

LYON GROUP AUSTRALIA

# South Dural Development

Transport Management and Accessibility Plan

SEPTEMBER 2016

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## Transport Management and Accessibility Plan

Lyon Group Australia

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# EXECUTIVE SUMMARY

This report documents the results of a strategic traffic and transport assessment of the proposed rezoning of the South Dural area to accommodate up to 2,900 houses and apartments. It provides advice on a range of transport measures that are potentially required to support the levels of growth under the proposed rezoning.

## Existing transport challenges

While the site has good access to the arterial and motorway road network, this also contributes to its transport challenges:

- The two main arterial roads (Old Northern Road and New Line Road) are operating at or close to their capacity and at a poor level of performance.
- Key intersections (including Old Northern Road and Glenhaven Road and Old Northern Road and New Line Road) are operating with a poor level of service. The Hills Shire Council is planning to upgrade the intersection of Old Northern Road and Glenhaven Road with traffic signals.
- The connection of the South Dural area into the surrounding cycle and pedestrian networks is limited, as are crossing opportunities of the surrounding arterial road network.
- Existing bus services are relatively numerous due to the close proximity to a Hillsbus depot, but bus passenger facilities are limited and rarely have safe crossing opportunities nearby. Bus stops are closely spaced in places, providing the opportunity to rationalise the location and number of stops along Old Northern Road and New Line Road.
- As a result, the existing area has relatively high mode share for car driver (82%), which is a reflection of the current low level of pedestrian, cycling and bus passenger facilities.

## Planned transport improvements

The major transport improvement in the area will be the opening of the NorthWest Metro Line, anticipated in 2019. This will introduce a rapid and frequent service to the area which is currently served by local and express bus services. The South Dural area is located within a reasonable proximity to the Castle Hill, Cherrybrook and Showground Stations. It will be connected to Castle Hill and Cherrybrook stations by bus services. 400 park-and-ride spaces are planned at Cherrybrook Station.

## Proposed development

The 240 hectare site is bounded by New Line Road, Old Northern Road and Hastings Road. The development has been divided into five villages to enable a staged development. For the purposes of this transport assessment, the number of dwellings is assumed to be a total of 2,900, comprising:

- One, two and three bedroom apartments – Approximately 1,050; and
- Dwellings (houses and townhouses) on small allotments – Approximately 1,850; average 282 m<sup>2</sup>.

Access is proposed from the arterial roads without any vehicle access across the site. Development would gain access from local streets, reducing the impact on the arterial roads.

- The North West and Mid-West villages would gain access from Old Northern Road at a new road opposite Malabar Road, and via the existing Franlee Road.
- The Southern village would gain access via the existing Wayfield Road.
- The South East village would have unsignalised access to Old Northern Road.

- The Eastern village gain access to New Line Road via a connection to the intersection of New Line Road and Sebastian Drive, as well as to the roundabout giving access to 252 New Line Road.

## Walking and cycling

The following principles are proposed to maximise the walkability of the area:

- Focus walk links on key nodes such as signalised road crossings, the Round Corner village centre and bus stops.
- Provide safe crossing locations along Old Northern Road and New Line Road.
- Increased footpath provision within all areas, including both sides of street on key pedestrian connections and at least one side of the remaining streets.
- Reduce the separation impact of the riparian corridor by providing off-road walking and cycling paths between villages.

To achieve the abovementioned principles, improvements are required to pedestrian infrastructure, including:

- Improvements to arterial road crossing opportunities:
  - Four new pedestrian refuges (or signalised pedestrian crossing) on Old Northern Road and New Line Road.
  - Pedestrian crossing facilities at newly signalised intersections on Old Northern Road
  - Add pedestrian crossing facility to the existing traffic signals at the intersection of New Line Road and Hastings Road, across the Hastings Road approach.
- New footpaths:
  - Along the South Dural development side of Old Northern Road and New Line Road around the boundary roads are proposed to provide continuous footpath.
  - Provide footpaths within local streets on both sides of street on key pedestrian connections and areas with apartments and at least one side of all other local streets.
- Provide paths (unsealed when passing through riparian corridors) between the five precincts.

Improvements for cycling should include:

- Incorporate cycle facilities (either as kerbside lanes or a widened shared pedestrian path) as part of the proposed road widening of Old Northern Road and New Line Road.
- Design the off-road paths as shared pedestrian and cycle recreational paths.
- Provide bicycle parking and visitor bicycle parking in the residential development.

## Public transport

Bus service levels are set by Transport for NSW, based on bus patronage and plans for future patterns from land use changes. Recommendations for service level increases are:

- The Old Northern Road bus routes (637, 638 and 639) increase from a 30 minute frequency to a 15 minute frequency in the peak direction during the peak period – an increase of six services.
- An additional two services per hour in the peak direction during the peak period on one or more of bus routes 620N, 620X, 622, 642 or 642X.
- Improve Route 644 to a 15 minute frequency in the peak direction during the peak period.
- Increase service levels during non-peak times – i.e. during the middle of the weekday, in the evening and on weekends.



Recommendations to consolidate the number of bus stops, relocate them to more favourable locations and improve their facilities have been developed to match the additional residential development. Additional bus infrastructure to support the service improvement includes:

- Eight new bus shelters with seating and a bicycle rack.
- Three new bus stops U-Stems (where the stop is more likely to be used for set-down and passengers would not be waiting for long periods).
- New pedestrian refuges (previously listed) to provide a safe crossing opportunity where the stop is not located near existing or future planned traffic signals.

## Road upgrades

The impact on the road network has been assessed based on a method stipulated by Transport for NSW and Roads and Maritime Services. Transport for NSW supplied its NorthWest Metro Aimsun model to provide a consistent platform for transport planning, and had input into the calculation of trip generation for the development, modelling process and trip distribution.

Some sections of Old Northern Road and New Line Road are already operating above the threshold at which upgrades could be considered (assumed to be the change from Level of Service D to E – at approximately 90% of the lane capacity). When the future growth is added to the road network, the number of links at or over capacity increases. By 2026 the majority of the road network surrounding the South Dural development will require upgrading in one or both directions regardless of whether the development proceeds.

The traffic from the South Dural development places additional pressure on links around the network. In many locations around South Dural, this brings forward the need to upgrade the road by between one and seven years. In others, links that did not need upgrading before 2036 in the without development scenario do need upgrading.

It is recommended that Old Northern Road and New Line Road be upgraded to two lanes in each direction by 2026. The only sections that do not appear to need to be upgraded include the sections that already have two lanes in one direction as well as New Line Road, north of Hastings Road, and Hastings Road, between Old Northern Road and New Line Road.

The intersections of Old Northern Road and Glenhaven Road and Old Northern Road and New Line Road are currently performing at a poor level of service during peak periods. By 2036, the intersections of Old Northern Road and Hastings Road, Old Northern Road and Kenthurst Road and New Line Road and Hastings Road would also be performing poorly, with or without the development, unless upgraded beyond the road widening. To augment the road widening and accommodate future traffic growth, the following intersections are recommended to be upgraded with new traffic signals and/or additional turn capacity:

- Old Northern Road and Hastings Road
- Old Northern Road and Gilbert Road
- Old Northern Road and Blue Gum Drive
- Old Northern Road and Kenthurst Road
- Old Northern Road and New Line Road
- New Line Road and Hastings Road
- New Line Road, James Henty Drive and David Road
- New Line Road and Boundary Road
- New Line Road and Victoria Road
- New Line Road and Castle Hill Road.

## Parking

The current DCP parking rates for Hornsby Shire are considered sufficient to cater for the parking demands of the future residents. However, considering the recommendations for improved public services and walking and cycling facilities, and to provide incentive for the use of non-car based modes of transport, these rates are recommended to be applied as maximum rates rather than minimums.

## Infrastructure timing, funding and delivery

The transport assessment for this study has identified several pieces of infrastructure to provide for future development within the South Dural development and attempt to change travel behaviour to reduce the need for road network upgrades. It is envisaged that the development would contribute to the cost of this infrastructure. In some instances, where the infrastructure provides a regional benefit, this contribution may be for only a part of the full cost. If the South Dural development does not proceed, the full cost of the upgrade will be borne by the NSW Government and other developments.

