55 Coonara Avenue West Pennant Hills

Planning Proposal Revisions 3

Traffic Assessment

October 2016

prepared for

Mirvac

prepared by

ARC Traffic + Transport

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Introduction

Mirvac proposes the rezoning of the 55 Coonara Avenue, West Pennant Hills (the Site), to provide for a residential development project (the Project). The Project provides for: -

- A total of 800 residential dwelling, comprising: -
  - 192 one-bedroom units
  - 352 two-bedroom units
  - 60 two-bedroom terrace dwellings
  - 196 three-bedroom unit/terrace dwellings

- Ancillary retail space (~500m^2 GFA)

- A total of approximately 1,200 parking spaces, or some 400 spaces less than currently provided on-site

ARC Traffic + Transport (ARC) has been commissioned to provide an assessment of the access, traffic and parking characteristics of the Project, and the potential impacts on the local road network arising from the Project; this assessment will accompany a broader Planning Proposal for the Site. In preparing this assessment, ARC has: -

- Discussed the Project with Mirvac and GLN Planning
- Discussed the operation of the local road network with representatives of Hills Shire Council (Council), NSW Department of Planning & Environment (DP&E); Transport for NSW (TNSW); and the Roads & Maritime Authority (RMS)
- Commissioned and reviewed peak period traffic surveys of the Site and key local intersections
- Examined 'existing' Site trip generation and distribution characteristics – with specific focus on the potential 'capacity' operations of the Site based on its current zoning and on-site parking provision, and the operation of the local road network subject to that existing trip generation
- Determined the trip generation of the Site further to the Project, and the operation of the local road network further to the introduction of those trips.
- Referenced The Hills Council DCP 2012 (Hills DCP), The Hills LEP 2012 (Hills LEP), as well as available planning and transport assessments relating to the North West Rail Link (NWRL); the (draft) Hills Corridor Strategy (Corridor Strategy); and the Cherrybrook (Railway Station) Precinct in which the Site lies.

From the outset, it is noted that this assessment revises a July 2016 assessment prepared by ARC, which was included as part of a Planning Proposal submission to Council which proposed the development of the Site for some 1,119 dwellings and some 1,500 parking spaces. This revised Project therefore represents a reduction of some 319 dwellings, and a reduction of some 300 parking spaces, from that provided for in the recent Planning Proposal.

This revised assessment also specifically includes feedback provided by Council in regard to the July 2016 assessment, and ARC would specifically acknowledge the feedback provided by Mr Andrew King, Mr Stewart Seale and Mr Michael Edgar in regard to key traffic and transport issues.

Finally, it is essential to state that the Project would 'replace' the current commercial operations at the Site, operations which have been significantly reduced over recent years. In assessing the Project, it is therefore appropriate to examine the peak potential impacts of those commercial operations – based on some 34,000m^2 of commercial office space and moreover some 1,600 parking spaces across the Site - which could effectively be generated 'tomorrow' if the Site were to again be fully utilised for commercial operations as currently provided for by the existing Site zoning.

1 The Existing Site

1.1 Location

The Site located at 55 Coonara Avenue, West Pennant Hills, and is shown in its local context in **Figure 1.1** below.

Figure 1.1 Location

Source: GoogleMaps

1.2 Usage

The Site was purpose built for IBM in the 1980's, and comprises 34,000m^2 GFA, which includes a data centre and disaster recovery centre. A total of some 1,600 parking spaces are provided on-site, or approximately 1 space per 20m^2 GFA.

More recently, IBM have downsized at the Site, leasing only 16,500m^2 GFA of office area. Lend Lease Bouygues currently lease some 5,000m^2 GFA, and approximately 4,600m^2 of the original total GFA has been converted to common area. Some 7,500m^2 GFA remains vacant at this time.

It is noted also that staff levels (a key driver of traffic generation) at the Site have also fallen significantly over time. At peak occupancy in the 1980's, IBM employed approximately 3,500 staff on-site; by 2009, that figure had slightly reduced to 3,000 staff, but at this time (2015) it is estimated that some 1,200 people are employed across the Site (all tenants). Employment figures provided in the draft Hills Corridor Strategy (Corridor Strategy) indicate 2,237 jobs in the Cherrybrook Precinct in 2011, almost all of which are focused at the Site.

1.3 Access

1.3.1 Site Access

The Site has two vehicle access points to Coonara Avenue, located approximately 330m and 540m south of the intersection with Castle Hill Road. Both access points provide for two-way movements, and left and right turns to and from the Site are permitted at each. ARC has termed these access points Access North and Access South for ease of reference in later sections.

These access points connect to an internal road network providing access to car parks and service areas (see further below). It is noted that the internal road network also provides what is essentially a perimeter road between the built environment and surrounding bushland.

While barrier gates are provided at both access intersections, our observations suggest that access to/from the Site is currently unrestricted.

1.3.2 Sub-Regional Access

Primary access to the sub-regional road network is provided via Coonara Avenue to the intersection of Castle Hill Road & Edward Bennet Drive. Castle Hill Road in turn links to the south-east (to Pennant Hills Road and the M2); and to the north-east (to Showground Road and Windsor Road). Edward Bennet Drive links north to Cherrybrook and then through to Dural.

Secondary access to the sub-regional network is provided via Coonara Avenue south to Taylor Street and then to Aitken Road to Pennant Hills Road south of Castle Hill Road; and via Oakes Road and Jenkins Road to Pennant Hills Road at Carlingford.

1.4 Local Road Network

The local road network is shown in **Figure 1.1** and further examined below.

1.4.1 Key Roads

Coonara Avenue is a wide local collector road providing two lanes for two-way traffic, and parking lanes on both sides which have been adapted (on the eastern side of Coonara Avenue) to provide short designated left turn lanes on the approaches to the Site access points.

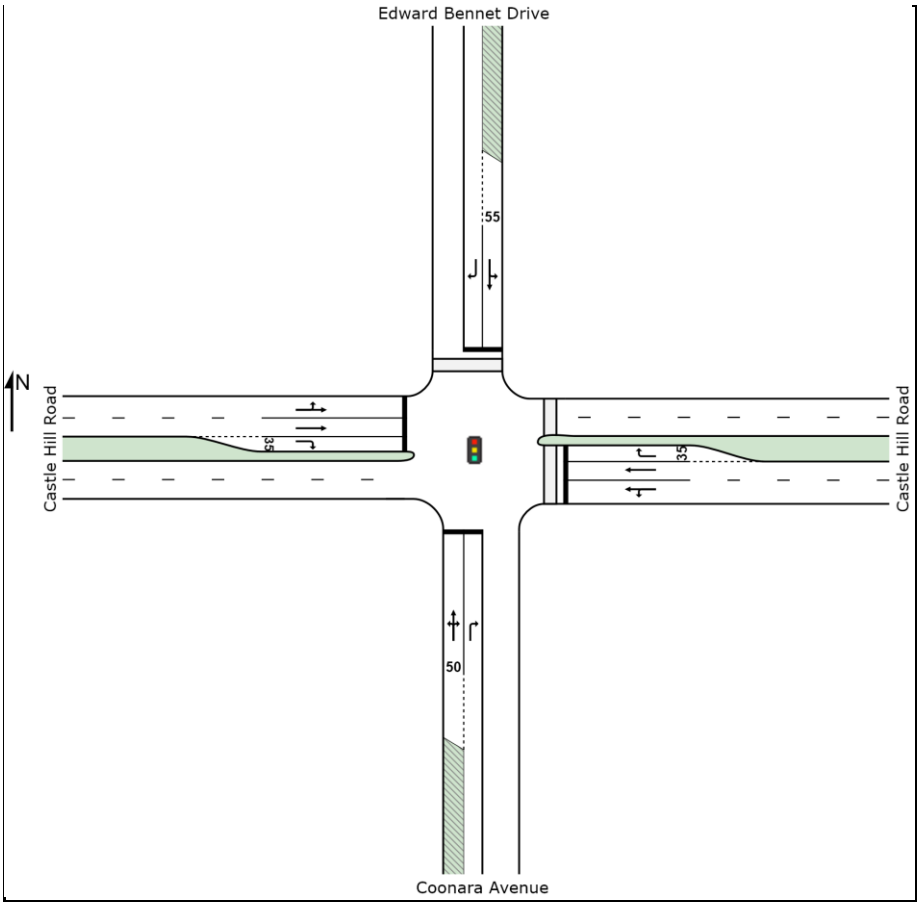
An additional short lane is also provided on the approach to Castle Hill Road. Coonara Avenue has a speed limit of 50km/h.

Castle Hill Road in the vicinity of the Site provides 4 lanes for two-way traffic, with significant additional approach infrastructure at the intersection of Coonara Avenue & Edward Bennet Drive. Castle Hill Road has a speed limit of 60km/h.

1.4.2 Intersection of Castle Hill Road & Coonara Avenue & Edward Bennet Drive

The key intersection in the local road network is the signalised intersection of Castle Hill Road & Coonara Avenue & Edward Bennet Drive, the existing design of which is shown in **Figure 1.4.2** below.

Figure 1.4.2 Intersection Castle Hill Road & Coonara Avenue & Edward Bennet Drive



Traffic surveys were conducted in 2015 (provided in **Appendix A**) during the AM and PM peak periods. Analysis of intersection operations using the SIDRA model indicates that the intersection currently operates at an acceptable Level of Service (LoS) in the AM peak (LoS 'B') but at a LoS 'E' in the PM peak period, with capacity constraints on the Coonara Avenue approach (specifically associated with the significant departure peak of the Site – see also **Section 2** below).

The Corridor Strategy indicates that the intersection will be upgraded to provide additional approach lanes in both Coonara Avenue and Edward Bennet Drive, and an extension of the right turn lane in Castle Hill Road to Coonara Avenue. In addition, a Council and RMS jointly funded project was recently announced (2015) to provide an additional pedestrian crossing of the Coonara Avenue approach, which is expected to be constructed at the same time as the broader intersection upgrade.

At present, the intersection operates with split phasing of the Coonara Avenue and Edward Bennet Drive approaches. Further to our discussions with Council, the RMS and TNSW, it is anticipated that additional approach lanes (further to an upgrade) would focus on allowing for future diamond turn phasing, accommodating not only the (existing) high demand from Coonara Avenue (particularly in the PM peak generated by departing commercial traffic) but also the potential for future growth of trips from Edward Bennet Drive associated with the broader growth of the Cherrybrook Precinct north of Castle Hill Road.

Notwithstanding the above, while our discussions with Mr King have confirmed that the intersection will be upgraded (by others), the design of the upgrade remains to be finalised pending investigations in regard to the broader Cherrybrook Precinct. While the upgrades outlined above (based on available information) are certainly logical in the context of likely future growth (in accordance with the Corridor Strategy) it remains the case that the final design/phasing of the intersection has not been determined at this time.

1.4.3 Site Intersections

The two Site access intersection both operate as priority 'T' intersections; as discussed, both provide a designated left turn lane from Coonara Avenue to the Site.

Analysis of intersection operations using the SIDRA model indicates that these intersections currently operate at a good LoS with minimal delays in both peak periods (see also traffic data in **Section 2** below).

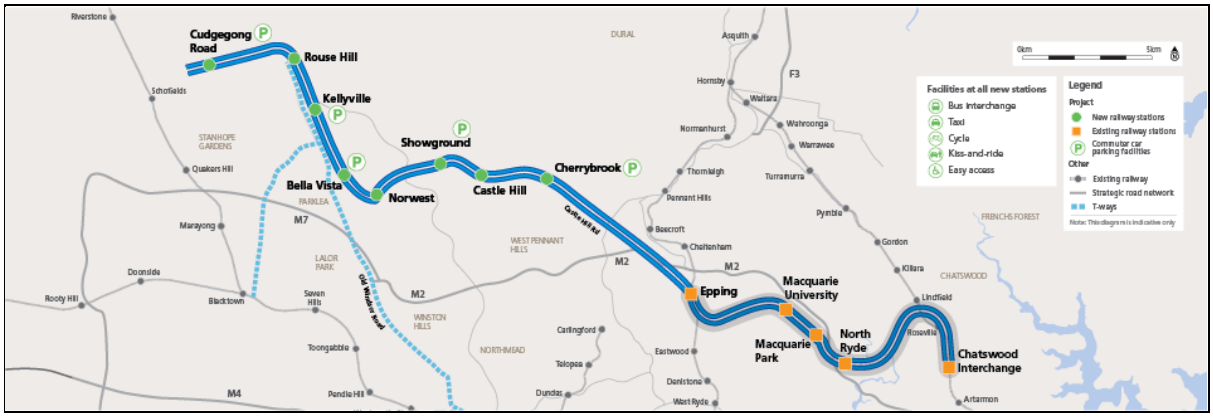
1.5 Public Transport

1.5.1 Rail

The Site lies within 800m of the future Cherrybrook Railway Station, part of the North West Rail Line currently under construction. The NWRL will connect between Cudgegong Road and Epping, and thence to the broader Sydney rail network.

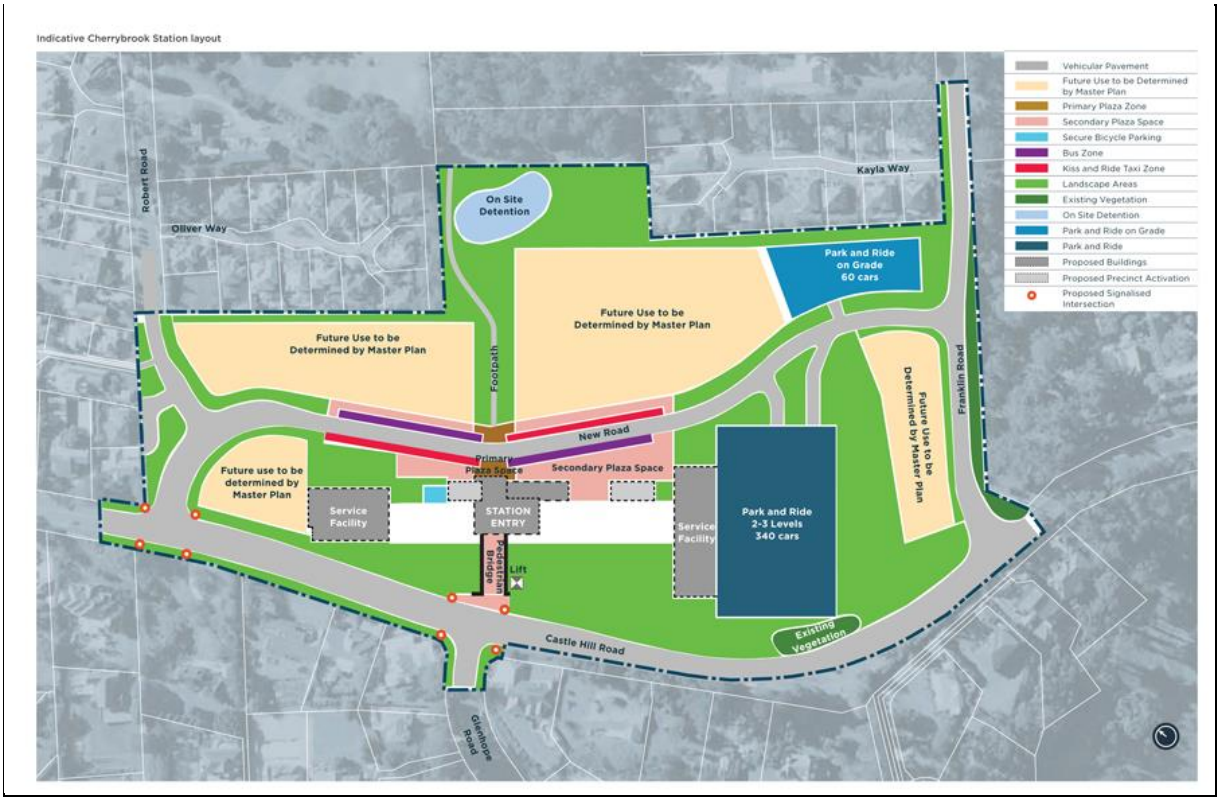
The NWRL is shown in **Figure 1.5.1.1**, while the future Cherrybrook Station is shown in **Figure 1.5.1.2**.

Figure 1.5.1.1 NWRL



Source: Transport NSW

Figure 1.5.1.2 Cherrybrook Station Design



Source: Transport NSW

Trains are forecast to operate at a 4 minute headway through peak periods.

1.5.2 Bus Services

Bus services operate along Castle Hill Road to the north of the Site, and along Coonara Avenue directly adjacent to the Site. Existing routes provide access to key local destinations including Castle Hill and Pennant Hills (and specifically Pennant Hills Station) and sub-regional destinations (Macquarie Park, North Sydney and the CBD). Existing routes are shown in the figures below.

Figure 1.5.2.1 Bus Route 631

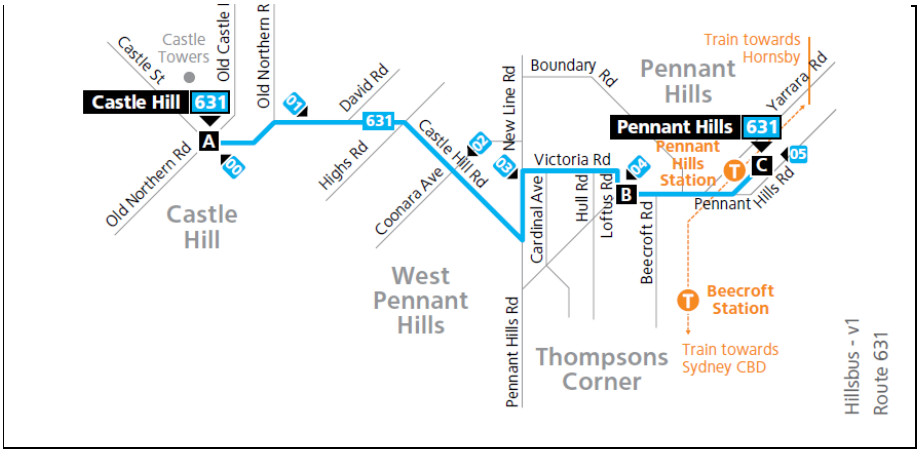


Figure 1.5.2.2 Bus Routes 632/633

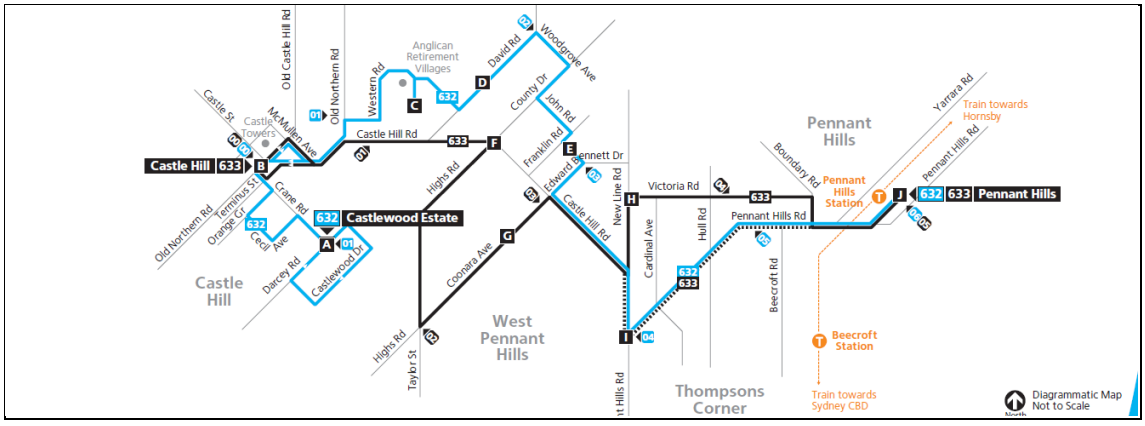
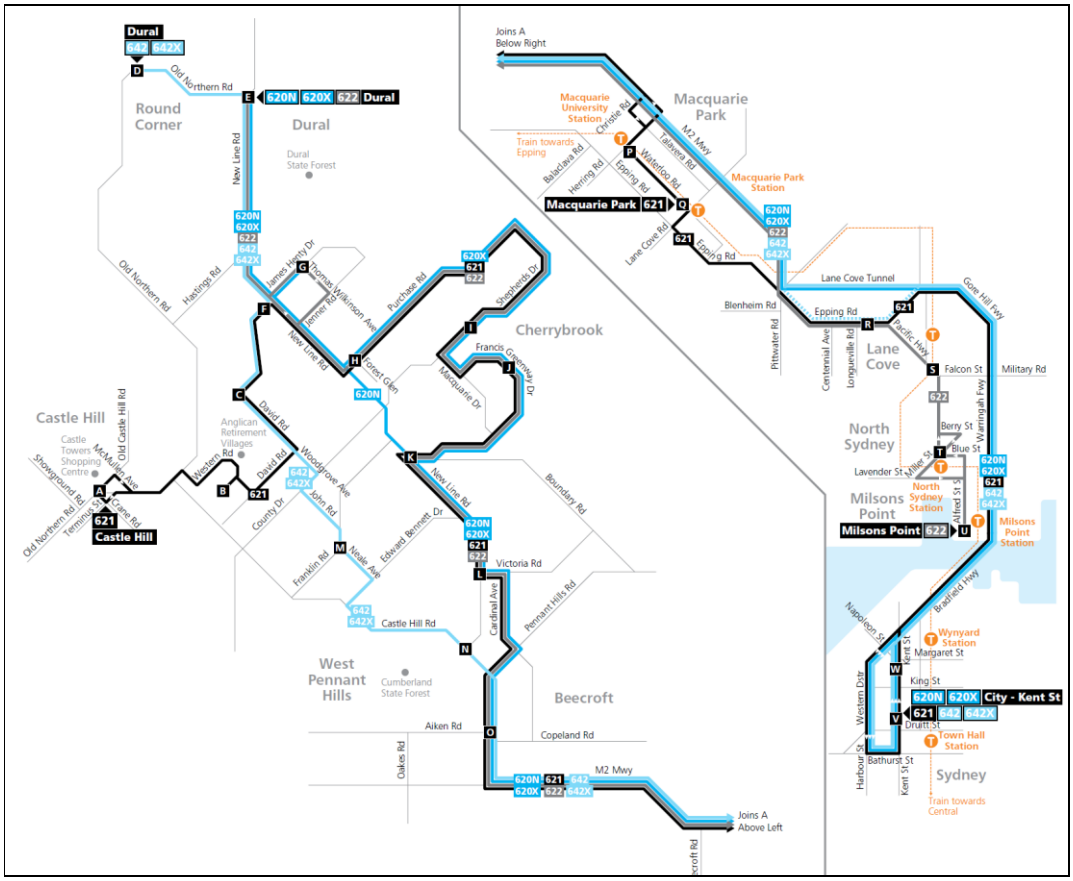


Figure 1.5.2.3 Bus Routes 642/642X



The 642/642X services operate at a high frequency in the commuter peak periods, and currently has high patronage levels; however, a high percentage of these patrons are likely to switch to the NWRL once operational. The local services – and specifically the 633 route past the Site – operate at a 30 minute headway through the commuter periods; there is potential for these services to increase as feeder services (to Cherrybrook Station) once the NWRL is operational.

1.6 Pedestrian & Cycle

1.6.1 Infrastructure

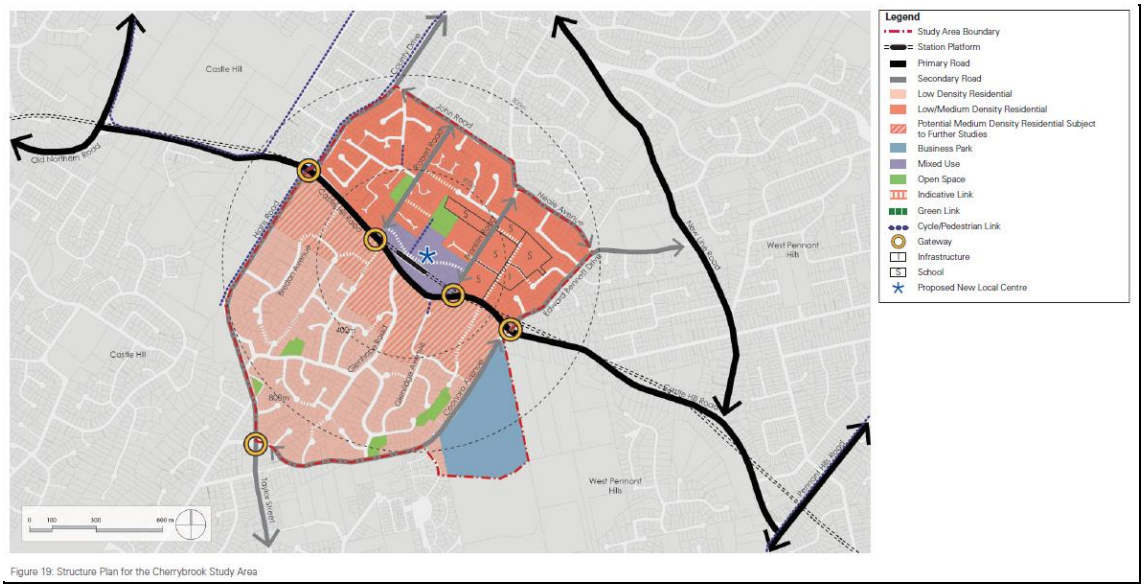
A pedestrian path is provided on the eastern side of Coonara Avenue south from Castle Hill Road to a pedestrian path into the Site itself located immediately north of Access North; this in turn provides access to the on-site pedestrian path network. No pedestrian path is provided along Coonara Avenue south of this divergence, nor is a path provided on the western side of Coonara.

A pedestrian route to the future Cherrybrook Station is also available via Grosvenor Place Reserve opposite the Site, linking to Hampshire Avenue and Stanley Circuit (to Castle Hill Road); however, these minor roads do not provide pedestrian infrastructure. Pedestrian paths/trails are also available through the adjacent Cumberland Forest to Castle Hill Road.

Castle Hill Road itself provides pedestrian paths on both sides of the road, which link to the east and west, and importantly connect through to the future Cherrybrook Station. On the southern side of Castle Hill Road, a relatively new and wide path (suitable as a shared path) is available, but there is currently no access available to this path (from the Site) given the location of pedestrian crossings at the intersection of Castle Hill Road & Coonara Avenue & Edward Bennet Drive. As discussed a new pedestrian crossing will be introduced across the Coonara Avenue approach, most likely to be constructed as part of the proposed broader upgrades of the intersections.

Further to the above, the NWRL Cherrybrook Station Structure Plan (Structure Plan) indicates the future provision of new links through the land opposite the Site to a future internal road network within the (largely undeveloped) land south of Castle Hill Road and west of Coonara Avenue. With specific regard to the Site, the Structure Plan indicates a new link directly opposite the Site connecting through to Hampshire Avenue and then north to Staley Court (which would then be provided with a pedestrian/cycle link to Castle Hill Road opposite Cherrybrook Station); and there is the potential to connect further west from this new link to Glenhope Road and direct to the main Cherrybrook Station entrance at Castle Hill Road.

Figure 1.6.1 Cherrybrook Structure Plan



Source: TNSW/DP&E

These routes would additionally reduce walking distance/time between the Site and Cherrybrook Station.

An overview of these walk routes is provided in the figures below based on a single central origin/destination for the Site at Coonara Road.

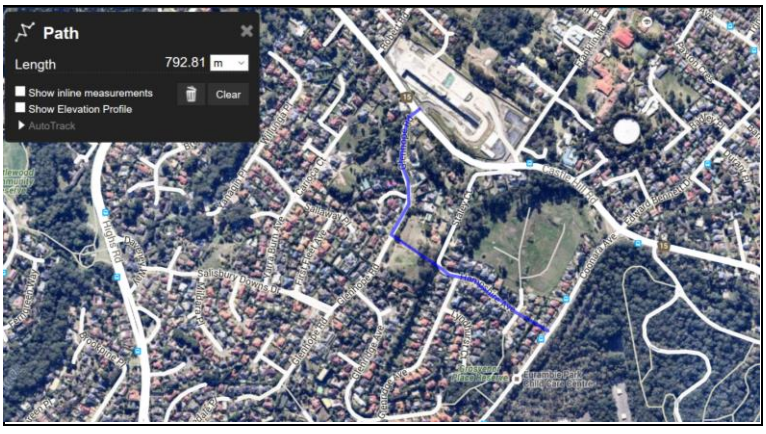
1.6.2 Site to Cherrybrook Station via Coonara Avenue & Castle Hill Road

Source: NearMap

1.6.3 Site to Cherrybrook Station via Hampshire Avenue & Staley Court

Source: NearMap

1.6.4 Site to Cherrybrook Station via Hampshire Avenue & Glenhope Road



Source: NearMap

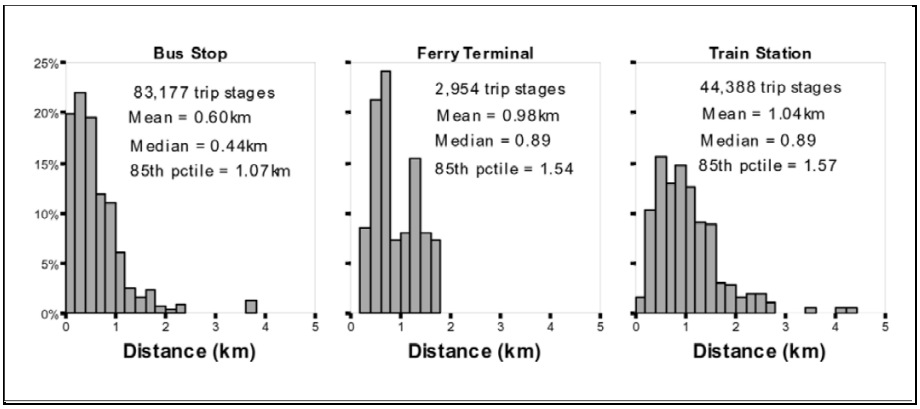
1.6.2 'Walkability'

As shown in the Structure Plan (**Figure 1.6.1** above) the Site lies within 800m of Cherrybrook Station, a distance which is often adopted as the 'standard' for walkability to rail stations. While it is acknowledged that walking distance between the central and southern parts of the Site and Cherrybrook Station would exceed 800m, there is a significant amount of data/research available showing that walk distance to good quality public transport – and particularly high frequency rail services – is not limited to an 800m catchment area.

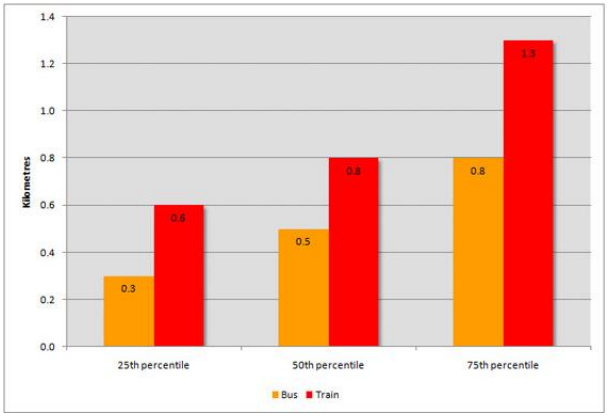
Indeed, it is illogical to suggest that walkability is acceptable for a dwelling 795m from a station but not 805m from a station; or that a gradient which may be uphill on a departure trip (but necessarily downhill on an arrival trip) would inherently reduce walkability. Further, any such considerations would equally apply to a commercial or as proposed residential use of the Site, and should not in our opinion be a significant consideration as part of a Planning Proposal.

Further to the above, Australian and international research consistently shows a high percentage of walk to rail trips exceed the 800m standard; some examples are provided below: -

- *Distances people walk for transport* (Matthew Burke and A.L. Brown) based on Brisbane walk trip data.



- *How far do we walk to the station?* (Davies) based on Melbourne walk trip data.



- *Walkable Catchments Analysis at Auckland Train and Northern Busway Stations* (Auckland Council) based on Auckland walk trip data.

Train station	Walking distance for 50% (median) of respondents	Walking distance for 85% of respondents
Papatoetoe	1200m	2180m
New Lynn	1125m	2116m
Glen Innes	943m	1526m
Mt Albert	862m	1617m

- *Carbon Reductions and Co-benefits: Literature and practice review of Australian policies relating urban planning and public health* (Michael A P Taylor & Susan Thompson) based on Sydney, Melbourne and Brisbane walk trip data.

	Public transport mode								
	Train			Tram			Public bus		
Statistic	Access	Egress	Total	Access	Egress	Total	Access	Egress	Total
15th percentile (km)	0.30	0.30	0.78	0.14	0.13	0.38	0.22	0.22	0.58
25th percentile (km)	0.39	0.40	0.98	0.19	0.18	0.48	0.29	0.28	0.71
Median (km)	0.61	0.64	1.34	0.34	0.32	0.74	0.47	0.48	1.06
75th percentile (km)	0.94	0.96	1.87	0.56	0.56	1.11	0.81	0.80	1.52
85th percentile (km)	1.19	1.21	2.16	0.71	0.73	1.32	0.99	1.02	1.88
Mean (km)	0.74	0.75	1.49	0.43	0.42	0.84	0.61	0.60	1.22
Standard deviation (km)	0.50	0.51	0.73	0.35	0.32	0.48	0.48	0.48	0.70
Coefficient of variation	68%	68%	49%	81%	78%	57%	78%	79%	58%

All of this research indicates that the Site is well positioned to generate combined walk/public transport trips.

2 Site Traffic Characteristics

2.1 2015 Site Trip Generation

Traffic surveys (provided in full in **Appendix A**) were conducted in November 2015 in order to determine the existing trip generation of the Site, and moreover a current peak hour trip rate (per 100m^2 GFA). To determine such, AM and PM peak hour trip generation of the Site was essentially divided by the currently leased GFA; this provides the following trip rates: -

- AM Peak Hour 371 trips, or 1.4 trips per 100m^2 GFA
- PM Peak Hour 345 trips, or 1.3 trips per 100m^2 GFA

2.2 Capacity Commercial Trips

The current (2015) trip generation of the Site is significantly lower than generated in the past, or that which could realistically be generated ('tomorrow') were the Site to be leased in full for standard commercial operations. In this regard, it is noted that: -

- IBM, the major tenant, occupies a space significantly larger than (currently) required, resulting in a much lower staff occupancy per 100m^2 GFA than required.

- The current tenants (both IBM and Lend Lease) do not operate in accordance with standard office hours further to the provision of flexi-time and staff not working on-site at all times.

Critically, the total GFA of the Site could at any time be leased to tenants providing a standard office environment, i.e. standard office hours, and staff being on-site every day, as originally approved for the Site, and reflected in the amount of parking (some 1,600 parking spaces) provided at the Site.

In this regard, it is instructive to examine the RTA trip generation calculations used at the time when the Site was approved. The RTA Guide to Traffic Generating Developments (GTGD) until recently (2013) provided the following base calculations in determining commercial office peak hour trip rates: -

- A car travel mode of 62%
- A car occupancy of 1.19 persons per vehicle
- A resultant car driver mode 52%
- An average of 4.75 employees per 100m^2 GFA (or 21m^2 GFA per employee)
- 80% of employees departing in the PM peak hour

These calculations provide a PM peak hour trip generation of 2 trips per 100m^2 GFA (or an estimated Site trip generation of 680vph), a rate which has (again until recently) generally also been applied to the AM peak hour (though with reference to **Section 2.1** the existing Site trip generation is slightly higher in the AM peak hour, a finding consistent with the recent RMS GTGD Update).

Critically though, these GTGD trip generation rates are 'accompanied' by a parking rate of 1 space per 40m^2 (which essentially accommodates the peak parking demand generated per the calculations above); application of this parking rate to the 34,000m^2 GFA provides a ('required') parking total of 850 parking spaces, compared to the 1,600 spaces actually provided on the Site. This in our opinion confirms past Site staff estimates, and the likelihood of a higher car driver percentage (based on relatively poor past public transport options, and current Journey to Work data suggesting 84% of employees drive to the travel zone in which the Site lies). Overall, this strongly suggests that the Site has a significantly higher trip generation potential than that calculated by the application of the base GTGD rates.

As outlined above, at the time the Site was approved, the GTGD trip generation calculations provided an estimate of 80% of employees departing in the PM peak hour. If this is applied to the available parking of 1,600 spaces, this would suggest a PM peak hour trip generation of 1,280vph.

While acknowledging that the future public transport opportunities available to (proposed) residents would also be available to future commercial employees, there is little doubt in our opinion that the parking available at the Site could be fully utilised every day by a future commercial tenant, and indeed would likely be an important consideration for a future tenant. Allowing for some broader flexibility in work hours: -

- An estimate of 70% of employees arriving/departing in a peak hour suggests a peak hour trip generation of 1,120vph
- An estimate of 60% of employees arriving/departing in a peak hour suggests a peak hour trip generation of 960vph

Based on an assessment of commercial parking provision, it is therefore estimated that the Site would generate a minimum of some 960vph in a peak hour under capacity commercial operations. Again, the current zoning of the Site means that such a level of trip generation could occur by filling tenancies with commercial tenants undertaking standard commercial operations and fully utilising the existing 1,600 parking spaces provided on-site.

Notwithstanding the above – and with reference to the 2015 traffic surveys undertaken - even the (relatively) minor current commercial operations of the Site – with significantly lower employment (1,200 employees) and less than full occupancy of available floor space – generates some 376 trips in the AM peak and 344 trips in the PM peak. A simple factoring of these surveyed rates alone to account for the currently unused floor space (7,500m^2) provides a total Site trip generation estimate of 482 trips in the AM peak and 441 trips in the PM peak, a total that would be even higher if the common areas were returned to commercial space.

At present, some 1,200 people are employed at the Site; a simply factoring of 2015 employment numbers to the available Corridor Strategy employment estimates (to an estimated 2,000 jobs minimum at the Site itself) provides a trip generation estimate of 626 trips in the AM peak and 573 trips in the PM peak.

2.3 Trip Distribution

2.3.1 Directional Distribution

Based on the traffic surveys, our on-site observations and a review of sub-regional trip paths, the following directional trip distribution has been determined: -

- 80% of trips to/from the north via Coonara Avenue, of which approximately: -
  - 65% to/from the east
  - 15% to/from the north
  - 20% to/from the west

- 20% of trips to/from the south via Coonara Avenue

There is no information to suggest that these distribution paths would be significantly different following the rezoning.

2.3.2 Arrival & Departure Distribution

Based on the 2015 traffic surveys, the following arrival/departure trip distribution has been determined for the existing use of the Site: -

- In the AM Peak Hour: -
  - 93% of trips arrival
  - 7% of trips departure

- In the PM Peak Hour: -
  - 4% of trips arrival
  - 96% of trips departure

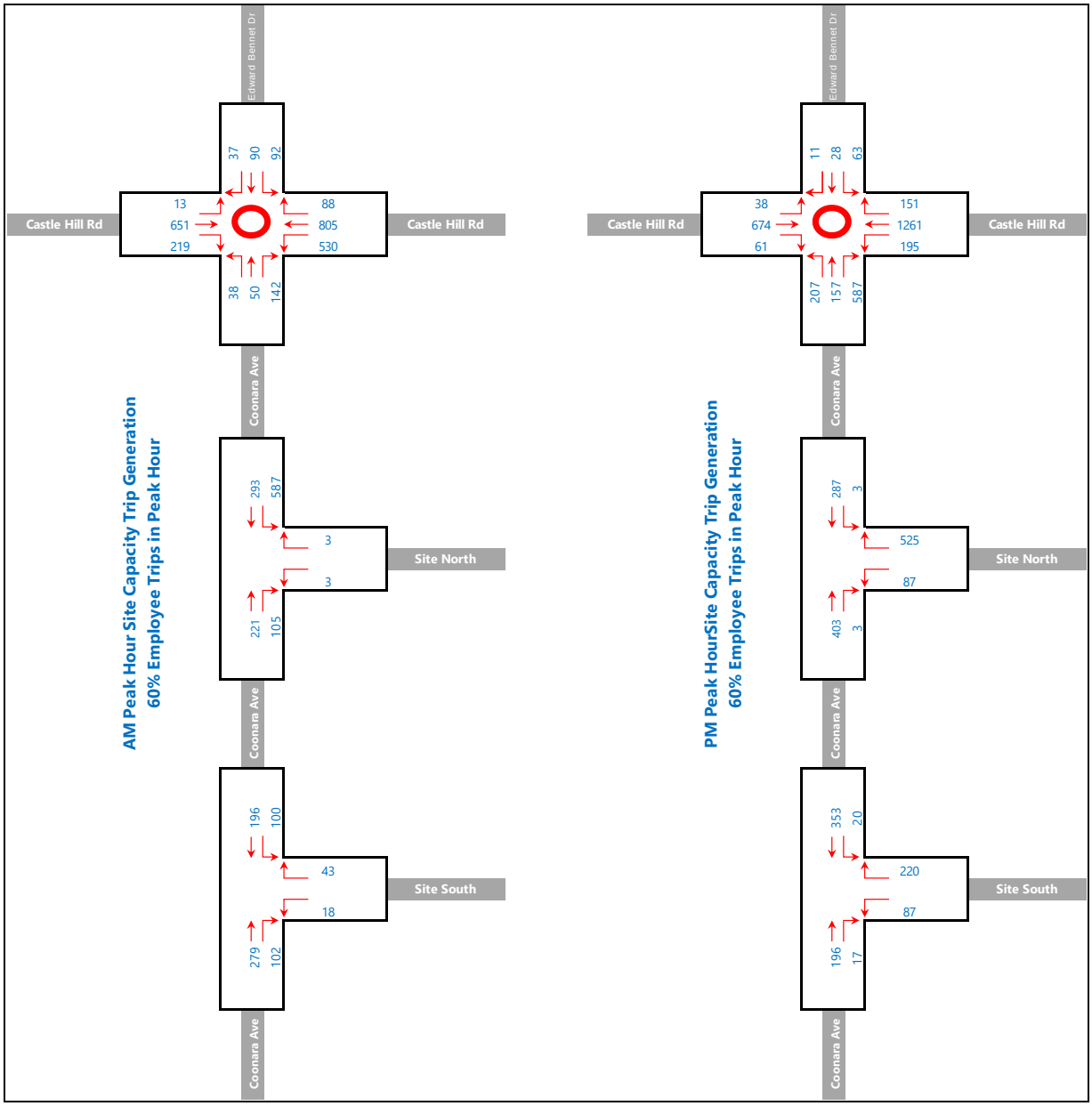
These arrival and departure patterns will change significantly following the rezoning (see **Section 3**).

2.4 Capacity Site Assignment

As discussed, the Site is currently operating well below (traffic generating) capacity; however, for the purpose of this traffic assessment it is essential to consider the 'impacts' of the Site operating at capacity. As such, additional trips have been assigned to the Site access intersections, and to the key intersection of Castle Hill Road & Coonara Avenue & Edward Bennet Drive, based on the parking space Site trip generation estimate detailed in **Section 2.2** (60% car park capacity generated in a peak hour, or 960vph) and the trip distribution detailed in **Section 2.3**.

The resulting Site flows based on these capacity commercial operations are shown in **Figure 2.4**.

Figure 2.4 Peak Hour Traffic Flows Site Capacity Operations



2.5 Site Capacity Impacts

The impact of trips associated with the Site operating at commercial capacity (as shown in **Figure 2.4**) at the key intersection of Castle Hill Road & Coonara Avenue & Edward Bennet Drive have been assessed using SIDRA. This modelling indicates that the additional trips associated with commercial capacity operations would increase delays and reduce capacity at the intersection, such that it reports a LoS 'C' in the AM peak and LoS 'F' in the PM peak.

Importantly, these performance results generally match those reported in the NWRL Construction EIS (2012), which was prepared at a time when the Site had a significantly higher occupancy than in 2015.

In Coonara Avenue, these capacity commercial operations would generate some 768vph two-way south of Castle Hill Road, and some 192vph two-way south of the Site.

3 The Rezoning Project

3.1 Components

The Project proposes the rezoning of the Site to provide for a residential development, and would indicatively provide the following: -

- A total of 800 residential dwellings, comprising: -
  - 192 one-bedroom units
  - 352 two-bedroom units
  - 60 two-bedroom terrace dwellings
  - 196 three-bedroom unit/terrace dwellings

- Ancillary retail space (~500m^2 GFA)

- A total of approximately 1,200 parking spaces, or some 400 spaces less than currently provided on-site

3.2 Access

All vehicle access would continue to be provided by the existing Site access points. While the on-site access road network will be determined further to future detailed planning, preliminary concept plans indicate that access to all on-site areas would be available via both access points and the retention of the existing internal perimeter road system. This suggests that Access North may continue to provide for a higher percentage of arrival and departure trips given that most trips will continue to be to and from the north.

The detailed distribution of trips to the two access points would be determined further to more detailed planning.

Further to our discussions with Council, it is Council's view that the design of the existing left turn entry lanes at both access points could be augmented to appropriately distinguish these lanes as entry lanes, though it is noted that the design of these lanes has provided for the Site since opening, and that the Project would reduce traffic movements to these lanes. Notwithstanding, the design of these lanes could be further investigated as part of future detailed design stages, and should not in our opinion have specific bearing on the broader Planning Proposal submission.

3.3 Public Transport

One of the key focuses of the Project is the accessibility of the Site to Cherrybrook Station and sub-regional bus services in Castle Hill Road. It is the opinion of ARC that the high frequency of services provided will ensure a significant uptake of public transport usage.

In addition, there is significant potential to extend local bus services to link the Site with Cherrybrook Station, either utilising the future network outlined in the Structure Plan, i.e. with a potential new link west from Coonara Avenue opposite the Site; and/or utilising the bus accessible internal Site road network. At the very least, bus services linking the Site with Cherrybrook Station along Coonara Avenue and Castle Hill Road, utilising the existing bus stops immediately adjacent to the Site, would provide an excellent level of additional accessibility and connectivity.

At present, detailed bus route planning has been undertaken by Hornsby Council for the northern part of the Cherrybrook Precinct (i.e. north of Castle Hill Road) and it is our understanding that Council is undertaking similar planning for the area south of Castle Hill Road.

3.4 Pedestrian & Cycle Links

The internal road network will provide a good level of pedestrian/cycle accessibility to Coonara Avenue. As discussed, at Coonara Avenue an existing path provides access to Cherrybrook Station via the Castle Hill Road & Edward Bennet Drive intersection, which will be further augmented in the future with a new pedestrian crossing of the Coonara Avenue approach, further improving accessibility for walk trips to/from Cherrybrook Station. Additionally, and as discussed in **Section 1.6**, the Structure Plan also identifies a future link directly opposite the Site linking to the west and then north to Cherrybrook Station via Staley Court (or potentially via Glenhope Road). Again, these future paths would even further enhance the connectivity of the Site to Cherrybrook Station.

3.5 Trip Generation

3.5.1 RMS Trip Rates

The RMS update to the GTGD provides surveys of high density residential sites across the Sydney metropolitan area (and Newcastle and Wollongong). Almost all of the GTGD survey sites lie within close proximity of rail, and most also are located near regional or sub-regional centres (i.e. in immediate proximity of employment, retail and other services). Summary rates provided in the GTGD Update are shown below.

Table 3.5.1 RMS GTGD Update High Density Residential Trip Rates

Weekday Rates	Sydney Average	Sydney Range	Regional Average	Regional Range
AM peak (1 hour) vehicle trips per unit	0.19	0.07-0.32	0.53	0.39-0.67
AM peak (1 hour) vehicle trips per car space	0.15	0.09-0.29	0.35	0.32-0.37
AM peak (1 hour) vehicle trips per bedroom	0.09	0.03-0.13	0.21	0.20-0.22
PM peak (1 hour) vehicle trips per unit	0.15	0.06-0.41	0.32	0.22-0.42
PM peak (1hour) vehicle trips per car space	0.12	0.05-0.28	0.26	0.11-0.40
PM peak (1 hour) vehicle trips per bedroom	0.07	0.03-0.17	0.15	0.07-0.22
Daily vehicle trips per unit	1.52	0.77-3.14	4.58	4.37-4.78
Daily vehicle trips per car space	1.34	0.56-2.16	3.22	2.26-4.18
Daily vehicle trips per bedroom	0.72	0.35-1.29	1.93	1.59-2.26

As discussed and agreed with Council, in our opinion the application of the RMS base trip generation rates directly to the Project would understate the potential trip generation of the proposed dwellings. Specifically, it is not appropriate – as part of a sensitivity assessment – to assign rates that are primarily based on sites within key metropolitan centres with immediate proximity to public transport, employment and services. Notwithstanding, it is also the case that the majority of the residential dwellings proposed have a significantly lower occupancy than standard dwellings, which in and of itself reduces trip generation potential.

Based on a more detailed analysis of the GTGD Update data, and with reference to the previous GTGD, it is our opinion that an appropriate rate of trip generation would be similar to that previously assigned to high density residential development in sub-regional centres (as detailed in Section 3 of the GTGD) – a rate of 0.29 trips per dwelling, or a rate some 35% higher than the summary RMS AM peak hour rate. This trip generation rate has then been modified further, providing for the GTGD Update identification of trip rate differences based on parking provision. Accordingly, ARC provides the following rates for the assessment: -

- 0.30 trips per dwelling in the AM and PM peak hour
- 0.25 trips per parking space in the AM and PM peak hour

It is noted that these rates are similar to (though still higher than) those reported in the GTGD Update for the Liberty Grove site, the centre point of which lies some 1.4km from Rhodes railway station; has no significant retail/commercial infrastructure; but which also provides a (sustainable) level of residential parking similar to that intended to be provided for in the Project (see also **Section 3.9**).

3.5.2 Total Trip Generation by Dwelling Trip Rate

Based on the trip rates per dwelling detailed above, the trip generation of the residential component of the Project would be: -

- 240 AM and PM peak hour trips

3.5.3 Total Trip Generation by Parking Provision Trip Rate

With reference to **Section 3.9** below, it is proposed that parking for the Project be provided further to consideration of the parking rates outlined in the Apartment Design Guide (ADG) and the (draft) Hills LEP Castle Hill North amendments, and provides: -

- 1 space per one-bedroom/two-bedroom unit
- 1.5 spaces per two-bedroom terrace dwellings
- 2 spaces per three-bedroom/four-bedroom unit/terrace dwelling
- 1 space per 5 dwellings for visitors

Based on these parking rates, the residential component of the Project would require a total of some 1,200 parking spaces, or some 400 spaces less than currently provided on-site. Based on the trip rate per parking space detailed above, the trip generation of the residential component of the Project would be: -

- 300 AM and PM peak hour trips

3.5.4 Council Trip Generation Rates

As discussed with Council, the trip rates assessed in sections above specifically acknowledge the different characteristics of the Site when compared to the primary sites surveyed by the RMS (per the GTGD Update), including the immediacy of employment and services, and availability of/access to public transport services.

Notwithstanding, as a point of comparison, Council surveys of high density residential development are reported in the 2006 (Council) Traffic Impact Report: Balmoral Road Release Area (BRRA Report). These surveyed rates were generally 50% higher than the GTGD rates at the time, specifically: -

- 0.35 peak hour trips per one or two-bedroom dwelling
- 0.5 peak hour trips per three-bedroom/four-bedroom dwelling

Using these rates provides an estimate of 310vph for the Project (in both peak periods), though it is noted that the BRRA Report also provides the following: -

> *The Baulkham Hills Council traffic generation rates are reflective of the Shire where access to public transport is limited. Using the [significantly lower] RTA rates would more accurately reflect the greater Sydney Traffic generations, where there is greater access to public transport. This would be relevant to consider with the provision of the proposed Transitways and, ultimately, the North-West Rail link to this area.*

Using the RTA rates is a conservative estimate of traffic generating potential with some improvement for public transport mode share. Further reduction in traffic generation could be achieved with increased public transport mode share. If higher public transport mode share is achieved there is an obvious lowering of the vehicular traffic generation, particularly in the critical AM peak travelling period.

It is certainly our opinion that the future accessibility to Cherrybrook Station (and indeed sub-regional bus services in Castle Hill Road) will lead to an increase in public transport mode share.

3.5.5 Retail Trip Generation

It is noted that the proposed minor retail space would serve only an auxiliary function, and is not expected to generate any significant level of trips in and of itself.

3.6 Trip Distribution

While no significant changes to directional distribution (from that identified in **Section 2.3**) are expected following the rezoning, the arrival and departure distribution will change (from that identified in **Section 2.3**), with the majority of AM peak hour trips being departure trips (as opposed to existing arrival trips) and vice versa in the PM peak. The following arrival/departure distribution profile has been assigned: -

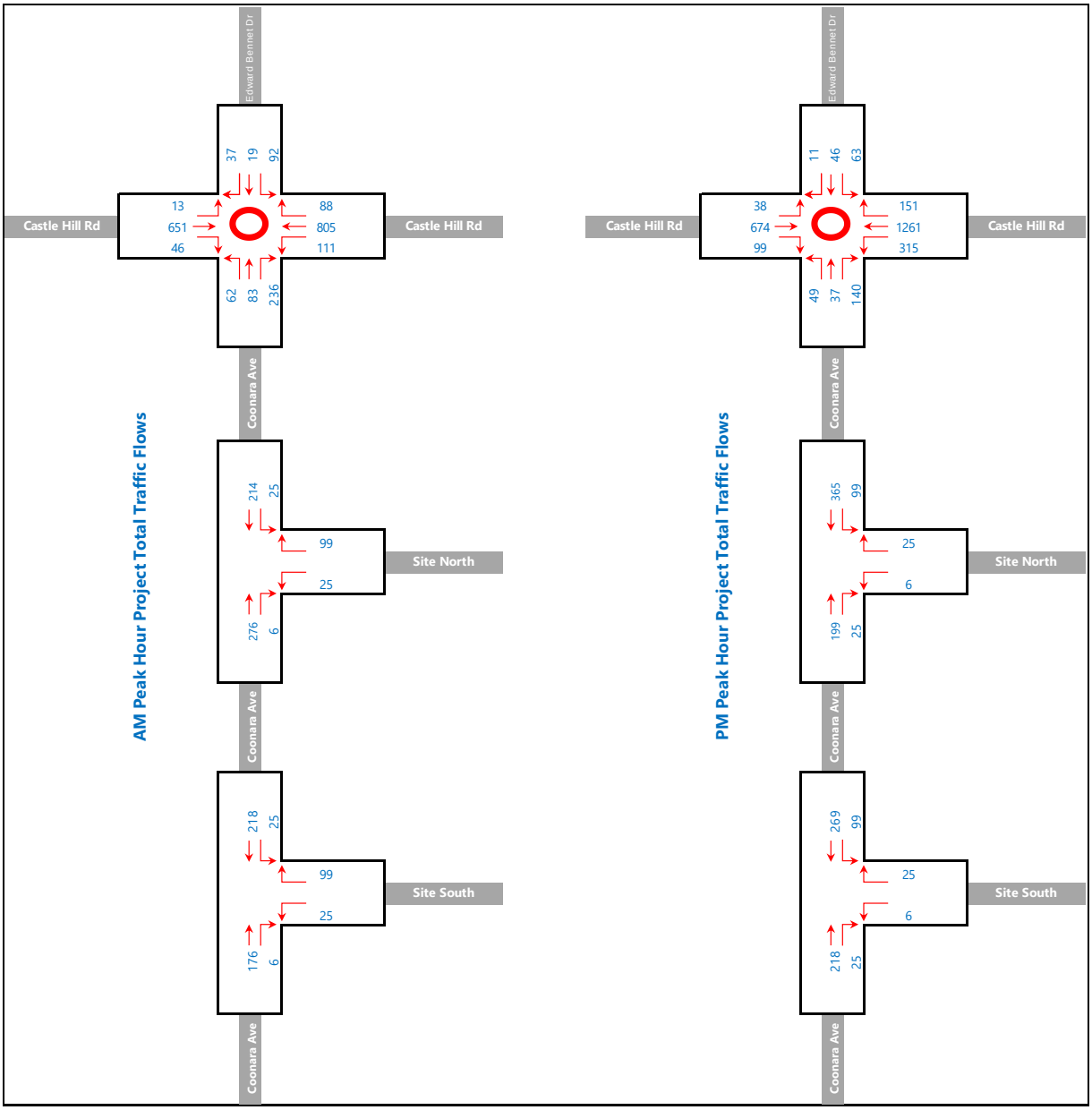
- In the AM Peak Hour: -
  - 20% of trips arrival
  - 80% of trips departure

- In the PM Peak Hour: -
  - 80% of trips arrival
  - 20% of trips departure

3.7 Future Trip Assignment

With reference to sections above, the forecast trip generation of the Project (based on the maximum forecast total provided by application of the Council trip rates per unit) has been assigned to the local road network, entirely replacing commercial trips as assigned in **Section 2.4**. The resulting flows at the key intersections are shown in **Figure 3.7** below.

Figure 3.7 Project Total Traffic Flows



3.8 Traffic Impacts

3.8.1 Site Trip Generation Comparison

Based on the trip generation potential of the Site based on various commercial capacity scenarios, and the trip generation of the Project with reference to either the ARC trip rate estimates or Council surveyed trip rates, it is immediately apparent that the trip generation of the Project would be significantly less than commercial use of the Site.

With reference to the ARC Project trip estimates provided in sections above and the Site commercial operation trip estimates provided in **Section 2.2**, **Table 3.8.1** provides a comparison of trip generation for the different Site scenarios: -

Table 3.8.1 Project Trips v Commercial Trips

Commercial Traffic Generation Factor	Traffic Generation Scenario	AM Trip Rate	AM Trips	PM Trip Rate	PM Trips
26500	m^2 GFA 2016 Commercial Occupancy	1.42	376	1.30	344
34000	m^2 GFA Full Commercial Occupancy	1.42	482	1.30	441
1600	Site Parking Spaces Peak Trips	60%	960	60%	960
1200	Employees 2016	0.31	376	0.29	344
2000	Precinct Plan Employees Forecast	0.31	626	0.29	573

Project Traffic Generation Factor	Traffic Generation Scenario	AM Trip Rate	AM Trips	PM Trip Rate	PM Trips
800	Project units	0.30	240	0.30	240
1200	Project unit parking spaces	0.25	300	0.25	300

Project trips % of 2016 Full Commercial Occupancy Trips		62%		68%
Project trips % of Site Parking Spaces Peak Trips		31%		31%
Project trips % of Precinct Plan Employees Forecast Trips		48%		52%

In summary, there is no question in our opinion that the Project would generate significantly fewer trips than would be generated by the Site under commercial operations. This is a conclusion that was generally agreed with Council (based on Council's own trip generation estimates) in our meeting of 13th September 2016 even when considering the higher trip generation of the previous Planning Proposal providing some 1,119 dwellings and 1,500 parking spaces, or some 319 dwellings and 300 parking spaces more than now proposed in the Project. This in turn would result in significantly fewer trips being generated to Coonara Avenue (both in the peak periods and across the day) and significantly fewer trips being generated to the key intersection of Castle Hill Road & Coonara Avenue & Edward Bennet Drive (see also below) than would be generated further to commercial operations at the Site.

