areas and sites which are expected to remain largely unchanged through the delivery of the NWRL and the Structure Plan.

This is due to a number of factors including existing uses, varying degrees of constraints, connectivity, accessibility and market demand.

Figure 24: Areas to remain largely unchanged under the Structure Plan

5.4 PROJECTED GROWTH

Calculating Projected Growth

The projected growth is a calculation of the amount of residential and employment development that is expected to take place in the Study Area. The projected growth calculations take into consideration the following factors:

- **Development on Opportunity Sites.** Development is projected to occur on the opportunity sites identified in Section 4.1 of this report.
- **The Proposed Future Character and Built Form.** The Structure Plan identifies the future desired character and built form for areas within the Study Area. These character/building types have been applied to the opportunity sites.
- **Assumptions.** A series of assumptions related to the different development types have been applied to calculate the land areas required for each built form. Details can be found in the North West Rail Link Corridor Strategy.
- **Demand.** The amount, and rate of development is influenced by market demand for different types of development within the Study Area. Market demand is determined by 'take-up' or 'realisation' rates, which reflect market conditions and has been informed by a high-level feasibility analysis. In Cherrybrook, due to the high level of amenity and quality of life afforded within the Study Area at present and the added accessibility delivered by the North West Rail Link, the take up/ realisation rate is considered to be 91% for housing and 100% for employment. Take-up/realisation rates have been identified for each development type and these have been used in the projected growth calculations.

Projected Growth in the Study Area

The outcome of these projected growth calculations is provided in the tables below. Total opportunity site area within the Study Area equates to approximately 73 hectares.

Application of the proposed land uses and typologies in the Structure Plan will result in a total capacity for an additional 3,500 dwellings by 2036. However, it is anticipated that only 91% of this capacity will be realised by 2036, delivering an additional **3,200** dwellings within the Study Area.

Employment is limited to jobs generated by the retail floorspace within the proposed local centre adjacent the station and the Coonara Ave Business Park. Therefore, it is anticipated that employment capacity within the Study Area, generated by the new local centre could deliver **50** new jobs through to 2036.

RESIDENTIAL

TYPE OF HOUSING	DWELLINGS IN 2012		DWELLINGS IN 2036		GROWTH
	TOTAL	%	TOTAL	%	TOTAL
SINGLE DETACHED	1,100	100%	750	17%	-350
TOWNHOUSE	0	0%	400	10%	400
3-6 STOREY APARTMENT	0	0%	3,150	73%	3,150
7-12 STOREY APARTMENT	0	0%	0	0%	0
TOTAL DWELLINGS	**1,100**	**100%**	**4,300**	**100%**	**3,200**

Table 5.1: Projected Residential Growth in Cherrybrook under the Structure Plan

EMPLOYMENT

TYPE OF JOBS	JOBS IN 2012		JOBS IN 2036		GROWTH
	TOTAL	%	TOTAL	%	TOTAL
COMMERCIAL	2,000	100%	2,000	98%	0
RETAIL	0	0%	50	2%	50
BULKY GOODS	0	0%	0	0%	0
INDUSTRIAL	0	0%	0	0%	0
TOTAL JOBS	**2,000**	**100%**	**2,050**	**100%**	**50**

Table 5.2: Projected Employment Growth in Cherrybrook under the Structure Plan

Demand Analysis

A high level demand analysis has been undertaken to ascertain the demand for potential development scenarios on opportunity sites within the Study Area. The analysis:

- Assessed the proposed future desired character and built form, including densities, as proposed under the Structure Plan, against market conditions and demand; and
- Identified take-up/realisation rates for each land use within the Study Area, which informed the calculation of projected growth.

Outcomes of the demand analysis:

1. **Demand for Additional Dwellings**. Future demand for additional residential development in the Study Area is estimated to be in the order of **128** dwellings per annum comprised of 11% townhouses and 89% 3-6 storey apartments in addition to existing stock resulting in the total dwelling diversity shown in the adjacent table in 2036. Such demand is related to the high level of amenity and quality of life afforded within Cherrybrook, the demand for housing diversity and improved access to social, recreational and employment opportunities as a result of the North West Rail Link.
2. **Demand for Employment Lands**. Future demand for additional employment (commercial and retail) floorspace within the Study Area is projected to remain a constant within the Study Area through to 2036.
3. **Type and Location of Development.** The analysis supports the provision for 3-6 storey apartments within close walking distance of the new train station. These areas of residential uplift and renewal may serve as the catalyst for regeneration within the broader precinct. In particular, future residents will be attracted to these areas for their high levels of amenity, employment opportunities, retail, cultural and community facilities and close proximity to the train station.

   The analysis supports the provision for townhouse development on the periphery of the Study Area where large single lots could accommodate 2-4 townhouses each and the possibility to amalgamate sites into larger contiguous landholdings exists.

   In terms of future employment generating development, the feasibility analysis supports the provision for retail land-use at the mixed use area around the new station to provide for the day to day needs of residents and workers. Future retail floorspace within Cherrybrook is expected to increase in line with the growth of the population catchment and provide a small amount of additional employment within the new Local Centre.

Appendix C1

SIDRA Modelling Results - Existing

MOVEMENT SUMMARY

Site: 1 [J01 - Castle Hill Rd x Highs Rd_AM Peak - EX]

Intersetion: Castle Hill Road x Highs Road x County Drive
Period: AM Peak
Scenario: Existing
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: Highs Road												
1	L2	355	2.7	0.919	71.3	LOS F	24.3	174.2	1.00	1.00	1.35	36.7
2	T1	116	0.0	0.719	62.0	LOS E	7.1	50.0	1.00	0.85	1.13	38.5
3	R2	1	0.0	0.719	67.6	LOS E	7.1	50.0	1.00	0.85	1.13	37.3
Approach		472	2.0	0.919	69.0	LOS E	24.3	174.2	1.00	0.96	1.30	37.2
East: Castle Hill Road												
4	L2	9	44.4	0.678	48.3	LOS D	22.0	162.8	0.91	0.82	1.28	41.6
5	T1	880	5.6	0.678	38.9	LOS C	22.2	162.9	0.91	0.81	1.09	37.2
6	R2	93	11.4	0.498	62.2	LOS E	5.3	40.9	0.99	0.78	0.99	28.7
Approach		982	6.5	0.678	41.2	LOS C	22.2	162.9	0.92	0.81	1.08	36.3
North: County Drive												
7	L2	92	9.2	0.143	21.8	LOS B	2.5	19.2	0.70	0.73	0.70	42.5
8	T1	208	0.5	0.415	39.9	LOS C	10.2	71.4	0.88	0.73	0.88	44.2
9	R2	821	2.1	0.909	68.0	LOS E	27.8	198.3	1.00	1.00	1.29	30.1
Approach		1121	2.3	0.909	59.0	LOS E	27.8	198.3	0.95	0.93	1.17	33.6
West: Castle Hill Road												
10	L2	601	2.5	0.679	16.6	LOS B	17.6	125.8	0.55	0.75	0.55	47.4
11	T1	904	4.3	0.919	57.9	LOS E	36.8	267.0	0.93	1.04	1.24	31.4
12	R2	207	2.5	0.634	29.7	LOS C	7.0	50.4	0.93	0.81	0.93	47.1
Approach		1713	3.4	0.919	40.0	LOS C	36.8	267.0	0.80	0.91	0.96	38.3
All Vehicles		4287	3.7	0.919	48.4	LOS D	36.8	267.0	0.89	0.90	1.08	36.4

