Parkland Heights Neighbourhood Centre LSP Amendment

Transport Impact Assessment

PREPARED FOR:
Rockingham Park Pty Ltd

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1.0 Introduction

This Transport Impact Assessment (TIA) addresses a proposed Amendment to the Local Structure Plan (LSP) for Lot 1507 Eighty Road, Baldivis, known as Parkland Heights, on the eastern side of Eighty Road and north of Sixty Eight Road and extends east across the future Nairn Drive road alignment.

The LSP area is anticipated to accommodate approximately 1,400 dwellings, a proposed neighbourhood centre and a future primary school site. Subdivision and residential development has already commenced in the northwest quadrant of the LSP area.

In the original LSP the neighbourhood centre was proposed with a relatively small village centre (nominally 700m^2 NLA retail floor space) but the proponent now seeks to increase this to around 10,000m^2 NLA.

Transcore previously prepared the *Parkland Heights Local Structure Plan, Lot 1507 Eighty Road, Baldivis Transport Assessment* (July 2011), so this current Transport Impact Assessment report will revise and update that report for this proposed Amendment to the LSP. The proposed change of the village centre land uses to a larger neighbourhood centre development will result in some traffic increases on the surrounding road network but this report will demonstrate that this traffic can be accommodated within the planned road network of the current LSP without any significant changes.

Access to the LSP area will be provided via a number of intersections on Nairn Drive, which is an Other Regional Road (ORR) in the Metropolitan Region Scheme. These are proposed to include three roundabouts within the LSP area.

There will also be a number of access points from Sixty Eight Road and Eighty Road, which are classified as Neighbourhood Connector roads, as well as connections to neighbouring subdivisions on the northern and eastern sides.

Analysis of future traffic volumes on Nairn Drive indicates that traffic volumes on some parts of this road through the LSP area will be less than 15,000 vehicles per day and will not warrant future upgrading to dual carriageway standard with two lanes each way as currently allowed for by the 40m wide ORR reservation. These sections will be planned as dual carriageway with only one lane each way but the 40m road reserve will be retained to allow for future widening if required.

The planned road network provides for a future bus service on Arpenteur Drive to extend south through the LSP area to Sixty Eight Road.

The LSP also provides for a comprehensive network of shared paths to encourage and facilitate non-motorised travel.

Previous versions of this report had made allowance for full urban development of rural land south of Sixty Eight Road (north of the Karnup Road reservation) and future construction of Karnup Road from Eighty Road to Baldivis Road, to be consistent with assumptions in the 2011 transport assessment report for the Parkland Heights LSP. That assumption was based on planning in the WAPC's Directions 2031 planning framework but the more recent *Perth and Peel @ 3.5million* report (WAPC, 2015) now indicates only the eastern half of that area will become urban and the western portion will remain rural. Therefore more recent revisions of the transport impact assessment report take into consideration the reduced extent of future urban development south of Sixty Eight Road and do not assume future construction of Karnup Road between Eighty Road and Baldivis Road.

The December 2018 revision of the TIA specifically addresses items in a schedule of modifications requested by the Department of Planning, Lands and Heritage (DPLH). The items addressed in this TIA are summarised in Table 1.

Table 1: DPLH requested modifications addessed in TIA

Modification	Where Addressed
Sixty Eight Road is to be widened to 22.2m and to allow a central median.	Sections 4.1 and 7.0
Limit access onto Nairn Drive at the three access streets south of the village centre (intersections 3, 4 and 5 to left in / left out.	Figure 9 (traffic volumes), Figure 10 (intersection treatments) and Sections 6.3 and 7.0 (text)
Remove the right in turn from Nairn Drive at intersection 10 north of the village centre.	
A right turning pocket from Sixty Eight Road should be included at the intersection with SE3 (intersection 13).	Section 6.3
On Figure 10, include all intersections shown on the SIDRA Intersection Analysis.	Figure 10 revised. (DPLH confirmed that revised SIDRA analysis is not required.)
Indicate preference for signalised intersections adjacent to the village centre (on Nairn Drive).	Sections 6.3 and 7.0

2.0 Proposed Local Structure Plan

The location of the Parkland Heights LSP study area is illustrated in Figure 1, which shows it in its regional context within the Metropolitan Region Scheme.

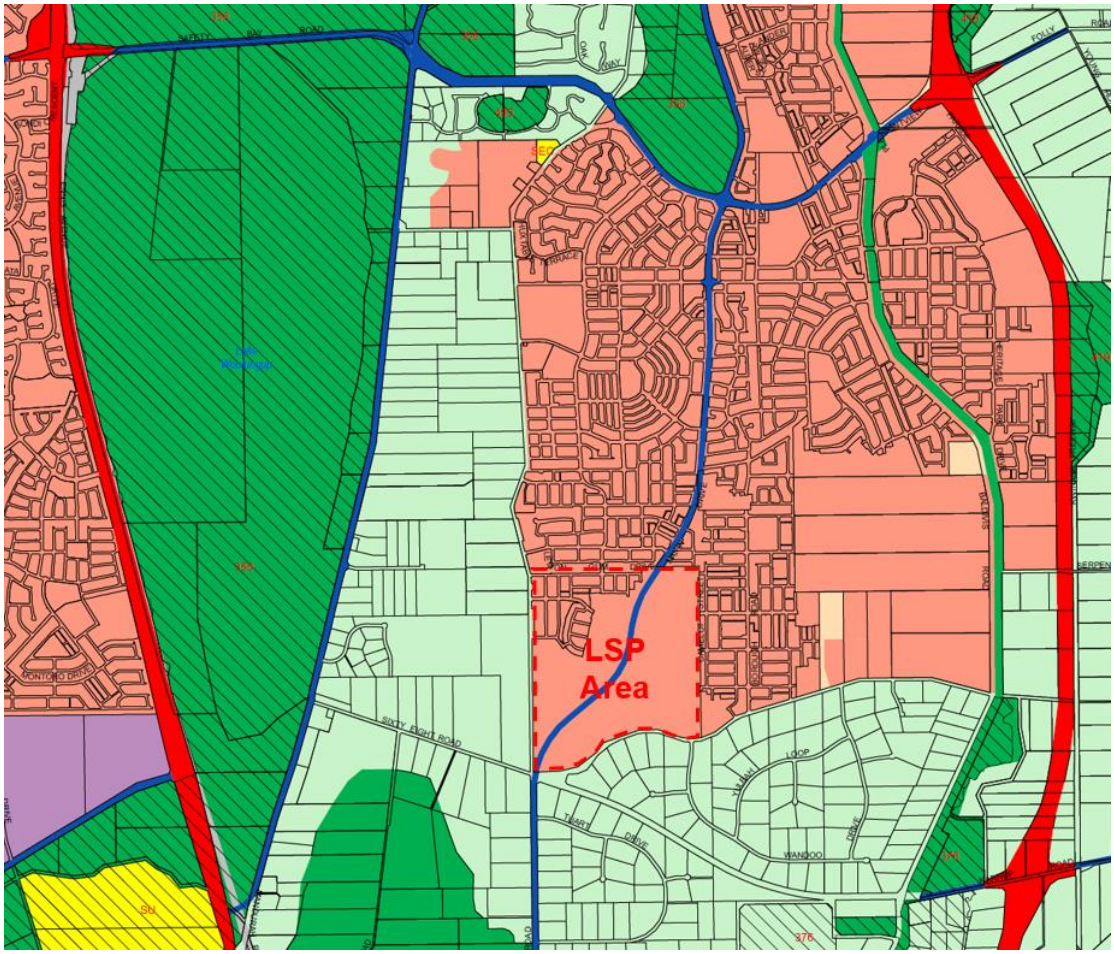


Figure 1: Site location

The LSP area is anticipated to accommodate approximately 1,400 dwellings, a proposed neighbourhood centre (approximately 10,000m^2 NLA) and a future primary school site.

The location of these proposed land uses is shown on the LSP plan at Appendix A.

Access to the LSP area will be provided via a number of intersections on Nairn Drive, which is an Other Regional Road (ORR) in the Metropolitan Region Scheme. These are proposed to include three roundabouts within the LSP area.

There will also be a number of access points from Safety Bay Road and Eighty Road, which are classified as Neighbourhood Connector roads, as well as connections to neighbouring subdivisions on the north and east sides.

3.0 Existing Situation

3.1 Existing Land Use

The LSP area is located approximately 9km southeast of the Rockingham city centre and 45 km south of the Perth CBD.

The LSP area was previously a pine plantation but has since been fully cleared. Subdivisional development has commenced in the northwest corner of the site abutting Eighty Road. It is abutted on the northern side by the existing subdivision known as "The Ridge" and by "The Dales" and "Avalon at Baldivis" estates to the east, as shown in Figure 2.

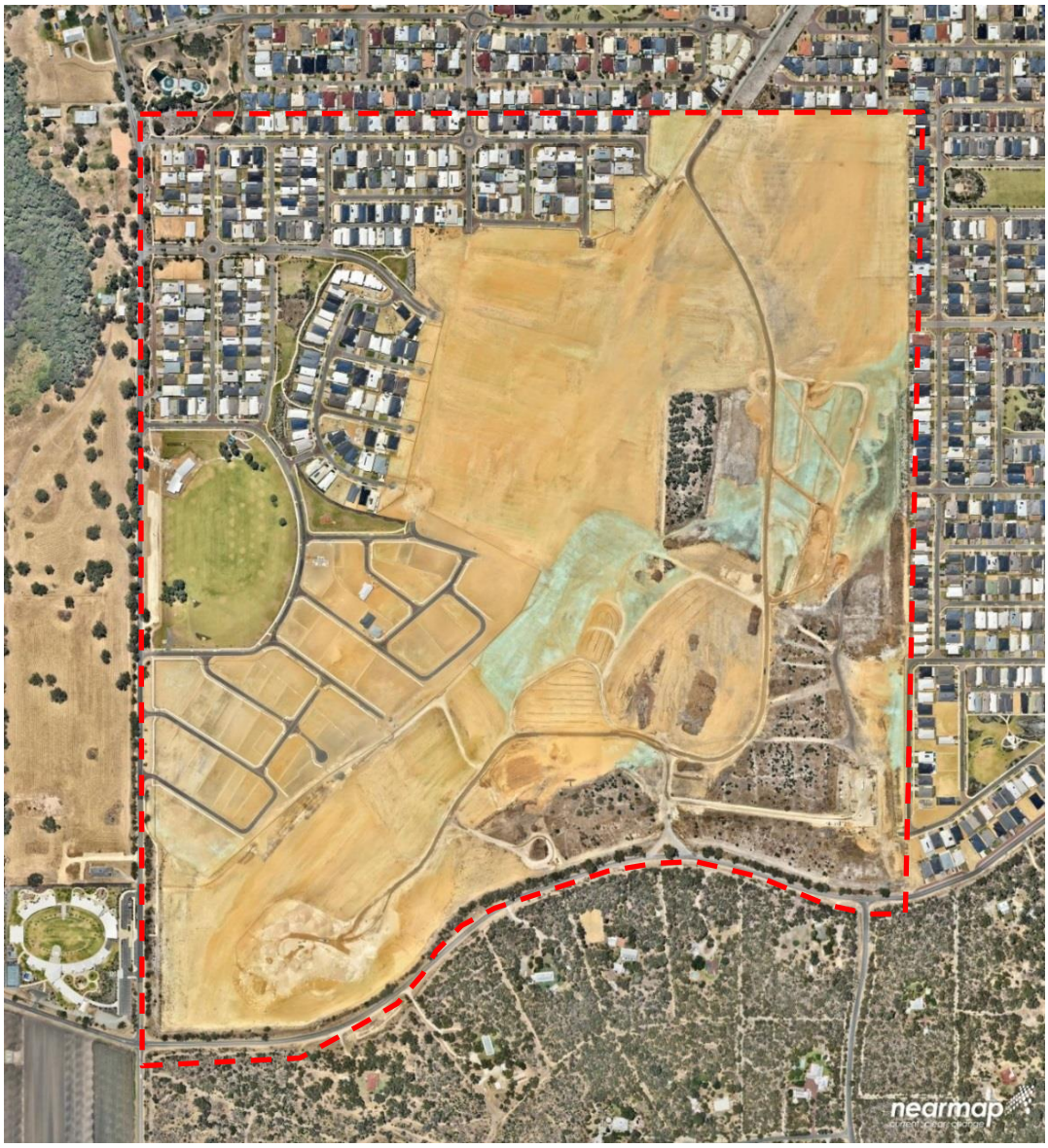


Figure 2: Existing development

Mother Teresa Catholic School is located on the western side of Baldivis Road, north of Sixty Eight Road, opposite the LSP area.

South of Sixty Eight Road is an area of low density rural residential development accessed directly from Sixty Eight Road or from local access roads connecting to Sixty Eight Road.

3.2 Existing Road Network

The existing road network in the surrounding area is illustrated in Figure 3, which shows the current classification of roads in the Main Roads WA functional road hierarchy.

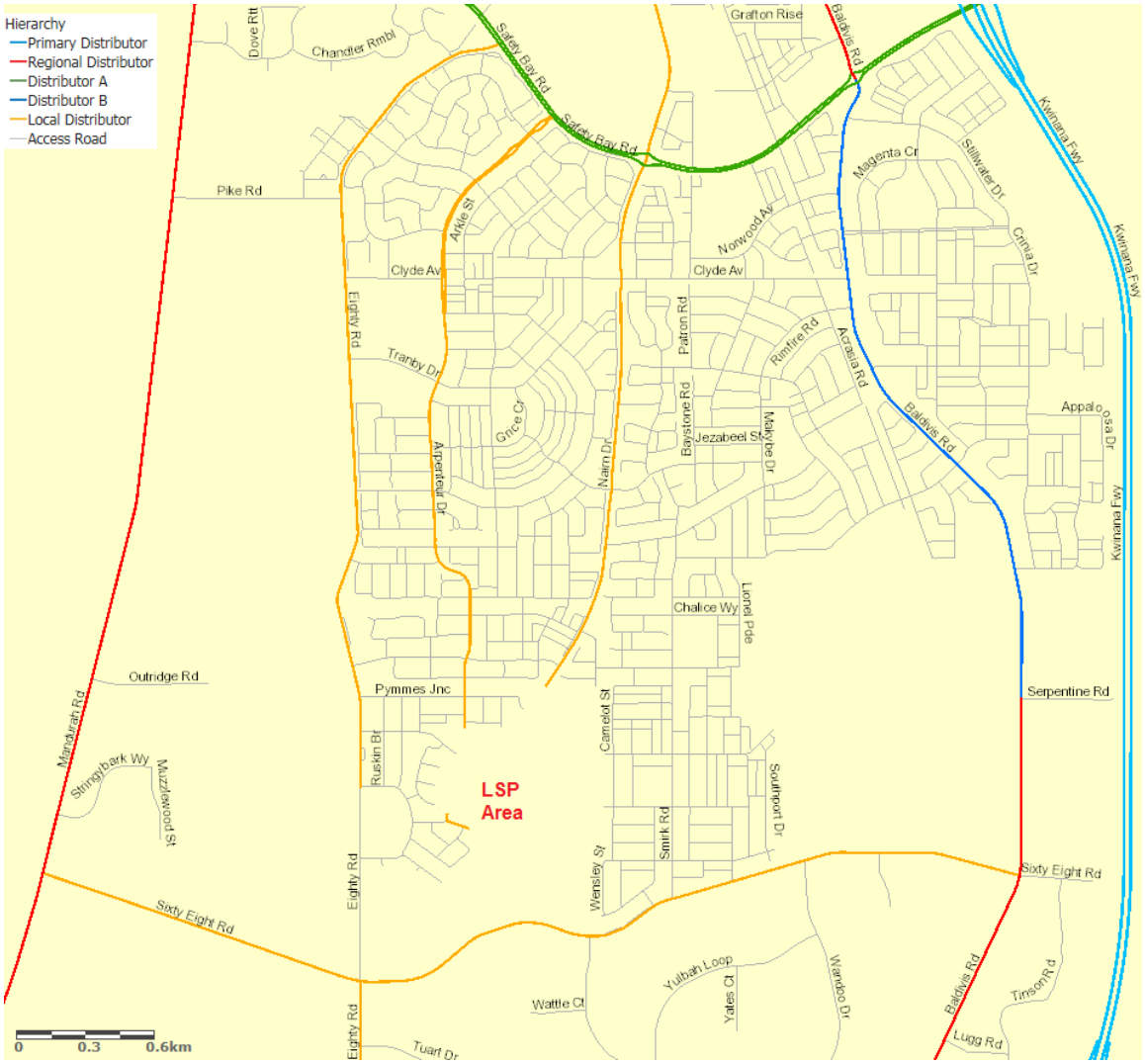


Figure 3: Existing road network and road hierarchy

Sixty Eight Road is currently constructed as a two-lane sealed rural road with a 70km/h speed limit.

Baldivis Road, further to the east, is also currently a two-lane sealed rural road with an 80km/h speed limit but sections further north that have been upgraded for adjacent development have a 70km/h speed limit in place.

Eighty Road is another two-lane sealed rural road with an 80km/h speed limit south of Sixty Eight Road but north of the site and along developed sections of the LSP area it has been upgraded to a kerbed and drained urban standard and the speed limit has been reduced to 60km/h.

On sections of Eighty Road and Sixty Eight Road adjacent to Mother Teresa Catholic School 40km/h school zones apply before and after school hours.

The Sixty Eight Road / Eighty Road intersection is an unchannelised four-way intersection controlled by Stop signs on the Eighty Road approaches.

Arpenteur Drive is constructed as a neighbourhood connector road north of the LSP area through to Safety Bay Road. It has a 50km/h speed limit and 40km/h school zones apply before and after school hours adjacent to schools further north from the LSP area.

Notwithstanding the MRS Other Regional Roads reservation shown in Figure 1, Nairn Drive is currently not constructed through the LSP area. North of the LSP area Nairn Drive has been constructed as the western carriageway of a future dual carriageway road (two lanes each way).

3.3 Existing Traffic Volumes

Existing weekday traffic counts sourced from the Main Roads WA website and the City of Rockingham (*) are summarised in Table 2.

Table 2: Existing Traffic Volumes

Road Name	Location	AWT (HV)	AM Peak	PM Peak	Date
Eighty Rd	North of Sixty Eight Rd	3,078 (5.0%)	422vph 0800-0900	426vph 1445-1545	Aug 2015
Sixty Eight Rd	East of Mandurah Rd	3,128 (8.4%)	288vph 0800-0900	318vph 1500-1600	Aug 2014
Sixty Eight Rd*	West of Smirk Rd	2,650	250vph 0800-0900	273vph 1500-1600	Nov 2015
Baldivis Rd	North of Sixty Eight Rd	4,371 (19.9%)	398vph 0800-0900	401vph 1445-1545	Aug 2015
Mandurah Rd	South of Sixty Eight Rd	7,293 (7.4%)	617vph 0745-0845	701vph 1615-1715	Aug 2015
Karnup Rd	East of Baldivis Rd	6,046 (20.9%)	503vph 0715-0815	555vph 1530-1630	Sep 2014

3.4 *Existing Public Transport*

The existing bus service in the Baldivis area includes routes 564 and 565 from Warnbro station, as shown in Figure 4. Route 564 currently terminates at Ridge Boulevard north of the LSP area and route 565 passes to the east of the LSP area on Smirk Road. Route 565 deviates to Stockland Baldivis Shopping Centre during business hours (typically 9am to 5pm) on all days of the week. Both services operate hourly on all days with higher frequency of service for peak direction travel during weekday peak hours.

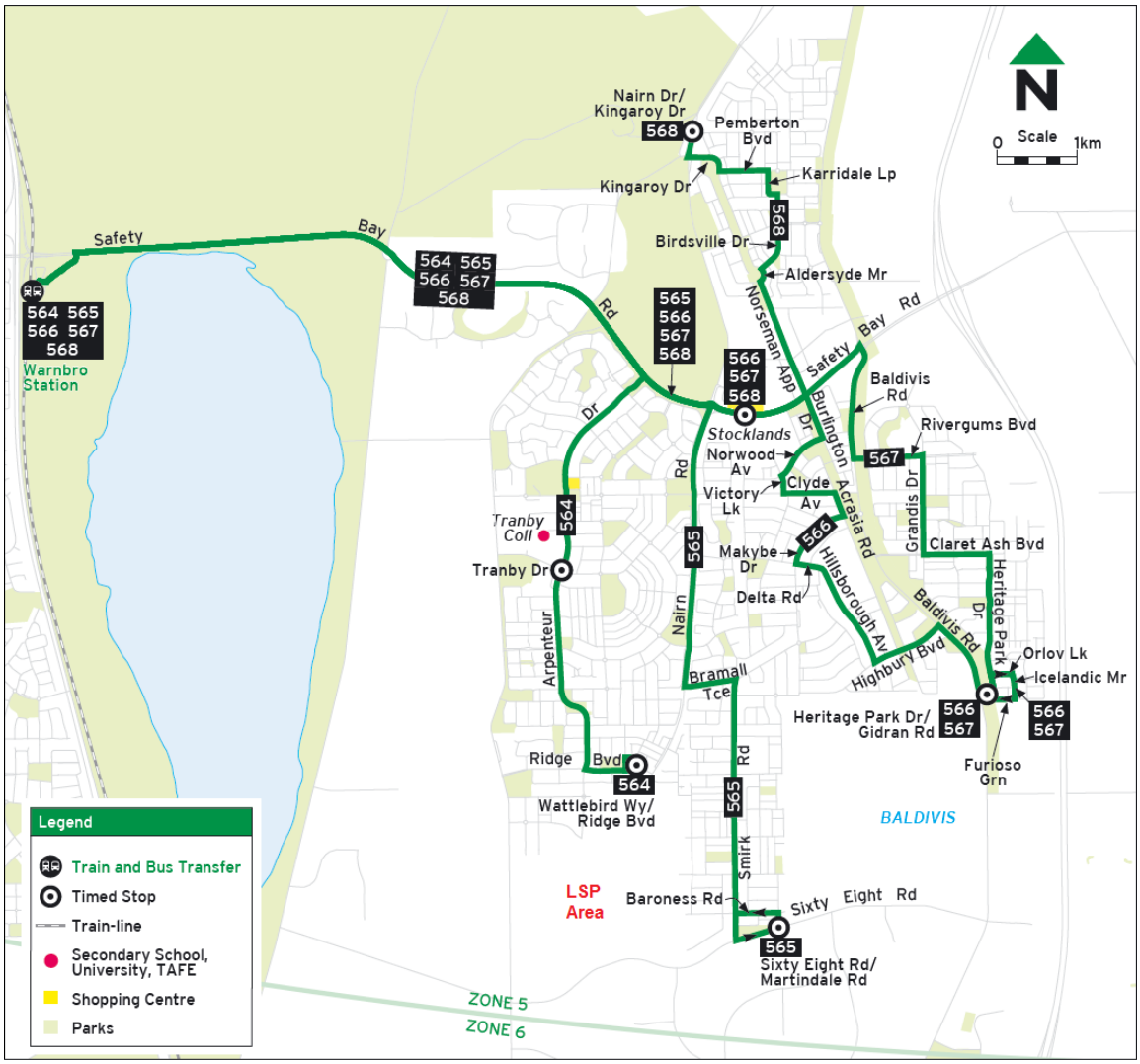


Figure 4: Existing public transport

3.5 *Existing Pedestrian and Cyclist Facilities*

The Perth Bike Map series published by the Department of Transport covers the northern part of Baldivis but does not extend all the way to the LSP area, as shown in Figure 5.