3.8.2 Intersection Operations

Notwithstanding the above, the trips generated by the Project would have a different distribution pattern to those generated by the existing Site, specifically in regard to the arrival and departure distribution (which would essentially be the opposite of the commercial distribution).

SIDRA testing of the intersection of Castle Hill Road & Coonara Avenue & Edward Bennet Drive based on the existing intersection design and phasing indicates that the Project would result in similar operations to capacity commercial operations in the AM peak (LoS 'C') but with significantly lower delays in the PM peak (LoS 'C' compared to LoS 'F'). Based on the proposed upgrade of the intersection (as currently proposed, as detailed in **Section 1.4.2**) the Project would result in significantly improved operations (LoS 'B' in the AM peak and LoS 'C' in the PM peak) when compared to capacity commercial operations.

As stated in **Section 1.4.2**, our discussions with Council, the RMS and TNSW confirm that traffic modelling of the broader Cherrybrook Precinct has yet to be finalised. It is almost certainly the case that further to the development of the Cherrybrook Precinct there will be (proportionally higher) trip generation increases to the Edward Bennet Drive approach to the intersection, as well as more general average annual increases in flows in Castle Hill Road, and the determination of these future increases will guide the future intersection upgrade design process.

As discussed with Council, it is not appropriate to provide a detailed forecast assessment of the future intersection flows while these Precinct wide assessments are underway. Notwithstanding, the SIDRA modelling – and more generally the significant reduction in Site trips further to the proposed Project – clearly indicates that the intersection of Castle Hill Road & Coonara Avenue & Edward Bennet Drive would operate with lower average delays based on the proposed Project trip generation/distribution than would be the case if the Site was accommodating commercial operations.

With regard to the Site access intersections, SIDRA modelling indicates that these intersections will continue to operate at a good level of service in both peaks, even if a higher percentage of trips are generated to Access North than suggested in **Figure 3.7**; indeed, all trips could be generated to a single access intersection (noting that this is not proposed) while still retaining a good level of service.

3.9 Parking

3.9.1 Parking Requirements

The parking requirements for the Project can be determined with reference to the ADG, which provides the following: -

> *For development in the following locations:*
>
> - *on sites that are within 800 metres of a railway station or light rail stop in the Sydney Metropolitan Area; or*
> - *on land zoned, and sites within 400 metres of land zoned, B3 Commercial Core, B4 Mixed Use or equivalent in a nominated regional centre*
>
> *the minimum car parking requirement for residents and visitors is set out in the Guide to Traffic Generating Developments, or the car parking requirement prescribed by the relevant council, whichever is less.*

Reference in turn to the GTGD (for sub-regional centres) provides the following rates: -

- 0.6 spaces per one-bedroom unit
- 0.9 spaces per two-bedroom unit
- 1.4 spaces per three-bedroom unit
- 1 space per 5 units for visitor parking

Based on these parking rates the Site would require a minimum of 972 parking spaces.

It is noted that these rates are similar to, though slightly less than, the minimum parking requirements when calculated with reference to the recently proposed amendment to the (draft) Hills LEP, which require 1 space per unit (all sizes) and an additional 1 space per 4 units, or a total of some 1,000 parking spaces when applied to the Project. These rates in turn are similar to those provided for high density development in the North Kellyville DCP (acknowledging that this is a Growth Centres prepared DCP) even though high density sites within the North Kellyville precinct are not provided with equivalent access to rail as provided at the Site.

3.9.2 Proposed Parking

With reference to the ADG minimum requirements, the proposed amendments to the (draft) Hills LEP, and moreover to providing a sustainable level of car parking that responds to current market conditions without unduly increasing trip generation or the potential for off-site parking, the following parking rates are proposed: -

- 1 space per one-bedroom unit
- 1 space per two-bedroom unit
- 1.5 spaces per two-bedroom terrace dwelling
- 2 spaces per three-bedroom/four-bedroom unit/terrace dwelling
- 1 space per 5 units for visitor parking

Based on these parking rates, the Site would require a total of 1,200 parking spaces, some 230 spaces more than the minimum provided for under the ADG, but some 400 spaces fewer than currently provided on-site.

It is anticipated that these (residential and residential visitor) spaces would be provided as part of the Project utilising new parking levels designed within residential buildings; as (internal) street parking; and within the existing multi-storey car park in the northern part of the Site (likely for visitor parking). The detailed design of parking areas would be undertaken as part of a future design process (as part of a future Site specific Development Application) and necessarily provide compliance with Australian Standards.

With regard to the proposed ancillary retail space, parking would also be provided in accordance with the appropriate guidelines further to refinement of the specific type of retail space proposed, though again the retail space is generally expected to serve Site residents only.

3 Conclusions

Further to a detailed assessment, ARC has determined that the Project would generate significantly fewer trips to the local road network than would be generated by commercial operations at the Site, and that as such all information supports a conclusion that the Project would have a reduced impact on the local traffic environment when compared to commercial operations at the Site. Specifically, ARC has determined that: -

- The Site is very well located for future residents to utilise Cherrybrook Station (currently under construction) with pedestrian access to be further improved via the provision of a signalised crossing of the Coonara Avenue approach to Castle Hill Road (by others). Moreover, the Structure Plan indicates additional links immediately west of the Site in turn linking to Cherrybrook Station, links which would likely provide additional efficient pedestrian/cycles routes between the Site and Cherrybrook Station.

- There are excellent opportunities to supplement local bus routes to provide more frequent services between the Site and Cherrybrook Station, either via the links indicated in the Structure Plan; via Coonara Avenue; or indeed through the Site itself, a more than viable opportunity given the future residential population of the Site.

- The past trip generation of the Site – and most significantly the potential trip generation of the Site that could be generated 'tomorrow' based on the existing floorspace, the existing 1,600 on-site parking spaces, and the existing commercial zoning – is significantly higher than currently being generated. It is estimated that capacity commercial operations could generate some 1,000vph to the commuter peak periods.

- The trip generation of the Project would be significant lower during the commuter peak periods, estimated at up to 310vph in the commuter peak hours utilising Council's (maximum) trip generation rates. This is a total significantly less than would be generated under capacity commercial operations at the Site; a total significantly less than would be generated based on the Corridor Strategy employment estimates for the Site; and indeed a total less than the existing (significantly under capacity) commercial use of the Site.

- While it is acknowledged that future flows at the intersection of Castle Hill Road & Coonara Avenue & Edward Bennet Drive are yet to be modelled in detail as part of planning for the broader Cherrybrook Precinct, sensitivity modelling using SIDRA indicates that the significantly reduced trip generation of the Site further to the proposed Project would result in improved operations at the intersection when compared to commercial operations. This finding specifically accounts for the redistribution of arrival/departure trips during the peak periods.

- The Site access intersections would operate at a good level of service as a function of the very moderate Site trip generation and Coonara Avenue through traffic flows. This would be the case even if all trips were generated to a single Site access intersection, though the proposed internal road network is expected to provide some balance of trips between the two (existing) access intersections.

- Parking is proposed at an appropriately sustainable level which would remove the potential for an off-site parking demand while simultaneously reducing the potential for additional Site trip generation. The Proposal would provide some 400 less parking spaces than currently provided on-site.

The Project is therefore supportable in regard to traffic and transport considerations.

20th March 2017

Mr Adrian Checchin
Mirvac
Level 26, 60 Margaret Street
Sydney NSW 2000

55 Coonara Avenue, West Pennant Hills – Summary of Traffic Assessment

Dear Adrian,

Further to our recent discussions, provided below is a summary of our thorough assessment in regard to the proposed residential redevelopment of 55 Coonara Avenue, West Pennant Hills, specifically focusing on the trip generation characteristics of the Proposal. Full details of our assessment are available in the (October 2016) *55 Coonara Avenue West Pennant Hills Planning Proposal Revisions 3 Traffic Assessment*.

Executive Summary

Based on all available information, it is the opinion of ARC that the proposal to rezone the Site to provide for residential development will: -

- Generate significantly fewer peak hour trips than would be generated by currently allowable commercial operations at the Site.
- Result in the key intersection of Castle Hill Road & Coonara Avenue & Edward Bennet Drive operating at a better level of service (i.e. with lower delays) than it would further to currently allowable commercial operations at the Site, even further to the identified change in arrival and departure trip distribution.

Existing Site Trip Generation

2015 traffic surveys of the Site reported a trip generation of 371 vehicle trips per hour (vph) in the AM Peak and 345vph in the PM Peak. The occupancy of the Site at the time of the surveys was significantly below capacity, with regard to both occupied floor area and more importantly employee levels; at the time of the surveys there were some 1,200 people employed at the Site, representing approximately 30% of the 3,500 employees at the Site as recently as 2009 (IBM).

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Clearly therefore, the potential (and indeed very recent) trip generation of the Site under commercial operations – and specifically the potential trip generation which could occur 'tomorrow' further to full Site occupation (if that were to occur) - is significant. ARC has estimated that the peak IBM operations were likely to have generated some 1,000vph in the peak periods (noting the car park capacity alone of 1,600 spaces), and that even the more moderate commercial operations (based on the employee forecasts outlined in the Hills Corridor Strategy or in line with Bureau of Transport Statistics employment data) would generate some 600vph in the peak periods.

These estimates of past and potential commercial trip generation were fully discussed and in our opinion agreed with Council traffic officers.

Proposal Site Trip Generation

As acknowledged in our 2016 assessment – and as discussed and agreed with Council traffic officers - the simple application of summary RMS high density residential trip rates to the Proposal is not appropriate, given that those (RMS) summary rates are based on survey sites within regional and sub-regional centres with immediate access not only to public transport, but also to education, service and retail infrastructure. As such, higher trip rates (per dwelling) were adopted for the assessment, including sensitivity analysis using past Council surveys of high density residential sites with no immediate access to high quality public transport (i.e. rail). Using these Council trip rates, the Proposal is estimated to generate some 310vph in the peak periods.

Again, these estimates of residential trip generation further to the Proposal were fully discussed and in our opinion agreed with Council traffic officers.

Proposal Traffic Impacts

With reference to sections above **the Proposal would, quite simply, generate fewer peak hour trips (and potentially very significantly fewer trips) than currently allowable commercial operations at the Site**. Adopting the (essentially worst-case) Council trip rate estimates, the Proposal would generate: -

- **Approximately 20% fewer peak hour trips than the existing low occupancy commercial operations at the Site (1,200 employees);**
- **Approximately 50% fewer peak hour trips than entirely compliant medium occupancy commercial operations at the Site (i.e. 2,000 employees in line with the Hills Corridor Strategy); and**
- **Approximately 70% fewer peak hour trips than entirely compliant peak occupancy commercial operations at the Site (i.e. 3,500 employees per past IBM operations)**.

As such, there is no question in our opinion that the Proposal would generate significantly fewer trips during the peak periods than commercial operations at the Site. Again, this conclusion was fully discussed and in our opinion agreed with Council traffic officers.

Notwithstanding, a lower trip generation (even one as substantial as forecast) does not alone provide justification of reduced impacts. In this regard, it is acknowledged that the distribution of Site trips will change further to the Proposal, specifically as residential development will generate outbound trips in the AM peak hour and inbound trips in the PM peak hour, the opposite of commercial development**. However, analysis of the key intersection of Castle Hill Road & Coonara Avenue & Edward Bennet Drive indicates that during the peak periods the intersection would operate at a better level of service (i.e. with lower delays) under the Proposal as opposed to the commercial generation scenarios under current (background traffic) conditions**.

This conclusion is further enhanced when consideration is given to the additional infrastructure proposed for the intersection as part of the North-West Metro upgrade works, specifically including additional approach lane infrastructure in and to Coonara Avenue.

Conclusion

Based on all available information, it is the opinion of ARC that the proposal to rezone the Site to provide for residential development will: -

- Generate significantly fewer peak hour trips than would currently allowable commercial operations at the Site.
- Result in the key intersection of Castle Hill Road & Coonara Avenue & Edward Bennet Drive operating at a better level of service (i.e. with lower delays) than it would further to currently allowable commercial operations at the Site, even further to the identified change in arrival and departure trip distribution.

We trust that the information provided above will be of assistance to Mirvac and Council. If you or any Council representatives wish to discuss the issues outlined above further, please don't hesitate to contact Anton Reisch on 0427 995160, or by email at antonreisch@optusnet.com.au.

Yours sincerely,

Anton Reisch

Director, ARC Traffic + Transport

Reference: 0442l01v2

21 April 2017

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Attention: Adrian Checchin – Development Director, Apartments, Residential Development

RE: Planning Proposal – Coonara Avenue Business Park, 55 Coonara Avenue, West Pennant Hills (20 / 2016 / PLP)

Dear Adrian,

EXECUTIVE SUMMARY

This peer review and accessibility and transport assessment responds to the accessibility, transport and traffic matters raised by Council in their assessment of the Planning Proposal submitted that seeks rezoning for a master planned community residential scheme at the subject site. The areas of discussion include strategic context, pedestrian connectivity and local and regional traffic impacts. Our findings are summarised as follows.

- The nominated retention of the B7 business park zoning on the Site is not a predetermined conclusion of the NWRL strategy and the proposed rezoning of the Site for a master planned community residential scheme is consistent with the provisions of the NWRL corridor strategy, and indeed further analysis of the Site is anticipated by that strategy.
- The Site is within the Cherrybrook Study Area and within 800 metres of the new Cherrybrook station. If Council's position is accepted that the Site is suitably located in terms of pedestrian connections to the train station for pedestrians accessing their place of work, then it must also be accepted that it is suitably located for pedestrians accessing their place of residence. Or in simple terms, the Site is suitably located for pedestrian connections to the train station.
- The length of a walking route to a train station has a greater impact on walkability than the gradient of that route due to topography. Accordingly, the benefits arising from the Site being within the target 800-metre walking catchment of Cherrybrook train station outweigh any perceived disadvantages associated with topography. Topographical factors should be viewed positively to justify expansion of the standard 800-metre walking catchment to maximise the transport benefits of the new rail infrastructure and to ensure its viability. The negative application of topographical factors as outlined by Council risks underutilisation of the NWRL, compromising its ability to achieve its target headways of 1 train every 4 minutes.
- Council accepts that the residential proposals would result in significantly lower levels of Site car traffic. However, Council adopts a narrow view that considers the issues with car traffic relate solely to local network performance and congestion, ignoring wider traffic impacts and other significant issues such as emissions, health, road safety, noise, etc. Notwithstanding that such an approach is inconsistent with the objectives of the NWRL corridor strategy to develop Transit Oriented Developments around each of the new stations, Council's position that the change in the tidal characteristics of the Site traffic would result in traffic congestion are unfounded and indeed the technical analysis undertaken by ARC clearly demonstrates that the reduction in car traffic due to the Proposal would improve the performance of the local road network. Accordingly, there is no justification for Council's position that retaining the B7 uses, which would generate significantly more car traffic, is a preferred outcome. In fact, the technical analysis demonstrates the opposite; that the Proposal's master planned community residential scheme would in fact be a preferred outcome.

It is our conclusion that following our peer review of the accessibility, transport and traffic matters, Council's views are unfounded and the Proposal is supportable and has been thoroughly assessed and justified to support this position.

Introduction and Background

Ason Group has been commissioned by Mirvac to undertake a peer review and provide an Accessibility and Transport Assessment of the proposed Planning Proposal for the Coonara Avenue Business Park (the Site) located at 55 Coonara Avenue, West Pennant Hills. The Site is within the Cherrybrook Study Area (the Precinct) surrounding the Cherrybrook railway station that is currently under construction and due to open in 2019. The Planning Proposal generally seeks to rezone the Site from its nominated B7 Business Park zoning to a master planned community residential scheme (the Proposal).

A total of 3 revisions have been lodged with Hills Shire Council seeking a recommendation to proceed to Gateway Determination. The initial proposal submitted on 10 March 2016 (#1) included a Concept Plan proposing approximately 1,270 dwellings; the most recent proposal submitted on 21 October 2016 (#3) proposed a significant reduction in residential development to approximately 800 dwellings. **Figure 1** presents a plan that shows the latest Proposal within the context of its proximity of Cherrybrook station.

Figure 1: Location and Site Plan

On 28 March 2017, Council submitted a report (the Council report) recommending the planning proposal not proceed to Gateway Determination. The Council report included several perceived matters that – in Council's opinion – rendered the Site unsupportable for high-density residential development. In terms of accessibility, transport and traffic, the perceived matters raised by Council are summarised as follows:

- Inconsistencies with the State and Local Government strategic framework for the land under the State Government's North West Rail Link Corridor Strategy and the Hills Corridor Strategy.
- Poor pedestrian accessibility to the future Cherrybrook railway station due to topography and distance.
- Impacts on the local and regional road network due to the replacement of employment destination traffic with residential origin traffic.

We note that these matters appear to be very subjective and not substantiated in the Council report with technical data, particularly the responses to the traffic impacts. The objective of this assessment is to respond

to the accessibility, transport and traffic matters raised by Council. In preparing this statement, we have reviewed several key planning and background documents, including:

- *North West Rail Link Corridor Strategy* (the NWRL corridor strategy) prepared by NSW Transport and NSW Planning and dated September 2013.
- *North West Rail Link, Cherrybrook Station Structure Plan – A Vision for Cherrybrook Station Surrounds* (the Cherrybrook strategy) prepared by NSW Transport and NSW Planning and dated September 2013. Consistent with the NWRL corridor strategy, this strategy includes a structure plan for the Precinct (the Structure Plan) that currently nominates the Site as a significant short-term opportunity site.
- *The effects of topography on walking and cycling in suburban centres: A comparison of flat Salisbury with hilly Golden Grove in Adelaide's north-east* dated October 2013 and prepared by Andrew Allan (the Allan report) of the School of Natural & Built Environments and Barbara Hardy Institute, City East Campus, University of South Australia.
- *Proposed Rezoning, 55 Coonara Avenue West Pennant Hills – Traffic Assessment* prepared by ARC Traffic + Transport (ARC) and dated January 2016 (the original ARC report). This is the traffic report that supported the initial planning proposal (#1) for indicatively 1,270 dwellings on the Site.
- *55 Coonara Avenue West Pennant Hills Planning, Proposal Revisions 3 – Traffic Assessment* prepared by ARC and dated October 2016 (the revised ARC report). This is the traffic report that supported the latest planning proposal (#3) for indicatively 800 dwellings on the Site.
- *55 Coonara Avenue, West Pennant Hills – Summary of Traffic Assessment* letter prepared by ARC and dated 20 March 2017 (the ARC letter). This letter summarised the findings of the revised ARC report.

Figure 2: The Cherrybrook Study Area Structure Plan (*ref: Figure 19, Cherrybrook strategy*)

In conjunction with Council's planning report, we have reviewed the above-mentioned documents and provide our peer review advice herewith.

Strategic Context

In summary, the Council report states that the Proposal is inconsistent with strategic policy in terms of the proposed use of the Site. These inconsistencies generally relate to 2 areas:

1. Proposed R4 high-density residential use versus the nominated (and historic) B7 business park use.
2. The connectivity of the Site to Cherrybrook station.

Regarding the proposed use, the Council report states the, "*site is not identified for housing under either Strategy and instead, proposes that the land be used for business park activities, thereby facilitating employment outcomes*". This however is an oversimplification of the NWRL corridor strategy, which states that the, "*Coonara Avenue Business Park site and the Inala and Tangara Schools have been identified as significant sites and a potential future land use has been nominated.* ***These sites will be subject to further consideration and collaboration with stakeholders, to determine their likely role in the future***". Within the context of the above statement, clearly the nomination of retaining the B7 business park use for the Site is a response to a position held in 2013 by NSW Planning that further studies – commercial, ecological, traffic/transport, etc – were considered necessary to realise the full potential of the Site.

This point that the nomination is of a 'flexible' nature is further enhanced by the section of the NWRL strategy that identifies areas that are to remain unchanged due to, "*a number of factors including existing uses, varying degrees of constraints, connectivity, accessibility and market demand*". **Figure 3** has been extracted from this section, which clearly illustrates that the Site is not included as a site to remain unchanged.

Figure 3: Areas to Remain Unchanged (*ref: Figure 24, Cherrybrook strategy*)

In summary, the nominated retention of the B7 business park zoning on the Site is not a predetermined conclusion of the NWRL strategy and the proposed rezoning of the Site for a master planned community residential scheme is consistent with the provisions of the NWRL corridor strategy, and indeed further analysis of the Site is anticipated by that strategy.

Regarding connectivity, there are several statements in the Council report that suggest residential development at the Site – by virtue of its proximity to the Cherrybrook station and the topography between the Site and the station – is contrary to state and local government policy, in particular the NWRL corridor strategy. To respond to Council's comments, it is important to clarify the relevance of the 800-metre zone around train stations that is referred to in many policy documents and specifically the NWRL corridor strategy.

In delivering public transport accessibility goals and targets, service planning makes assumptions about walk distance to access public transport. Guidelines often use ¼ mile or 400 metres, or multiples such as ½ mile

or 800 metres, as key distances in network and service planning. The empirical origin of these commonly used "rules of thumb" is unclear. Service planning guidelines for Sydney (NSW Ministry of Transport 2006) specify that 90% of households in each of the 15 metropolitan bus contract regions should be within 400 metres of a rail line and/or bus route during the day (commuter peaks, inter peak and weekend day time), and within 800 metres of a rail line and/or bus route at night time.

With regard to NSW Policy, the 800-metre distance is measured as the **straight line distance** (often referred to 'as the crow flies'), not road or walking distance. This recognises that the 800-metre distance is a guide, and that the distance pedestrians will walk to access commercial centres and/or public transport varies greatly. The original ARC report and the revised ARC report included findings from several local, national and international studies that clearly demonstrate that commuters will readily walk in excess of 800-metres (and indeed in excess of 1 kilometre) to access a train station. Furthermore, as an example of policy variation, Transport for London adopts a rule of thumb of 960 metres walking distance around a train station for its Public Transport Accessibility Level (PTAL) calculations.

With regard to the NWRL corridor strategy, the importance of the 800-metre distance is stated in 1 of the 5 key objectives identified by the strategy to provide Transit Oriented Developments (TODs) around each of the 8 new NWRL train stations. The objective states:

> *Ensure a population density within walking distance of each station (generally within 800m) to provide an appropriate threshold to deliver a range of activities and uses.*

The Council report often refers to the Site being 'undesirable' due to its distance to the station. However, Figure 1 and Figure 2 clearly show that the Site is within 800 metres of the Cherrybrook station and therefore within the desirable walking catchment distance of a train station under NSW guidance.

More importantly, the Council report by notionally supporting the nominated B7 use, effectively takes the position that the Site is unsatisfactorily located to promote residential pedestrian traffic; however, it is suitably located for employee pedestrian traffic. Or in other words, pedestrians walking between their home and a train station are less likely to walk a longer (and arguably steeper) route than pedestrians walking between a train station and their place of employment.

Recognising that residential pedestrians and employee pedestrians are one and the same, this is an untenable position for Council to take, particularly for a site that is within 800 metres of a station. Indeed, a review of the whole corridor strategy suggests that the opposite has in fact been planned for, with the commercial uses generally adjacent to the train stations and the residential uses located further out, as can be seen from the corridor structure plan at **Figure 4**. In fact, a detailed review of the structure plans for Castle Hill, Bella Vista, Kellyville and Rouse Hill show areas zoned for high-density residential that are beyond 800 metres from their respective train stations.

In summary, the Site is within the Cherrybrook Study Area and within 800 metres of the station. If Council's position is accepted that the Site is suitably located in terms of pedestrian connections to the train station for pedestrians accessing their place of work, then it must also be accepted that it is suitably located for pedestrians accessing their place of residence. Or in simple terms, the Site is suitably located for pedestrian connections to the train station, regardless of the Site's current use or it is developed as proposed under the Planning Proposal.

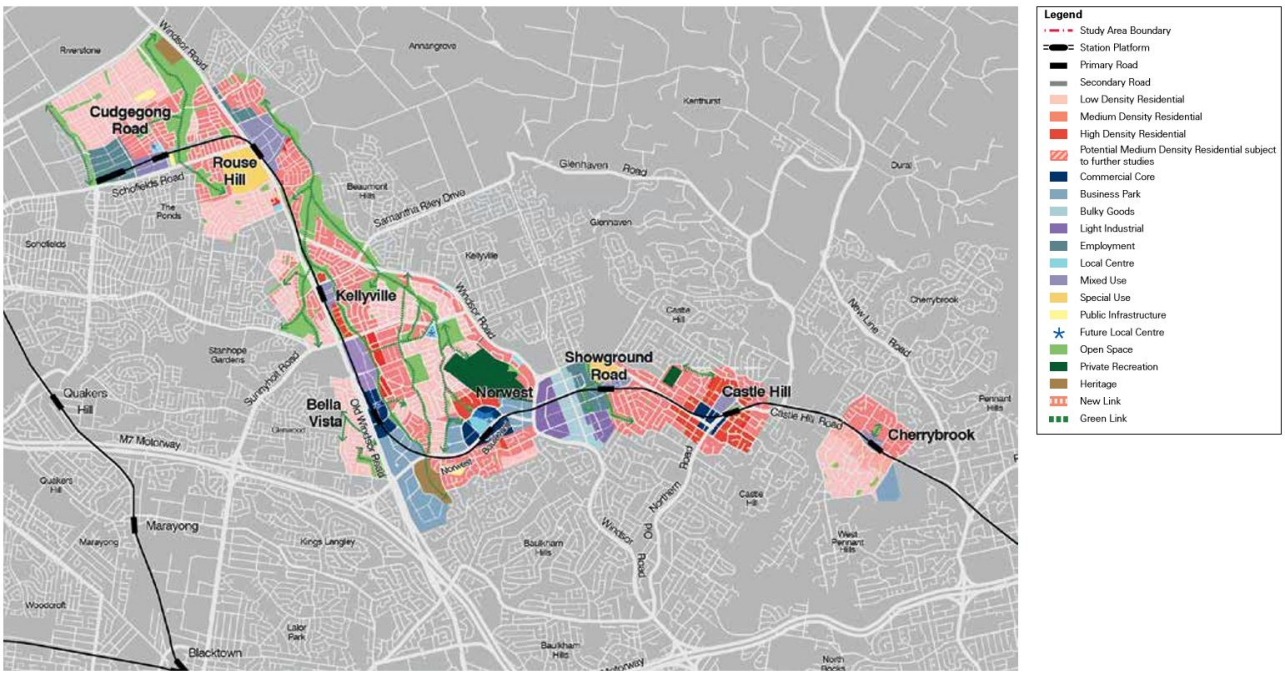


Figure 4: Corridor Structure Plan (*ref: Figure 9, NWRL corridor strategy*)

Pedestrian Accessibility

It is accepted that the Cherrybrook strategy recognises that pedestrian (and cycling) accessibility for the portion of the study area south of Castle Hill Road (which includes the subject Site) is restricted by the, "*lack of street network permeability, due to the number of cul-de-sacs, and the Study Area's steep topography south of Castle Hill Road. There are also a number of local streets with limited street lighting and pedestrian footpaths that further restricts active modes of transport*".

Council's report reiterates topography, as well as the perceived matter of being beyond 800-metres walking distance from the station. The following passage from the Council report summarises Council's position:

> *The site is not easily accessible by foot as it is affected by challenging topography and poor pedestrian accessibility to the future Cherrybrook train station (excess of 800m). Locating high density development on the outer edge of the precinct, out of a comfortable walking distance to the future Cherrybrook Rail Station and with grades of approximately 15% is not the best practice for planning for better connected centres.*

Regarding the issues of network permeability and infrastructure, the Site – as a large single lot site that extends south from Castle Hill Road – will include a pedestrian network that ensures permeability through the Site providing maximum connectivity between the Site and Cherrybrook train station. All new footpaths would be designed to relevant standards and include necessary street lighting. Furthermore, the Proposal does not rely upon any existing substandard footpaths to connect the Site to the train station.

The Site is within the NSW target walking catchment of 800 metres of Cherrybrook station; therefore (as discussed above) distance is not a matter of concern. Ultimately, topography – like distance – cannot be reasonably considered a matter of concern by Council recognising Council's support of B7 uses on the Site effectively extends support to the Proposal in terms of pedestrian connectivity. Again, as discussed above, any alternative view would place Council in the untenable position of suggesting that the route is satisfactory for pedestrians accessing their place of work, but unsatisfactory for pedestrian accessing their place of residence.

Notwithstanding, to understand the matter of topography, the findings of the Allan report on *The effects of topography on walking and cycling in suburban centres* have been reviewed. Dr Andrew Allan is a Senior Lecturer of the School of Art, Architecture and Design at the University of South Australia, who specialises in, "*include transport planning and policy, regional planning, infrastructure planning and the application of technology to manage and plan urban and regional environments*".

The Allan report presents, "*the results of a comparative analysis of two metropolitan Adelaide suburbs (Salisbury and Golden Grove) with public transit interchanges that service a predominantly residential neighbourhood precinct within their respective local catchments of approximately a 1.6km radius, to determine the impact of topography on local transport modal choice. Both Salisbury and Golden Grove are located approximately 20km from the centre of Adelaide city centre in Adelaide's north-eastern suburbs and both have similar intensity of retailing activity and style and density of residential development. However, Golden Grove is extremely hilly with changes in elevation varying by up to 90m up to a maximum height of 214m above sea level, whereas Salisbury is predominantly level at an elevation of approximately 35m*".

Strictly speaking, direct conclusions on the effects of topography are limited. However, the Allan report does conclude that, "*distance is still the major determinant of walking effort*". Regarding the subject Site, this finding indicates that the benefits arising from the Site's location within the target walking catchment, outweigh any perceived disadvantages relating to the gradient of the limited sections of the walk route between the Site and the station.

It is our opinion that this finding accords with a common-sense approach that recognises that a commuter – who would generally undertake the same walk route to and from the station – would accept any perceived difficulties associated with an uphill walk in one direction, recognising that the downhill walk in the opposing direction would require much less effort.

More importantly, development and density around train stations should be encouraged, not just because it makes sound transport planning sense, but also as it will assist with providing a critical mass of future rail users, ensuring the viability of the rail line. This viability is important if the NWRL is to achieve its target of providing a train service every 4 minutes during peak periods.

Within this context, the matter of topography should be viewed as a factor for expanding the area around stations for development and density. For example, NSW policy and guidance refers to an 800-metre standard walking catchment (straight line distance, no topographical requirements); within this catchment area, development and density is to be encouraged and factors like a level topography at the boundary of the catchment should be used as justification to expand the area for development and density. This represents a positive approach that seeks to maximise the regional transport benefits of the new rail infrastructure.

The contrasting view held by Council however is to take the 800-metre standard walking catchment, then use topographical factors to reduce the area surrounding a station that (in Council's opinion) should provide development and density. This negative approach risks underutilising the new infrastructure, which would likely affect the viability of the NWRL and compromise the service's ability to achieve its target headways of 1 train every 4 minutes, thereby reducing the services desirability to potential users.

In summary, the length of a walking route to a train station has a greater impact on walkability than the gradient of that route due to topography. Accordingly, the benefits arising from the Site being within the target 800-metre walking catchment of Cherrybrook train station outweigh any perceived disadvantages associated with topography. Topographical factors should be viewed positively to justify expansion of the standard 800-metre walking catchment to maximise the transport benefits of the new rail infrastructure and to ensure its viability. The negative application of topographical factors as employed by Council risks underutilisation of the NWRL, compromising its ability to achieve its target headways of 1 train every 4 minutes.

Traffic Impacts

Council's position in relation to traffic impacts is summarised in several passages from the Council report. These are presented below with our corresponding responses:

> *A Traffic and Transport Assessment (ARC Traffic and Transport, October 2016) was submitted with the amended planning proposal (November, 2016) which evaluates the traffic and parking implications of the proposed residential development at 55 Coonara Avenue, West Pennant Hills. The assessment compares the IBM site as a commercial use to the proposed residential with 240 trips in the AM and PM peak compared to 482 trips and 441 trips in the AM and PM peaks respectively. This is based on full occupancy of the original IBM commercial floor space if it was still operating.*

It is noteworthy that Council accepts the methodology adopted by ARC, that the residential proposals should be considered against what the Site would generate under full commercial operations (assessed to be 482 trips during the AM peak hour and 441 trips during the PM peak hour).

Furthermore, Council accepts that the latest 800-dwelling proposal would generate (at 0.3 trips per dwelling) 240 AM and PM peak hour trips, an average peak hour Site traffic reduction of 48%. It is noted that the original 1,270-dwelling scheme would have been forecast to generate 381 AM and PM peak hour trips, an average peak hour Site traffic reduction of 17%.

> *The proposed residential development will alter the existing traffic pattern in the local area. Traffic congestion issues along Coonara Ave, and its nearby intersections with Castle Hill Rd and Aiken Rd, will actually be worse than previous performance because motorists will generally be travelling in the opposite direction to the existing employment activities on the site.*
>
> *The applicant's assessment notes that access conditions out of Coonara Avenue will be improved as part of this proposal. However this will not be correct considering the impact on the wider network, particularly because access through the area is restricted to only three road links, with few public transport options, and certainly none that provide faster travel times. Castle Hill Road to the north already suffers from significant queuing issues in the morning peak from 6am through to well after 9:00am, and the main access from the sub-arterial route to the south along Oaks Road will also further be congested. Therefore, any further residential development in the area should be closely controlled.*

The ARC studies recognised that whilst the Proposal would have beneficial traffic implications due to the reduced traffic generation, there would be effects associated with the change from a commercial-destination 'tidal' traffic flow (predominantly inbound traffic during the AM peak, with minimal outbound traffic, and vice versa during the PM peak) to a residential-origin tidal flow (predominantly outbound traffic during the AM peak, with minimal inbound traffic, and vice versa during the PM peak). Any adverse impacts resulting from a tidal shift in traffic flows from/to a Site is usually experienced the greatest at the intersection(s) nearest the Site.

The Council report suggests that despite the significant reduction in Site traffic generation, the overall traffic impacts would be negative due to the tidal change of the flow; however, the Council report provides no technical evidence or analysis to support this claim.

Conversely, the ARC studies include SIDRA Intersection performance testing of the key local intersection in the area; the signalised intersection of Castle Hill Road with Coonara Avenue and Edward Bennet Drive. Intersection modelling analysis (such as SIDRA) captures the effects of tidal changes and is the recognised means for determining whether a tidal shift would have any additional (and negative) impacts.

The ARC SIDRA testing of the intersection based on the existing intersection design and phasing indicates that the Proposal would result in:

- Similar 'satisfactory' performance levels to commercial operations at the Site in the AM peak, with a forecast Level of Service (LOS) of 'C' for both scenarios.
- Significantly lower delays in the PM peak, improving the performance from an unsatisfactory LOS F under commercial operations, to a satisfactory LOS C under high-density residential.

In summary, the ARC analysis confirms that the network performance benefits arising from the significant reduction in Site traffic due to the change of use to high-density residential would outweigh any perceived detrimental impacts resulting from the tidal shift of Site traffic.

> *As a consequence of these factors, it is recommended that the existing employment zone be retained as an appropriate land use because the reliance on private motor vehicles to access that zone does not significantly add to the traffic congestion issues for West Pennant Hills residents exiting the area in the morning peak travelling period.*

This final summary of Council's effectively states that it is a better outcome for the area that the Site generates significantly higher levels of commercial-destination car traffic rather than lower levels of residential-origin car traffic. Excluding the fact that Council provides no technical evidence to support this claim, and that technical analysis undertaken by ARC confirms that the Proposal would actually improve network performance, this position is flawed on several levels.

Firstly, Council's rational adopts a scale of measure that is based on local traffic impacts; in other words, regardless of where traffic has come from or will go to, the main priority (in Council's opinion) is the traffic impacts on the network local to the Site. However, if traffic impacts are to be used in this way, then it stands to reason that all impacts between origin and destination should be considered, not just those surrounding the

Site. As problematic as such an exercise would be to perform accurately, it is nevertheless a necessary exercise to undertake to justify a claim that considerably higher levels of Site car traffic represents a preferred outcome.

Secondly, the potentially greatest flaw of Council's approach is that it considers that the issues with car traffic relate solely to network performance and congestion. Such a narrow view ignores other significant issues with car traffic (and car driving) such as emissions, health (both personal and community), road safety, noise, etc.

Furthermore, the view that more car traffic can somehow be a preferred outcome is totally inconsistent with the objectives of the NWRL corridor strategy to develop Transit Oriented Developments around each of the new stations. Indeed, it is directly at odds with the objective of Council's Integrated Transport Direction of, "*facilitating an efficient transport network and a reduction in car dependency*".

In summary, Council accepts that the residential proposals would result in significantly lower levels of Site car traffic. However, to justify the position that more cars on the road (up to twice as many associated with the Site) is a preferred transport outcome, Council adopts a narrow view that considers the issues with car traffic relate solely to local network performance and congestion, ignoring wider traffic impacts and other significant issues such as emissions, health, road safety, noise, etc. Notwithstanding that such an approach is inconsistent with the objectives of the NWRL corridor strategy to develop TODs around each of the new stations, Council's position that the change in the tidal characteristics of the Site traffic would result in traffic congestion are unfounded and indeed the technical analysis undertaken by ARC clearly demonstrates that the reduction in car traffic due to the Proposal would improve the performance of the local road network. Accordingly, there is no justification for Council's position that retaining the B7 uses, which would generate significantly more car traffic, is a preferred outcome. In fact, the technical analysis demonstrates the opposite; that the Proposal's master planned community residential scheme would in fact be a preferred outcome.

Conclusion

In summary,

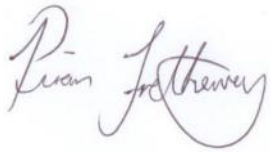
- The nominated retention of the B7 business park zoning on the Site is not a predetermined conclusion of the NWRL strategy and the proposed rezoning of the Site for a master planned community residential scheme is consistent with the provisions of the NWRL corridor strategy, and indeed further analysis of the Site is anticipated by that strategy.
- The Site is within the Cherrybrook Study Area and within 800 metres of the new Cherrybrook station. If Council's position is accepted that the Site is suitably located in terms of pedestrian connections to the train station for pedestrians accessing their place of work, then it must also be accepted that it is suitably located for pedestrians accessing their place of residence. Or in simple terms, the Site is suitably located for pedestrian connections to the train station.
- The length of a walking route to a train station has a greater impact on walkability than the gradient of that route due to topography. Accordingly, the benefits arising from the Site being within the target 800-metre walking catchment of Cherrybrook train station outweigh any perceived disadvantages associated with topography. Topographical factors should be viewed positively to justify expansion of the standard 800-metre walking catchment to maximise the transport benefits of the new rail infrastructure and to ensure its viability. The negative application of topographical factors as employed by Council risks underutilisation of the NWRL, compromising its ability to achieve its target headways of 1 train every 4 minutes.
- Council accepts that the residential proposals would result in significantly lower levels of Site car traffic. However, Council adopts a narrow view that considers the issues with car traffic relate solely to local network performance and congestion, ignoring wider traffic impacts and other significant issues such as emissions, road safety, noise, etc. Notwithstanding that such an approach is inconsistent with the objectives of the NWRL corridor strategy to develop TODs around each of the new stations, Council's position that the change in the tidal characteristics of the Site traffic would result in traffic congestion are unfounded and indeed the technical analysis undertaken by ARC clearly demonstrates that the reduction in car traffic due to the Proposal would improve the performance of the local road network. Accordingly, there is no justification for Council's position that retaining the B7 uses, which would generate significantly

more car traffic, is a preferred outcome. In fact, the technical analysis demonstrates the opposite; that the Proposal's master planned community residential scheme would in fact be a preferred outcome.

It is our conclusion that following our peer review of the accessibility, transport and traffic matters, Council's views are unfounded and the Proposal is supportable and has been thoroughly assessed and justified to support this position.

Should you have any questions, please contact the undersigned.

Yours sincerely,



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29 August 2019

Mirvac
Level 28, 200 George Street
Sydney NSW 2000

Attn: Amanda Blake, Senior Development Manager

RE: 55 Coonara Avenue, West Pennant Hills — Response to RMS Submission

Dear Amanda,

I refer to Roads & Maritime Services (RMS) letter dated 12 August 2019 in relation to the draft Voluntary Planning Agreement for 55 Coonara Avenue, West Pennant Hills. It is important to note that RMS "…*does not have any objections to the planning proposa*l…", instead providing comments for consideration only. Nevertheless, we provide the following comments with respect to each comment for further clarification. This is particularly relevant noting that RMS comments relate to material from August 2018 which has subsequently been superseded by an independent peer review by GTA Consultants and more recent traffic data and modelling by Ason Group.

1 Background

To provide background to the history of the proposal, Mirvac has provided the following summary:

Mirvac commissioned ARC Traffic and Transport in 2015, to inform our initial proposal for the site which comprised 1,269 dwellings. A number of traffic assessments were undertaken throughout the evolution of the Planning Proposal as negotiations progressed with The Hills Shire Council (Council). Subsequently, a peer review and further traffic studies were undertaken by Ason Group and discussed in detail with RMS and Department of Planning, Industry and Environment (DPIE). All transport studies have been undertaken in consultation with engagement from Council's Traffic Engineer.

A summary of the studies and reports undertaken to date are noted below.

Report	Date	Dwellings	Summary
ARC Report (Revision 1)	*January 2016*	*1,269*	*"Trip generation of the project would be significantly lower during the commuter peak periods."*
ARC Report (Revision 2)	*July 2016*	*1,119*	*"Trip generation of the project would be significantly lower during the commuter peak periods."*
ARC Report (Revision 3)	*October 2016*	*800*	*"The trip generation of the Project would be significant lower during the commuter peak periods."* *"This is a total significantly less than would be generated under capacity commercial operations at the Site."* *"This finding specifically accounts for the redistribution of arrival/departure trips during the peak periods."*

ARC Letter	*March 2017*	*800*	*"the Proposal would, quite simply, generate fewer peak hour trips (and potentially very significantly fewer trips) than currently allowable commercial operations at the Site."* *"As such, there is no question in our opinion that the Proposal would generate significantly fewer trips during the peak periods than commercial operations at the Site. Again, this conclusion was fully discussed and in our opinion agreed with Council traffic officers."*
Ason Peer Review	*April 2017*	*800*	*"the Proposal is supportable and has been thoroughly assessed and justified to support this position."*
ARC Report (Revision 4)	*July 2017*	*600*	*"The trip generation of the Proposal would be significant lower during the peak periods than capacity commercial operations,"* *"as agreed with Council officers, the total trip generation determined with regard to any of these rates is significantly less than would be generated under capacity commercial operations at the Site"* *"The Proposal would generate significantly fewer trips to the southern route in both peak periods…… the Proposal would have little if any significant impact on the operation of the southern route."*
ARC Letter	*July 2017*	*600*	*"the fact is that the Planning Proposal would result in the generation of significantly fewer trips to the road network when compared to commercial operations, and as such could not in any way be considered to be contributing to the cumulative intensification of traffic issues within the locality."* *"The only conclusion that can be reached is that the Planning Proposal will result in a deintensification of traffic issues within the locality, as literally hundreds of trips in the peak periods and across the day are removed not only from local intersections but from the broader road network providing access to and from the Site when compared to commercial operations at the Site. Indeed, if anything this could only reduce the demand for local and broader road network upgrades."*

In addition, The Hills Shire Council engaged GTA Consultants in October 2018 to conduct a peer review, which concluded:

> *Based on the analysis and discussions presented within this report it can be concluded the additional traffic generated by the proposed development is expected to have marginal impact on the performance of the existing network. The results of SIDRA analysis indicate that there are existing capacity constraints at Castle Hill Road, Oakes Road and Aiken Road. The opening of NorthConnex is expected to reduce traffic volumes on the arterial road network, which in turn may relieve congestion on local roads.*
>
> *The Aiken Road / Oakes Road roundabout is currently performing at capacity and any increase in traffic will lead to long queues and delays at this roundabout. The poor performance of this intersection is attributed to downstream queues reaching the roundabout and reducing its capacity. Therefore, the*

poor performance of this roundabout cannot be directly attributed to the development traffic as the additional traffic only exacerbates existing issues.

The following meetings have been held directly with RMS since issue of the Gateway Determination by DPIE in October 2017:

28 June 2018	*Meeting held with RMS (James Hall, Liam (surname not noted)), Mirvac (Adrian Checchin, Amanda Blake) and Ason (Piran Trethewey, Tim Lewis).* *Copies of all reports undertaken to date were provided.* *Electronic SIDRA files were provided to RMS to confirm inputs, particularly:* • *Phasing arrangement (split phasing)* • *Signal phase timings (priority to Castle Hill Rd)* • *Surveyed volumes vs. SCATS volumes to confirm not latent demand not picked up by surveys.* • *Scenarios provided to RMS:* 1. *Existing (current surveys) baseline* 2. *Business park at full operation* 3. *Existing 2018 baseline PLUS the proposed development*
21 September 2018	*Response received from James Hall outlining:* • *Recommendations for amendments to the phasing system scenario used in the SIDRA model.* • *Further guidance on RMS requirements in relation to 117 Direction - Ministerial Direction 5.9 – North West Rail Link Corridor Strategy.* • *Further guidance on additional information required by RMS – a strategic level understanding of the likely road network interventions (intersection upgrades) required on the adjacent regional road network.*
22 October 2018	*Meeting held with RMS (James Hall), DPE (Ann-Maree Carruthers, Sebastian Tauny), Mirvac (Adrian Checchin, Amanda Blake), FPD (Michael File), Ason (Piran Trethewey)* *Confirmed that the subject site was to be considered on its site-specific merits and not be assessed as part of a wider study area, as previously indicated.* *Mirvac agreed to undertake updated traffic surveys.*
15 January 2019	*Updated traffic assessment.* *Review of GTA's traffic study provided to RMS.*
14 February 2019	*Meeting held with RMS (James Hall, Laura Van Putten) and Mirvac (Adrian Checchin, Amanda Blake), FPD (Michael File), Ason (Piran Trethewey).*

Accordingly, we believe RMS' submission raises issues which have already been addressed during the many meetings held, correspondence and information provided to RMS throughout the planning proposal process.

Notwithstanding we respond to each item as follows.

2 Response to Latest RMS Submission

RMS Comment
Cumulative studies and developer contributions towards regional transport infrastructure upgrades
It is understood that the site is located within the Cherrybrook Precinct of the North West Rail Link (NWRL) Corridor Strategy. The Cherrybrook Precinct Structure Plan identifies the need for detailed cumulative studies and infrastructure contributions plans in support of the proposed Precinct uplift. It is understood that a precinct-wide traffic and transport study has not yet been completed. Council should be satisfied that a suitable funding mechanism is in place to obtain developer contributions on an equitable basis towards regional transport infrastructure upgrades to support future growth associated with the multiple planning proposals across the Cherrybrook precinct.

As previously demonstrated to RMS, the vehicular trip generation associated with the proposed residential land-use is actually lower than that of the existing site (being a commercial land-use zoning). As such, the proposal has benefits for the local transport network and, accordingly, there is no nexus between the planning proposal and any negative impacts found via cumulative studies — therefore no justification for developer contributions. Indeed, at the meeting on 22 October 2018 with DPIE, it was confirmed that this proposal should be considered on its own merits and wider traffic studies are not required. There is no apparent justification to link this proposal to any upgrades or contributions on the basis of traffic and transport matters.

Given the intensity of use of the site is reduced under the proposal, Mirvac do not believe any developer contributions are justified for the site. However, in the spirit of meeting community expectations, Mirvac have offered to enter into a Voluntary Planning Agreement (VPA) with Council to provide public benefits of 2.493ha of public open space, a synthetic soccer field and upgrade and dedication of the perimeter road within the site, in lieu of any developer contributions. Council endorsed the Draft VPA in September 2018 and it was exhibited alongside the Planning Proposal in May 2019. In addition, Mirvac have offered to dedicate approximately 10 hectares of forest area to the State Government, on the basis that it will fully satisfy all NSW government levies, charges, fees, contributions or works related to the proposal. This offer is currently being considered by DPIE.

RMS Comment
Connectivity with bus stops and active transport linkage
It is noted that the Cherrybrook Precinct Structure Plan indicated that pedestrian/cycle access across Castle Hill Road is a key connectivity issue within the Cherrybrook area. To encourage connecting people to public transport as indicated in the planning proposal's supporting material Attachment H Traffic Assessment Report, consideration should be given to improving whole journey accessibility. The emphasis being on pedestrian and cycling amenity in line with the movement and place framework. This may include (but is not be limited to) provisions for safe and accessible footpaths, pedestrian crossing points (taking into account pedestrian desire lines) and cycle paths. These considerations will better meet the needs of the community in a way that supports a safe, efficient and reliable journey for pedestrians and cyclist in addition to reducing the congestion on the road network.

As discussed in the previous Ason Group letter in response to Transport of NSW (TfNSW) dated in 5 July 2019 (ref: *0442l10*) – copy provided at **Attachment 1** for ease of reference — the mode share of bus and 'active transport' travel is limited in West Pennant Hills and, accordingly, does not warrant special provisions or improvements to local infrastructure.

Notwithstanding, as shown in Figure 1 below, a pedestrian footpath is already in place along the site frontage, providing connections to:

- Castle Hill Road and on to Cherrybrook Metro Station, via signalised crossing points, and
- Coonara Shopping Village

Figure 1: Pedestrian Routes to Metro and Coonara Shopping Village

Additional crossing points are not required to aid these desire lines.

The demand for bus services is expected to be moderate only. Therefore, the proposal does not necessitate improvements to bus facilities or connectivity thereto.

RMS Comment
Comments on traffic assessment report
Roads and Maritime provides comments at Tab A on the Traffic Assessment Report submitted for Council's consideration and to be addressed before further studies are undertaken.

It is noted that the *Traffic Assessment Report* that RMS assessed is dated 1 August 2018. The SIDRA modelling included in that report was based upon historic modelling files provided by ARC Traffic + Transport (the former traffic consultants on the project), not the most current information.

The most current traffic assessment report is Ason Group, *0442l08v1 RMS Memorandum in relation to GTA Review_55 Coonara Ave, West Pennant Hills*, dated 15 January 2019, which was provided to RMS (James Hall) on 15 January 2019. A copy of this report has been included at **Attachment 2**.

Notwithstanding, a detailed response to the comments on the *Traffic Assessment Report* is included in **Attachment 3**.

In summary, given the proposal reduces traffic generation, we do not believe any future scenario modelling is necessary, as both the current and the future case models will logically show an improvement between the existing business park use and the proposed residential use.

RMS' detailed comments are based on a report which has been superseded and have already been addressed in the current report, included at Attachment 2.

RMS Comment
Bus priority measures
In consultation with Transport for NSW (TfNSW) and Roads and Maritime, Council should give consideration to identifying potential bus service planning options and routes, including the need for bus priority measures for the cumulative development uplift associated with the Cherrybrook Structure Plan.

It is understood that this is a requirement for Council in context of wider redevelopment of the Cherrybrook Station precinct. As explained in our response to Transport for NSW, the proposed development does not warrant any special provisions or improvements to local bus infrastructure.

Council's peer review by GTA also finds that "*it would be expected that impacts to bus travel times resulting from the additional traffic generated by the development would be minimal*" and indicates that Council already have plans for a dedicated bus lane along Highs Road and Aiken Road all the way to Oakes Road roundabout. This is a State Government / Council issue and is unrelated to the proposed development which reduces the intensity of use of the site.

RMS Comment
Site access point
Vehicular access to Coonara Avenue from the development should occur to ensure safe and efficient access with minimal impacts on the queuing traffic. Consideration should be given to one access to the development with appropriate intersection traffic controls. The access should be located as far as practical away from the intersection of Coonara Avenue and Castle Hill Road to minimise impacts to the traffic signals.

There are already two existing established access points servicing the site from Coonara Avenue. These provide access for circa 1,700 existing car spaces. The existing use generates more car trips than the planning proposal and notwithstanding this, the two existing access points to the site currently operate efficiently. The proposal includes deletion of approximately 700 car spaces and reduces trip generation. The northern access is a desire line for pedestrian and cycle access to the new Metro Station, encouraging the use of those services and thereby promoting active transport.

The Coonara Avenue frontage comprises established bushland which is proposed to be maintained. The existing ring road around the site from the two entrance points is proposed to be maintained and upgraded, primarily to avoid environmental impacts which would occur if this road or the two Coonara Avenue access points were moved.

The concept plan of the proposed development was established when discussions first commenced with Council in 2015 and has been discussed with RMS on numerous occasions previously and formed the basis

of extensive public consultation. Furthermore, Fire and Rescue NSW have advised that multiple access points are required for emergency services access. Therefore, it is considered unreasonable to revisit the site access point fundamentals at this late stage.

RMS Comment
Assessment of transport demand
Given the proximity of the site to the new NWRL Cherrybrook station, consideration should be given to appropriate maximum parking controls for the future residential development, which could be included in the LEP or DCP for the site. This will help to reduce reliance on private vehicles and encourage the use of public transport.

Car parking has been an item that has been negotiated and agreed with Council in July 2017 as follows;

- 1 and 2 bedroom dwellings: 1 space per dwelling
- 3 or more bedroom dwellings: 2 spaces per dwelling
- Visitors: 1 space per 5 dwellings

These rates reduce existing parking levels by circa 700 car spaces and result in less traffic than compared to existing uses. The proposed planning controls for the site outline the above agreed parking requirements with council and were exhibited alongside the Planning Proposal in May 2019.

Furthermore, it is emphasised that the traffic modelling undertaken in support of the proposal is not reliant on reduced trip generation rates as a result of car parking restraint measures. Therefore, provision of parking at reasonable levels has been demonstrated to improve the surrounding road network.

In closing we note the proposal clearly reduces existing traffic and public transport trips compared to the current approved land-use and zoning. Many years of studies, negotiations with council, consultation with RMS and analysis has demonstrated this.

We trust the above is of assistance and please contact the undersigned should you have any queries or require further information in relation to the above.

Yours sincerely,

Principal Traffic Engineer – Ason Group
Email: tim.lewis@asongroup.com.au

Attachments:

1) *Response to TFNSW submission, dated 18 July 19, by Ason*
2) *0442l08v1 RMS Memorandum in relation to GTA Review 55 Coonara Ave, West Pennant Hills*, dated 15 January 2019, by Ason

   (Note: the above includes the Traffic Assessment Review of 55 Coonara Avenue West Pennant Hills, dated October 2018, by GTA Consultants)
3) Response to RMS Comments on the *Traffic Assessment Report*

Attachment 1

MEMO

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Sydney, NSW 2000
www.asongroup.com.au

18 July 2019

Mirvac
Level 28, 200 George Street
Sydney NSW 2000

Attn: Amanda Blake, Senior Development Manager

RE: 55 Coonara Avenue, West Pennant Hills — Response to TfNSW

Dear Amanda,

I refer to Transport for NSW (TfNSW) letter dated 31 May 2019 in relation to the draft Voluntary Planning Agreement for 55 Coonara Avenue, West Pennant Hills. In this regard, we provide the following comments, as summarised below.

TfNSW Comment / Recommendation
Assessment of transport demand
Comment: *There are two traffic studies prepared for the planning proposal, however, both of the studies focused on assessing the traffic implications of private vehicles. Limited information is provided to assess the impact of other transport users, in particular bus and active transport including pedestrian and cyclist. The proposal would have a potential public transport demand of more than 400 people based on average people per household and existing travel patterns based on the ABS's Census data for West Pennant Hills.* *Recommendation:* *An assessment of public and active transport demand should be carried out to examine the adequacy of existing facilities in the vicinity of the site and any mitigation measures identified should be considered to be included in the draft VPA.*

A summary of the travel by various modes, adopting historic West Pennant Hills rates, is provided in **Table 1**.

Table 1: Summary of Travel by Mode (West Pennant Hills rates)

Travel Mode	Mode Share	Peak Hourly Pers Trips @ 0.30 / pers.	Daily Pers Trips @ 2.86 / pers.
Car Driver	57.4%	325	3,103
Bus	15.9%	90	859
Worked at home / Not Stated / Did Not Work	15.6%	88	843
Train	5.7%	32	308
Car Passenger	3.6%	20	195
Other	0.7%	4	38
Walked only	0.4%	2	22
Truck	0.2%	1	11
Motorcycle	0.2%	1	11

Bicycle	0.2%	1	11
TOTAL	**100%**	**564**	**5,401**

Notes: 1) Journey-to-Work (JTW) data for West Pennant Hills is included in Attachment 1. .Assumes 3.15 persons per dwelling. This is based on 2016 Census data for West Pennant Hills and may not be reflective of the future dwelling character which, with more medium density housing typologies, is likely to have reduced per dwelling occupancy.

2) 600 dwellings envisaged by Planning Proposal submission.

3) Daily and peak hourly trips based on Person Trip data for Westleigh included in RMS TDT 2013/04a

Notwithstanding the above, it is emphasised that Cherrybrook Station was not complete at the time the 2016 Census was undertaken. As such, further reference to more realistic mode share has been made with comparison to mode share data from Epping and Pennant Hills; nearby suburbs that include train stations; travel modes for Pennant Hills as follows.