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	5	30.1	LOS D	0.0	0.0	0.71	0.71
P2	East Full Crossing	5	45.1	LOS E	0.0	0.0	0.87	0.87
P3	North Full Crossing	5	37.6	LOS D	0.0	0.0	0.79	0.79
All Pedestrians		16	37.6	LOS D			0.79	0.79

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

MOVEMENT SUMMARY

Site: 1 [J02 - Castle Hill Rd x Glenhope Rd_AM Peak - EX]

Intersection: Castle Hill Road x Glenhope Road
Period: AM Peak
Scenario: Existing
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: Glenhope Road												
1	L2	83	0.0	0.149	21.4	LOS B	1.8	12.7	0.77	0.72	0.77	34.7
3	R2	46	0.0	0.249	33.4	LOS C	1.3	9.4	0.96	0.73	0.96	36.7
Approach		129	0.0	0.249	25.7	LOS B	1.8	12.7	0.84	0.72	0.84	35.6
East: Castle Hill Road												
4	L2	21	5.0	0.486	16.4	LOS B	8.8	65.8	0.71	0.63	0.71	47.1
5	T1	878	8.3	0.486	10.8	LOS A	8.8	65.9	0.71	0.62	0.71	48.3
Approach		899	8.2	0.486	10.9	LOS A	8.8	65.9	0.71	0.62	0.71	48.2
West: Castle Hill Road												
11	T1	1024	1.8	0.380	3.9	LOS A	6.1	43.5	0.44	0.39	0.44	55.1
12	R2	34	0.0	0.072	10.9	LOS A	0.3	2.3	0.59	0.67	0.59	41.7
Approach		1058	1.8	0.380	4.2	LOS A	6.1	43.5	0.44	0.40	0.44	54.6
All Vehicles		2086	4.4	0.486	8.4	LOS A	8.8	65.9	0.58	0.51	0.58	50.0

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	5	11.4	LOS B	0.0	0.0	0.62	0.62
P2	East Full Crossing	5	24.3	LOS C	0.0	0.0	0.90	0.90
All Pedestrians		11	17.9	LOS B			0.76	0.76

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

MOVEMENT SUMMARY

Site: 1 [J04 - Castle Hill Rd x Robert Rd_AM Peak - EX]

Intersection: Castle Hill Road x Robert Road
Period: AM Peak
Scenario: Existing
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
East: Castle Hill Road												
5	T1	997	2.6	0.260	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
Approach		997	2.6	0.260	0.0	NA	0.0	0.0	0.00	0.00	0.00	59.9
North: Robert Road												
7	L2	38	2.8	0.043	6.4	LOS A	0.2	1.1	0.42	0.61	0.42	44.1
Approach		38	2.8	0.043	6.4	LOS A	0.2	1.1	0.42	0.61	0.42	44.1
West: Castle Hill Road												
10	L2	13	8.3	0.213	5.7	LOS A	0.0	0.0	0.00	0.02	0.00	57.6
11	T1	809	1.4	0.213	0.0	LOS A	0.0	0.0	0.00	0.01	0.00	59.8
Approach		822	1.5	0.213	0.1	NA	0.0	0.0	0.00	0.01	0.00	59.8
All Vehicles		1857	2.2	0.260	0.2	NA	0.2	1.1	0.01	0.02	0.01	59.4

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

MOVEMENT SUMMARY

Site: 1 [J03 - Castle Hill Rd x Coonara Ave_AM Peak - EX]

Intersection: Castle Hill Road x Coonara Avenue x Edward Bennett Drive
Period: AM Peak
Scenario: Existing
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Site User-Given Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: Coonara Avenue												
1	L2	27	3.8	0.236	29.9	LOS C	3.5	25.3	0.83	0.71	0.83	38.9
2	T1	56	1.9	0.236	25.3	LOS B	3.5	25.3	0.83	0.71	0.83	36.3
3	R2	138	2.3	0.236	30.6	LOS C	3.5	25.3	0.83	0.74	0.83	42.7
Approach		221	2.4	0.236	29.2	LOS C	3.5	25.3	0.83	0.73	0.83	40.9
East: Castle Hill Road												
4	L2	231	5.0	0.953	60.4	LOS E	29.6	219.5	1.00	1.26	1.74	35.6
5	T1	807	8.6	0.953	55.7	LOS D	29.6	219.5	1.00	1.26	1.65	38.0
6	R2	67	10.9	0.300	26.0	LOS B	1.6	12.5	0.95	0.74	0.95	44.4
Approach		1105	8.0	0.953	54.9	LOS D	29.6	219.5	1.00	1.23	1.62	37.8
North: Edward Bennett Drive												
7	L2	139	5.3	0.518	23.2	LOS B	2.9	21.2	0.96	0.78	0.96	44.9
8	T1	52	0.0	0.706	43.4	LOS D	4.2	29.9	1.00	0.86	1.20	30.8
9	R2	48	2.2	0.706	48.0	LOS D	4.2	29.9	1.00	0.86	1.20	33.1
Approach		239	3.5	0.706	32.6	LOS C	4.2	29.9	0.98	0.81	1.06	39.6
West: Castle Hill Road												
10	L2	27	3.8	0.976	70.4	LOS E	33.3	241.7	1.00	1.33	1.66	28.6
11	T1	997	4.2	0.976	64.9	LOS E	33.3	241.7	1.00	1.33	1.69	36.1
12	R2	115	0.9	0.497	26.7	LOS B	2.9	20.2	0.99	0.76	0.99	39.8
Approach		1139	3.9	0.976	61.2	LOS E	33.3	241.7	1.00	1.27	1.62	36.1
All Vehicles		2704	5.4	0.976	53.5	LOS D	33.3	241.7	0.98	1.17	1.51	37.4

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	53	24.9	LOS C	0.1	0.1	0.79	0.79
P2	East Full Crossing	5	34.2	LOS D	0.0	0.0	0.93	0.93
P3	North Full Crossing	5	24.8	LOS C	0.0	0.0	0.79	0.79
All Pedestrians		63	25.6	LOS C			0.80	0.80

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

MOVEMENT SUMMARY

Site: 1 [J01 - Castle Hill Rd x Highs Rd_PM Peak - EX]