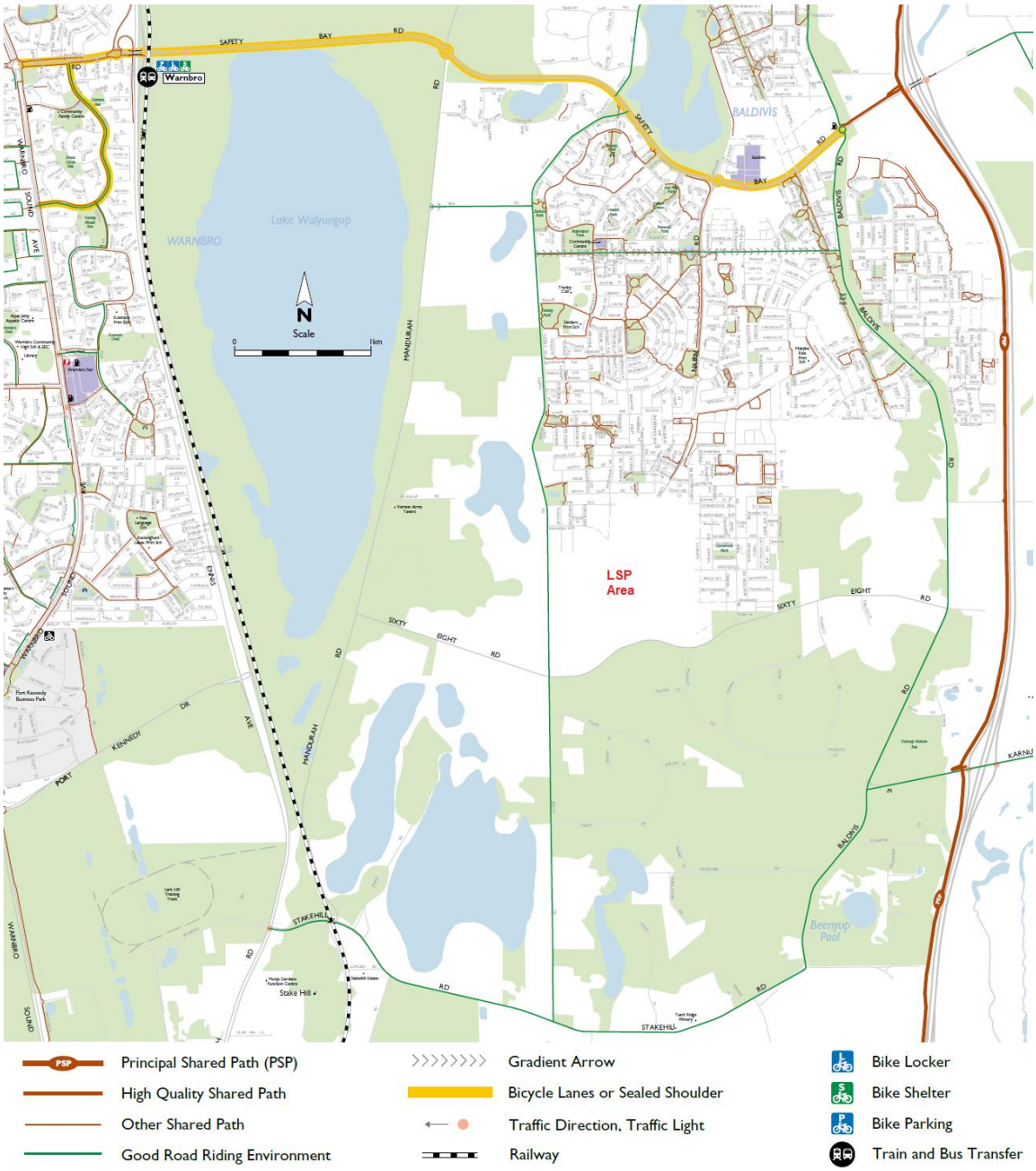


Figure 5: Existing cycling facilities

It does show that Eighty Road is considered a good road riding environment north of this site and also shows the existing Principal Shared Path along the freeway and bicycle lanes on Safety Bay Road further north.

There are no existing paths or cycle facilities in or adjacent to the LSP area although neighbouring subdivision roads that connect with the LSP area do have either a 1.5m foot path or 2m shared path on one side.

4.0 Proposed Transport Network

4.1 Road Hierarchy

The hierarchy of roads within the LSP area is illustrated in Figure 6 using the road hierarchy defined in the WAPC *Liveable Neighbourhoods* policy.

Figure 6: Road hierarchy

Roads in the LSP area that are not coloured in Figure 6 are lower order access streets and laneways.

Some key characteristics of the relevant road classifications have been summarised in Table 3 below. These are generally based on Liveable Neighbourhoods guidelines although the proposed widths do vary slightly from the standard Liveable Neighbourhoods cross-section diagrams.

Table 3. Road hierarchy

Road Classification	Indicative Upper Volume (vpd)	Indicative road reserve width (m)	Indicative road pavement width (m)
Integrator A	35,000	40m	2 x 8.5m (incl. cycle lanes), 6m median and embayed parking
Integrator B	15,000	29m	2 x 5m (incl. cycle lanes), 6m median and embayed parking
Neighbourhood Connector A	7,000	23m	2 x 5m (incl. cycle lanes), 2m median and embayed parking
Neighbourhood Connector B	3,000	20m (18m min)	7.4m (plus embayed parking)
Access Street B	3,000	18m (16.5 min)	6m (plus embayed parking)
Access Street C/D	3,000 (C) or 1,000 (D)	16m	6m (may include embayed parking)
Laneway	300	6m	6m typical

It should be noted that these reserve widths are indicative and may be subject to further adjustment in consultation with the Department of Planning and City of Rockingham during detailed subdivision design. However, it should also be noted that these general road reserve widths and indicative road pavement widths are still in accordance with the LSP that was approved in 2012 and are not proposed to be changed in the current LSP amendment.

Nairn Drive

Nairn Drive is an 'Arterial Integrator Road', with its alignment and reservation width set by its 40m wide 'Other Regional Road' reservation in the MRS. Nairn Drive serves the function of an 'Integrator A' at its northern and southern ends within Lot 1507, however projected traffic volumes in the middle of the Structure Plan area allow it to be classified as an 'Integrator B' through this section for the foreseeable future.

A 70km/h speed limit on the 'Integrator A' is proposed, however a lower speed is recommended for the Integrator B section. A 60km/h speed limit would assist pedestrian crossing and general integration of the estate across Nairn Drive.

The design of Nairn Drive allows for its ultimate upgrade to four-lane divided standard in the future. The initial cross section design for Nairn Drive will be agreed with the City of Rockingham at the time the road is constructed and based on current and ongoing negotiations with the city regarding this matter.

Eighty Road

It is proposed that Eighty Road adjacent to the LSP area be upgraded to a fully kerbed and drained, 7.4m wide, single carriageway standard similar to the standard of construction of Eighty Road further north. The speed limit has already been reduced to 60km/h adjacent to the LSP area and north of this LSP area adjacent to existing residential development.

Development on the eastern side of Eighty Road will be set back because of an existing high voltage power line and access to lots fronting Eighty Road will be limited to CAP roads (Controlled Access Place or service roads) in the northwest corner of the estate. There is no development on the western side of Eighty Road (north of the Mother Teresa Catholic School site) so the boulevard-style neighbourhood connector A cross section of Liveable Neighbourhoods is not considered necessary on Eighty Road.

Sixty Eight Road

On the section of Sixty Eight Road abutting the LSP area there is no requirement for on-street parking because all residential lots in the LSP area have other road frontages within the LSP area to accommodate on-street visitor parking requirements. Therefore the verge widths can be reduced to 5m which is sufficient to accommodate all standard utility service alignments in the verge.

On this section of Sixty Eight Road there will only be rural properties on the southern side. Ultimately, if the southern side is rezoned for Urban development in future it would justify widening of Sixty Eight Road to full Neighbourhood Connector A standard but in the interim the WAPC requires the existing 20m road reserve to be widened on the northern side to 22.2m (i.e. half of the widening for a future full 24.4m Neighbourhood Connector A road reserve).

The proposed cross-section for this section of Sixty Eight Road therefore consists of two 3.5m traffic lanes, two 1.5m cycle lanes, a 2m median and two 5m verges, which can be accommodated within the widened 22.2m road reserve of Sixty Eight Road.

It is anticipated that the existing 70km/h speed limit on Sixty Eight Road would ultimately be reduced to 60km/h as for Eighty Road.

Furnivall Parade

Furnivall Parade is the main east west road through the LSP area (north of the proposed neighbourhood centre and future primary school) will function as a Neighbourhood Connector road. The traffic flows are generally expected to be below 3,000vpd so it is classified as a Neighbourhood Connector B, except for the section abutting the neighbourhood centre west of Nairn Drive where the traffic

volumes are expected to be in the 3,000 – 7,000vpd range of a Neighbourhood Connector A.

For the first street block east of Eighty Road the road has been constructed as a boulevard-style road in a 22.5m road reserve as an entry statement to the first stage of subdivision. This will accommodate two 3.5m traffic lanes separated by a median (nominally 3m wide to accommodate tree planting). The resulting 6.25m verges can accommodate embayed parking where required, as well as street trees and 2m shared paths on both sides. The precise cross section design will be finalised at detailed design stage.

The sections adjacent to the neighbourhood centre and future primary school are proposed to be widened to 25m wide, which will accommodate a wider median (eg. 5.5m wide) and turn pockets for right turning vehicles. This is compatible with the standard Liveable Neighbourhoods 24.2m width for a Neighbourhood Connector A (which can be reduced to 23m with indented parking in the verges).

Arpenteur Drive
The existing Arpenteur Drive road reservation north of the LSP area is 20m wide and this standard will be continued south into the LSP area. It is a Neighbourhood Connector B road. It will provide two 3.7m traffic lanes and embayed parking on both sides within the 6.3m verges, but generally no median or cycle lanes.

Other Neighbourhood Connectors
There are a number of other Neighbourhood Connector roads indicated on Figure 6. These are all considered as type B based on the traffic volume each will carry.

Various road reserve widths are proposed for the other Neighbourhood Connector B roads. These range from 25m to 18m but all are based on a standard 7.4m carriageway (two 3.7m traffic lanes) and a typical verge width of 5.5m including embayed parking where appropriate for adjacent development. The range of road reserve widths results in a narrower or wider verge on one side of the road based on a landscaped walkway network proposed in this LSP area.

Access Streets
The Access Street B classification (typical reservation of 16.5 to 18m) will be used for streets adjacent to high-density residential development (R60), schools and commercial premises. On-street parking will be highly utilised in these areas. A reservation width of 18m is proposed for the Access Street B roads adjacent to the future primary school site.

The basic standard of access street proposed in this subdivision is a 6m wide carriageway in a 16m road reserve. This Access Street C/D has been used in the approved stage 1 and 2 subdivisions within this LSP area. This results in 5m verges on both sides, with embayed parking accommodated in the verges where required, such as to provide visitor parking for lots serviced by rear laneways.

On access streets abutting public open space (POS) the verge adjacent to the POS is reduced to 2.5m, which results in road reserve widths of 13.5m.

Laneways
The proposed road reserve width of the laneways is 6.0 metres plus a 0.5m building setback on each side. Laneways are proposed to be constructed with a carriageway width of 6m to accommodate two-way vehicle movement and rubbish collection. Details relating to the design of these laneways will be addressed in more detail during the subdivision planning stages.

Visitor car parking is to be constructed in the road reserve adjacent to proposed lots serviced by laneways at a minimum rate of one bay per every two dwellings.

4.2 Public Transport

Existing bus services in this area are described in section 3.4 of this report. Current planning for future bus routes in Baldivis is indicated in the Transperth service development plan shown in Figure 7 below.

The Public Transport Authority has confirmed that the future bus route shown on the LSP plan at Appendix A is consistent with their current planning for extension of bus route 564 south from Arpenteur Drive to a new terminus north of Sixty Eight Road.

Previous discussions with PTA officers have indicated that bus embayments would not be required on neighbourhood connector roads.

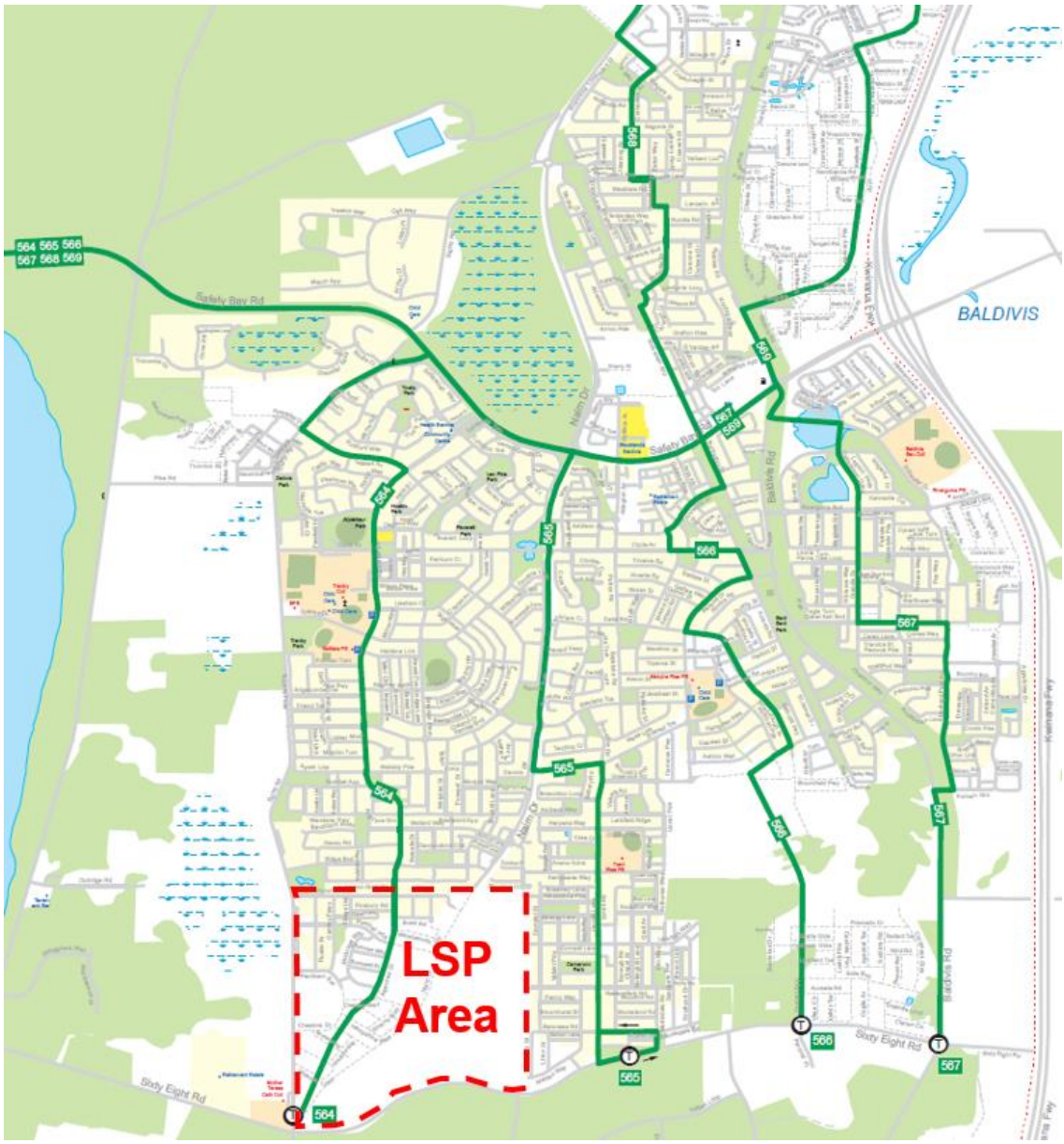


Figure 7: Future bus routes

4.3 Pedestrian and Cyclist Facilities

A highly permeable road network within the LSP area creates excellent opportunities for the provision of good pedestrian and cyclist facilities that maximise use of non-motorised transport modes.

Figure 8 outlines the proposed pedestrian and cyclist network for the LSP area.

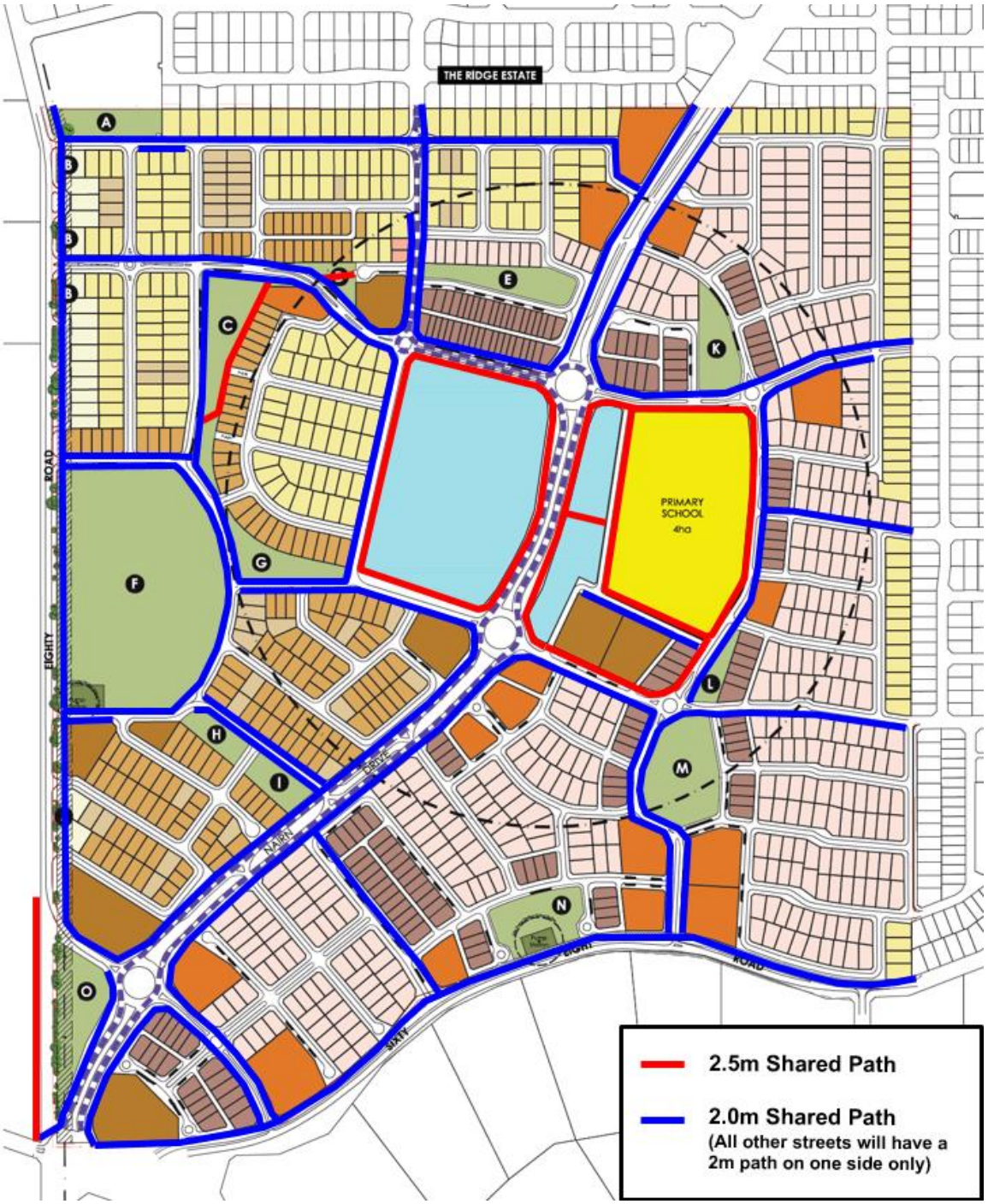


Figure 8: Pedestrian and cyclist facilities

In accordance with current practice adopted by the City of Rockingham it is proposed to construct all paths to a minimum width of two metres so that they can all be designated as shared paths for pedestrians and cyclists. A 2.5m width is proposed in high pedestrian-traffic locations such as adjacent to the future primary school and bordering the neighbourhood centre.

Paths will be provided on at least one side of all roads. There would be paths on both sides of roads adjacent to the future primary school site and on both sides on all the Integrator Arterial and Neighbourhood Connector roads.

Laneway lots are to have footpath access to visitor parking bays provided in a nearby road reserve.

On-street cycle lanes will be included on the Integrator B and Neighbourhood Connector A roads, as indicated in the details of the road hierarchy listed in Table 1.

5.0 Integration with Surrounding Area

The road network of the LSP area will connect to the surrounding road network at a number of locations.

Arpenteur Drive will be the only connection to "The Ridge" subdivision along the northern boundary of the property west of Nairn Drive. East of Nairn Drive there are a further six local road connections with neighbouring subdivisions. In each case roads in the LSP area connecting to these existing roads will be designed to match in terms of reserve widths and carriageway design.

Local street connections at the LSP area boundary will carry less than 3,000vpd as shown in Figure 9 of the TIA, so the existing local street network in adjacent areas will be satisfactory. The standard of other external roads such as Eighty Rd abutting and north of the LSP area is determined by previous studies commissioned by the City of Rockingham (eg. the Baldivis Road Needs Study 2005 and the Baldivis Road Study Update 2012).

The LSP path network will also connect with these existing streets and integrate with the existing path networks of the adjoining estates.

The potential urbanisation of the eastern half of the area south of Sixty Eight Road indicated in the 2015 draft *South Metropolitan Peel Sub-region Planning Framework* has been taken into account in the traffic assessment so that the road network of the LSP area is capable of accommodating through traffic generated by this area.

6.0 Analysis of the Transport Network

6.1 Traffic Generation and Distribution

Detailed traffic modelling was undertaken for the original transport assessment report in 2011 and has been revised to reflect the land uses now proposed in the neighbourhood centre.

The assessment assumes full development of the LSP area and Baldivis urban area north of Sixty Eight Road. Regional traffic modelling previously sourced from the ROM and STEM models was for year 2031, so the assessment year for this TIA report is nominally 2031 with full development of Baldivis.

Daily traffic generation rates used in this assessment have been derived from peak hour trip generation rates recommended in the Western Australian Planning Commission (WAPC) *Transport Impact Assessment Guidelines* (2016). The trip rates used are 8 vehicle trips per day (vpd) per dwelling and 2 vpd per student for schools. Lower trip generation rates have been applied for higher density development, such as a rate of 6 vpd per dwelling at R60 density based on rates from the NSW *Guide to Traffic Generating Developments*.

The anticipated 1,400 dwellings of the LSP area (including 372 dwellings assumed at R60) will therefore generate approximately 10,400vpd (5,200 in / 5,200 out). The future primary school has been modelled as 400 students, which implies it would attract 800vpd (400 in / 400 out).