Table 2: Summary of Travel by Mode (Pennant Hills rates)

Travel Mode	Mode Share	Peak Hourly Pers Trips @ 0.30 / pers.	Daily Pers Trips @ 2.86 / pers.
Car Driver	47.8%	271	2,584
Train	28.1%	159	1,519
Worked at home / Not Stated / Did Not Work	14.4%	82	778
Bus	1.8%	10	97
Car Passenger	3.0%	17	162
Walked only	3.3%	19	178
Other	0.5%	3	27
Motorcycle	0.4%	2	22
Bicycle	0.2%	1	11
Truck	0.5%	3	27
TOTAL	**100%**	**567**	**5,405**

Notes: 1) Journey-to-Work (JTW) data for West Pennant Hills is included in Attachment 1. .Assumes 3.15 persons per dwelling. This is based on 2016 Census data for West Pennant Hills and may not be reflective of the future dwelling character which, with more medium density housing typologies, is likely to have reduced per dwelling occupancy.

2) 600 dwellings envisaged by Planning Proposal submission.

3) Daily and peak hourly trips based on Person Trip data for Westleigh included in RMS TDT 2013/04a

The above trip profile in Table 2 is expected to be more representative of future travel characteristics of the subject site than reliance on historic data from West Pennant Hills which – at that time – did not include rail or Metro services.

Following from the above, it is evident that the mode share of bus and active transport travel is limited. Furthermore, the planning proposal reduces the intensity of use of the site from a 34,000m^2 business park with 3,000 workers at capacity, to a residential community with 600 dwellings. Studies and analysis has confirmed that the proposal will reduce the demand on public and active transport. **Accordingly, the proposal does not warrant special provisions or improvements to bus or active transport infrastructure.**

TfNSW Comment / Recommendation
Connectivity with bus stops and active transport linkage
Comment: *Coonara Avenue is currently configured with one traffic lane on each direction and served with parking lane on both sides. There are currently three bus stops located on the northbound direction of Coonara Avenue where the subject site fronts. Consideration should be given to the increase pedestrian crossing demand to access these bus stops which provide the necessary bus services connecting with Cherrybrook Station. On the southbound direction, there are currently two bus stops provided on Coonara Avenue. The preliminary concept indicates that future dwellings would locate along the site frontage on Coonara Avenue.* *Recommendation:* *The planning proposal should consider the need for improved pedestrian facilities on and along Coonara Avenue to accommodate the future demand as a result of the proposed development. In the subsequent design phases, it is recommended to promote through site links where new cycle and walking routes provide connectivity within the local neighbourhood.*

A pedestrian footpath is provided along the site frontage, providing connections to:

- Castle Hill Road and on to Cherrybrook Metro Station, via signalised crossing points, and
- Coonara Shopping Village

Additional pedestrian crossings are not required to aid these desire lines, with suitable paths available, as shown in Attachment 3.

As explained above, the demand for bus services is expected to be moderate and not necessitate improvements to bus facilities or connectivity thereto.

Future development applications will provide for and promote pedestrian and cycle links from within the site to existing pedestrian and cycle links to bus and rail connections.

Existing pedestrian footpaths and crossings provide pedestrian access from the site to the new Cherrybrook Metro Station. **Accordingly, the proposal does not warrant special provisions or improvements to local infrastructure.**

TfNSW Comment / Recommendation
Access to public open space
Comment: *The planning proposal is accompanied by a preliminary concept that indicates a public road connection between Coonara Avenue and the proposed public open space including the synthetic turf playing field. It is reasonable to assume the playing field would be accessible for sports activities held by schools or local sport clubs.* *Recommendation:* *In the subsequent design phases, the design of this public road should consider accommodating larger vehicles such as buses for use during events.*

The proposed public perimeter road – being delivered by Mirvac – between Coonara Avenue and Council's connection to the proposed public open space and soccer field was the subject of negotiation and agreement

with the Hills Shire Council, with the detailed road design to be provided at development application phase. The width of the perimeter road was negotiated with Council to ensure public access to the new playing field, including by schools and local sporting clubs; being designed to accommodate access by fire trucks and other large services vehicles as per Council and NSW Rural Fire Service requirements.

It is noted that the connection between the perimeter road and open space / playing field car park is to be owned by Council, with no changes to the existing car park proposed as part of the agreement between Mirvac and the Hills Shire Council.

With reference to Attachment 4, it is noted that the existing car park itself is not capable of facilitating access by large buses/coaches. Therefore it would be expected that any demand for bus setdown / pick-up would occur from the perimeter road and not from the car park area itself. This is considered an acceptable outcome given the low frequency that bus demands would occur and moderate walking distances required between the perimeter road and playing fields. Nevertheless, this is a future detailed matter for Council consideration.

On the above basis, we do not believe the road width included in the Proposal needs to be adjusted.

We trust the above is of assistance and please contact the undersigned should you have any queries or require further information in relation to the above.

Yours sincerely,

Principal Traffic Engineer – Ason Group
Email: tim.lewis@asongroup.com.au

Attachments:
1) Travel Mode Share data summaries
2) Hills Bus Area Map
3) Pedestrian Access Routes
4) Swept Paths

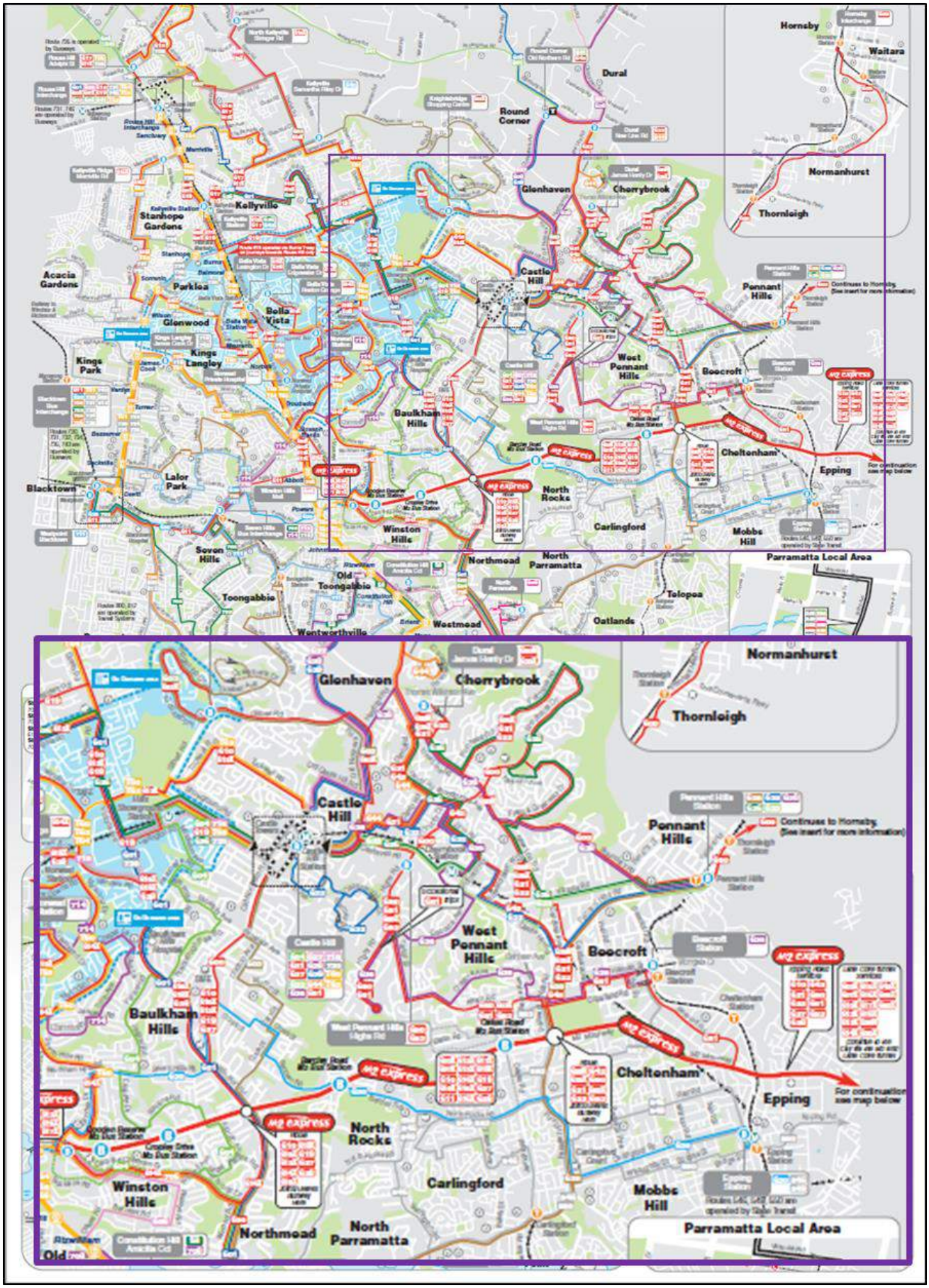
Attachment 1

West Pennant Hills - Employed persons (Usual residence)	2016			2011			Change
Main method of travel	Number	%	The Hills Shire %	Number	%	The Hills Shire %	2011 to 2016
Train	371	5.7	3.8	306	4.6	3.0	+65
Bus	1,030	15.9	12.2	859	12.8	9.9	+171
Tram or Ferry	0	--	0.0	0	--	--	0
Taxi	3	0.0	0.1	9	0.1	0.1	-6
Car - as driver	3,707	57.4	62.1	4,031	60.1	64.1	-324
Car - as passenger	232	3.6	3.6	278	4.1	4.1	-46
Truck	15	0.2	0.9	21	0.3	1.0	-6
Motorbike	16	0.2	0.4	16	0.2	0.3	0
[a] Bicycle	11	0.2	0.2	3	0.0	0.1	+8
[a] Walked only	27	0.4	1.2	35	0.5	1.2	-8
Other	43	0.7	0.9	22	0.3	0.6	+21
[a] Worked at home	474	7.3	6.1	439	6.5	5.8	+35
Did not go to work	515	8.0	7.7	626	9.3	8.7	-111
Not stated	17	0.3	0.6	65	1.0	1.1	-48
Total employed persons aged 15+	6,461	100.0	100.0	6,710	100.0	100.0	-249

Epping - Employed persons (Usual residence)	2016			2011			Change
Main method of travel	Number	%	City of Parramatta %	Number	%	City of Parramatta %	2011 to 2016
Train	3,798	33.9	21.5	2,838	28.4	18.8	+961
Bus	385	3.4	5.9	273	2.7	5.0	+111
Tram or Ferry	0	--	0.2	0	--	0.1	0
Taxi	0	0.0	0.2	24	0.2	0.1	-24
Car - as driver	4,937	44.0	51.4	4,742	47.5	54.1	+195
Car - as passenger	331	3.0	3.7	380	3.8	4.2	-49
Truck	15	0.1	0.6	35	0.4	0.7	-20
Motorbike	33	0.3	0.5	35	0.4	0.5	-2
[a] Bicycle	36	0.3	0.4	35	0.4	0.4	0
[a] Walked only	204	1.8	3.5	269	2.7	3.6	-65
Other	67	0.6	0.9	25	0.3	0.7	+43
[a] Worked at home	528	4.7	3.4	418	4.2	3.0	+111
Did not go to work	831	7.4	7.1	823	8.2	7.8	+8
Not stated	42	0.4	0.8	89	0.9	1.1	-47
Total employed persons aged 15+	11,212	100.0	100.0	9,990	100.0	100.0	+1,222

Pennant Hills - Employed persons (Usual residence)	2016			2011			Change
Main method of travel	Number	%	Hornsby Shire %	Number	%	Hornsby Shire %	2011 to 2016
Train	1,028	28.1	23.3	947	26.8	20.3	+81
Bus	65	1.8	3.9	59	1.7	3.4	+7
Tram or Ferry	0	--	0.0	0	--	0.0	0
Taxi	0	--	0.1	0	--	0.1	0
Car - as driver	1,747	47.8	49.6	1,751	49.5	51.8	-4
Car - as passenger	107	3.0	3.1	102	2.9	3.4	+5
Truck	18	0.5	0.6	7	0.2	0.8	+11
Motorbike	14	0.4	0.5	7	0.2	0.4	+8
[a] Bicycle	9	0.2	0.3	6	0.2	0.2	+3
[a] Walked only	122	3.3	2.7	95	2.7	2.9	+27
Other	17	0.5	0.9	28	0.8	0.7	-11
[a] Worked at home	182	5.0	5.8	160	4.5	5.6	+22
Did not go to work	318	8.7	8.6	342	9.7	9.7	-24
Not stated	23	0.7	0.6	28	0.8	0.9	-5
Total employed persons aged 15+	3,656	100.0	100.0	3,536	100.0	100.0	+119

Attachment 2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Dural
Round Corner
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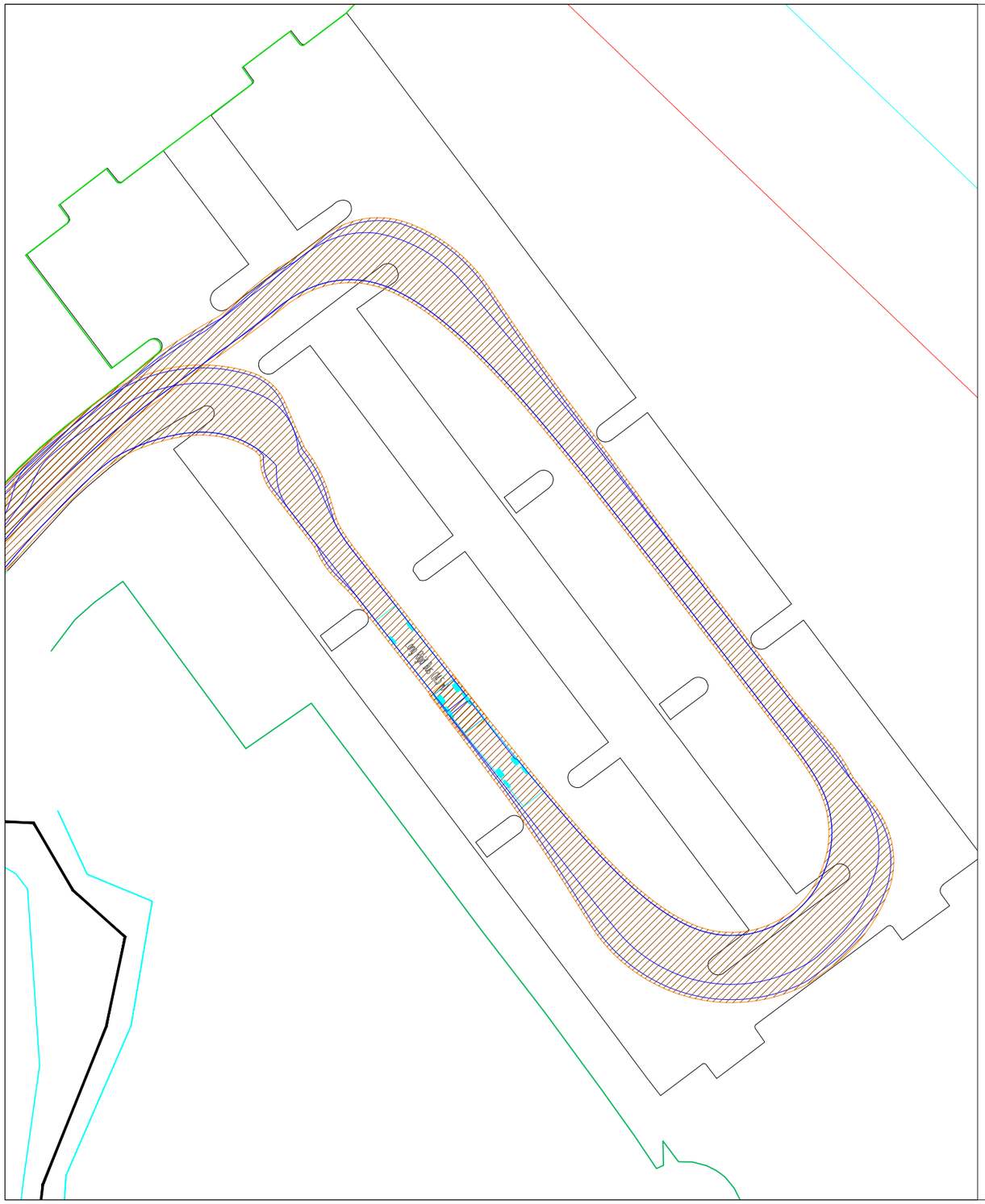
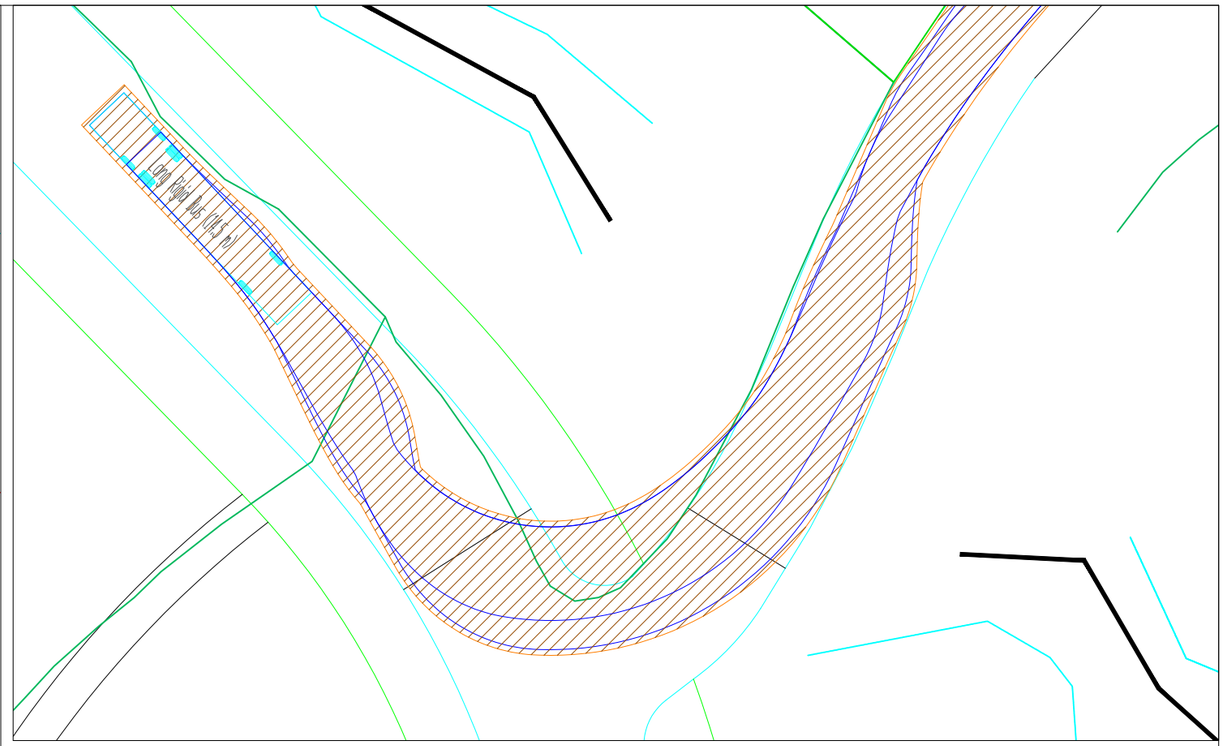
Thornleigh
Glenhaven
Cherrybrook
Kellyville
Stanhope Gardens
Acacia Gardens
Parklea
Castle Hill
Pennant Hills
Glenwood
Bella Vista
Kings Langley
Kings Park
West Pennant Hills
Boocroft
Baulkham Hills
Cheltenham
Epping
Blacktown
Lalor Park
North Rocks
Winston Hills
Carlingford
Mobbs Hill
Seven Hills
Northmead
North Parramatta
Parramatta Local Area
Old Toongabbie
Toongabbie
Telopea
Oatlands
Westmead
Wentworthville
M2 express

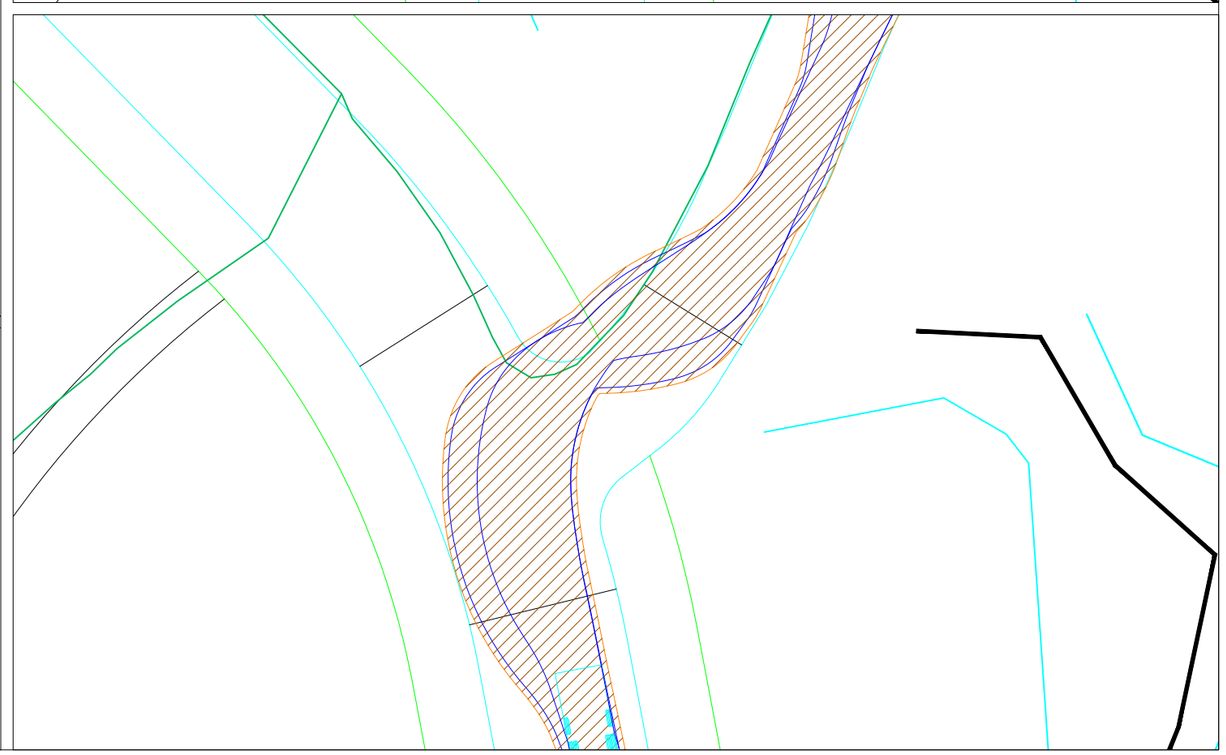
Attachment 3

Figure 1: Pedestrian Routes to Metro and Coonara Shopping Village

Attachment 4







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File name: P0442d02 Bus Access Review.dwg

Client:

Mirvac

Project:

0442

55 Coonara Ave, West Pennant Hills

Drawing Title:

Swept Paths

14.5m coach access to playing fields

Date:

18-Jul-19

Scale @ A3:

Varies

Drawing Number:

P0442D.02-SK.01

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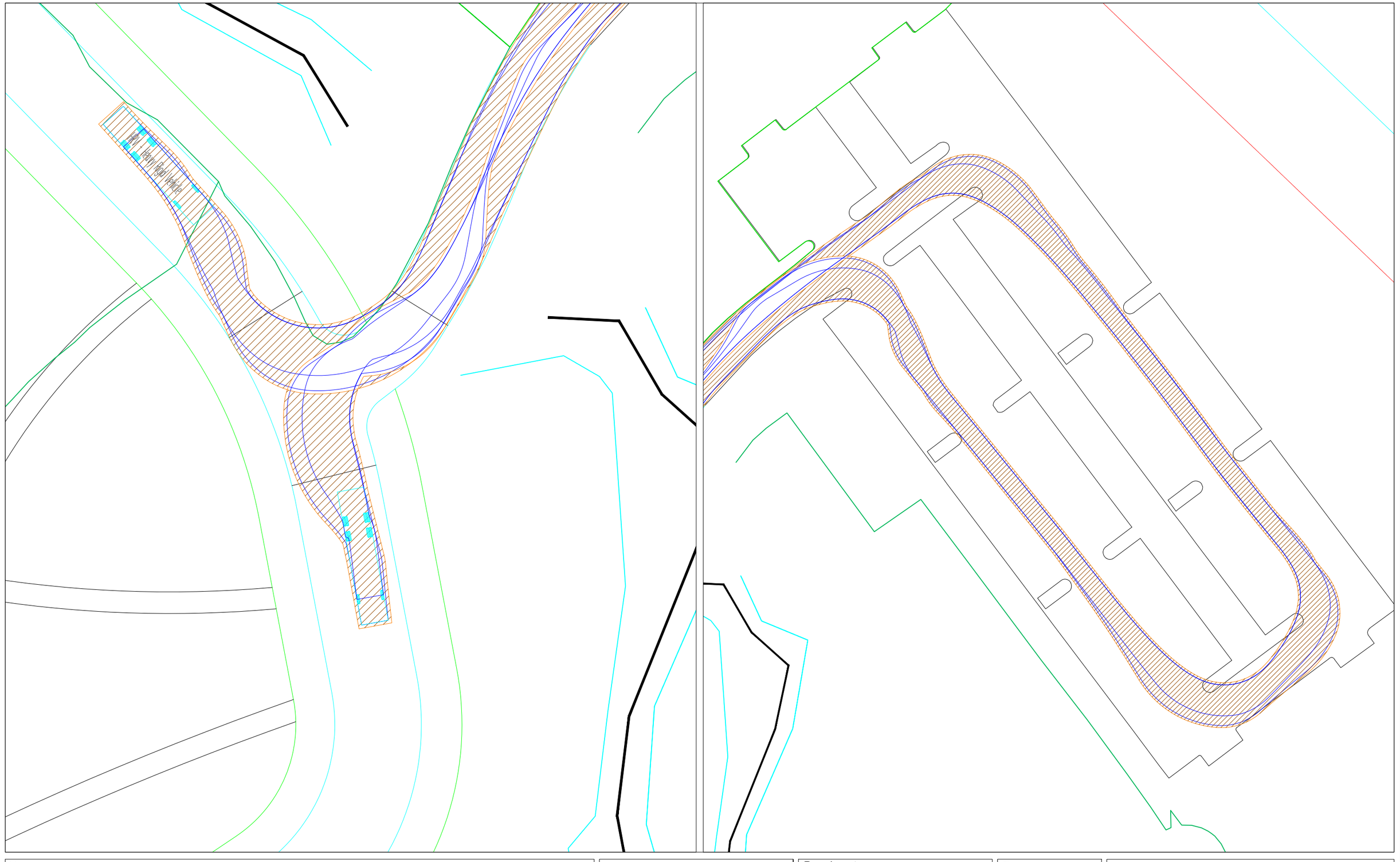

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Document Info:

Drawn by: timle

File name: P0442d02 Bus Access Review.dwg

Client:

Mirvac

Project:

0442

55 Coonara Ave, West Pennant Hills

Drawing Title:

Swept Paths

12.5m rigid vehicle access to playing fields

Date:

18-Jul-19

Scale @ A3:

Varies

Drawing Number:

P0442D.02-SK.02

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Attachment 2

Ref: 0442l08v1

15 January 2019

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Mirvac
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Attn: Amanda Blake; Development Manager

RE: 55 Coonara Avenue, West Pennant Hills – RMS Memorandum in relation to GTA Review

Dear Amanda,

We refer to the site at 55 Coonara Avenue, West Pennant Hills and the rezoning submission (Proposal) which has received Council and Department of Planning and Environment (DPE) support for public exhibition. The Proposal has been the subject of extensive assessment and analysis with a number of reports and reviews being undertaken in relation to transport matters.

We note that additional requested SIDRA modelling was provided by Mirvac on email to RMS on 21 August 2018.

At our recent meeting on 22 October 2018 with RMS, DPE, Mirvac and Ason Group (Ason), it was confirmed by DPE that the subject site was to be considered on its site-specific merits and not be assessed as part of a wider study area. We believe the reports completed by ARC Traffic and Transport and Ason, as previously provided to RMS (refer Mirvac's letter of 24 May 2018), have conclusively demonstrated that the subject site's existing use operating at full capacity has a far greater traffic impact than the Proposal.

As further validation, it has come to our attention that Council (via Mu Group) requested GTA Consultants (GTA) to undertake a further, independent study to assess the implications of the development on the broader road network. This study included assessment of:

- Castle Hill Road / Coonara Avenue / Edward Bennett Drive (RMS signals)
- Castle Hill Road/Highs Road/County Drive (RMS signals)
- Coonara Avenue / Highs Road / Taylor Street (Council roundabout)
- Aiken Road / Oakes Road (Council roundabout)

A copy of the GTA report is provided at **Attachment 1**.

Ason takes this opportunity to provide our commentary as follows in relation to review of the following document(s):

- GTA Consultants, Traffic Assessment Review, Issue A, dated 16/10/18 (GTA Review)
- GTA Consultants, *Roads and Maritime Services Trip Generation Surveys, Medium Density Residential Dwellings Analysis Report*, Issue B, dated 08/08/2013 (RMS M-D Report)

For the purposes of this advice, special consideration is given to the impacts at RMS signal sites along Castle Hill Road at Coonara Avenue and Highs Road. Impacts at other intersections being considered a Council matter and therefore outside the RMS scope of assessment and therefore not forming part of this commentary.

Having regard for the above, we now advise as follows.

1. There appears to be a missing piece in the assessment undertaken by GTA in that there has not been regard for the traffic generation that could reasonably be generated by the existing facilities operating at full capacity. This is a fundamental baseline that must be used as the relevant comparison metric to the rezoning proposal; not existing traffic counts which understate implications of the existing facilities operating at full capacity. After all, there has not been a concerted effort to seek a long-term commercial tenant to replace the historic use and fulfil the site potential; pending resolution of the current planning proposal.

2. Notwithstanding the above, we note GTA's conclusion: "…*traffic generated by the proposed development is expected to have marginal impact on the performance of the existing network"*. This indicates to us, that even though GTA's assessment was undertaken using existing traffic counts and not data relating to traffic generation that could reasonably be generated by the existing facilities operating at full capacity, their review concludes a marginal impact at one location. Our view is that this understates the reduction in traffic the proposal will have on the overall network which has broader transport benefits. There is no doubt the existing facilities operating at full capacity will have a far greater impact on the network than that of the rezoning proposal.

3. There are a number of minor modelling aspects of note in relation to the calibration of the SIDRA models presented in the GTA Review. Of particular note are the adopted signal cycle timings at Coonara Ave / Castle Hill Rd; generally less than the SCATS History files provided to Ason Group by RMS. Notwithstanding, further review by Ason Group has shown this to have only marginal - but inconsequential - impacts on the conclusions of the assessment. In this regard, reference is made to the alternative modelling undertaken by Ason Group as summarised in **Annexure 2**.

4. The GTA Review has effectively adopted the traffic generation figures presented in the ARC Report, being:

   AM Peak 339 veh/hr

   PM peak 347 veh/hr

5. In this regard, it is our view that reduced rates would be appropriate; further minimising the impact of the proposal. Indeed, reducing the generation rate for the medium-density townhouse product to 0.6 veh/hr/dwelling (consistent with RMS surveys for low-density development in Westleigh, further from a train station and therefore still conservative in this instance) would result in the following volumes:

   AM Peak 269 veh/hr (-70 veh/hr) (or -691 veh/hr comparing to Full Commercial)

   PM peak 269 veh/hr (-78 veh/hr) (or -691 veh/hr comparing to Full Commercial)

6. If adopting the Sydney average generation rates for medium-density development during surrounding road network peak periods (0.27 in AM and 0.31 in PM) – as outlined in the RMS M-D Report - would result in the following peak hourly volumes:

   AM Peak 203 veh/hr (-136 veh/hr) (or -757 veh/hr comparing to Full Commercial)

   PM peak 211 veh/hr (-136 veh/hr) (or -749 veh/hr comparing to Full Commercial)

7. Notwithstanding, a summary of the relative performance of key intersections based on recent Ason Group modelling is presented in **Attachment 2**. This analysis is based on the conservative (low-density) traffic generation rates outlined in Item 5 above, with a distribution pattern derived from review of 2016 journey-to-work data. Adoption of lower traffic generation rates – in our opinion supportable given the medium-

density and high-density nature of the development – as outlined in Item 6, would further improve the 'relative' performance of Project Case scenarios.

8. It is noted that signalised intersections along Castle Hill Road – the focus of RMS consideration with regard to the Classified Road network – all operate at acceptable Level of Service D or better during all Project Case scenarios assessed by GTA and Ason Group.

9. Furthermore, the comparison of link flows on north of the site access on Coonara Avenue show a clear reduction in traffic volumes as a result of the proposal. As such, assessment of other signalised intersections originally requested by RMS is not deemed necessary.

10. Finally, even though the GTA Review fails to compare the existing improvements operating at full capacity to the rezoning proposal, as referred in Point 1, the GTA Review is taken as an endorsement of the proposal, demonstrating acceptable performance at all key RMS signalised intersections in the locality. Capacity issues at Oakes Rd / Aiken Rd being an existing issue – not attributable to the proposal – and therefore a matter to be addressed by Council.

In summary, the GTA Review does not include a complete assessment comparing the difference between existing facilities operating at full capacity compared to the rezoning proposal. Notwithstanding this, even using the lower traffic count numbers, which we believe is not reasonable to use as the relevant baseline assessment, GTA have undertaken a fairly robust assessment exploring the 'sensitivity' of the modelling to varying distribution assumptions. Whilst we there is some contention regarding some of the finer details with regard to traffic generation and modelling; the conclusions are clear in that the proposal is supportable.

We trust the above provides further support of the Proposal providing RMS additional analysis and evidence. We would greatly appreciate a further meeting at your earliest convenience to close this matter out.

Yours sincerely,

Principal Traffic Engineer – Ason Group
Email: tim.lewis@asongroup.com.au

Attachment(s): 1) GTA Consultants, Traffic Assessment Review, Issue A, dated 16/10/18
2) SIDRA Results
3) Link Volume Comparison

Attachment 1

GTAconsultants

Traffic Assessment Review
55 Coonara Avenue, West Pennant Hills

Client // The Hills Shire Council
Office // NSW
Reference // N148250
Date // 16/10/18

55 Coonara Avenue, West Pennant Hills

Traffic Assessment Review

Issue: A 16/10/18

Client: The Hills Shire Council
Reference: N148250
GTA Consultants Office: NSW

Quality Record

Issue	Date	Description	Prepared By	Checked By	Approved By	Signed
A	16/10/18	Final	John Duong, Mansee Sachdeva	Mansee Sachdeva	Robert Dus	Robert Dus

GTAconsultants

Melbourne | Sydney | Brisbane
Canberra | Adelaide | Perth

Table of Contents

Appendices

Figures

Tables

1. Introduction

1.1 Background

GTA has been engaged by Mu Group, who have been engaged by the Hills Shire Council, to assess the wider network impacts of proposed rezoning of land at 55 Coonara Avenue West Pennant Hills. The site is presently zoned as office/ commercial and is proposed to be zoned as a mix of high and low density residential. Mirvac proposes to develop a total of 600 dwellings (200 low density and 400 apartment style dwellings) within the site.

Anton Reich Consulting (ARC) have previously prepared a traffic impact assessment[1] (ARC Report) for the proposed development. The assessment looked at the impact of the traffic generated by the development on the nearby intersection of Coonara Avenue/ Castle Hill Road/ Edward Bennett Drive. The Hills Shire Council identified the need to assess the wider impacts of this development traffic particularly on congested intersections such as the Oakes Road/ Aiken Road.

ARC have assessed comprehensive scenarios looking at trip generation for the site. It is noted that should the full commercial potential of the site be realised, it would generate significantly higher amount of traffic as compared to what is currently being proposed. As such, the zoned potential of the site was never realised with the highest occupancy being 3500 staff in 1980. This number has significantly dropped since then and 2015 estimates show that about 1200 staff are currently employed there.

With the decreasing employment figures, it can be deduced that the site was never really an attractive site for commercial operations and therefore never realised its full commercial potential. In assessing the potential impacts of the proposed residential development, trip rates and distribution calculated in Section 3 of the ARC Report have been utilised, noting that these are based on The Hills Shire Council (Council) trip rates.

1.2 Purpose of this Report

This report sets out an assessment of the anticipated traffic impacts of the proposed rezoning development, including consideration of the following:

i existing traffic conditions surrounding the site
ii the traffic generating characteristics of the proposed development
iii the transport impact of the rezoning proposal on the surrounding road network.

[1] 55 Coonara Avenue West Pennant Hills Planning Proposal Revision 4 Traffic Assessment July 2017

1.3 References

In preparing this report, reference has been made to the following:

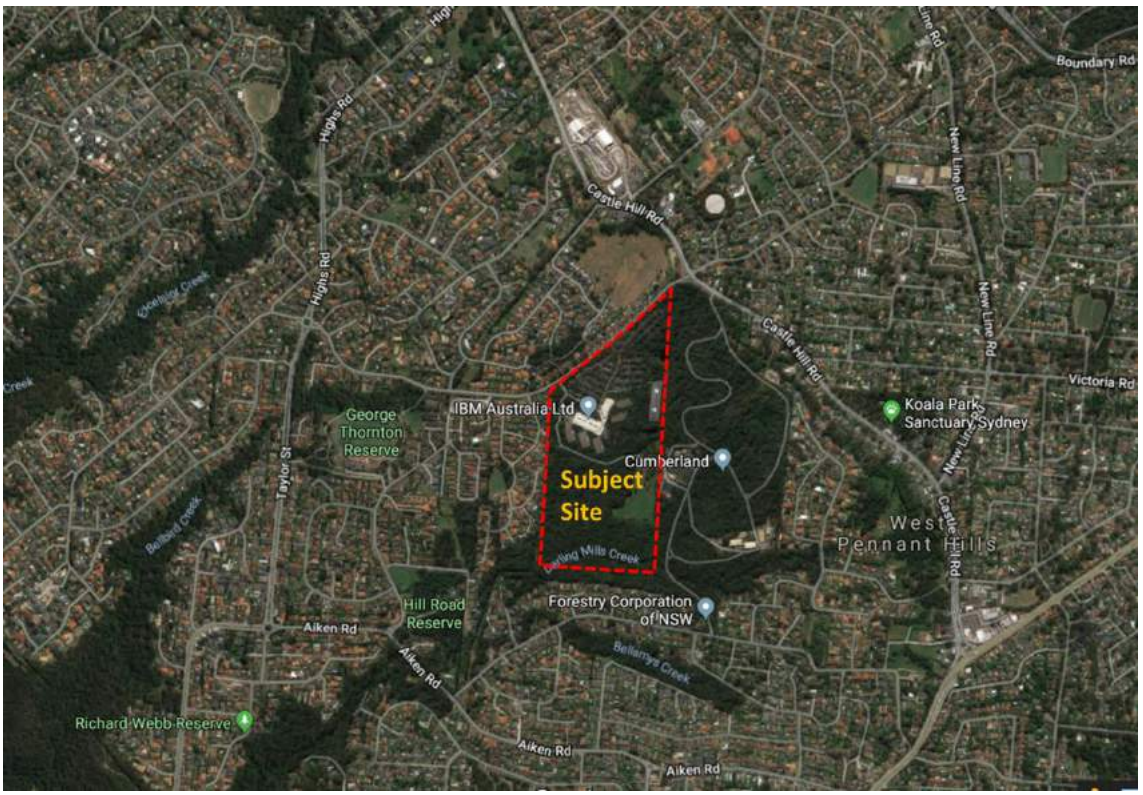
- an inspection of the site and its surrounds
- The Hills Shire Council Development Control Plan (DCP) 2012
- The Hills Shire Council Local Environmental Plan (LEP) 2012
- Anton Reich Consulting Traffic and Transport Traffic Assessment, July 2017
- West Pennant Hills Bus Priority Measure, Cardno, June 2010
- NorthConnex EIS (July 2014)
- other documents and data as referenced in this report.

2. Existing Conditions

The subject site is located at 55 Coonara Avenue, West Pennant Hills. The site currently has a land use classification as B7 Business Park and is occupied by NorthConnex.

The surrounding properties are predominately low density residential. There is a local shopping centre located 300 metres west of the site. The location of the subject site and its surrounding environs is shown in Figure 2.1.

Figure 2.1: Subject site and its environs



2.1 Existing Network

Coonara Avenue

Coonara Avenue is a collector road and on the northern boundary of the site running in the east-west direction. It is a two-way road with one lane in each direction and a posted speed limit of 50 km/hr. It is a 13-metre-wide carriageway, set within a 20-metre-wide road reserve (approximately). Parking lane is marked along the length of Coonara Avenue subject to time restrictions on some sections.

Figure 2.2: Coonara Avenue- looking southbound outside the site access point

Source: Google Maps

Castle Hill Road

Castle Hill Road is a State Road and is generally two lanes in each direction with storage lanes provided for turning traffic. It has a posted speed limit of 60 km/hr.

Figure 2.3: Castle Hill Road – looking westbound

Source: Google Maps

2.2 Existing Traffic

2.2.1 Traffic Surveys

The following surveys were conducted by Council in order to understand the existing conditions within the study area:

- Classified Intersection Counts – Tuesday 5th June 2018 Queue Length Surveys – Tuesday 5th June 2018
- Origin-Destination Surveys – Wednesday 7th February 2018

The following sections provide further details on each type of data collected.

Classified Intersection Counts

Classified intersection turn counts were collected at the following four intersections:

- Aiken Road & Oakes Road
- Coonara Avenue & Highs Road & Taylor Street
- Coonara Avenue & Castle Hill Road & Edward Bennett Drive
- Highs Road & Castle Hill Road & Country Drive

The data was collected for the morning hours from 7 am to 9 am and afternoon hours of 4 pm to 6 pm. The total traffic volumes (summed up across all sites) are shown in Figure 2.4 and Figure 2.5 for AM and PM peak hours respectively. The intersection counts indicate the AM peak period for the study intersections is 8:00am to 9:00am and the PM peak is 4:30pm to 5:30pm.

Figure 2.4: AM Peak Hour Volume

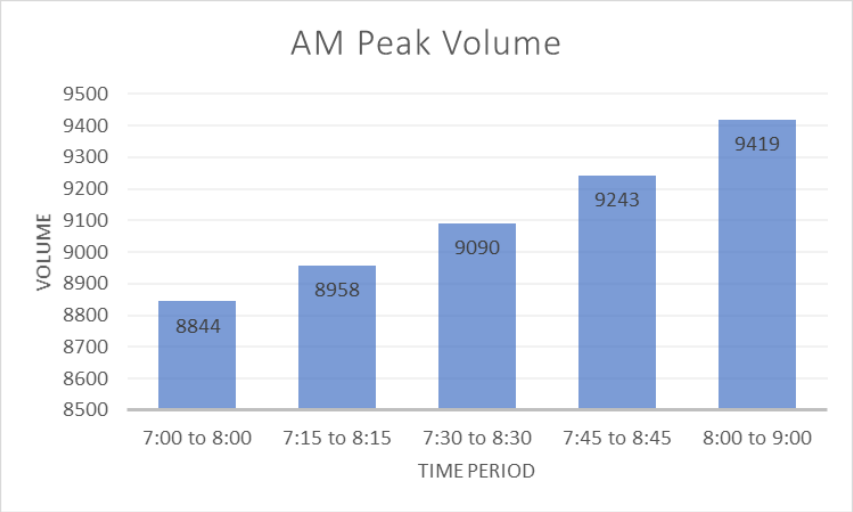
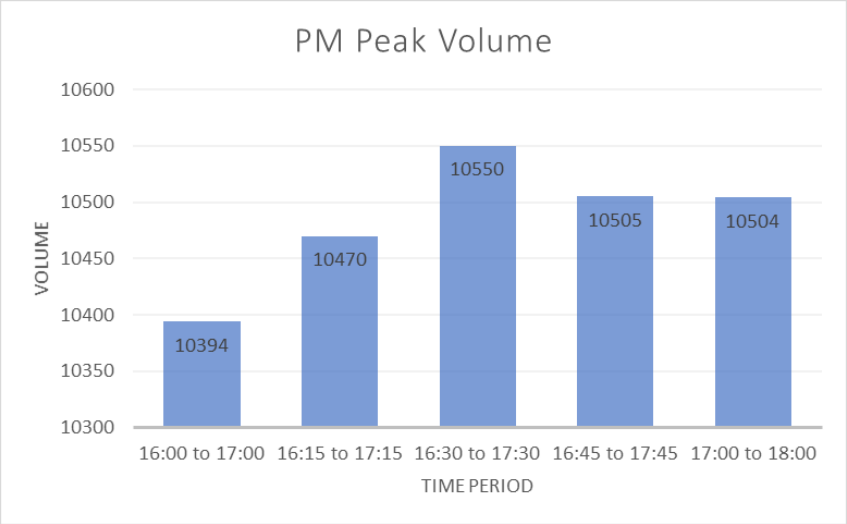


Figure 2.5: PM Peak Hour Volume



The observed peak hour turn traffic for all four intersections is shown in Figure 2.6 and Figure 2.7 for AM and PM peak hours respectively.

Figure 2.6: Existing AM Peak Hour Traffic Volumes

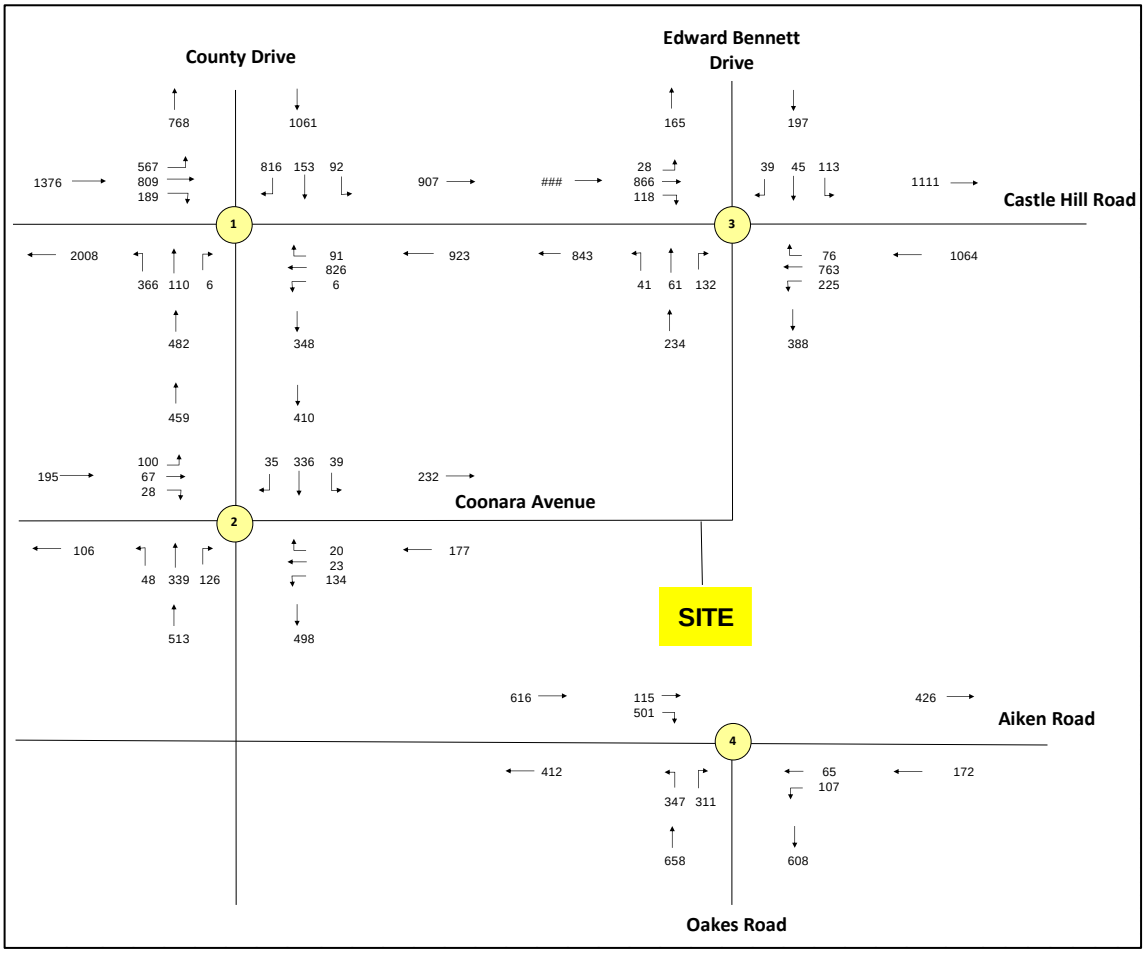
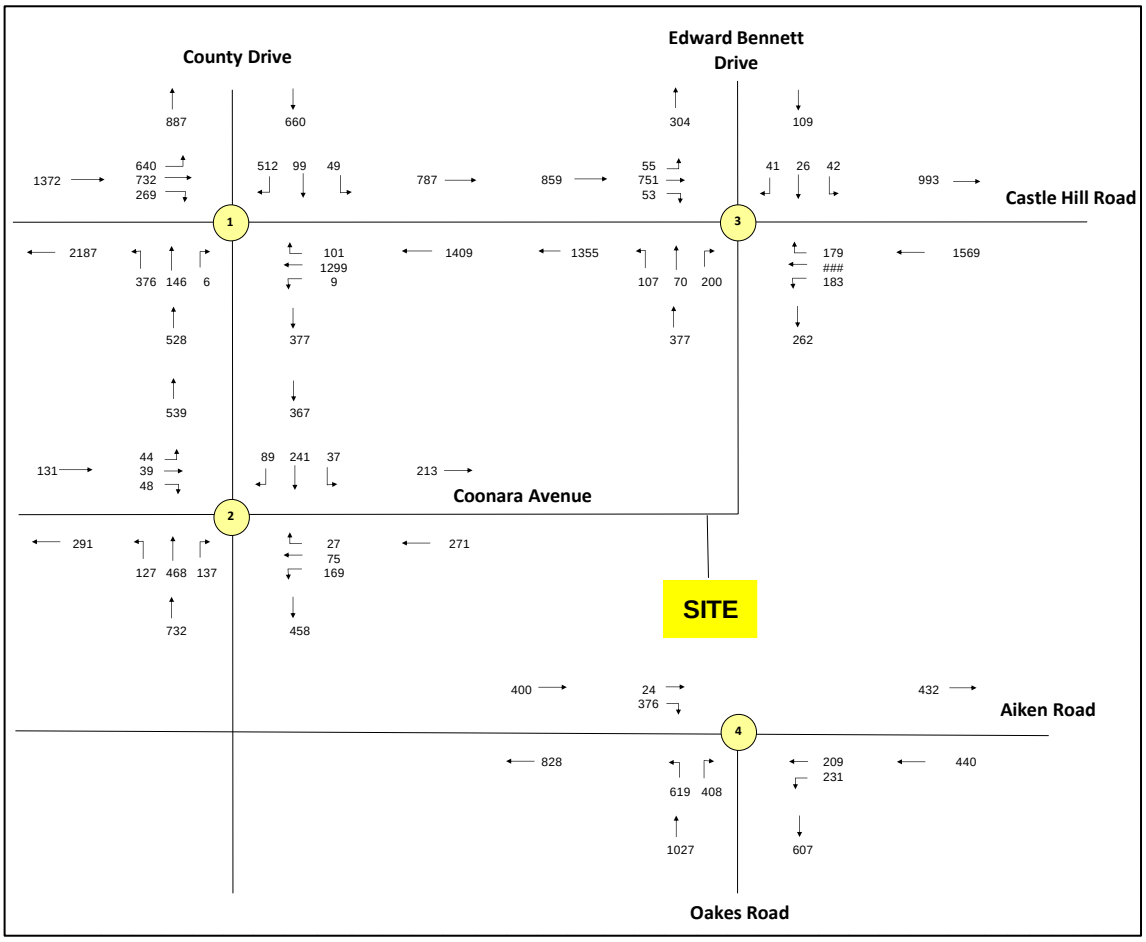
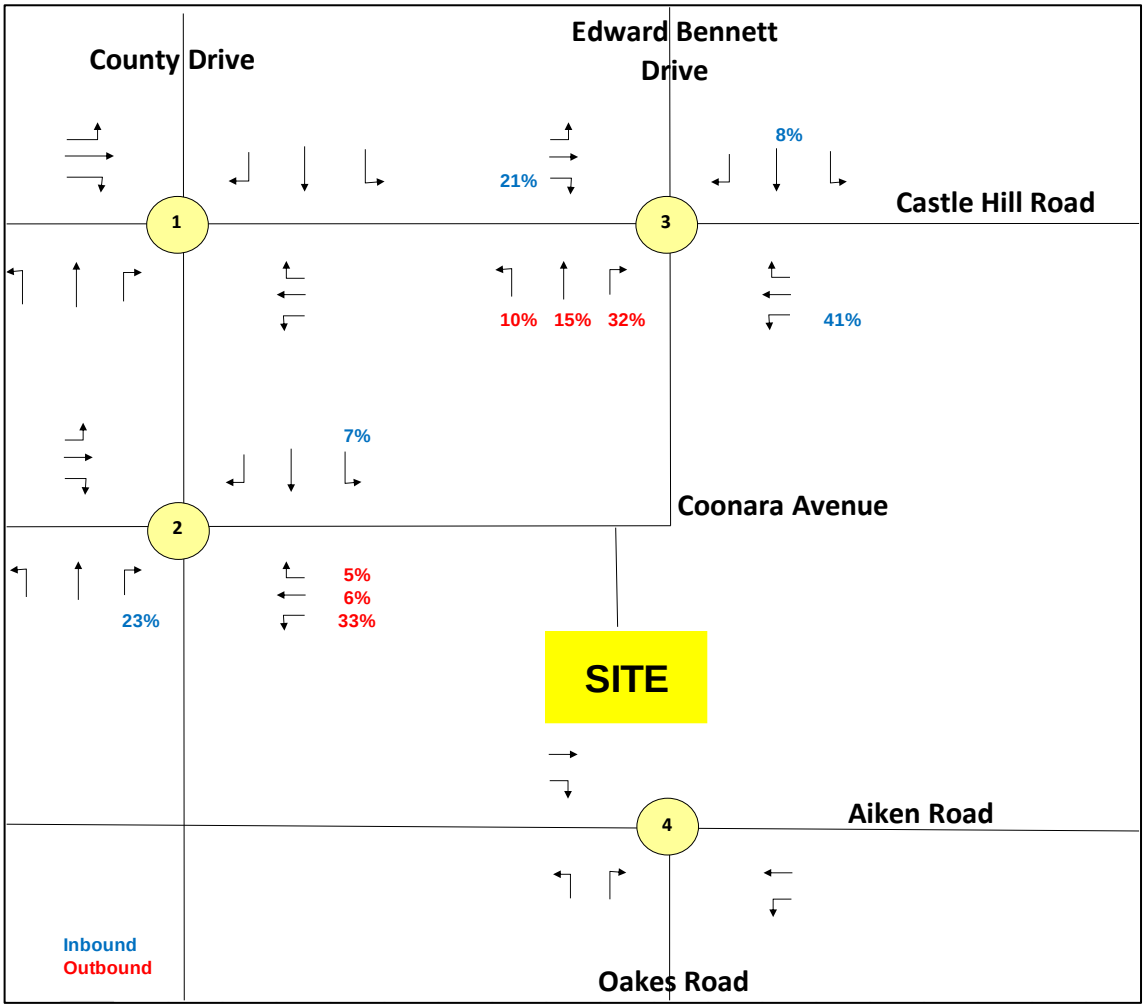


Figure 2.7: Existing PM Peak Hour Traffic Volumes



It is noted that traffic surveys did not include the site access. It is expected that the majority of traffic on Coonara Avenue would either have an origin or a destination at the site as the area is predominantly residential with a small shopping complex including a Woolworths located about 300 meters south of the site. Therefore the existing percentage split (Figure 2.9) inbound and outbound traffic is based on the existing survey data shown in Figure 2.6 and Figure 2.7.