Due to the existing road network operating close to capacity, the majority of the road and intersection upgrades are required during the first half of the development (i.e. by 2026). The remaining intersection upgrades are required by 2036. Pedestrian, cycle and bus infrastructure upgrades would be delivered in-line with the progression of the development within the five precincts.

A high-level strategic costing of the proposed road and intersection upgrades has been undertaken for the purpose of providing an initial order of magnitude estimate of the road upgrade costs for planning purposes. These estimates have been prepared using standard unit costs based on previous projects. Apportionment has been based on the principle that developments should contribute to the cost of transport infrastructure upgrades to the extent that they contribute to the need for that upgrade. This has been calculated from the output of the Aimsun model supplied by Transport for NSW and the agreed modelling process.

The estimated upgrade costs, contribution from the South Dural development based on its apportionment are summarised in Table ES.1. The remaining \$84,660,000 (54%) would be required from other funding sources.

**Table ES.1 Estimates of road and intersection upgrade costs and South Dural contribution**

Item	Cost estimate (\$2016)	South Dural contribution	South Dural percentage
Road widening	\$114,690,000	\$60,050,000	52%
Intersection upgrades	\$43,300,000	\$13,280,000	31%
<b>Total</b>	<b>\$157,990,000</b>	<b>\$73,330,000</b>	<b>46%</b>

Notes All estimates are in \$2016.

These estimates are high-level strategic costing, for planning purposes only. They are based upon information made available to WSP | Parsons Brinckerhoff at the time of preparation. The estimates have been prepared for this specific Client and Project, and should not be used or relied on for any other use. Parsons Brinckerhoff accepts no liability for actual costs varying from those estimated.

# 1 Introduction

In October 2013, a planning proposal was submitted to Hornsby Shire Council on behalf of landowners to rezone 240 hectares of land in South Dural for urban residential development. This planning proposal resulted in a Gateway Determination on 12 March 2014. The Gateway Determination summarised the additional work required to precede the rezoning at South Dural. This work included the preparation of a Transport Management and Accessibility Plan (TMAP) to support the planning proposal.

A previous planning proposal and transport assessment identified an impact on transport infrastructure within the surrounding area due to the development traffic and the existing traffic levels. The updated planning proposal has been assessed in consultation with State road and transport agencies to assist them in assessing the rezoning application. This TMAP outlines the travel requirements of the rezoning site by road, public transport, walking and cycling. The objective of this TMAP is to:

- Assess the traffic impact of the rezoning site on the surrounding road network, by utilising a recently developed mesoscopic model covering the development and surrounding area. This provides a robust assessment of the future year and incorporates the committed/planned transport initiatives and other confirmed developments in the area.
- Apply transport planning principles to maximise the use of public transport, walking and cycling and reduce reliance on the private car.
- Identifying a package of infrastructure and non-infrastructure measures to help manage the travel demand from the development and mitigate the impacts on the surrounding road network.
- Propose an apportionment of the costs of these measures, which depends on a number of factors including a technical assessment of the additional demand from the development.

The rezoning of the South Dural area is being managed by APP Corporation Pty Limited, on behalf of the South Dural Resident and Ratepayers' Association, including the Folkestone-Lyon Joint Venture. WSP | Parsons Brinckerhoff Australia Pty Ltd has been appointed by Lyon Group Australia to prepare a Transport Management and Accessibility Plan in support of the planning proposal for the rezoning.

## 1.1 Site location

The existing land use within the site is mainly rural / residential use as shown on Figure 1.1. There is a recently completed retirement village at the southwest corner and limited commercial development immediately to the north of the retirement village and along New Line Road. In addition, at the northeast corner of the site, there is a motel and small-size residential development.

The study area is located within the Local Government Area (LGA) of Hornsby. Old Northern Road to the west of the study area forms the boundary of Hornsby LGA and Baulkham Hills LGA. The release area is approximately 5 km to the north of Castle Hill, 11 km to the west of Hornsby, and 25 km to the north-west of Sydney CBD. The proposed development area is circled by Old Northern Road to its south, west and north, Hastings Road to its south-east and New Line Road to its east as shown on Figure 1.2.

The Sydney Metro NorthWest is currently being constructed with three stations close to the study site. The site is around 3.5 km, 4.2 km and 3.8 km from Castle Hill Station, Showground Station and Cherrybrook Station, respectively.





Base image source: Google earth website, photo taken in October of 2016

**Figure 1.1** Site existing land use





Base image source: Google Maps, 2016

**Figure 1.2** Site location



## 1.2 Scope of this report

This report is structured as follows:

- Section 2 presents information on existing transport conditions.
- Section 3 contains a review of the relevant State and Local government plans and strategies, and recent studies for other developments. This section also summarises the consultation undertaken with key local and state government stakeholders during the preparation of the report.
- Section 4 briefly outlines the development potential to realise the South Dural Precinct.
- Section 5 calculates the trip generation potential for the site and assesses the potential impact on the road network.
- Section 6 assesses the potential redevelopment in terms of its provision for and impact on public transport, pedestrians and cyclists, parking.
- Section 7 contains a strategic level assessment of the large-scale infrastructure potentially required to support the development and demonstrates how it could be implemented.
- Section 8 presents a summary of the conclusions of the assessment and lists the recommendations.

## 2 Existing conditions

The site is located on the fringe of the suburban area. While there are some bus services running along Old Northern Road and New Line Road, most travel is undertaken by private car. The arterial road network is operating close to its current capacity. The North West Metro is currently being constructed to the south of the study site, which should improve the level of accessibility of the area to public transport within the next three years<sup>1</sup>.

### 2.1 Travel behaviour

The travel behaviour of existing nearby residents varies widely, but certain characteristics can be grouped depending on the:

- purpose for the journey
- the time period of journey
- the mode or combination of modes of transport used from the origin to the destination.

Three sets of data exist for assessing these travel characteristics:

- Australian Bureau of Statistics publishes broad travel data gathered from the questions asked in the 5-yearly Census. Useful data includes the population, number of dwellings, amount of workers and students, mode of travel to work and time of work trips made.
- Australian Bureau of Statistics Census results for NSW are further analysed by the Bureau of Transport Statistics (BTS), within Transport for NSW. The Journey to Work data set analyses work commuting trips and links their origin and destination zones, creating a matrix of movements around the Sydney Greater Metropolitan Area (GMA). This is useful to determine the current directions of travel to and from an area and mode share.
- BTS also undertakes a continuous Household Travel Survey (HTS) which samples households in the GMA. The survey involves respondents completing a diary of their travel patterns for all trip purposes. The results are compiled on an annual basis, but can be combined to form a large pool of data.

Due to the sample size, only certain types of data are available from each data set.

#### REASON FOR TRAVELLING

Trips generated from dwellings can be made for several purposes, and may often have different destinations using varied modes of travel. Trip purposes can include: commute to work, work related business, education/childcare, shopping, personal business, social/recreation, serve passenger or other. For the purposes of this study, these categories have been amalgamated to work-related (including commute to work and work related business) and other trip purposes. Data from the 2012/2013 release of HTS data for The Hills LGA is summarised in Table 2.1. Serve passenger trips have been distributed between other purposes.

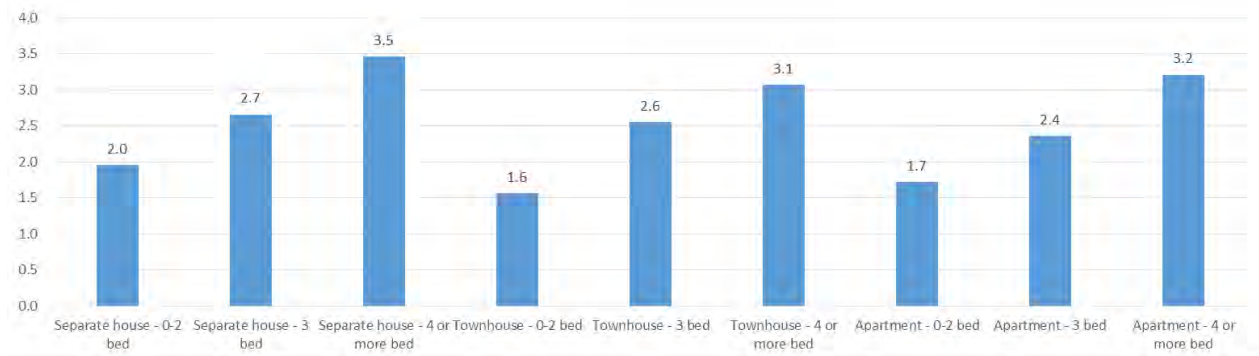
**Table 2.1 Proportion of work-related and other purpose trips by time period**

	Daily	AM peak	PM peak
Work related	32%	46%	32%
Other purposes	68%	54%	68%

<sup>1</sup> Transport for NSW – Sydney Metro website

## PEOPLE PER DWELLING

An analysis of the 2011 Census data for people and dwelling type in surrounding suburbs (Beaumont Hills, Glenhaven, Castle Hill and Cherrybrook) is shown in Figure 2.1. It shows an obvious trend of population based on the number of bedrooms, as well as higher people living in a house compared to a townhouse or apartment with the same number of bedrooms.