The traffic generation of the neighbourhood centre has been based on the Thursday shopping centre trip rates from the NSW *Guide to Traffic Generating Developments* and office and bulky goods retail trip rates from the NSW *Guide to Traffic Generating Developments Updated Traffic Surveys* (TDT 2013/04a). A preliminary estimate of approximately 11,500m^2 net lettable area (NLA) has been used for the traffic analysis for the proposed neighbourhood centre site west of Nairn Drive and 3,000m^2 GFA of commercial floor area is assumed on the eastern side of Nairn Drive as indicated on the neighbourhood centre concept plan at Appendix B. It is noted that the LSP amendment is seeking 10,000m^2 NLA for the neighbourhood centre rather than the figure of 11,500m^2 used in this analysis. However, it is considered that the slightly higher figure will ensure a robust analysis of future potential traffic flows and road network requirements.

Based on guidance in the NSW *Guide to Traffic Generating Developments* Thursday traffic attraction by the shopping centre (trip rate 78vpd/100m^2) is estimated at approximately 8,970vpd (4,485 in / 4,485 out) for the purpose of this transport assessment, with approximately 20% (1,790vpd) of this total being pass by trips by vehicles that would normally be travelling past this site on Nairn Drive as part of another journey (eg. a person who visits the shopping centre on their way home from work).

The anticipated commercial development component on the eastern side of Nairn Drive is estimated to generate approximately 510vpd (255 in / 255 out). No adjustment for passing trade has been made for these commercial developments as the specific nature of those future developments is not known at this stage.

It should be noted that some of these traffic generation figures represent two ends of the same trips.

The surrounding areas of Baldivis were also included in the traffic model (although in less detail) for the area bounded by Safety Bay Road in the north, Kwinana Freeway in the east, the future Karnup Road alignment in the south and Eighty Road as the western boundary. For that model the future total lot yield between Safety Bay Road and Sixty Eight Road was estimated at approximately 9,150 lots (including the LSP area) and a further 1,335 lots was assumed in the eastern part of the precinct between Safety Bay Road and Karnup Road.

For this outer area it was assumed that 25% of trips will be local within that area, so it was estimated 6 vehicle trips per day per dwelling will travel to external destinations from this area.

The trip distribution to external destinations on the surrounding road network was estimated based on the distribution of trips shown by Main Roads WA 2031 weekday traffic modelling for the Baldivis area. The estimated distribution of these trips is shown in **Table 4**.

Table 4. Overall trip distribution

External node	Proportion of trips
Kwinana Fwy / Safety Bay Rd (northeast)	16%
Safety Bay Rd (west)	32%
Sixty Eight Rd (west)	20%
Eighty Rd (south)	4%
Baldivis Rd / Karnup Rd (southeast)	8%
Baldivis Town Centre (north)	20%

The previously proposed local centre was previously modelled as only attracting local trips from within the LSP area but the current proposal to increase this to a larger neighbourhood centre means it would then attract trips from a wider catchment area. Some of this will be passing trade from vehicles passing the site on Nairn Drive but most of the traffic attracted to this larger neighbourhood centre will come from the surrounding residential areas of Baldivis north and east of the LSP area. The distribution of these neighbourhood centre trips is shown in **Table 5**.

Table 5. Neighbourhood centre trip distribution

External node	Proportion of trips
Nairn Dr (north)	53%
Arpenteur Dr (north)	6%
Eighty Rd (north)	1%
Local roads (east)	13%
Sixty Eight Rd (west)	8%
Eighty Rd (south)	12%
Sixty Eight Rd (west)	2%
LSP area	5%

6.2 Traffic Flows

The daily traffic generated by the LSP area has been assigned onto the road network by a traffic model using the EMME transport modelling software package. The model was extended at a lower level of detail to include existing and future development within the area bounded by Safety Bay Road in the north, Kwinana Freeway in the east, the future Karnup Road alignment in the south and Eighty Road as the western boundary.

There will also potentially be additional through traffic on Nairn Drive, Eighty Road and Sixty Eight Road, which has not been modelled in this EMME traffic model. In the 2011 transport assessment report for this LSP area this through traffic was estimated based on evaluation of information from the Main Roads WA Regional Operational Model (ROM) and the Department of Planning's Strategic Transport Evaluation Model (STEM). The same through traffic assumptions have been maintained in the current Transport Impact Assessment to ensure consistency between these reports.

Figure 9 illustrates the future total daily traffic flows anticipated on the road network of the LSP area with the revised traffic flows associated with the proposed changes to the neighbourhood centre land uses. Traffic flows on each of the driveways indicated on the concept plan at Appendix B are also shown in that figure.

It should be noted that these traffic flows assume Karnup Road is not constructed as a through connection between Eighty Road and Baldivis Road. If this section of Karnup Road was constructed the traffic model indicates a reduction of around 1700 to 1800vpd on Sixty Eight Road adjacent to the LSP area.

Figure 9: Future daily traffic volumes

6.3 Roads and Intersections

The proposed road network to accommodate these traffic volumes has been detailed in section 4 of this transport assessment, including the details of the proposed road hierarchy in section 4.1.

Figure 10 details the proposed intersection controls for intersections within the LSP area. This includes left in / left out access at the proposed driveways on Nairn Drive as indicated in the neighbourhood centre concept plan at Appendix B. Other driveways into the neighbourhood centre from the other street frontages will be designed as full movement T-intersections.

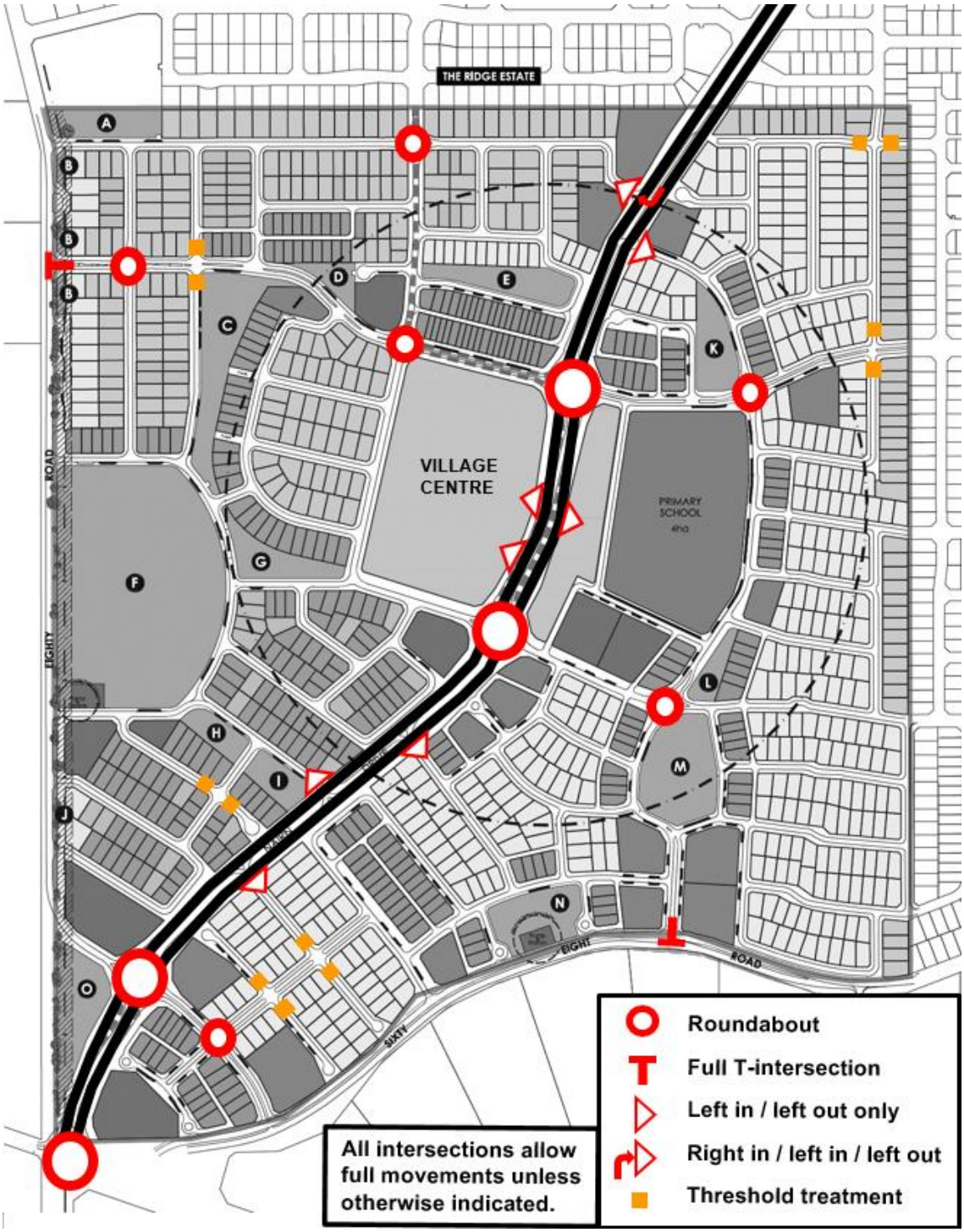


Figure 10: Intersection treatments

Nairn Drive Intersections

Access to the LSP area will be provided by several intersections on Nairn Drive. The four main intersections along Nairn Drive will be four-way intersections. These are located at Sixty Eight Road, the realigned Eighty Road and the two Neighbourhood Connector roads at the north and south edges of the neighbourhood centre. These were proposed to be constructed as roundabouts due to lower traffic delays and maintenance costs than at traffic signal controlled intersections, as well as Main Roads WA current strategy of discouraging construction of signalised intersections when a roundabout would be a more efficient treatment.

Notwithstanding MRWA's default position on roundabouts, there is a preference for signalised intersections adjacent to the village centre. However there is an existing/current subdivision approval for the School Site (WAPC 155055) which shows this the northern intersection as a roundabout, which is also consistent with the Parkland Heights Structure Plan.

The City of Rockingham (in collaboration with Rockingham Park) has submitted a submission to Main Roads WA justifying why this intersection should be signalised but (at the time of writing) this has not yet been agreed by MRWA.

The State Government recently announced that the Baldivis South Primary School will be opening in 2021 meaning that civil construction will need to commence in early 2019. This deadline to deliver the Primary School impacts the timing to resolve the intersection treatment adjacent the Neighbourhood Centre. Whilst it is the proponent's preference for a signalised intersection, if agreement on this preferred outcome cannot be reached in time to meet the Primary School delivery timeframes then that intersection will be constructed as a roundabout in accordance with the subdivision approval.

The northern-most access street intersection on Nairn Drive will allow right in / left in / left out movements, as previously proposed. As shown on Figure 10, the other side road intersections on Nairn Drive will be restricted to left in / left out only.

The three access points on the neighbourhood centre section of Nairn Drive are proposed to be restricted to left turns only, as shown on Figure 10. This will provide good access to/from the neighbourhood centre and the future primary school site. Right turns will be accommodated at the roundabouts on Nairn Drive. It is highly desirable that the speed limit on this Integrator B section of Nairn Drive should be lower than the 70km/h speed limit further north on Nairn Drive, so left turn slip lanes are not considered necessary.

Eighty Road and Sixty Eight Road Intersections

There are six road connections proposed from the LSP area onto Eighty Road and three on Sixty Eight Road. The easternmost connection on Sixty Eight Road will be constructed with a right turn pocket on Sixty Eight Road. All other intersections will have relatively low traffic flows on the side roads and will not require right turn pockets on Eighty Road and Sixty Eight Road.

Internal Intersections
Within the structure plan area there are a number of proposed four-way intersections. The busiest of these are recommended to be roundabouts, as shown in Figure 10.

There are also 4 four-way intersections formed on short, low-traffic-volume access streets. These are recommended to be constructed as priority-controlled intersections with give way signs on the minor road approaches as suggested in Liveable Neighbourhoods (LN Element 2 pages 31-33). Appropriate entry treatments will be provided on the side roads to help to alert drivers to the presence of the intersection and that traffic on the major road has priority.

6.4 Intersection Analysis

Intersection capacity analysis has been undertaken for all of the intersections along Nairn Drive through the LSP area plus the busiest intersection on Eighty Road (at Furnivall Parade) and the neighbourhood connector intersection on Sixty Eight Road. These intersections have been analysed for the weekday AM peak and PM peak hour flows that correspond to the modelled 2031 daily traffic flows in Figure 9.

Capacity analysis of these intersections has been undertaken using the SIDRA computer software package. SIDRA is an intersection modelling tool commonly used by traffic engineers for all types of intersections. SIDRA outputs are presented in the form of Degree of Saturation, Level of Service, Average Delay and 95% Queue. These characteristics are defined as follows:

- Degree of Saturation is the ratio of the arrival traffic flow to the capacity of the approach during the same period. The Degree of Saturation ranges from close to zero for infrequent traffic flow up to one for saturated flow or capacity.
- Level of Service is the qualitative measure describing operational conditions within a traffic stream and the perception by motorists and/or passengers. In general, there are 6 levels of service, designated from A to F, with Level of Service A representing the best operating condition (i.e. free flow) and Level of Service F the worst (i.e. forced or breakdown flow).
- Average Delay is the average of all travel time delays for vehicles through the intersection.
- 95% Queue is the queue length below which 95% of all observed queue lengths fall.

The results of the SIDRA analysis are summarised in Appendix D and satisfactory intersection performance is shown for each of the indicative intersection treatments shown in Appendix D.

It should be noted that two-lane roundabouts have been assumed at the Sixty Eight Road, Eighty Road and Furnivall Parade intersections, which is appropriate for the

planned dual carriageway standard of Nairn Drive north of the neighbourhood centre and south of the Eighty Road intersection.

A single-lane roundabout is modelled at the Nairn Drive / southern neighbourhood centre intersection, which is consistent with the assumption that this section of Nairn Drive would not require upgrading to four-lane divided standard. However, the design of the roundabout and associated land requirements will be designed to accommodate future upgrading to dual-lane roundabout to preserve the potential future option of upgrading this section of Nairn Drive to four-lane divided standard, if required in future.

The SIDRA results for the two T-intersections analysed along Eighty Road and Sixty Eight Road demonstrate that a simple T-intersection treatment (without any road widening or turn lanes) would operate satisfactorily under the forecast future traffic flows with full development of the surrounding Baldivis area. All movements at these intersections would operate at level of service A with minimal queues and delays.

6.5 Access to Frontage Properties

The WAPC *Liveable Neighbourhoods* policy requires that "Development along integrator B and neighbourhood connector streets with ultimate vehicle volumes over 5,000 vehicles per day should be designed either so vehicles entering the street can do so travelling forward, or are provided with alternative forms of vehicle access. Wider lots with paired driveways and protected reversing areas in the parking lane may be used on streets with up to 7,000 vehicles per day."

Future traffic volumes are modelled as greater than 5,000vpd only on Nairn Drive, Eighty Road, Sixty Eight Road and the section of Furnivall Parade between Arpenteur Drive and Nairn Drive, adjacent to the neighbourhood centre. There will be no direct driveway access from abutting residential development on any of these roads. Access for abutting residential development along Eighty Road has been addressed by CAP roads (Controlled Access Places or service roads) in the approved Stage 1 subdivision area in the northwest corner of the LSP area. Access for properties along this section of Furnivall Parade will be provided by rear laneway access.

6.6 Pedestrian / Cycle Networks

The proposed network of shared paths for pedestrians and cyclists is described in section 4.3 of this transport assessment. This network of paths will provide an excellent level of accessibility and permeability for pedestrians and cyclists within the Revised LSP area, and connections to neighbouring precincts at strategic locations.

There are some locations where there is anticipated to be strong demand for pedestrian and cyclist movements crossing the road network, which warrant further

consideration. In particular these are around the future primary school site and the proposed neighbourhood centre on Nairn Drive.

The WAPC *Transport Impact Assessment Guidelines* (2016) provides guidance on the levels of traffic volumes that are likely to affect the ability for pedestrians to cross various types of road. Based on that guidance an undivided two-lane road should be acceptable for pedestrians crossing traffic volumes of up to approximately 11,000vpd and this threshold can be increased to around 28,000vpd by adding a central median or pedestrian refuge islands. On a four-lane road, because of its greater carriageway width, this threshold is lower; even with a median island the threshold is only around 16,000vpd.

The section of Nairn Drive adjacent to the neighbourhood centre is expected to carry up to 14,700vpd if there is further urban development south of Sixty Eight Road. The proposed one traffic lane in each direction, with a central median, complies with the guidance in the Transport Impact Assessment Guidelines. It is also anticipated that the speed limit on this section will be set as low as practical, certainly less than the 70km/h anticipated further north on Nairn Drive. Suitable pedestrian crossing locations on Nairn Drive will be provided with grab rails and pram ramps to assist these movements. Overall it is therefore anticipated that the environment will be satisfactory for pedestrians and cyclists to cross this road while this section of Nairn Drive is planned as an Integrator B (one lane each way with a central median) through the neighbourhood centre precinct. If future regional development results in more through traffic than currently anticipated and the City of Rockingham decides to upgrade this section of Nairn Drive to Integrator A standard (two lanes each way with a central median) then additional pedestrian facilities (such as a signalised pedestrian crossing) may need to be considered as part of that road upgrade project.

6.7 Safe Routes to Schools

The LSP plan includes a new primary school site east of the neighbourhood centre land uses on the eastern side of Nairn Drive. There is also an existing Catholic primary school (and future Catholic high school) on the western side of Eighty Road opposite the LSP area.

Information from the 2002-2006 *Perth & Regions Travel Survey* (PARTS) indicated that 25.4% of primary school students and 17.1% of high school students walk or cycle to school while 26.7% of primary and 21.9% of high school students walk or cycle home from school. Therefore a 430 student primary school would typically have about 110 students walking or cycling and a 1450 student high school would typically have about 250-320 students walking or cycling.

Hence it would be appropriate to plan for warden-controlled school crossing facilities to assist school students to cross neighbourhood connector or integrator arterial roads around these school sites.

Warrant criteria provided on the WA Police website indicate that a Type A Children's Crossing may be provided where a minimum of 20 students and 200 vehicle movements occur within the hour immediately before and immediately after school, for a primary school, or 20 students and 700vph for high schools. The warrants are lower for a Type B Children's Crossing at 10 students and 100vph for a primary school or 10 students and 350vph for a high school. Such facilities can only be applied for by a School Principal or the President / Secretary of the relevant school/parent organisation (eg. P&C or P&F). The anticipated numbers of primary students crossing neighbourhood connector or integrator arterial roads around the school sites would potentially meet these warrants in future so it would be expected that the school would apply for this type of facility when future student numbers and movements meet those warrants.

6.8 Access to Public Transport

At structure planning stage the WAPC *Transport Impact Assessment Guidelines* (2016) suggest that it is desirable for at least 90 per cent of dwellings to be within 400m straight line distance of a bus route.

The bus routes shown on Figure 7 are located about 900m apart and approximately 450m from the western boundary of the LSP area. Therefore about 80% of the site area will be within 400m straight line distance of a bus route. The location of POS on the western side of the LSP area and concentration of density near the centre will further help to increase the percentage of dwellings closer to public transport. This should be considered satisfactory for future public transport provision in this LSP area.

7.0 Conclusions

The main findings of the transport assessment for the Parkland Heights Local Structure Plan are outlined below.

The LSP area is anticipated to accommodate approximately 1,400 dwellings, a proposed neighbourhood centre and a future primary school site.

The residential component is anticipated to generate traffic flows of approximately 10,400vpd, including some of the 800vpd attracted to the proposed school and 9,500vpd attracted to the neighbourhood centre. It is anticipated that around 20% of the neighbourhood centre traffic would be pass by trips already on the road network and not new trips generated by the neighbourhood centre development.

The road network of the LSP area has been designed based on WAPC Liveable Neighbourhoods guidelines to accommodate the future traffic flows that will be generated in this area.

The proposed change of the village centre land uses to a larger neighbourhood centre development does result in traffic increases on the surrounding road network but does not result in any significant changes to the LSP road network or surrounding area. The adjacent section of Furnivall Parade would be upgraded to Neighbourhood Connector A standard but that can already be accommodated within the planned 25m road reserve for that section of road.

Access to the LSP area will be served by a number of access points on Nairn Drive, which is an Other Regional Road in the Metropolitan Region Scheme, as well as access from Eighty Road and Sixty Eight Road.

There are four 4-way intersections proposed on Nairn Drive within the LSP area. All have previously been planned to be constructed as roundabouts due to lower traffic delays and maintenance costs than at traffic signal controlled intersections, as well as MRWA's current strategy of minimising new signalised intersections. However, it is acknowledged that the City of Rockingham and DPLH would prefer signalised intersections adjacent to the village centre to assist pedestrian and cyclist movements across Nairn Drive. Hence the future intersection treatment at these locations will depend upon whether timely agreement can be reached between the City and MRWA for a signalised intersection.

Other access points on Nairn Drive will be three-way intersections with appropriate restrictions on turn movements where required. Most will be restricted to left in / left out only. Access into the neighbourhood centre from Nairn Drive will be left in / left out only with all right turns via the planned roundabouts on Nairn Drive.