Figure 2.8: Existing Percentage Traffic Distribution



Queue Length Surveys

Consistent with the Intersection count surveys, queue length data was collected for the morning hours from 7:00am to 9:00am and afternoon hours of 4:00pm to 6:00pm. Observed queue lengths in each traffic lane for the assessed intersections is provided from Figure 2.9 to Figure 2.12

Figure 2.9: Observed Queue Length at Oakes Road / Aiken Road roundabout

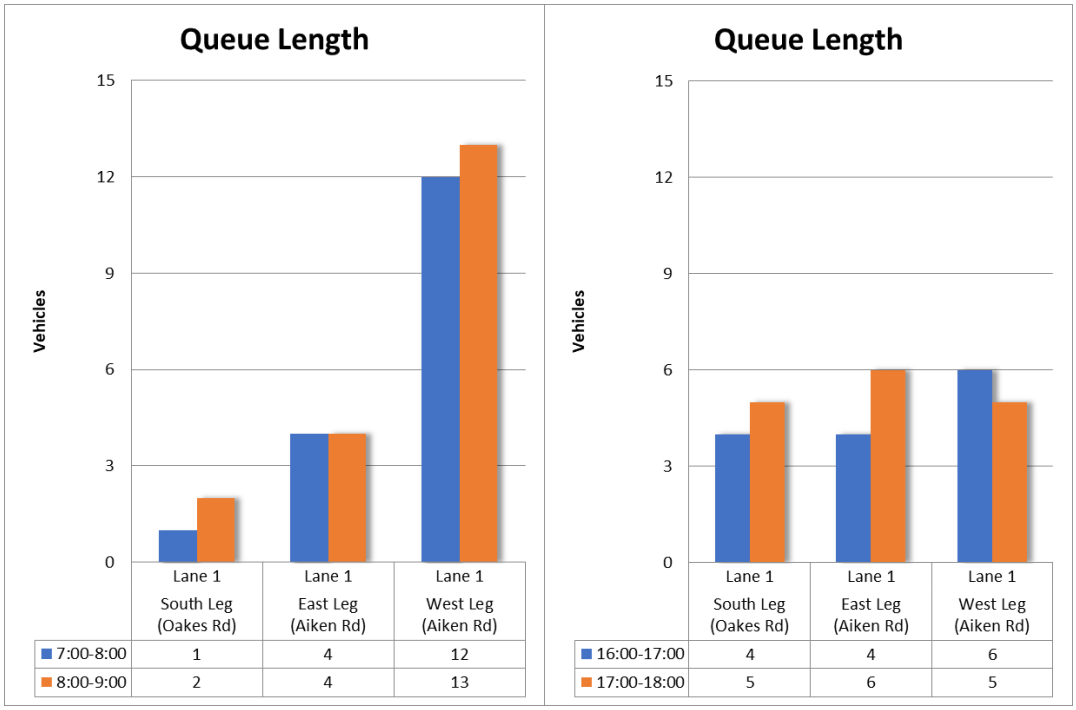


Figure 2.10: Observed Queue Length at Coonara Avenue / Highs Road / Taylor Street intersection

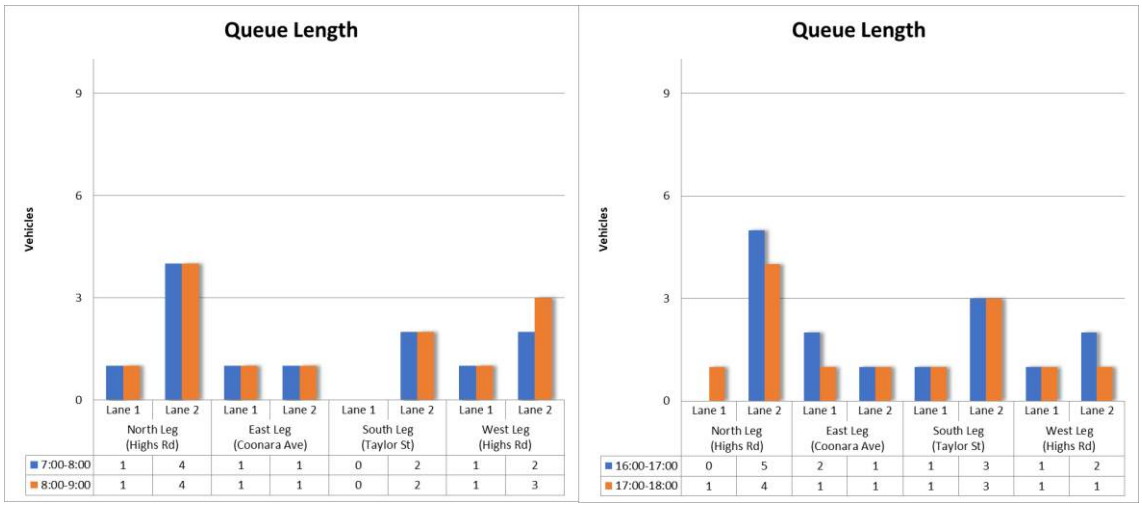
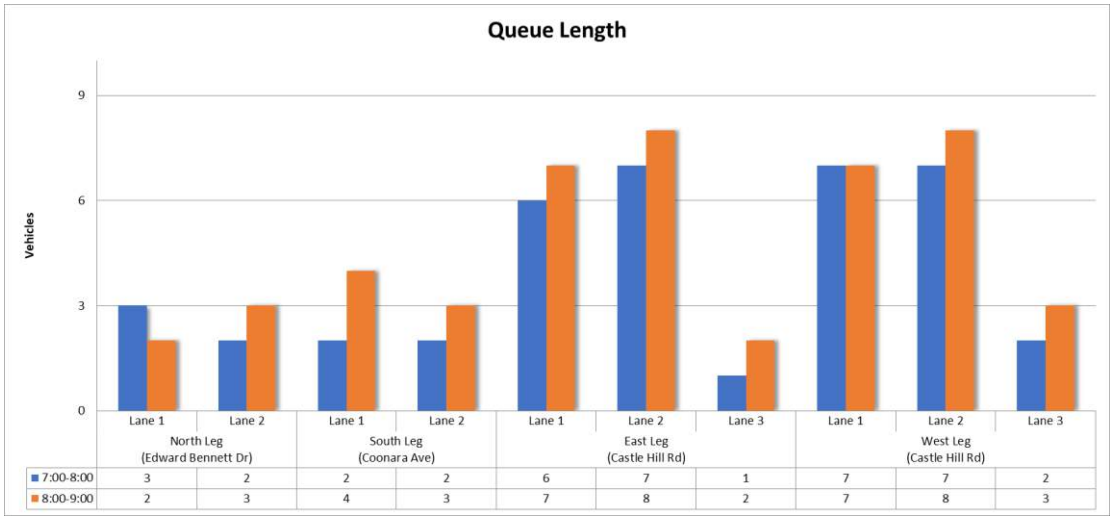


Figure 2.11: Observed Queue Length at Coonara Avenue/ Castle Hill Road/ Edward Bennett Drive intersection



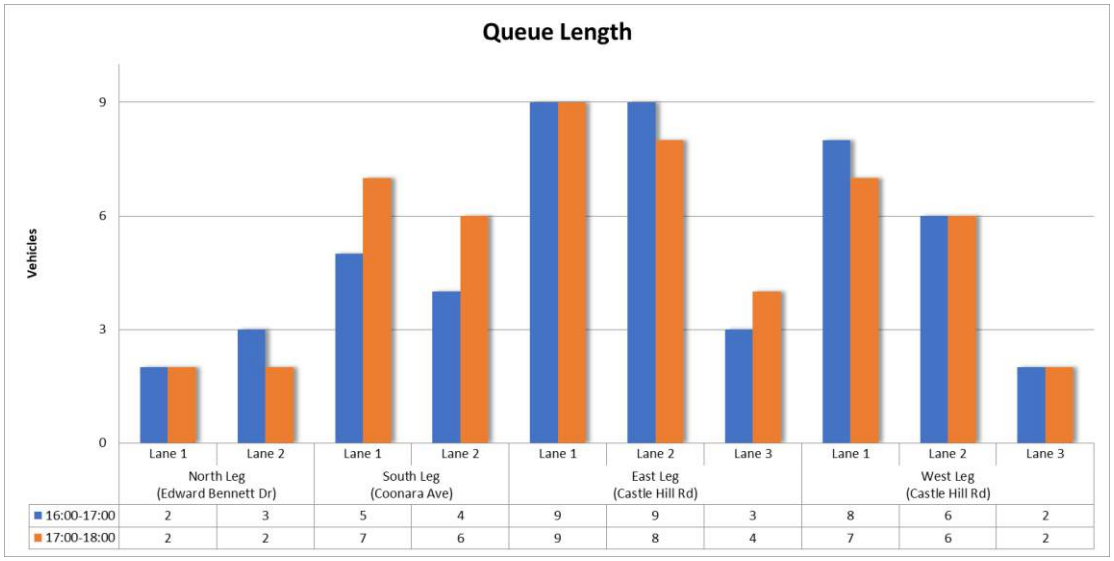
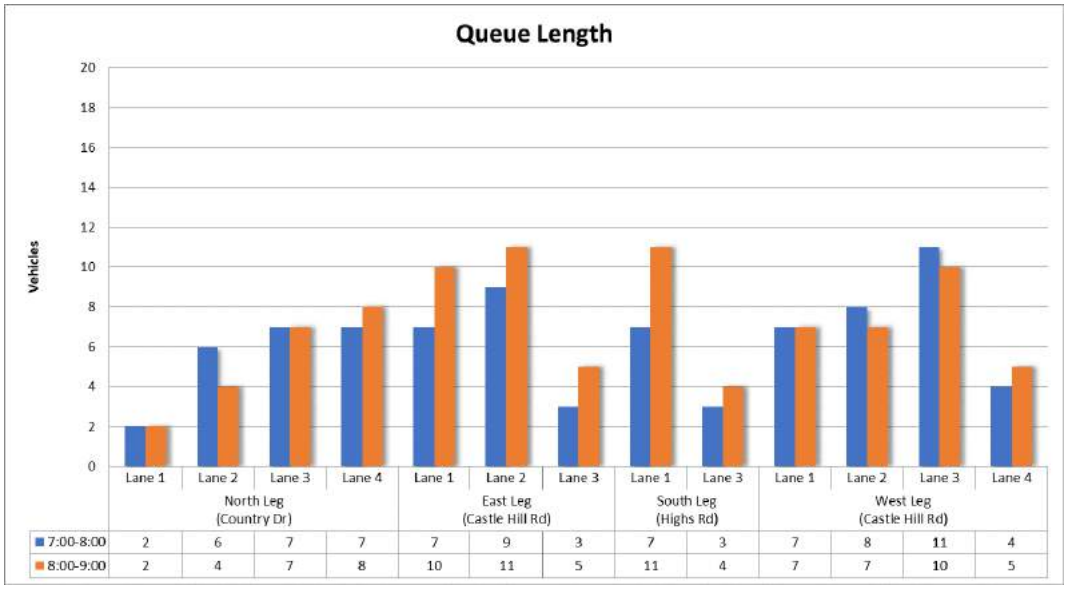
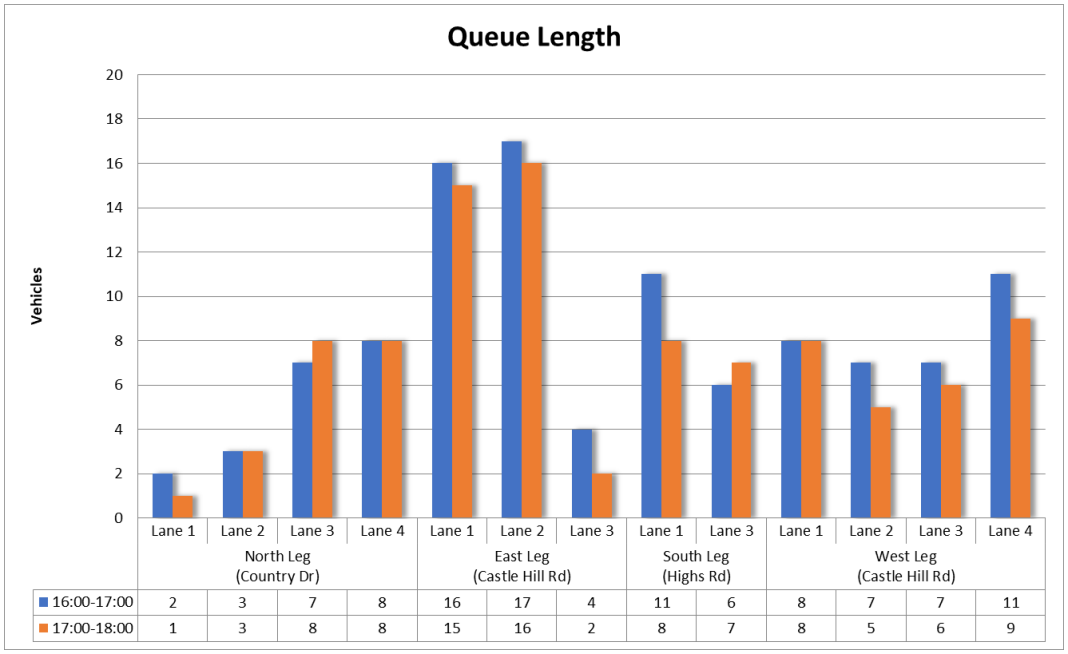


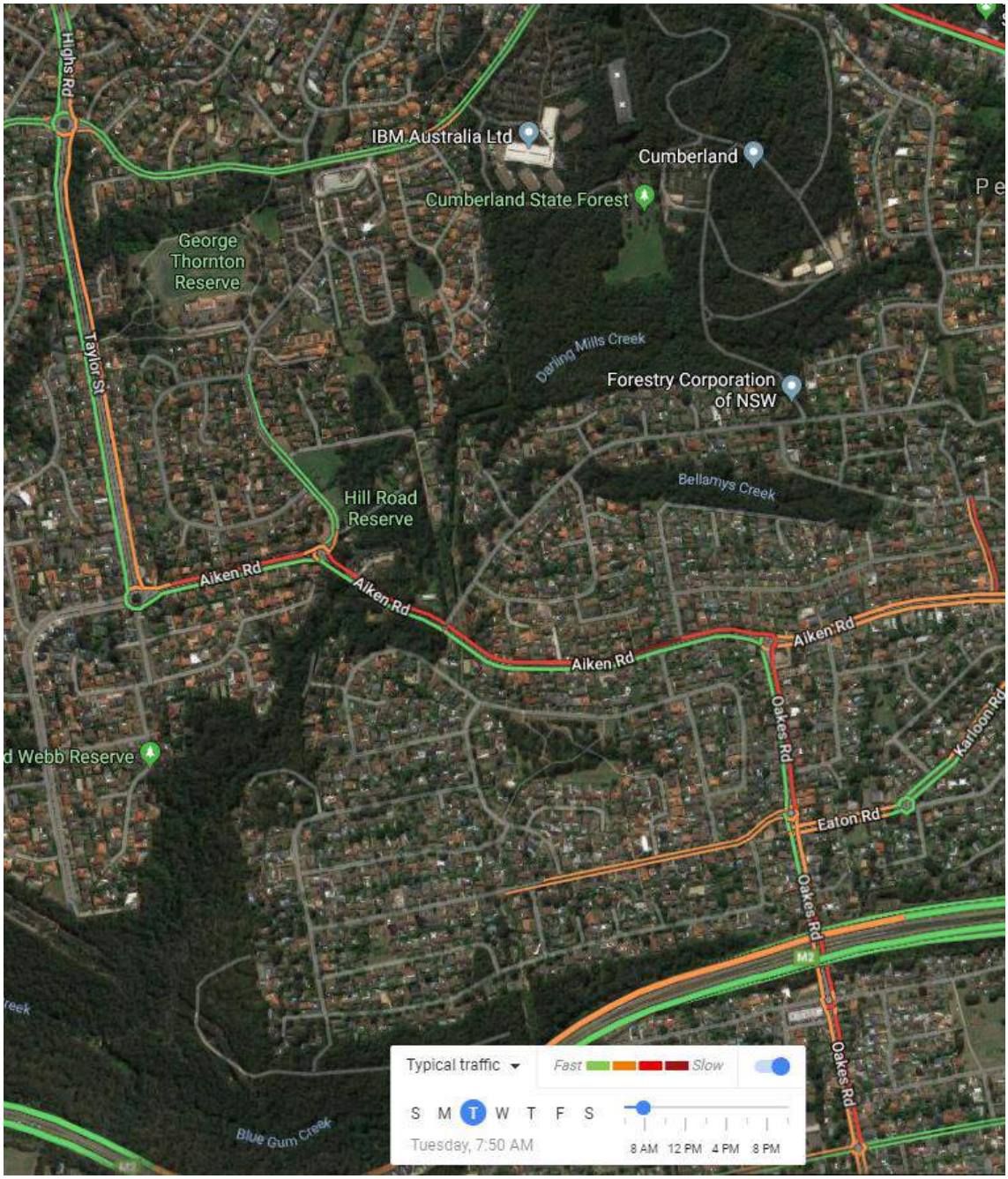
Figure 2.12: Observed Queue Length at Highs Road/ Castle Hill Road/ County Drive intersection





It is noted that the collection of queue length data is very subjective as it depends on the person collecting data to quantify the queue length. Desktop review and local knowledge indicated that long moving queues are observed at Aiken Road in the eastbound direction that extend from Oakes Road all the way back to Taylor Street during the AM peak period. A screenshot from Google Traffic is provided in Figure 2.13.

Figure 2.13: Observed Queue Length at Aiken Road during AM peak period



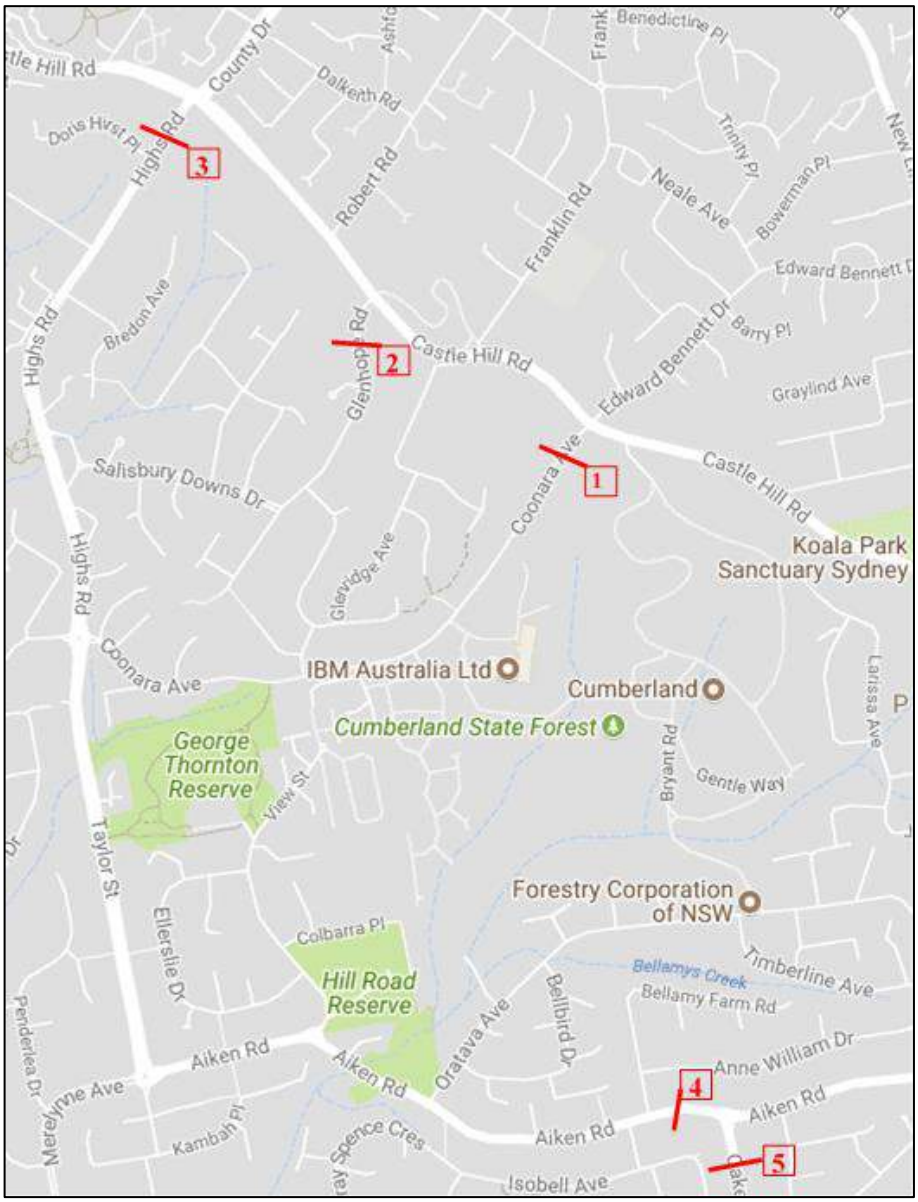
Origin Destination Surveys

To determine travel patterns in the study area, an O-D survey was commissioned by Council on 7th February 2018 at five survey locations for the AM peak period only in the southbound/ eastbound direction. Locations of the five O-D survey stations are described in Table 2.1 and shown graphically in Figure 2.14.

Table 2.1: Origin-Destination Survey Locations

Number	Direction	Road	Location
1S	Southbound	Coonara Avenue	south of Castle Hill Road
2S	Southbound	Glenhope Road	south of Castle Hill Road
3S	Southbound	Highs Road	south of Castle Hill Road
4E	Eastbound	Aitken Road	west of Oakes Road
5S	Southbound	Oakes Road	south of Aitken Road

Figure 2.14: Origin- Destination Survey Locations



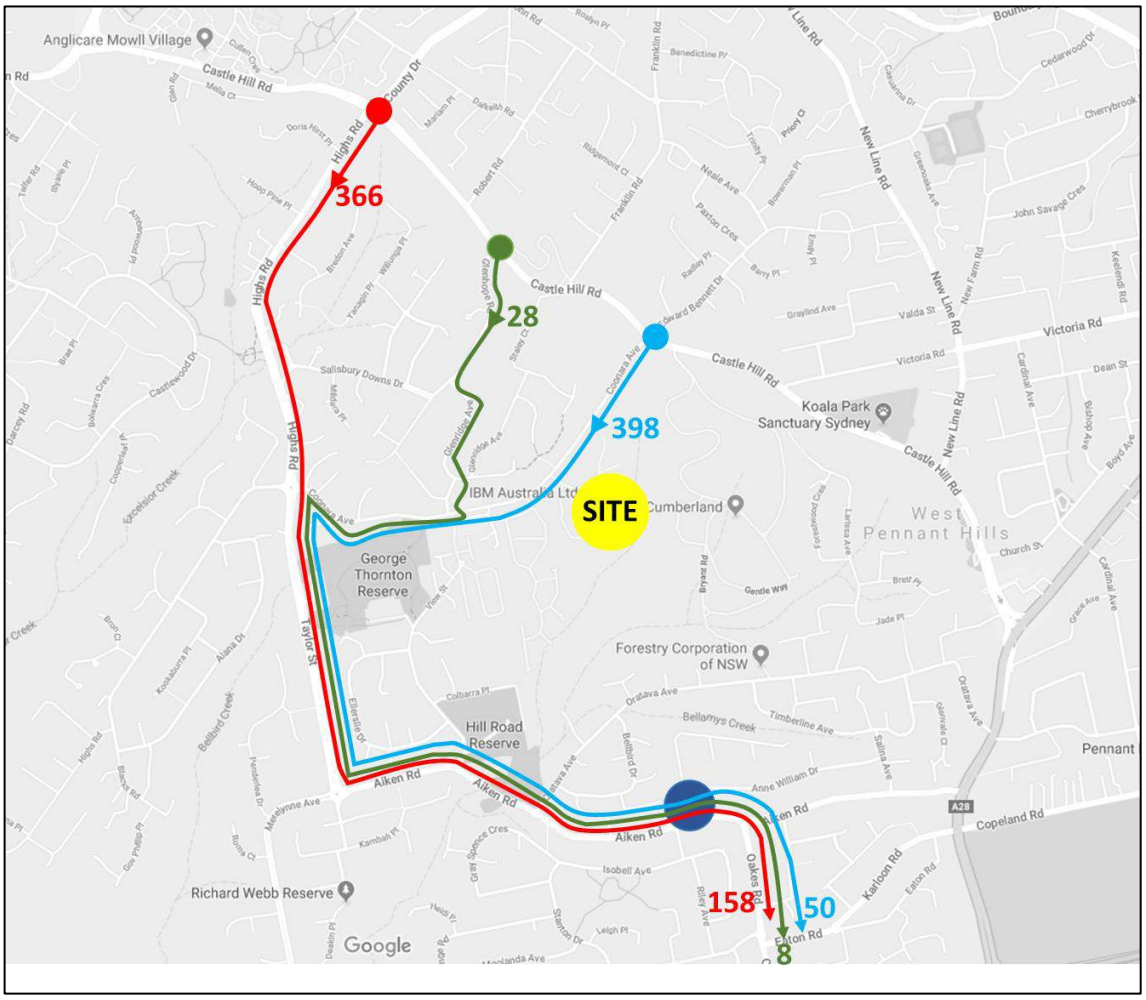
The O-D surveys provide an understanding of how many vehicles utilise Oakes Road to travel towards Paramatta and Carlingford and their respective origins.

Following was observed from the O-D data analysis:

- About 608 vehicles per hour are observed to travel southbound at Oakes Road (Station 5S)
- 36% (216 vehicles) of this southbound traffic is observed to arrive from the three stations in total, namely Coonara Avenue, Glenhope Road and Highs Road.
    - About 158 (26%) vehicles arrive from the Highs Road Station (3S)
    - About 50 (8%) vehicles arrive from the Coonara Avenue Station (1S)
    - About 8 (1%) vehicles arrive from the Glenhope Road intersection (2S)
- Similar amount of traffic is observed travelling southbound at Coonara Avenue (388 veh per hour) and at Highs Road (356 veh per hour)
    - A higher proportion of traffic at Highs Road travels towards Oakes Road (SB) from Highs Road (44%) as compared to Coonara Avenue (13%).

The O-D analysis is shown graphically in Figure 2.15.

Figure 2.15: Origin-Destination Analysis



2.3 Existing Network Performance

The operation of the key intersections within the study area have been assessed using SIDRA INTERSECTION[2], a computer-based modelling package which calculates intersection performance.

The commonly used measure of intersection performance, as defined by the Road and Maritime, is vehicle delay. SIDRA INTERSECTION determines the average delay that vehicles encounter and provides a measure of the level of service.

Table 2.2 shows the criteria that SIDRA INTERSECTION adopts in assessing the level of service. For the purposes of this assessment LOS D is considered acceptable.

Degree of saturation (DOS) is defined as the ration of demand (in vehicles per hour) over the capacity. DOS is a good measure of spare capacity available at the intersection. A DOS >0.9 implies that the intersection is performing close to capacity.

For a signalised intersection an overall average delay is reported whereas for a roundabout the worst movement is reported.

Table 2.2: SIDRA INTERSECTION Level of Service Criteria

Level of Service (LOS)	Average Delay per vehicle (secs/veh)	Traffic Signals, Roundabout	Give Way & Stop Sign
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	Near capacity	Near capacity, accident study required
E	57 to 70	At capacity, at signals incidents will cause excessive delays	At capacity, requires other control mode
F	Greater than 70	Extra capacity required	Extreme delay, major treatment required

Table 2.3 presents a summary of the existing operation of the intersection, with detailed results presented in Appendix B of this report.

Table 2.3: Existing Performance Results

Intersection	Control	Peak	Degree of Saturation (DOS)	Average Delay (sec)	95th Percentile Queue (m)	Level of Service (LOS)
Highs Road/ Castle Hill Road/ County Drive	Signals	AM	0.92	39	164	C
		PM	0.95	46	308	D
Coonara Avenue/ Highs Road/ Taylor Street	Roundabout	AM	0.10	10	4	A
		PM	0.07	9	2	A
Coonara Avenue/ Castle Hill Road/ Edward Bennett Drive	Signals	AM	0.91	34	169	C
		PM	0.89	33	290	C
Aiken Road/ Oakes Road	Roundabout	AM	0.96	44	170	D
		PM	0.47	10	25	A

[2] Program used under license from Akcelik & Associates Pty Ltd.

The following can be observed from the intersection performance results:

- All intersections assessed are performing at acceptable levels (LOS D) or better except for the Aiken Road/ Oakes Road roundabout during the AM peak hour.
- The right turn from Aiken Road to Oakes Road is operating at acceptable LOS D, however has a high degree of saturation (>0.9). This is due to the southbound queues at Oakes Road spilling back from upstream intersections as observed in Figure 2.9. Any further increase in traffic will significantly impact the performance of this roundabout.

It is noted that, should the upstream queues not impact the performance of the Aiken Road/ Oakes Road roundabout, the roundabout is expected to operate at acceptable levels

3. Traffic Impact Assessment

3.1 Traffic Generation

For the purposes of this assessment the trips generated by the proposed development have been added to the observed traffic volumes at the adjacent intersections. This approach does not exclude traffic generated by the existing land uses at the site (included in the traffic surveys) and is therefore considered on the conservative side

3.1.1 Trip Rates

Traffic generation estimates for the proposed development have been sourced from Section 3 of the ARC Report. Estimated peak hour traffic volumes resulting from the proposal are set out in Table 3.1.

Table 3.1: Traffic Generation Estimates

Period	Traffic Generation Rate (trips)
AM Peak	339
PM Peak	347

Table 3.1 indicates that the site could potentially generate 339 vehicle movements in the AM peak hour and up to 347 vehicle movements in the PM peak hour.

The following trip inbound/ outbound distribution has been applied (as per the ARC Report):

- AM Peak hour
  - Arrival – 20%
  - Departure – 80%
- PM Peak Hour
  - Arrival – 80%
  - Departure – 20%

3.1.2 Trip Distribution

With the development of the NorthConnex and the Sydney Metro station it is anticipated that congestion levels at Castle Hill Road and at Pennant Hills Road are likely to reduce. Traffic distribution may also change after opening of the NorthConnex and Sydney Metro in 2019. Therefore, for a robust analysis three different trip distribution analysis have been tested.

- Scenario 1 – 80% traffic to/ from Castle Hill Road
- Scenario 2 – 20% traffic to/ from Castle Hill Road
- Scenario 3 – 50% traffic to/ from Castle Hill Road

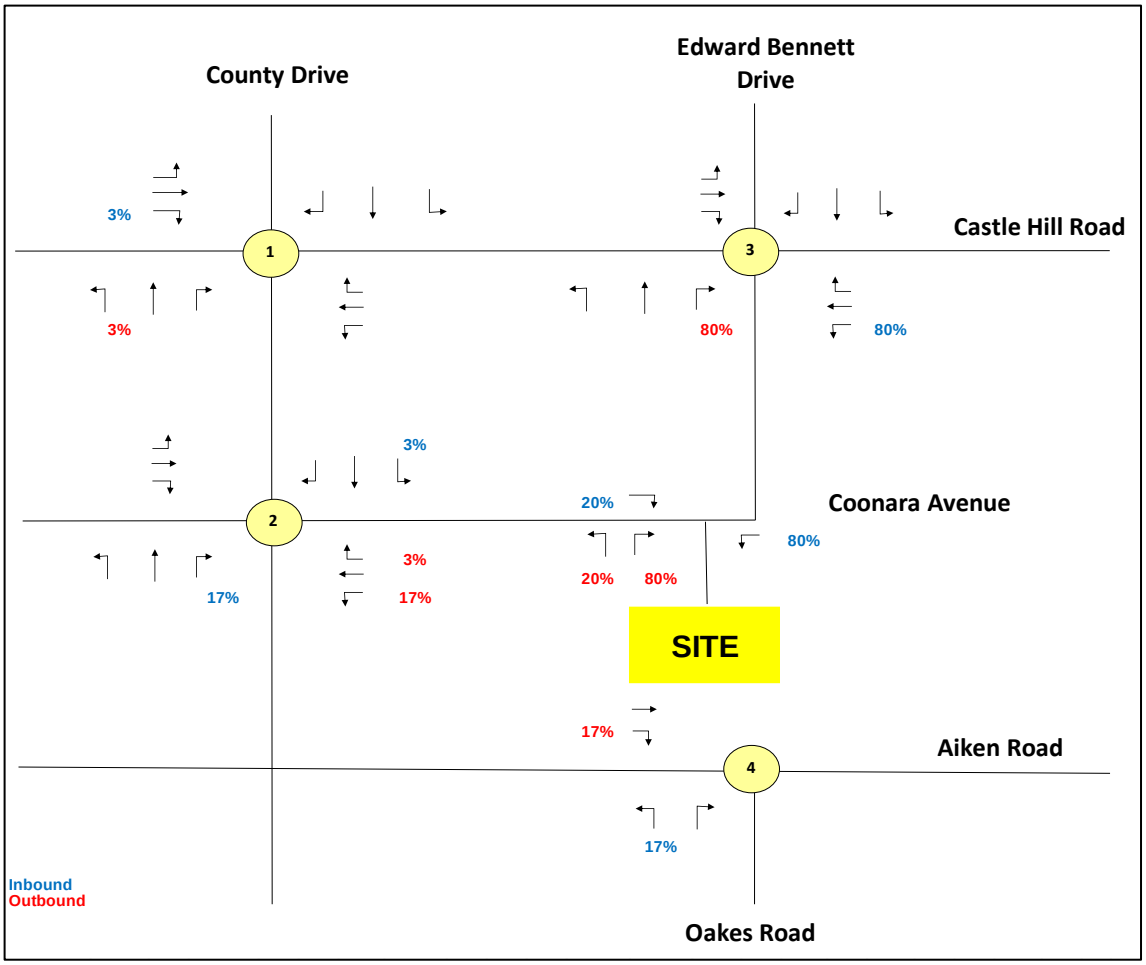
Scenario 1

For the purposes of estimating vehicle movements, the following directional distributions have been assumed:

- Taylor Street 17 per cent
- Highs Road 3 per cent
- Castle Hill Road (via Coonara Avenue) 80 per cent.

Figure 3.1 graphically shows the percentage of traffic distribution across the four intersections.

Figure 3.1: Percentage Traffic Distribution under Scenario 1



Additional traffic generated due to the development under Scenario 1 is shown in Figure 3.2 for the AM peak hour and Figure 3.3 for the PM peak hour.

Figure 3.2: Scenario 1 Development Traffic -AM Peak Hour

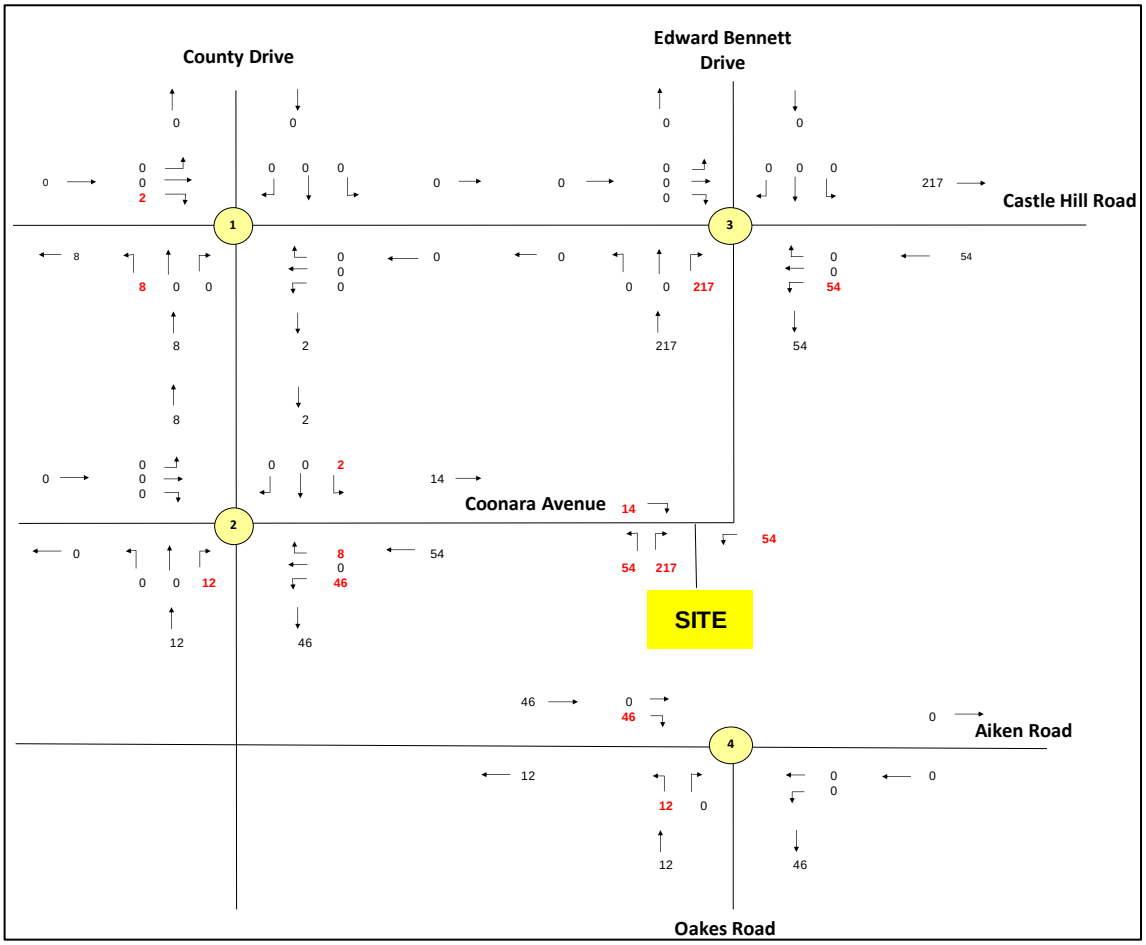
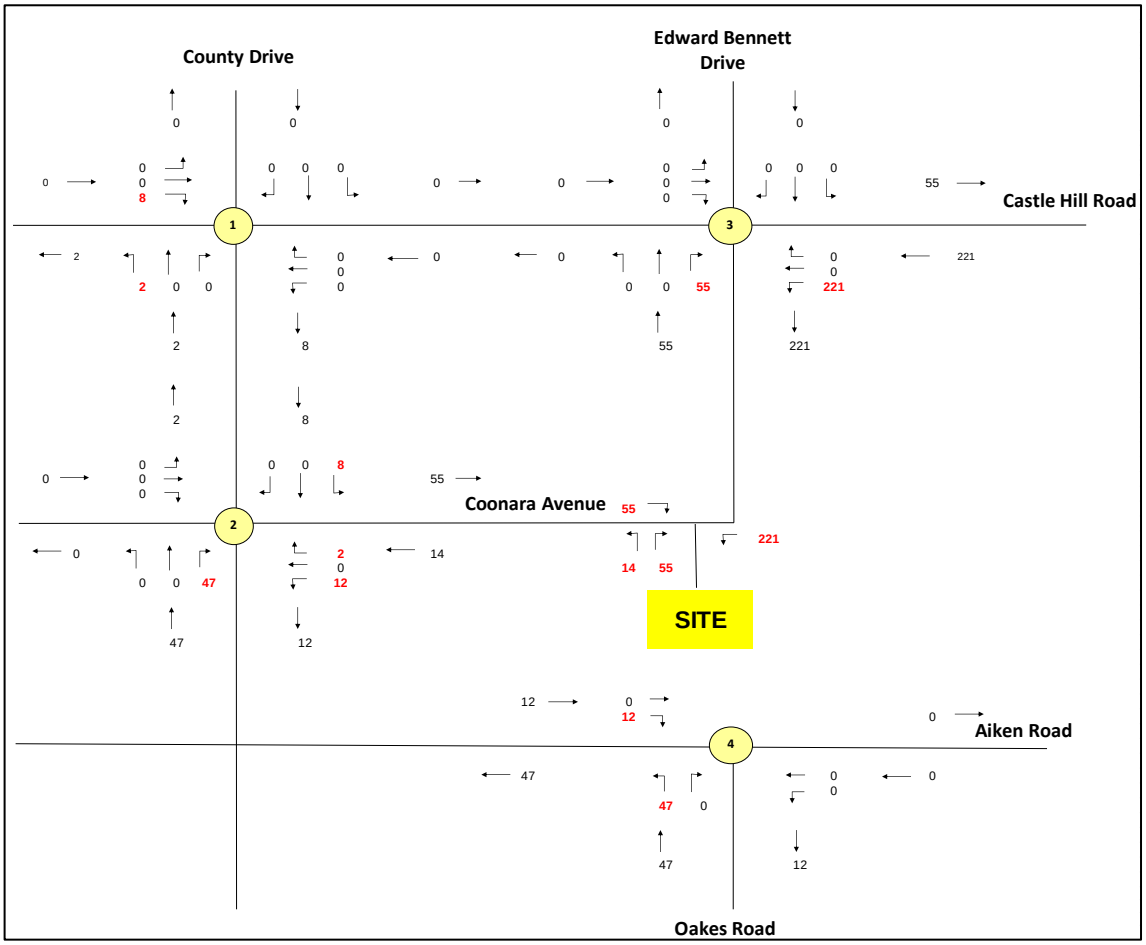


Figure 3.3: Scenario 1 Development Traffic - PM Peak Hour



Total traffic with the proposed development under Scenario 1 is shown in Figure 3.4 and Figure 3.5 for AM and PM peak hours respectively.

Figure 3.4: Scenario 1 total traffic with proposed development – AM Peak Hour

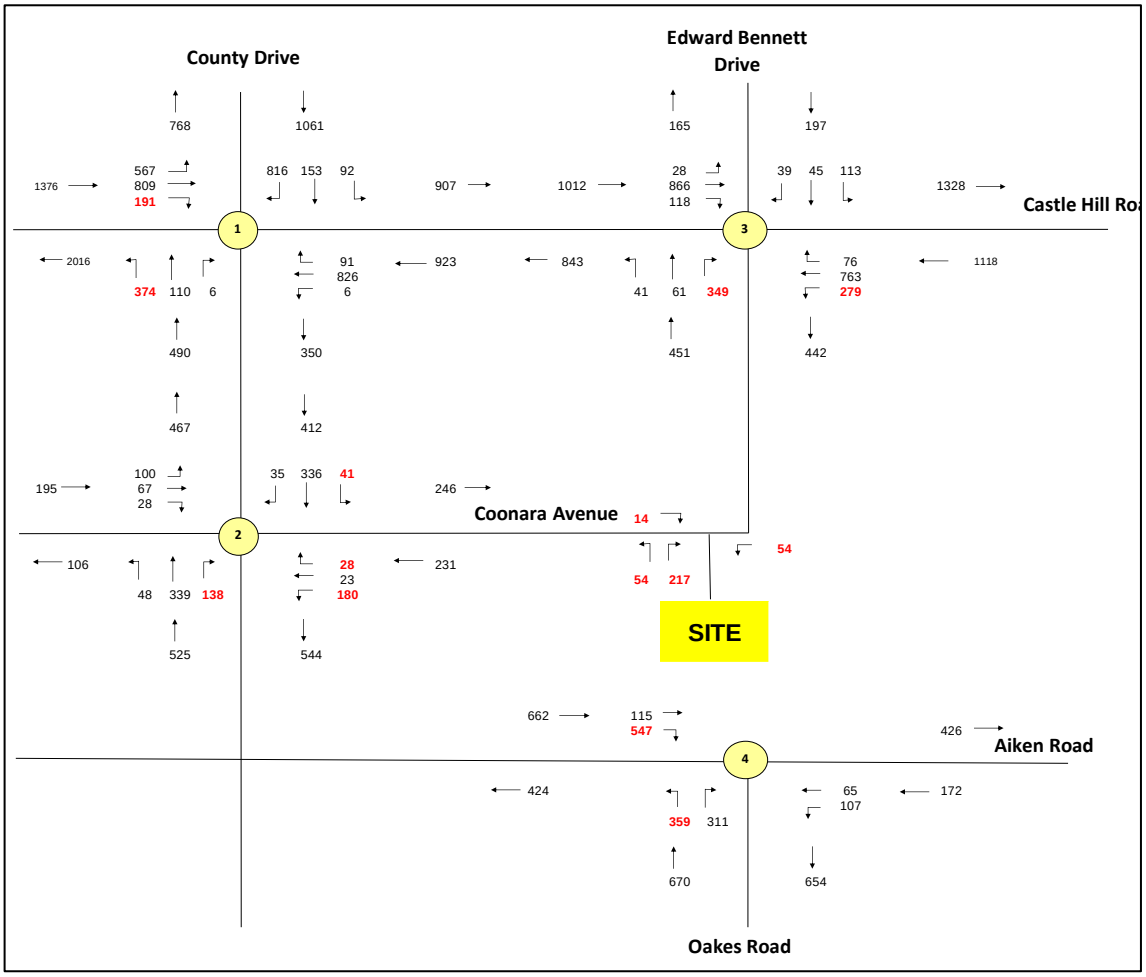
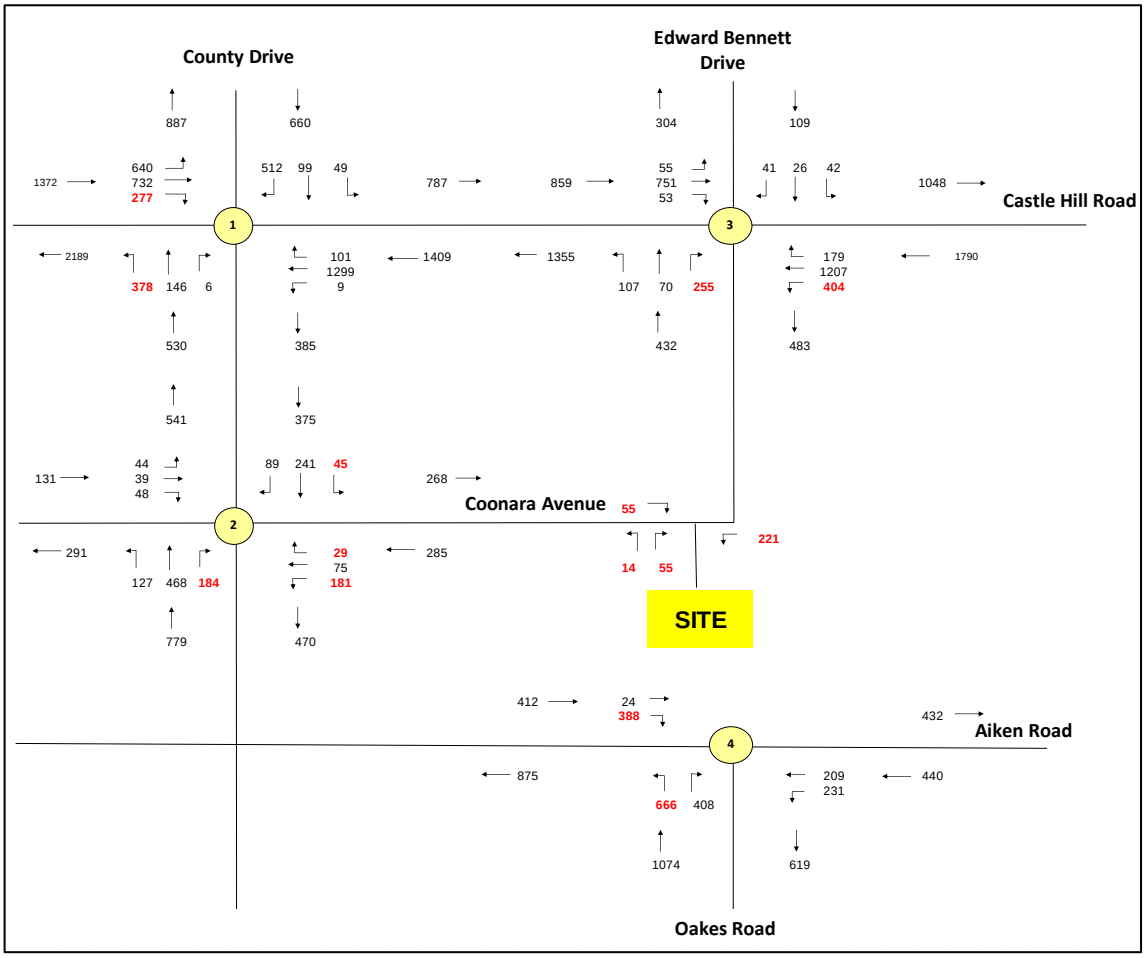


Figure 3.5: Scenario 1 total traffic with proposed development – PM Peak Hour



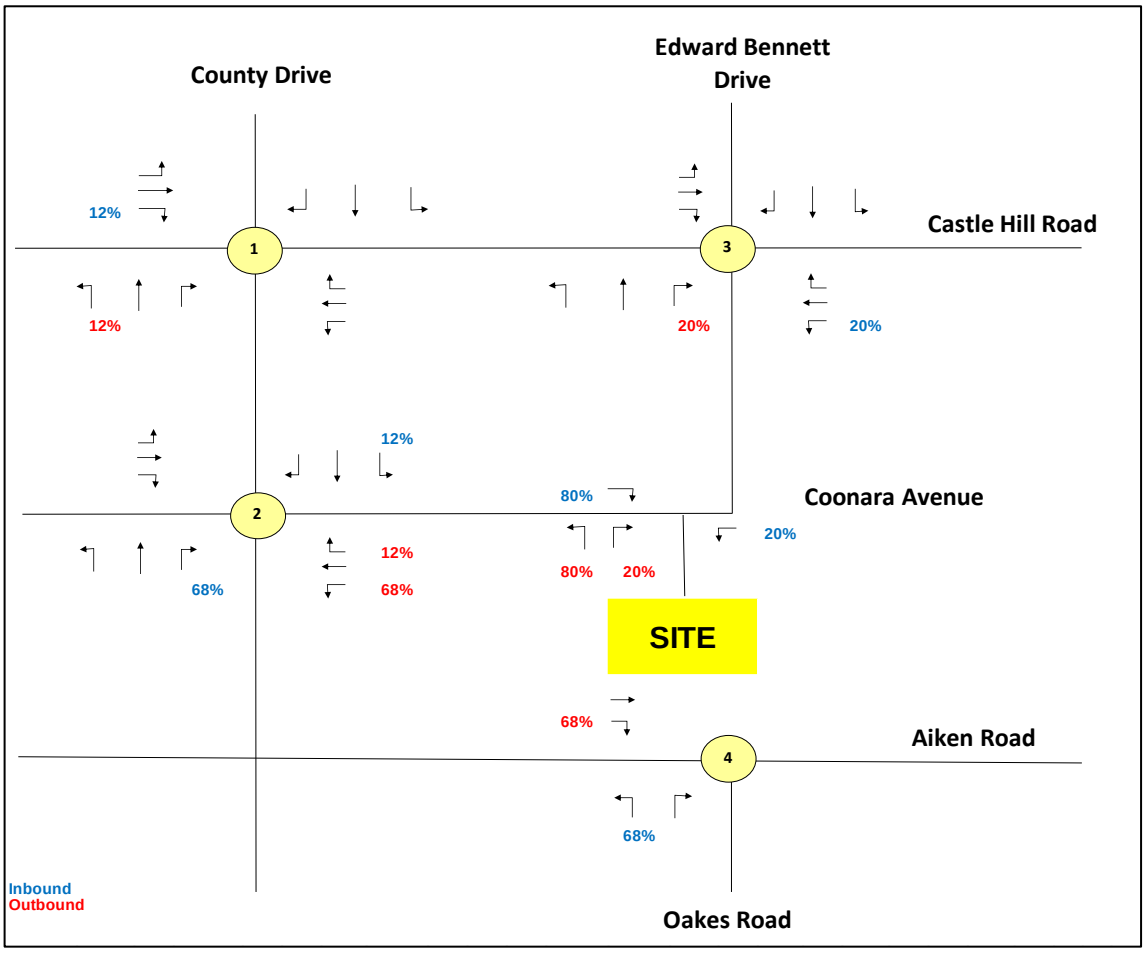
Scenario 2

For the purposes of estimating vehicle movements, the following directional distributions have been assumed under Scenario 2:

- Taylor Street 68 per cent
- Highs Road 12 per cent
- Castle Hill Road (via Coonara Avenue) 20 per cent.

Figure 3.6 graphically shows the percentage of traffic distribution under Scenario 2 across the four intersections.

Figure 3.6: Percentage Traffic Distribution under Scenario 2



Additional traffic generated due to the development under scenario 2 is shown in Figure 3.7 for the AM peak hour and Figure 3.8 for the PM peak hour.

Figure 3.7: Scenario 2 Development Traffic -AM Peak Hour

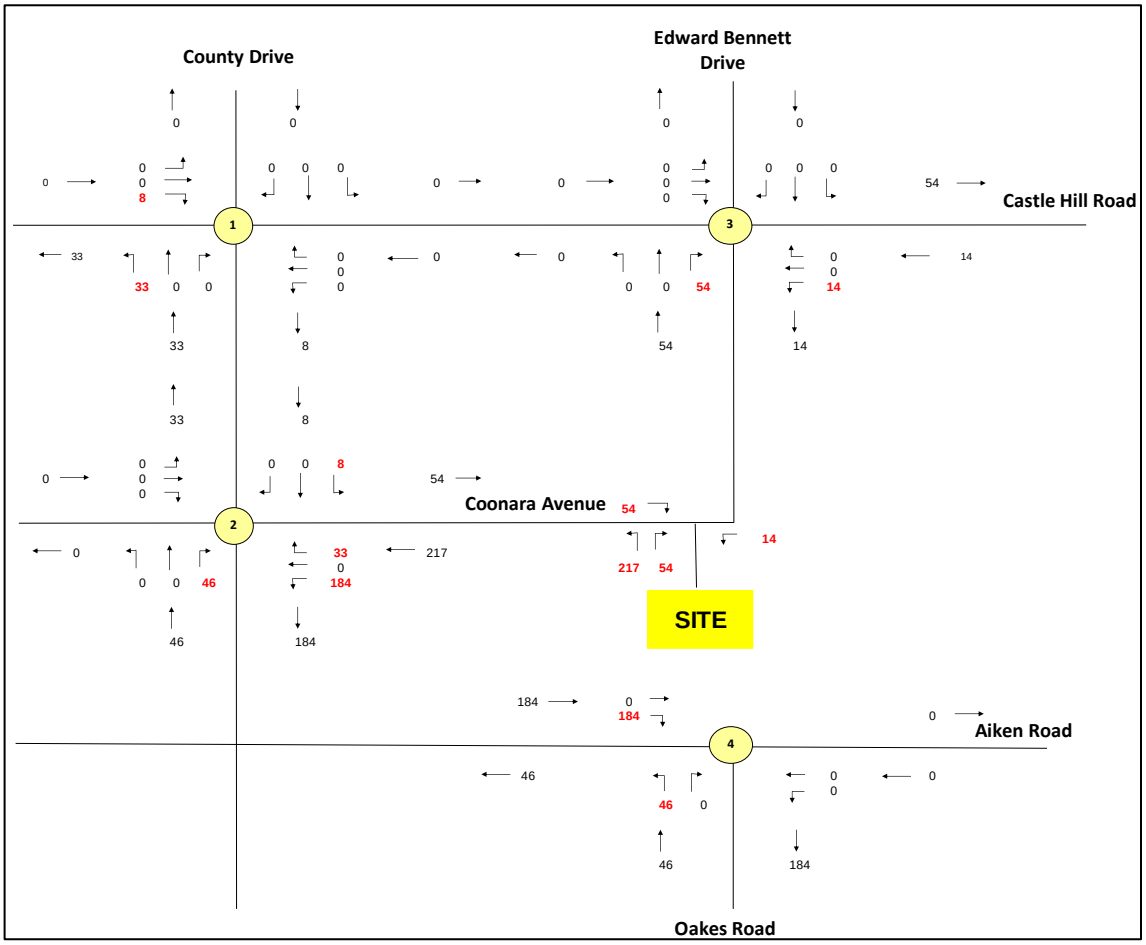
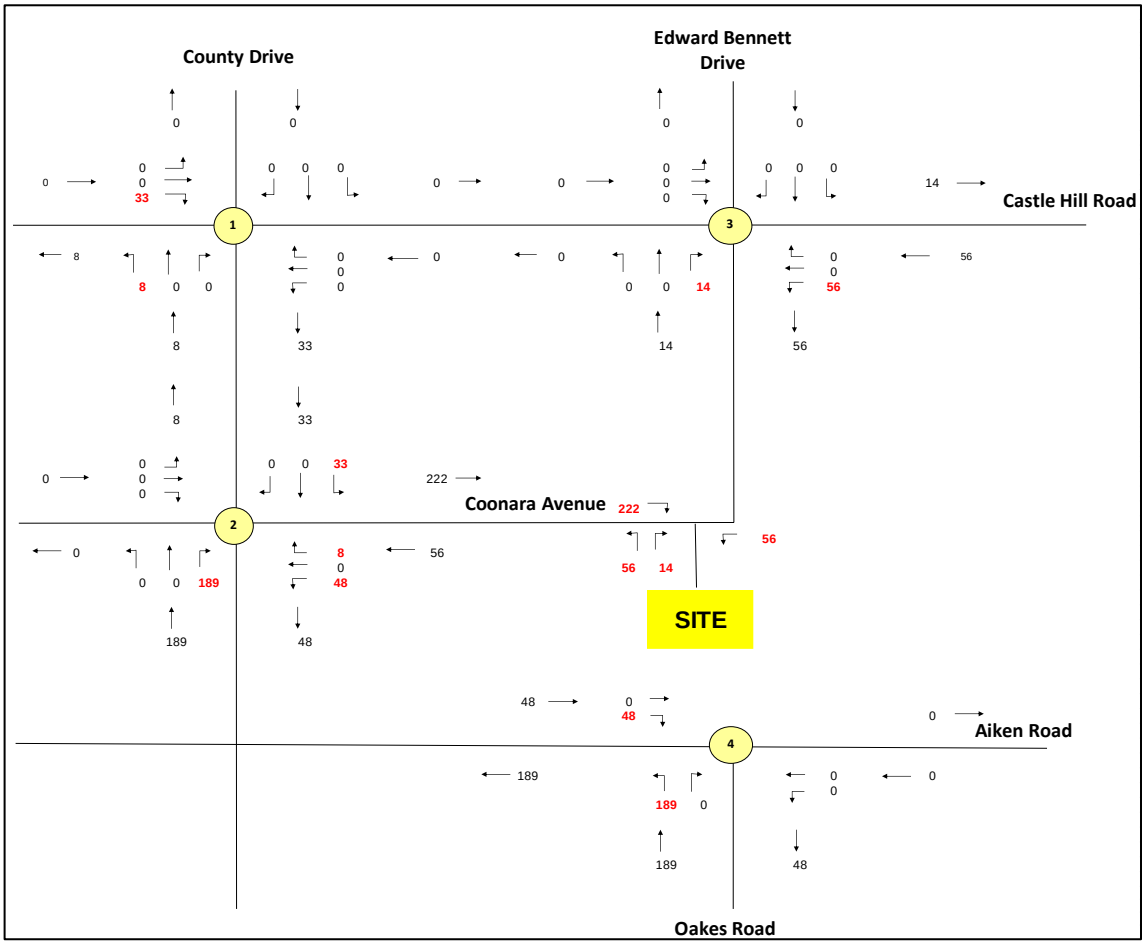


Figure 3.8: Scenario 2 Development Traffic - PM Peak Hour



Total traffic with the proposed development under Scenario 2 is shown in Figure 3.9 and Figure 3.10 for AM and PM peak hours respectively.