Intersetion: Castle Hill Road x Highs Road x County Drive
Period: PM Peak
Scenario: Existing
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: Highs Road												
1	L2	373	3.4	0.799	53.0	LOS D	22.9	165.2	0.91	0.87	0.99	40.7
2	T1	152	1.4	0.971	98.5	LOS F	13.7	98.0	1.00	1.11	1.59	31.8
3	R2	7	28.6	0.971	104.4	LOS F	13.7	98.0	1.00	1.11	1.59	30.4
Approach		532	3.2	0.971	66.7	LOS E	22.9	165.2	0.94	0.94	1.17	37.6
East: Castle Hill Road												
4	L2	13	0.0	0.944	75.9	LOS F	59.7	423.2	1.00	1.10	1.47	35.5
5	T1	1394	1.6	0.944	68.5	LOS E	59.7	423.2	1.00	1.10	1.36	28.8
6	R2	109	3.8	0.314	58.2	LOS E	6.5	46.7	0.90	0.78	0.90	29.8
Approach		1516	1.7	0.944	67.8	LOS E	59.7	423.2	0.99	1.08	1.33	29.0
North: County Drive												
7	L2	57	3.7	0.092	26.4	LOS B	2.0	14.2	0.71	0.71	0.71	40.4
8	T1	135	0.8	0.463	59.3	LOS E	8.5	60.1	0.96	0.77	0.96	39.1
9	R2	538	1.4	0.975	104.1	LOS F	23.9	169.2	1.00	1.07	1.52	23.9
Approach		729	1.4	0.975	89.8	LOS F	23.9	169.2	0.97	0.99	1.35	27.4
West: Castle Hill Road												
10	L2	725	1.2	0.880	36.1	LOS C	38.8	274.2	0.73	0.86	0.82	38.8
11	T1	863	2.6	0.868	47.6	LOS D	34.4	246.4	0.85	0.86	1.01	34.3
12	R2	309	2.7	0.753	53.3	LOS D	16.3	116.9	0.99	0.95	1.28	40.6
Approach		1898	2.1	0.880	44.1	LOS D	38.8	274.2	0.83	0.87	0.98	37.3
All Vehicles		4675	2.0	0.975	61.5	LOS E	59.7	423.2	0.92	0.97	1.17	32.9

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	5	29.6	LOS C	0.0	0.0	0.65	0.65
P2	East Full Crossing	5	64.1	LOS F	0.0	0.0	0.96	0.96
P3	North Full Crossing	5	36.4	LOS D	0.0	0.0	0.72	0.72
All Pedestrians		16	43.4	LOS E			0.78	0.78

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

MOVEMENT SUMMARY

Site: 1 [J02 - Castle Hill Rd x Glenhope Rd_PM Peak - EX]

Intersection: Castle Hill Road x Glenhope Road
Period: PM Peak
Scenario: Existing
Site Category: (None)
Signals - Fixed Time Coordinated Cycle Time = 115 seconds (Site Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: Glenhope Road												
1	L2	69	1.5	0.242	51.1	LOS D	3.5	24.7	0.92	0.75	0.92	24.3
3	R2	32	0.0	0.326	65.1	LOS E	1.8	12.8	1.00	0.72	1.00	28.3
Approach		101	1.0	0.326	55.5	LOS D	3.5	24.7	0.94	0.74	0.94	25.9
East: Castle Hill Road												
4	L2	42	0.0	0.525	6.5	LOS A	2.6	18.3	0.07	0.09	0.07	53.5
5	T1	1451	2.0	0.525	0.8	LOS A	2.6	18.3	0.06	0.07	0.06	58.8
Approach		1493	1.9	0.525	0.9	LOS A	2.6	18.3	0.06	0.07	0.06	58.6
West: Castle Hill Road												
11	T1	845	3.9	0.263	1.9	LOS A	4.6	33.6	0.22	0.19	0.22	57.6
12	R2	69	1.5	0.225	7.7	LOS A	0.7	4.9	0.27	0.63	0.27	44.2
Approach		915	3.7	0.263	2.3	LOS A	4.6	33.6	0.22	0.23	0.22	56.4
All Vehicles		2508	2.5	0.525	3.6	LOS A	4.6	33.6	0.15	0.15	0.15	54.8

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	5	6.0	LOS A	0.0	0.0	0.32	0.32
P2	East Full Crossing	5	51.7	LOS E	0.0	0.0	0.95	0.95
All Pedestrians		11	28.8	LOS C			0.63	0.63

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

MOVEMENT SUMMARY

Site: 1 [J03 - Castle Hill Rd x Coonara Ave_PM Peak - EX]

Intersection: Castle Hill Road x Coonara Avenue x Edward Bennett Drive
Period: PM Peak
Scenario: Existing
Site Category: (None)
Signals - Fixed Time Coordinated Cycle Time = 120 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: Coonara Avenue												
1	L2	126	0.0	0.509	44.9	LOS D	12.6	89.0	0.90	0.80	0.90	33.7
2	T1	79	0.0	0.509	40.3	LOS C	12.6	89.0	0.90	0.80	0.90	31.4
3	R2	279	3.4	0.509	46.2	LOS D	12.6	89.0	0.91	0.81	0.91	38.0
Approach		484	2.0	0.509	44.9	LOS D	12.6	89.0	0.91	0.80	0.91	36.1
East: Castle Hill Road												
4	L2	268	4.7	0.890	42.2	LOS C	43.4	312.2	0.94	0.97	1.20	40.4
5	T1	1138	2.4	0.890	35.3	LOS C	43.4	312.2	0.85	0.87	1.03	43.8
6	R2	151	4.9	0.410	25.7	LOS B	4.5	32.7	0.84	0.78	0.84	44.5
Approach		1557	3.0	0.890	35.6	LOS C	43.4	312.2	0.87	0.88	1.04	43.3
North: Edward Bennett Drive												
7	L2	60	5.3	0.192	29.3	LOS C	1.9	13.7	0.89	0.73	0.89	42.8
8	T1	31	0.0	0.582	64.9	LOS E	3.4	24.1	1.00	0.77	1.06	26.2
9	R2	24	4.3	0.582	69.5	LOS E	3.4	24.1	1.00	0.77	1.06	28.1
Approach		115	3.7	0.582	47.3	LOS D	3.4	24.1	0.94	0.75	0.97	35.0
West: Castle Hill Road												
10	L2	33	6.5	0.645	38.1	LOS C	22.0	159.0	0.88	0.78	0.88	37.4
11	T1	826	3.8	0.645	32.1	LOS C	22.0	159.0	0.86	0.76	0.86	45.1
12	R2	68	1.5	0.397	32.3	LOS C	2.0	14.4	0.94	0.76	0.94	37.6
Approach		927	3.7	0.645	32.4	LOS C	22.0	159.0	0.87	0.76	0.87	44.4
All Vehicles		3083	3.1	0.890	36.5	LOS C	43.4	312.2	0.88	0.83	0.97	42.2

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	53	28.1	LOS C	0.1	0.1	0.68	0.68
P2	East Full Crossing	5	54.2	LOS E	0.0	0.0	0.95	0.95
P3	North Full Crossing	5	28.0	LOS C	0.0	0.0	0.68	0.68
All Pedestrians		63	30.2	LOS D			0.71	0.71

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

MOVEMENT SUMMARY

Site: 1 [J04 - Castle Hill Rd x Robert Rd_PM Peak - EX]

Intersection: Castle Hill Road x Robert Road
Period: PM Peak
Scenario: Existing
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
East: Castle Hill Road												
5	T1	1573	0.2	0.404	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
Approach		1573	0.2	0.404	0.0	NA	0.0	0.0	0.00	0.00	0.00	59.9
North: Robert Road												
7	L2	19	0.0	0.022	6.5	LOS A	0.1	0.6	0.44	0.60	0.44	44.2
Approach		19	0.0	0.022	6.5	LOS A	0.1	0.6	0.44	0.60	0.44	44.2
West: Castle Hill Road												
10	L2	17	0.0	0.236	5.6	LOS A	0.0	0.0	0.00	0.02	0.00	58.0
11	T1	895	1.3	0.236	0.0	LOS A	0.0	0.0	0.00	0.01	0.00	59.8
Approach		912	1.3	0.236	0.1	NA	0.0	0.0	0.00	0.01	0.00	59.7
All Vehicles		2503	0.6	0.404	0.1	NA	0.1	0.6	0.00	0.01	0.00	59.6

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.
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.