When the Baldivis area (including this LSP area) is fully developed Sixty Eight Road will potentially carry traffic flows of up to 6,000-7,000vpd. On sections where there

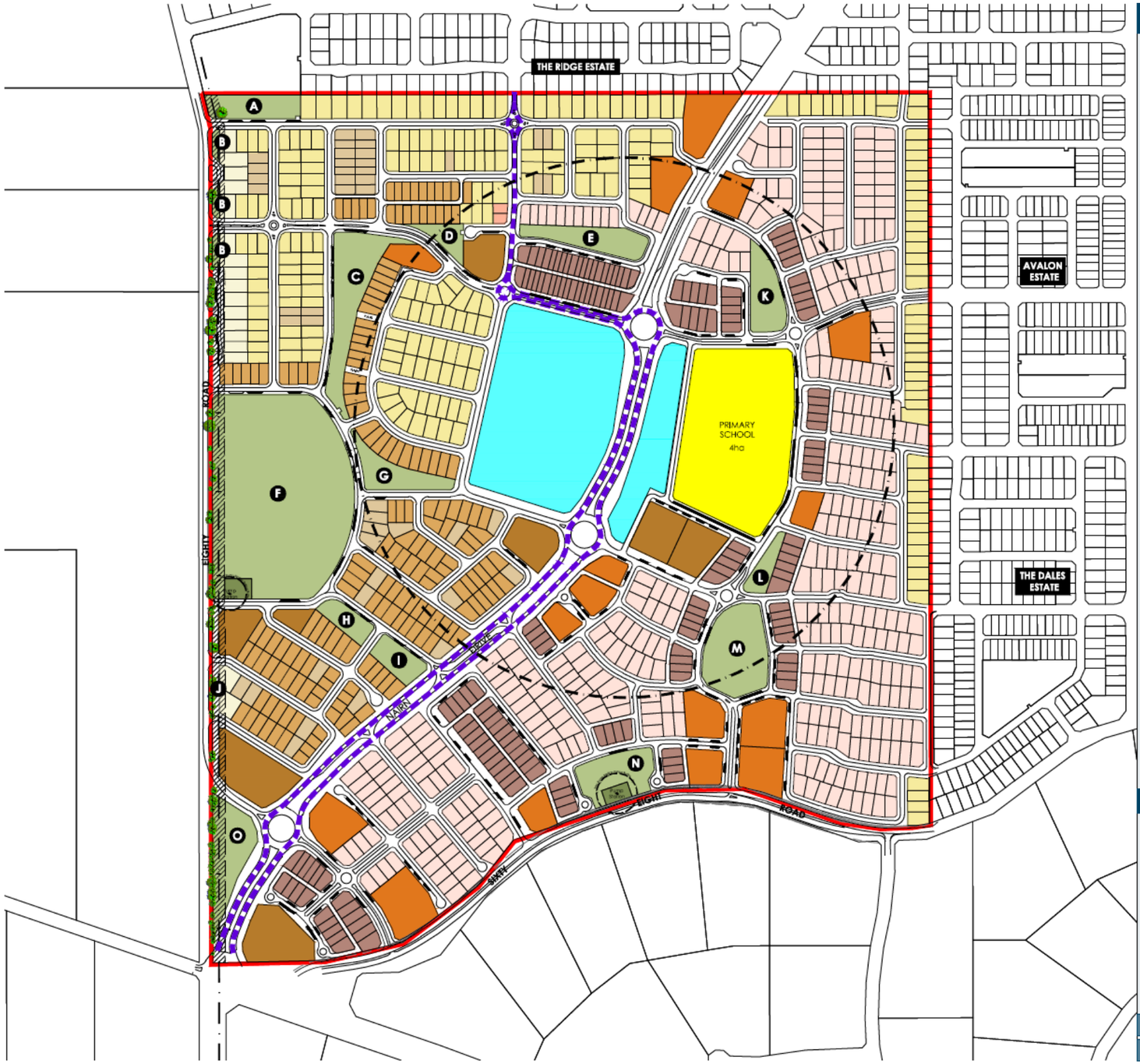
is future urban development on both sides this would warrant an urban Neighbourhood Connector A road standard (one lane each way with cycle lanes and 2-metre median in a road reserve up to 24.4m wide) but the rural land south of this LSP area is not planned for future urban development. Agreement has been reached that this section of Sixty Eight Road is to be widened on the northern side to 22.2m total width, which can accommodate the Neighbourhood Connector A cross section of one lane each way, 1.5m cycle lanes and 2m median with 5m verges on both sides.

The proposed road network provides for a future bus route extension along Arpenteur Drive and through the LSP area in accordance with current Transperth public transport planning.

The proposed LSP also provides for a comprehensive network of shared paths and footpaths to encourage and facilitate non-motorised travel as well.

Appendix A

Proposed Local Structure Plan



LEGEND

ZONES / RESERVES

- RESIDENTIAL R60
- RESIDENTIAL R40
- RESIDENTIAL R30
- RESIDENTIAL R25
- RESIDENTIAL R20
- RESIDENTIAL R15
- COMMERCIAL
- EDUCATION
- PUBLIC OPEN SPACE
- RMD R40
- RMD R30
- RMD R25

OTHER

- LOCAL STRUCTURE PLAN BOUNDARY
- 400m NEIGHBOURHOOD WALKABLE CATCHMENT
- PUMP STATION ODOUR BUFFER
- POWERLINE EASEMENT
- ROAD WIDENING (SIXTY EIGHT ROAD)
- PLANNED BUS ROUTE
- VEGETATION TO BE PROTECTED (WHERE POSSIBLE)
- SEWER PUMP STATION (900m²-1200m²)

NOTES

1. The boundary of this Local Structure Plan (LSP) is in accordance with the approved Comprehensive Development Plan (CDP) 2002 and original Lot 1507 boudary.
2. The access street and associated lot layout shown on the Plan is indicative only and subject to refinement as part of the detailed subdivision process.
3. POS areas are indicative only and subject to further detailed design and drainage considerations.
4. All road carriageway detail depicted on this Plan including pavements, road treatments, medians and parking are for illustrative purposes only and are subject to final engineering design and any relevant approvals. The detail reflects the intent of road network standards preferred for this subdivision. All dimensions and areas depicted on this Plan are subject to pre-cal and final survey and may vary from figures shown.
5. Bushfire attack level to be reviewed prior to creation of titles. Development may require construction in accordance with AS3959 - Construction in Bushfire Prone Areas.
6. Sixty-Eight Road widening to accomodate future upgrade to boulevard standard. Construction requirements to be negotiated at subdivision stage of development.

PUBLIC OPEN SPACE TABLE

NOTES	CREDITABLE AREA (ha)	NOTES	CREDITABLE AREA (ha)
A	0.4009	I	0.3235
B	0.1463	J	CONVERTED TO ROAD RESERVE
C	0.8566	K	0.3439
D	0.2283	L	0.2328
E	0.5220	M	0.8281
F	5.3214	N	0.4755
G	0.4668	O	0.7076
H	0.2747		
TOTAL AREA OF POS & DRAINAGE			11.1284
% OF GROSS LANDHOLDING			10.90%

CLE TOWN PLANNING + DESIGN

LOCAL STRUCTURE PLAN
Lot 1507 Eighty Road, Baldivis
A Rockingham Park Project

DRAFT

0 50 100 150 200 250m

N

Original local structure plan prepared by Taylor Burrell Barnett.

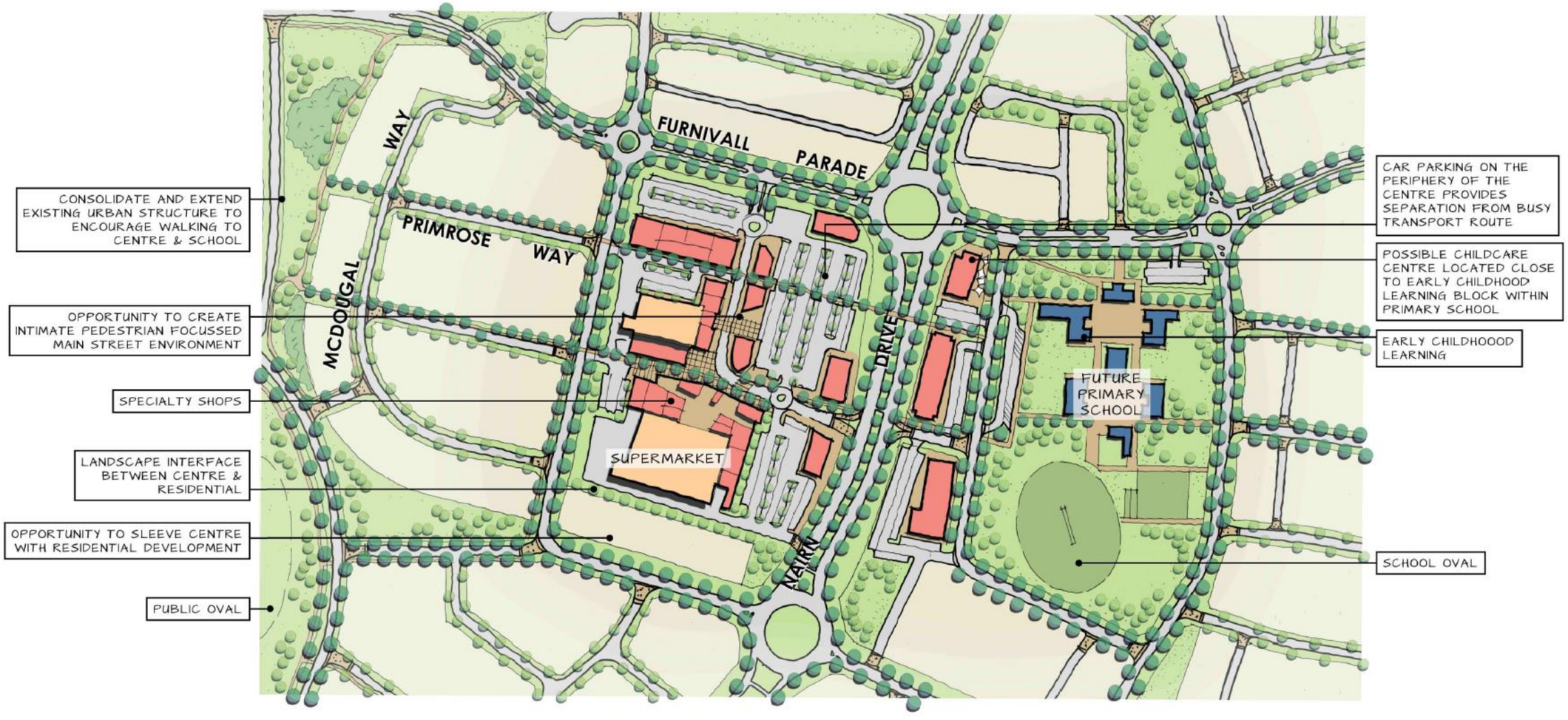
plan no: **3039-24-01**
date: 16 January 2017
scale: 1:6000 @A3

Appendix B

Neighbourhood Centre Concept Plan

CLE TOWN PLANNING + DESIGN

NHArchitecture



DRAFT

Source: NH Architecture (Core Centre Concept Design)
3039-14A-01 (21.04.2016), NTS

PARKLAND HEIGHTS VILLAGE CENTRE MASTERPLAN
Parkland Heights, Baldivis

Appendix C

Traffic Modelling

An Overview of the Traffic Modelling for Parkland Heights, Baldivis

The traffic analysis in this Transport Impact Assessment report has utilised the traffic modelling that was done for the Parkland Heights LSP area in 2010-2012 as the basis for the current revised traffic model.

The previous approved 2012 LSP traffic flows are shown on Figure 20 from the 2012 LSP report. Those traffic flows were from Transcore EMME traffic model scenario 35, which included full development of land between Sixty Eight Rd and Karnup Rd (south of this LSP area). See attached daily traffic volumes plot for Scenario 35 (refer Figure C3).

Note that the traffic model for this LSP area only directly models the area of Baldivis south from Safety Bay Rd to Karnup Rd. Extraneous through traffic: was determined by examination of information obtained from MRWA ROM traffic volume plots for the Baldivis area for 2031 (run 8 Sep 2009, refer Figure C1) which was provided to Transcore by the City of Rockingham in 2010, and STEM traffic model information from DoP in 2011 based on land use scenario 3321 (refer Figure C2) which reflected Directions 2031 future land use south of Sixty Eight Rd and indicated 11,222vpd on Nairn Drive through this LSP area.

The total traffic volumes shown on Figure 20 from the 2012 LSP report are the scenario 35 daily traffic volumes plus through traffic of 5300vpd on Nairn Drive and 5300vpd on Eighty Rd.

Review of the 2010 analysis indicates the 5300vpd through traffic on Eighty Rd was calculated very early on when only the MRWA ROM projections were available. That 5300vpd through traffic on Eighty Rd was calculated as 5600vpd total daily traffic from the ROM model minus 300vpd from stage 1 subdivision development in the LSP area. That figure of 5300vpd through traffic on Eighty Rd has been applied ever since, without further review. Now it could be argued that it is excessive. The ROM model has a traffic zone that stretches west from Nairn Drive to Eighty Rd generating traffic flows of 12000vpd but it is incorrectly modelled as only having connection to Eighty Rd, so the ROM modelled traffic volume of Eighty Rd north of Nairn Drive is too high. The STEM scenario 3321 goes to the other extreme with no zones connected directly to Eighty Rd, so the 1409vpd on Eighty Rd north of Nairn Drive in the STEM model is a much more appropriate estimate of future through traffic on this section of Eighty Rd. Following discussion with the City of Rockingham in October 2017 it was decided to continue to use this through traffic figure on Eighty Road in lieu of detailed modelling of other future land uses on Eighty Road (eg. future Catholic school expansion and future district recreation facility).

Review of the 2011 analysis indicates the 5300vpd through traffic on Nairn Drive was calculated from the STEM scenario 3321 figure of 11,222vpd on Nairn Drive north of Eighty Rd. An earlier EMME model scenario (Scenario 3) had indicated 5945vpd on that section of Nairn Drive (compared to 6607vpd in scenario 35), so through traffic on Nairn Drive was calculated as 11,222-5945=5277vpd, rounded up to 5300vpd through traffic on Nairn Drive. This through traffic component has been

maintained in all calculations since then for consistency between modelled scenarios and is still considered to be a reasonable through traffic figure to use on Nairn Drive north of Eighty Rd.

That provides the necessary background information about the modelled traffic flows in the 2012 LSP report.

The current 2017 analysis incorporates the proposal to increase the neighbourhood centre size to 10,000sqm. The 2010-2012 EMME model was not set up to model the catchment area that type of shopping centre but Transcore has developed a subregional Mandurah-Rockingham EMME model in recent years that can model the shopping centre traffic (primary trips) appropriately. It was still considered appropriate to utilise the 2012 EMME model to maintain consistency with the 2012 approved LSP report, so we ended up with a hybrid model using parts of both EMME traffic models, as follows:

- Daily traffic from the LSP area and surrounding parts of Baldivis (excluding neighbourhood centre traffic flows) come from the LSP area EMME traffic model (now scenario 41);
- Neighbourhood centre primary trips come from the subregional EMME traffic model (scenario 200);
- Neighbourhood centre pass-by trips are already on the road network so these turn in / out movements are manually assigned adjacent to the neighbourhood centre only; and
- Previously calculated regional through traffic is manually added on Nairn Drive and Eighty Rd within / adjacent to the LSP area.

There are some minor differences within the LSP area between 2012 EMME scenario 35 and 2017 EMME scenario 41 but the main difference is that scenario 35 had all of the land between Sixty Eight Rd and Karnup Rd as future residential development and therefore included construction of Karnup Rd between Baldivis Rd and the Sixty Eight Rd/Eighty Rd intersection. Scenario 41 reflects current planning for only the eastern portion of land south of Sixty Eight Rd to be residential development and therefore assumes construction of Karnup Rd will not be required.

Figures C4 and C5 are EMME scenario 35 and 41 (total minus select link volume) plots of daily traffic excluding neighbourhood centre traffic for comparison of this component of the traffic flows.

- In scenario 41 there is naturally a reduction of traffic flows on Sixty Eight Rd adjacent to the LSP area (due to less future development south of Sixty Eight Rd).
- On Nairn Drive south of the neighbourhood centre there is a reduction (approx. 300vpd) in Nairn Drive traffic (6345 vpd in scenario 35 reduces to 6042vpd in scenario 41)

- On Nairn Drive through the neighbourhood centre there is a reduction (approx. 1400vpd) in Nairn Drive traffic (8314 vpd in scenario 35 reduces to 6892vpd in scenario 41)
- On Nairn Drive north of the neighbourhood centre there is a reduction (approx. 1100vpd) in Nairn Drive traffic (8544 vpd in scenario 35 reduces to 7447vpd in scenario 41)
- The different reductions on different sections on Nairn Drive are a result of traffic redistribution associated with the model changes to land use and road network south of Sixty Eight Rd.

The neighbourhood centre traffic (primary trips) are shown in the attached EMME scenario 200 select links plot (Figure C6). This shows the heaviest traffic generation of the neighbourhood centre is along Nairn Drive to the north as that is where most of the catchment population will be located. Scenario 200 shows the following neighbourhood centre primary trips on Nairn Drive:

- 1197vpd on Nairn Drive south of the neighbourhood centre (was 492vpd in scenario 35).
- 941 vpd to 1048vpd On Nairn Drive through the neighbourhood centre, taking into account left in / left out driveway connections on Nairn Drive within the neighbourhood centre and corresponding diversion via side roads to other driveways for right turn movements (was 728 to 828vpd in scenario 35, which did not assume LILO access).
- 4133vpd on Nairn Drive north of the neighbourhood centre (was 566vpd in scenario 35).

Note that the total daily traffic volumes in Figure 9 of the current TIA report includes the regional through traffic flows manually added in on Eighty Rd and Nairn Drive, and manual redistribution of pass-by trips turning into and out from the neighbourhood centre site.

It should also be noted that Figure 9 daily traffic volumes have been manually adjusted to account for the restriction of four T-intersections along Nairn Drive to left in / left out only, as discussed in section 6.3 of the TIA report.

Figure C1

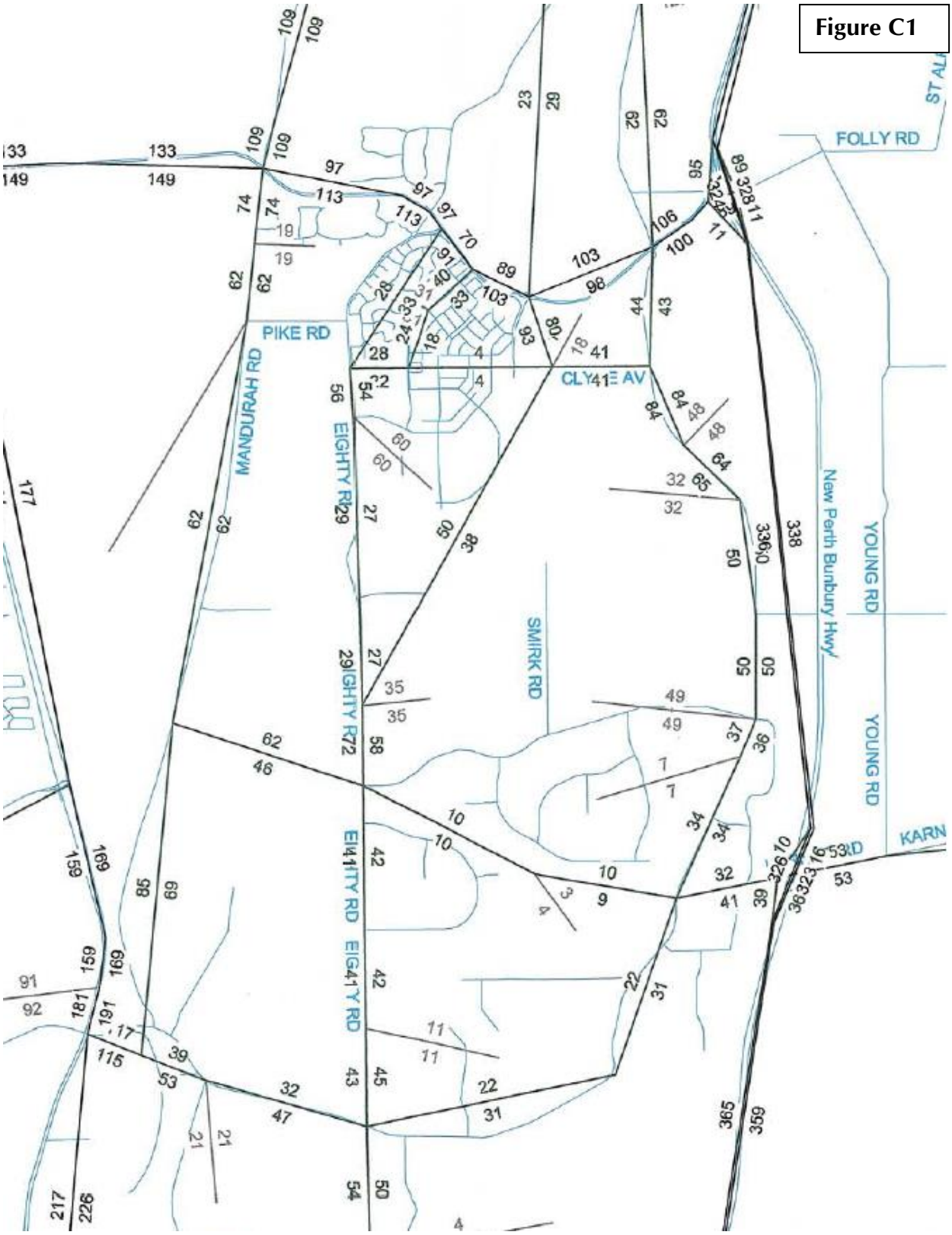

FOLLY RD
PIKE RD
MANDURAH RD
EIGHTY RD
CLY41E AV
SMIRK RD
New Perth Bunbury Hwy
YOUNG RD
YOUNG RD
KARN
EIG41TY RD
EIG41Y RD

Figure C2

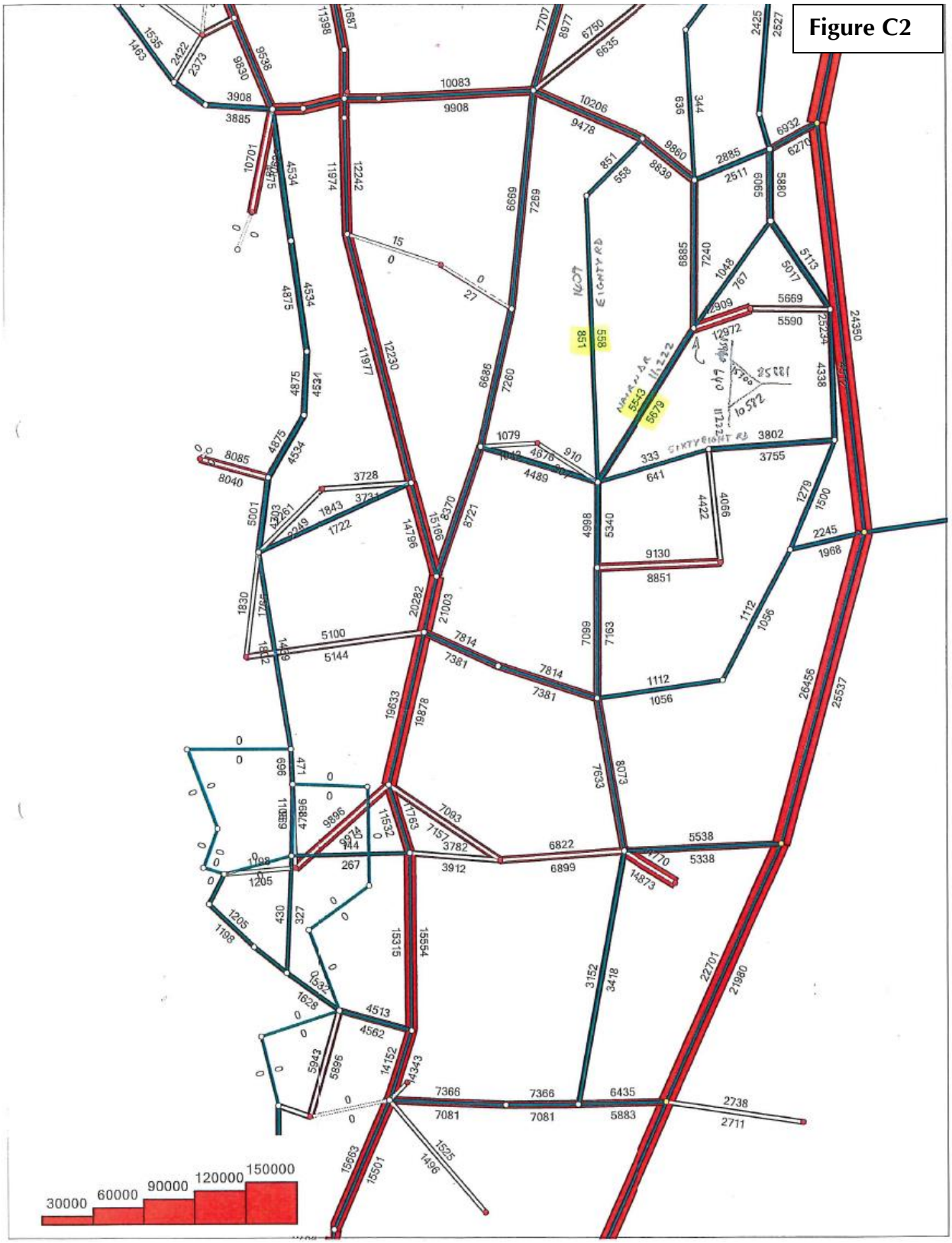


Figure C3


Scenario 35: Date: 2017-01-31
Scenario 32 with revised LSP Apr 2012
30000
60000
90000
120000
150000