Figure 3.9: Scenario 2 Total Traffic - AM Peak Hour

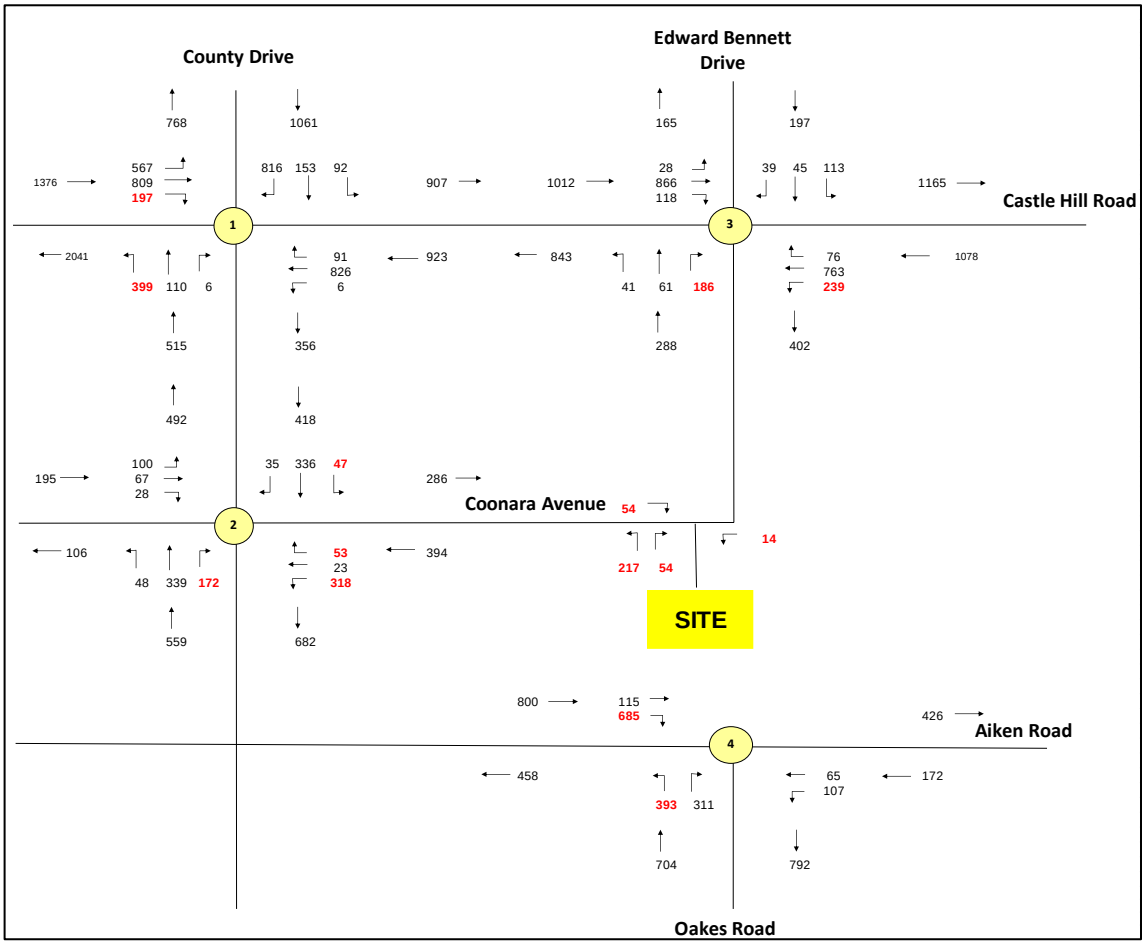
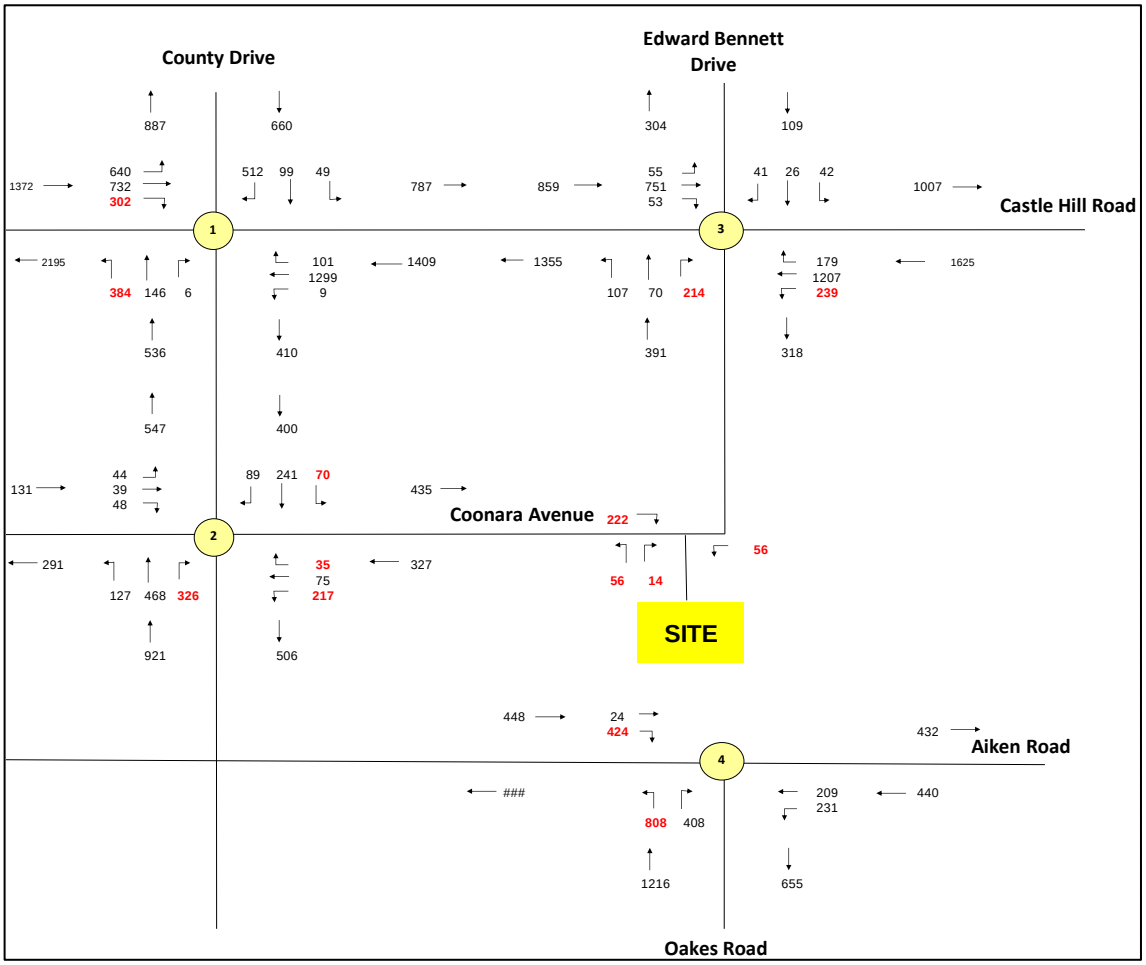


Figure 3.10: Scenario 2 Total Traffic - PM Peak Hour



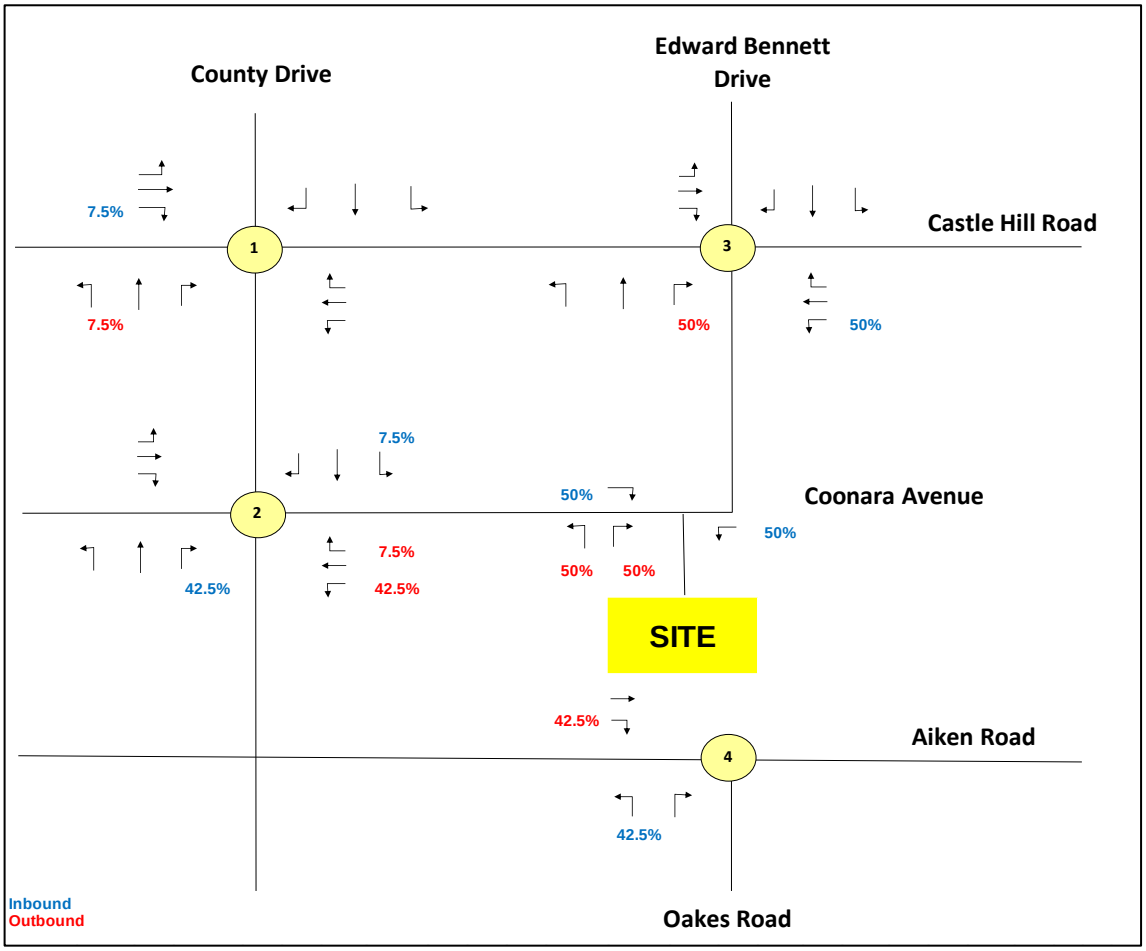
Scenario 3

For the purposes of estimating vehicle movements, the following directional distributions have been assumed:

- Taylor Street 42.5 per cent
- Highs Road 7.5 per cent
- Castle Hill Road (via Coonara Avenue) 50 per cent.

Figure 3.11 graphically shows the percentage of traffic distribution under Scenario 3 across the four intersections.

Figure 3.11: Percentage Traffic Distribution under Scenario 3



Additional traffic generated due to the development under Scenario 3 is shown in Figure 3.12 for the AM peak hour and Figure 3.13 for the PM Peak hour.

Figure 3.12: Scenario 3 Development Traffic – AM Peak Hour

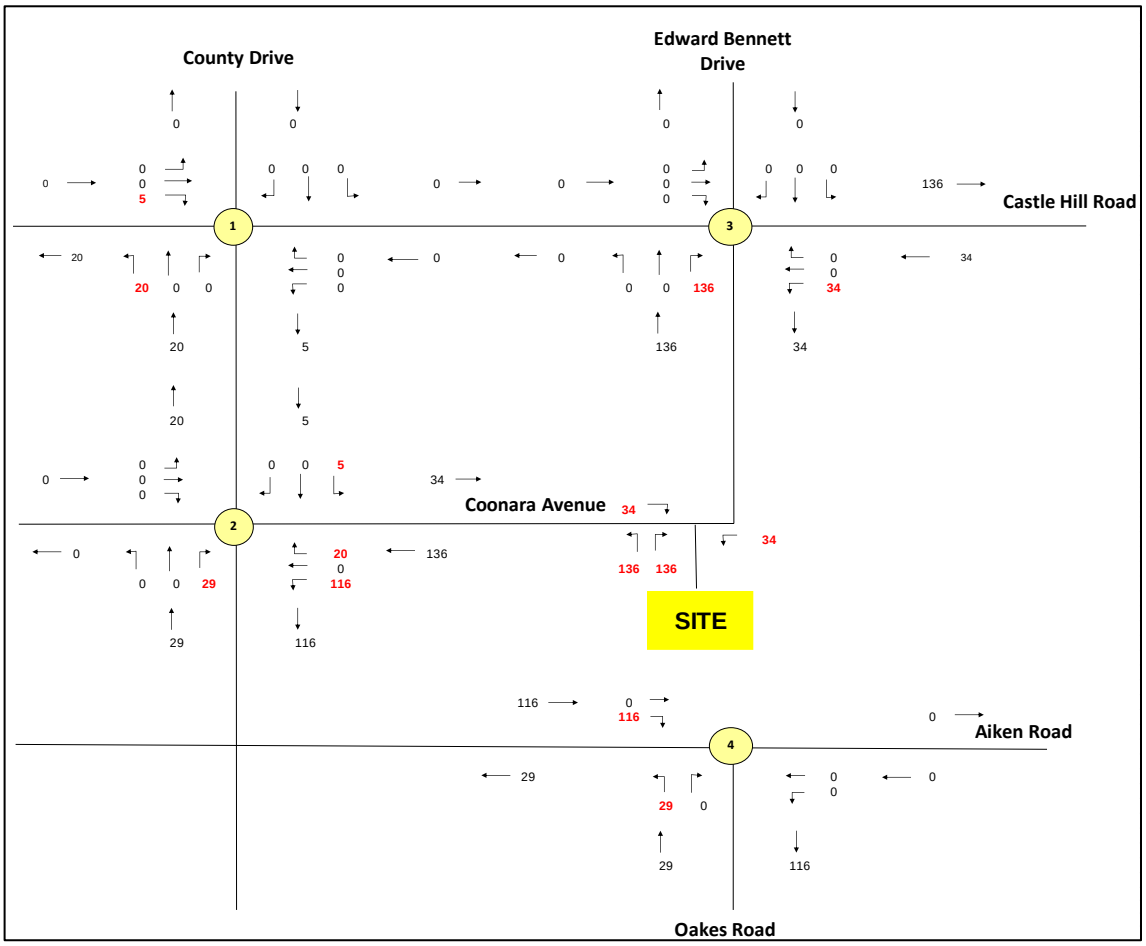
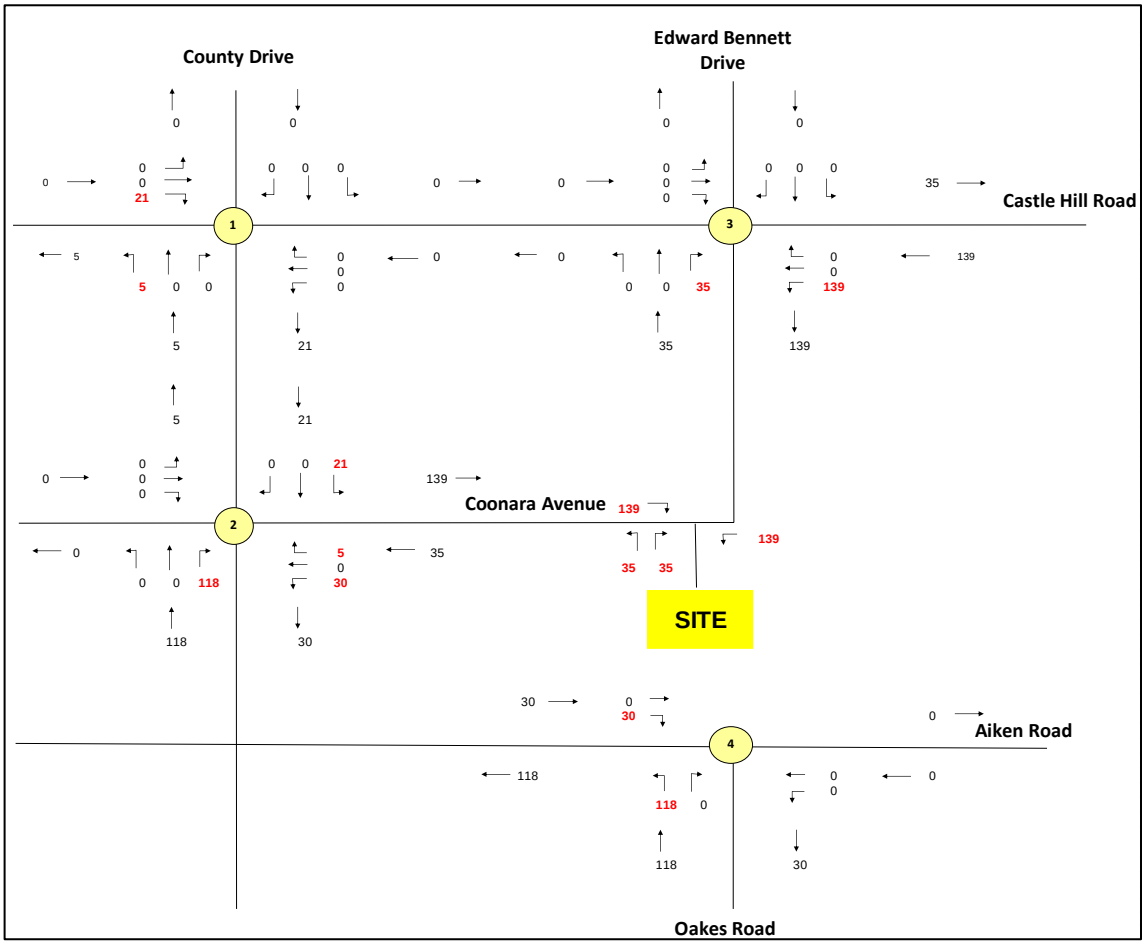


Figure 3.13: Scenario 3 Development Traffic – PM Peak Hour



Total traffic with the proposed development under Scenario 2 is shown in Figure 3.14 and Figure 3.15 for AM and PM peak hours respectively.

Figure 3.14: Scenario 3 Total Traffic – AM Peak Hour

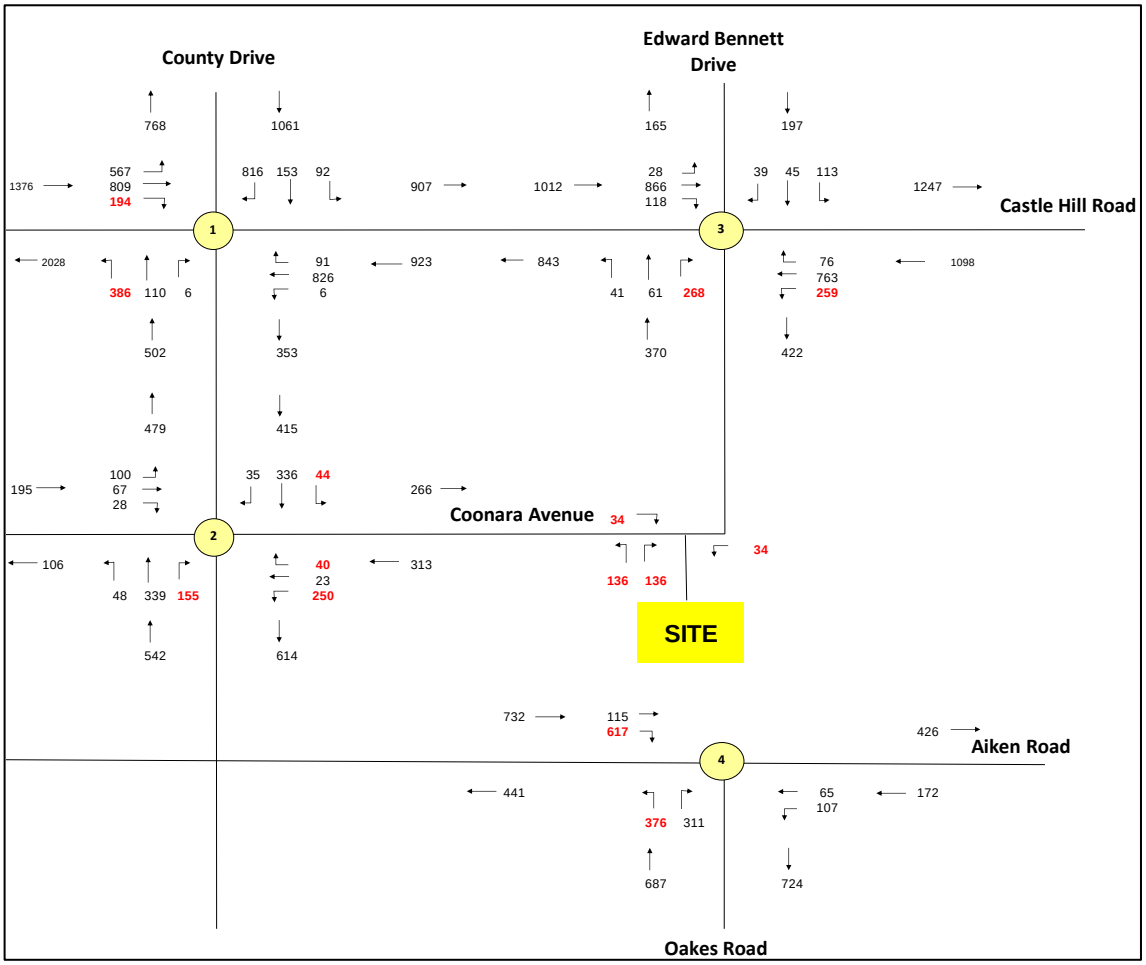
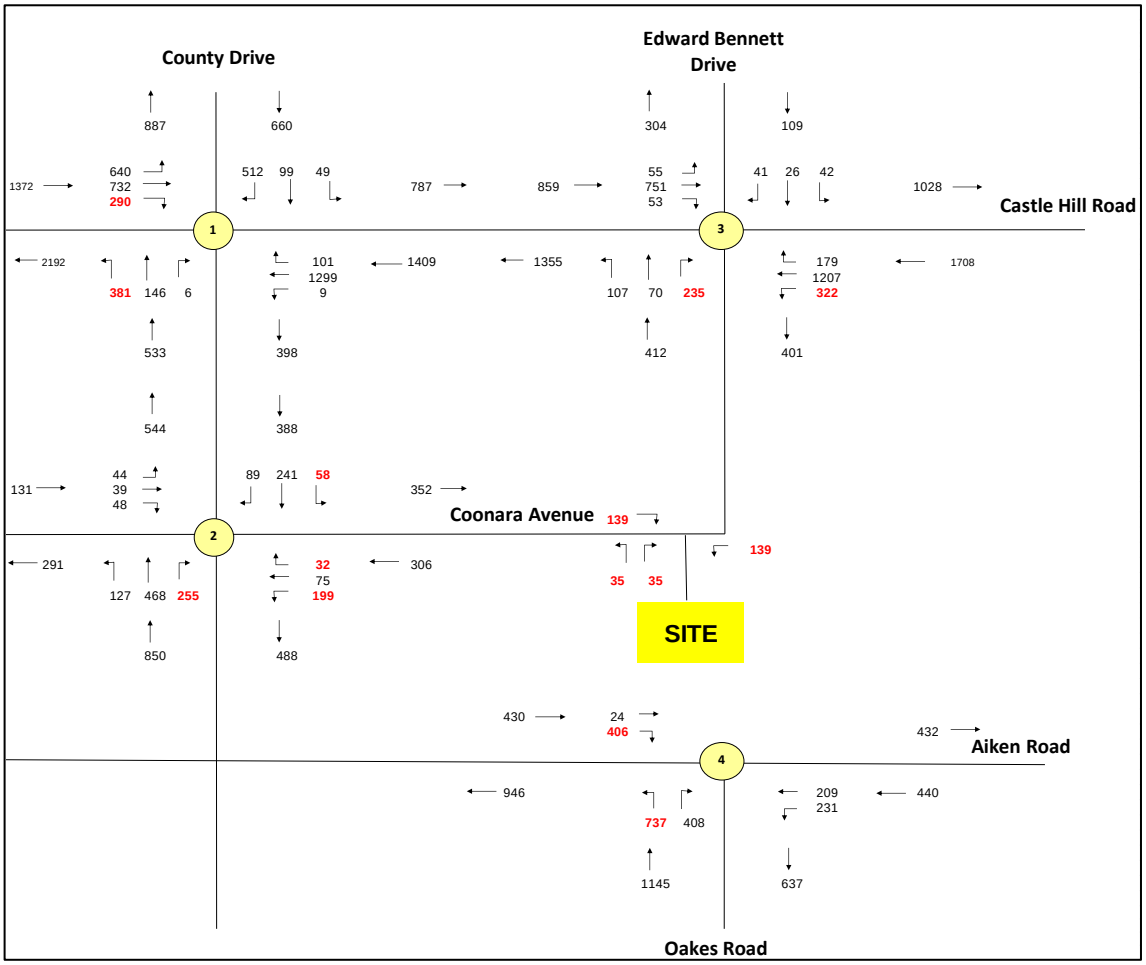


Figure 3.15: Scenario 3 Total Traffic – PM Peak Hour



3.2 Traffic Impact Assessment

All four intersections were assessed in SIDRA using volumes estimated for the three distribution scenarios. The LOS results are summarised in Table 3.2 with detailed results provided in Appendix B.

Table 3.2: Level of Service Summary

Intersection	Peak	Existing Conditions	Scenario 1	Scenario 2	Scenario 3
Highs Road/ Castle Hill Road/ County Drive	AM	C	C	C	C
	PM	D	D	D	D
Coonara Avenue/ Highs Road/ Taylor Street	AM	A	A	A	A
	PM	A	A	A	A
Coonara Avenue/ Castle Hill Road/ Edward Bennett Drive	AM	C	C	C	C
	PM	C	D	C	C
Aiken Road/ Oakes Road	AM	D	F	F	F
	PM	A	A	A	A

With the development traffic, all four intersections are expected to operate at similar levels (acceptable LOS D or better) which is comparable to the existing conditions for both the AM and the PM peak hours for all scenarios tested. The Aiken Road/ Oakes Road roundabout is operating at capacity under existing condition and the additional development traffic leads to its deterioration in performance. As outlined in Section 2, the operation of this roundabout is impacted by the upstream queues and should this constraint be removed, the roundabout itself is expected to perform at acceptable levels. Therefore, the impacts from the development traffic is considered minimal at this roundabout and it only exacerbates the existing congestion issues.

Scenario 1 Performance

The performance of all four intersections is summarised in Table 3.3.

Table 3.3: Scenario 1 Operating Conditions

Intersection	Peak	Degree of Saturation (DOS)	Average Delay (sec)	95th Percentile Queue (m)	Level of Service (LOS)
Highs Road/ Castle Hill Road/ County Drive	AM	0.95	40	163	C
	PM	0.95	46	305	D
Coonara Avenue/ Highs Road/ Taylor Street	AM	0.10	10	3	A
	PM	0.08	10	2	A
Coonara Avenue/ Castle Hill Road/ Edward Bennett Drive	AM	0.94	42	234	C
	PM	0.92	46	437	D
Aiken Road/ Oakes Road	AM	1.04	87	332	F
	PM	0.73	10	27	A

The following can be observed from Scenario 1 results:

- Except for the Aiken Road/ Oakes Road roundabout, all intersections are performing at acceptable LOS D or better
- Long queues (>200 meters) and a high DOS (>0.9) are observed at Highs Road/ Castle Hill Road/ County Drive intersection indicating that the intersection is operating at capacity during the PM peak hour
- Long queues (>200 meters) and a high DOS (>0.9) are observed at Coonara Avenue/ Castle Hill Road/ Edward Bennett Drive intersection indicating that the intersection is operating at capacity during the PM peak hour

Scenario 2 Performance

The performance of all four intersections is summarised in Table 3.4

Table 3.4: Scenario 2 Operating Conditions

Intersection	Peak	Degree of Saturation (DOS)	Average Delay (sec)	95th Percentile Queue (m)	Level of Service (LOS)
Highs Road/ Castle Hill Road/ County Drive	AM	0.95	42	178	C
	PM	0.96	49	318	D
Coonara Avenue/ Highs Road/ Taylor Street	AM	0.12	10	3	A
	PM	0.09	10	3	A
Coonara Avenue/ Castle Hill Road/ Edward Bennett Drive	AM	0.92	36	181	C
	PM	0.94	36	323	C
Aiken Road/ Oakes Road	AM	1.29	284	979	F
	PM	0.82	11	5	A

The following can be observed from Scenario 2 results:

- Except for the Aiken Road/ Oakes Road roundabout, all intersections are performing at acceptable LOS D or better
- Long queues (>200 meters) and a high DOS (>0.9) are observed at Highs Road/ Castle Hill Road/ County Drive intersection indicating that the intersection is operating at capacity during the PM peak hour
- Long queues (>200 meters) and a high DOS (>0.9) are observed at Coonara Avenue/ Castle Hill Road/ Edward Bennett Drive intersection indicating that the intersection is operating at capacity during the PM peak hour

Scenario 3 Performance

The performance of all four intersections is summarised in Table 3.5

Table 3.5: Scenario 3 Operating Conditions

Intersection	Peak	Degree of Saturation (DOS)	Average Delay (sec)	95th Percentile Queue (m)	Level of Service (LOS)
Highs Road/ Castle Hill Road/ County Drive	AM	0.92	41	176	C
	PM	0.97	53	309	D
Coonara Avenue/ Highs Road/ Taylor Street	AM	0.11	10	4	A
	PM	0.08	10	3	A
Coonara Avenue/ Castle Hill Road/ Edward Bennett Drive	AM	0.93	39	208	C
	PM	0.88	40	364	C
Aiken Road/ Oakes Road	AM	1.17	180	643	F
	PM	0.52	11	29	A

The following can be observed from Scenario 3 results:

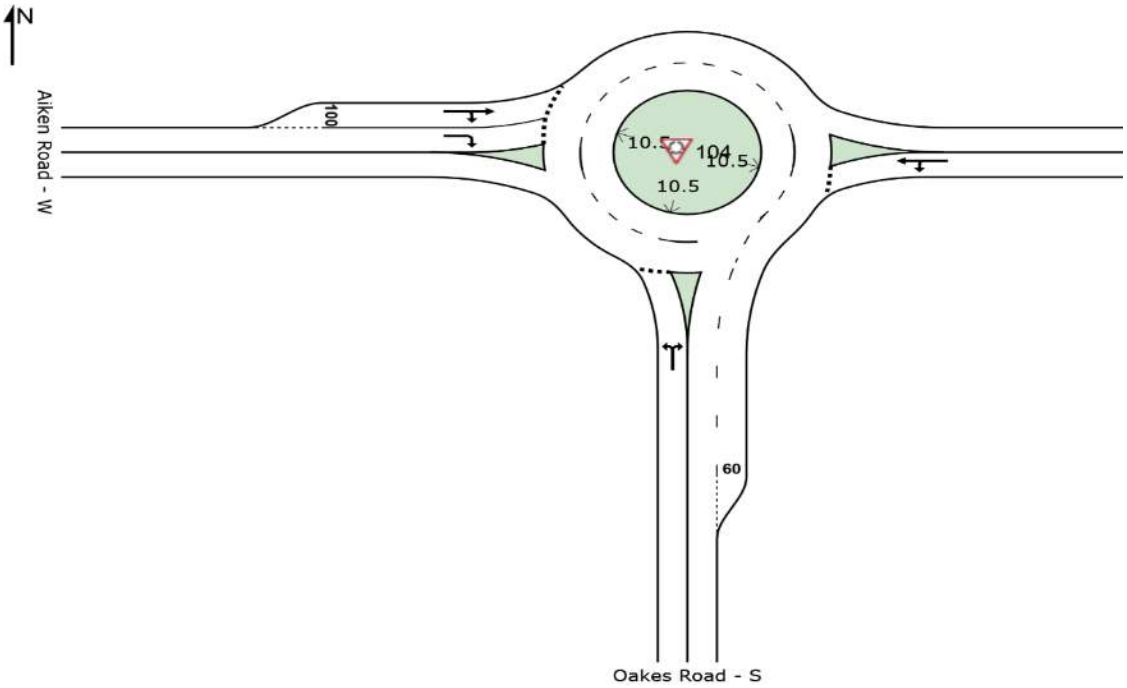
- Except for the Aiken Road/ Oakes Road roundabout, all intersections are performing at acceptable LOS D or better
- Long queues (>200 meters) and a high DOS (>0.9) are observed at Highs Road/ Castle Hill Road/ County Drive intersection indicating that the intersection is operating at capacity during the PM peak hour
- Long queues (>200 meters) and a high DOS (>0.9) are observed at Coonara Avenue/ Castle Hill Road/ Edward Bennett Drive intersection indicating that the intersection is operating at capacity during both AM and PM peak hour

Mitigation Measures

As discussed in Section 3.1.2, travel patterns in the vicinity of the site are likely to change due to the NorthConnex and Sydney Metro opening in year 2019. As such it is expected that congestion levels at Castle Hill Road and Pennant Hills Road improve which may attract some of the existing rut running trips to revert back to the arterial road network. This change in travel patterns offers opportunities for improved performance at the Aiken Road/ Oakes Road intersection.

In case the future congestion levels remain at the level observed currently, a potential upgrade option was assessed at the Aiken Road/ Oakes Road roundabout. A layout change was assessed for Scenario 2 conditions as this scenario generates the highest proportion of development traffic at this intersection. The proposed layout is shown in Figure 3.16.

Figure 3.16: Proposed Layout at Aiken Road / Oakes Road intersection



The dual right turn provides additional storage capacity and the SIDRA results illustrate that the intersection performs at LOS B and has a DOS of 0.85. Detailed SIDRA results are provided in Appendix B.

3.3 Potential Impact on buses with and without the proposed development traffic

The West Pennant Hills Bus Priority Measures Business Case was prepared by Cardno in June 2010 (the Bus Priority Cardno Report). In general, it proposes to provide dedicated bus lane along Highs Road and Aiken Road all the way to Oakes Road Roundabout. As the program provides a separate bus lane, it would be expected that impacts to bus travel times resulting from the additional traffic generated by the development would be minimal. Notwithstanding, any additional traffic at intersections where bus priorities cannot be incorporated (give-way or roundabout intersection) is likely to increase delays to bus travel times.

Given the amount of infrastructure upgrades within the area, the travel patterns and levels of congestion are likely to change with some local traffic routes likely to experience reductions in volumes. However, the extent and probability of those changes is still uncertain and outside the scope of this assessment.

4. Conclusion

Based on the analysis and discussions presented within this report it can be concluded the additional traffic generated by the proposed development is expected to have marginal impact on the performance of the existing network. The results of SIDRA analysis indicate that there are existing capacity constraints at Castle Hill Road, Oakes Road and Aiken Road. The opening of NorthConnex is expected to reduce traffic volumes on the arterial road network, which in turn may relieve congestion on local roads.

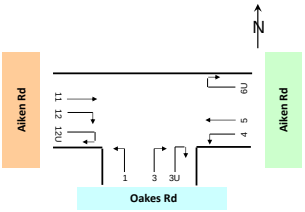
The Aiken Road/ Oakes Road roundabout is currently performing at capacity and any increase in traffic will lead to long queues and delays at this roundabout. The poor performance of this intersection is attributed to downstream queues reaching the roundabout and reducing its capacity. Therefore, the poor performance of this roundabout I cannot be directly attributed to the development traffic as the additional traffic only exacerbates existing issues.

Appendix A

Survey Results

Job No.	: N4220
Client	: GTA
Suburb	: West Pennant Hills
Location	: 1. Aiken Rd / Oakes Rd
Day/Date	: Tue, 5th June 2018
Weather	: Fine
Description	: Classified Intersection Count
	: 15 mins Data

Classifications	**Class 1**	**Class 2**
	Lights	Heavies



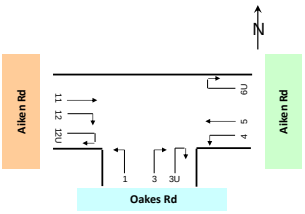
Approach	**Oakes Rd**									**Aiken Rd**									
Direction	**Direction 1 (Left Turn)**				**Direction 3 (Right Turn)**			**Direction 3U (U Turn)**			**Direction 4 (Left Turn)**			**Direction 5 (Through)**				**Direction 6U (U Turn)**		
Time Period	**Lights**	**Heavies**	**Total**		**Lights**	**Heavies**	**Total**	**Lights**	**Heavies**	**Total**	**Lights**	**Heavies**	**Total**	**Lights**	**Heavies**	**Total**		**Lights**	**Heavies**	**Total**
7:00 to 7:15	35	1	**36**		62	2	**64**	1	0	**1**	39	0	**39**	12	2	**14**		1	0	**1**
7:15 to 7:30	45	1	**46**		77	0	**77**	0	0	**0**	26	2	**28**	11	4	**15**		0	0	**0**
7:30 to 7:45	58	1	**59**		49	1	**50**	8	0	**8**	25	1	**26**	9	2	**11**		1	0	**1**
7:45 to 8:00	69	3	**72**		100	0	**100**	0	0	**0**	30	0	**30**	15	2	**17**		1	0	**1**
8:00 to 8:15	79	1	**80**		74	3	**77**	1	0	**1**	26	0	**26**	14	2	**16**		0	0	**0**
8:15 to 8:30	81	3	**84**		84	0	**84**	4	0	**4**	26	0	**26**	17	0	**17**		0	1	**1**
8:30 to 8:45	85	1	**86**		79	0	**79**	1	0	**1**	28	4	**32**	13	1	**14**		1	2	**3**
8:45 to 9:00	95	2	**97**		68	3	**71**	0	0	**0**	22	1	**23**	17	1	**18**		0	0	**0**
AM Totals	**547**	**13**	**560**		**593**	**9**	**602**	**15**	**0**	**15**	**222**	**8**	**230**	**108**	**14**	**122**		**4**	**3**	**7**
16:00 to 16:15	134	3	**137**		110	1	**111**	3	0	**3**	49	1	**50**	39	1	**40**		0	0	**0**
16:15 to 16:30	126	2	**128**		112	0	**112**	0	0	**0**	59	1	**60**	31	1	**32**		1	0	**1**
16:30 to 16:45	149	1	**150**		109	1	**110**	2	0	**2**	56	0	**56**	41	0	**41**		0	0	**0**
16:45 to 17:00	152	0	**152**		105	0	**105**	5	0	**5**	65	0	**65**	48	1	**49**		1	0	**1**
17:00 to 17:15	147	2	**149**		96	0	**96**	2	0	**2**	60	0	**60**	65	2	**67**		0	0	**0**
17:15 to 17:30	168	0	**168**		96	1	**97**	1	0	**1**	50	0	**50**	51	1	**52**		1	0	**1**
17:30 to 17:45	159	2	**161**		75	0	**75**	2	0	**2**	49	0	**49**	53	3	**56**		1	0	**1**
17:45 to 18:00	172	1	**173**		81	0	**81**	1	0	**1**	62	0	**62**	54	2	**56**		0	0	**0**
PM Totals	**1,207**	**11**	**1,218**		**784**	**3**	**787**	**16**	**0**	**16**	**450**	**2**	**452**	**382**	**11**	**393**		**4**	**0**	**4**

Approach				**Aiken Rd**								
Direction				**Direction 11 (Through)**			**Direction 12 (Right Turn)**			**Direction 12U (U Turn)**		
Time Period				**Lights**	**Heavies**	**Total**	**Lights**	**Heavies**	**Total**	**Lights**	**Heavies**	**Total**
7:00	to	7:15		23	2	**25**	226	1	**227**	0	0	**0**
7:15	to	7:30		28	6	**34**	193	1	**194**	0	0	**0**
7:30	to	7:45		27	4	**31**	142	2	**144**	0	0	**0**
7:45	to	8:00		19	3	**22**	103	1	**104**	0	0	**0**
8:00	to	8:15		20	4	**24**	88	0	**88**	0	0	**0**
8:15	to	8:30		35	6	**41**	161	2	**163**	0	0	**0**
8:30	to	8:45		22	1	**23**	90	0	**90**	0	0	**0**
8:45	to	9:00		24	3	**27**	157	3	**160**	0	0	**0**
AM Totals				**198**	**29**	**227**	**1,160**	**10**	**1,170**	**0**	**0**	**0**
16:00	to	16:15		10	2	**12**	113	1	**114**	0	0	**0**
16:15	to	16:30		7	1	**8**	103	0	**103**	0	0	**0**
16:30	to	16:45		5	0	**5**	110	1	**111**	1	0	**1**
16:45	to	17:00		5	1	**6**	99	0	**99**	0	0	**0**
17:00	to	17:15		6	0	**6**	80	2	**82**	0	0	**0**
17:15	to	17:30		7	0	**7**	84	0	**84**	0	0	**0**
17:30	to	17:45		8	1	**9**	102	1	**103**	0	0	**0**
17:45	to	18:00		13	1	**14**	89	1	**90**	0	0	**0**
PM Totals				**61**	**6**	**67**	**780**	**6**	**786**	**1**	**0**	**1**

Job No. : N4220
Client : GTA
Suburb : West Pennant Hills
Location : 1. Aiken Rd / Oakes Rd

Day/Date : Tue, 5th June 2018
Weather : Fine
Description : Classified Intersection Count
: Hourly Summary

MATRIX Traffic and Transport Data

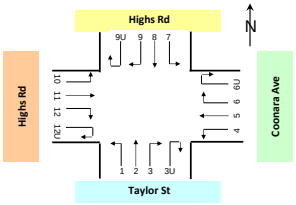


Approach	Oakes Rd										Aiken Rd													
Direction	Direction 1 (Left Turn)				Direction 3 (Right Turn)				Direction 3U (U Turn)				Direction 4 (Left Turn)				Direction 5 (Through)				Direction 6U (U Turn)			
Time Period	Lights	Heavies	Total		Lights	Heavies	Total		Lights	Heavies	Total		Lights	Heavies	Total		Lights	Heavies	Total		Lights	Heavies	Total	
7:00 to 8:00	207	6	**213**		288	3	**291**		9	0	**9**		120	3	**123**		47	10	**57**		3	0	**3**	
7:15 to 8:15	251	6	**257**		300	4	**304**		9	0	**9**		107	3	**110**		49	10	**59**		2	0	**2**	
7:30 to 8:30	287	8	**295**		307	4	**311**		13	0	**13**		107	1	**108**		55	6	**61**		2	1	**3**	
7:45 to 8:45	314	8	**322**		337	3	**340**		6	0	**6**		110	4	**114**		59	5	**64**		2	3	**5**	
8:00 to 9:00	340	7	**347**		305	6	**311**		6	0	**6**		102	5	**107**		61	4	**65**		1	3	**4**	
AM Totals	**547**	**13**	**560**		**593**	**9**	**602**		**15**	**0**	**15**		**222**	**8**	**230**		**108**	**14**	**122**		**4**	**3**	**7**	
16:00 to 17:00	561	6	**567**		436	2	**438**		10	0	**10**		229	2	**231**		159	3	**162**		2	0	**2**	
16:15 to 17:15	574	5	**579**		422	1	**423**		9	0	**9**		240	1	**241**		185	4	**189**		2	0	**2**	
16:30 to 17:30	616	3	**619**		406	2	**408**		10	0	**10**		231	0	**231**		205	4	**209**		2	0	**2**	
16:45 to 17:45	626	4	**630**		372	1	**373**		10	0	**10**		224	0	**224**		217	7	**224**		3	0	**3**	
17:00 to 18:00	646	5	**651**		348	1	**349**		6	0	**6**		221	0	**221**		223	8	**231**		2	0	**2**	
PM Totals	**1,207**	**11**	**1,218**		**784**	**3**	**787**		**16**	**0**	**16**		**450**	**2**	**452**		**382**	**11**	**393**		**4**	**0**	**4**	

Approach					Aiken Rd								
Direction					Direction 11 (Through)			Direction 12 (Right Turn)			Direction 12U (U Turn)		
Time Period					Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total
7:00 to 8:00					97	15	**112**	664	5	**669**	0	0	**0**
7:15 to 8:15					94	17	**111**	526	4	**530**	0	0	**0**
7:30 to 8:30					101	17	**118**	494	5	**499**	0	0	**0**
7:45 to 8:45					96	14	**110**	442	3	**445**	0	0	**0**
8:00 to 9:00					101	14	**115**	496	5	**501**	0	0	**0**
AM Totals					**198**	**29**	**227**	**1,160**	**10**	**1,170**	**0**	**0**	**0**
16:00 to 17:00					27	4	**31**	425	2	**427**	1	0	**1**
16:15 to 17:15					23	2	**25**	392	3	**395**	1	0	**1**
16:30 to 17:30					23	1	**24**	373	3	**376**	1	0	**1**
16:45 to 17:45					26	2	**28**	365	3	**368**	0	0	**0**
17:00 to 18:00					34	2	**36**	355	4	**359**	0	0	**0**
PM Totals					**61**	**6**	**67**	**780**	**6**	**786**	**1**	**0**	**1**

Job No.	: N4220
Client	: GTA
Suburb	: West Pennant Hills
Location	: 2. Coonara Ave / Highs Rd / Taylor St
Day/Date	: Tue, 5th June 2018
Weather	: Fine
Description	: Classified Intersection Count
	: 15 mins Data

MATRIX Traffic and Transport Data



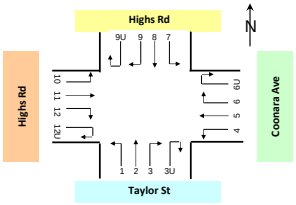
Classifications	Class 1	Class 2
	Lights	Heavies

Approach	Taylor St												Coonara Ave											
Direction	Direction 1 (Left Turn)			Direction 2 (Through)			Direction 3 (Right Turn)			Direction 3U (U Turn)			Direction 4 (Left Turn)			Direction 5 (Through)			Direction 6 (Right Turn)			Direction 6U (U Turn)		
Time Period	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total
7:00 to 7:15	7	0	**7**	41	0	**41**	19	1	**20**	2	0	**2**	35	0	**35**	2	0	**2**	9	0	**9**	2	0	**2**
7:15 to 7:30	5	4	**9**	46	0	**46**	15	0	**15**	3	0	**3**	36	2	**38**	5	0	**5**	3	1	**4**	2	1	**3**
7:30 to 7:45	4	1	**5**	50	2	**52**	21	0	**21**	6	0	**6**	39	2	**41**	4	0	**4**	7	0	**7**	3	1	**4**
7:45 to 8:00	12	0	**12**	65	1	**66**	16	1	**17**	1	0	**1**	40	0	**40**	4	0	**4**	2	1	**3**	1	0	**1**
8:00 to 8:15	10	4	**14**	97	2	**99**	26	0	**26**	2	0	**2**	34	0	**34**	2	0	**2**	4	1	**5**	1	0	**1**
8:15 to 8:30	7	1	**8**	83	2	**85**	32	1	**33**	4	0	**4**	37	0	**37**	5	0	**5**	3	1	**4**	0	0	**0**
8:30 to 8:45	9	0	**9**	73	0	**73**	37	0	**37**	6	0	**6**	26	0	**26**	8	0	**8**	3	1	**4**	0	0	**0**
8:45 to 9:00	15	2	**17**	80	2	**82**	30	0	**30**	8	0	**8**	37	0	**37**	8	0	**8**	7	0	**7**	1	1	**2**
AM Totals	**69**	**12**	**81**	**535**	**9**	**544**	**196**	**3**	**199**	**32**	**0**	**32**	**284**	**4**	**288**	**38**	**0**	**38**	**38**	**5**	**43**	**10**	**3**	**13**
16:00 to 16:15	31	3	**34**	90	2	**92**	36	1	**37**	3	0	**3**	43	0	**43**	16	2	**18**	5	1	**6**	3	0	**3**
16:15 to 16:30	21	1	**22**	96	2	**98**	31	2	**33**	2	0	**2**	27	0	**27**	8	0	**8**	10	1	**11**	0	1	**1**
16:30 to 16:45	23	0	**23**	115	1	**116**	29	0	**29**	2	0	**2**	54	0	**54**	19	0	**19**	10	0	**10**	0	0	**0**
16:45 to 17:00	30	1	**31**	119	3	**122**	37	0	**37**	4	0	**4**	29	1	**30**	17	0	**17**	7	0	**7**	0	0	**0**
17:00 to 17:15	42	1	**43**	109	2	**111**	33	0	**33**	1	0	**1**	39	1	**40**	18	0	**18**	2	1	**3**	0	0	**0**
17:15 to 17:30	30	0	**30**	117	2	**119**	38	0	**38**	0	0	**0**	45	0	**45**	21	0	**21**	6	1	**7**	1	1	**2**
17:30 to 17:45	34	3	**37**	113	2	**115**	34	0	**34**	2	0	**2**	57	1	**58**	23	0	**23**	11	0	**11**	1	0	**1**
17:45 to 18:00	24	0	**24**	115	2	**117**	42	0	**42**	2	0	**2**	32	0	**32**	15	0	**15**	7	0	**7**	0	1	**1**
PM Totals	**235**	**9**	**244**	**874**	**16**	**890**	**280**	**3**	**283**	**16**	**0**	**16**	**326**	**3**	**329**	**137**	**2**	**139**	**58**	**4**	**62**	**5**	**3**	**8**

Approach	Highs Rd												Highs Rd											
Direction	Direction 7 (Left Turn)			Direction 8 (Through)			Direction 9 (Right Turn)			Direction 9U (U Turn)			Direction 10 (Left Turn)			Direction 11 (Through)			Direction 12 (Right Turn)			Direction 12U (U Turn)		
Time Period	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total
7:00 to 7:15	5	0	**5**	123	4	**127**	5	4	**9**	3	0	**3**	19	0	**19**	16	2	**18**	49	4	**53**	0	0	**0**
7:15 to 7:30	7	2	**9**	139	6	**145**	8	4	**12**	6	0	**6**	21	1	**22**	20	1	**21**	43	4	**47**	0	0	**0**
7:30 to 7:45	5	1	**6**	89	5	**94**	8	3	**11**	2	0	**2**	17	4	**21**	18	1	**19**	32	1	**33**	0	0	**0**
7:45 to 8:00	2	0	**2**	80	4	**84**	7	4	**11**	0	0	**0**	28	0	**28**	11	0	**11**	31	3	**34**	0	0	**0**
8:00 to 8:15	5	1	**6**	66	2	**68**	6	3	**9**	1	0	**1**	29	1	**30**	16	1	**17**	20	4	**24**	0	0	**0**
8:15 to 8:30	8	0	**8**	93	2	**95**	9	2	**11**	3	0	**3**	35	0	**35**	18	2	**20**	47	5	**52**	0	0	**0**
8:30 to 8:45	8	0	**8**	83	2	**85**	5	0	**5**	1	0	**1**	17	0	**17**	18	0	**18**	29	0	**29**	0	0	**0**
8:45 to 9:00	16	1	**17**	84	4	**88**	9	1	**10**	1	0	**1**	16	2	**18**	11	1	**12**	22	1	**23**	0	0	**0**
AM Totals	**56**	**5**	**61**	**757**	**29**	**786**	**57**	**21**	**78**	**17**	**0**	**17**	**182**	**8**	**190**	**128**	**8**	**136**	**273**	**22**	**295**	**0**	**0**	**0**
16:00 to 16:15	11	0	**11**	74	0	**74**	22	1	**23**	3	0	**3**	19	3	**22**	10	0	**10**	12	0	**12**	0	0	**0**
16:15 to 16:30	9	1	**10**	61	1	**62**	17	0	**17**	4	0	**4**	13	3	**16**	12	0	**12**	14	1	**15**	0	0	**0**
16:30 to 16:45	3	0	**3**	60	0	**60**	22	1	**23**	1	0	**1**	7	0	**7**	9	0	**9**	12	1	**13**	0	0	**0**
16:45 to 17:00	11	1	**12**	56	1	**57**	14	0	**14**	2	0	**2**	7	1	**8**	9	0	**9**	13	0	**13**	0	0	**0**
17:00 to 17:15	10	0	**10**	55	0	**55**	19	0	**19**	0	0	**0**	15	0	**15**	11	0	**11**	8	0	**8**	0	0	**0**
17:15 to 17:30	11	1	**12**	69	0	**69**	32	1	**33**	4	0	**4**	13	1	**14**	10	0	**10**	13	1	**14**	0	0	**0**
17:30 to 17:45	7	0	**7**	73	1	**74**	20	0	**20**	2	0	**2**	12	1	**13**	13	0	**13**	9	0	**9**	0	0	**0**
17:45 to 18:00	14	1	**15**	68	0	**68**	10	0	**10**	6	0	**6**	5	2	**7**	12	0	**12**	4	0	**4**	0	0	**0**
PM Totals	**76**	**4**	**80**	**516**	**3**	**519**	**156**	**3**	**159**	**22**	**0**	**22**	**91**	**11**	**102**	**86**	**0**	**86**	**85**	**3**	**88**	**0**	**0**	**0**

Job No. : N4220
Client : GTA
Suburb : West Pennant Hills
Location : 2. Coonara Ave / Highs Rd / Taylor St

Day/Date : Tue, 5th June 2018
Weather : Fine
Description : Classified Intersection Count
: Hourly Summary

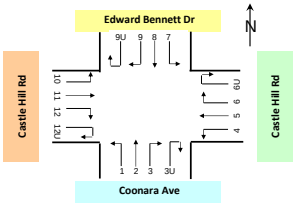


Approach	Taylor St												Coonara Ave											
Direction	Direction 1 (Left Turn)			Direction 2 (Through)			Direction 3 (Right Turn)			Direction 3U (U Turn)			Direction 4 (Left Turn)			Direction 5 (Through)			Direction 6 (Right Turn)			Direction 6U (U Turn)		
Time Period	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total
7:00 to 8:00	28	5	**33**	202	3	**205**	71	2	**73**	12	0	**12**	150	4	**154**	15	0	**15**	21	2	**23**	8	2	**10**
7:15 to 8:15	31	9	**40**	258	5	**263**	78	1	**79**	12	0	**12**	149	4	**153**	15	0	**15**	16	3	**19**	7	2	**9**
7:30 to 8:30	33	6	**39**	295	7	**302**	95	2	**97**	13	0	**13**	150	2	**152**	15	0	**15**	16	3	**19**	5	1	**6**
7:45 to 8:45	38	5	**43**	318	5	**323**	111	2	**113**	13	0	**13**	137	0	**137**	19	0	**19**	12	4	**16**	2	0	**2**
8:00 to 9:00	41	7	**48**	333	6	**339**	125	1	**126**	20	0	**20**	134	0	**134**	23	0	**23**	17	3	**20**	2	1	**3**
AM Totals	**69**	**12**	**81**	**535**	**9**	**544**	**196**	**3**	**199**	**32**	**0**	**32**	**284**	**4**	**288**	**38**	**0**	**38**	**38**	**5**	**43**	**10**	**3**	**13**
16:00 to 17:00	105	5	**110**	420	8	**428**	133	3	**136**	11	0	**11**	153	1	**154**	60	2	**62**	32	2	**34**	3	1	**4**
16:15 to 17:15	116	3	**119**	439	8	**447**	130	2	**132**	9	0	**9**	149	2	**151**	62	0	**62**	29	2	**31**	0	1	**1**
16:30 to 17:30	125	2	**127**	460	8	**468**	137	0	**137**	7	0	**7**	167	2	**169**	75	0	**75**	25	2	**27**	1	1	**2**
16:45 to 17:45	136	5	**141**	458	9	**467**	142	0	**142**	7	0	**7**	170	3	**173**	79	0	**79**	26	2	**28**	2	1	**3**
17:00 to 18:00	130	4	**134**	454	8	**462**	147	0	**147**	5	0	**5**	173	2	**175**	77	0	**77**	26	2	**28**	2	2	**4**
PM Totals	**235**	**9**	**244**	**874**	**16**	**890**	**280**	**3**	**283**	**16**	**0**	**16**	**326**	**3**	**329**	**137**	**2**	**139**	**58**	**4**	**62**	**5**	**3**	**8**

Approach	Highs Rd												Highs Rd											
Direction	Direction 7 (Left Turn)			Direction 8 (Through)			Direction 9 (Right Turn)			Direction 9U (U Turn)			Direction 10 (Left Turn)			Direction 11 (Through)			Direction 12 (Right Turn)			Direction 12U (U Turn)		
Time Period	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total
7:00 to 8:00	19	3	**22**	431	19	**450**	28	15	**43**	11	0	**11**	85	5	**90**	65	4	**69**	155	12	**167**	0	0	**0**
7:15 to 8:15	19	4	**23**	374	17	**391**	29	14	**43**	9	0	**9**	95	6	**101**	65	3	**68**	126	12	**138**	0	0	**0**
7:30 to 8:30	20	2	**22**	328	13	**341**	30	12	**42**	6	0	**6**	109	5	**114**	63	4	**67**	130	13	**143**	0	0	**0**
7:45 to 8:45	23	1	**24**	322	10	**332**	27	9	**36**	5	0	**5**	109	1	**110**	63	3	**66**	127	12	**139**	0	0	**0**
8:00 to 9:00	37	2	**39**	326	10	**336**	29	6	**35**	6	0	**6**	97	3	**100**	63	4	**67**	118	10	**128**	0	0	**0**
AM Totals	**56**	**5**	**61**	**757**	**29**	**786**	**57**	**21**	**78**	**17**	**0**	**17**	**182**	**8**	**190**	**128**	**8**	**136**	**273**	**22**	**295**	**0**	**0**	**0**
16:00 to 17:00	34	2	**36**	251	2	**253**	75	2	**77**	10	0	**10**	46	7	**53**	40	0	**40**	51	2	**53**	0	0	**0**
16:15 to 17:15	33	2	**35**	232	2	**234**	72	1	**73**	7	0	**7**	42	4	**46**	41	0	**41**	47	2	**49**	0	0	**0**
16:30 to 17:30	35	2	**37**	240	1	**241**	87	2	**89**	7	0	**7**	42	2	**44**	39	0	**39**	46	2	**48**	0	0	**0**
16:45 to 17:45	39	2	**41**	253	2	**255**	85	1	**86**	8	0	**8**	47	3	**50**	43	0	**43**	43	1	**44**	0	0	**0**
17:00 to 18:00	42	2	**44**	265	1	**266**	81	1	**82**	12	0	**12**	45	4	**49**	46	0	**46**	34	1	**35**	0	0	**0**
PM Totals	**76**	**4**	**80**	**516**	**3**	**519**	**156**	**3**	**159**	**22**	**0**	**22**	**91**	**11**	**102**	**86**	**0**	**86**	**85**	**3**	**88**	**0**	**0**	**0**

Job No.	: N4220
Client	: GTA
Suburb	: West Pennant Hills
Location	: 3. Coonara Ave / Castle Hill Rd / Edward Bennett Dr
Day/Date	: Tue, 5th June 2018
Weather	: Fine
Description	: Classified Intersection Count
	: 15 mins Data