Note: Townhouse includes semi-detached, row or terrace house, townhouse etc. with one storey. Apartment includes a flat, unit or apartment

Source: Australian Bureau of Statistics, 2011 Census Data, Number of Persons Usually Resident in Dwelling (NPRD) by Dwelling Structure (STRD), Number of Bedrooms in Private Dwelling (ranges) (BEDRD) and State Suburbs (Beaumont Hills, Glenhaven, Castle Hill and Cherrybrook)

**Figure 2.1 Number of people by residence type and number of bedrooms**

From this data, a weighted average (based on the number of each dwelling type) number of people per dwelling type has been estimated as:

- Separate house 3.3
- Semi-detached, row or terrace house, townhouse etc. 2.4 (72% of separate house number)
- Flat, unit or apartment 1.9 (57% of separate house number).

This confirms that smaller dwellings have fewer people per dwelling.

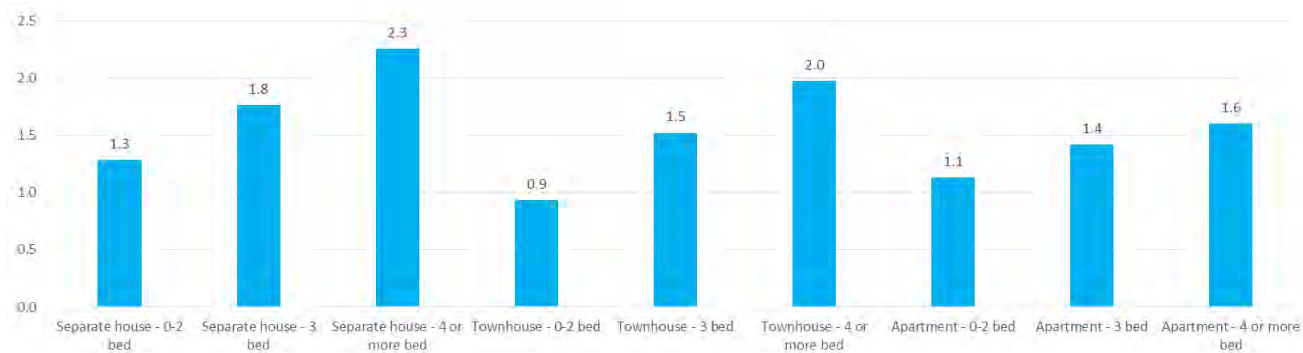
## CAR OWNERSHIP

The choice of travel mode varies depending on the range of transport services available, car availability, need for predictable arrival, the length of the journey and the reason for travelling. Car ownership numbers for the existing area have not been extracted, as the proposed medium density development is anticipated to have car ownership guided by the provision of parking space, whereas the current area has little restriction on space for vehicles.

An analysis of car ownership by dwelling type in surrounding suburbs (Beaumont Hills, Glenhaven, Castle Hill and Cherrybrook) is shown in Figure 2.1.

From this data, the number of vehicles per dwelling is estimated as:

- Separate house 2.1
- Semi-detached, row or terrace house, townhouse etc. 1.4 (67% of separate house number)
- Flat, unit or apartment 1.2 (56% of separate house number).



Note: Townhouse includes semi-detached, row or terrace house, townhouse etc. with one storey. Apartment includes a flat, unit or apartment

Source: Australian Bureau of Statistics, 2011 Census Data, Number of vehicles owned (VEHRD) by Dwelling Structure (STRD), Number of Bedrooms in Private Dwelling (ranges) (BEDRD) and State Suburbs (SSC) (Beaumont Hills, Glenhaven, Castle Hill and Cherrybrook)

**Figure 2.2 Number of cars owned by residence type and number of bedrooms**

The data indicates that smaller dwellings have lower levels of car ownership.

## TRANSPORT MODE SHARE

The choice of travel mode varies depending on the range of transport services available, car availability, need for predictable arrival, the length of the journey and the reason for travelling. The Journey to Work mode share for trips originating in 2011 Traffic Zones 4558, 4529, 4312, 4546, 4311, 4557, 4310 (covering study site) during the AM peak are shown in Table 2.5. They indicate a typical dominance of trips made by car driver. However, with the opening of the North West Metro Line, improvements to the bus network and pedestrian and cycle infrastructure, this mode share is expected to change in the future.

**Table 2.2 AM peak period mode split examples for journey to work trips by residents**

Transport mode	Mode share
Vehicle driver	82%
Vehicle passenger	6%
Train	3%
Bus	6%
Walked only	1%
Other mode	1%
Mode not stated	1%
Total	100%

Source: BTS, Journey to Work, 2011

## DIRECTION OF TRAVEL

The trip distribution for journey to work trips (all modes) in the AM peak to and from Traffic Zones 4558, 4529, 4312, 4546, 4311, 4557, 4310 are listed in Table 2.7. Trips within Baulkham Hills represent the largest share of all destinations/origins (more than one quarter). For trips by residents to work, areas within The Dural and Sydney Inner City are also important.

**Table 2.3 Destination and origin council area for commute trips to/from seven Traffic Zones**

Destination LGA	% of trips from zone
Baulkham Hills	30%
Dural – Wisemans Ferry	17%
Sydney Inner City	7%
Parramatta	5%
Ryde – Hunters Hill	4%
Chatswood – Lane Cove	2%
Blacktown	3%
Hornsby	3%
Ku-ring-gai	2%
North Sydney – Mosman	2%
Pennant Hills – Epping	2%
Auburn	1%
Other areas	22%
<b>Total</b>	<b>100%</b>

Source: 2011 Journey to Work (BTS, 2013), Traffic Zones 4558, 4529, 4312, 4546, 4311, 4557, 4310, all modes