Figure C4


Scenario 35: Date: 2017-01-31
Scenario 32 with revised LSP Apr 2012
Total - select link volumes
30000
60000
90000
120000
150000

Figure C5

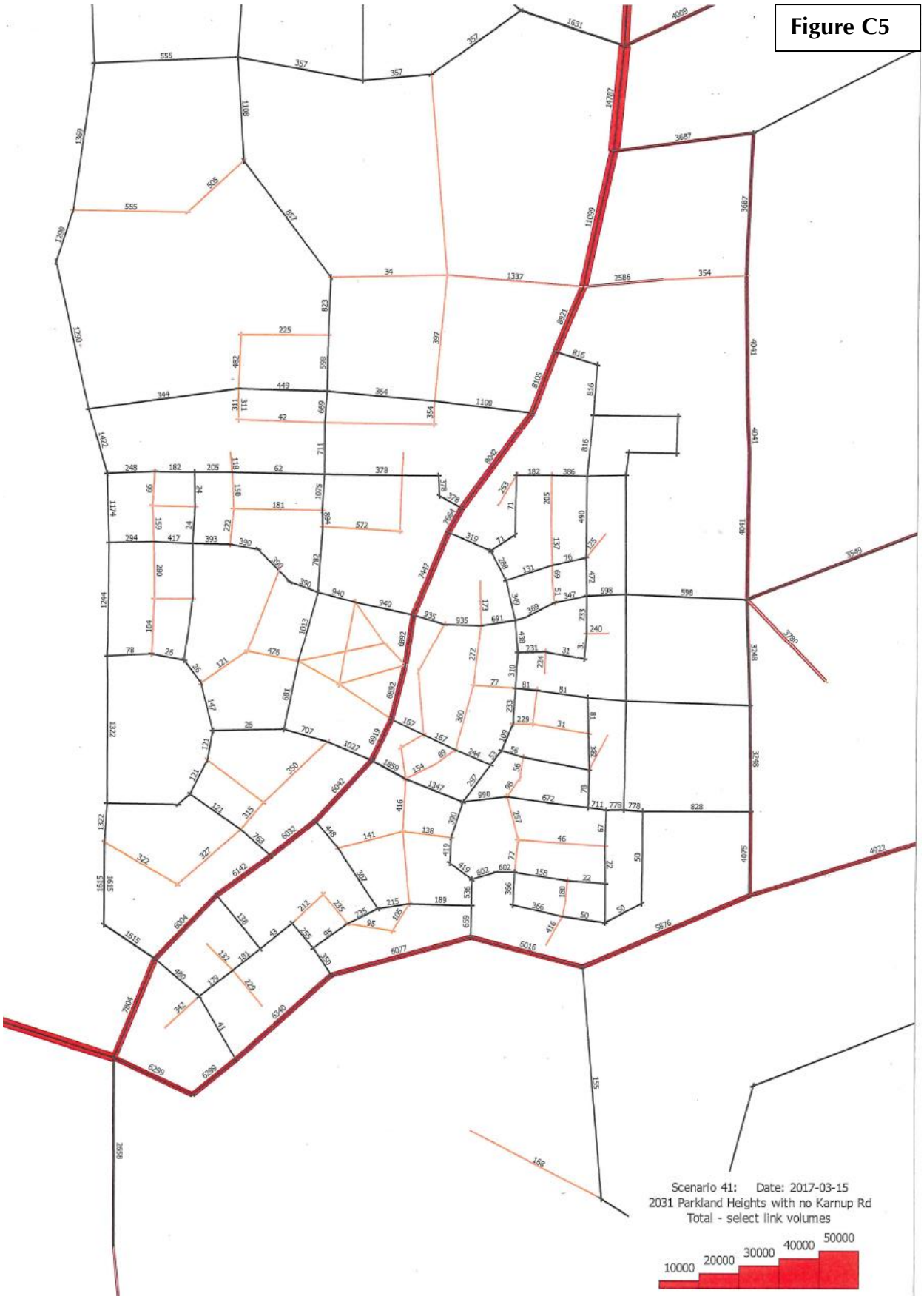
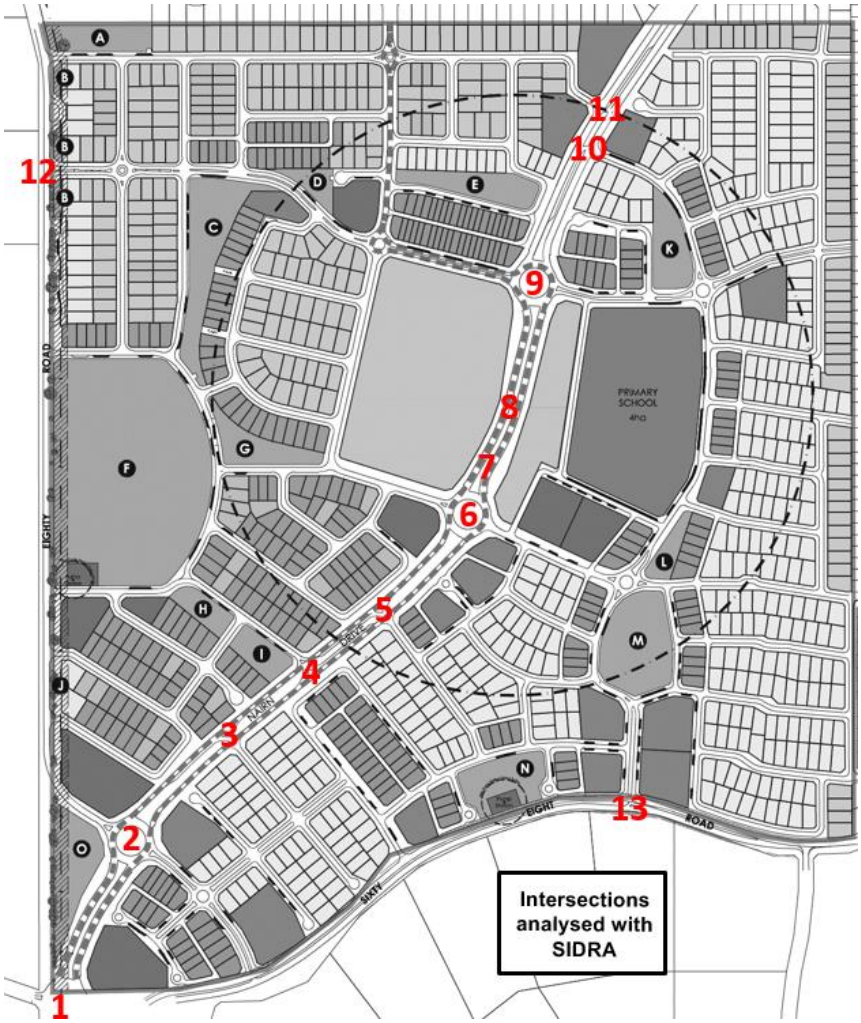

Scenario 41: Date: 2017-03-15
2031 Parkland Heights with no Karnup Rd
Total - select link volumes
10000
20000
30000
40000
50000

Figure C6


Scenario 200: Date: 2017-01-31
Parkland Heights Baldivis LSP 10000sqm NC
Selected links plot
5000
10000
15000
20000
25000

Appendix D

SIDRA Intersection Analysis



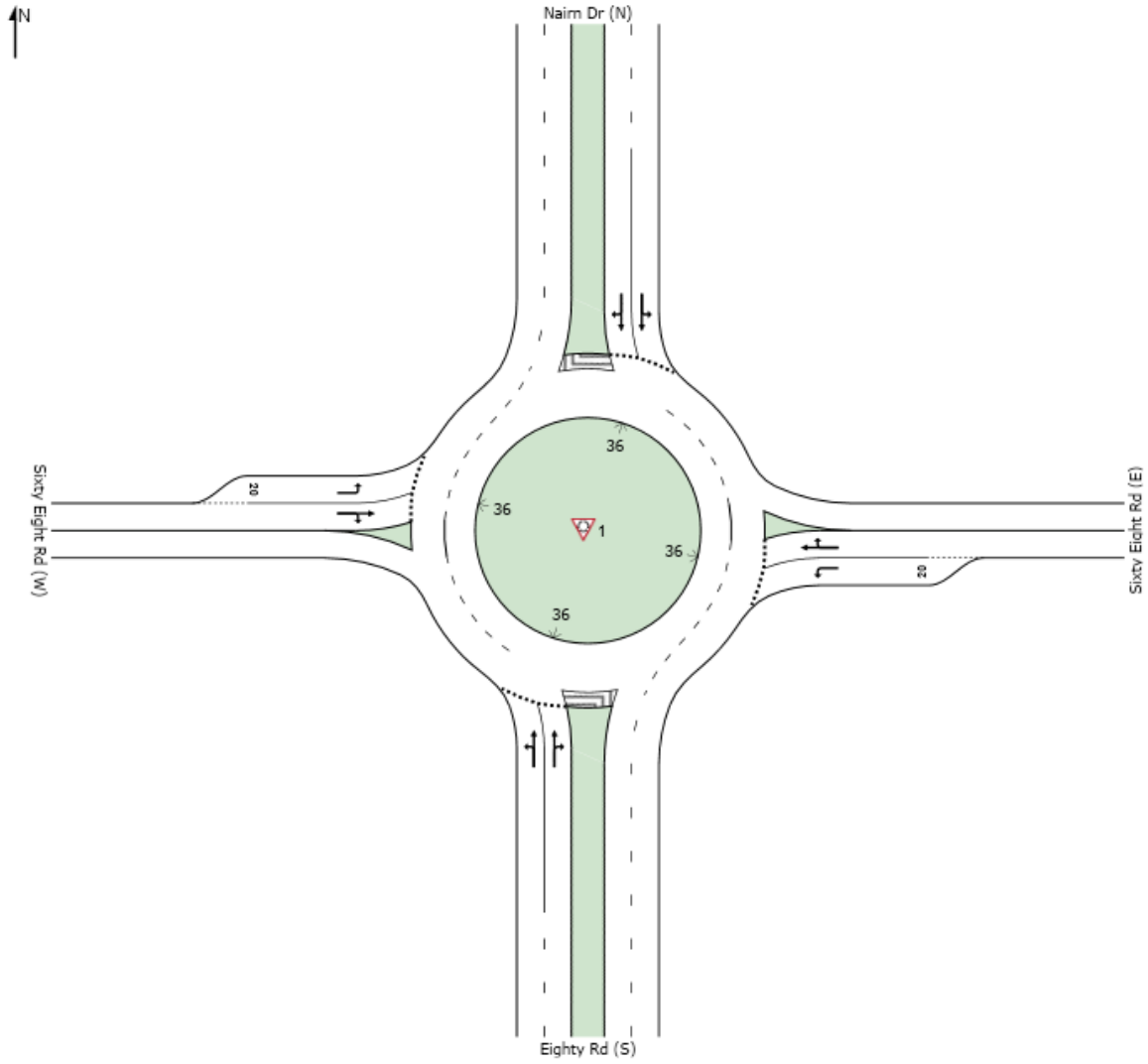


Figure D1. Nairn Drive / Sixty Eight Rd roundabout layout analysed in SIDRA

Table D1a. SIDRA results – Nairn Drive / Sixty Eight Rd roundabout – 2031 weekday AM peak with full development

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: Eighty Rd (S)											
1	L2	10	5.0	0.417	9.0	LOS A	3.3	24.2	0.84	0.78	57.9
2	T1	754	5.0	0.417	9.6	LOS A	3.3	24.2	0.83	0.82	59.9
3	R2	25	5.0	0.417	16.9	LOS B	3.0	21.6	0.82	0.88	58.7
Approach		789	5.0	0.417	9.9	LOS A	3.3	24.2	0.83	0.82	59.8
East: Sixty Eight Rd (E)											
4	L2	74	5.0	0.104	6.9	LOS A	0.3	2.4	0.51	0.73	60.7
5	T1	399	5.0	0.375	6.4	LOS A	1.6	11.6	0.57	0.57	61.8
6	R2	10	5.0	0.375	12.8	LOS B	1.6	11.6	0.57	0.57	61.0
Approach		483	5.0	0.375	6.6	LOS A	1.6	11.6	0.56	0.60	61.6
North: Nairn Dr (N)											
7	L2	10	5.0	0.315	5.0	LOS A	1.8	13.2	0.33	0.44	61.2
8	T1	498	5.0	0.315	5.1	LOS A	1.8	13.2	0.33	0.44	63.6
9	R2	462	5.0	0.345	11.6	LOS B	2.0	14.3	0.36	0.65	57.4
Approach		970	5.0	0.345	8.2	LOS A	2.0	14.3	0.34	0.54	60.4
West: Sixty Eight Rd (W)											
10	L2	155	5.0	0.150	5.8	LOS A	0.6	4.6	0.54	0.60	60.6
11	T1	133	5.0	0.164	6.1	LOS A	0.6	4.7	0.54	0.55	61.8
12	R2	10	5.0	0.164	12.5	LOS B	0.6	4.7	0.54	0.55	60.9
Approach		298	5.0	0.164	6.1	LOS A	0.6	4.7	0.54	0.58	61.1
All Vehicles		2540	5.0	0.417	8.2	LOS A	3.3	24.2	0.56	0.64	60.5

Table D1b. SIDRA results – Nairn Drive / Sixty Eight Rd roundabout – 2031 weekday PM peak with full development

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: Eighty Rd (S)											
1	L2	10	5.0	0.226	5.8	LOS A	1.3	9.4	0.50	0.51	60.0
2	T1	512	5.0	0.226	6.0	LOS A	1.3	9.4	0.50	0.55	62.0
3	R2	62	5.0	0.226	12.7	LOS B	1.2	8.6	0.51	0.60	60.4
Approach		584	5.0	0.226	6.7	LOS A	1.3	9.4	0.50	0.55	61.8
East: Sixty Eight Rd (E)											
4	L2	37	5.0	0.058	7.1	LOS A	0.2	1.5	0.57	0.74	60.4
5	T1	199	5.0	0.215	6.4	LOS A	0.9	6.7	0.60	0.57	61.5
6	R2	10	5.0	0.215	12.7	LOS B	0.9	6.7	0.60	0.57	60.6
Approach		246	5.0	0.215	6.7	LOS A	0.9	6.7	0.59	0.59	61.3
North: Nairn Dr (N)											
7	L2	10	5.0	0.416	6.0	LOS A	2.7	20.0	0.56	0.52	59.6
8	T1	810	5.0	0.416	6.2	LOS A	2.7	20.0	0.56	0.57	61.4
9	R2	237	5.0	0.416	12.9	LOS B	2.5	18.6	0.58	0.67	59.0
Approach		1057	5.0	0.416	7.7	LOS A	2.7	20.0	0.57	0.59	60.8
West: Sixty Eight Rd (W)											
10	L2	390	5.0	0.328	5.7	LOS A	1.3	9.6	0.46	0.59	60.9
11	T1	332	5.0	0.332	5.9	LOS A	1.3	9.4	0.48	0.53	62.4
12	R2	10	5.0	0.332	12.3	LOS B	1.3	9.4	0.48	0.53	61.5
Approach		732	5.0	0.332	5.9	LOS A	1.3	9.6	0.47	0.56	61.6
All Vehicles		2619	5.0	0.416	6.9	LOS A	2.7	20.0	0.53	0.57	61.3

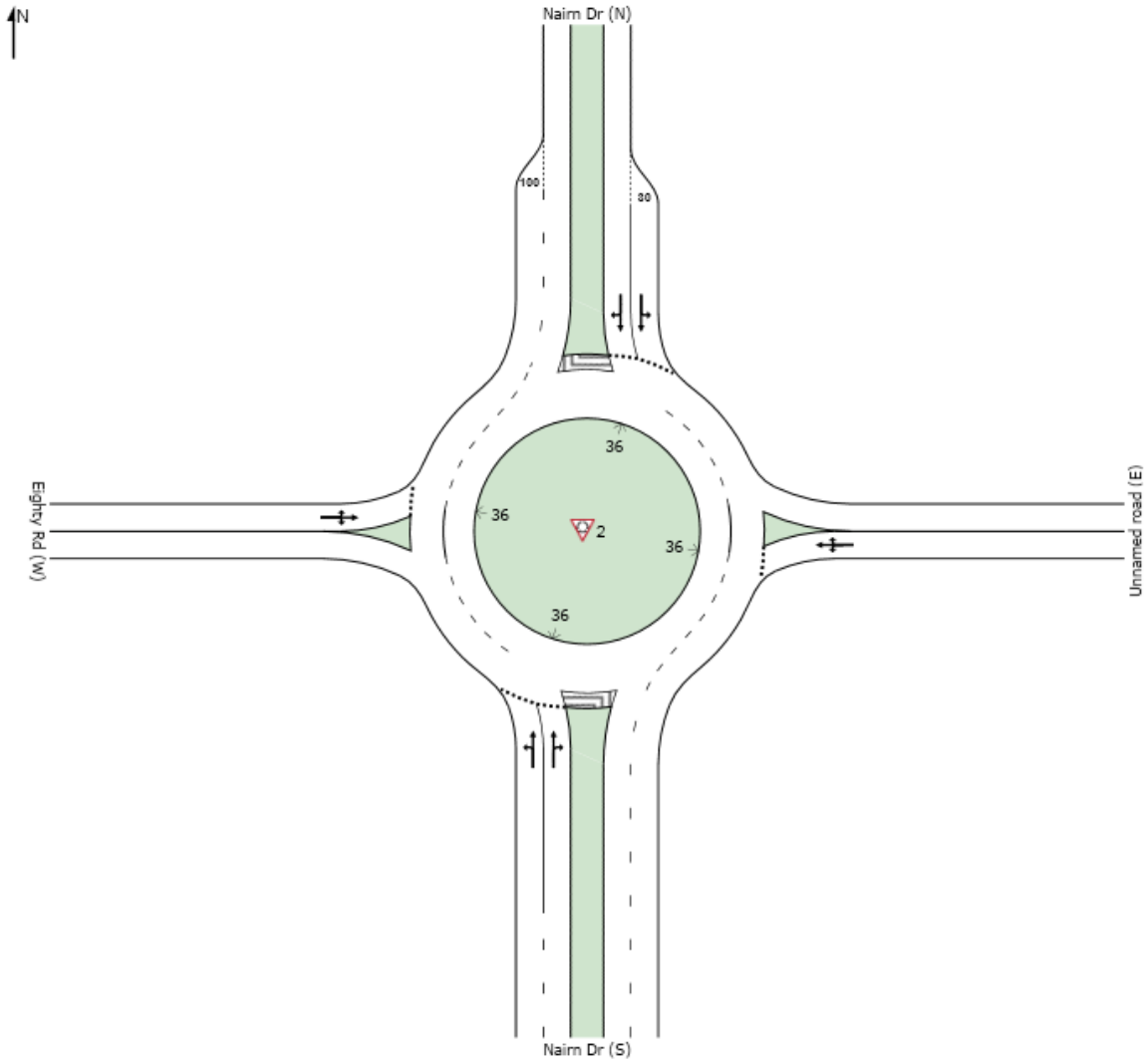


Figure D2. Nairn Drive / Eighty Rd roundabout layout analysed in SIDRA

Table D2a. SIDRA results – Nairn Drive / Eighty Rd roundabout – 2031 weekday AM peak with full development

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: Nairn Dr (S)											
1	L2	391	5.0	0.257	4.6	LOS A	1.4	10.0	0.07	0.46	62.9
2	T1	520	5.0	0.286	4.6	LOS A	1.6	11.8	0.07	0.39	65.5
3	R2	8	2.0	0.286	11.0	LOS B	1.6	11.8	0.07	0.39	58.9
Approach		919	5.0	0.286	4.7	LOS A	1.6	11.8	0.07	0.42	64.3
East: Unnamed road (E)											
4	L2	25	2.0	0.042	3.9	LOS A	0.1	1.0	0.49	0.61	52.6
5	T1	1	2.0	0.042	3.4	LOS A	0.1	1.0	0.49	0.61	54.3
6	R2	10	2.0	0.042	9.3	LOS A	0.1	1.0	0.49	0.61	54.2
Approach		36	2.0	0.042	5.4	LOS A	0.1	1.0	0.49	0.61	53.1
North: Nairn Dr (N)											
7	L2	3	2.0	0.242	5.4	LOS A	1.4	9.9	0.43	0.47	53.5
8	T1	644	5.0	0.242	5.6	LOS A	1.4	9.9	0.44	0.48	62.8
9	R2	1	5.0	0.242	12.1	LOS B	1.3	9.3	0.45	0.50	61.8
Approach		648	5.0	0.242	5.6	LOS A	1.4	9.9	0.44	0.48	62.8
West: Eighty Rd (W)											
10	L2	1	5.0	0.312	6.6	LOS A	1.4	9.9	0.50	0.78	55.8
11	T1	1	2.0	0.312	6.8	LOS A	1.4	9.9	0.50	0.78	51.6
12	R2	301	5.0	0.312	13.2	LOS B	1.4	9.9	0.50	0.78	56.9
Approach		303	5.0	0.312	13.2	LOS B	1.4	9.9	0.50	0.78	56.8
All Vehicles		1906	4.9	0.312	6.3	LOS A	1.6	11.8	0.27	0.50	62.2

Table D2b. SIDRA results – Nairn Drive / Eighty Rd roundabout – 2031 weekday PM peak with full development

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: Nairn Dr (S)											
1	L2	284	5.0	0.229	4.6	LOS A	1.2	8.6	0.05	0.45	63.1
2	T1	607	5.0	0.304	4.6	LOS A	1.8	12.9	0.05	0.40	65.5
3	R2	21	2.0	0.304	11.0	LOS B	1.8	12.9	0.05	0.40	58.9
Approach		912	4.9	0.304	4.7	LOS A	1.8	12.9	0.05	0.42	64.6
East: Unnamed road (E)											
4	L2	12	2.0	0.022	4.2	LOS A	0.1	0.6	0.54	0.61	52.5
5	T1	1	2.0	0.022	3.8	LOS A	0.1	0.6	0.54	0.61	54.1
6	R2	5	2.0	0.022	9.7	LOS A	0.1	0.6	0.54	0.61	54.0
Approach		18	2.0	0.022	5.7	LOS A	0.1	0.6	0.54	0.61	53.0
North: Nairn Dr (N)											
7	L2	9	2.0	0.256	5.8	LOS A	1.6	11.3	0.53	0.52	53.0
8	T1	619	5.0	0.256	6.1	LOS A	1.6	11.3	0.54	0.53	62.1
9	R2	1	5.0	0.256	12.7	LOS B	1.4	10.4	0.55	0.55	61.2
Approach		629	5.0	0.256	6.1	LOS A	1.6	11.3	0.54	0.53	62.0
West: Eighty Rd (W)											
10	L2	2	5.0	0.428	6.8	LOS A	1.9	14.0	0.52	0.84	55.6
11	T1	1	2.0	0.428	7.0	LOS A	1.9	14.0	0.52	0.84	51.5
12	R2	415	5.0	0.428	13.5	LOS B	1.9	14.0	0.52	0.84	56.8
Approach		418	5.0	0.428	13.4	LOS B	1.9	14.0	0.52	0.84	56.7
All Vehicles		1977	4.9	0.428	7.0	LOS A	1.9	14.0	0.31	0.54	61.8