Appendix C2

SIDRA Modelling Results – Existing + Development

MOVEMENT SUMMARY

Site: 1 [J01 - Castle Hill Rd x Highs Rd_AM Peak - EX + DEV]

Intersetion: Castle Hill Road x Highs Road x County Drive
Period: AM Peak
Scenario: Existing + DEV
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: Highs Road												
1	L2	373	2.5	0.783	43.4	LOS D	19.0	135.5	0.87	0.86	0.95	43.1
2	T1	126	0.0	1.008	106.6	LOS F	23.8	166.5	1.00	1.27	1.74	30.1
3	R2	145	0.0	1.008	112.2	LOS F	23.8	166.5	1.00	1.27	1.74	29.0
Approach		644	1.5	1.008	71.3	LOS F	23.8	166.5	0.93	1.03	1.28	36.4
East: Castle Hill Road												
4	L2	26	16.0	0.969	92.0	LOS F	38.2	281.0	1.00	1.25	1.79	32.4
5	T1	935	5.3	0.969	83.2	LOS F	38.2	281.0	1.00	1.23	1.62	25.9
6	R2	125	8.4	0.953	88.8	LOS F	9.2	68.8	1.00	1.08	1.66	23.6
Approach		1086	5.9	0.969	84.0	LOS F	38.2	281.0	1.00	1.22	1.63	25.9
North: County Drive												
7	L2	108	7.8	0.200	23.0	LOS B	2.8	20.7	0.77	0.75	0.77	41.9
8	T1	225	0.5	0.497	43.2	LOS D	11.5	80.9	0.92	0.77	0.92	43.2
9	R2	821	2.1	1.019	114.4	LOS F	37.2	265.0	1.00	1.18	1.70	22.5
Approach		1155	2.3	1.019	91.9	LOS F	37.2	265.0	0.96	1.06	1.46	27.0
West: Castle Hill Road												
10	L2	601	2.5	0.786	22.7	LOS B	21.8	156.1	0.66	0.79	0.68	44.3
11	T1	921	4.2	1.023	111.0	LOS F	51.3	372.3	1.00	1.39	1.71	21.7
12	R2	224	2.3	0.824	46.5	LOS D	10.5	74.7	1.00	0.90	1.25	42.3
Approach		1746	3.4	1.023	72.4	LOS F	51.3	372.3	0.88	1.12	1.29	29.7
All Vehicles		4632	3.4	1.023	79.8	LOS F	51.3	372.3	0.94	1.12	1.41	29.2

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	5	37.6	LOS D	0.0	0.0	0.79	0.79
P2	East Full Crossing	5	47.7	LOS E	0.0	0.0	0.89	0.89
P3	North Full Crossing	5	41.7	LOS E	0.0	0.0	0.83	0.83
All Pedestrians		16	42.3	LOS E			0.84	0.84

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

MOVEMENT SUMMARY

Site: 2 [J02 - Castle Hill Rd x Glenhope Rd_AM Peak - EX + DEV]

Intersection: Castle Hill Road x Glenhope Road
Period: AM Peak
Scenario: Existing + DEV
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: Glenhope Road												
1	L2	158	0.0	0.182	14.7	LOS B	2.7	19.0	0.62	0.71	0.62	38.5
3	R2	431	0.0	0.869	36.5	LOS C	15.0	105.3	1.00	1.03	1.38	35.7
Approach		588	0.0	0.869	30.6	LOS C	15.0	105.3	0.90	0.94	1.17	36.2
East: Castle Hill Road												
4	L2	54	2.0	0.837	32.1	LOS C	16.8	124.5	0.99	1.02	1.23	39.6
5	T1	983	7.4	0.837	26.5	LOS B	16.8	125.2	0.99	1.02	1.23	37.6
Approach		1037	7.1	0.837	26.8	LOS B	16.8	125.2	0.99	1.02	1.23	37.7
West: Castle Hill Road												
11	T1	1172	3.2	0.575	10.2	LOS A	11.7	83.8	0.72	0.64	0.72	48.9
12	R2	119	0.9	0.364	18.5	LOS B	1.9	13.4	0.91	0.76	0.91	36.9
Approach		1291	3.0	0.575	11.0	LOS A	11.7	83.8	0.74	0.65	0.74	47.6
All Vehicles		2916	3.9	0.869	20.6	LOS B	16.8	125.2	0.86	0.84	1.00	40.8

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	5	18.4	LOS B	0.0	0.0	0.78	0.78
P2	East Full Crossing	5	24.3	LOS C	0.0	0.0	0.90	0.90
All Pedestrians		11	21.4	LOS C			0.84	0.84

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

MOVEMENT SUMMARY

Site: 3 [J03 - Castle Hill Rd x Coonara Ave_AM Peak - EX + DEV]

Intersection: Castle Hill Road x Coonara Avenue x Edward Bennett Drive
Period: AM Peak
Scenario : Existing + DEV
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Site User-Given Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: Coonara Avenue												
1	L2	53	2.0	0.501	39.8	LOS C	5.0	35.3	0.96	0.78	0.96	35.4
2	T1	56	1.9	0.501	35.2	LOS C	5.0	35.3	0.96	0.78	0.96	33.0
3	R2	138	2.3	0.501	41.3	LOS C	5.0	35.3	0.98	0.78	0.98	39.4
Approach		246	2.1	0.501	39.6	LOS C	5.0	35.3	0.97	0.78	0.97	37.4
East: Castle Hill Road												
4	L2	231	5.0	0.704	24.6	LOS B	16.9	125.5	0.87	0.84	1.07	46.1
5	T1	840	8.3	0.704	19.5	LOS B	16.9	125.5	0.86	0.79	0.94	49.6
6	R2	67	10.9	0.300	24.9	LOS B	1.4	10.6	0.95	0.74	0.95	44.7
Approach		1138	7.8	0.704	20.9	LOS B	16.9	125.5	0.86	0.79	0.96	48.6
North: Edward Bennett Drive												
7	L2	139	5.3	0.518	25.4	LOS B	3.7	27.1	0.96	0.78	0.96	44.1
8	T1	52	0.0	0.766	44.6	LOS D	4.7	33.0	1.00	0.90	1.29	30.5
9	R2	57	1.9	0.766	49.2	LOS D	4.7	33.0	1.00	0.90	1.29	32.7
Approach		247	3.4	0.766	34.9	LOS C	4.7	33.0	0.98	0.83	1.11	38.8
West: Castle Hill Road												
10	L2	36	2.9	1.000	79.2	LOS F	54.6	391.6	1.00	1.47	1.72	26.9
11	T1	1465	2.9	1.000	74.9	LOS F	54.6	391.6	1.00	1.46	1.74	34.0
12	R2	149	0.7	0.513	20.1	LOS B	3.0	20.8	0.88	0.78	0.88	42.6
Approach		1651	2.7	1.000	70.1	LOS E	54.6	391.6	0.99	1.40	1.66	34.3
All Vehicles		3282	4.5	1.000	48.1	LOS D	54.6	391.6	0.94	1.10	1.33	38.9