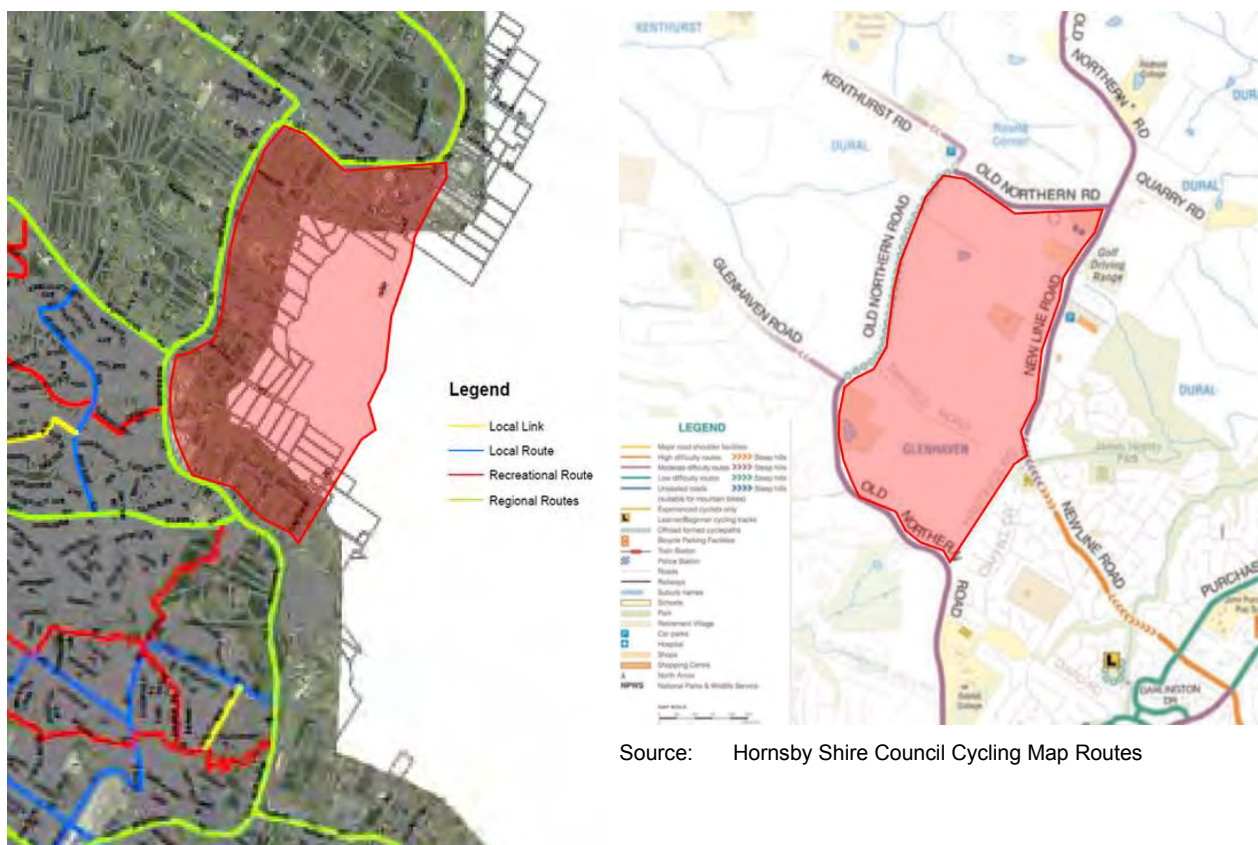
## 2.2 Pedestrians

The semi-rural nature of the area surrounding the site, means that pedestrian demand is low. As a consequence, pedestrian facilities are currently limited. However, improvements in the pedestrian and cycle network are planned to accommodate the increase in the number of walking and cycling trips generated by the development in the South Dural Precincts.



## 2.3 Cycles

An extract from the Hornsby Shire Council Cycling Map 2013 in Figure 2.3, shows the existing routes. The surrounding roads currently have no bike facilities.



Source: Hornsby Shire Council Cycling Map Routes

Source: The Hills Shire Council Bike Plan Review, 2009

**Figure 2.3 Existing bike route on surrounding road network of the development site**

## 2.4 Bus

The study site is within Region 4 of the Sydney bus network. The Region 4 bus network is shown in Figure 2.4. The development site is located in the less developed rural area, and it is served by nine bus routes, with four bus routes (620, 622, 642 and 644) on New Line Road and five bus routes (603, 652X (south of Gilbert Road only), 637, 638 and 639) on Old Northern Road. All of these bus routes are operated by Hills Bus Company.

Route 637 runs from Glenorie to Castle Hill via Galston, Round Corner & Rogans Hill, and its occasional peak hour services extend to Pennant Hills Station. Route 638 runs from Castle Hill towards Berrilee via Galston, Round Corner and New Line Rd, and its occasional peak hour services operate to Castle Hill. Routes 639 runs from Castle Hill towards Pitt Town Road via Dural, Round Corner and Rogans Hill. These three bus routes all pass by the study site along Old Northern Road. Routes 638 and 639 provide direct connection between the study site and Pennant Hills Station.

Bus routes 603 and 652X runs a short section on Old Northern Road from Gilbert Road to Hastings Road and offer a direct connection of the site with Parramatta and Sydney CBD.



Source: Region 1 Bus Network Map Effective 27 July 2015

**Figure 2.4 South Dural bus network**

Bus routes 620N and 620X both run on New Line Road from Dural Bus Depot to the Sydney CBD. Bus Routes 622 runs from Dural to Milsons Point via Cherrybrook, M2 Busway, Lane Cove Interchange, St Leonards and North Sydney. Bus Routes 642 runs from Dural to City via Cherrybrook, Thompsons Corner, M2 Busway and Lane Cove Interchange. Bus Routes 644 runs from Dural to Castle Towers via Anglican Retirement Villages.

Bus routes 652X, 620N and 620X, 622 and 642 provide a direct connection of the site with North Sydney and City via M2 Busway, the study site can also access the express bus services from Castle Hill to City at the bus stop located at the grade-separated intersection of M2 and Oakes Road.



Table 2.4 provides an overview of the bus service frequency and operating hours on the surrounding streets.

**Table 2.4 Current bus services at surrounding roads of the development site**

Line	Direction	AM peak frequency	PM peak frequency	Daily services	First/Last bus
637	Glenorie to Castle Hill	30 min	30 min	14	5:28 to 19:43
	Castle Hill to Glenorie	45 min	25 min	15	7:09 to 21:48
638	Berrilee to Castle Hill and Pennant Hills	40 min	35 min	8	6:16 to 17:44
	Castle Hill and Pennant Hills To Berrilee	40 min	60 min	7	7:44 to 18:18
639	Pitt Town Road to Pennant Hills and Castle Towers	30 min	60 min	6	6:20 to 17:07
	Pennant Hills and Castle Towers to Pitt Town Road	-	60 min	4	12:08 to 18:43
622	Dural to Milsons Point	20 min	-	6	6:10 to 7:50
	Milsons Point to Dural	-	25–55 min	7	16:49 to 19:56
642	Dural to City	6–20 min	-	29	5:20 to 14:30
	City to Dural	-	4–10 min	30	12:20 to 19:01
644	Dural to Castle Towers	30 min	60 min	7	06:57 to 16:10
	Castle Towers to Dural	-	30 min	7	10:41 to 17:51
603	Rouse Hill Town Centre to Parramatta	30 min	60 min	18	05:45 to 17:05
	Parramatta to Rouse Hill Town Centre	30 min	30 min	34	7:41 to 21:05
652X	Knightsbridge Shops to City Kent Street	20 min	-	6	06:00 to 7:56
	City Kent Street to Knightsbridge Shops	-	30 min	6	16:05 to 18:35
620N	Dural Bus Depot to City Kent Street	15 min	-	7	06:40 to 8:03
	City Kent Street to Dural Bus Depot	-	60 min	4	17:08 to 19:35
620X	Dural Bus Depot to City Kent Street	7.5 min	-	7	05:25 to 7:40
	City Kent Street to Dural Bus Depot	-	30 min	13	15:30 to 2:30

Source: TfNSW website, effective since 27 January 2015, 4 October 2015, 29 February 2016, 26 April 2016 and 2 May 2016, respectively

There are currently a number of bus stops surrounding the site. However, they have varying levels of infrastructure ranging from a plate bolted to a power pole to a stop with shelter, seating and a timetable. Some stops are closely spaced (less than 200 metres) along the same route, indicating there is opportunity to consolidate the location of bus stops and improve the level of facilities as the area develops.

## 2.5 Rail

The closest active railway station to the study site is Pennant Hills Station on the T1 North Shore and Northern Line (shown on Figure 2.5). From the centre of the study site to Pennant Hills Station, the route distance is around 10 km and accessed less than 30 mins via bus routes 637, 638 and 639. Trains on the T1 line operate between Central and Hornsby, with options to interchange at Epping Station to trains on the T1 Northern Line (via Strathfield) and the Central Coast and Newcastle Line.

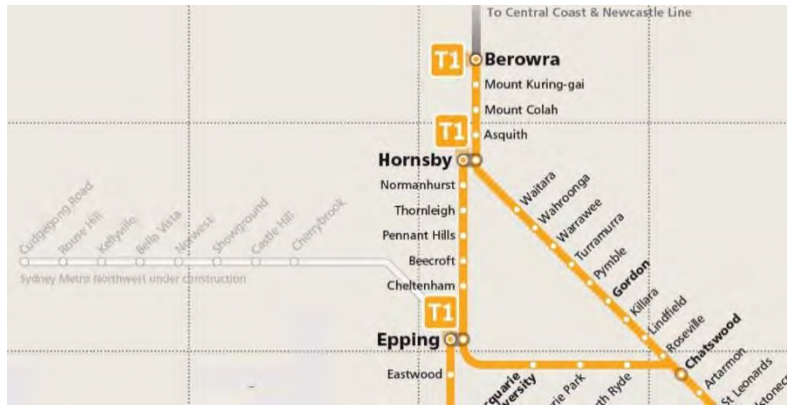


Figure 2.5 Pennant Hills connection to Sydney Trains suburban network

Table 2.5 provides an overview of the train service frequency and operating hours at Pennant Hills Station.