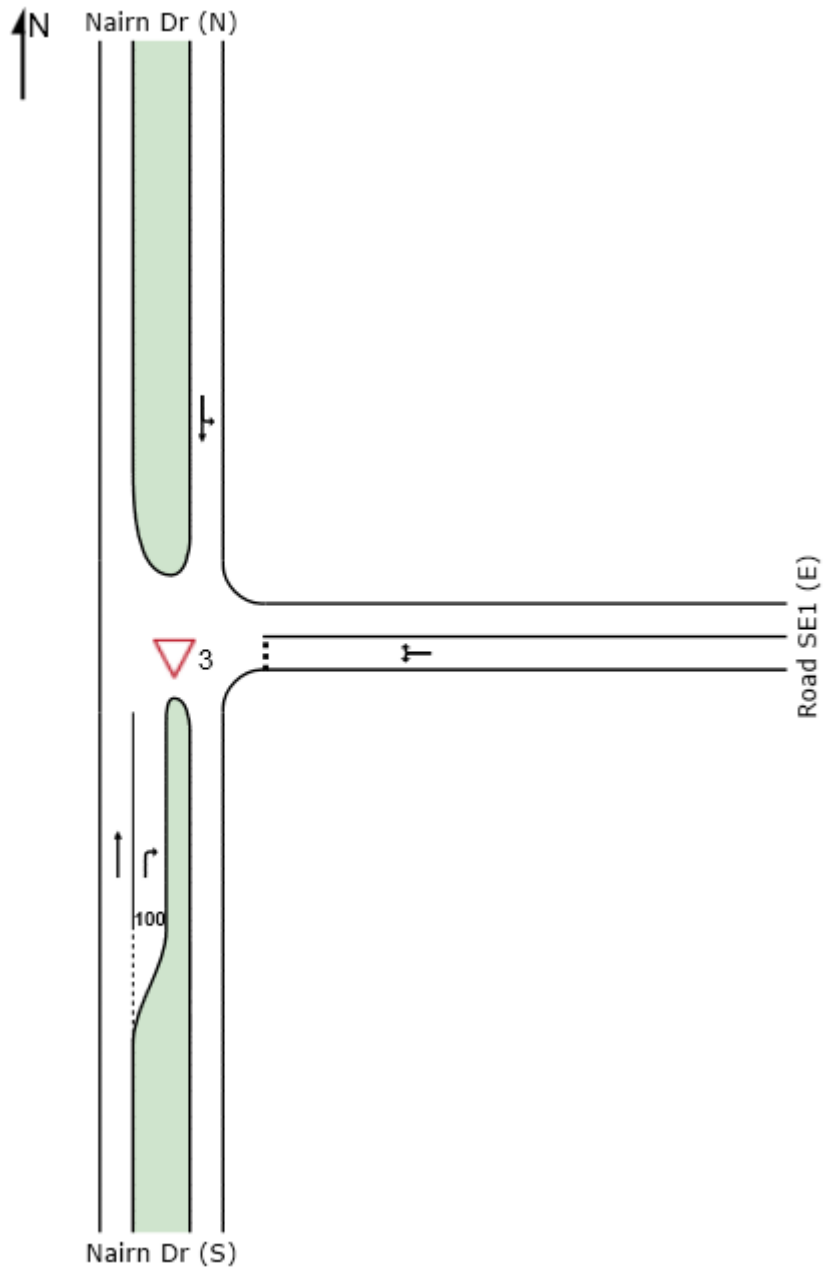


Figure D3. Nairn Drive / SE1 intersection layout analysed in SIDRA

Table D3a. SIDRA results – Nairn Drive / SE1 intersection – 2031 weekday AM peak with full development

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: Nairn Dr (S)											
2	T1	530	5.0	0.278	0.0	LOS A	0.0	0.0	0.00	0.00	69.9
3	R2	1	2.0	0.001	9.0	LOS A	0.0	0.0	0.56	0.60	50.1
Approach		531	5.0	0.278	0.0	NA	0.0	0.0	0.00	0.00	69.9
East: Road SE1 (E)											
4	L2	1	2.0	0.052	7.5	LOS A	0.2	1.2	0.83	0.91	42.2
6	R2	10	2.0	0.052	21.9	LOS C	0.2	1.2	0.83	0.91	42.0
Approach		11	2.0	0.052	20.6	LOS C	0.2	1.2	0.83	0.91	42.0
North: Nairn Dr (N)											
7	L2	3	2.0	0.341	6.4	LOS A	0.0	0.0	0.00	0.00	65.8
8	T1	647	5.0	0.341	0.0	LOS A	0.0	0.0	0.00	0.00	69.8
Approach		650	5.0	0.341	0.1	NA	0.0	0.0	0.00	0.00	69.8
All Vehicles		1192	5.0	0.341	0.3	NA	0.2	1.2	0.01	0.01	69.4

Table D3b. SIDRA results – Nairn Drive / SE1 intersection – 2031 weekday PM peak with full development

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: Nairn Dr (S)											
2	T1	613	5.0	0.321	0.0	LOS A	0.0	0.0	0.00	0.00	69.9
3	R2	1	2.0	0.001	8.9	LOS A	0.0	0.0	0.56	0.60	50.2
Approach		614	5.0	0.321	0.1	NA	0.0	0.0	0.00	0.00	69.8
East: Road SE1 (E)											
4	L2	1	2.0	0.035	7.4	LOS A	0.1	0.8	0.83	0.91	41.7
6	R2	6	2.0	0.035	23.9	LOS C	0.1	0.8	0.83	0.91	41.5
Approach		7	2.0	0.035	21.5	LOS C	0.1	0.8	0.83	0.91	41.5
North: Nairn Dr (N)											
7	L2	10	2.0	0.336	6.4	LOS A	0.0	0.0	0.00	0.01	65.7
8	T1	630	5.0	0.336	0.0	LOS A	0.0	0.0	0.00	0.01	69.7
Approach		640	5.0	0.336	0.1	NA	0.0	0.0	0.00	0.01	69.7
All Vehicles		1261	5.0	0.336	0.2	NA	0.1	0.8	0.01	0.01	69.5

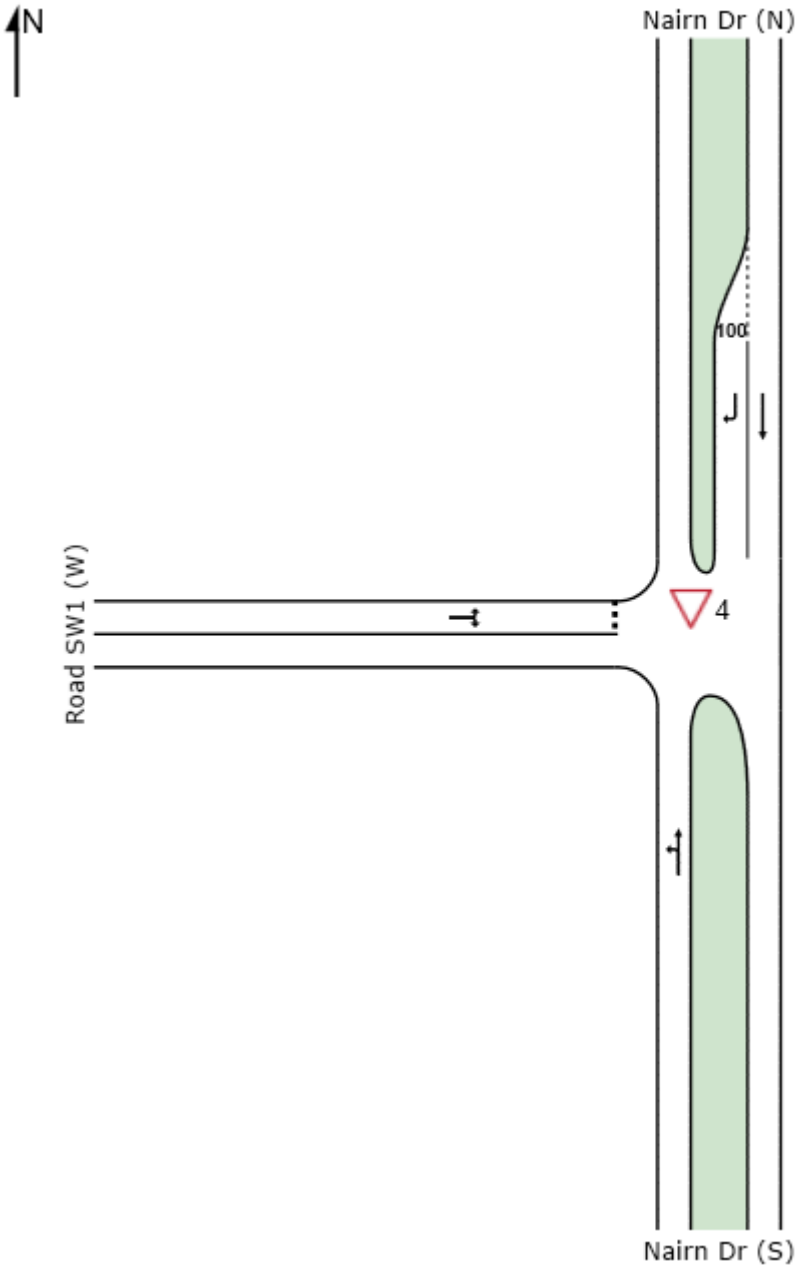


Figure D4. Nairn Drive / SW1 intersection layout analysed in SIDRA

Table D4a. SIDRA results – Nairn Drive / SW1 intersection – 2031 weekday AM peak with full development

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: Nairn Dr (S)											
7	L2	11	2.0	0.283	6.4	LOS A	0.0	0.0	0.00	0.01	65.7
8	T1	529	5.0	0.283	0.0	LOS A	0.0	0.0	0.00	0.01	69.7
Approach		540	4.9	0.283	0.2	NA	0.0	0.0	0.00	0.01	69.6
North: Nairn Dr (N)											
2	T1	617	5.0	0.323	0.0	LOS A	0.0	0.0	0.00	0.00	69.9
3	R2	8	2.0	0.008	8.3	LOS A	0.0	0.2	0.52	0.64	50.6
Approach		625	5.0	0.323	0.1	NA	0.0	0.2	0.01	0.01	69.6
West: Road SW1 (W)											
4	L2	24	2.0	0.183	6.9	LOS A	0.6	4.4	0.75	0.86	44.7
6	R2	33	2.0	0.183	22.0	LOS C	0.6	4.4	0.75	0.86	44.5
Approach		57	2.0	0.183	15.6	LOS C	0.6	4.4	0.75	0.86	44.6
All Vehicles		1222	4.8	0.323	0.9	NA	0.6	4.4	0.04	0.05	67.8

Table D4b. SIDRA results – Nairn Drive / SW1 intersection – 2031 weekday PM peak with full development

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: Nairn Dr (S)											
7	L2	27	2.0	0.325	6.4	LOS A	0.0	0.0	0.00	0.03	65.5
8	T1	592	5.0	0.325	0.0	LOS A	0.0	0.0	0.00	0.03	69.5
Approach		619	4.9	0.325	0.3	NA	0.0	0.0	0.00	0.03	69.3
North: Nairn Dr (N)											
2	T1	624	5.0	0.327	0.0	LOS A	0.0	0.0	0.00	0.00	69.9
3	R2	20	2.0	0.023	8.9	LOS A	0.1	0.6	0.56	0.71	50.2
Approach		644	4.9	0.327	0.3	NA	0.1	0.6	0.02	0.02	69.0
West: Road SW1 (W)											
4	L2	13	2.0	0.104	7.2	LOS A	0.3	2.4	0.77	0.86	44.2
6	R2	16	2.0	0.104	24.4	LOS C	0.3	2.4	0.77	0.86	43.9
Approach		29	2.0	0.104	16.7	LOS C	0.3	2.4	0.77	0.86	44.0
All Vehicles		1292	4.8	0.327	0.7	NA	0.3	2.4	0.03	0.04	68.3

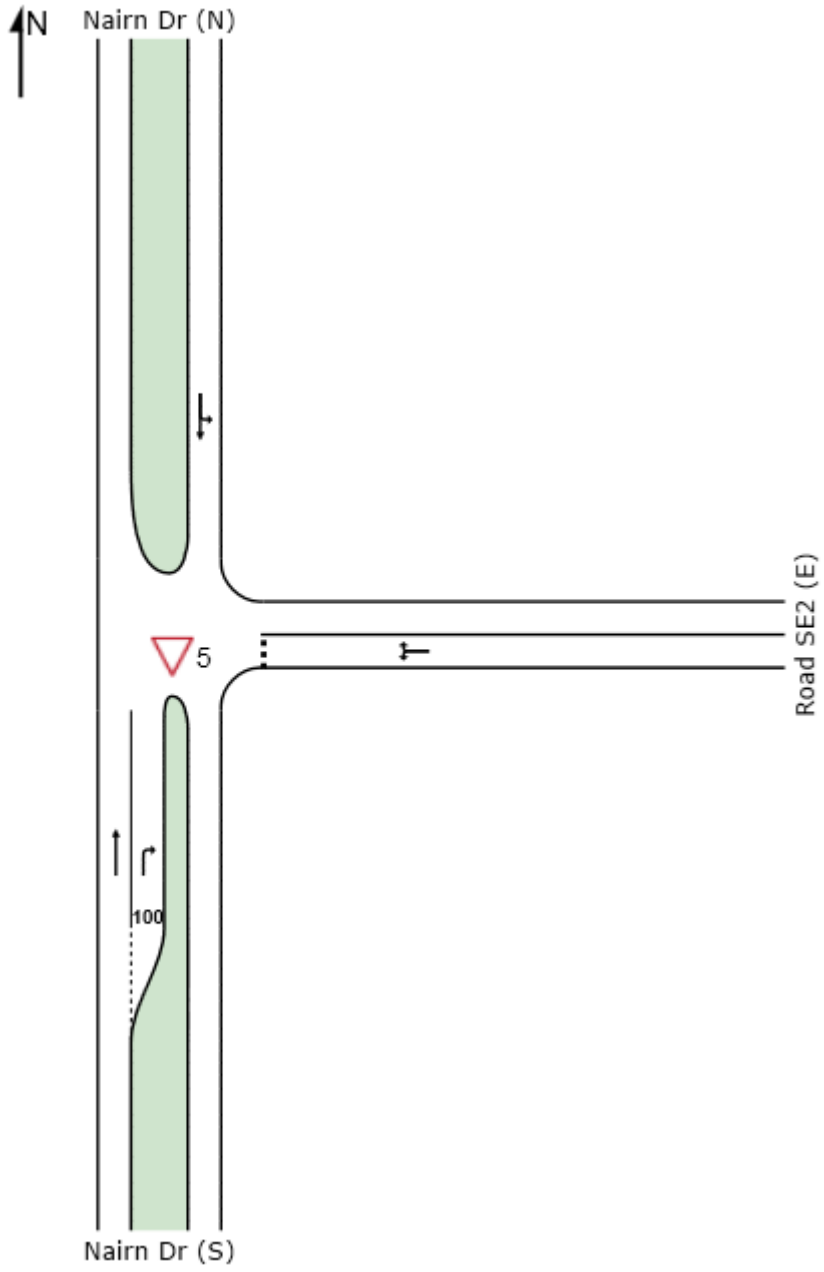


Figure D5. Nairn Drive / SE2 intersection layout analysed in SIDRA

Table D5a. SIDRA results – Nairn Drive / SE2 intersection – 2031 weekday AM peak with full development

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: Nairn Dr (S)											
2	T1	547	5.0	0.287	0.0	LOS A	0.0	0.0	0.00	0.00	69.9
3	R2	6	2.0	0.007	8.8	LOS A	0.0	0.2	0.55	0.66	50.2
Approach		553	5.0	0.287	0.1	NA	0.0	0.2	0.01	0.01	69.6
East: Road SE2 (E)											
4	L2	17	2.0	0.107	7.3	LOS A	0.4	2.5	0.74	0.85	45.3
6	R2	18	2.0	0.107	21.6	LOS C	0.4	2.5	0.74	0.85	45.0
Approach		35	2.0	0.107	14.7	LOS B	0.4	2.5	0.74	0.85	45.1
North: Nairn Dr (N)											
7	L2	8	2.0	0.323	6.4	LOS A	0.0	0.0	0.00	0.01	65.7
8	T1	608	5.0	0.323	0.0	LOS A	0.0	0.0	0.00	0.01	69.8
Approach		616	5.0	0.323	0.1	NA	0.0	0.0	0.00	0.01	69.7
All Vehicles		1204	4.9	0.323	0.5	NA	0.4	2.5	0.02	0.03	68.6

Table D5b. SIDRA results – Nairn Drive / SE2 intersection – 2031 weekday PM peak with full development

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: Nairn Dr (S)											
2	T1	591	5.0	0.310	0.0	LOS A	0.0	0.0	0.00	0.00	69.9
3	R2	14	2.0	0.017	9.2	LOS A	0.1	0.5	0.57	0.71	50.0
Approach		605	4.9	0.310	0.2	NA	0.1	0.5	0.01	0.02	69.3
East: Road SE2 (E)											
4	L2	8	2.0	0.095	7.5	LOS A	0.3	2.2	0.80	0.89	43.1
6	R2	15	2.0	0.095	24.7	LOS C	0.3	2.2	0.80	0.89	42.9
Approach		23	2.0	0.095	18.7	LOS C	0.3	2.2	0.80	0.89	43.0
North: Nairn Dr (N)											
7	L2	22	2.0	0.345	6.4	LOS A	0.0	0.0	0.00	0.02	65.5
8	T1	636	5.0	0.345	0.0	LOS A	0.0	0.0	0.00	0.02	69.6
Approach		658	4.9	0.345	0.3	NA	0.0	0.0	0.00	0.02	69.4
All Vehicles		1286	4.9	0.345	0.6	NA	0.3	2.2	0.02	0.03	68.6

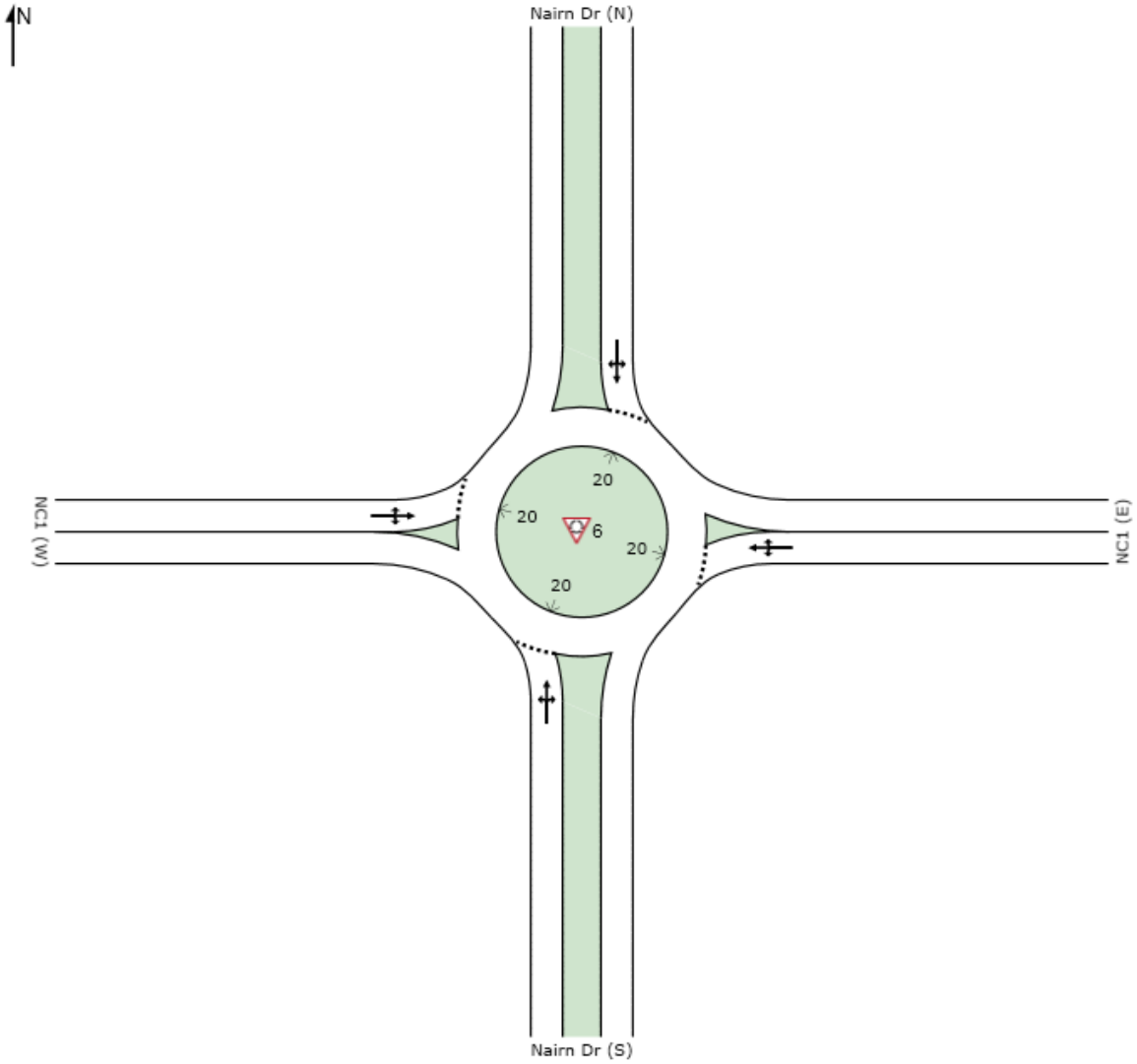


Figure D6. Nairn Drive / NC1 roundabout layout analysed in SIDRA

Table D6a. SIDRA results – Nairn Drive / NC1 roundabout – 2031 weekday AM peak with full development