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	53	17.6	LOS B	0.1	0.1	0.66	0.66
P2	East Full Crossing	5	34.2	LOS D	0.0	0.0	0.93	0.93
P3	North Full Crossing	5	17.6	LOS B	0.0	0.0	0.66	0.66
All Pedestrians		63	19.0	LOS B			0.69	0.69

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

MOVEMENT SUMMARY

Site: 4 [J04 - Castle Hill Rd x New Access Rd_AM Peak - EX + DEV - Import]

Intersection: Castle Hill Road x New Access Road
Period: AM Peak
Scenario: Existing + Development (315 Medium Density + 3285 High Density = 3600 Residential Units + Commuter Carpark)
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: New Access Road												
1	L2	28	0.0	0.037	7.2	LOS A	0.1	0.9	0.48	0.66	0.48	44.2
Approach		28	0.0	0.037	7.2	LOS A	0.1	0.9	0.48	0.66	0.48	44.2
East: Castle Hill Rd												
4	L2	33	0.0	0.286	5.6	LOS A	0.0	0.0	0.00	0.04	0.00	57.3
5	T1	1036	7.0	0.286	0.0	LOS A	0.0	0.0	0.00	0.02	0.00	59.5
Approach		1068	6.8	0.286	0.2	NA	0.0	0.0	0.00	0.02	0.00	59.4
West: Castle Hill Rd												
11	T1	1175	4.0	0.309	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
Approach		1175	4.0	0.309	0.0	NA	0.0	0.0	0.00	0.00	0.00	59.9
All Vehicles		2272	5.3	0.309	0.2	NA	0.1	0.9	0.01	0.02	0.01	59.3

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

MOVEMENT SUMMARY

Site: 1 [J01 - Castle Hill Rd x Highs Rd_PM Peak - EX + DEV]

Intersetion: Castle Hill Road x Highs Road x County Drive
Period: PM Peak
Scenario: Existing + DEV
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: Highs Road												
1	L2	380	3.3	0.859	60.5	LOS E	25.5	183.5	0.93	0.91	1.09	39.0
2	T1	159	1.3	1.006	115.5	LOS F	18.4	131.1	1.00	1.19	1.69	29.2
3	R2	35	6.1	1.006	121.2	LOS F	18.4	131.1	1.00	1.19	1.69	28.1
Approach		574	2.9	1.006	79.4	LOS F	25.5	183.5	0.95	1.01	1.29	35.1
East: Castle Hill Road												
4	L2	26	0.0	1.007	86.0	LOS F	60.7	430.5	1.00	1.18	1.45	29.2
5	T1	1415	1.6	1.007	90.7	LOS F	68.8	488.2	1.00	1.23	1.46	22.6
6	R2	131	3.2	0.458	64.2	LOS E	8.2	59.1	0.96	0.80	0.96	28.4
Approach		1572	1.7	1.007	88.5	LOS F	68.8	488.2	1.00	1.19	1.42	23.1
North: County Drive												
7	L2	75	2.8	0.125	26.3	LOS B	2.5	18.1	0.73	0.73	0.73	40.5
8	T1	153	0.7	0.459	56.7	LOS E	9.5	66.6	0.95	0.77	0.95	39.7
9	R2	641	1.0	1.014	122.6	LOS F	31.5	222.2	1.00	1.14	1.63	21.5
Approach		868	1.1	1.014	102.7	LOS F	31.5	222.2	0.97	1.04	1.43	25.3
West: Castle Hill Road												
10	L2	725	1.2	0.879	35.3	LOS C	38.2	269.9	0.72	0.85	0.80	39.1
11	T1	894	2.5	0.927	63.7	LOS E	41.2	294.6	0.88	0.99	1.17	29.9
12	R2	340	2.5	0.992	100.9	LOS F	27.8	198.7	1.00	1.14	1.80	31.8
Approach		1959	2.0	0.992	59.6	LOS E	41.2	294.6	0.84	0.97	1.14	33.1
All Vehicles		4973	1.8	1.014	78.6	LOS F	68.8	488.2	0.92	1.05	1.30	28.5

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	5	30.9	LOS D	0.0	0.0	0.66	0.66
P2	East Full Crossing	5	61.3	LOS F	0.0	0.0	0.94	0.94
P3	North Full Crossing	5	37.9	LOS D	0.0	0.0	0.74	0.74
All Pedestrians		16	43.4	LOS E			0.78	0.78

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

MOVEMENT SUMMARY

Site: 2 [J02 - Castle Hill Rd x Glenhope Rd_PM Peak - EX + DEV]

Intersection: Castle Hill Road x Glenhope Road
Period: PM Peak
Scenario: Existing + DEV
Site Category: (None)
Signals - Fixed Time Coordinated Cycle Time = 130 seconds (Site Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: Glenhope Road												
1	L2	111	1.0	0.354	56.6	LOS E	6.3	44.3	0.93	0.78	0.93	23.0
3	R2	73	0.0	0.847	80.9	LOS F	5.2	36.1	1.00	0.93	1.40	25.5
Approach		183	0.6	0.847	66.2	LOS E	6.3	44.3	0.96	0.84	1.12	24.2
East: Castle Hill Road												
4	L2	255	0.0	0.677	9.4	LOS A	13.4	94.8	0.25	0.35	0.25	50.6
5	T1	1663	1.7	0.677	2.7	LOS A	13.4	94.8	0.18	0.22	0.18	55.8
Approach		1918	1.5	0.677	3.6	LOS A	13.4	94.8	0.19	0.24	0.19	54.8
West: Castle Hill Road												
11	T1	859	3.8	0.262	1.7	LOS A	4.7	34.2	0.19	0.17	0.19	57.8
12	R2	132	0.8	0.515	13.9	LOS A	5.3	37.5	0.78	0.82	0.78	39.6
Approach		991	3.4	0.515	3.3	LOS A	5.3	37.5	0.27	0.26	0.27	54.8
All Vehicles		3092	2.0	0.847	7.2	LOS A	13.4	94.8	0.26	0.28	0.27	50.7

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	5	6.5	LOS A	0.0	0.0	0.32	0.32
P2	East Full Crossing	5	59.2	LOS E	0.0	0.0	0.95	0.95
All Pedestrians		11	32.8	LOS D			0.63	0.63

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

MOVEMENT SUMMARY

Site: 3 [J03 - Castle Hill Rd x Coonara Ave_PM Peak - EX + DEV]