Table 2.5 Train services at Pennant Hills Station

Line	Direction	AM peak frequency	PM peak frequency	Daily services	First/Last bus
T1 North Shore and Northern Line	Hornsby to Central	15 min	15 min	73	4:48 to 23:33
	Central to Hornsby	15 min	15 min	71	5:54 to 00:36

Source: Sydney Trains timetable, effective from October 2013

## 2.6 Road network

The Study Site is circled by main roads including Old Northern Road, New Line Road and Hastings Road. The site is also connected to a wider road network via Old Northern Road, New Line Road, Kenthurst Road, Gilbert Road and Glenhaven Road. The latter three roads are all connected with Old Northern Road. A description of the roads in the study area and their characteristics are shown in Table 2.5.

Table 2.6 Description of key roads in the local network

Road name	Classification	Carriageway	Speed limit	Truck load restriction	Role in network
Old Northern Road	Management hierarchy 4U	Undivided one lane in each direction	60 km/h	No restriction	Provides access to the south, west and north of the site
New Line Road	Management hierarchy 4U	Undivided, one lane in each direction	60 km/h	No restriction	Provides access to the site from eastern direction.
Hastings Road	Connector Road	Undivided, two lanes in each direction	60 km/h	3 tonne limit	Provides access to the southeast of the study site
Gilbert Road	Connector Road	Undivided, one lane each way with parking on both sides	60 km/h	8 tonne limit	Connects to the southwest of the study site
Glenhaven Road	Connector Road	Undivided, one lane each way	60 km/h	8 tonne limit	Connects the west of the development site to Kellyville
Kenthurst Road	Connector Road	Undivided, one lane each way	60 km/h	8 tonne limit	Connects the northwest of the development site to Kellyville

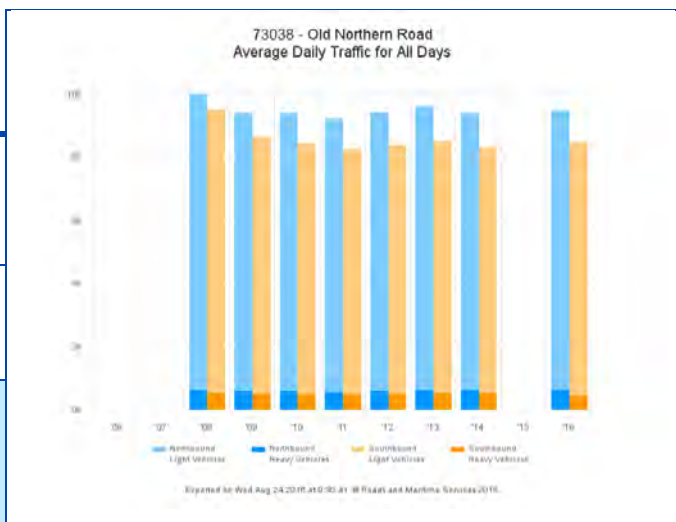
Notes: 1. Old Northern Road and New Line Road information is from RMS (Last update January 2014). "Schedule of Classified Roads and State & Regional Roads" <http://www.rms.nsw.gov.au>. 2. Information of other roads is from Street Directory

DAILY TRAFFIC VOLUMES

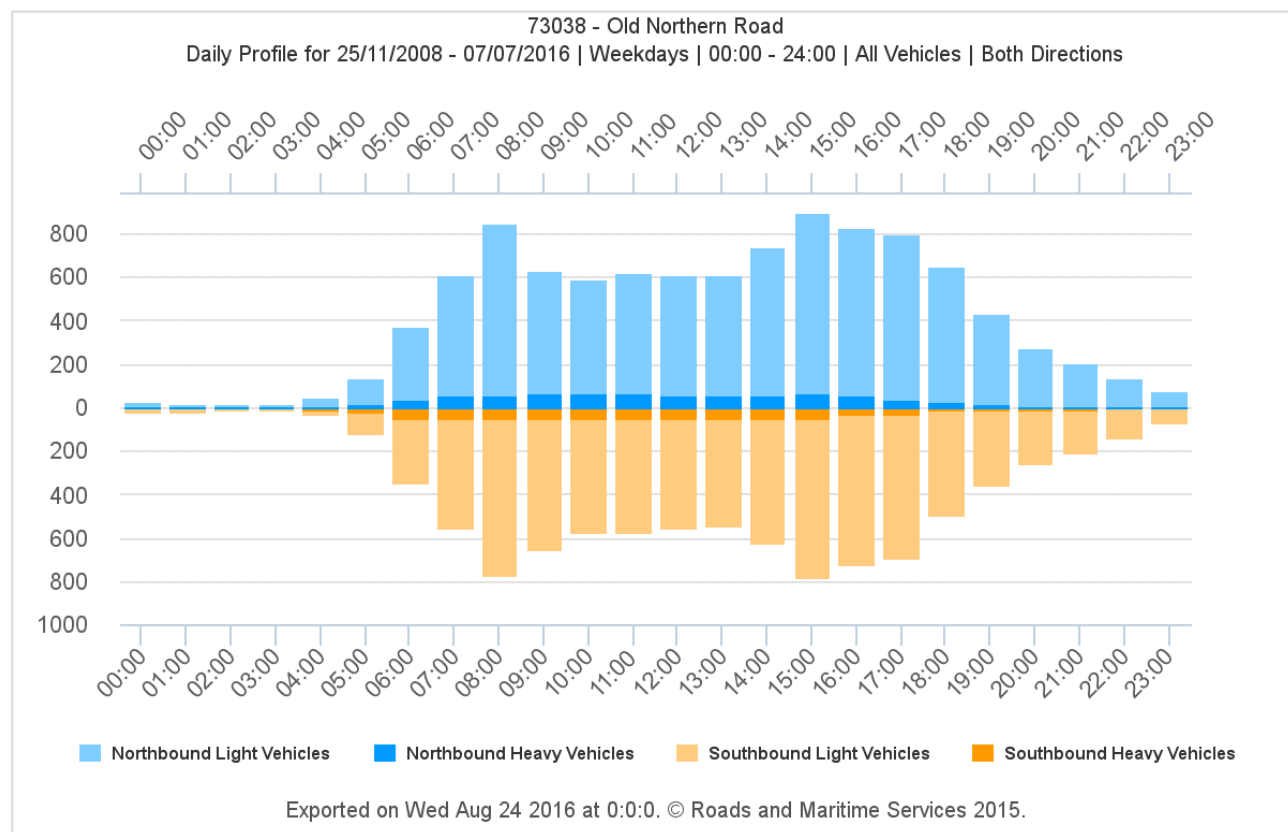
Roads and Maritime Services collects traffic volume data at a number of locations on the arterial road network, including on Old Northern Road and New Line Road near the site. Table 2.7 shows the daily traffic volume and percentage of heavy vehicles at the Old Northern Road site, while Figure 2.6 shows the weekday hourly profile of traffic in each direction.