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: Nairn Dr (S)											
1	L2	3	2.0	0.432	5.5	LOS A	2.8	20.3	0.36	0.51	52.5
2	T1	555	5.0	0.432	6.0	LOS A	2.8	20.3	0.36	0.51	60.0
3	R2	7	2.0	0.432	10.7	LOS B	2.8	20.3	0.36	0.51	54.3
Approach		565	4.9	0.432	6.1	LOS A	2.8	20.3	0.36	0.51	59.9
East: NC1 (E)											
4	L2	12	2.0	0.149	5.6	LOS A	0.8	5.4	0.58	0.71	49.5
5	T1	32	2.0	0.149	5.6	LOS A	0.8	5.4	0.58	0.71	45.9
6	R2	91	2.0	0.149	10.1	LOS B	0.8	5.4	0.58	0.71	50.4
Approach		135	2.0	0.149	8.6	LOS A	0.8	5.4	0.58	0.71	49.2
North: Nairn Dr (N)											
7	L2	21	2.0	0.430	5.2	LOS A	2.8	20.7	0.27	0.47	53.0
8	T1	580	5.0	0.430	5.7	LOS A	2.8	20.7	0.27	0.47	60.6
9	R2	7	2.0	0.430	10.4	LOS B	2.8	20.7	0.27	0.47	54.7
Approach		608	4.9	0.430	5.8	LOS A	2.8	20.7	0.27	0.47	60.2
West: NC1 (W)											
10	L2	16	2.0	0.095	5.8	LOS A	0.5	3.4	0.60	0.66	50.5
11	T1	42	2.0	0.095	5.7	LOS A	0.5	3.4	0.60	0.66	46.7
12	R2	24	2.0	0.095	10.2	LOS B	0.5	3.4	0.60	0.66	51.4
Approach		82	2.0	0.095	7.0	LOS A	0.5	3.4	0.60	0.66	48.7
All Vehicles		1390	4.4	0.432	6.2	LOS A	2.8	20.7	0.36	0.52	58.0

Table D6b. SIDRA results – Nairn Drive / NC1 roundabout – 2031 weekday PM peak with full development

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: Nairn Dr (S)											
1	L2	8	2.0	0.457	5.5	LOS A	3.0	22.1	0.36	0.51	52.5
2	T1	582	5.0	0.457	6.0	LOS A	3.0	22.1	0.36	0.51	60.0
3	R2	16	2.0	0.457	10.6	LOS B	3.0	22.1	0.36	0.51	54.3
Approach		606	4.9	0.457	6.1	LOS A	3.0	22.1	0.36	0.51	59.7
East: NC1 (E)											
4	L2	6	2.0	0.129	6.0	LOS A	0.7	4.9	0.63	0.72	49.4
5	T1	34	2.0	0.129	5.9	LOS A	0.7	4.9	0.63	0.72	45.8
6	R2	68	2.0	0.129	10.4	LOS B	0.7	4.9	0.63	0.72	50.3
Approach		108	2.0	0.129	8.7	LOS A	0.7	4.9	0.63	0.72	48.7
North: Nairn Dr (N)											
7	L2	54	2.0	0.508	5.6	LOS A	3.6	26.3	0.41	0.53	52.3
8	T1	590	5.0	0.508	6.1	LOS A	3.6	26.3	0.41	0.53	59.7
9	R2	19	2.0	0.508	10.8	LOS B	3.6	26.3	0.41	0.53	54.0
Approach		663	4.7	0.508	6.2	LOS A	3.6	26.3	0.41	0.53	58.9
West: NC1 (W)											
10	L2	11	2.0	0.158	6.0	LOS A	0.8	6.0	0.63	0.71	49.8
11	T1	62	2.0	0.158	5.9	LOS A	0.8	6.0	0.63	0.71	46.2
12	R2	62	2.0	0.158	10.5	LOS B	0.8	6.0	0.63	0.71	50.7
Approach		135	2.0	0.158	8.0	LOS A	0.8	6.0	0.63	0.71	48.5
All Vehicles		1512	4.3	0.508	6.5	LOS A	3.6	26.3	0.42	0.55	57.2

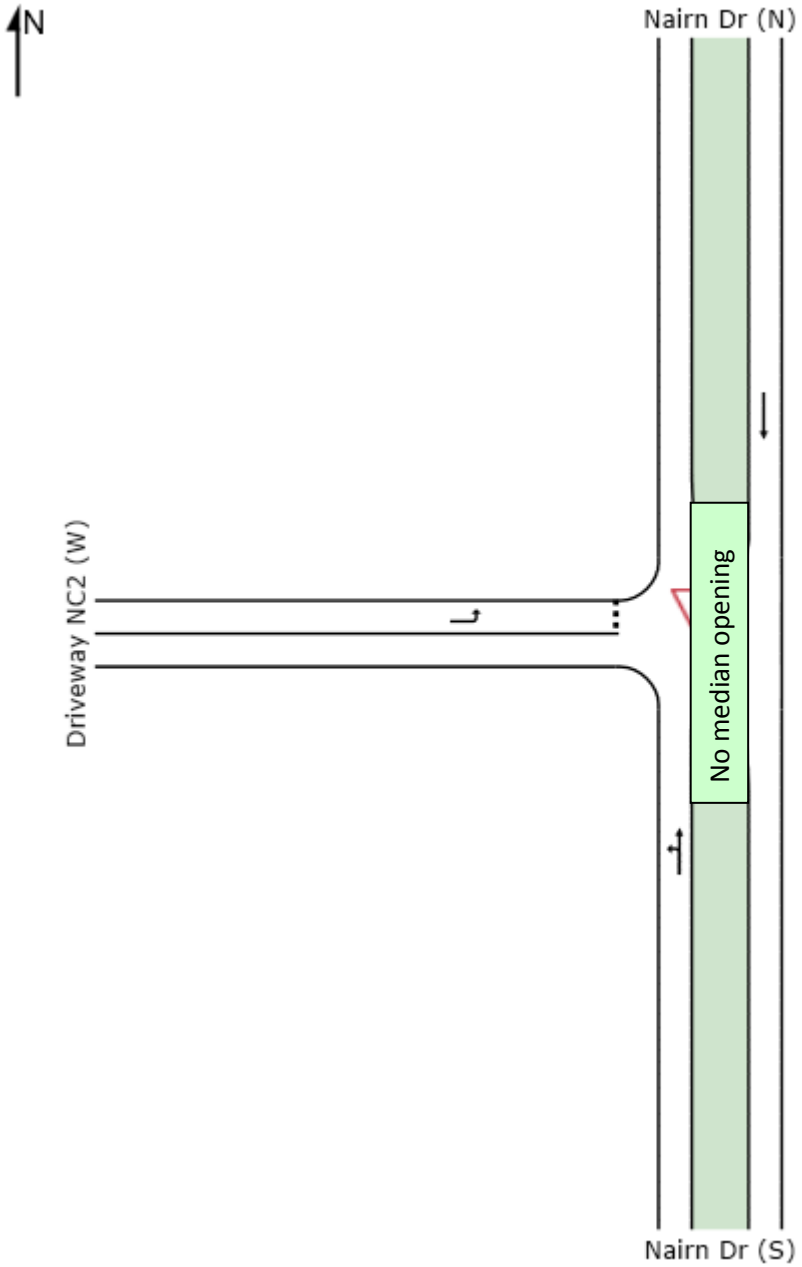


Figure D7. Nairn Drive / NC2 driveway intersection layout analysed in SIDRA

Table D7a. SIDRA results – Nairn Drive / NC2 driveway intersection – 2031 weekday AM peak with full development

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: Nairn Dr (S)											
7	L2	37	2.0	0.348	6.4	LOS A	0.0	0.0	0.00	0.04	65.4
8	T1	625	5.0	0.348	0.0	LOS A	0.0	0.0	0.00	0.04	69.4
Approach		662	4.8	0.348	0.4	NA	0.0	0.0	0.00	0.04	69.2
North: Nairn Dr (N)											
2	T1	608	5.0	0.319	0.0	LOS A	0.0	0.0	0.00	0.00	69.9
Approach		608	5.0	0.319	0.0	NA	0.0	0.0	0.00	0.00	69.9
West: Driveway NC2 (W)											
4	L2	1	2.0	0.001	7.2	LOS A	0.0	0.0	0.53	0.56	49.9
Approach		1	2.0	0.001	7.2	LOS A	0.0	0.0	0.53	0.56	49.9
All Vehicles		1271	4.9	0.348	0.2	NA	0.0	0.0	0.00	0.02	69.5

Table D7b. SIDRA results – Nairn Drive / NC2 driveway intersection – 2031 weekday PM peak with full development

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: Nairn Dr (S)											
7	L2	147	2.0	0.349	6.4	LOS A	0.0	0.0	0.00	0.14	64.1
8	T1	514	5.0	0.349	0.0	LOS A	0.0	0.0	0.00	0.14	68.0
Approach		661	4.3	0.349	1.5	NA	0.0	0.0	0.00	0.14	67.1
North: Nairn Dr (N)											
2	T1	663	5.0	0.347	0.0	LOS A	0.0	0.0	0.00	0.00	69.9
Approach		663	5.0	0.347	0.0	NA	0.0	0.0	0.00	0.00	69.9
West: Driveway NC2 (W)											
4	L2	1	2.0	0.001	6.5	LOS A	0.0	0.0	0.48	0.53	50.4
Approach		1	2.0	0.001	6.5	LOS A	0.0	0.0	0.48	0.53	50.4
All Vehicles		1325	4.7	0.349	0.8	NA	0.0	0.0	0.00	0.07	68.4

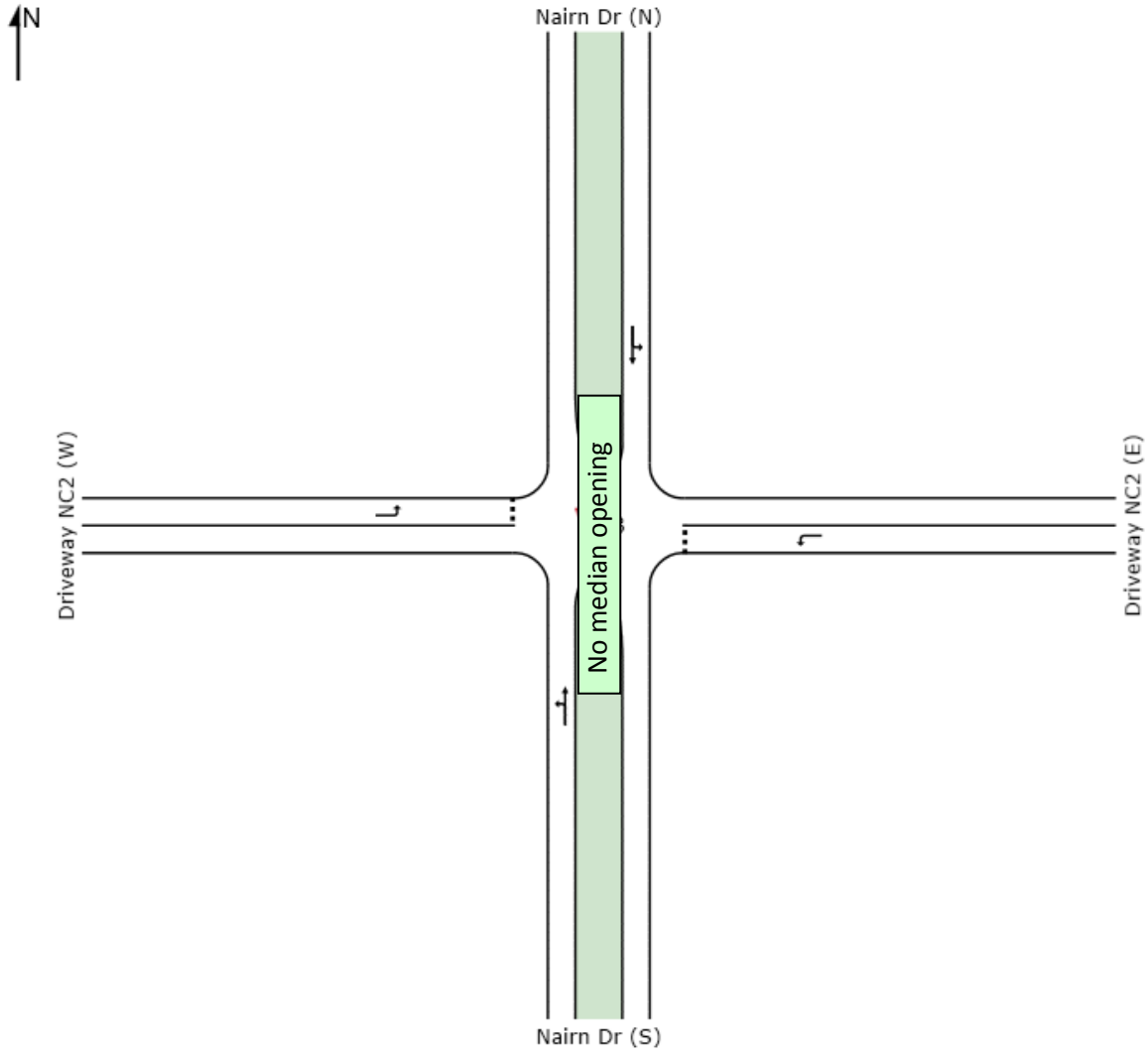


Figure D8. Nairn Drive / NC3 driveway intersection layout analysed in SIDRA

Table D8a. SIDRA results – Nairn Drive / NC3 driveway intersection – 2031 weekday AM peak with full development

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: Nairn Dr (S)											
7	L2	8	2.0	0.328	6.4	LOS A	0.0	0.0	0.00	0.01	65.7
8	T1	618	5.0	0.328	0.0	LOS A	0.0	0.0	0.00	0.01	69.8
Approach		626	5.0	0.328	0.1	NA	0.0	0.0	0.00	0.01	69.7
East: Driveway NC2 (E)											
4	L2	16	2.0	0.019	8.1	LOS A	0.1	0.5	0.52	0.67	51.6
Approach		16	2.0	0.019	8.1	LOS A	0.1	0.5	0.52	0.67	51.6
North: Nairn Dr (N)											
7	L2	6	2.0	0.313	6.4	LOS A	0.0	0.0	0.00	0.01	65.7
2	T1	592	5.0	0.313	0.0	LOS A	0.0	0.0	0.00	0.01	69.7
Approach		598	5.0	0.313	0.1	NA	0.0	0.0	0.00	0.01	69.7
West: Driveway NC2 (W)											
4	L2	61	2.0	0.074	7.5	LOS A	0.3	1.9	0.54	0.73	49.7
Approach		61	2.0	0.074	7.5	LOS A	0.3	1.9	0.54	0.73	49.7
All Vehicles		1301	4.8	0.328	0.6	NA	0.3	1.9	0.03	0.05	68.1

Table D8b. SIDRA results – Nairn Drive / NC3 driveway intersection – 2031 weekday PM peak with full development

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: Nairn Dr (S)											
7	L2	30	2.0	0.270	6.4	LOS A	0.0	0.0	0.00	0.04	65.4
8	T1	485	5.0	0.270	0.0	LOS A	0.0	0.0	0.00	0.04	69.4
Approach		515	4.8	0.270	0.4	NA	0.0	0.0	0.00	0.04	69.2
East: Driveway NC2 (E)											
4	L2	9	2.0	0.012	7.5	LOS A	0.0	0.3	0.54	0.65	49.7
Approach		9	2.0	0.012	7.5	LOS A	0.0	0.3	0.54	0.65	49.7
North: Nairn Dr (N)											
7	L2	15	2.0	0.351	6.4	LOS A	0.0	0.0	0.00	0.01	65.6
2	T1	654	5.0	0.351	0.0	LOS A	0.0	0.0	0.00	0.01	69.7
Approach		669	4.9	0.351	0.2	NA	0.0	0.0	0.00	0.01	69.6
West: Driveway NC2 (W)											
4	L2	243	2.0	0.246	6.9	LOS A	1.0	7.3	0.53	0.73	50.1
Approach		243	2.0	0.246	6.9	LOS A	1.0	7.3	0.53	0.73	50.1
All Vehicles		1436	4.4	0.351	1.5	NA	1.0	7.3	0.09	0.15	65.0

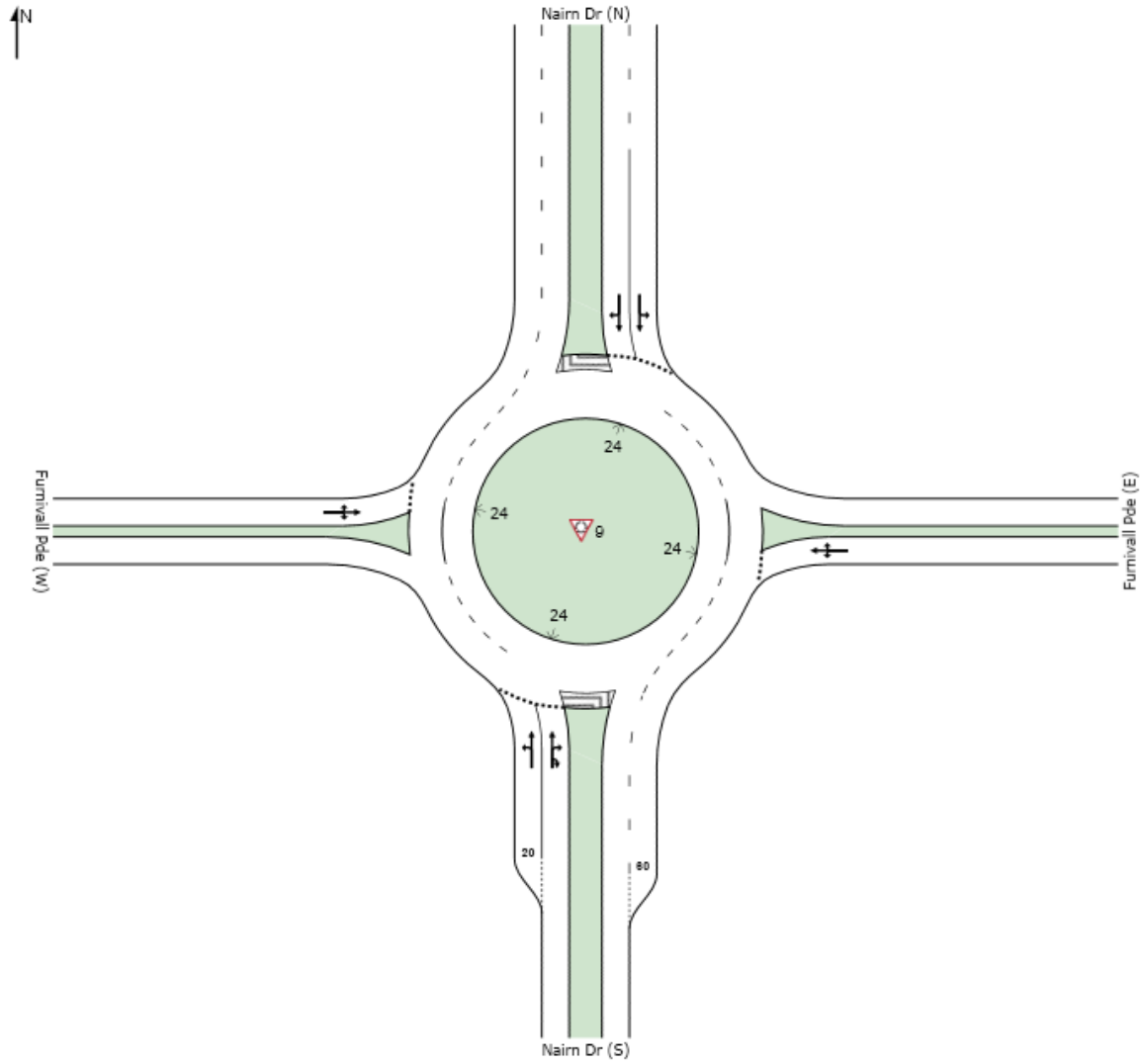


Figure D9. Nairn Drive / Furnivall Pde roundabout layout analysed in SIDRA

Table D9a. SIDRA results – Nairn Drive / Furnivall Pde roundabout – 2031 weekday AM peak with full development

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: Nairn Dr (S)											
1	L2	1	2.0	0.240	5.5	LOS A	1.1	8.3	0.27	0.47	53.2
2	T1	644	5.0	0.240	5.7	LOS A	1.1	8.3	0.28	0.49	61.9
3	R2	11	2.0	0.240	10.8	LOS B	1.1	8.1	0.29	0.52	54.9
3u	U	23	2.0	0.240	13.3	LOS B	1.1	8.1	0.29	0.52	62.4
Approach		679	4.8	0.240	6.0	LOS A	1.1	8.3	0.28	0.49	61.8
East: Furnivall Pde (E)											
4	L2	19	2.0	0.098	4.3	LOS A	0.3	2.2	0.41	0.62	51.2
5	T1	32	2.0	0.098	4.1	LOS A	0.3	2.2	0.41	0.62	47.4
6	R2	39	2.0	0.098	9.0	LOS A	0.3	2.2	0.41	0.62	52.3
Approach		90	2.0	0.098	6.3	LOS A	0.3	2.2	0.41	0.62	50.2
North: Nairn Dr (N)											
7	L2	5	2.0	0.136	5.3	LOS A	0.6	4.1	0.17	0.44	53.7
8	T1	549	5.0	0.284	5.4	LOS A	1.4	10.2	0.17	0.48	62.3
9	R2	82	2.0	0.284	10.5	LOS B	1.4	10.2	0.17	0.49	55.3
Approach		636	4.6	0.284	6.0	LOS A	1.4	10.2	0.17	0.48	61.2
West: Furnivall Pde (W)											
10	L2	76	2.0	0.116	4.2	LOS A	0.3	2.4	0.42	0.55	52.6
11	T1	28	2.0	0.116	4.0	LOS A	0.3	2.4	0.42	0.55	48.5
12	R2	1	2.0	0.116	8.9	LOS A	0.3	2.4	0.42	0.55	53.8
Approach		105	2.0	0.116	4.2	LOS A	0.3	2.4	0.42	0.55	51.5
All Vehicles		1510	4.4	0.284	5.9	LOS A	1.4	10.2	0.25	0.50	59.9

Table D9b. SIDRA results – Nairn Drive / Furnivall Pde roundabout – 2031 weekday PM peak with full development

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: Nairn Dr (S)											
1	L2	1	2.0	0.305	6.4	LOS A	1.7	12.5	0.50	0.58	52.1
2	T1	603	5.0	0.305	6.7	LOS A	1.7	12.5	0.51	0.61	60.0
3	R2	34	2.0	0.305	12.0	LOS B	1.6	11.7	0.52	0.68	52.8
3u	U	90	2.0	0.305	14.5	LOS B	1.6	11.7	0.52	0.68	59.6
Approach		728	4.5	0.305	7.9	LOS A	1.7	12.5	0.51	0.62	59.6
East: Furnivall Pde (E)											
4	L2	9	2.0	0.146	5.4	LOS A	0.6	4.0	0.56	0.69	50.8
5	T1	68	2.0	0.146	5.3	LOS A	0.6	4.0	0.56	0.69	47.0
6	R2	34	2.0	0.146	10.2	LOS B	0.6	4.0	0.56	0.69	51.9
Approach		111	2.0	0.146	6.8	LOS A	0.6	4.0	0.56	0.69	48.7
North: Nairn Dr (N)											
7	L2	19	2.0	0.207	5.8	LOS A	1.0	7.0	0.33	0.51	52.9
8	T1	554	5.0	0.431	5.9	LOS A	2.7	19.4	0.36	0.56	60.5
9	R2	308	2.0	0.431	10.9	LOS B	2.7	19.4	0.37	0.59	53.5
Approach		881	3.9	0.431	7.7	LOS A	2.7	19.4	0.36	0.57	57.7
West: Furnivall Pde (W)											
10	L2	162	2.0	0.251	4.4	LOS A	0.9	6.3	0.50	0.59	52.3
11	T1	51	2.0	0.251	4.3	LOS A	0.9	6.3	0.50	0.59	48.3
12	R2	1	2.0	0.251	9.2	LOS A	0.9	6.3	0.50	0.59	53.5
Approach		214	2.0	0.251	4.4	LOS A	0.9	6.3	0.50	0.59	51.3
All Vehicles		1934	3.8	0.431	7.4	LOS A	2.7	19.4	0.44	0.60	57.0