Intersection: Castle Hill Road x Coonara Avenue x Edward Bennett Drive
Period: PM Peak
Scenario: Existing + DEV
Site Category: (None)
Signals - Fixed Time Coordinated Cycle Time = 120 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: Coonara Avenue												
1	L2	155	0.0	0.750	55.9	LOS D	15.8	111.4	1.00	0.88	1.07	30.8
2	T1	79	0.0	0.750	51.4	LOS D	15.8	111.4	1.00	0.88	1.07	28.6
3	R2	279	3.4	0.750	58.0	LOS E	15.8	111.4	1.00	0.88	1.09	35.2
Approach		513	1.8	0.750	56.4	LOS D	15.8	111.4	1.00	0.88	1.08	33.1
East: Castle Hill Road												
4	L2	156	1.4	0.899	37.6	LOS C	50.4	358.0	0.91	0.94	1.16	42.1
5	T1	1527	1.8	0.899	31.2	LOS C	50.4	358.0	0.82	0.85	1.01	45.4
6	R2	151	4.9	0.354	20.9	LOS B	3.7	27.1	0.76	0.77	0.76	46.3
Approach		1834	2.0	0.899	30.9	LOS C	50.4	358.0	0.83	0.85	1.00	45.1
North: Edward Bennett Drive												
7	L2	60	5.3	0.175	30.3	LOS C	2.1	15.3	0.87	0.73	0.87	42.5
8	T1	31	0.0	0.661	65.8	LOS E	3.9	27.6	1.00	0.81	1.13	25.9
9	R2	32	3.3	0.661	70.4	LOS E	3.9	27.6	1.00	0.81	1.13	27.8
Approach		122	3.4	0.661	49.5	LOS D	3.9	27.6	0.94	0.77	1.00	34.3
West: Castle Hill Road												
10	L2	40	5.3	0.591	32.6	LOS C	21.4	154.4	0.81	0.73	0.81	39.4
11	T1	854	3.7	0.591	26.6	LOS B	21.4	154.4	0.79	0.70	0.79	47.1
12	R2	89	1.2	0.529	32.6	LOS C	3.1	21.7	0.96	0.79	0.96	37.5
Approach		983	3.5	0.591	27.4	LOS B	21.4	154.4	0.81	0.71	0.81	46.1
All Vehicles		3452	2.5	0.899	34.3	LOS C	50.4	358.0	0.85	0.81	0.96	43.0

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	53	23.5	LOS C	0.1	0.1	0.63	0.63
P2	East Full Crossing	5	54.2	LOS E	0.0	0.0	0.95	0.95
P3	North Full Crossing	5	23.4	LOS C	0.0	0.0	0.63	0.63
All Pedestrians		63	26.0	LOS C			0.65	0.65

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

MOVEMENT SUMMARY

Site: 1 [J04 - Castle Hill Rd x New Access Rd_PM Peak - EX + DEV - Import]

Intersection: Castle Hill Road x New Access Road
Period: PM Peak
Scenario: Existing + Development (315 Medium Density + 3285 High Density = 3600 Residential Units + Commuter Car Park)
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: New Access Road												
1	L2	14	0.0	0.023	8.5	LOS A	0.1	0.5	0.55	0.71	0.55	43.2
Approach		14	0.0	0.023	8.5	LOS A	0.1	0.5	0.55	0.71	0.55	43.2
East: Castle Hill Rd												
4	L2	213	0.0	0.462	5.6	LOS A	0.0	0.0	0.00	0.14	0.00	56.0
5	T1	1561	1.9	0.462	0.0	LOS A	0.0	0.0	0.00	0.06	0.00	58.5
Approach		1774	1.7	0.462	0.7	NA	0.0	0.0	0.00	0.07	0.00	58.1
West: Castle Hill Rd												
11	T1	1003	2.6	0.262	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
Approach		1003	2.6	0.262	0.0	NA	0.0	0.0	0.00	0.00	0.00	59.9
All Vehicles		2791	2.0	0.462	0.5	NA	0.1	0.5	0.00	0.05	0.00	58.5

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

MOVEMENT SUMMARY

Site: 1 [J01 - Castle Hill Rd x Highs Rd_AM Peak - EX + DEV]

Intersetion: Castle Hill Road x Highs Road x County Drive
Period: AM Peak
Scenario: Existing + DEV
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: Highs Road												
1	L2	373	2.5	0.811	51.4	LOS D	21.0	150.4	0.95	0.90	1.06	41.1
2	T1	126	0.0	0.912	60.8	LOS E	10.7	74.8	1.00	0.83	1.09	38.7
3	R2	145	0.0	0.912	78.9	LOS F	10.7	74.8	1.00	1.02	1.47	34.1
Approach		644	1.5	0.912	59.4	LOS E	21.0	150.4	0.97	0.91	1.16	38.9
East: Castle Hill Road												
4	L2	26	16.0	0.165	30.9	LOS C	2.8	20.1	0.80	0.67	0.85	47.2
5	T1	935	5.3	0.780	42.4	LOS C	24.4	179.1	0.97	0.88	1.02	36.0
6	R2	125	8.4	0.858	74.1	LOS F	8.2	61.6	1.00	0.96	1.37	26.2
Approach		1086	5.9	0.858	45.8	LOS D	24.4	179.1	0.97	0.88	1.05	34.9
North: County Drive												
7	L2	108	7.8	0.180	23.3	LOS B	3.2	23.6	0.74	0.74	0.74	41.8
8	T1	225	0.5	0.449	40.3	LOS C	11.1	77.9	0.89	0.74	0.89	44.1
9	R2	821	2.1	0.909	68.0	LOS E	27.8	198.3	1.00	1.00	1.29	30.1
Approach		1155	2.3	0.909	58.4	LOS E	27.8	198.3	0.95	0.93	1.16	33.8
West: Castle Hill Road												
10	L2	601	2.5	0.647	15.5	LOS B	16.7	119.6	0.52	0.75	0.52	48.0
11	T1	921	4.2	0.905	53.0	LOS D	35.8	260.0	0.91	1.00	1.18	32.7
12	R2	224	2.3	0.605	30.6	LOS C	7.7	55.0	0.95	0.82	0.95	47.1
Approach		1746	3.4	0.905	37.3	LOS C	35.8	260.0	0.78	0.89	0.92	39.3
All Vehicles		4632	3.4	0.912	47.6	LOS D	35.8	260.0	0.90	0.90	1.05	36.8

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	5	36.8	LOS D	0.0	0.0	0.78	0.78
P2	East Full Crossing	5	46.8	LOS E	0.0	0.0	0.88	0.88
P3	North Full Crossing	5	36.0	LOS D	0.0	0.0	0.78	0.78
All Pedestrians		16	39.9	LOS D			0.81	0.81

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

Appendix C3

SIDRA Modelling Results – Existing + Development + Improvements

MOVEMENT SUMMARY

Site: 1 [J01 - Castle Hill Rd x Highs Rd_PM Peak - EX + DEV]