MATRIX Traffic and Transport Data



Classifications	**Class 1**	**Class 2**
	Lights	Heavies

Approach	**Coonara Ave**												**Castle Hill Rd**											
Direction	**Direction 1 (Left Turn)**			**Direction 2 (Through)**			**Direction 3 (Right Turn)**			**Direction 3U (U Turn)**			**Direction 4 (Left Turn)**			**Direction 5 (Through)**			**Direction 6 (Right Turn)**			**Direction 6U (U Turn)**		
Time Period	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total
7:00 to 7:15	2	0	**2**	1	0	**1**	23	1	**24**	0	0	**0**	41	0	**41**	133	11	**144**	3	1	**4**	0	0	**0**
7:15 to 7:30	5	1	**6**	5	0	**5**	34	4	**38**	0	0	**0**	39	2	**41**	124	16	**140**	3	1	**4**	0	0	**0**
7:30 to 7:45	3	0	**3**	5	1	**6**	31	2	**33**	0	0	**0**	33	1	**34**	148	18	**166**	4	0	**4**	0	0	**0**
7:45 to 8:00	6	0	**6**	8	0	**8**	24	3	**27**	0	0	**0**	45	3	**48**	170	20	**190**	11	1	**12**	0	0	**0**
8:00 to 8:15	10	1	**11**	21	1	**22**	22	0	**22**	0	0	**0**	39	2	**41**	158	20	**178**	15	3	**18**	0	0	**0**
8:15 to 8:30	11	1	**12**	19	0	**19**	26	2	**28**	0	0	**0**	50	0	**50**	190	19	**209**	17	3	**20**	0	0	**0**
8:30 to 8:45	8	1	**9**	7	1	**8**	40	0	**40**	0	0	**0**	53	2	**55**	173	11	**184**	22	0	**22**	0	0	**0**
8:45 to 9:00	7	2	**9**	12	0	**12**	40	2	**42**	0	0	**0**	77	2	**79**	183	9	**192**	15	1	**16**	0	0	**0**
AM Totals	**52**	**6**	**58**	**78**	**3**	**81**	**240**	**14**	**254**	**0**	**0**	**0**	**377**	**12**	**389**	**1,279**	**124**	**1,403**	**90**	**10**	**100**	**0**	**0**	**0**
16:00 to 16:15	17	0	**17**	16	0	**16**	41	0	**41**	0	0	**0**	49	3	**52**	245	12	**257**	27	3	**30**	0	0	**0**
16:15 to 16:30	22	1	**23**	12	0	**12**	52	2	**54**	0	0	**0**	27	2	**29**	320	10	**330**	38	4	**42**	0	0	**0**
16:30 to 16:45	18	0	**18**	13	0	**13**	45	1	**46**	0	0	**0**	43	1	**44**	296	6	**302**	32	2	**34**	0	0	**0**
16:45 to 17:00	27	0	**27**	15	0	**15**	25	2	**27**	0	0	**0**	35	1	**36**	309	8	**317**	42	2	**44**	0	0	**0**
17:00 to 17:15	26	0	**26**	23	0	**23**	58	0	**58**	0	0	**0**	54	1	**55**	285	5	**290**	48	1	**49**	0	0	**0**
17:15 to 17:30	36	0	**36**	19	0	**19**	67	2	**69**	0	0	**0**	46	2	**48**	295	3	**298**	49	3	**52**	0	0	**0**
17:30 to 17:45	28	0	**28**	26	0	**26**	61	0	**61**	0	0	**0**	57	2	**59**	278	3	**281**	41	2	**43**	0	0	**0**
17:45 to 18:00	18	0	**18**	24	0	**24**	52	1	**53**	0	0	**0**	42	3	**45**	311	2	**313**	45	5	**50**	0	0	**0**
PM Totals	**192**	**1**	**193**	**148**	**0**	**148**	**401**	**8**	**409**	**0**	**0**	**0**	**353**	**15**	**368**	**2,339**	**49**	**2,388**	**322**	**22**	**344**	**0**	**0**	**0**

Approach	**Edward Bennett Dr**												**Castle Hill Rd**											
Direction	**Direction 7 (Left Turn)**			**Direction 8 (Through)**			**Direction 9 (Right Turn)**			**Direction 9U (U Turn)**			**Direction 10 (Left Turn)**			**Direction 11 (Through)**			**Direction 12 (Right Turn)**			**Direction 12U (U Turn)**		
Time Period	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total
7:00 to 7:15	22	5	**27**	7	0	**7**	4	1	**5**	0	0	**0**	4	2	**6**	251	9	**260**	12	1	**13**	0	0	**0**
7:15 to 7:30	36	2	**38**	8	0	**8**	5	0	**5**	0	0	**0**	3	1	**4**	311	8	**319**	14	0	**14**	0	0	**0**
7:30 to 7:45	25	4	**29**	7	0	**7**	14	0	**14**	0	0	**0**	6	3	**9**	256	12	**268**	16	2	**18**	0	0	**0**
7:45 to 8:00	33	5	**38**	7	0	**7**	4	0	**4**	0	0	**0**	6	0	**6**	200	5	**205**	18	2	**20**	0	0	**0**
8:00 to 8:15	19	3	**22**	12	0	**12**	5	0	**5**	0	0	**0**	9	0	**9**	204	10	**214**	30	0	**30**	0	0	**0**
8:15 to 8:30	27	3	**30**	15	0	**15**	10	0	**10**	0	0	**0**	6	0	**6**	206	8	**214**	16	1	**17**	0	0	**0**
8:30 to 8:45	28	2	**30**	5	0	**5**	16	0	**16**	0	0	**0**	5	0	**5**	210	3	**213**	31	0	**31**	0	0	**0**
8:45 to 9:00	30	1	**31**	13	0	**13**	7	1	**8**	0	0	**0**	6	2	**8**	213	12	**225**	40	0	**40**	1	0	**1**
AM Totals	**220**	**25**	**245**	**74**	**0**	**74**	**65**	**2**	**67**	**0**	**0**	**0**	**45**	**8**	**53**	**1,851**	**67**	**1,918**	**177**	**6**	**183**	**1**	**0**	**1**
16:00 to 16:15	18	2	**20**	9	1	**10**	4	1	**5**	0	0	**0**	6	1	**7**	143	22	**165**	8	0	**8**	0	0	**0**
16:15 to 16:30	13	2	**15**	2	1	**3**	4	1	**5**	0	0	**0**	13	1	**14**	191	10	**201**	10	1	**11**	0	0	**0**
16:30 to 16:45	11	0	**11**	9	0	**9**	19	1	**20**	0	0	**0**	13	2	**15**	192	8	**200**	14	0	**14**	0	0	**0**
16:45 to 17:00	13	1	**14**	5	0	**5**	11	0	**11**	0	0	**0**	13	2	**15**	186	8	**194**	10	1	**11**	1	0	**1**
17:00 to 17:15	9	2	**11**	7	0	**7**	5	0	**5**	0	0	**0**	12	1	**13**	161	5	**166**	7	0	**7**	0	0	**0**
17:15 to 17:30	5	1	**6**	5	0	**5**	5	0	**5**	0	0	**0**	12	0	**12**	186	5	**191**	21	0	**21**	0	0	**0**
17:30 to 17:45	11	0	**11**	2	0	**2**	4	0	**4**	0	0	**0**	4	0	**4**	146	3	**149**	9	0	**9**	0	0	**0**
17:45 to 18:00	14	1	**15**	7	0	**7**	5	0	**5**	0	0	**0**	11	0	**11**	179	0	**179**	9	0	**9**	0	0	**0**
PM Totals	**94**	**9**	**103**	**46**	**2**	**48**	**57**	**3**	**60**	**0**	**0**	**0**	**84**	**7**	**91**	**1,384**	**61**	**1,445**	**88**	**2**	**90**	**1**	**0**	**1**

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Client : GTA
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Location : 3. Coonara Ave / Castle Hill Rd / Edward Bennett Dr

Day/Date : Tue, 5th June 2018
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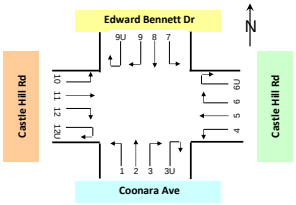
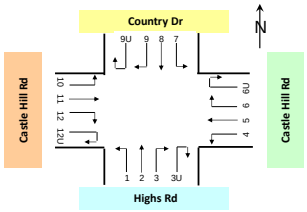


Approach	Coonara Ave												Castle Hill Rd											
Direction	Direction 1 (Left Turn)			Direction 2 (Through)			Direction 3 (Right Turn)			Direction 3U (U Turn)			Direction 4 (Left Turn)			Direction 5 (Through)			Direction 6 (Right Turn)			Direction 6U (U Turn)		
Time Period	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total
7:00 to 8:00	16	1	**17**	19	1	**20**	112	10	**122**	0	0	**0**	158	6	**164**	575	65	**640**	21	3	**24**	0	0	**0**
7:15 to 8:15	24	2	**26**	39	2	**41**	111	9	**120**	0	0	**0**	156	8	**164**	600	74	**674**	33	5	**38**	0	0	**0**
7:30 to 8:30	30	2	**32**	53	2	**55**	103	7	**110**	0	0	**0**	167	6	**173**	666	77	**743**	47	7	**54**	0	0	**0**
7:45 to 8:45	35	3	**38**	55	2	**57**	112	5	**117**	0	0	**0**	187	7	**194**	691	70	**761**	65	7	**72**	0	0	**0**
8:00 to 9:00	36	5	**41**	59	2	**61**	128	4	**132**	0	0	**0**	219	6	**225**	704	59	**763**	69	7	**76**	0	0	**0**
AM Totals	**52**	**6**	**58**	**78**	**3**	**81**	**240**	**14**	**254**	**0**	**0**	**0**	**377**	**12**	**389**	**1,279**	**124**	**1,403**	**90**	**10**	**100**	**0**	**0**	**0**
16:00 to 17:00	84	1	**85**	56	0	**56**	163	5	**168**	0	0	**0**	154	7	**161**	1,170	36	**1,206**	139	11	**150**	0	0	**0**
16:15 to 17:15	93	1	**94**	63	0	**63**	180	5	**185**	0	0	**0**	159	5	**164**	1,210	29	**1,239**	160	9	**169**	0	0	**0**
16:30 to 17:30	107	0	**107**	70	0	**70**	195	5	**200**	0	0	**0**	178	5	**183**	1,185	22	**1,207**	171	8	**179**	0	0	**0**
16:45 to 17:45	117	0	**117**	83	0	**83**	211	4	**215**	0	0	**0**	192	6	**198**	1,167	19	**1,186**	180	8	**188**	0	0	**0**
17:00 to 18:00	108	0	**108**	92	0	**92**	238	3	**241**	0	0	**0**	199	8	**207**	1,169	13	**1,182**	183	11	**194**	0	0	**0**
PM Totals	**192**	**1**	**193**	**148**	**0**	**148**	**401**	**8**	**409**	**0**	**0**	**0**	**353**	**15**	**368**	**2,339**	**49**	**2,388**	**322**	**22**	**344**	**0**	**0**	**0**

Approach	Edward Bennett Dr												Castle Hill Rd											
Direction	Direction 7 (Left Turn)			Direction 8 (Through)			Direction 9 (Right Turn)			Direction 9U (U Turn)			Direction 10 (Left Turn)			Direction 11 (Through)			Direction 12 (Right Turn)			Direction 12U (U Turn)		
Time Period	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total
7:00 to 8:00	116	16	**132**	29	0	**29**	27	1	**28**	0	0	**0**	19	6	**25**	1,018	34	**1,052**	60	5	**65**	0	0	**0**
7:15 to 8:15	113	14	**127**	34	0	**34**	28	0	**28**	0	0	**0**	24	4	**28**	971	35	**1,006**	78	4	**82**	0	0	**0**
7:30 to 8:30	104	15	**119**	41	0	**41**	33	0	**33**	0	0	**0**	27	3	**30**	866	35	**901**	80	5	**85**	0	0	**0**
7:45 to 8:45	107	13	**120**	39	0	**39**	35	0	**35**	0	0	**0**	26	0	**26**	820	26	**846**	95	3	**98**	0	0	**0**
8:00 to 9:00	104	9	**113**	45	0	**45**	38	1	**39**	0	0	**0**	26	2	**28**	833	33	**866**	117	1	**118**	1	0	**1**
AM Totals	**220**	**25**	**245**	**74**	**0**	**74**	**65**	**2**	**67**	**0**	**0**	**0**	**45**	**8**	**53**	**1,851**	**67**	**1,918**	**177**	**6**	**183**	**1**	**0**	**1**
16:00 to 17:00	55	5	**60**	25	2	**27**	38	3	**41**	0	0	**0**	45	6	**51**	712	48	**760**	42	2	**44**	1	0	**1**
16:15 to 17:15	46	5	**51**	23	1	**24**	39	2	**41**	0	0	**0**	51	6	**57**	730	31	**761**	41	2	**43**	1	0	**1**
16:30 to 17:30	38	4	**42**	26	0	**26**	40	1	**41**	0	0	**0**	50	5	**55**	725	26	**751**	52	1	**53**	1	0	**1**
16:45 to 17:45	38	4	**42**	19	0	**19**	25	0	**25**	0	0	**0**	41	3	**44**	679	21	**700**	47	1	**48**	1	0	**1**
17:00 to 18:00	39	4	**43**	21	0	**21**	19	0	**19**	0	0	**0**	39	1	**40**	672	13	**685**	46	0	**46**	0	0	**0**
PM Totals	**94**	**9**	**103**	**46**	**2**	**48**	**57**	**3**	**60**	**0**	**0**	**0**	**84**	**7**	**91**	**1,384**	**61**	**1,445**	**88**	**2**	**90**	**1**	**0**	**1**

Job No.	: N4220
Client	: GTA
Suburb	: West Pennant Hills
Location	: 4. Highs Rd / Castle Hill Rd / Country Dr
Day/Date	: Tue, 5th June 2018
Weather	: Fine
Description	: Classified Intersection Count
	: 15 mins Data

Classifications	**Class 1**	**Class 2**
	Lights	Heavies



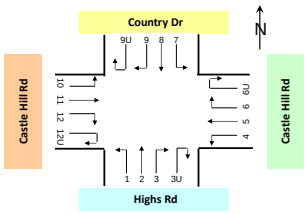
Approach	**Highs Rd**												**Castle Hill Rd**											
Direction	**Direction 1 (Left Turn)**			**Direction 2 (Through)**			**Direction 3 (Right Turn)**			**Direction 3U (U Turn)**			**Direction 4 (Left Turn)**			**Direction 5 (Through)**			**Direction 6 (Right Turn)**			**Direction 6U (U Turn)**		
Time Period	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total
7:00 to 7:15	42	1	**43**	18	0	**18**	0	0	**0**	0	0	**0**	1	2	**3**	127	10	**137**	11	4	**15**	0	0	**0**
7:15 to 7:30	56	2	**58**	5	2	**7**	2	1	**3**	0	0	**0**	1	0	**1**	140	11	**151**	26	1	**27**	0	0	**0**
7:30 to 7:45	59	3	**62**	14	0	**14**	2	0	**2**	0	0	**0**	3	0	**3**	167	13	**180**	9	7	**16**	0	0	**0**
7:45 to 8:00	71	2	**73**	15	2	**17**	3	0	**3**	0	0	**0**	0	3	**3**	184	12	**196**	18	4	**22**	0	0	**0**
8:00 to 8:15	94	3	**97**	27	0	**27**	2	0	**2**	0	0	**0**	0	1	**1**	172	17	**189**	24	3	**27**	0	0	**0**
8:15 to 8:30	108	3	**111**	29	0	**29**	1	0	**1**	0	0	**0**	0	0	**0**	217	13	**230**	31	8	**39**	0	0	**0**
8:30 to 8:45	83	2	**85**	33	0	**33**	2	0	**2**	0	0	**0**	1	1	**2**	197	9	**206**	8	0	**8**	0	0	**0**
8:45 to 9:00	70	3	**73**	20	1	**21**	1	0	**1**	0	0	**0**	3	0	**3**	189	12	**201**	15	2	**17**	0	0	**0**
AM Totals	**583**	**19**	**602**	**161**	**5**	**166**	**13**	**1**	**14**	**0**	**0**	**0**	**9**	**7**	**16**	**1,393**	**97**	**1,490**	**142**	**29**	**171**	**0**	**0**	**0**
16:00 to 16:15	87	2	**89**	24	0	**24**	1	0	**1**	0	0	**0**	1	0	**1**	243	12	**255**	21	1	**22**	0	0	**0**
16:15 to 16:30	84	2	**86**	33	4	**37**	1	0	**1**	0	0	**0**	3	0	**3**	334	8	**342**	20	3	**23**	0	0	**0**
16:30 to 16:45	79	2	**81**	32	0	**32**	4	0	**4**	0	0	**0**	4	0	**4**	356	5	**361**	17	4	**21**	0	0	**0**
16:45 to 17:00	89	5	**94**	40	1	**41**	0	0	**0**	0	0	**0**	0	0	**0**	331	11	**342**	24	0	**24**	0	0	**0**
17:00 to 17:15	95	1	**96**	47	0	**47**	2	0	**2**	0	0	**0**	2	0	**2**	284	3	**287**	25	0	**25**	0	0	**0**
17:15 to 17:30	102	3	**105**	26	0	**26**	0	0	**0**	0	0	**0**	3	0	**3**	307	2	**309**	30	1	**31**	0	0	**0**
17:30 to 17:45	73	2	**75**	27	0	**27**	0	0	**0**	0	0	**0**	3	0	**3**	350	1	**351**	16	2	**18**	0	0	**0**
17:45 to 18:00	116	3	**119**	43	2	**45**	2	0	**2**	0	0	**0**	5	0	**5**	311	2	**313**	22	0	**22**	0	0	**0**
PM Totals	**725**	**20**	**745**	**272**	**7**	**279**	**10**	**0**	**10**	**0**	**0**	**0**	**21**	**0**	**21**	**2,516**	**44**	**2,560**	**175**	**11**	**186**	**0**	**0**	**0**

Approach	**Country Dr**												**Castle Hill Rd**											
Direction	**Direction 7 (Left Turn)**			**Direction 8 (Through)**			**Direction 9 (Right Turn)**			**Direction 9U (U Turn)**			**Direction 10 (Left Turn)**			**Direction 11 (Through)**			**Direction 12 (Right Turn)**			**Direction 12U (U Turn)**		
Time Period	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total
7:00 to 7:15	18	0	**18**	62	1	**63**	86	4	**90**	0	0	**0**	90	6	**96**	244	14	**258**	64	7	**71**	0	0	**0**
7:15 to 7:30	14	0	**14**	63	6	**69**	140	4	**144**	0	0	**0**	152	7	**159**	279	9	**288**	60	6	**66**	0	0	**0**
7:30 to 7:45	12	2	**14**	34	1	**35**	133	4	**137**	0	0	**0**	109	7	**116**	255	9	**264**	40	9	**49**	0	0	**0**
7:45 to 8:00	19	2	**21**	42	2	**44**	200	4	**204**	0	0	**0**	170	6	**176**	180	7	**187**	33	2	**35**	0	0	**0**
8:00 to 8:15	19	1	**20**	22	1	**23**	185	3	**188**	0	0	**0**	154	3	**157**	204	9	**213**	37	4	**41**	0	0	**0**
8:15 to 8:30	18	1	**19**	41	0	**41**	186	8	**194**	0	0	**0**	166	2	**168**	180	5	**185**	51	2	**53**	0	0	**0**
8:30 to 8:45	23	3	**26**	47	2	**49**	242	7	**249**	0	0	**0**	121	4	**125**	177	9	**186**	49	0	**49**	0	0	**0**
8:45 to 9:00	25	2	**27**	40	0	**40**	179	6	**185**	0	0	**0**	112	5	**117**	218	7	**225**	41	5	**46**	0	0	**0**
AM Totals	**148**	**11**	**159**	**351**	**13**	**364**	**1,351**	**40**	**1,391**	**0**	**0**	**0**	**1,074**	**40**	**1,114**	**1,737**	**69**	**1,806**	**375**	**35**	**410**	**0**	**0**	**0**
16:00 to 16:15	14	2	**16**	33	0	**33**	173	4	**177**	0	0	**0**	146	3	**149**	175	16	**191**	73	1	**74**	0	0	**0**
16:15 to 16:30	15	0	**15**	35	2	**37**	150	4	**154**	0	0	**0**	138	4	**142**	186	6	**192**	50	1	**51**	0	0	**0**
16:30 to 16:45	9	1	**10**	17	0	**17**	121	0	**121**	0	0	**0**	158	3	**161**	189	8	**197**	65	1	**66**	0	0	**0**
16:45 to 17:00	12	1	**13**	19	0	**19**	131	2	**133**	0	0	**0**	151	2	**153**	177	6	**183**	61	1	**62**	0	0	**0**
17:00 to 17:15	12	1	**13**	36	0	**36**	139	4	**143**	0	0	**0**	177	1	**178**	171	4	**175**	51	0	**51**	0	0	**0**
17:15 to 17:30	12	1	**13**	27	0	**27**	114	1	**115**	0	0	**0**	145	3	**148**	174	3	**177**	88	2	**90**	0	0	**0**
17:30 to 17:45	10	0	**10**	30	0	**30**	160	2	**162**	0	0	**0**	142	4	**146**	163	1	**164**	62	1	**63**	0	0	**0**
17:45 to 18:00	2	0	**2**	26	0	**26**	131	1	**132**	0	0	**0**	164	3	**167**	160	3	**163**	60	1	**61**	0	0	**0**
PM Totals	**86**	**6**	**92**	**223**	**2**	**225**	**1,119**	**18**	**1,137**	**0**	**0**	**0**	**1,221**	**23**	**1,244**	**1,395**	**47**	**1,442**	**510**	**8**	**518**	**0**	**0**	**0**

Job No. : N4220
Client : GTA
Suburb : West Pennant Hills
Location : 4. Highs Rd / Castle Hill Rd / Country Dr

Day/Date : Tue, 5th June 2018
Weather : Fine
Description : Classified Intersection Count
: Hourly Summary

MATRIX Traffic and Transport Data



Approach	Highs Rd												Castle Hill Rd											
Direction	Direction 1 (Left Turn)			Direction 2 (Through)			Direction 3 (Right Turn)			Direction 3U (U Turn)			Direction 4 (Left Turn)			Direction 5 (Through)			Direction 6 (Right Turn)			Direction 6U (U Turn)		
Time Period	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total
7:00 to 8:00	228	8	**236**	52	4	**56**	7	1	**8**	0	0	**0**	5	5	**10**	618	46	**664**	64	16	**80**	0	0	**0**
7:15 to 8:15	280	10	**290**	61	4	**65**	9	1	**10**	0	0	**0**	4	4	**8**	663	53	**716**	77	15	**92**	0	0	**0**
7:30 to 8:30	332	11	**343**	85	2	**87**	8	0	**8**	0	0	**0**	3	4	**7**	740	55	**795**	82	22	**104**	0	0	**0**
7:45 to 8:45	356	10	**366**	104	2	**106**	8	0	**8**	0	0	**0**	1	5	**6**	770	51	**821**	81	15	**96**	0	0	**0**
8:00 to 9:00	355	11	**366**	109	1	**110**	6	0	**6**	0	0	**0**	4	2	**6**	775	51	**826**	78	13	**91**	0	0	**0**
AM Totals	**583**	**19**	**602**	**161**	**5**	**166**	**13**	**1**	**14**	**0**	**0**	**0**	**9**	**7**	**16**	**1,393**	**97**	**1,490**	**142**	**29**	**171**	**0**	**0**	**0**
16:00 to 17:00	339	11	**350**	129	5	**134**	6	0	**6**	0	0	**0**	8	0	**8**	1,264	36	**1,300**	82	8	**90**	0	0	**0**
16:15 to 17:15	347	10	**357**	152	5	**157**	7	0	**7**	0	0	**0**	9	0	**9**	1,305	27	**1,332**	86	7	**93**	0	0	**0**
16:30 to 17:30	365	11	**376**	145	1	**146**	6	0	**6**	0	0	**0**	9	0	**9**	1,278	21	**1,299**	96	5	**101**	0	0	**0**
16:45 to 17:45	359	11	**370**	140	1	**141**	2	0	**2**	0	0	**0**	8	0	**8**	1,272	17	**1,289**	95	3	**98**	0	0	**0**
17:00 to 18:00	386	9	**395**	143	2	**145**	4	0	**4**	0	0	**0**	13	0	**13**	1,252	8	**1,260**	93	3	**96**	0	0	**0**
PM Totals	**725**	**20**	**745**	**272**	**7**	**279**	**10**	**0**	**10**	**0**	**0**	**0**	**21**	**0**	**21**	**2,516**	**44**	**2,560**	**175**	**11**	**186**	**0**	**0**	**0**

Approach	Country Dr												Castle Hill Rd											
Direction	Direction 7 (Left Turn)			Direction 8 (Through)			Direction 9 (Right Turn)			Direction 9U (U Turn)			Direction 10 (Left Turn)			Direction 11 (Through)			Direction 12 (Right Turn)			Direction 12U (U Turn)		
Time Period	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total	Lights	Heavies	Total
7:00 to 8:00	63	4	**67**	201	10	**211**	559	16	**575**	0	0	**0**	521	26	**547**	958	39	**997**	197	24	**221**	0	0	**0**
7:15 to 8:15	64	5	**69**	161	10	**171**	658	15	**673**	0	0	**0**	585	23	**608**	918	34	**952**	170	21	**191**	0	0	**0**
7:30 to 8:30	68	6	**74**	139	4	**143**	704	19	**723**	0	0	**0**	599	18	**617**	819	30	**849**	161	17	**178**	0	0	**0**
7:45 to 8:45	79	7	**86**	152	5	**157**	813	22	**835**	0	0	**0**	611	15	**626**	741	30	**771**	170	8	**178**	0	0	**0**
8:00 to 9:00	85	7	**92**	150	3	**153**	792	24	**816**	0	0	**0**	553	14	**567**	779	30	**809**	178	11	**189**	0	0	**0**
AM Totals	**148**	**11**	**159**	**351**	**13**	**364**	**1,351**	**40**	**1,391**	**0**	**0**	**0**	**1,074**	**40**	**1,114**	**1,737**	**69**	**1,806**	**375**	**35**	**410**	**0**	**0**	**0**
16:00 to 17:00	50	4	**54**	104	2	**106**	575	10	**585**	0	0	**0**	593	12	**605**	727	36	**763**	249	4	**253**	0	0	**0**
16:15 to 17:15	48	3	**51**	107	2	**109**	541	10	**551**	0	0	**0**	624	10	**634**	723	24	**747**	227	3	**230**	0	0	**0**
16:30 to 17:30	45	4	**49**	99	0	**99**	505	7	**512**	0	0	**0**	631	9	**640**	711	21	**732**	265	4	**269**	0	0	**0**
16:45 to 17:45	46	3	**49**	112	0	**112**	544	9	**553**	0	0	**0**	615	10	**625**	685	14	**699**	262	4	**266**	0	0	**0**
17:00 to 18:00	36	2	**38**	119	0	**119**	544	8	**552**	0	0	**0**	628	11	**639**	668	11	**679**	261	4	**265**	0	0	**0**
PM Totals	**86**	**6**	**92**	**223**	**2**	**225**	**1,119**	**18**	**1,137**	**0**	**0**	**0**	**1,221**	**23**	**1,244**	**1,395**	**47**	**1,442**	**510**	**8**	**518**	**0**	**0**	**0**

Appendix B

SIDRA INTERSECTION Results

MOVEMENT SUMMARY

Site: 104 [4. Aiken Road/ Oakes Road - AM - Scenario 1]

Aiken Road/ Oakes Road existing intersection
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Oakes Road - S											
1	L2	378	1.9	0.315	3.7	LOS A	2.7	19.0	0.23	0.53	45.0
3	R2	327	1.9	0.315	7.1	LOS A	2.7	19.0	0.23	0.53	45.8
Approach		705	1.9	0.315	5.3	LOS A	2.7	19.0	0.23	0.53	45.4
East: Aiken Road - E											
4	L2	113	4.7	0.325	7.3	LOS A	1.7	12.3	0.73	0.77	44.1
5	T1	68	6.2	0.325	7.3	LOS A	1.7	12.3	0.73	0.77	45.7
Approach		181	5.2	0.325	7.3	LOS A	1.7	12.3	0.73	0.77	44.8
West: Aiken Road - W											
11	T1	121	12.2	1.043	79.2	LOS F	46.4	332.7	1.00	2.69	23.3
12	R2	576	0.9	1.043	86.5	LOS F	46.4	332.7	1.00	2.69	21.2
Approach		697	2.9	1.043	85.2	LOS F	46.4	332.7	1.00	2.69	21.6
All Vehicles		1583	2.7	1.043	40.7	LOS C	46.4	332.7	0.63	1.51	30.3

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

MOVEMENT SUMMARY

Site: 104 [4. Aiken Road/ Oakes Road - AM - Scenario 2_mitigation]

Aiken Road/ Oakes Road existing intersection
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Oakes Road - S											
1	L2	414	1.8	0.330	3.7	LOS A	2.8	20.2	0.23	0.53	45.1
3	R2	327	1.9	0.330	7.1	LOS A	2.8	20.2	0.23	0.53	45.8
Approach		741	1.8	0.330	5.2	LOS A	2.8	20.2	0.23	0.53	45.4
East: Aiken Road - E											
4	L2	113	4.7	0.351	7.8	LOS A	1.5	11.2	0.71	0.83	43.8
5	T1	68	6.2	0.351	7.9	LOS A	1.5	11.2	0.71	0.83	45.4
Approach		181	5.2	0.351	7.9	LOS A	1.5	11.2	0.71	0.83	44.4
West: Aiken Road - W											
11	T1	121	12.2	0.373	5.7	LOS A	1.6	12.0	0.57	0.73	45.2
12	R2	721	0.7	0.851	17.3	LOS B	8.9	62.7	0.76	1.14	39.5
Approach		842	2.4	0.851	15.7	LOS B	8.9	62.7	0.74	1.08	40.3
All Vehicles		1764	2.4	0.851	10.5	LOS A	8.9	62.7	0.52	0.82	42.7

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

MOVEMENT SUMMARY

Site: 104 [4. Aiken Road/ Oakes Road - AM - Scenario 2]

Aiken Road/ Oakes Road existing intersection
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Oakes Road - S											
1	L2	414	1.8	0.331	3.7	LOS A	2.9	20.4	0.24	0.53	45.1
3	R2	327	1.9	0.331	7.1	LOS A	2.9	20.4	0.24	0.53	45.8
Approach		741	1.8	0.331	5.2	LOS A	2.9	20.4	0.24	0.53	45.4
East: Aiken Road - E											
4	L2	113	4.7	0.329	7.3	LOS A	1.7	12.4	0.73	0.77	44.1
5	T1	68	6.2	0.329	7.4	LOS A	1.7	12.4	0.73	0.77	45.7
Approach		181	5.2	0.329	7.4	LOS A	1.7	12.4	0.73	0.77	44.7
West: Aiken Road - W											
11	T1	121	12.2	1.287	276.9	LOS F	137.0	978.8	1.00	6.06	10.4
12	R2	721	0.7	1.287	283.6	LOS F	137.0	978.8	1.00	6.06	9.0
Approach		842	2.4	1.287	282.7	LOS F	137.0	978.8	1.00	6.06	9.2
All Vehicles		1764	2.4	1.287	137.9	LOS F	137.0	978.8	0.65	3.19	15.7

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

MOVEMENT SUMMARY

Site: 104 [4. Aiken Road/ Oakes Road - AM - Scenario 3]

Aiken Road/ Oakes Road existing intersection
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Oakes Road - S											
1	L2	396	1.9	0.323	3.7	LOS A	2.8	19.7	0.23	0.53	45.1
3	R2	327	1.9	0.323	7.1	LOS A	2.8	19.7	0.23	0.53	45.8
Approach		723	1.9	0.323	5.3	LOS A	2.8	19.7	0.23	0.53	45.4
East: Aiken Road - E											
4	L2	113	4.7	0.328	7.3	LOS A	1.7	12.4	0.73	0.77	44.1
5	T1	68	6.2	0.328	7.4	LOS A	1.7	12.4	0.73	0.77	45.7
Approach		181	5.2	0.328	7.3	LOS A	1.7	12.4	0.73	0.77	44.8
West: Aiken Road - W											
11	T1	121	12.2	1.166	172.8	LOS F	89.8	642.7	1.00	4.45	14.6
12	R2	649	0.8	1.166	179.8	LOS F	89.8	642.7	1.00	4.45	12.9
Approach		771	2.6	1.166	178.7	LOS F	89.8	642.7	1.00	4.45	13.2
All Vehicles		1675	2.6	1.166	85.3	LOS F	89.8	642.7	0.64	2.36	21.2

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

MOVEMENT SUMMARY

Site: 104 [4. Aiken Road/ Oakes Road - AM]

Aiken Road/ Oakes Road existing intersection
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Oakes Road - S											
1	L2	365	2.0	0.309	3.7	LOS A	2.6	18.3	0.23	0.53	45.0
3	R2	327	1.9	0.309	7.1	LOS A	2.6	18.3	0.23	0.53	45.8
Approach		693	2.0	0.309	5.3	LOS A	2.6	18.3	0.23	0.53	45.4
East: Aiken Road - E											
4	L2	113	4.7	0.309	7.0	LOS A	1.6	11.4	0.70	0.75	44.2
5	T1	68	6.2	0.309	7.1	LOS A	1.6	11.4	0.70	0.75	45.9
Approach		181	5.2	0.309	7.0	LOS A	1.6	11.4	0.70	0.75	44.9
West: Aiken Road - W											
11	T1	121	12.2	0.962	37.9	LOS C	23.7	170.2	0.94	1.77	31.8
12	R2	527	1.0	0.962	44.1	LOS D	23.7	170.2	0.94	1.77	29.7
Approach		648	3.1	0.962	42.9	LOS D	23.7	170.2	0.94	1.77	30.2
All Vehicles		1522	2.8	0.962	21.5	LOS B	23.7	170.2	0.59	1.09	37.2

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

MOVEMENT SUMMARY

Site: 104 [4. Aiken Road/ Oakes Road - PM - Scenario 1]

Aiken Road/ Oakes Road existing intersection
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Oakes Road - S											
1	L2	701	0.5	0.728	4.7	LOS A	8.1	57.0	0.68	0.62	44.2
3	R2	429	0.5	0.728	8.5	LOS A	8.1	57.0	0.68	0.62	44.9
Approach		1131	0.5	0.728	6.2	LOS A	8.1	57.0	0.68	0.62	44.5
East: Aiken Road - E											
4	L2	243	0.0	0.535	7.4	LOS A	4.3	30.5	0.74	0.78	44.1
5	T1	220	1.9	0.535	7.5	LOS A	4.3	30.5	0.74	0.78	45.7
Approach		463	0.9	0.535	7.5	LOS A	4.3	30.5	0.74	0.78	44.9
West: Aiken Road - W											
11	T1	25	4.2	0.487	7.0	LOS A	3.7	26.4	0.75	0.81	44.3
12	R2	408	0.8	0.487	10.3	LOS A	3.7	26.4	0.75	0.81	43.2
Approach		434	1.0	0.487	10.1	LOS A	3.7	26.4	0.75	0.81	43.3
All Vehicles		2027	0.7	0.728	7.3	LOS A	8.1	57.0	0.71	0.70	44.3

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

MOVEMENT SUMMARY

Site: 104 [4. Aiken Road/ Oakes Road - PM - Scenario 2]

Aiken Road/ Oakes Road existing intersection
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Oakes Road - S											
1	L2	851	0.4	0.819	5.7	LOS A	12.8	89.8	0.79	0.66	44.1
3	R2	429	0.5	0.819	9.5	LOS A	12.8	89.8	0.79	0.66	44.8
Approach		1280	0.4	0.819	7.0	LOS A	12.8	89.8	0.79	0.66	44.3
East: Aiken Road - E											
4	L2	243	0.0	0.558	8.2	LOS A	4.8	33.6	0.78	0.84	43.6
5	T1	220	1.9	0.558	8.3	LOS A	4.8	33.6	0.78	0.84	45.2
Approach		463	0.9	0.558	8.2	LOS A	4.8	33.6	0.78	0.84	44.4
West: Aiken Road - W											
11	T1	25	4.2	0.536	7.6	LOS A	4.6	32.4	0.79	0.85	44.0
12	R2	446	0.7	0.536	10.8	LOS A	4.6	32.4	0.79	0.85	42.9
Approach		472	0.9	0.536	10.7	LOS A	4.6	32.4	0.79	0.85	43.0
All Vehicles		2215	0.6	0.819	8.0	LOS A	12.8	89.8	0.79	0.74	44.0

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

MOVEMENT SUMMARY

Site: 104 [4. Aiken Road/ Oakes Road - PM - Scenario 3]

Aiken Road/ Oakes Road existing intersection
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Oakes Road - S											
1	L2	776	0.4	0.774	5.2	LOS A	10.1	71.1	0.73	0.64	44.1
3	R2	429	0.5	0.774	8.9	LOS A	10.1	71.1	0.73	0.64	44.9
Approach		1205	0.4	0.774	6.5	LOS A	10.1	71.1	0.73	0.64	44.4
East: Aiken Road - E											
4	L2	243	0.0	0.547	7.8	LOS A	4.5	32.0	0.76	0.81	43.8
5	T1	220	1.9	0.547	7.9	LOS A	4.5	32.0	0.76	0.81	45.5
Approach		463	0.9	0.547	7.8	LOS A	4.5	32.0	0.76	0.81	44.7
West: Aiken Road - W											
11	T1	25	4.2	0.512	7.3	LOS A	4.1	29.3	0.77	0.83	44.1
12	R2	427	0.7	0.512	10.5	LOS A	4.1	29.3	0.77	0.83	43.1
Approach		453	0.9	0.512	10.4	LOS A	4.1	29.3	0.77	0.83	43.1
All Vehicles		2121	0.6	0.774	7.6	LOS A	10.1	71.1	0.75	0.72	44.2

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

MOVEMENT SUMMARY

Site: 104 [4. Aiken Road/ Oakes Road - PM]

Aiken Road/ Oakes Road existing intersection
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Oakes Road - S											
1	L2	652	0.5	0.698	4.7	LOS A	7.4	52.0	0.65	0.62	44.2
3	R2	429	0.5	0.698	8.4	LOS A	7.4	52.0	0.65	0.62	45.0
Approach		1081	0.5	0.698	6.1	LOS A	7.4	52.0	0.65	0.62	44.5
East: Aiken Road - E											
4	L2	243	0.0	0.527	7.2	LOS A	4.2	29.5	0.73	0.77	44.2
5	T1	220	1.9	0.527	7.3	LOS A	4.2	29.5	0.73	0.77	45.8
Approach		463	0.9	0.527	7.2	LOS A	4.2	29.5	0.73	0.77	45.0
West: Aiken Road - W											
11	T1	25	4.2	0.472	6.9	LOS A	3.5	24.7	0.74	0.80	44.4
12	R2	396	0.8	0.472	10.1	LOS A	3.5	24.7	0.74	0.80	43.3
Approach		421	1.0	0.472	9.9	LOS A	3.5	24.7	0.74	0.80	43.4
All Vehicles		1965	0.7	0.698	7.2	LOS A	7.4	52.0	0.69	0.69	44.4

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

MOVEMENT SUMMARY

Site: 2575 [3. Coonara Avenue/ Castle Hill Road/ Edward Bennett Drive - AM - Scenario 1]

Existing intersection
Signals - Fixed Time Isolated Cycle Time = 85 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Coonara Avenue - S											
10	L2	43	12.2	0.804	47.2	LOS D	10.4	74.8	1.00	0.96	31.7
11	T1	64	3.3	0.804	42.6	LOS D	10.4	74.8	1.00	0.96	30.7
12	R2	367	1.1	0.804	47.0	LOS D	10.9	77.0	1.00	0.95	31.7
Approach		475	2.4	0.804	46.4	LOS D	10.9	77.0	1.00	0.95	31.6
East: Castle Hill Road - E											
1	L2	294	2.2	0.938	56.3	LOS D	32.1	234.3	1.00	1.20	30.1
2	T1	803	7.7	0.938	51.8	LOS D	32.1	234.3	0.98	1.19	32.1
3	R2	80	9.2	0.340	25.3	LOS B	2.0	15.1	0.92	0.75	39.3
Approach		1177	6.4	0.938	51.2	LOS D	32.1	234.3	0.98	1.16	32.0
North: Edward Bennett Drive - N											
4	L2	119	8.0	0.303	21.0	LOS B	2.6	19.4	0.87	0.76	40.5
5	T1	47	0.0	0.306	35.6	LOS C	3.4	23.8	0.93	0.74	33.0
6	R2	41	2.6	0.306	40.2	LOS C	3.4	23.8	0.93	0.74	34.3
Approach		207	5.1	0.306	28.1	LOS B	3.4	23.8	0.90	0.75	37.3
West: Castle Hill Road - W											
7	L2	29	7.1	0.804	37.7	LOS C	20.8	150.7	0.98	0.94	36.4
8	T1	912	3.8	0.804	31.8	LOS C	20.8	150.7	0.95	0.92	39.3
9	R2	124	0.8	0.559	27.7	LOS B	3.2	22.5	0.99	0.77	38.3
Approach		1065	3.6	0.804	31.5	LOS C	20.8	150.7	0.96	0.91	39.1
All Vehicles		2924	4.6	0.938	41.6	LOS C	32.1	234.3	0.97	1.00	34.5

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 per ped
P4	South Full Crossing	53	24.1	LOS C	0.1	0.1	0.75	0.75
P1	East Full Crossing	53	36.8	LOS D	0.1	0.1	0.93	0.93
P2	North Full Crossing	53	24.1	LOS C	0.1	0.1	0.75	0.75
All Pedestrians		158	28.4	LOS C			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.

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PHASING SUMMARY

Site: 2575 [3. Coonara Avenue/ Castle Hill Road/ Edward Bennett Drive - AM - Scenario 1]

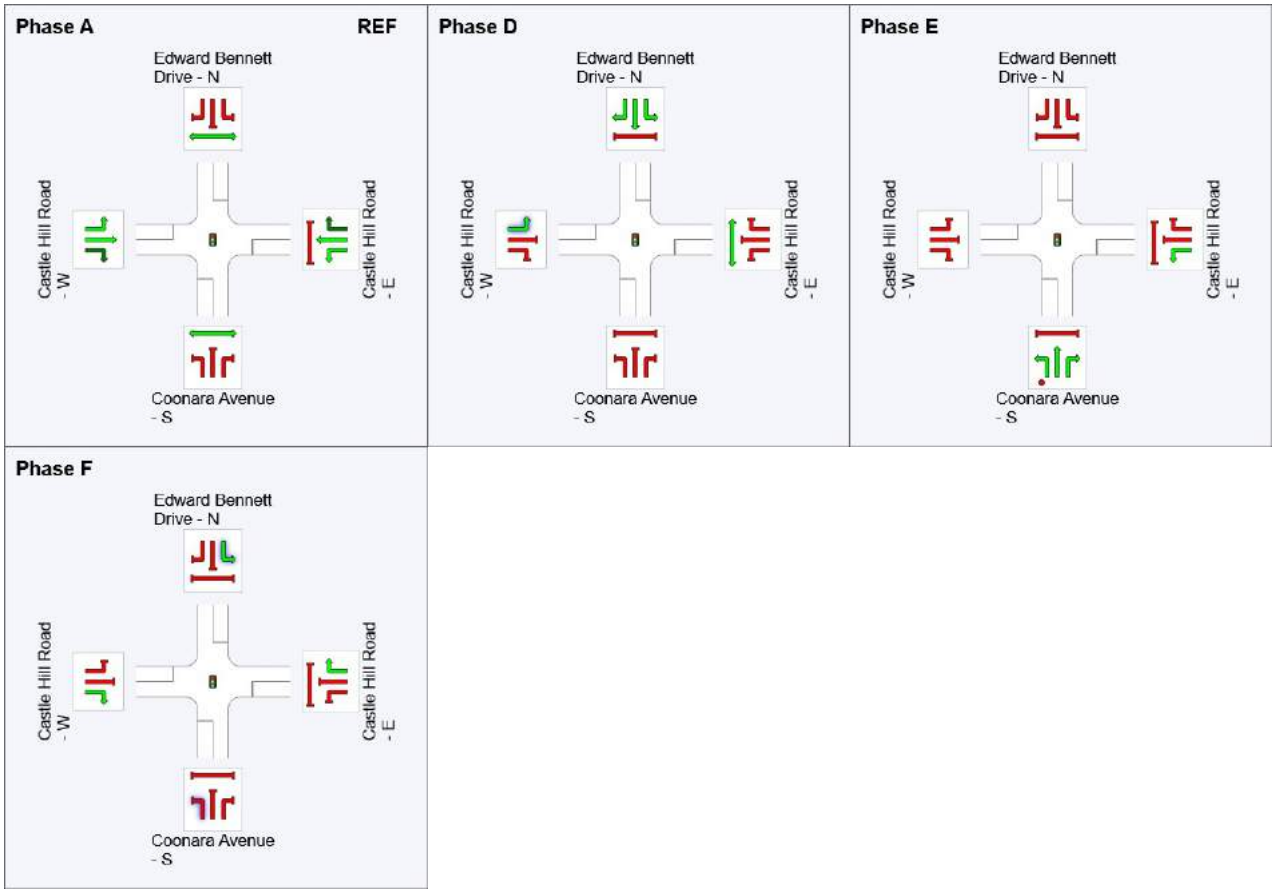
Existing intersection
Signals - Fixed Time Isolated Cycle Time = 85 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase Times determined by the program
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, B*, C*, D, E, F, F1*, F2*
Output Phase Sequence: A, D, E, F
(* Variable Phase)

Phase Timing Results

Phase	A	D	E	F
Phase Change Time (sec)	0	34	53	73
Green Time (sec)	28	13	14	6
Phase Time (sec)	34	19	20	12
Phase Split	40%	22%	24%	14%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

 Other Movement Class (MC) Stopped

 Phase Transition Applied

MOVEMENT SUMMARY

Site: 2575 [3. Coonara Avenue/ Castle Hill Road/ Edward Bennett Drive - AM - Scenario 2]

Existing intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Coonara Avenue - S											
10	L2	43	12.2	0.851	46.1	LOS D	5.9	43.2	1.00	1.02	32.2
11	T1	64	3.3	0.851	41.6	LOS C	5.9	43.2	1.00	1.02	31.2
12	R2	196	2.2	0.851	45.9	LOS D	6.2	44.0	1.00	1.02	32.0
Approach		303	3.8	0.851	45.0	LOS D	6.2	44.0	1.00	1.02	31.8
East: Castle Hill Road - E											
1	L2	252	2.5	0.924	48.0	LOS D	24.8	181.4	1.00	1.22	32.4
2	T1	803	7.7	0.924	42.8	LOS D	24.8	181.4	0.99	1.20	34.9
3	R2	80	9.2	0.301	21.8	LOS B	1.6	12.1	0.92	0.75	40.8
Approach		1135	6.7	0.924	42.5	LOS D	24.8	181.4	0.99	1.17	34.6
North: Edward Bennett Drive - N											
4	L2	119	8.0	0.279	17.9	LOS B	2.2	16.6	0.85	0.75	42.0
5	T1	47	0.0	0.298	29.3	LOS C	2.8	19.7	0.92	0.74	35.0
6	R2	41	2.6	0.298	33.9	LOS C	2.8	19.7	0.92	0.74	36.5
Approach		207	5.1	0.298	23.7	LOS B	2.8	19.7	0.88	0.74	39.0
West: Castle Hill Road - W											
7	L2	29	7.1	0.837	35.8	LOS C	18.6	134.9	0.99	1.01	37.1
8	T1	912	3.8	0.837	30.2	LOS C	18.6	134.9	0.97	0.99	40.0
9	R2	124	0.8	0.462	22.8	LOS B	2.6	18.0	0.97	0.77	40.4
Approach		1065	3.6	0.837	29.5	LOS C	18.6	134.9	0.97	0.97	40.0
All Vehicles		2711	5.0	0.924	36.2	LOS C	24.8	181.4	0.98	1.04	36.5

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 per ped
P4	South Full Crossing	53	21.7	LOS C	0.1	0.1	0.79	0.79
P1	East Full Crossing	53	29.3	LOS C	0.1	0.1	0.92	0.92
P2	North Full Crossing	53	21.7	LOS C	0.1	0.1	0.79	0.79
All Pedestrians		158	24.2	LOS C			0.83	0.83

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.

PHASING SUMMARY

Site: 2575 [3. Coonara Avenue/ Castle Hill Road/ Edward Bennett Drive - AM - Scenario 2]

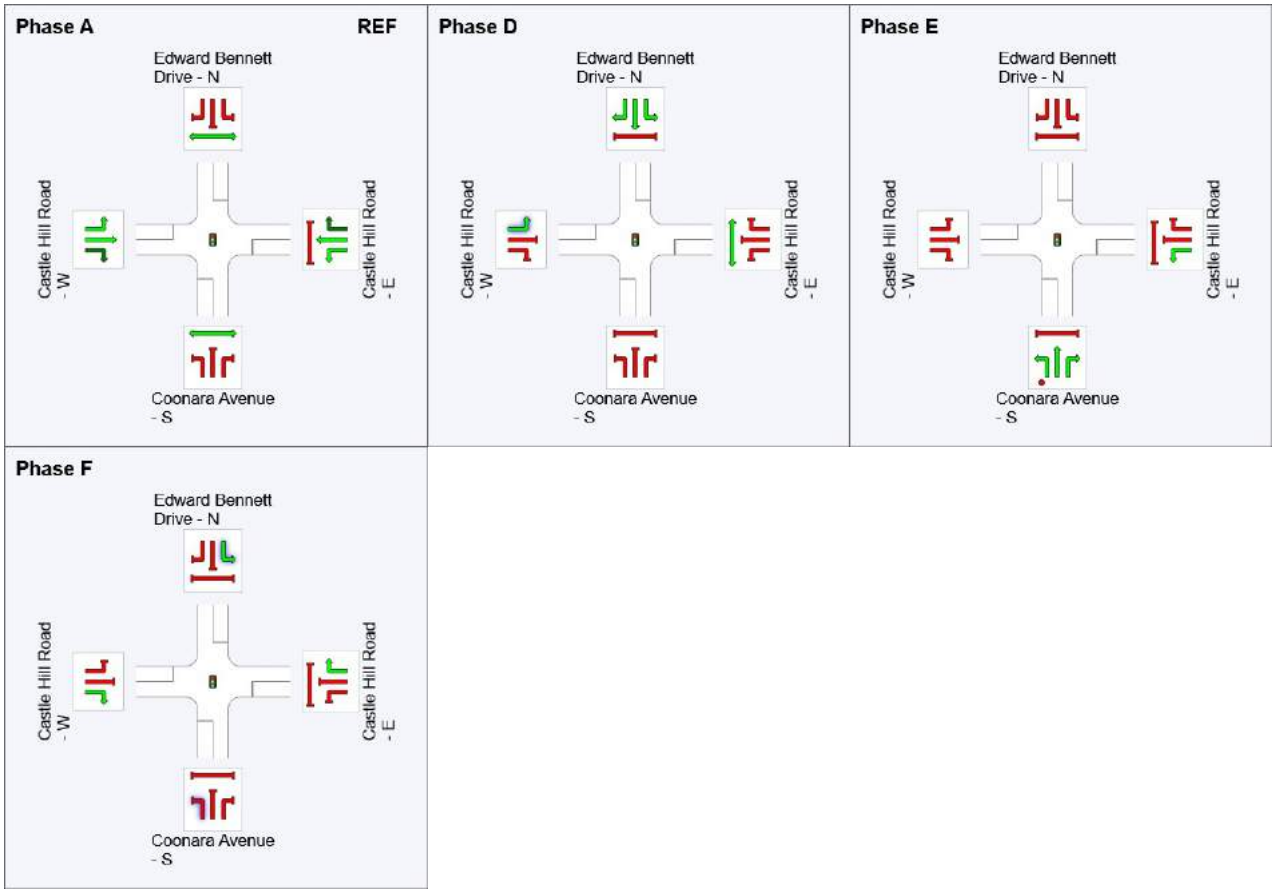
Existing intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase Times determined by the program
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, B*, C*, D, E, F, F1*, F2*
Output Phase Sequence: A, D, E, F
(* Variable Phase)

Phase Timing Results

Phase	A	D	E	F
Phase Change Time (sec)	0	28	45	58
Green Time (sec)	22	11	7	6
Phase Time (sec)	28	17	13	12
Phase Split	40%	24%	19%	17%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

 Other Movement Class (MC) Stopped

 Phase Transition Applied

MOVEMENT SUMMARY

Site: 2575 [3. Coonara Avenue/ Castle Hill Road/ Edward Bennett Drive - AM - Scenario 3]

Existing intersection
Signals - Fixed Time Isolated Cycle Time = 78 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Coonara Avenue - S											
10	L2	43	12.2	0.772	44.2	LOS D	7.8	56.4	1.00	0.94	32.6
11	T1	64	3.3	0.772	39.6	LOS C	7.8	56.4	1.00	0.94	31.6
12	R2	282	1.5	0.772	44.0	LOS D	8.2	57.8	1.00	0.92	32.5
Approach		389	3.0	0.772	43.3	LOS D	8.2	57.8	1.00	0.93	32.4
East: Castle Hill Road - E											
1	L2	273	2.3	0.932	52.6	LOS D	28.5	208.4	1.00	1.21	31.1
2	T1	803	7.7	0.932	47.8	LOS D	28.5	208.4	0.99	1.20	33.3
3	R2	80	9.2	0.327	24.0	LOS B	1.8	13.8	0.93	0.75	39.8
Approach		1156	6.6	0.932	47.3	LOS D	28.5	208.4	0.99	1.17	33.1
North: Edward Bennett Drive - N											
4	L2	119	8.0	0.293	19.5	LOS B	2.4	18.0	0.86	0.75	41.2
5	T1	47	0.0	0.304	32.7	LOS C	3.1	21.9	0.93	0.74	33.9
6	R2	41	2.6	0.304	37.3	LOS C	3.1	21.9	0.93	0.74	35.3
Approach		207	5.1	0.304	26.1	LOS B	3.1	21.9	0.89	0.75	38.1
West: Castle Hill Road - W											
7	L2	29	7.1	0.824	37.0	LOS C	20.0	144.8	0.98	0.98	36.7
8	T1	912	3.8	0.824	31.4	LOS C	20.0	144.8	0.96	0.96	39.5
9	R2	124	0.8	0.514	25.5	LOS B	2.9	20.5	0.98	0.77	39.3
Approach		1065	3.6	0.824	30.9	LOS C	20.0	144.8	0.97	0.94	39.4
All Vehicles		2818	4.8	0.932	39.0	LOS C	28.5	208.4	0.97	1.02	35.5

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 per ped
P4	South Full Crossing	53	23.1	LOS C	0.1	0.1	0.77	0.77
P1	East Full Crossing	53	33.3	LOS D	0.1	0.1	0.93	0.93
P2	North Full Crossing	53	23.1	LOS C	0.1	0.1	0.77	0.77
All Pedestrians		158	26.5	LOS C			0.82	0.82

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.