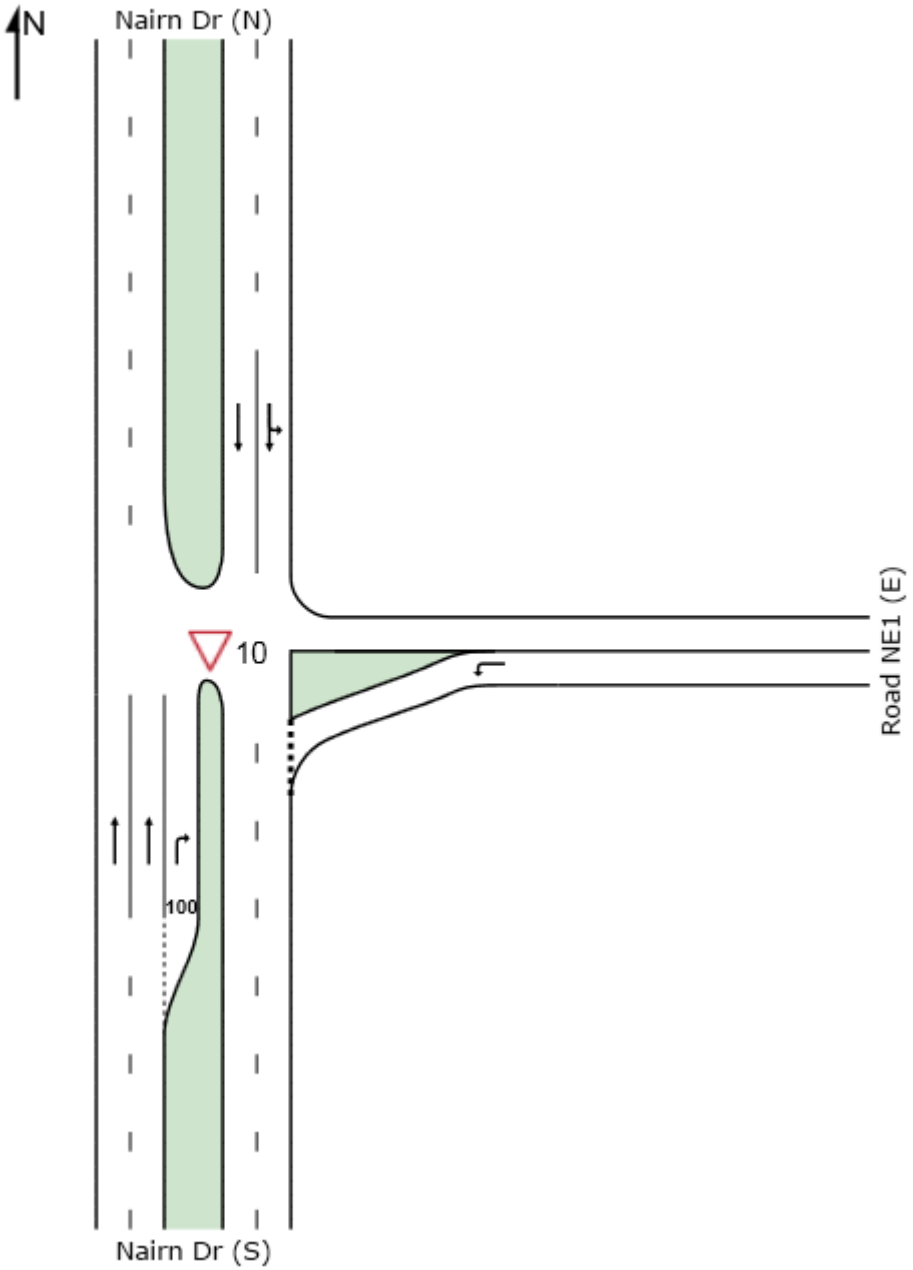


Figure D10. Nairn Drive / NE1 intersection layout analysed in SIDRA

Table D10a. SIDRA results – Nairn Drive / NE1 intersection – 2031 weekday AM peak with full development

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: Nairn Dr (S)											
2	T1	758	5.0	0.199	0.0	LOS A	0.0	0.0	0.00	0.00	69.9
3	R2	1	2.0	0.001	9.5	LOS A	0.0	0.0	0.54	0.61	50.0
Approach		759	5.0	0.199	0.0	NA	0.0	0.0	0.00	0.00	69.9
East: Road NE1 (E)											
4	L2	4	2.0	0.004	5.8	LOS A	0.0	0.1	0.36	0.51	51.2
Approach		4	2.0	0.004	5.8	LOS A	0.0	0.1	0.36	0.51	51.2
North: Nairn Dr (N)											
7	L2	13	2.0	0.169	6.4	LOS A	0.0	0.0	0.00	0.03	65.5
8	T1	632	5.0	0.169	0.0	LOS A	0.0	0.0	0.00	0.01	69.8
Approach		645	4.9	0.169	0.1	NA	0.0	0.0	0.00	0.01	69.7
All Vehicles		1408	5.0	0.199	0.1	NA	0.0	0.1	0.00	0.01	69.7

Table D10b. SIDRA results – Nairn Drive / NE1 intersection – 2031 weekday PM peak with full development

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: Nairn Dr (S)											
2	T1	796	5.0	0.209	0.0	LOS A	0.0	0.0	0.00	0.00	69.9
3	R2	3	2.0	0.006	12.3	LOS B	0.0	0.2	0.67	0.74	48.2
Approach		799	5.0	0.209	0.1	NA	0.0	0.2	0.00	0.00	69.8
East: Road NE1 (E)											
4	L2	2	2.0	0.002	6.4	LOS A	0.0	0.1	0.43	0.53	51.0
Approach		2	2.0	0.002	6.4	LOS A	0.0	0.1	0.43	0.53	51.0
North: Nairn Dr (N)											
7	L2	34	2.0	0.240	6.4	LOS A	0.0	0.0	0.00	0.05	65.3
8	T1	879	5.0	0.240	0.0	LOS A	0.0	0.0	0.00	0.02	69.6
Approach		913	4.9	0.240	0.3	NA	0.0	0.0	0.00	0.02	69.4
All Vehicles		1714	4.9	0.240	0.2	NA	0.0	0.2	0.00	0.01	69.6

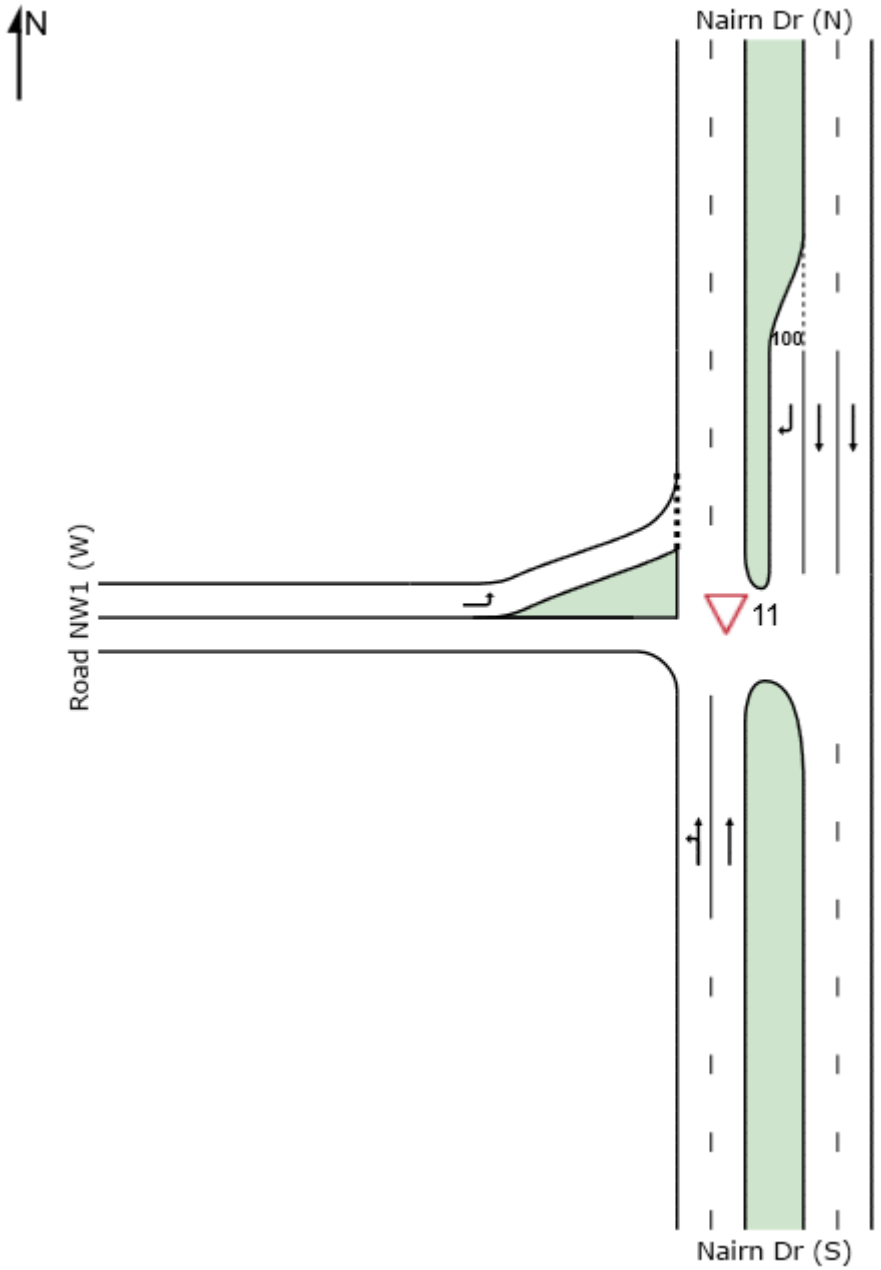


Figure D11. Nairn Drive / NW1 intersection layout analysed in SIDRA

Table D11a. SIDRA results – Nairn Drive / NW1 intersection – 2031 weekday AM peak with full development

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: Nairn Dr (S)											
7	L2	1	2.0	0.199	6.4	LOS A	0.0	0.0	0.00	0.00	65.8
8	T1	757	5.0	0.199	0.0	LOS A	0.0	0.0	0.00	0.00	69.9
Approach		758	5.0	0.199	0.0	NA	0.0	0.0	0.00	0.00	69.9
North: Nairn Dr (N)											
2	T1	645	5.0	0.169	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
3	R2	10	2.0	0.017	10.7	LOS B	0.1	0.4	0.58	0.74	49.3
Approach		655	5.0	0.169	0.2	NA	0.1	0.4	0.01	0.01	69.5
West: Road NW1 (W)											
4	L2	28	2.0	0.032	6.3	LOS A	0.1	0.8	0.41	0.58	51.0
Approach		28	2.0	0.032	6.3	LOS A	0.1	0.8	0.41	0.58	51.0
All Vehicles		1441	4.9	0.199	0.2	NA	0.1	0.8	0.01	0.02	69.2

Table D11b. SIDRA results – Nairn Drive / NW1 intersection – 2031 weekday PM peak with full development

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: Nairn Dr (S)											
7	L2	1	2.0	0.209	6.4	LOS A	0.0	0.0	0.00	0.00	65.8
8	T1	795	5.0	0.209	0.0	LOS A	0.0	0.0	0.00	0.00	69.9
Approach		796	5.0	0.209	0.0	NA	0.0	0.0	0.00	0.00	69.9
North: Nairn Dr (N)											
2	T1	879	5.0	0.230	0.0	LOS A	0.0	0.0	0.00	0.00	69.9
3	R2	24	2.0	0.042	11.2	LOS B	0.2	1.1	0.61	0.80	48.9
Approach		903	4.9	0.230	0.3	NA	0.2	1.1	0.02	0.02	69.1
West: Road NW1 (W)											
4	L2	14	2.0	0.016	6.3	LOS A	0.1	0.4	0.42	0.57	51.0
Approach		14	2.0	0.016	6.3	LOS A	0.1	0.4	0.42	0.57	51.0
All Vehicles		1713	4.9	0.230	0.2	NA	0.2	1.1	0.01	0.02	69.3

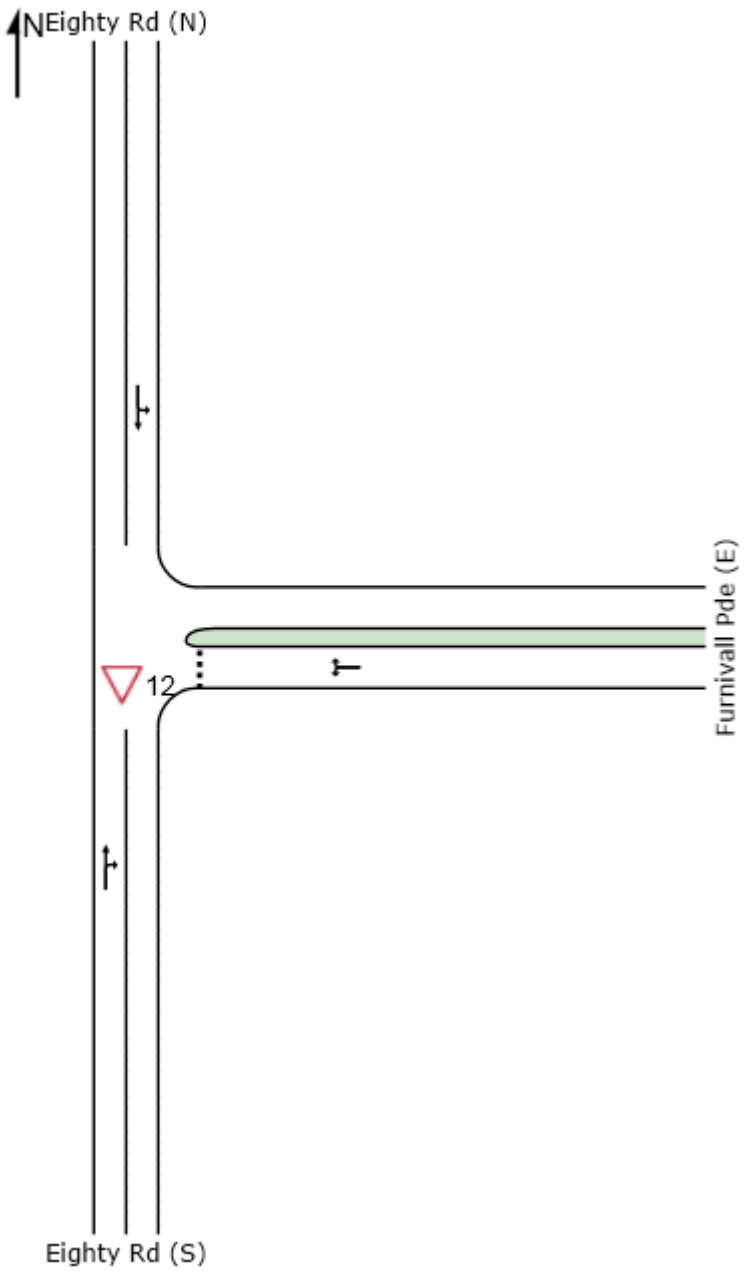


Figure D12. Eighty Rd / Furnivall Pde intersection layout analysed in SIDRA

Table D12a. SIDRA results – Eighty Rd / Furnivall Pde intersection – 2031 weekday AM peak with full development

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: Eighty Rd (S)											
2	T1	377	5.0	0.201	0.0	LOS A	0.0	0.3	0.01	0.01	69.8
3	R2	5	2.0	0.201	7.4	LOS A	0.0	0.3	0.01	0.01	57.2
Approach		382	5.0	0.201	0.1	NA	0.0	0.3	0.01	0.01	69.6
East: Furnivall Pde (E)											
4	L2	14	2.0	0.025	5.4	LOS A	0.1	0.6	0.37	0.58	50.5
6	R2	9	2.0	0.025	7.8	LOS A	0.1	0.6	0.37	0.58	50.3
Approach		23	2.0	0.025	6.3	LOS A	0.1	0.6	0.37	0.58	50.4
North: Eighty Rd (N)											
7	L2	4	2.0	0.138	6.4	LOS A	0.0	0.0	0.00	0.01	65.8
8	T1	260	5.0	0.138	0.0	LOS A	0.0	0.0	0.00	0.01	69.8
Approach		264	5.0	0.138	0.1	NA	0.0	0.0	0.00	0.01	69.8
All Vehicles		669	4.9	0.201	0.3	NA	0.1	0.6	0.02	0.03	68.8

Table D12b. SIDRA results – Eighty Rd / Furnivall Pde intersection – 2031 weekday PM peak with full development

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: Eighty Rd (S)											
2	T1	246	5.0	0.138	0.1	LOS A	0.1	0.8	0.05	0.03	69.3
3	R2	11	2.0	0.138	8.0	LOS A	0.1	0.8	0.05	0.03	56.9
Approach		257	4.9	0.138	0.5	NA	0.1	0.8	0.05	0.03	68.7
East: Furnivall Pde (E)											
4	L2	7	2.0	0.020	6.0	LOS A	0.1	0.5	0.46	0.63	50.1
6	R2	9	2.0	0.020	7.8	LOS A	0.1	0.5	0.46	0.63	49.8
Approach		16	2.0	0.020	7.0	LOS A	0.1	0.5	0.46	0.63	49.9
North: Eighty Rd (N)											
7	L2	12	2.0	0.211	6.4	LOS A	0.0	0.0	0.00	0.02	65.6
8	T1	390	5.0	0.211	0.0	LOS A	0.0	0.0	0.00	0.02	69.7
Approach		402	4.9	0.211	0.2	NA	0.0	0.0	0.00	0.02	69.6
All Vehicles		675	4.8	0.211	0.5	NA	0.1	0.8	0.03	0.04	68.6

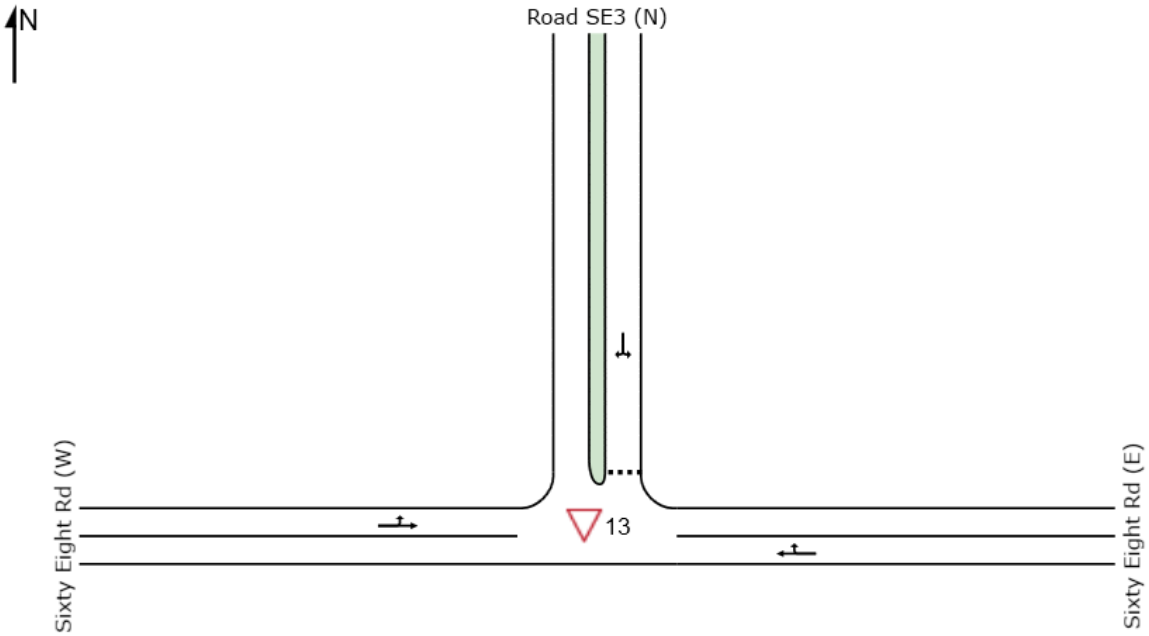


Figure D13. Sixty Eight Rd / SE3 intersection layout analysed in SIDRA

Table D13a. SIDRA results – Sixty Eight Rd / SE3 intersection – 2031 weekday AM peak with full development

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
East: Sixty Eight Rd (E)											
2	T1	429	5.0	0.235	0.0	LOS A	0.1	1.0	0.03	0.02	69.5
3	R2	16	2.0	0.235	6.9	LOS A	0.1	1.0	0.03	0.02	57.0
Approach		445	4.9	0.235	0.3	NA	0.1	1.0	0.03	0.02	69.0
North: Road SE3 (N)											
4	L2	31	2.0	0.061	5.0	LOS A	0.2	1.5	0.28	0.57	50.6
6	R2	27	2.0	0.061	7.6	LOS A	0.2	1.5	0.28	0.57	50.4
Approach		58	2.0	0.061	6.2	LOS A	0.2	1.5	0.28	0.57	50.5
West: Sixty Eight Rd (W)											
7	L2	9	2.0	0.080	6.4	LOS A	0.0	0.0	0.00	0.04	65.4
8	T1	143	5.0	0.080	0.0	LOS A	0.0	0.0	0.00	0.04	69.5
Approach		152	4.8	0.080	0.4	NA	0.0	0.0	0.00	0.04	69.2
All Vehicles		655	4.6	0.235	0.8	NA	0.2	1.5	0.04	0.08	66.9

Table D13b. SIDRA results – Sixty Eight Rd / SE3 intersection – 2031 weekday PM peak with full development

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
East: Sixty Eight Rd (E)											
2	T1	214	5.0	0.153	0.5	LOS A	0.4	3.2	0.21	0.12	67.2
3	R2	49	2.0	0.153	7.9	LOS A	0.4	3.2	0.21	0.12	55.5
Approach		263	4.4	0.153	1.9	NA	0.4	3.2	0.21	0.12	64.7
North: Road SE3 (N)											
4	L2	41	2.0	0.057	5.9	LOS A	0.2	1.4	0.42	0.62	50.5
6	R2	14	2.0	0.057	7.8	LOS A	0.2	1.4	0.42	0.62	50.3
Approach		55	2.0	0.057	6.4	LOS A	0.2	1.4	0.42	0.62	50.4
West: Sixty Eight Rd (W)											
7	L2	23	2.0	0.200	6.4	LOS A	0.0	0.0	0.00	0.04	65.4
8	T1	357	5.0	0.200	0.0	LOS A	0.0	0.0	0.00	0.04	69.4
Approach		380	4.8	0.200	0.4	NA	0.0	0.0	0.00	0.04	69.2
All Vehicles		698	4.5	0.200	1.4	NA	0.4	3.2	0.11	0.12	65.5