Intersetion: Castle Hill Road x Highs Road x County Drive
Period: PM Peak
Scenario: Existing + DEV
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 135 seconds (Site Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: Highs Road												
1	L2	380	3.3	0.861	61.0	LOS E	25.2	181.5	0.95	0.92	1.12	38.9
2	T1	159	1.3	0.882	76.3	LOS F	11.2	79.1	1.00	0.97	1.34	35.6
3	R2	35	6.1	0.262	69.4	LOS E	2.7	19.5	0.97	0.74	0.97	36.0
Approach		574	2.9	0.882	65.8	LOS E	25.2	181.5	0.97	0.92	1.17	37.7
East: Castle Hill Road												
4	L2	26	0.0	0.065	20.3	LOS B	1.1	7.6	0.65	0.60	0.65	50.9
5	T1	1415	1.6	0.967	74.5	LOS F	60.7	430.6	0.99	1.16	1.32	27.7
6	R2	131	3.2	0.441	61.3	LOS E	7.9	56.6	0.95	0.79	0.95	29.0
Approach		1572	1.7	0.967	72.5	LOS F	60.7	430.6	0.99	1.12	1.28	28.1
North: County Drive												
7	L2	75	2.8	0.120	25.7	LOS B	2.5	17.8	0.72	0.72	0.72	40.8
8	T1	153	0.7	0.442	53.8	LOS D	9.1	63.8	0.94	0.77	0.94	40.5
9	R2	641	1.0	0.978	101.5	LOS F	28.0	197.6	1.00	1.08	1.51	24.3
Approach		868	1.1	0.978	86.6	LOS F	28.0	197.6	0.97	1.00	1.34	27.9
West: Castle Hill Road												
10	L2	725	1.2	0.858	29.5	LOS C	33.9	239.4	0.69	0.83	0.75	41.3
11	T1	894	2.5	0.906	55.4	LOS D	37.8	269.9	0.87	0.94	1.11	32.0
12	R2	340	2.5	0.949	81.0	LOS F	24.0	171.7	1.00	1.11	1.66	35.1
Approach		1959	2.0	0.949	50.3	LOS D	37.8	269.9	0.83	0.93	1.07	35.6
All Vehicles		4973	1.8	0.978	65.4	LOS E	60.7	430.6	0.92	1.00	1.20	32.1

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	5	31.4	LOS D	0.0	0.0	0.68	0.68
P2	East Full Crossing	5	60.7	LOS F	0.0	0.0	0.95	0.95
P3	North Full Crossing	5	36.3	LOS D	0.0	0.0	0.73	0.73
All Pedestrians		16	42.8	LOS E			0.79	0.79

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

MOVEMENT SUMMARY

Site: 2 [J02 - Castle Hill Rd x Glenhope Rd_AM Peak - EX + DEV]

Intersection: Castle Hill Road x Glenhope Road
Period: AM Peak
Scenario: Existing + DEV
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Site Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: Glenhope Road												
1	L2	158	0.0	0.182	14.7	LOS B	2.7	19.0	0.62	0.71	0.62	38.5
3	R2	431	0.0	0.869	36.5	LOS C	15.0	105.3	1.00	1.03	1.38	35.7
Approach		588	0.0	0.869	30.6	LOS C	15.0	105.3	0.90	0.94	1.17	36.2
East: Castle Hill Road												
4	L2	54	2.0	0.837	32.1	LOS C	16.8	124.5	0.99	1.02	1.23	39.6
5	T1	983	7.4	0.837	26.5	LOS B	16.8	125.2	0.99	1.02	1.23	37.6
Approach		1037	7.1	0.837	26.8	LOS B	16.8	125.2	0.99	1.02	1.23	37.7
West: Castle Hill Road												
11	T1	1172	3.2	0.575	10.2	LOS A	11.7	83.8	0.72	0.64	0.72	48.9
12	R2	119	0.9	0.364	18.5	LOS B	1.9	13.4	0.91	0.76	0.91	36.9
Approach		1291	3.0	0.575	11.0	LOS A	11.7	83.8	0.74	0.65	0.74	47.6
All Vehicles		2916	3.9	0.869	20.6	LOS B	16.8	125.2	0.86	0.84	1.00	40.8

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	5	18.4	LOS B	0.0	0.0	0.78	0.78
P2	East Full Crossing	5	24.3	LOS C	0.0	0.0	0.90	0.90
All Pedestrians		11	21.4	LOS C			0.84	0.84

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

MOVEMENT SUMMARY

Site: 2 [J02 - Castle Hill Rd x Glenhope Rd_PM Peak - EX + DEV]

Intersection: Castle Hill Road x Glenhope Road
Period: PM Peak
Scenario: Existing + DEV
Site Category: (None)
Signals - Fixed Time Coordinated Cycle Time = 130 seconds (Site Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: Glenhope Road												
1	L2	111	1.0	0.354	56.6	LOS E	6.3	44.3	0.93	0.78	0.93	23.0
3	R2	73	0.0	0.847	80.9	LOS F	5.2	36.1	1.00	0.93	1.40	25.5
Approach		183	0.6	0.847	66.2	LOS E	6.3	44.3	0.96	0.84	1.12	24.2
East: Castle Hill Road												
4	L2	255	0.0	0.677	9.4	LOS A	13.4	94.8	0.25	0.35	0.25	50.6
5	T1	1663	1.7	0.677	2.7	LOS A	13.4	94.8	0.18	0.22	0.18	55.8
Approach		1918	1.5	0.677	3.6	LOS A	13.4	94.8	0.19	0.24	0.19	54.8
West: Castle Hill Road												
11	T1	859	3.8	0.262	1.7	LOS A	4.7	34.2	0.19	0.17	0.19	57.8
12	R2	132	0.8	0.515	13.9	LOS A	5.3	37.5	0.78	0.82	0.78	39.6
Approach		991	3.4	0.515	3.3	LOS A	5.3	37.5	0.27	0.26	0.27	54.8
All Vehicles		3092	2.0	0.847	7.2	LOS A	13.4	94.8	0.26	0.28	0.27	50.7

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	5	6.5	LOS A	0.0	0.0	0.32	0.32
P2	East Full Crossing	5	59.2	LOS E	0.0	0.0	0.95	0.95
All Pedestrians		11	32.8	LOS D			0.63	0.63

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

MOVEMENT SUMMARY

Site: 3 [J03 - Castle Hill Rd x Coonara Ave_AM Peak - EX + DEV]