PHASING SUMMARY

Site: 2575 [3. Coonara Avenue/ Castle Hill Road/ Edward Bennett Drive - AM - Scenario 3]

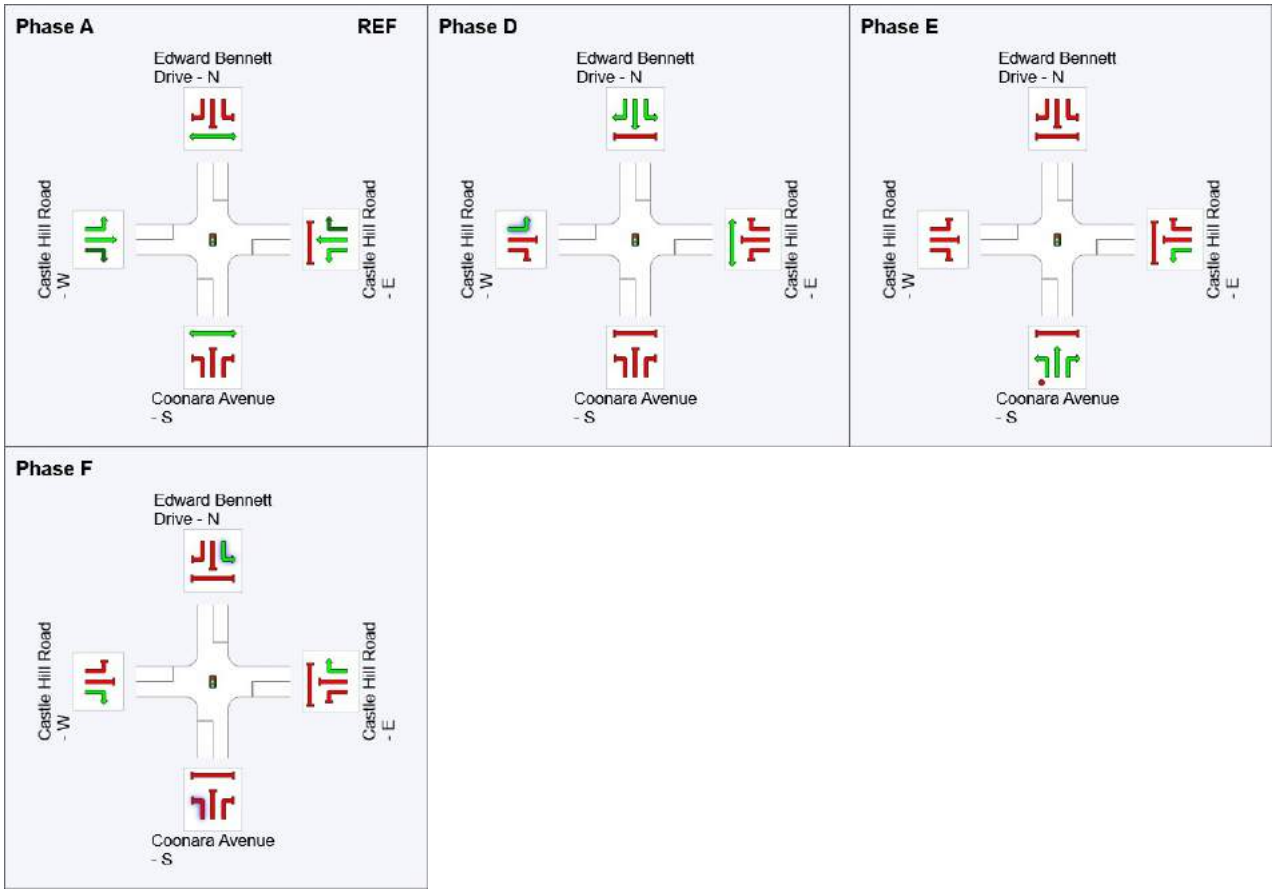
Existing intersection
Signals - Fixed Time Isolated Cycle Time = 78 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase Times determined by the program
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, B*, C*, D, E, F, F1*, F2*
Output Phase Sequence: A, D, E, F
(* Variable Phase)

Phase Timing Results

Phase	A	D	E	F
Phase Change Time (sec)	0	31	49	66
Green Time (sec)	25	12	11	6
Phase Time (sec)	31	18	17	12
Phase Split	40%	23%	22%	15%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

 Other Movement Class (MC) Stopped  Phase Transition Applied

MOVEMENT SUMMARY

Site: 2575 [3. Coonara Avenue/ Castle Hill Road/ Edward Bennett Drive - AM]

Existing intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Coonara Avenue - S											
10	L2	43	12.2	0.694	41.3	LOS C	4.4	32.6	1.00	0.87	33.8
11	T1	64	3.3	0.694	36.7	LOS C	4.4	32.6	1.00	0.87	32.7
12	R2	139	3.0	0.694	41.2	LOS C	4.6	33.1	1.00	0.87	33.3
Approach		246	4.7	0.694	40.0	LOS C	4.6	33.1	1.00	0.87	33.2
East: Castle Hill Road - E											
1	L2	237	2.7	0.906	44.5	LOS D	23.0	168.4	1.00	1.18	33.5
2	T1	803	7.7	0.906	39.1	LOS C	23.0	168.4	0.99	1.15	36.2
3	R2	80	9.2	0.303	22.1	LOS B	1.6	12.1	0.93	0.75	40.7
Approach		1120	6.8	0.906	39.1	LOS C	23.0	168.4	0.99	1.13	35.8
North: Edward Bennett Drive - N											
4	L2	119	8.0	0.279	17.9	LOS B	2.2	16.6	0.85	0.75	42.0
5	T1	47	0.0	0.298	29.3	LOS C	2.8	19.7	0.92	0.74	35.0
6	R2	41	2.6	0.298	33.9	LOS C	2.8	19.7	0.92	0.74	36.5
Approach		207	5.1	0.298	23.7	LOS B	2.8	19.7	0.88	0.74	39.0
West: Castle Hill Road - W											
7	L2	29	7.1	0.837	35.8	LOS C	18.6	134.9	0.99	1.01	37.1
8	T1	912	3.8	0.837	30.2	LOS C	18.6	134.9	0.97	0.99	40.0
9	R2	124	0.8	0.459	22.8	LOS B	2.6	18.0	0.97	0.77	40.4
Approach		1065	3.6	0.837	29.5	LOS C	18.6	134.9	0.97	0.97	40.0
All Vehicles		2639	5.1	0.906	34.1	LOS C	23.0	168.4	0.98	1.01	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 per ped
P4	South Full Crossing	53	21.7	LOS C	0.1	0.1	0.79	0.79
P1	East Full Crossing	53	29.3	LOS C	0.1	0.1	0.92	0.92
P2	North Full Crossing	53	21.7	LOS C	0.1	0.1	0.79	0.79
All Pedestrians		158	24.2	LOS C			0.83	0.83

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.

PHASING SUMMARY

Site: 2575 [3. Coonara Avenue/ Castle Hill Road/ Edward Bennett Drive - AM]

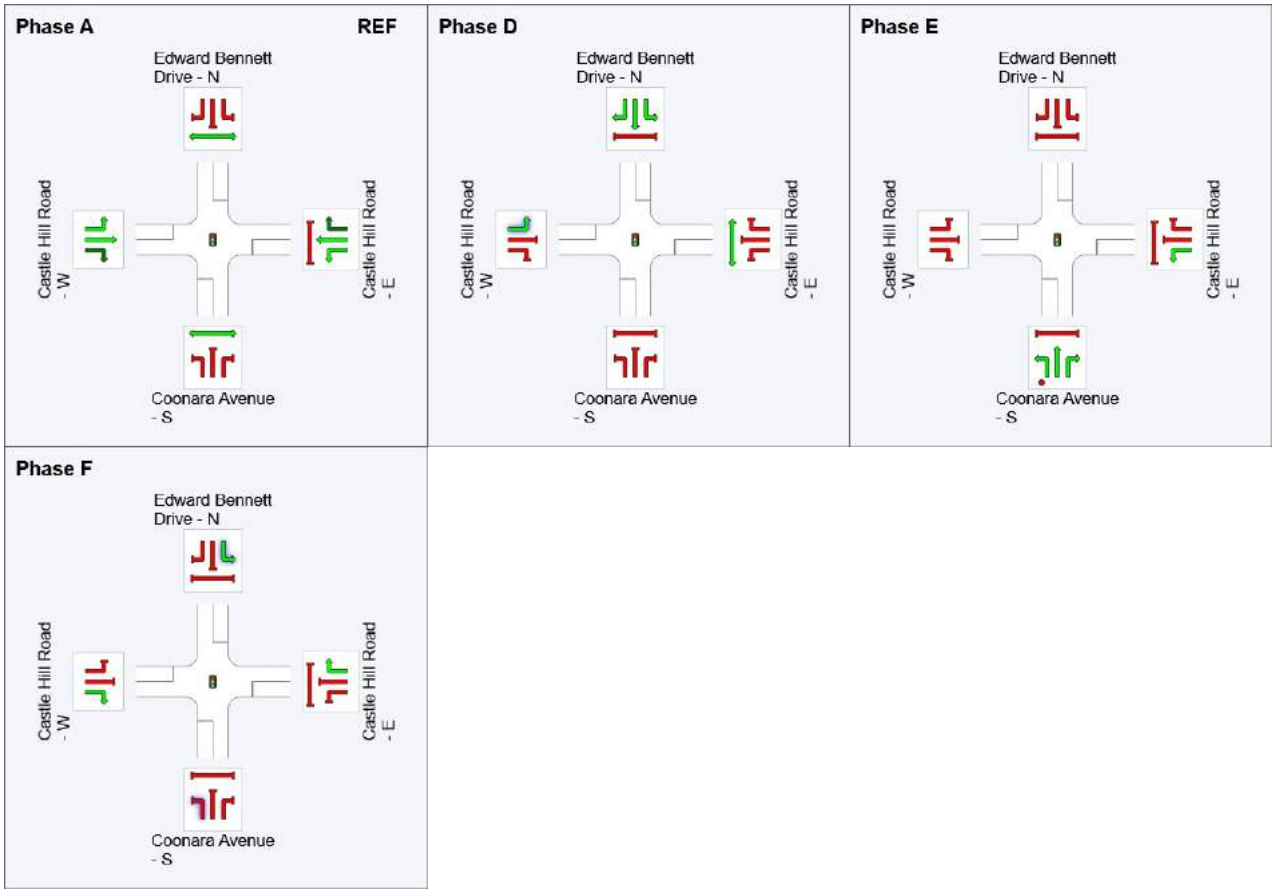
Existing intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase Times determined by the program
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, B*, C*, D, E, F, F1*, F2*
Output Phase Sequence: A, D, E, F
(* Variable Phase)

Phase Timing Results

Phase	A	D	E	F
Phase Change Time (sec)	0	28	45	58
Green Time (sec)	22	11	7	6
Phase Time (sec)	28	17	13	12
Phase Split	40%	24%	19%	17%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

 Other Movement Class (MC) Stopped

 Phase Transition Applied

MOVEMENT SUMMARY

Site: 2575 [3. Coonara Avenue/ Castle Hill Road/ Edward Bennett Drive - PM - Scenario 1]

Existing intersection
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Coonara Avenue - S											
10	L2	113	0.0	0.887	71.4	LOS F	15.0	105.1	1.00	1.03	26.4
11	T1	74	0.0	0.887	66.9	LOS E	15.0	105.1	1.00	1.03	25.6
12	R2	268	2.0	0.887	71.2	LOS F	15.3	108.9	1.00	1.00	26.2
Approach		455	1.2	0.887	70.6	LOS F	15.3	108.9	1.00	1.01	26.1
East: Castle Hill Rd - E											
1	L2	425	1.2	0.920	43.8	LOS D	61.6	436.8	0.95	0.98	33.7
2	T1	1271	1.8	0.920	39.7	LOS C	61.6	436.8	0.82	0.90	35.9
3	R2	188	4.5	0.428	44.1	LOS D	9.3	67.3	0.89	0.88	32.7
Approach		1884	2.0	0.920	41.1	LOS C	61.6	436.8	0.86	0.92	35.1
North: Edward Bennett Drive - N											
4	L2	44	9.5	0.191	55.5	LOS D	2.4	17.8	0.93	0.74	29.3
5	T1	27	0.0	0.283	51.5	LOS D	3.8	26.9	0.94	0.75	28.7
6	R2	43	2.4	0.283	56.1	LOS D	3.8	26.9	0.94	0.75	29.7
Approach		115	4.6	0.283	54.8	LOS D	3.8	26.9	0.94	0.74	29.3
West: Castle Hill Road - W											
7	L2	58	9.1	0.748	47.1	LOS D	25.0	181.0	0.95	0.87	33.2
8	T1	791	3.5	0.748	39.0	LOS C	25.0	181.0	0.91	0.83	36.4
9	R2	56	1.9	0.767	73.3	LOS F	3.7	26.6	1.00	0.91	25.9
Approach		904	3.7	0.767	41.6	LOS C	25.0	181.0	0.92	0.84	35.3
All Vehicles		3358	2.4	0.920	45.7	LOS D	61.6	436.8	0.90	0.90	33.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
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 per ped
P4	South Full Crossing	53	30.9	LOS D	0.1	0.1	0.72	0.72
P1	East Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95
P2	North Full Crossing	53	30.9	LOS D	0.1	0.1	0.72	0.72
All Pedestrians		158	38.7	LOS D			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.

PHASING SUMMARY

Site: 2575 [3. Coonara Avenue/ Castle Hill Road/ Edward Bennett Drive - PM - Scenario 1]

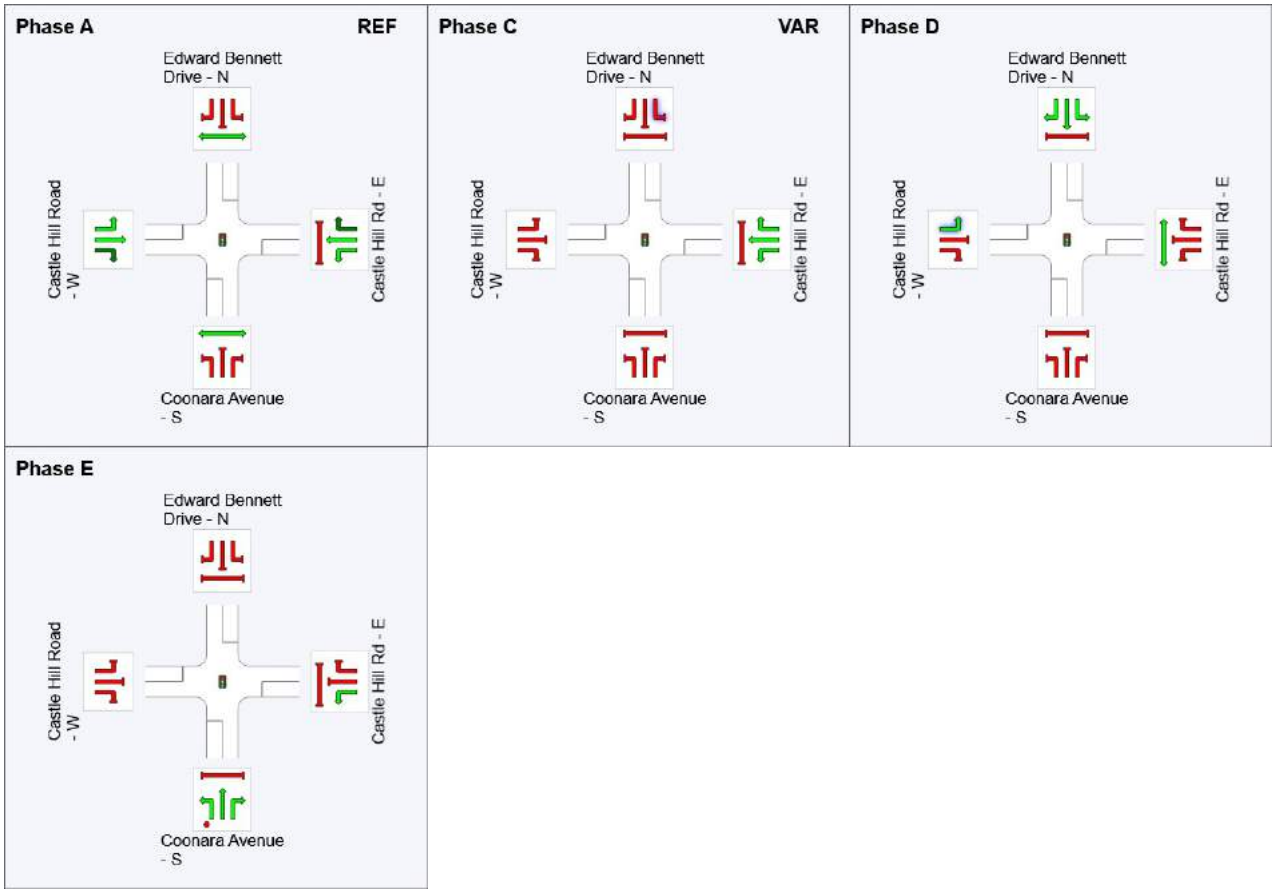
Existing intersection
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase Times determined by the program
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, B*, C*, D, E, F*, F1*, F2*
Output Phase Sequence: A, C*, D, E
(* Variable Phase)

Phase Timing Results

Phase	A	C	D	E
Phase Change Time (sec)	0	47	75	97
Green Time (sec)	41	22	16	17
Phase Time (sec)	47	28	22	23
Phase Split	39%	23%	18%	19%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

 Other Movement Class (MC) Stopped  Phase Transition Applied

MOVEMENT SUMMARY

Site: 2575 [3. Coonara Avenue/ Castle Hill Road/ Edward Bennett Drive - PM - Scenario 2]

Existing intersection
Signals - Fixed Time Isolated Cycle Time = 107 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Coonara Avenue - S											
10	L2	113	0.0	0.936	74.8	LOS F	13.2	92.8	1.00	1.15	25.8
11	T1	74	0.0	0.936	70.3	LOS E	13.2	92.8	1.00	1.15	25.0
12	R2	225	2.3	0.936	74.6	LOS F	13.5	96.1	1.00	1.09	25.5
Approach		412	1.3	0.936	73.9	LOS F	13.5	96.1	1.00	1.11	25.5
East: Castle Hill Rd - E											
1	L2	252	2.1	0.870	32.1	LOS C	45.5	323.3	0.90	0.90	38.2
2	T1	1271	1.8	0.870	27.5	LOS B	45.5	323.3	0.79	0.82	40.9
3	R2	188	4.5	0.531	36.1	LOS C	8.5	62.0	0.92	0.83	35.2
Approach		1711	2.2	0.870	29.1	LOS C	45.5	323.3	0.82	0.84	39.8
North: Edward Bennett Drive - N											
4	L2	44	9.5	0.181	49.4	LOS D	2.1	15.8	0.92	0.73	30.8
5	T1	27	0.0	0.269	45.3	LOS D	3.4	23.9	0.93	0.74	30.2
6	R2	43	2.4	0.269	49.9	LOS D	3.4	23.9	0.93	0.74	31.3
Approach		115	4.6	0.269	48.6	LOS D	3.4	23.9	0.93	0.74	30.8
West: Castle Hill Road - W											
7	L2	58	9.1	0.577	34.0	LOS C	17.5	127.1	0.83	0.77	37.7
8	T1	791	3.5	0.577	27.2	LOS B	17.5	127.1	0.82	0.74	41.3
9	R2	56	1.9	0.759	67.9	LOS E	3.2	23.0	1.00	0.82	27.0
Approach		904	3.7	0.759	30.2	LOS C	17.5	127.1	0.83	0.74	39.7
All Vehicles		3141	2.6	0.936	36.0	LOS C	45.5	323.3	0.85	0.84	36.7

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 per ped
P4	South Full Crossing	53	23.6	LOS C	0.1	0.1	0.67	0.67
P1	East Full Crossing	53	47.8	LOS E	0.2	0.2	0.95	0.95
P2	North Full Crossing	53	23.6	LOS C	0.1	0.1	0.67	0.67
All Pedestrians		158	31.7	LOS D			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.

PHASING SUMMARY

Site: 2575 [3. Coonara Avenue/ Castle Hill Road/ Edward Bennett Drive - PM - Scenario 2]

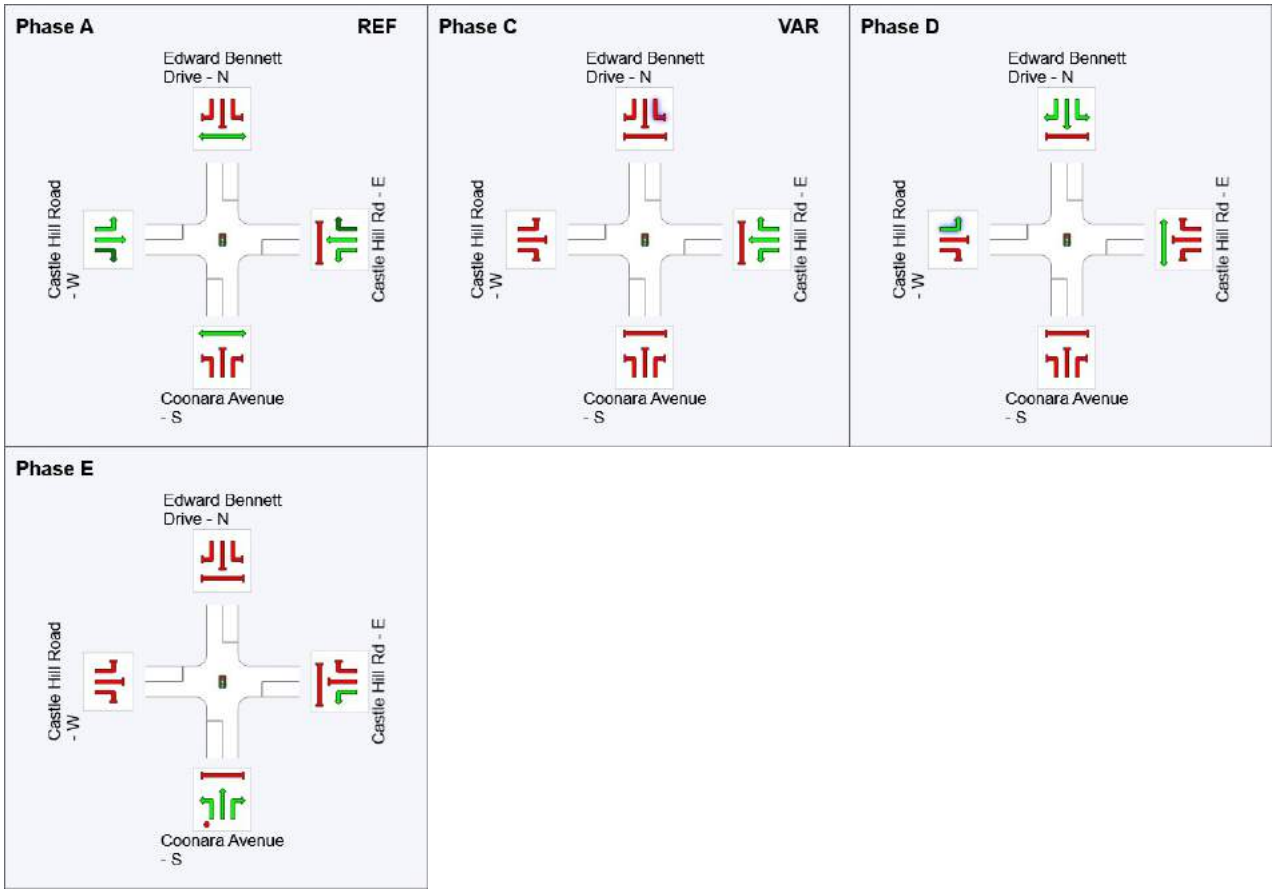
Existing intersection
Signals - Fixed Time Isolated Cycle Time = 107 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase Times determined by the program
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, B*, C*, D, E, F*, F1*, F2*
Output Phase Sequence: A, C*, D, E
(* Variable Phase)

Phase Timing Results

Phase	A	C	D	E
Phase Change Time (sec)	0	49	67	88
Green Time (sec)	43	12	15	13
Phase Time (sec)	49	18	21	19
Phase Split	46%	17%	20%	18%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

 Other Movement Class (MC) Stopped  Phase Transition Applied

MOVEMENT SUMMARY

Site: 2575 [3. Coonara Avenue/ Castle Hill Road/ Edward Bennett Drive - PM - Scenario 3]

Existing intersection
Signals - Fixed Time Isolated Cycle Time = 118 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Coonara Avenue - S											
10	L2	113	0.0	0.884	70.5	LOS E	14.0	98.5	1.00	1.03	26.6
11	T1	74	0.0	0.884	65.9	LOS E	14.0	98.5	1.00	1.03	25.8
12	R2	247	2.1	0.884	70.3	LOS E	14.3	102.0	1.00	0.99	26.3
Approach		434	1.2	0.884	69.6	LOS E	14.3	102.0	1.00	1.01	26.3
East: Castle Hill Rd - E											
1	L2	339	1.6	0.881	34.5	LOS C	51.2	363.9	0.91	0.91	37.1
2	T1	1271	1.8	0.881	29.9	LOS C	51.2	363.9	0.80	0.82	39.8
3	R2	188	4.5	0.448	44.0	LOS D	9.2	67.2	0.91	0.88	32.7
Approach		1798	2.0	0.881	32.3	LOS C	51.2	363.9	0.83	0.85	38.4
North: Edward Bennett Drive - N											
4	L2	44	9.5	0.187	54.4	LOS D	2.3	17.5	0.92	0.73	29.6
5	T1	27	0.0	0.278	50.4	LOS D	3.7	26.4	0.94	0.74	29.0
6	R2	43	2.4	0.278	55.0	LOS D	3.7	26.4	0.94	0.74	30.0
Approach		115	4.6	0.278	53.7	LOS D	3.7	26.4	0.93	0.74	29.6
West: Castle Hill Road - W											
7	L2	58	9.1	0.737	44.5	LOS D	24.7	179.3	0.94	0.86	34.0
8	T1	791	3.5	0.737	36.5	LOS C	24.7	179.3	0.89	0.81	37.3
9	R2	56	1.9	0.696	66.5	LOS E	3.5	25.2	1.00	0.88	27.2
Approach		904	3.7	0.737	38.9	LOS C	24.7	179.3	0.90	0.82	36.3
All Vehicles		3251	2.5	0.884	39.9	LOS C	51.2	363.9	0.88	0.86	35.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
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 per ped
P4	South Full Crossing	53	29.3	LOS C	0.1	0.1	0.70	0.70
P1	East Full Crossing	53	53.3	LOS E	0.2	0.2	0.95	0.95
P2	North Full Crossing	53	29.3	LOS C	0.1	0.1	0.70	0.70
All Pedestrians		158	37.3	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.

PHASING SUMMARY

Site: 2575 [3. Coonara Avenue/ Castle Hill Road/ Edward Bennett Drive - PM - Scenario 3]

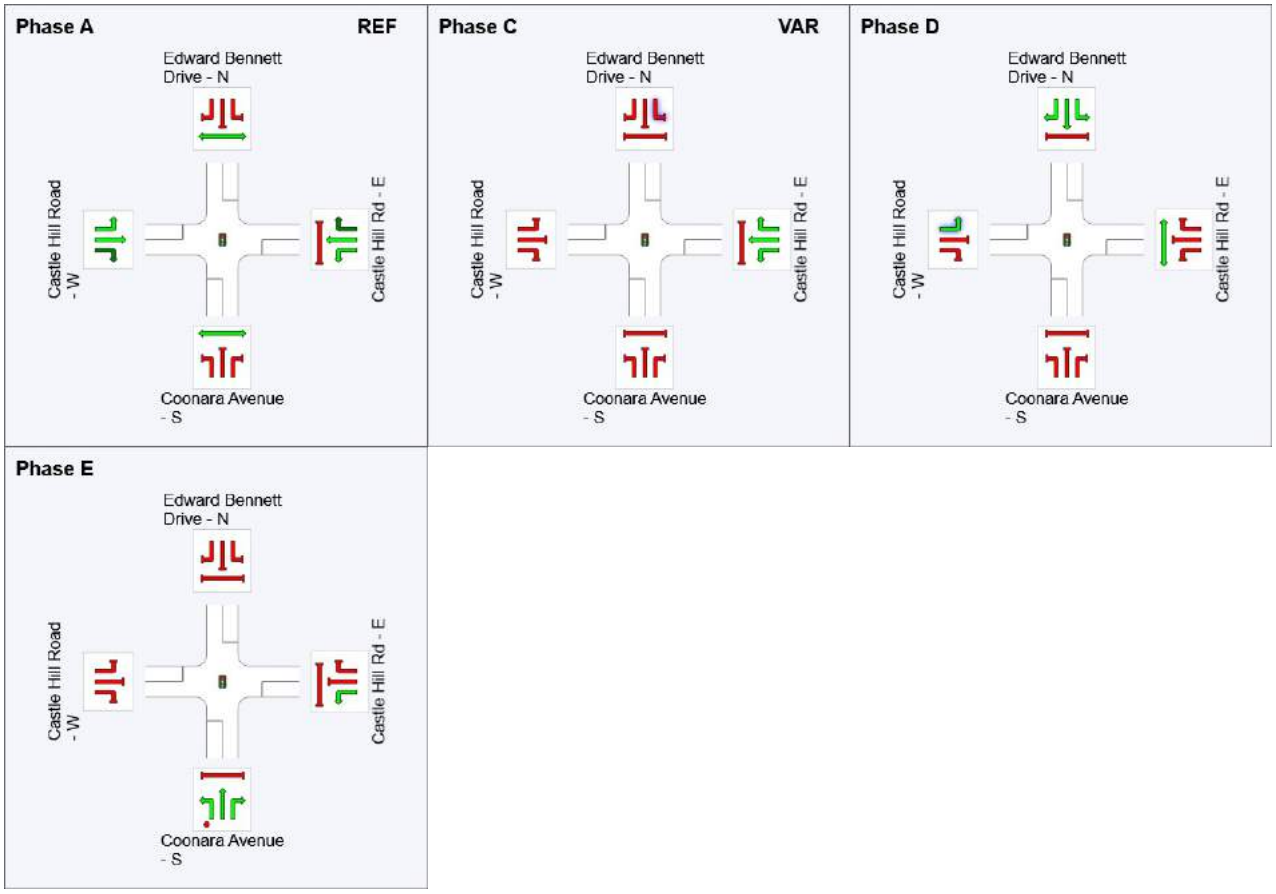
Existing intersection
Signals - Fixed Time Isolated Cycle Time = 118 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase Times determined by the program
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, B*, C*, D, E, F*, F1*, F2*
Output Phase Sequence: A, C*, D, E
(* Variable Phase)

Phase Timing Results

Phase	A	C	D	E
Phase Change Time (sec)	0	48	74	96
Green Time (sec)	42	20	16	16
Phase Time (sec)	48	26	22	22
Phase Split	41%	22%	19%	19%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

 Other Movement Class (MC) Stopped  Phase Transition Applied

MOVEMENT SUMMARY

Site: 2575 [3. Coonara Avenue/ Castle Hill Road/ Edward Bennett Drive - PM]

Existing intersection
Signals - Fixed Time Isolated Cycle Time = 105 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Coonara Avenue - S											
10	L2	113	0.0	0.886	65.2	LOS E	11.6	81.5	1.00	1.05	27.7
11	T1	74	0.0	0.886	60.6	LOS E	11.6	81.5	1.00	1.05	26.8
12	R2	211	2.5	0.886	65.1	LOS E	11.8	84.4	1.00	1.01	27.3
Approach		397	1.3	0.886	64.3	LOS E	11.8	84.4	1.00	1.03	27.3
East: Castle Hill Rd - E											
1	L2	193	2.7	0.848	29.5	LOS C	40.7	290.1	0.89	0.87	39.4
2	T1	1271	1.8	0.848	24.5	LOS B	40.7	290.1	0.79	0.80	42.5
3	R2	188	4.5	0.527	36.5	LOS C	8.5	61.6	0.93	0.83	35.1
Approach		1652	2.2	0.848	26.4	LOS B	40.7	290.1	0.82	0.81	41.1
North: Edward Bennett Drive - N											
4	L2	44	9.5	0.178	48.3	LOS D	2.0	15.5	0.92	0.73	31.1
5	T1	27	0.0	0.264	44.2	LOS D	3.3	23.4	0.93	0.74	30.5
6	R2	43	2.4	0.264	48.8	LOS D	3.3	23.4	0.93	0.74	31.6
Approach		115	4.6	0.264	47.5	LOS D	3.3	23.4	0.92	0.74	31.1
West: Castle Hill Road - W											
7	L2	58	9.1	0.594	34.6	LOS C	17.5	127.2	0.85	0.78	37.5
8	T1	791	3.5	0.594	27.8	LOS B	17.5	127.2	0.84	0.75	41.0
9	R2	56	1.9	0.745	66.6	LOS E	3.2	22.5	1.00	0.81	27.2
Approach		904	3.7	0.745	30.6	LOS C	17.5	127.2	0.85	0.76	39.5
All Vehicles		3067	2.6	0.886	33.3	LOS C	40.7	290.1	0.85	0.82	37.7

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 per ped
P4	South Full Crossing	53	24.1	LOS C	0.1	0.1	0.68	0.68
P1	East Full Crossing	53	46.8	LOS E	0.1	0.1	0.94	0.94
P2	North Full Crossing	53	24.1	LOS C	0.1	0.1	0.68	0.68
All Pedestrians		158	31.6	LOS D			0.77	0.77

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.

PHASING SUMMARY

Site: 2575 [3. Coonara Avenue/ Castle Hill Road/ Edward Bennett Drive - PM]

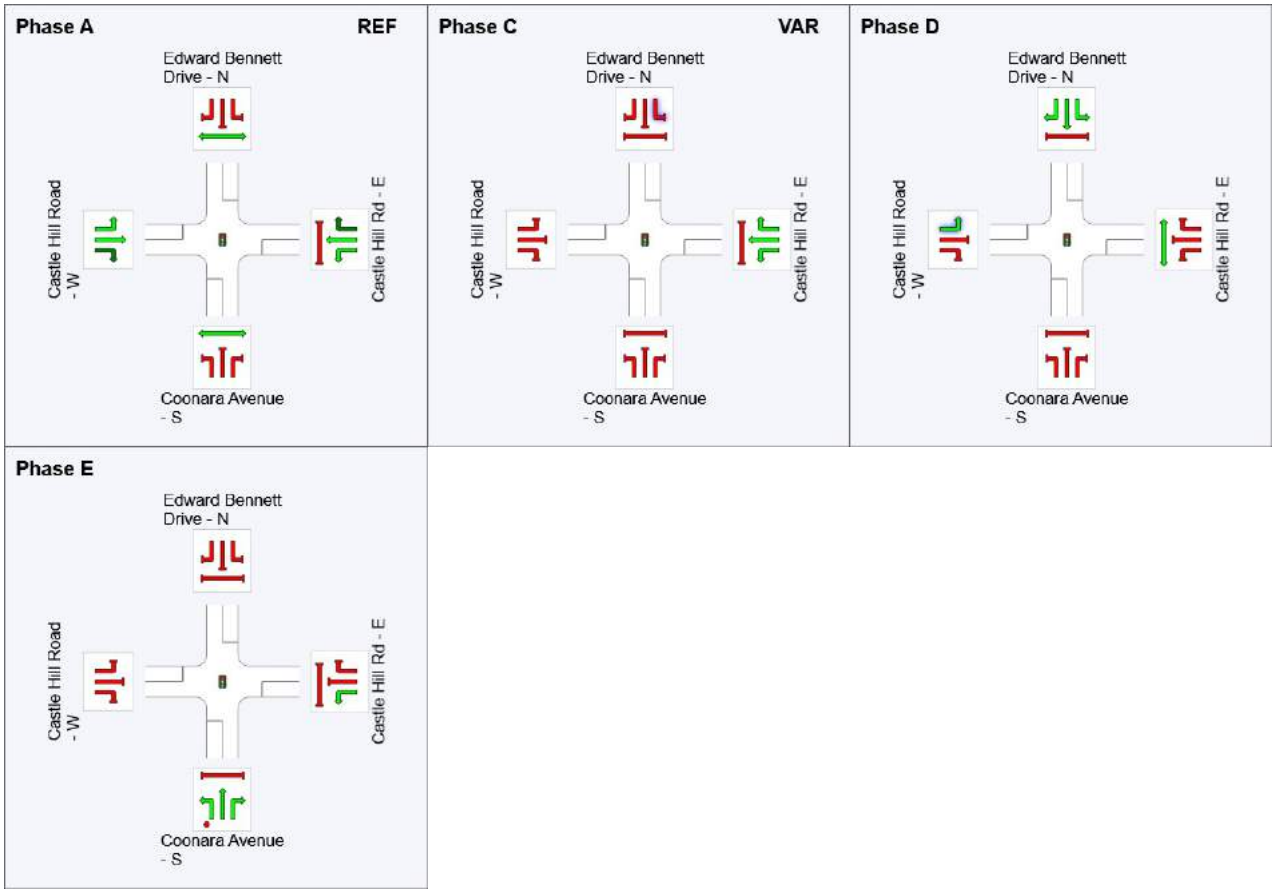
Existing intersection
Signals - Fixed Time Isolated Cycle Time = 105 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase Times determined by the program
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, B*, C*, D, E, F*, F1*, F2*
Output Phase Sequence: A, C*, D, E
(* Variable Phase)

Phase Timing Results

Phase	A	C	D	E
Phase Change Time (sec)	0	47	65	86
Green Time (sec)	41	12	15	13
Phase Time (sec)	47	18	21	19
Phase Split	45%	17%	20%	18%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

 Other Movement Class (MC) Stopped  Phase Transition Applied

MOVEMENT SUMMARY

Site: 102 [2. Coonara Avenue/ Highs Road/ Taylor Street - AM - Scenario 1]

Coonara Avenue/ Highs Road/ Taylor Street existing conditions
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Taylor St - S											
1	L2	51	14.6	0.203	3.3	LOS A	1.0	7.1	0.23	0.34	47.5
2	T1	357	1.8	0.203	2.9	LOS A	1.0	7.1	0.23	0.40	48.5
3	R2	145	0.7	0.203	7.7	LOS A	1.0	6.9	0.23	0.50	47.9
Approach		553	2.7	0.203	4.2	LOS A	1.0	7.1	0.23	0.42	48.2
East: Coonara Ave - E											
4	L2	189	0.0	0.166	4.1	LOS A	0.7	4.9	0.44	0.56	47.1
5	T1	24	0.0	0.076	4.7	LOS A	0.3	2.1	0.47	0.65	46.8
6	R2	29	10.7	0.076	9.8	LOS A	0.3	2.1	0.47	0.65	46.9
Approach		243	1.3	0.166	4.8	LOS A	0.7	4.9	0.44	0.58	47.0
North: Highs Rd - N											
7	L2	43	4.9	0.184	3.8	LOS A	0.8	6.0	0.36	0.41	47.1
8	T1	354	3.0	0.184	3.5	LOS A	0.8	6.0	0.36	0.43	48.3
9	R2	37	17.1	0.184	8.6	LOS A	0.8	6.1	0.37	0.46	48.2
Approach		434	4.4	0.184	4.0	LOS A	0.8	6.1	0.36	0.43	48.2
West: Highs Road - W											
10	L2	105	3.0	0.104	4.3	LOS A	0.4	2.9	0.44	0.56	47.0
11	T1	71	6.0	0.104	4.3	LOS A	0.4	2.9	0.46	0.58	47.6
12	R2	29	35.7	0.104	9.9	LOS A	0.4	3.1	0.47	0.58	47.4
Approach		205	8.7	0.104	5.1	LOS A	0.4	3.1	0.45	0.57	47.2
All Vehicles		1435	3.8	0.203	4.4	LOS A	1.0	7.1	0.34	0.47	47.9

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

MOVEMENT SUMMARY

Site: 102 [2. Coonara Avenue/ Highs Road/ Taylor Street - AM - Scenario 3]

Coonara Avenue/ Highs Road/ Taylor Street existing conditions
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Taylor St - S											
1	L2	51	14.6	0.212	3.4	LOS A	1.0	7.6	0.25	0.35	47.4
2	T1	357	1.8	0.212	2.9	LOS A	1.0	7.6	0.25	0.40	48.4
3	R2	163	0.6	0.212	7.8	LOS A	1.0	7.3	0.25	0.51	47.7
Approach		571	2.6	0.212	4.4	LOS A	1.0	7.6	0.25	0.43	48.1
East: Coonara Ave - E											
4	L2	263	0.0	0.230	4.2	LOS A	1.0	7.2	0.46	0.57	47.0
5	T1	24	0.0	0.099	4.9	LOS A	0.4	2.7	0.48	0.68	46.4
6	R2	42	7.5	0.099	10.0	LOS A	0.4	2.7	0.48	0.68	46.7
Approach		329	1.0	0.230	5.0	LOS A	1.0	7.2	0.46	0.59	46.9
North: Highs Rd - N											
7	L2	46	4.5	0.188	3.9	LOS A	0.9	6.1	0.37	0.42	47.1
8	T1	354	3.0	0.188	3.6	LOS A	0.9	6.1	0.38	0.44	48.2
9	R2	37	17.1	0.188	8.7	LOS A	0.8	6.2	0.38	0.46	48.1
Approach		437	4.3	0.188	4.0	LOS A	0.9	6.2	0.38	0.44	48.1
West: Highs Road - W											
10	L2	105	3.0	0.106	4.4	LOS A	0.4	3.0	0.45	0.57	47.0
11	T1	71	6.0	0.106	4.3	LOS A	0.4	3.0	0.48	0.59	47.5
12	R2	29	35.7	0.106	10.0	LOS A	0.4	3.2	0.48	0.59	47.3
Approach		205	8.7	0.106	5.2	LOS A	0.4	3.2	0.47	0.58	47.2
All Vehicles		1542	3.5	0.230	4.5	LOS A	1.0	7.6	0.36	0.49	47.7

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

MOVEMENT SUMMARY

Site: 102 [2. Coonara Avenue/ Highs Road/ Taylor Street - AM -Scenario 2]

Coonara Avenue/ Highs Road/ Taylor Street existing conditions
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Taylor St - S											
1	L2	51	14.6	0.222	3.5	LOS A	1.1	8.0	0.27	0.35	47.4
2	T1	357	1.8	0.222	3.0	LOS A	1.1	8.0	0.27	0.41	48.3
3	R2	181	0.6	0.222	7.9	LOS A	1.1	7.8	0.27	0.53	47.5
Approach		588	2.5	0.222	4.5	LOS A	1.1	8.0	0.27	0.44	48.0
East: Coonara Ave - E											
4	L2	335	0.0	0.293	4.3	LOS A	1.4	9.6	0.48	0.58	46.9
5	T1	24	0.0	0.119	5.0	LOS A	0.5	3.3	0.49	0.70	46.3
6	R2	56	5.7	0.119	10.0	LOS A	0.5	3.3	0.49	0.70	46.5
Approach		415	0.8	0.293	5.1	LOS A	1.4	9.6	0.48	0.60	46.8
North: Highs Rd - N											
7	L2	49	4.3	0.191	3.9	LOS A	0.9	6.3	0.38	0.43	47.0
8	T1	354	3.0	0.191	3.6	LOS A	0.9	6.3	0.39	0.45	48.2
9	R2	37	17.1	0.191	8.8	LOS A	0.9	6.3	0.39	0.47	48.1
Approach		440	4.3	0.191	4.1	LOS A	0.9	6.3	0.39	0.45	48.0
West: Highs Road - W											
10	L2	105	3.0	0.108	4.4	LOS A	0.4	3.1	0.47	0.58	46.9
11	T1	71	6.0	0.108	4.4	LOS A	0.4	3.1	0.49	0.60	47.5
12	R2	29	35.7	0.108	10.2	LOS A	0.4	3.3	0.49	0.60	47.3
Approach		205	8.7	0.108	5.3	LOS A	0.4	3.3	0.48	0.59	47.2
All Vehicles		1648	3.3	0.293	4.6	LOS A	1.4	9.6	0.38	0.50	47.6

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

MOVEMENT SUMMARY

Site: 102 [2. Coonara Avenue/ Highs Road/ Taylor Street - AM]

Coonara Avenue/ Highs Road/ Taylor Street existing conditions
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Taylor St - S											
1	L2	51	14.6	0.197	3.3	LOS A	0.9	6.8	0.21	0.34	47.6
2	T1	357	1.8	0.197	2.9	LOS A	0.9	6.8	0.21	0.39	48.5
3	R2	133	0.8	0.197	7.7	LOS A	0.9	6.6	0.22	0.48	48.0
Approach		540	2.7	0.197	4.1	LOS A	0.9	6.8	0.21	0.41	48.3
East: Coonara Ave - E											
4	L2	141	0.0	0.123	4.0	LOS A	0.5	3.5	0.42	0.54	47.1
5	T1	24	0.0	0.061	4.5	LOS A	0.2	1.7	0.46	0.61	47.1
6	R2	21	15.0	0.061	9.7	LOS A	0.2	1.7	0.46	0.61	47.2
Approach		186	1.7	0.123	4.7	LOS A	0.5	3.5	0.43	0.56	47.1
North: Highs Rd - N											
7	L2	41	5.1	0.182	3.8	LOS A	0.8	5.9	0.35	0.40	47.2
8	T1	354	3.0	0.182	3.4	LOS A	0.8	5.9	0.35	0.43	48.3
9	R2	37	17.1	0.182	8.6	LOS A	0.8	6.0	0.36	0.45	48.2
Approach		432	4.4	0.182	3.9	LOS A	0.8	6.0	0.35	0.43	48.2
West: Highs Road - W											
10	L2	105	3.0	0.103	4.2	LOS A	0.4	2.9	0.43	0.55	47.0
11	T1	71	6.0	0.103	4.2	LOS A	0.4	2.9	0.46	0.57	47.6
12	R2	29	35.7	0.103	9.8	LOS A	0.4	3.1	0.46	0.57	47.4
Approach		205	8.7	0.103	5.0	LOS A	0.4	3.1	0.44	0.56	47.3
All Vehicles		1363	4.0	0.197	4.3	LOS A	0.9	6.8	0.32	0.46	48.0

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

MOVEMENT SUMMARY

Site: 102 [2. Coonara Avenue/ Highs Road/ Taylor Street - PM - Scenario 1]

Coonara Avenue/ Highs Road/ Taylor Street existing conditions
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Taylor St - S											
1	L2	134	1.6	0.327	3.8	LOS A	1.8	12.6	0.38	0.42	47.1
2	T1	493	1.7	0.327	3.5	LOS A	1.8	12.6	0.38	0.47	47.9
3	R2	194	0.0	0.327	8.3	LOS A	1.8	12.4	0.39	0.54	47.6
Approach		820	1.3	0.327	4.7	LOS A	1.8	12.6	0.38	0.47	47.7
East: Coonara Ave - E											
4	L2	191	1.1	0.165	4.0	LOS A	0.7	5.0	0.42	0.55	47.1
5	T1	79	0.0	0.116	4.0	LOS A	0.5	3.3	0.43	0.53	47.6
6	R2	31	6.9	0.116	9.0	LOS A	0.5	3.3	0.43	0.53	47.8
Approach		300	1.4	0.165	4.5	LOS A	0.7	5.0	0.43	0.54	47.3
North: Highs Rd - N											
7	L2	47	4.4	0.168	3.9	LOS A	0.8	5.4	0.38	0.42	47.1
8	T1	254	0.4	0.168	3.5	LOS A	0.8	5.4	0.38	0.47	48.0
9	R2	94	2.2	0.168	8.4	LOS A	0.7	5.3	0.38	0.55	47.6
Approach		395	1.3	0.168	4.7	LOS A	0.8	5.4	0.38	0.48	47.8
West: Highs Road - W											
10	L2	46	4.5	0.075	4.7	LOS A	0.3	2.2	0.51	0.56	46.7
11	T1	41	0.0	0.075	4.4	LOS A	0.3	2.2	0.52	0.61	47.4
12	R2	51	4.2	0.075	9.6	LOS A	0.3	2.1	0.53	0.71	46.4
Approach		138	3.1	0.075	6.4	LOS A	0.3	2.2	0.52	0.63	46.8
All Vehicles		1653	1.5	0.327	4.8	LOS A	1.8	12.6	0.40	0.50	47.6

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

MOVEMENT SUMMARY

Site: 102 [2. Coonara Avenue/ Highs Road/ Taylor Street - PM - Scenario 2]

Coonara Avenue/ Highs Road/ Taylor Street existing conditions
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Taylor St - S											
1	L2	134	1.6	0.387	3.8	LOS A	2.2	15.9	0.41	0.42	47.0
2	T1	493	1.7	0.387	3.5	LOS A	2.2	15.9	0.41	0.47	47.9
3	R2	343	0.0	0.387	8.4	LOS A	2.2	15.6	0.42	0.60	46.9
Approach		969	1.1	0.387	5.3	LOS A	2.2	15.9	0.41	0.51	47.4
East: Coonara Ave - E											
4	L2	228	0.9	0.200	4.1	LOS A	0.9	6.3	0.45	0.55	47.0
5	T1	79	0.0	0.128	4.1	LOS A	0.5	3.7	0.45	0.56	47.4
6	R2	37	5.7	0.128	9.1	LOS A	0.5	3.7	0.45	0.56	47.7
Approach		344	1.2	0.200	4.6	LOS A	0.9	6.3	0.45	0.55	47.2
North: Highs Rd - N											
7	L2	74	2.9	0.199	4.4	LOS A	1.0	6.8	0.48	0.50	46.7
8	T1	254	0.4	0.199	4.1	LOS A	1.0	6.8	0.49	0.54	47.6
9	R2	94	2.2	0.199	9.1	LOS A	0.9	6.6	0.49	0.60	47.3
Approach		421	1.3	0.199	5.3	LOS A	1.0	6.8	0.49	0.55	47.4
West: Highs Road - W											
10	L2	46	4.5	0.081	5.0	LOS A	0.3	2.4	0.56	0.60	46.6
11	T1	41	0.0	0.081	4.7	LOS A	0.3	2.4	0.56	0.65	47.3
12	R2	51	4.2	0.081	10.0	LOS A	0.3	2.3	0.57	0.75	46.2
Approach		138	3.1	0.081	6.7	LOS A	0.3	2.4	0.57	0.67	46.6
All Vehicles		1873	1.3	0.387	5.3	LOS A	2.2	15.9	0.45	0.54	47.3

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

MOVEMENT SUMMARY

Site: 102 [2. Coonara Avenue/ Highs Road/ Taylor Street - PM - Scenario 3]

Coonara Avenue/ Highs Road/ Taylor Street existing conditions
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Taylor St - S											
1	L2	134	1.6	0.357	3.8	LOS A	2.0	14.2	0.39	0.42	47.1
2	T1	493	1.7	0.357	3.5	LOS A	2.0	14.2	0.39	0.47	47.9
3	R2	268	0.0	0.357	8.4	LOS A	2.0	13.9	0.40	0.57	47.2
Approach		895	1.2	0.357	5.0	LOS A	2.0	14.2	0.40	0.49	47.5
East: Coonara Ave - E											
4	L2	209	1.0	0.182	4.1	LOS A	0.8	5.6	0.44	0.55	47.0
5	T1	79	0.0	0.122	4.0	LOS A	0.5	3.5	0.44	0.55	47.5
6	R2	34	6.3	0.122	9.0	LOS A	0.5	3.5	0.44	0.55	47.8
Approach		322	1.3	0.182	4.6	LOS A	0.8	5.6	0.44	0.55	47.2
North: Highs Rd - N											
7	L2	61	3.4	0.183	4.1	LOS A	0.9	6.0	0.43	0.46	46.9
8	T1	254	0.4	0.183	3.8	LOS A	0.9	6.0	0.43	0.50	47.8
9	R2	94	2.2	0.183	8.8	LOS A	0.8	5.9	0.44	0.57	47.4
Approach		408	1.3	0.183	5.0	LOS A	0.9	6.0	0.43	0.51	47.6
West: Highs Road - W											
10	L2	46	4.5	0.078	4.8	LOS A	0.3	2.3	0.54	0.58	46.6
11	T1	41	0.0	0.078	4.5	LOS A	0.3	2.3	0.54	0.63	47.3
12	R2	51	4.2	0.078	9.8	LOS A	0.3	2.2	0.55	0.73	46.3
Approach		138	3.1	0.078	6.6	LOS A	0.3	2.3	0.54	0.65	46.7
All Vehicles		1763	1.4	0.357	5.0	LOS A	2.0	14.2	0.42	0.52	47.4

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

MOVEMENT SUMMARY

Site: 102 [2. Coonara Avenue/ Highs Road/ Taylor Street - PM]

Coonara Avenue/ Highs Road/ Taylor Street existing conditions
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Taylor St - S											
1	L2	134	1.6	0.308	3.7	LOS A	1.6	11.6	0.37	0.42	47.1
2	T1	493	1.7	0.308	3.4	LOS A	1.6	11.6	0.37	0.46	48.0
3	R2	144	0.0	0.308	8.3	LOS A	1.6	11.4	0.38	0.51	47.8
Approach		771	1.4	0.308	4.4	LOS A	1.6	11.6	0.37	0.46	47.8
East: Coonara Ave - E											
4	L2	178	1.2	0.154	4.0	LOS A	0.6	4.6	0.42	0.54	47.1
5	T1	79	0.0	0.112	4.0	LOS A	0.4	3.1	0.43	0.53	47.6
6	R2	28	7.4	0.112	8.9	LOS A	0.4	3.1	0.43	0.53	47.9
Approach		285	1.5	0.154	4.5	LOS A	0.6	4.6	0.42	0.54	47.3
North: Highs Rd - N											
7	L2	39	5.4	0.160	3.7	LOS A	0.7	5.0	0.34	0.40	47.2
8	T1	254	0.4	0.160	3.3	LOS A	0.7	5.0	0.34	0.45	48.1
9	R2	94	2.2	0.160	8.3	LOS A	0.7	4.9	0.35	0.53	47.7
Approach		386	1.4	0.160	4.6	LOS A	0.7	5.0	0.34	0.46	47.9
West: Highs Road - W											
10	L2	46	4.5	0.073	4.6	LOS A	0.3	2.1	0.50	0.55	46.8
11	T1	41	0.0	0.073	4.2	LOS A	0.3	2.1	0.50	0.60	47.5
12	R2	51	4.2	0.073	9.4	LOS A	0.3	2.1	0.51	0.69	46.5
Approach		138	3.1	0.073	6.2	LOS A	0.3	2.1	0.50	0.62	46.9
All Vehicles		1580	1.5	0.308	4.6	LOS A	1.6	11.6	0.38	0.49	47.7

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

MOVEMENT SUMMARY

Site: 2719 [1. Highs Road/ Castle Hill Road/ Country Drive - AM - Scenario 1]

Existing conditions
Signals - Fixed Time Coordinated Cycle Time = 82 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Highs Road - S											
10	L2	394	2.9	0.946	61.3	LOS E	21.5	154.0	1.00	1.14	28.1
11	T1	116	0.9	0.863	49.3	LOS D	5.7	39.9	1.00	1.00	31.8
12	R2	6	0.0	0.863	53.8	LOS D	5.7	39.9	1.00	1.00	31.0
Approach		516	2.4	0.946	58.5	LOS E	21.5	154.0	1.00	1.11	28.8
East: Castle Hill Road - E											
1	L2	6	33.3	0.913	59.8	LOS E	22.0	162.7	1.00	1.15	30.0
2	T1	869	6.2	0.913	50.7	LOS D	22.0	162.7	1.00	1.14	32.8
3	R2	96	14.3	0.777	52.3	LOS D	4.3	33.7	1.00	0.90	31.9
Approach		972	7.2	0.913	50.9	LOS D	22.0	162.7	1.00	1.12	32.7
North: Country Drive - N											
4	L2	97	7.6	0.167	17.7	LOS B	1.9	14.0	0.74	0.73	45.3
5	T1	161	2.0	0.327	28.3	LOS B	5.3	37.8	0.86	0.73	38.5
6	R2	859	2.9	0.922	51.8	LOS D	20.8	149.1	1.00	1.03	32.2
Approach		1117	3.2	0.922	45.5	LOS D	20.8	149.1	0.96	0.96	33.8
West: Castle Hill Road - W											
7	L2	597	2.5	0.657	14.3	LOS A	12.9	92.2	0.59	0.76	47.5
8	T1	852	3.7	0.733	28.4	LOS B	15.0	108.4	0.90	0.81	41.0
9	R2	201	5.8	0.651	26.7	LOS B	5.4	39.5	0.98	0.82	38.7
Approach		1649	3.5	0.733	23.1	LOS B	15.0	108.4	0.80	0.79	42.8
All Vehicles		4254	4.1	0.946	39.6	LOS C	22.0	162.7	0.91	0.95	35.7

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 per ped
P4	South Full Crossing	53	28.3	LOS C	0.1	0.1	0.83	0.83
P1	East Full Crossing	53	35.3	LOS D	0.1	0.1	0.93	0.93
P2	North Full Crossing	53	35.3	LOS D	0.1	0.1	0.93	0.93
All Pedestrians		158	33.0	LOS D			0.90	0.90

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.

PHASING SUMMARY

Site: 2719 [1. Highs Road/ Castle Hill Road/ Country Drive - AM - Scenario 1]

Existing conditions
Signals - Fixed Time Coordinated Cycle Time = 82 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

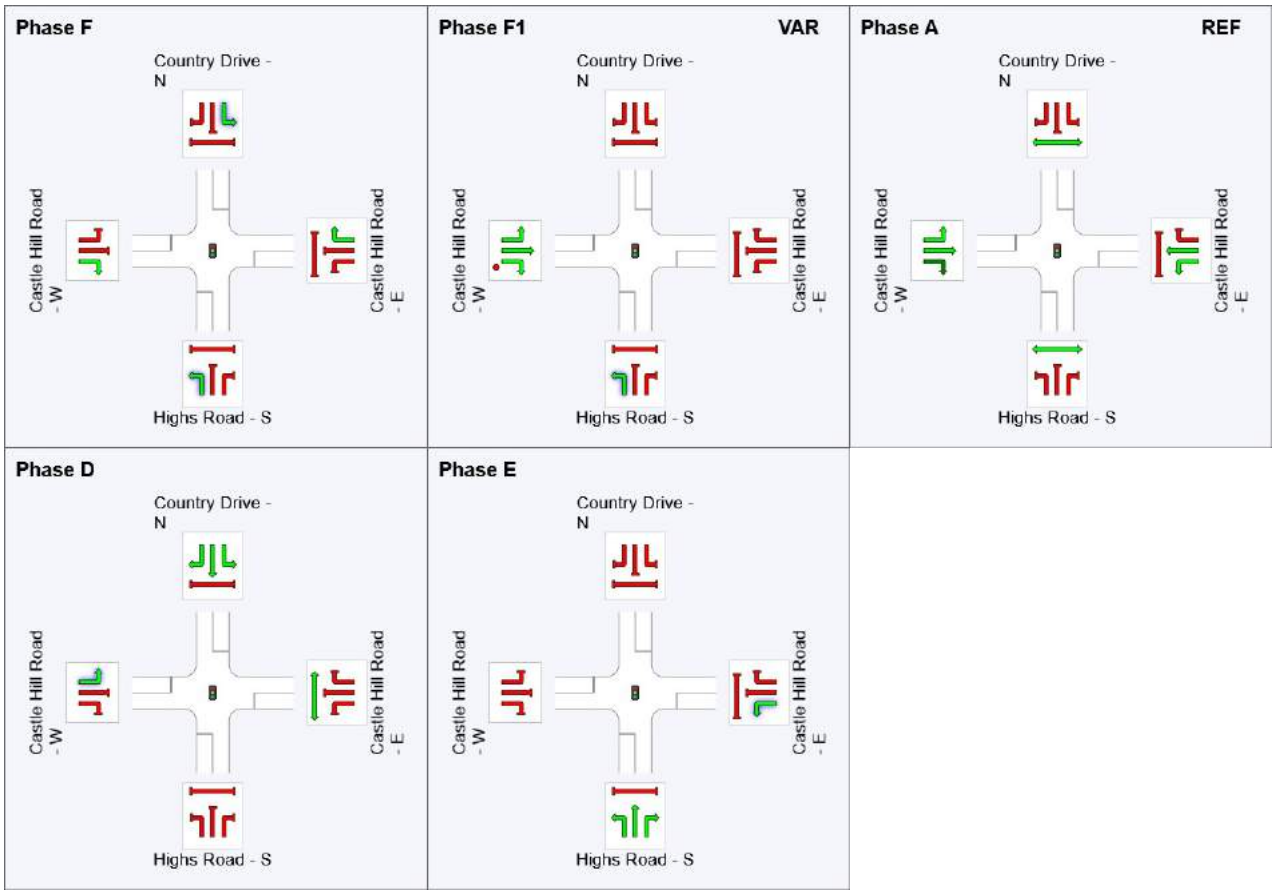
Phase Times determined by the program
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: F, F1*, F2*, A, B*, C*, D, E
Output Phase Sequence: F, F1*, A, D, E
(* Variable Phase)

Phase Timing Results

Phase	F	F1	A	D	E
Phase Change Time (sec)	66	78	0	27	54
Green Time (sec)	6	***	21	21	6
Phase Time (sec)	12	4	27	27	12
Phase Split	15%	5%	33%	33%	15%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

*** No green time has been calculated for this phase because the next phase starts during its intergreen time. This occurs with overlap phasing where there is no single movement connecting this phase to the next, or where the only such movement is a dummy movement with zero minimum green time specified.
If a green time is required for this phase, specify a dummy movement with a non-zero minimum green time.