**Table 2.7 2016 Average Daily Traffic volume on Old Northern Road, south of Malabar Road**

Direction	Daily traffic volume	Percentage of heavy vehicles
Northbound	9,496	6.82%
Southbound	8,475	5.36%
Combined	17,971	6.13%



Source: Roads and Maritime Services Traffic volume viewer, 2016



**Figure 2.6 Hourly profile of traffic on Old Northern Road, south of Malabar Road**



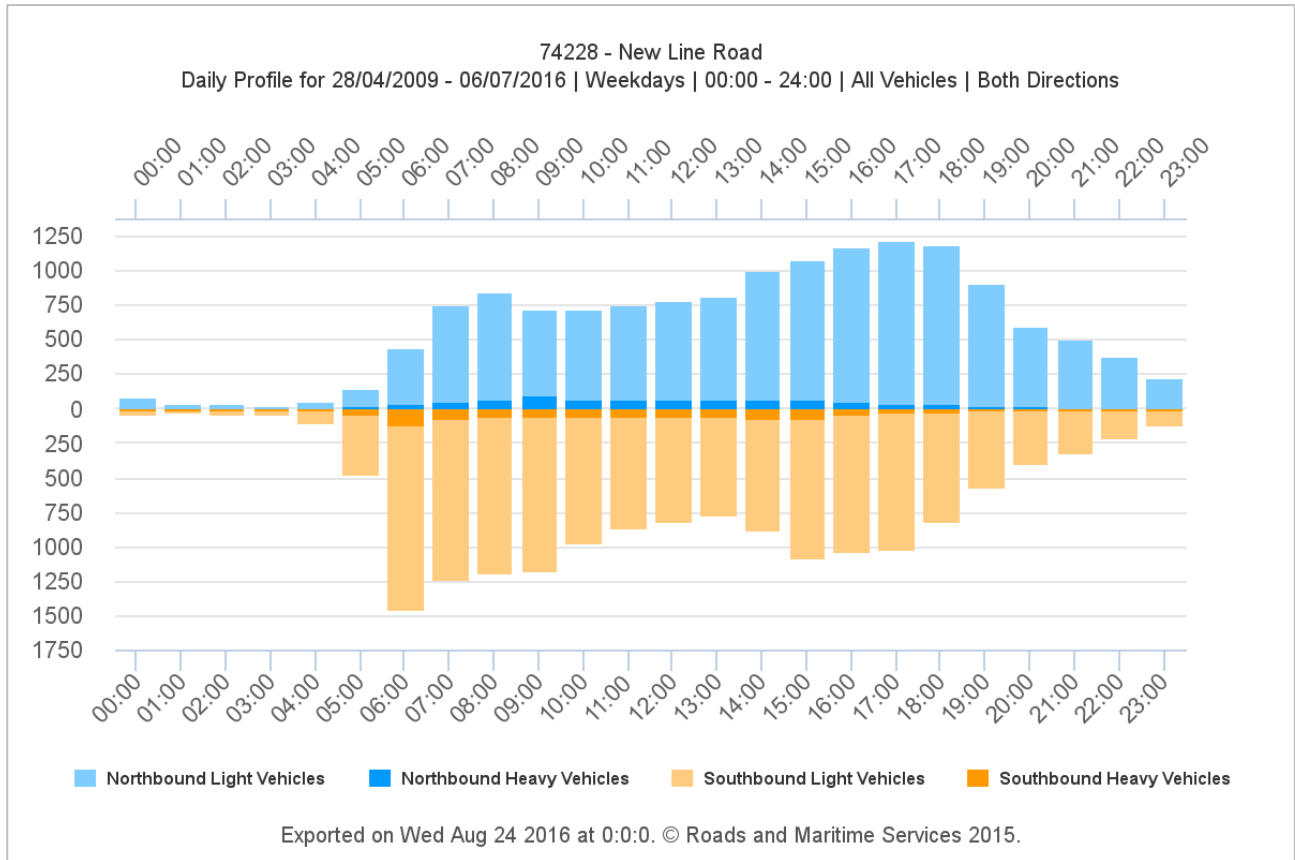
The hourly pattern shows a balanced peak in traffic in each direction in both the AM and PM peak periods. The PM peak is more protracted, while the AM peak is relatively short.

Table 2.8 shows the daily traffic volume and percentage of heavy vehicles at the New Line Road site. Figure 2.7 shows the weekday hourly profile of traffic in each direction.

**Table 2.8 Historical traffic volume changes on New Line Road at the study site**

Direction	Daily traffic volume	Percentage of heavy vehicles
Northbound	13,877	5.59%
Southbound	15,225	4.74%
Combined	29,102	5.15%

Source: Roads and Maritime Services Traffic volume viewer, 2016



**Figure 2.7 Hourly profile of traffic on New Line Road, south of Tennyson Close**

The year to year pattern shown in the graphs in Tables 2.7 and 2.8 shows that traffic volumes have stayed relatively constant in the past eight years. Figure 2.7 shows that New Line Road has a peak southbound direction bias (toward the city) in the AM peak and a small bias to northbound traffic in the PM peak.

### PEAK HOUR TRAFFIC VOLUMES

Traffic surveys were undertaken on Wednesday 6 April 2016 between 6:30 am and 9:30 am during the AM peak and 3:00 pm to 7:00 pm during the PM peak at the intersections below. The results of the surveys are included in Appendix A:

- Old Northern Road and Hastings Road
- Old Northern Road and Gilbert Road
- Old Northern Road and Blue Gum Drive
- Old Northern Road and Glenhaven Road
- Old Northern Road and Kenthurst Road
- Old Northern Road and New Line Road
- New Line Road and Sebastian Drive
- New Line Road and Hastings Road.

Figure 2.8 and 2.9 show the intersection turning movement volumes in vehicle per hour (vph) during the analysed AM and PM peak hour respectively. These are considered representative of the existing volumes for the assessment of the existing conditions and model calibration.

### TRAFFIC NETWORK OPERATION

The performance of each of the following intersections was analysed under existing conditions:

- Old Northern Road and Hastings Road
- Old Northern Road and Gilbert Road
- Old Northern Road and Blue Gum Drive
- Old Northern Road and Glenhaven Road
- Old Northern Road and Kenthurst Road
- Old Northern Road and New Line Road
- New Line Road and Sebastian Drive
- New Line Road and Hastings Road.

The analysis was undertaken using the SIDRA Intersection software package. This package provides several useful parameters to determine the level of intersection performance. Explanations of the criteria used are provided in Appendix B.

Typically acceptable intersection performance is defined as follows:

- LoS D or better (the worst case scenario of vehicle delay was less than or equal to 56 seconds)
- Degree of Saturation (DoS) less than equal to 0.8 at priority controlled intersection, and 0.90 at a signalised controlled intersection
- 95<sup>th</sup> percentile back of queue does not interfere with other traffic movements.