Intersection: Castle Hill Road x Coonara Avenue x Edward Bennett Drive
Period: AM Peak
Scenario : Existing + DEV
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Site User-Given Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: Coonara Avenue												
1	L2	53	2.0	0.749	42.9	LOS D	5.0	35.8	1.00	0.96	1.56	34.6
2	T1	56	1.9	0.749	38.4	LOS C	5.0	35.8	1.00	0.96	1.56	32.0
3	R2	138	2.3	0.749	47.4	LOS D	5.0	35.8	1.00	0.91	1.34	37.8
Approach		246	2.1	0.749	44.4	LOS D	5.0	35.8	1.00	0.93	1.44	36.1
East: Castle Hill Road												
4	L2	231	5.0	0.707	23.8	LOS B	15.9	118.2	0.88	0.82	0.97	46.7
5	T1	840	8.3	0.707	18.4	LOS B	16.3	122.5	0.85	0.77	0.88	50.1
6	R2	67	10.9	0.273	23.2	LOS B	1.4	10.8	0.91	0.75	0.91	45.4
Approach		1138	7.8	0.707	19.8	LOS B	16.3	122.5	0.86	0.78	0.90	49.2
North: Edward Bennett Drive												
7	L2	139	5.3	0.518	27.2	LOS B	4.0	29.5	0.96	0.78	0.96	43.5
8	T1	52	0.0	0.766	44.6	LOS D	4.7	33.0	1.00	0.90	1.29	30.5
9	R2	57	1.9	0.766	49.2	LOS D	4.7	33.0	1.00	0.90	1.29	32.7
Approach		247	3.4	0.766	35.9	LOS C	4.7	33.0	0.98	0.83	1.11	38.5
West: Castle Hill Road												
10	L2	36	2.9	0.897	38.6	LOS C	37.0	265.3	0.98	1.08	1.22	37.2
11	T1	1465	2.9	0.897	33.2	LOS C	37.0	265.3	0.94	1.04	1.19	44.8
12	R2	149	0.7	0.397	17.3	LOS B	2.6	18.0	0.80	0.77	0.80	43.9
Approach		1651	2.7	0.897	31.9	LOS C	37.0	265.3	0.92	1.02	1.15	44.6
All Vehicles		3282	4.5	0.897	28.9	LOS C	37.0	265.3	0.91	0.91	1.08	44.9

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	53	16.3	LOS B	0.1	0.1	0.64	0.64
P2	East Full Crossing	5	34.2	LOS D	0.0	0.0	0.93	0.93
P3	North Full Crossing	5	16.3	LOS B	0.0	0.0	0.64	0.64
All Pedestrians		63	17.8	LOS B			0.66	0.66

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

MOVEMENT SUMMARY

Site: 3 [J03 - Castle Hill Rd x Coonara Ave_PM Peak - EX + DEV]

Intersection: Castle Hill Road x Coonara Avenue x Edward Bennett Drive
Period: PM Peak
Scenario: Existing + DEV
Site Category: (None)
Signals - Fixed Time Coordinated Cycle Time = 120 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: Coonara Avenue												
1	L2	155	0.0	0.750	55.9	LOS D	15.8	111.4	1.00	0.88	1.07	30.8
2	T1	79	0.0	0.750	51.4	LOS D	15.8	111.4	1.00	0.88	1.07	28.6
3	R2	279	3.4	0.750	58.0	LOS E	15.8	111.4	1.00	0.88	1.09	35.2
Approach		513	1.8	0.750	56.4	LOS D	15.8	111.4	1.00	0.88	1.08	33.1
East: Castle Hill Road												
4	L2	156	1.4	0.899	37.6	LOS C	50.4	358.0	0.91	0.94	1.16	42.1
5	T1	1527	1.8	0.899	31.2	LOS C	50.4	358.0	0.82	0.85	1.01	45.4
6	R2	151	4.9	0.354	20.9	LOS B	3.7	27.1	0.76	0.77	0.76	46.3
Approach		1834	2.0	0.899	30.9	LOS C	50.4	358.0	0.83	0.85	1.00	45.1
North: Edward Bennett Drive												
7	L2	60	5.3	0.175	30.3	LOS C	2.1	15.3	0.87	0.73	0.87	42.5
8	T1	31	0.0	0.661	65.8	LOS E	3.9	27.6	1.00	0.81	1.13	25.9
9	R2	32	3.3	0.661	70.4	LOS E	3.9	27.6	1.00	0.81	1.13	27.8
Approach		122	3.4	0.661	49.5	LOS D	3.9	27.6	0.94	0.77	1.00	34.3
West: Castle Hill Road												
10	L2	40	5.3	0.591	32.6	LOS C	21.4	154.4	0.81	0.73	0.81	39.4
11	T1	854	3.7	0.591	26.6	LOS B	21.4	154.4	0.79	0.70	0.79	47.1
12	R2	89	1.2	0.529	32.6	LOS C	3.1	21.7	0.96	0.79	0.96	37.5
Approach		983	3.5	0.591	27.4	LOS B	21.4	154.4	0.81	0.71	0.81	46.1
All Vehicles		3452	2.5	0.899	34.3	LOS C	50.4	358.0	0.85	0.81	0.96	43.0

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	53	23.5	LOS C	0.1	0.1	0.63	0.63
P2	East Full Crossing	5	54.2	LOS E	0.0	0.0	0.95	0.95
P3	North Full Crossing	5	23.4	LOS C	0.0	0.0	0.63	0.63
All Pedestrians		63	26.0	LOS C			0.65	0.65

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

MOVEMENT SUMMARY

Site: 4 [J04 - Castle Hill Rd x New Access Rd_AM Peak - EX + DEV - Import - Import]

Intersection: Castle Hill Road x New Access Road
Period: AM Peak
Scenario: Existing + Development (315 Medium Density + 3285 High Density = 3600 Residential Units + Commuter Carpark)
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: New Access Road												
1	L2	28	0.0	0.037	7.2	LOS A	0.1	0.9	0.48	0.66	0.48	44.2
Approach		28	0.0	0.037	7.2	LOS A	0.1	0.9	0.48	0.66	0.48	44.2
East: Castle Hill Rd												
4	L2	33	0.0	0.286	5.6	LOS A	0.0	0.0	0.00	0.04	0.00	57.3
5	T1	1036	7.0	0.286	0.0	LOS A	0.0	0.0	0.00	0.02	0.00	59.5
Approach		1068	6.8	0.286	0.2	NA	0.0	0.0	0.00	0.02	0.00	59.4
West: Castle Hill Rd												
11	T1	1175	4.0	0.309	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
Approach		1175	4.0	0.309	0.0	NA	0.0	0.0	0.00	0.00	0.00	59.9
All Vehicles		2272	5.3	0.309	0.2	NA	0.1	0.9	0.01	0.02	0.01	59.3

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

MOVEMENT SUMMARY

Site: 1 [J04 - Castle Hill Rd x New Access Rd_PM Peak - EX + DEV - Import - Import]

Intersection: Castle Hill Road x New Access Road
Period: PM Peak
Scenario: Existing + Development (315 Medium Density + 3285 High Density = 3600 Residential Units + Commuter Car Park)
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: New Access Road												
1	L2	14	0.0	0.023	8.5	LOS A	0.1	0.5	0.55	0.71	0.55	43.2
Approach		14	0.0	0.023	8.5	LOS A	0.1	0.5	0.55	0.71	0.55	43.2
East: Castle Hill Rd												
4	L2	213	0.0	0.462	5.6	LOS A	0.0	0.0	0.00	0.14	0.00	56.0
5	T1	1561	1.9	0.462	0.0	LOS A	0.0	0.0	0.00	0.06	0.00	58.5
Approach		1774	1.7	0.462	0.7	NA	0.0	0.0	0.00	0.07	0.00	58.1
West: Castle Hill Rd												
11	T1	1003	2.6	0.262	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
Approach		1003	2.6	0.262	0.0	NA	0.0	0.0	0.00	0.00	0.00	59.9
All Vehicles		2791	2.0	0.462	0.5	NA	0.1	0.5	0.00	0.05	0.00	58.5

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.
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.