REF: Reference Phase
VAR: Variable Phase


Stopped Movement
Other Movement Class (MC) Running
Mixed Running & Stopped MCs
Other Movement Class (MC) Stopped
Turn On Red
Undetected Movement
Continuous Movement
Phase Transition Applied

MOVEMENT SUMMARY

Site: 2719 [1. Highs Road/ Castle Hill Road/ Country Drive - AM - Scenario 2]

Existing conditions
Signals - Fixed Time Coordinated Cycle Time = 90 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Highs Road - S											
10	L2	420	2.8	0.949	64.9	LOS E	24.8	177.6	1.00	1.12	27.3
11	T1	116	0.9	0.812	50.6	LOS D	6.0	42.0	1.00	0.94	31.4
12	R2	6	0.0	0.812	55.2	LOS D	6.0	42.0	1.00	0.94	30.6
Approach		542	2.3	0.949	61.8	LOS E	24.8	177.6	1.00	1.08	28.1
East: Castle Hill Road - E											
1	L2	6	33.3	0.915	63.7	LOS E	23.9	176.4	1.00	1.14	29.1
2	T1	869	6.2	0.915	54.6	LOS D	23.9	176.4	1.00	1.13	31.8
3	R2	96	14.3	0.852	59.9	LOS E	4.9	38.2	1.00	0.96	29.9
Approach		972	7.2	0.915	55.2	LOS D	23.9	176.4	1.00	1.12	31.5
North: Country Drive - N											
4	L2	97	7.6	0.171	19.4	LOS B	2.1	15.8	0.75	0.73	44.4
5	T1	161	2.0	0.327	30.9	LOS C	5.8	41.4	0.86	0.73	37.5
6	R2	859	2.9	0.924	55.6	LOS D	22.6	162.1	1.00	1.02	31.1
Approach		1117	3.2	0.924	48.9	LOS D	22.6	162.1	0.96	0.95	32.8
West: Castle Hill Road - W											
7	L2	597	2.5	0.627	14.0	LOS A	13.3	94.9	0.55	0.75	47.6
8	T1	852	3.7	0.671	26.8	LOS B	14.9	107.9	0.85	0.74	41.8
9	R2	207	5.6	0.606	26.9	LOS B	5.8	42.2	0.97	0.80	38.6
Approach		1656	3.5	0.671	22.2	LOS B	14.9	107.9	0.75	0.75	43.2
All Vehicles		4286	4.1	0.949	41.6	LOS C	24.8	177.6	0.89	0.93	35.0

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	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P4	South Full Crossing	53	30.5	LOS D	0.1	0.1	0.82	0.82
P1	East Full Crossing	53	37.4	LOS D	0.1	0.1	0.91	0.91
P2	North Full Crossing	53	39.3	LOS D	0.1	0.1	0.94	0.94
All Pedestrians		158	35.7	LOS D			0.89	0.89

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.

PHASING SUMMARY

Site: 2719 [1. Highs Road/ Castle Hill Road/ Country Drive - AM - Scenario 2]

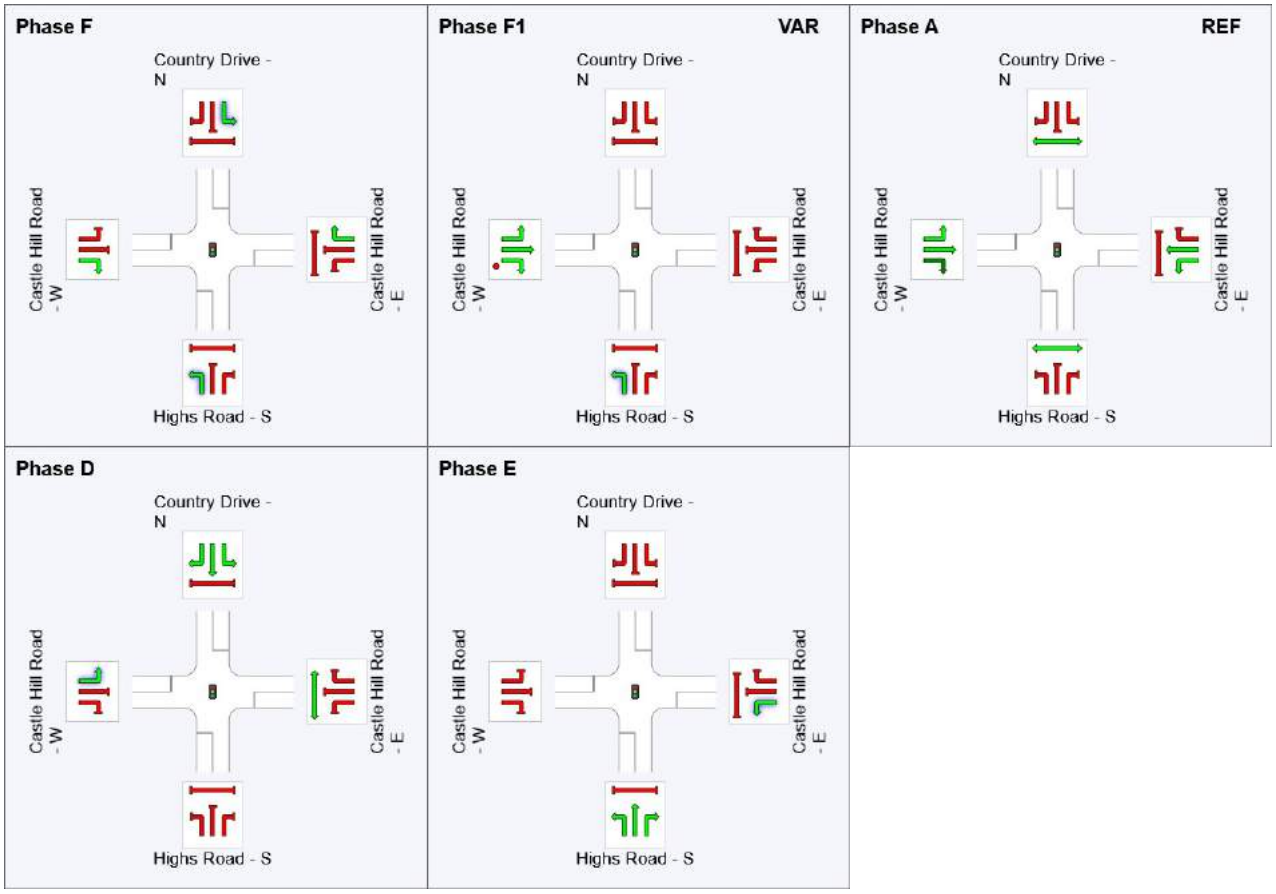
Existing conditions
Signals - Fixed Time Coordinated Cycle Time = 90 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase Times determined by the program
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: F, F1*, F2*, A, B*, C*, D, E
Output Phase Sequence: F, F1*, A, D, E
(* Variable Phase)

Phase Timing Results

Phase	F	F1	A	D	E
Phase Change Time (sec)	71	83	0	29	58
Green Time (sec)	6	1	23	23	7
Phase Time (sec)	12	7	29	29	13
Phase Split	13%	8%	32%	32%	14%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

 Other Movement Class (MC) Stopped

 Phase Transition Applied

MOVEMENT SUMMARY

Site: 2719 [1. Highs Road/ Castle Hill Road/ Country Drive - AM - Scenario 3]

Existing conditions
Signals - Fixed Time Coordinated Cycle Time = 90 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Highs Road - S											
10	L2	406	2.8	0.921	57.0	LOS E	22.2	159.1	0.99	1.07	29.0
11	T1	116	0.9	0.812	50.6	LOS D	6.0	42.0	1.00	0.94	31.4
12	R2	6	0.0	0.812	55.2	LOS D	6.0	42.0	1.00	0.94	30.6
Approach		528	2.4	0.921	55.6	LOS D	22.2	159.1	0.99	1.04	29.5
East: Castle Hill Road - E											
1	L2	6	33.3	0.915	63.7	LOS E	23.9	176.4	1.00	1.14	29.1
2	T1	869	6.2	0.915	54.6	LOS D	23.9	176.4	1.00	1.13	31.8
3	R2	96	14.3	0.852	59.9	LOS E	4.9	38.2	1.00	0.96	29.9
Approach		972	7.2	0.915	55.2	LOS D	23.9	176.4	1.00	1.12	31.5
North: Country Drive - N											
4	L2	97	7.6	0.171	19.4	LOS B	2.1	15.8	0.75	0.73	44.4
5	T1	161	2.0	0.327	30.9	LOS C	5.8	41.4	0.86	0.73	37.5
6	R2	859	2.9	0.924	55.6	LOS D	22.6	162.1	1.00	1.02	31.1
Approach		1117	3.2	0.924	48.9	LOS D	22.6	162.1	0.96	0.95	32.8
West: Castle Hill Road - W											
7	L2	597	2.5	0.627	14.0	LOS A	13.3	94.9	0.55	0.75	47.6
8	T1	852	3.7	0.671	26.8	LOS B	14.9	107.9	0.85	0.74	41.8
9	R2	204	5.7	0.597	26.9	LOS B	5.7	41.5	0.96	0.80	38.6
Approach		1653	3.5	0.671	22.2	LOS B	14.9	107.9	0.75	0.75	43.2
All Vehicles		4269	4.1	0.924	40.8	LOS C	23.9	176.4	0.89	0.92	35.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
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 per ped
P4	South Full Crossing	53	30.5	LOS D	0.1	0.1	0.82	0.82
P1	East Full Crossing	53	37.4	LOS D	0.1	0.1	0.91	0.91
P2	North Full Crossing	53	39.3	LOS D	0.1	0.1	0.94	0.94
All Pedestrians		158	35.7	LOS D			0.89	0.89

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.

PHASING SUMMARY

Site: 2719 [1. Highs Road/ Castle Hill Road/ Country Drive - AM - Scenario 3]

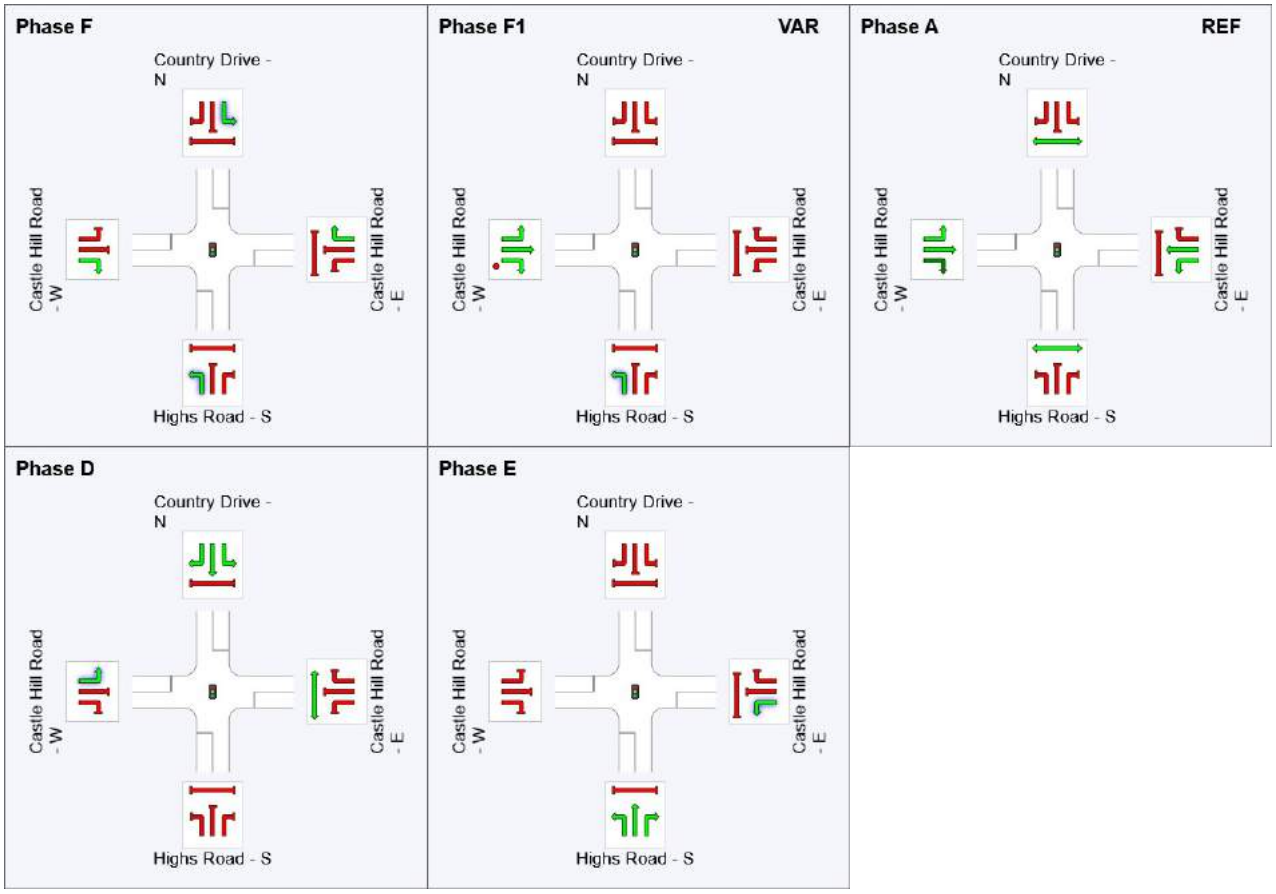
Existing conditions
Signals - Fixed Time Coordinated Cycle Time = 90 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase Times determined by the program
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: F, F1*, F2*, A, B*, C*, D, E
Output Phase Sequence: F, F1*, A, D, E
(* Variable Phase)

Phase Timing Results

Phase	F	F1	A	D	E
Phase Change Time (sec)	71	83	0	29	58
Green Time (sec)	6	1	23	23	7
Phase Time (sec)	12	7	29	29	13
Phase Split	13%	8%	32%	32%	14%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

 Other Movement Class (MC) Stopped

 Phase Transition Applied

MOVEMENT SUMMARY

Site: 2719 [1. Highs Road/ Castle Hill Road/ Country Drive - AM]

Existing conditions
Signals - Fixed Time Coordinated Cycle Time = 85 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Highs Road - S											
10	L2	385	3.0	0.925	56.7	LOS E	20.4	146.1	1.00	1.09	29.1
11	T1	116	0.9	0.894	53.3	LOS D	6.0	42.3	1.00	1.04	30.7
12	R2	6	0.0	0.894	57.9	LOS E	6.0	42.3	1.00	1.04	30.0
Approach		507	2.5	0.925	56.0	LOS D	20.4	146.1	1.00	1.08	29.4
East: Castle Hill Road - E											
1	L2	6	33.3	0.903	59.1	LOS E	22.2	163.8	1.00	1.12	30.1
2	T1	869	6.2	0.903	50.1	LOS D	22.2	163.8	1.00	1.12	33.0
3	R2	96	14.3	0.805	54.9	LOS D	4.5	35.3	1.00	0.92	31.2
Approach		972	7.2	0.903	50.6	LOS D	22.2	163.8	1.00	1.10	32.8
North: Country Drive - N											
4	L2	97	7.6	0.167	18.3	LOS B	2.0	14.7	0.74	0.73	45.0
5	T1	161	2.0	0.323	29.0	LOS C	5.5	39.0	0.85	0.72	38.2
6	R2	859	2.9	0.912	51.2	LOS D	20.9	150.2	1.00	1.01	32.3
Approach		1117	3.2	0.912	45.2	LOS D	20.9	150.2	0.96	0.95	33.9
West: Castle Hill Road - W											
7	L2	597	2.5	0.625	14.0	LOS A	12.9	92.1	0.57	0.76	47.7
8	T1	852	3.7	0.704	27.3	LOS B	14.8	107.1	0.88	0.77	41.5
9	R2	199	5.8	0.620	26.5	LOS B	5.3	39.3	0.98	0.81	38.8
Approach		1647	3.5	0.704	22.4	LOS B	14.8	107.1	0.78	0.77	43.2
All Vehicles		4243	4.1	0.925	38.9	LOS C	22.2	163.8	0.90	0.93	36.0

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 per ped
P4	South Full Crossing	53	28.9	LOS C	0.1	0.1	0.83	0.83
P1	East Full Crossing	53	35.9	LOS D	0.1	0.1	0.92	0.92
P2	North Full Crossing	53	36.8	LOS D	0.1	0.1	0.93	0.93
All Pedestrians		158	33.8	LOS D			0.89	0.89

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.

PHASING SUMMARY

Site: 2719 [1. Highs Road/ Castle Hill Road/ Country Drive - AM]

Existing conditions
Signals - Fixed Time Coordinated Cycle Time = 85 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

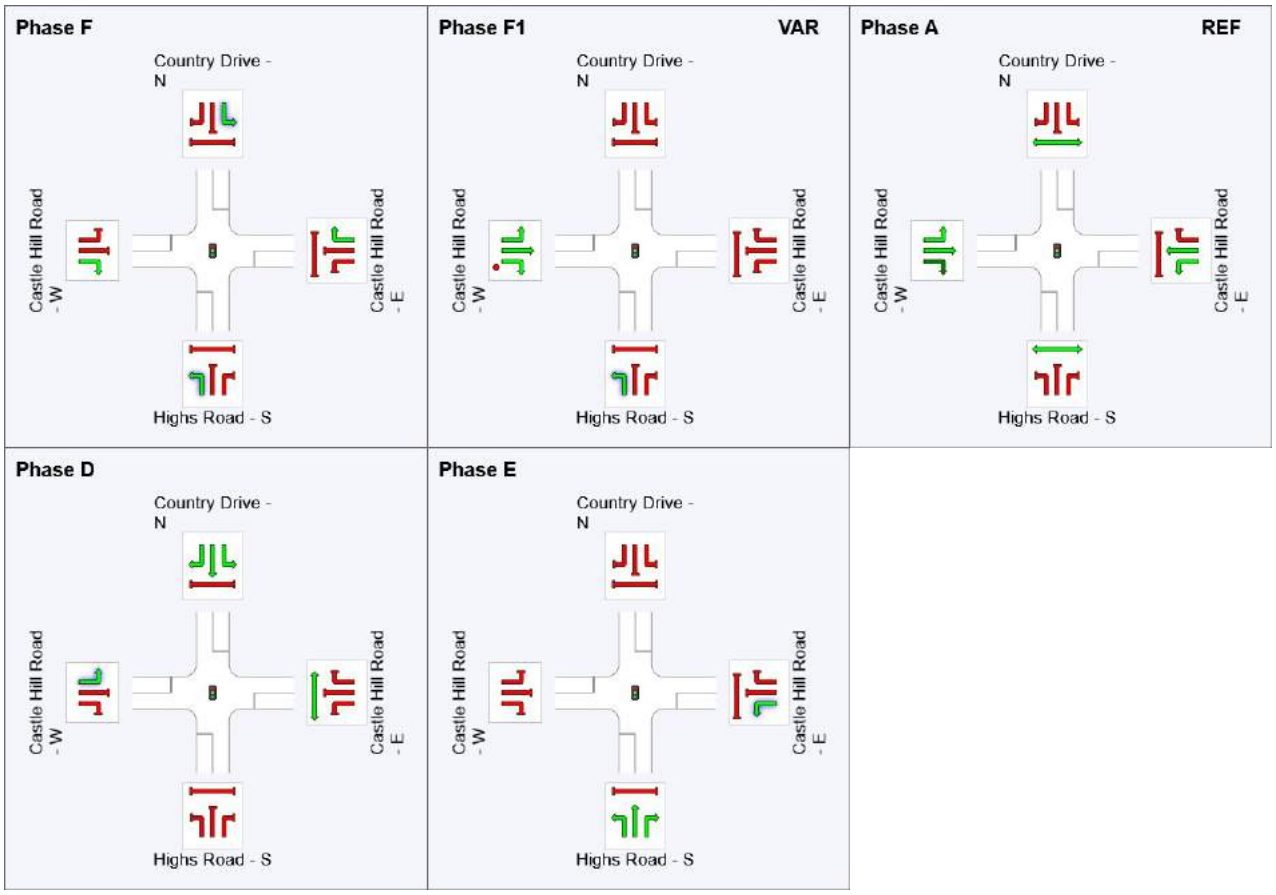
Phase Times determined by the program
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: F, F1*, F2*, A, B*, C*, D, E
Output Phase Sequence: F, F1*, A, D, E
(* Variable Phase)

Phase Timing Results

Phase	F	F1	A	D	E
Phase Change Time (sec)	68	80	0	28	56
Green Time (sec)	6	***	22	22	6
Phase Time (sec)	12	5	28	28	12
Phase Split	14%	6%	33%	33%	14%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

*** No green time has been calculated for this phase because the next phase starts during its intergreen time. This occurs with overlap phasing where there is no single movement connecting this phase to the next, or where the only such movement is a dummy movement with zero minimum green time specified.
If a green time is required for this phase, specify a dummy movement with a non-zero minimum green time.



REF: Reference Phase
VAR: Variable Phase


Stopped Movement
Other Movement Class (MC) Running
Mixed Running & Stopped MCs
Other Movement Class (MC) Stopped
Turn On Red
Undetected Movement
Continuous Movement
Phase Transition Applied

MOVEMENT SUMMARY

Site: 2719 [1. Highs Road/ Castle Hill Road/ Country Drive - PM - Scenario 1]

Existing conditions
Signals - Fixed Time Coordinated Cycle Time = 104 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Highs Road - S											
10	L2	398	2.9	0.952	72.2	LOS F	26.4	189.1	0.99	1.10	25.9
11	T1	154	0.7	0.859	58.8	LOS E	9.1	64.1	1.00	1.00	29.4
12	R2	6	0.0	0.859	63.3	LOS E	9.1	64.1	1.00	1.00	28.7
Approach		558	2.3	0.952	68.4	LOS E	26.4	189.1	0.99	1.07	26.8
East: Castle Hill Road - E											
1	L2	9	0.0	0.944	58.3	LOS E	43.0	305.0	1.00	1.13	30.5
2	T1	1367	1.6	0.944	51.2	LOS D	43.0	305.0	0.99	1.12	32.7
3	R2	106	5.0	0.616	57.3	LOS E	5.5	40.2	1.00	0.81	30.7
Approach		1483	1.8	0.944	51.6	LOS D	43.0	305.0	0.99	1.10	32.5
North: Country Drive - N											
4	L2	52	8.2	0.118	25.4	LOS B	1.5	11.1	0.81	0.72	41.3
5	T1	104	0.0	0.347	44.5	LOS D	4.8	33.9	0.94	0.75	32.9
6	R2	539	1.4	0.952	77.5	LOS F	17.8	126.0	1.00	1.09	26.3
Approach		695	1.7	0.952	68.7	LOS E	17.8	126.0	0.98	1.02	27.9
West: Castle Hill Road - W											
7	L2	674	1.4	0.802	20.2	LOS B	21.3	150.6	0.62	0.80	44.1
8	T1	771	2.9	0.476	20.2	LOS B	11.6	83.1	0.64	0.55	45.2
9	R2	292	1.4	0.894	52.1	LOS D	13.3	94.5	1.00	1.03	30.5
Approach		1736	2.1	0.894	25.5	LOS B	21.3	150.6	0.69	0.73	41.5
All Vehicles		4472	2.0	0.952	46.2	LOS D	43.0	305.0	0.87	0.94	33.6

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.
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	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P4	South Full Crossing	53	24.3	LOS C	0.1	0.1	0.68	0.68
P1	East Full Crossing	53	46.3	LOS E	0.1	0.1	0.94	0.94
P2	North Full Crossing	53	28.6	LOS C	0.1	0.1	0.74	0.74
All Pedestrians		158	33.0	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.

PHASING SUMMARY

Site: 2719 [1. Highs Road/ Castle Hill Road/ Country Drive - PM - Scenario 1]

Existing conditions
Signals - Fixed Time Coordinated Cycle Time = 104 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

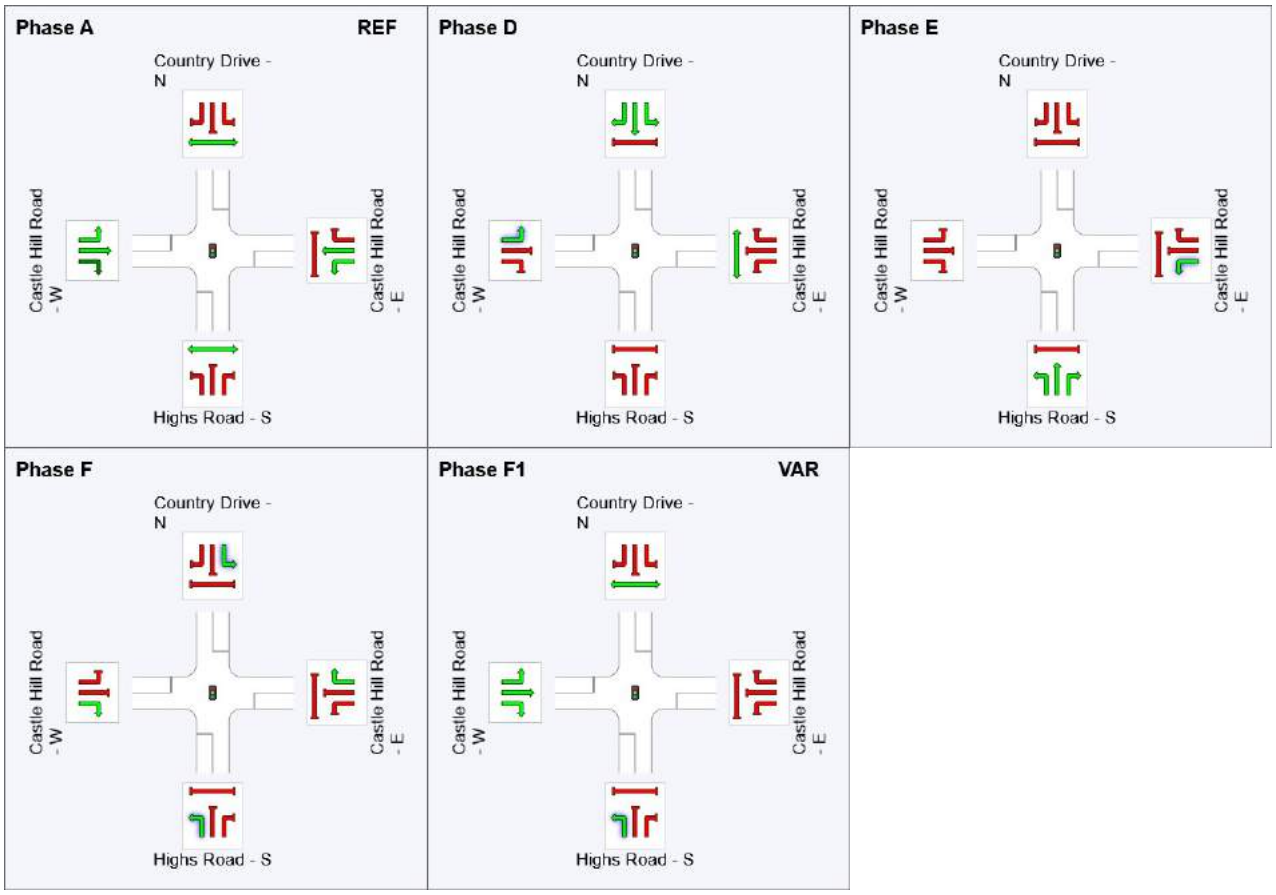
Phase Times determined by the program
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, B*, C*, D, E, F, F1*, F2*
Output Phase Sequence: A, D, E, F, F1*
(* Variable Phase)

Phase Timing Results

Phase	A	D	E	F	F1
Phase Change Time (sec)	0	46	68	84	100
Green Time (sec)	40	16	10	10	***
Phase Time (sec)	46	22	16	16	4
Phase Split	44%	21%	15%	15%	4%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

*** No green time has been calculated for this phase because the next phase starts during its intergreen time. This occurs with overlap phasing where there is no single movement connecting this phase to the next, or where the only such movement is a dummy movement with zero minimum green time specified.
If a green time is required for this phase, specify a dummy movement with a non-zero minimum green time.



REF: Reference Phase
VAR: Variable Phase


Stopped Movement
Other Movement Class (MC) Running
Mixed Running & Stopped MCs
Other Movement Class (MC) Stopped
Turn On Red
Undetected Movement
Continuous Movement
Phase Transition Applied

MOVEMENT SUMMARY

Site: 2719 [1. Highs Road/ Castle Hill Road/ Country Drive - PM - Scenario 2]

Existing conditions
Signals - Fixed Time Coordinated Cycle Time = 109 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Highs Road - S											
10	L2	404	2.9	0.955	75.1	LOS F	28.0	200.7	0.99	1.10	25.4
11	T1	154	0.7	0.900	65.5	LOS E	9.9	69.6	1.00	1.05	27.9
12	R2	6	0.0	0.900	70.1	LOS E	9.9	69.6	1.00	1.05	27.3
Approach		564	2.2	0.955	72.5	LOS F	28.0	200.7	0.99	1.09	26.0
East: Castle Hill Road - E											
1	L2	9	0.0	0.945	59.9	LOS E	44.8	318.1	1.00	1.12	30.0
2	T1	1367	1.6	0.945	52.8	LOS D	44.8	318.1	0.99	1.11	32.2
3	R2	106	5.0	0.497	55.9	LOS D	5.5	40.1	0.98	0.78	31.0
Approach		1483	1.8	0.945	53.1	LOS D	44.8	318.1	0.99	1.08	32.1
North: Country Drive - N											
4	L2	52	8.2	0.107	25.0	LOS B	1.5	11.3	0.78	0.72	41.5
5	T1	104	0.0	0.343	46.3	LOS D	5.0	35.3	0.94	0.75	32.4
6	R2	539	1.4	0.939	76.2	LOS F	18.0	127.3	1.00	1.06	26.5
Approach		695	1.7	0.939	67.9	LOS E	18.0	127.3	0.97	0.99	28.0
West: Castle Hill Road - W											
7	L2	674	1.4	0.819	22.7	LOS B	23.5	166.5	0.64	0.81	42.8
8	T1	771	2.9	0.532	22.2	LOS B	14.2	101.5	0.66	0.57	44.1
9	R2	318	1.3	0.920	60.0	LOS E	16.6	117.5	1.00	1.06	28.6
Approach		1762	2.0	0.920	29.2	LOS C	23.5	166.5	0.71	0.75	39.8
All Vehicles		4504	1.9	0.955	48.5	LOS D	44.8	318.1	0.88	0.94	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	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P4	South Full Crossing	53	25.2	LOS C	0.1	0.1	0.68	0.68
P1	East Full Crossing	53	48.8	LOS E	0.2	0.2	0.95	0.95
P2	North Full Crossing	53	30.2	LOS D	0.1	0.1	0.74	0.74
All Pedestrians		158	34.7	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.

PHASING SUMMARY

Site: 2719 [1. Highs Road/ Castle Hill Road/ Country Drive - PM - Scenario 2]

Existing conditions
Signals - Fixed Time Coordinated Cycle Time = 109 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

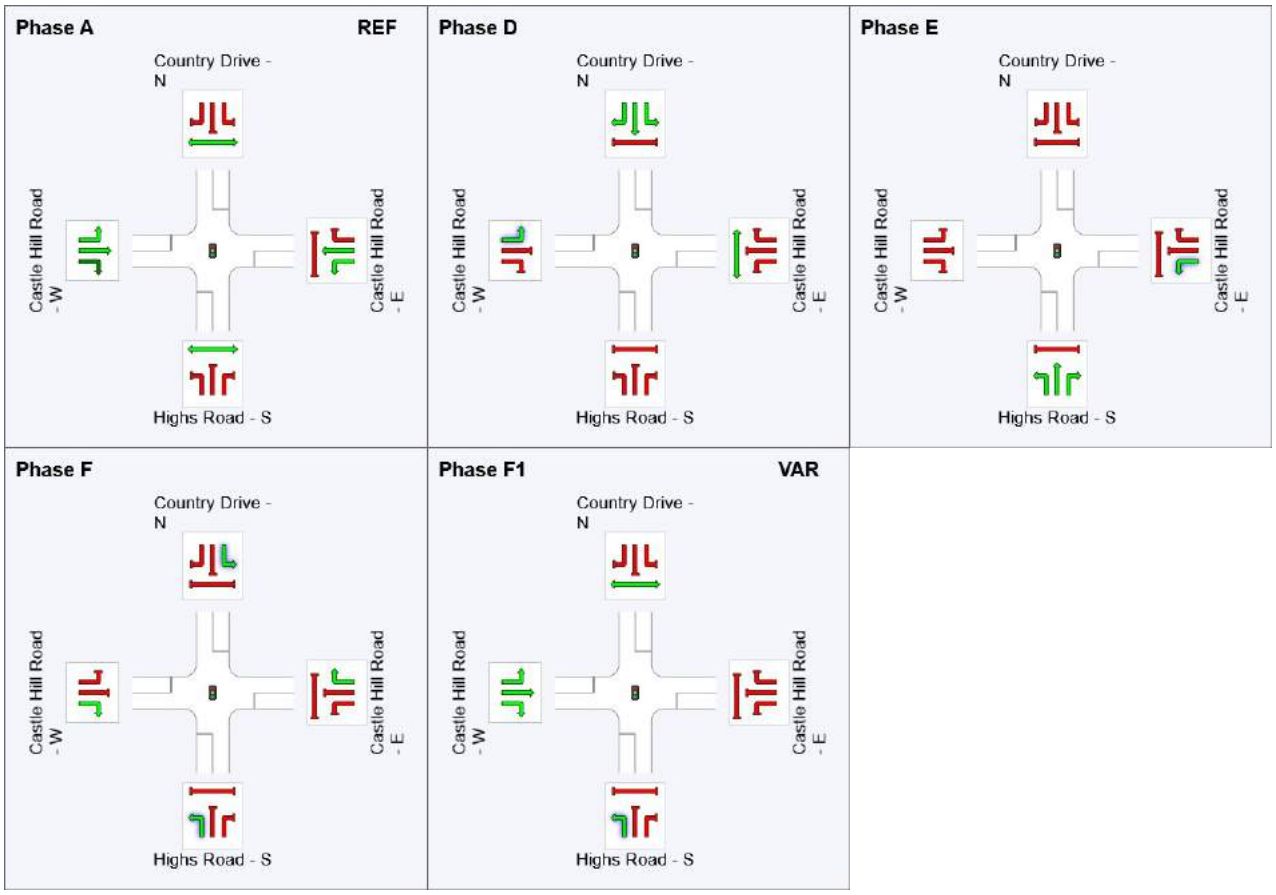
Phase Times determined by the program
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, B*, C*, D, E, F, F1*, F2*
Output Phase Sequence: A, D, E, F, F1*
(* Variable Phase)

Phase Timing Results

Phase	A	D	E	F	F1
Phase Change Time (sec)	0	48	71	87	106
Green Time (sec)	42	17	10	13	***
Phase Time (sec)	48	23	16	19	3
Phase Split	44%	21%	15%	17%	3%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

*** No green time has been calculated for this phase because the next phase starts during its intergreen time. This occurs with overlap phasing where there is no single movement connecting this phase to the next, or where the only such movement is a dummy movement with zero minimum green time specified.
If a green time is required for this phase, specify a dummy movement with a non-zero minimum green time.



REF: Reference Phase
VAR: Variable Phase


Stopped Movement
Other Movement Class (MC) Running
Mixed Running & Stopped MCs
Other Movement Class (MC) Stopped
Turn On Red
Undetected Movement
Continuous Movement
Phase Transition Applied

MOVEMENT SUMMARY

Site: 2719 [1. Highs Road/ Castle Hill Road/ Country Drive - PM - Scenario 3]

Existing conditions
Signals - Fixed Time Coordinated Cycle Time = 112 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Highs Road - S											
10	L2	401	2.9	0.949	73.9	LOS F	27.8	199.7	0.98	1.08	25.6
11	T1	154	0.7	0.925	70.9	LOS F	10.5	73.6	1.00	1.09	26.8
12	R2	6	0.0	0.925	75.5	LOS F	10.5	73.6	1.00	1.09	26.2
Approach		561	2.3	0.949	73.1	LOS F	27.8	199.7	0.99	1.08	25.9
East: Castle Hill Road - E											
1	L2	9	0.0	0.929	55.4	LOS D	43.5	308.8	1.00	1.08	31.2
2	T1	1367	1.6	0.929	48.3	LOS D	43.5	308.8	0.98	1.06	33.6
3	R2	106	5.0	0.289	27.0	LOS B	2.6	19.3	0.88	0.76	41.0
Approach		1483	1.8	0.929	46.8	LOS D	43.5	308.8	0.97	1.03	34.0
North: Country Drive - N											
4	L2	52	8.2	0.072	17.7	LOS B	1.1	8.5	0.63	0.70	45.3
5	T1	104	0.0	0.352	48.0	LOS D	5.2	36.5	0.94	0.75	31.9
6	R2	539	1.4	0.965	86.0	LOS F	19.5	138.1	1.00	1.10	24.8
Approach		695	1.7	0.965	75.2	LOS F	19.5	138.1	0.96	1.02	26.6
West: Castle Hill Road - W											
7	L2	674	1.4	0.940	49.5	LOS D	35.5	251.2	0.95	1.00	32.6
8	T1	771	2.9	0.727	39.1	LOS C	18.9	135.2	0.90	0.79	36.7
9	R2	305	1.4	0.752	29.3	LOS C	11.5	81.7	0.83	0.84	37.7
Approach		1749	2.0	0.940	41.4	LOS C	35.5	251.2	0.91	0.88	35.1
All Vehicles		4488	1.9	0.965	52.4	LOS D	43.5	308.8	0.95	0.98	31.8

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	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P4	South Full Crossing	53	25.2	LOS C	0.1	0.1	0.67	0.67
P1	East Full Crossing	53	50.3	LOS E	0.2	0.2	0.95	0.95
P2	North Full Crossing	53	42.1	LOS E	0.1	0.1	0.87	0.87
All Pedestrians		158	39.2	LOS D			0.83	0.83

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.

PHASING SUMMARY

Site: 2719 [1. Highs Road/ Castle Hill Road/ Country Drive - PM - Scenario 3]

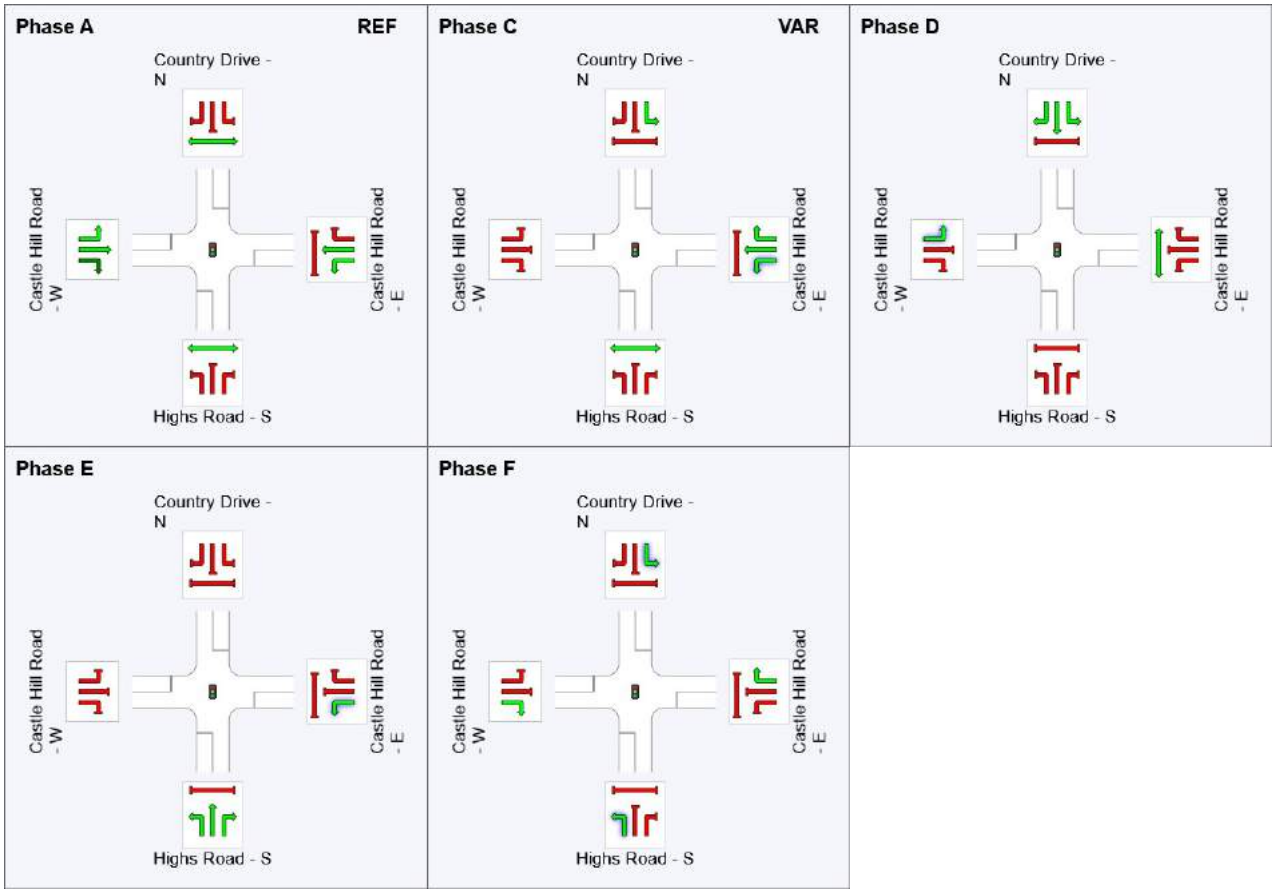
Existing conditions
Signals - Fixed Time Coordinated Cycle Time = 112 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase Times determined by the program
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, B*, C*, D, E, F, F1*, F2*
Output Phase Sequence: A, C*, D, E, F
(* Variable Phase)

Phase Timing Results

Phase	A	C	D	E	F
Phase Change Time (sec)	0	38	50	73	89
Green Time (sec)	32	6	17	10	17
Phase Time (sec)	38	12	23	16	23
Phase Split	34%	11%	21%	14%	21%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

 Other Movement Class (MC) Stopped

 Phase Transition Applied

MOVEMENT SUMMARY

Site: 2719 [1. Highs Road/ Castle Hill Road/ Country Drive - PM]

Existing conditions
Signals - Fixed Time Coordinated Cycle Time = 110 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Highs Road - S											
10	L2	396	2.9	0.947	72.7	LOS F	27.0	193.6	0.98	1.08	25.8
11	T1	154	0.7	0.908	67.2	LOS E	10.1	70.8	1.00	1.07	27.5
12	R2	6	0.0	0.908	71.7	LOS F	10.1	70.8	1.00	1.07	27.0
Approach		556	2.3	0.947	71.2	LOS F	27.0	193.6	0.99	1.08	26.3
East: Castle Hill Road - E											
1	L2	9	0.0	0.933	56.1	LOS D	43.4	307.7	1.00	1.09	31.0
2	T1	1367	1.6	0.933	48.9	LOS D	43.4	307.7	0.98	1.07	33.4
3	R2	106	5.0	0.593	59.3	LOS E	5.7	41.9	1.00	0.80	30.2
Approach		1483	1.8	0.933	49.7	LOS D	43.4	307.7	0.98	1.05	33.1
North: Country Drive - N											
4	L2	52	8.2	0.115	26.7	LOS B	1.6	11.9	0.80	0.72	40.8
5	T1	104	0.0	0.346	46.8	LOS D	5.1	35.7	0.94	0.75	32.2
6	R2	539	1.4	0.948	79.1	LOS F	18.5	130.7	1.00	1.08	26.0
Approach		695	1.7	0.948	70.4	LOS E	18.5	130.7	0.98	1.00	27.5
West: Castle Hill Road - W											
7	L2	674	1.4	0.795	19.0	LOS B	21.1	149.2	0.61	0.78	44.8
8	T1	771	2.9	0.461	19.9	LOS B	11.7	84.1	0.61	0.53	45.3
9	R2	283	1.5	0.823	46.2	LOS D	12.1	85.5	1.00	0.97	32.1
Approach		1727	2.1	0.823	23.9	LOS B	21.1	149.2	0.67	0.70	42.3
All Vehicles		4461	2.0	0.948	45.6	LOS D	43.4	307.7	0.86	0.91	33.8

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	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P4	South Full Crossing	53	24.9	LOS C	0.1	0.1	0.67	0.67
P1	East Full Crossing	53	49.3	LOS E	0.2	0.2	0.95	0.95
P2	North Full Crossing	53	28.4	LOS C	0.1	0.1	0.72	0.72
All Pedestrians		158	34.2	LOS D			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.

PHASING SUMMARY

Site: 2719 [1. Highs Road/ Castle Hill Road/ Country Drive - PM]

Existing conditions
Signals - Fixed Time Coordinated Cycle Time = 110 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

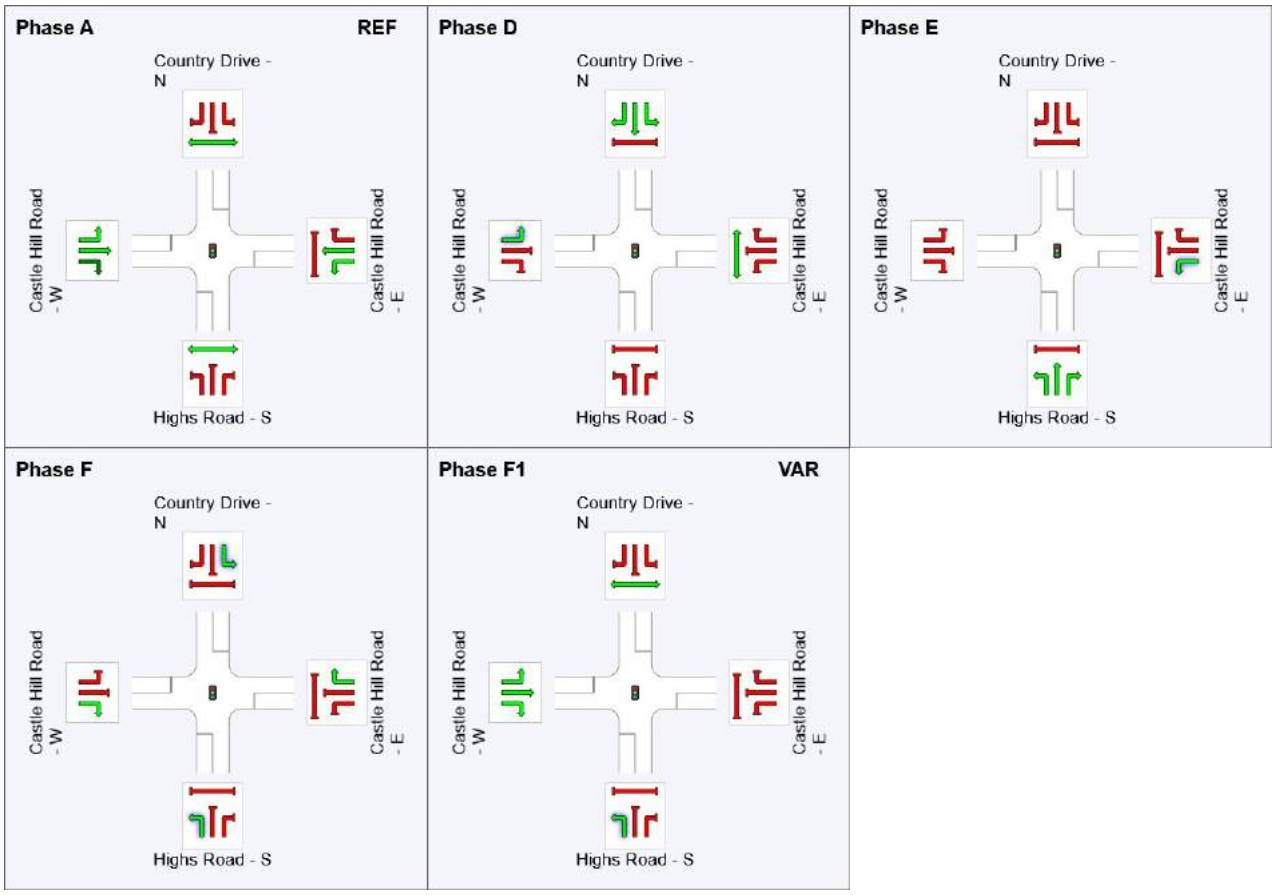
Phase Times determined by the program
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, B*, C*, D, E, F, F1*, F2*
Output Phase Sequence: A, D, E, F, F1*
(* Variable Phase)

Phase Timing Results

Phase	A	D	E	F	F1
Phase Change Time (sec)	0	49	72	88	105
Green Time (sec)	43	17	10	11	***
Phase Time (sec)	49	23	16	17	5
Phase Split	45%	21%	15%	15%	5%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

*** No green time has been calculated for this phase because the next phase starts during its intergreen time. This occurs with overlap phasing where there is no single movement connecting this phase to the next, or where the only such movement is a dummy movement with zero minimum green time specified.
If a green time is required for this phase, specify a dummy movement with a non-zero minimum green time.



REF: Reference Phase
VAR: Variable Phase


Stopped Movement
Other Movement Class (MC) Running
Mixed Running & Stopped MCs
Other Movement Class (MC) Stopped
Turn On Red
Undetected Movement
Continuous Movement
Phase Transition Applied

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Attachment 2

Table 1: Intersection Performance Summary

Intersection	Peak Period	2018 Survey		Full Commercial (Base Case)		Planning Proposal (Project Case)		Relative Change
		Delay	LoS	Delay	LoS	Delay	LoS	From Full Commercial
Castle Hill Rd / Coonara Ave	AM	49.1	D	47.5	D	45.8	D	-1.7
	PM	42.7	D	78.2	F	43.2	D	-35

NOTE: The above *Project Case* assumes:

- Trip generation rates:
  - 0.6 trips per townhouse

    (This is based on the review of the GTGD Update survey data for the Westleigh site, as more realistic estimate of future traffic generation rate in contrast to the overly conservative rate of 0.95-0.99 trips / dwelling adopted by the previous ARC report.)
- Apartment dwellings:
  - Based on Council High Density Trip Generation Rates
  - 0.35 peak hour trips per one or two-bedroom dwelling
  - 0.5 peak hour trips per three-bedroom / four-bedroom dwelling

Trip distribution has been assigned based on review of 2011 JTW data:

- Commercial:
  - 35.0% - Castle Hill Rd W
  - 13.9% - Oakes Rd S
  - 49.9% - Castle Hill Rd E
- Residential:
  - 24.2% - Castle Hill Rd W
  - 25.9% - Oakes Rd S
  - 49.9% - Castle Hill Rd E

Attachment 3

Table 2: Link Volume Comparison

Scenario	Period	Site Generation			Link flow - Coonara Ave North		Link flow - Coonara Ave South	
		In	Out	Total	N	S	N	S
Existing (2018 Survey)	AM	256	30	286	240	432	269	239
	PM	71	373	444	500	290	207	296
Base Case - Full Commercial	AM	768	192	960	382	890	323	259
	PM	192	768	960	864	388	230	327
Project Case - Planning Proposal (Low Density Rates)	AM	54	215	269	376	269	230	288
	PM	215	54	269	243	382	259	234
Project Case - Planning Proposal (Medium Density Rates)	AM	41	162	203	337	259	227	274
	PM	169	42	211	234	348	247	231
Relative Change (from Base Case)								
Project Case - Planning Proposal (Low Density Rates)	AM	-714	23	-691	-6	-621	-93	29
	PM	23	-714	-691	-621	-6	29	-93
Project Case - Planning Proposal (Medium Density Rates)	AM	-727	-30	-757	-45	-631	-96	15
	PM	-23	-726	-749	-630	-40	17	-96

Attachment 3

Ref:	RMS Comment	Ason Group Response
A	***Traffic Study***	
A1	*Roads and Maritime is of the view that any future traffic and transport study provided should be expanded to consider ultimate development plus 10 years background traffic (e.g. model key intersection(s) at 2031) and identify an equitable contribution for the provision regional infrastructure to support Precinct growth.*	As discussed above, the proposal actually reduced the traffic generated by the site and, accordingly, does not warrant extensive model of potential future scenarios, or contribution toward precinct infrastructure — for which there is no nexus associated with the subject proposal. Furthermore, and in light of the above, Council has already agreed to provision of open space (including synthetic sports field) and dedication of the perimeter road as a public road is sufficient contribution towards regional infrastructure.
A2	*Any future traffic studies should identify the impacts of an increase in pedestrian activity as a result of development in the area. The study should identify the pedestrian desire lines to the Cherrybrook Station - North West Rail Link in particular the impacts at the Castle Hill Road and Coonara Avenue intersection. The study should determine if there is a need to provide a direct pedestrian link across Castle Hill Road.*	An assessment of active and public transport mode share was provided in the response to TfNSW, dated July 2019, and is discussed further above. In this regard, it is our view that additional crossing points are not required to aid these desire lines to key destinations (Metro Station at Cherrybrook) or Coonara Shopping Village. Furthermore, the demand for bus services is expected to be moderate only and not, in isolation, necessitate improvements to bus facilities or connectivity thereto.
B	***SIDRA Modelling Report Ason Group report dated 1 August 2018 — TCS 2575***	As a general note, RMS comments are based on what is now an outdated report, dated 1 August 2018, and associated SIDRA modelling. That modelling was a revisited version of the historic modelling files provided by ARC Traffic + Transport (the former traffic consultants on the project) which has subsequently been superseded by subsequent traffic assessments by Ason Group — namely the memorandum dated 15 January 2019 (Ref: *0442l08v1 RMS Memorandum in relation to GTA Review_55 Coonara Ave, West Pennant Hills*)

Ref:	RMS Comment	Ason Group Response
B1	*The report quotes "Obtained intersection signal phase timing data (SCATS history files) from RMS", however the signal setting in SIDRA is not compatible with the SCATS.*	The original August 2018 modelling — based on the original 2015 work by other — had some discrepancies which were subsequently addressed as part of the updated SIDRA modelling. Ason Group has conducted traffic count surveys at Castle Hill Rd / Coonara Ave / Edward Bennet Dr on 31 October 2018 and obtained relevant signal timing (SCATS) data. Signal settings in the revised SIDRA models have been developed using the SCATS data provided by RMS and then then verified by review of survey videos and on-site inspections.
B2	*The exact date of the traffic survey has not been supplied in this report and therefore cannot be verified. However, analysis was undertaken of the SIDRA volumes against the SCATS output files 2018 for the intersection of Coonara Avenue and Castle Hill Road. Based on this data it is noted that the traffic volumes used to model the existing scenario are lower than the traffic counts from SCATS. It is further noted that Google typical PM peak queues show a high level of queuing in Coonara Avenue and Google Live traffic queuing in PM peak period in all directions. This queuing is different to what the base model supplied by the proponent. The justification is located in Tab B.*	As discussed above, the original modelling (upon which RMS comments are based) relied upon 18 November 2015 traffic surveys. More recent traffic count surveys were conducted on 31 October 2018. Additionally, site visits during both morning and evening have been undertaken for the purpose of queue length calibration. It is noted that the updated surveys are more consistent with the 2018 SCATS volumes noted by RMS.
B3	*As Roads and Maritime does not have details of the proposed zoning and FSR controls it cannot be confirmed whether the trip generation assumptions are appropriate. However, based on the analysis of the SIDRA output files it is noted that there is an additional 189 veh/hr (392-202) in the AM peak period in the modelling scenario. These additional volumes are lower than what Council's Planning Proposal report received by Roads and Maritime in December 2017 indicated. See justification located in Tab C.*	Adopted traffic generation rates are outlined in the Ason Group memo, dated 15 January 2019. These rates were agreed with Council during early stages of the assessment.
B4	*The signal phasing under AM proposed scenario shows conflicting vehicle movements with pedestrian movements. It is necessary to revise the proposed scenario phasing system. The revision should separate vehicles from pedestrian movements when filtering is not possible.*	As mentioned above, the signal setting in the revised SIDRA models has been updated and validated with the SCATS data, survey videos and on-site investigations.

Ref:	RMS Comment	Ason Group Response
B5	*Higher pedestrian numbers should be utilised in the AM and PM peak period together with allowance for adequate red arrow pedestrian protection during peak periods for the model to accurately reflect the site conditions and how the TCS would operate.*	Pedestrian volumes, whilst not included within the surveys, have been checked from review of the survey videos and on-site investigation. The survey videos indicate low pedestrian activity at the surveyed intersections during both morning and evening peak periods; however, for conservative assessment, the revised SIDRA model included 50 pedestrians per hour on all approaches (as default in SIDRA). It is acknowledged that pedestrian movements could increase in the future, upon completion of the Metro. However, the increase in pedestrian movements solely related to the subject site will be moderate and unlikely to materially impact the modelled signal performance — noting that the existing base case model adopted conservatively high pedestrian movement volumes in the first place.
B6	*Peak Hour Factors are used inconsistently in SIDRA model. Vehicles and most of pedestrian movements have a factor of 100%. The south approach pedestrian volume has a factor of 95%.*	This has been updated in subsequent models. A Peak Hour Factor of 95% (as default in SIDRA) has been applied for vehicles and pedestrian movements under all scenarios in the revised SIDRA models.
B7	*It is not clear whether pedestrian volume / percentage of heavy vehicles are surveyed.*	The updated traffic count survey undertaken on 31 October 2018 — adopted in the revised SIDRA model — included separate Light Vehicle and Heavy Vehicle counts. Pedestrian counts were not included, however numerous on-site investigations indicate that levels of pedestrian activity at the time of the surveys was low. As such, for conservative assessment, the revised SIDRA model includes 50 pedestrians per hour at all directions (as default in SIDRA).