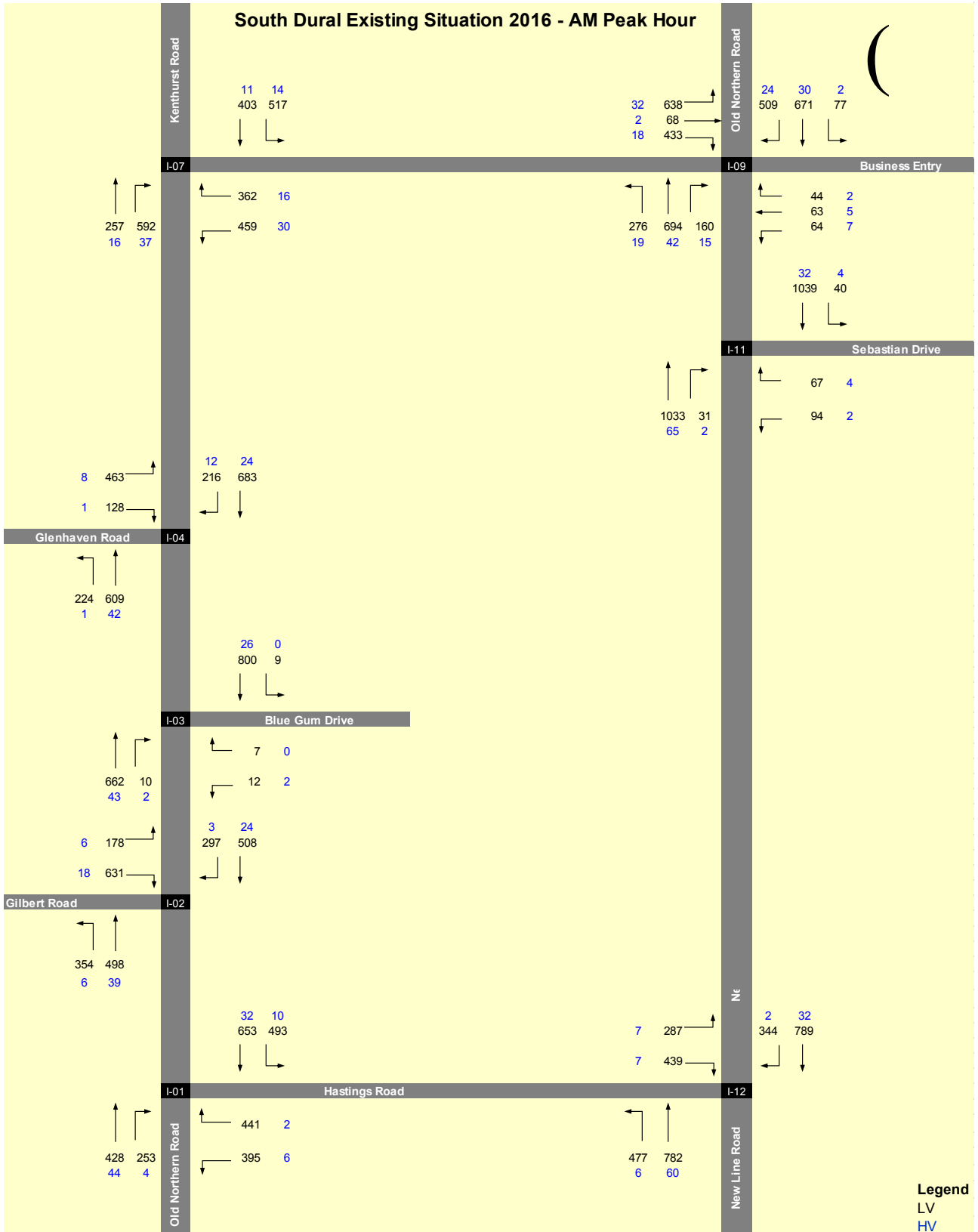


Figure 2.8 Existing AM peak hour (7:45 am to 8:45 am) intersection turning volumes – Year 2016

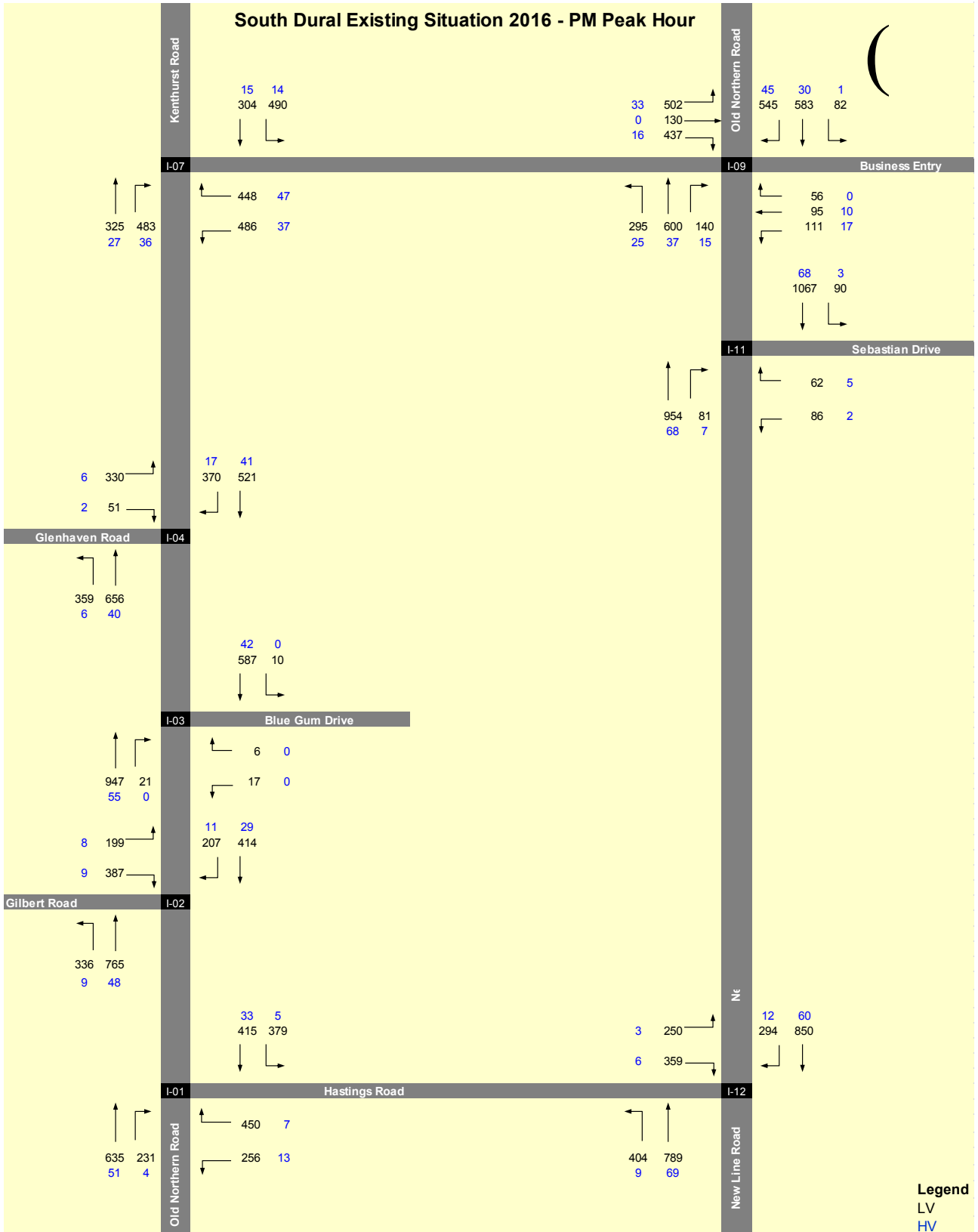


Figure 2.9 Existing PM peak hour (3:00 pm to 4:00 pm) intersection turning volumes – Year 2016

The performance of each of the key intersections was analysed for existing year 2016. The assessment of existing intersection performance was based on the existing surveyed traffic volumes for the AM and PM peak periods shown in Figure 2.8 and Figure 2.9. The results from the analysis are presented in Table 2.9. SIDRA model output containing more detail is provided in Appendix C.

**Table 2.9 Summary of existing intersection performance**

Site ID	Intersection	Peak period	Degree of Saturation	Average Delay (s)	Level of Service	95th percentile queue (m)
I-01	Old Northern Road and Hastings Road	AM	0.95	34	C	333
		PM	0.94	25	B	236
I-02	Old Northern Road and Gilbert Road	AM	0.82	29	C	157
		PM	0.94	39	C	323
I-03	Old Northern Road and Blue Gum Drive	AM	0.74	13	A	109
		PM	0.67	14	A	83
I-04	Old Northern Road and Glenhaven Road	AM	1.07	194	F	93
		PM	0.95	94	F	80
I-07	Old Northern Road and Kenthurst Road	AM	0.98	34	C	249
		PM	0.97	30	C	224
I-09	Old Northern Road and New Line Road	AM	1.06	96	F	411
		PM	0.94	34	C	154
I-11	New Line Road and Sebastian Drive	AM	0.79	11	A	186
		PM	0.64	6	A	110
I-12	New Line Road and Hastings Road	AM	1.16	46	D	405
		PM	0.94	19	B	180

At present, the intersection of Glenhaven Road with Old Northern Road is running with an unacceptable level of service F both in AM and PM peak periods. The intersection of New Line Road and Old Northern Road is operating in level of service F during AM peak but C during PM peak. All other intersections are operating at an acceptable level of service or better.



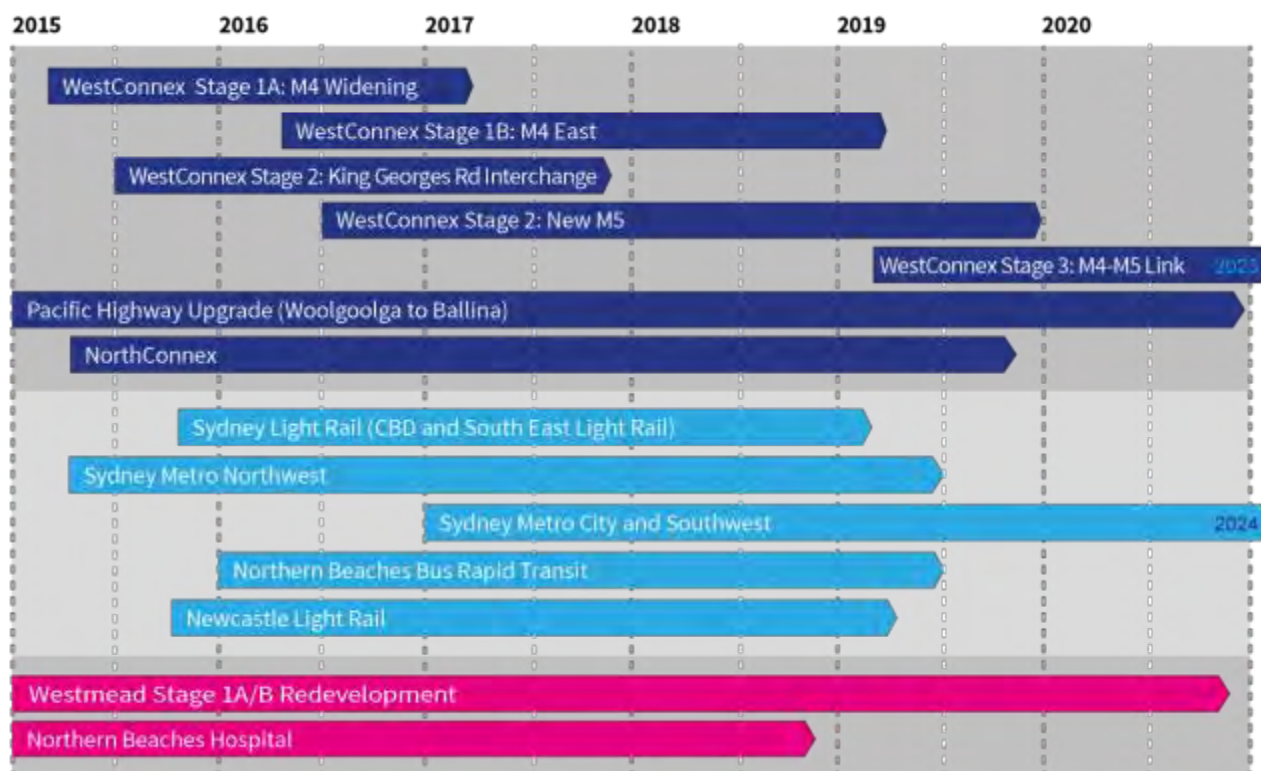
## 3 Strategic context

### 3.1 State planning context

#### 3.1.1 NSW Premier's Priorities

In September of 2015, NSW Premier announced *30 New Priorities for NSW*. Among these priorities, to deliver key infrastructure projects is an ambitious plan to support 40% more train trips, 30% more car trips and 31% more households over the next 15 years as a consequence of the growing population in NSW in the future.

The transport services in the study area in South Dural will benefit from these infrastructure projects, especially Sydney Metro Northwest and NorthConnex. Both projects are currently under construction, with delivery timeframes in 2019, as shown in Figure 3.1.



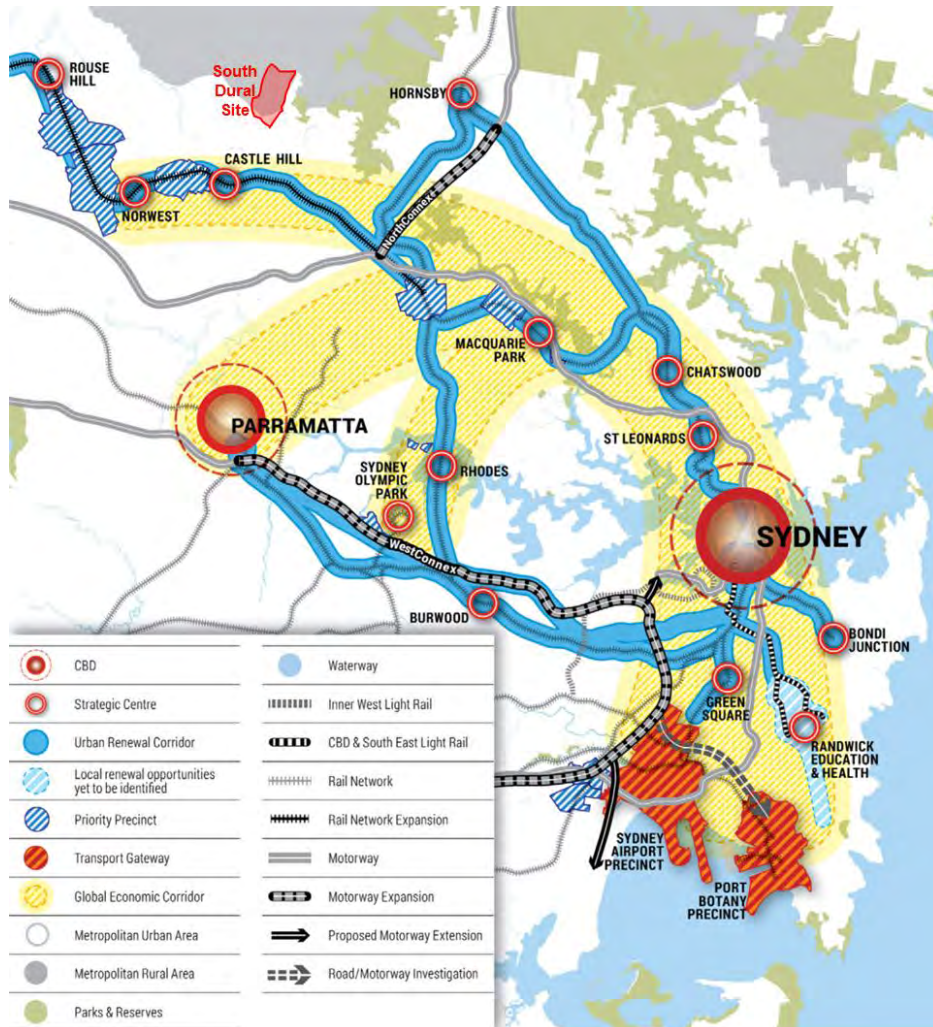
Source: infrastructure NSW <https://www.nsw.gov.au/premiers-priorities-list/building-infrastructure>

**Figure 3.1 Key Infrastructure Projects announced on the Premier's Priorities**

Along with the key infrastructure projects mentioned other improvements are planned, which will link the development of the South Dural precinct to them more easily. In combination with the Long Term Transport Master Plan and Sydney modal plans, it will locate more people within easy access of improved transport services in the future.

### 3.1.2 A Plan for Growing Sydney

*North West Rail Link Corridor Strategy* (now called the Sydney Metro NorthWest Line) was issued jointly by Transport for NSW and NSW Department of Planning and Environment in September 2013, to guide the land use and transport development along the corridor. This strategy is later incorporated into *A Plan for Growing Sydney*, a key planning policy document released by the NSW Government in December 2014. The South Dural site area is to the north of the NorthWest Metro corridor, as shown in Figure 3.2.



Source: A Plan for Growing Sydney, NSW Government, December 2014

**Figure 3.2 Central and Northern Sydney urban renewal corridors**

*A Plan for Growing Sydney* aims to guide land use planning decisions over the next 20 years. The NorthWest Line Corridor is identified as an urban renewal corridor in the plan, with development to be guided by the Corridor Strategies. The plan states that the corridor will be a focus for increased housing, economic activity and social infrastructure, especially around centres with good public transport and amenity.

Castle Hill, Norwest (including Bella Vista) and Rouse Hill are listed as strategic centres that will continue to be a particular focus for employment. This will shape the work-related trip distribution of the study area. For the South Dural area, it creates opportunities, increasing employment in the vicinity and reducing the need to make long trips to other parts of Sydney. For the Castle Hill strategic centre, the Metropolitan Strategy also outlines the intent to investigate a potential light rail corridor to Parramatta CBD via Old Northern Road.

### 3.1.3 NSW Long Term Transport Master Plan

The *NSW Long Term Transport Master Plan* (LTTMP) (Transport for NSW, December 2012) provides a framework for addressing transport challenges over the next 20 years. It identifies the NorthWest Metro Line as a priority rail infrastructure project, and as an essential piece of infrastructure for the development of the surrounding development corridor.

The LTTMP supports the strategies of *A Plan for Growing Sydney* by improving transit capacity in areas with increased development to make more efficient use of the public transport service. An action of the LTTMP is to plan transit-oriented development as part of the new NorthWest Line stations. Figure 3.3 shows the NorthWest Metro Line corridor as a medium-term opportunity for urban growth.



Source: Long Term Transport Master Plan (TfNSW, December 2012)

**Figure 3.3** Corridors to support urban growth

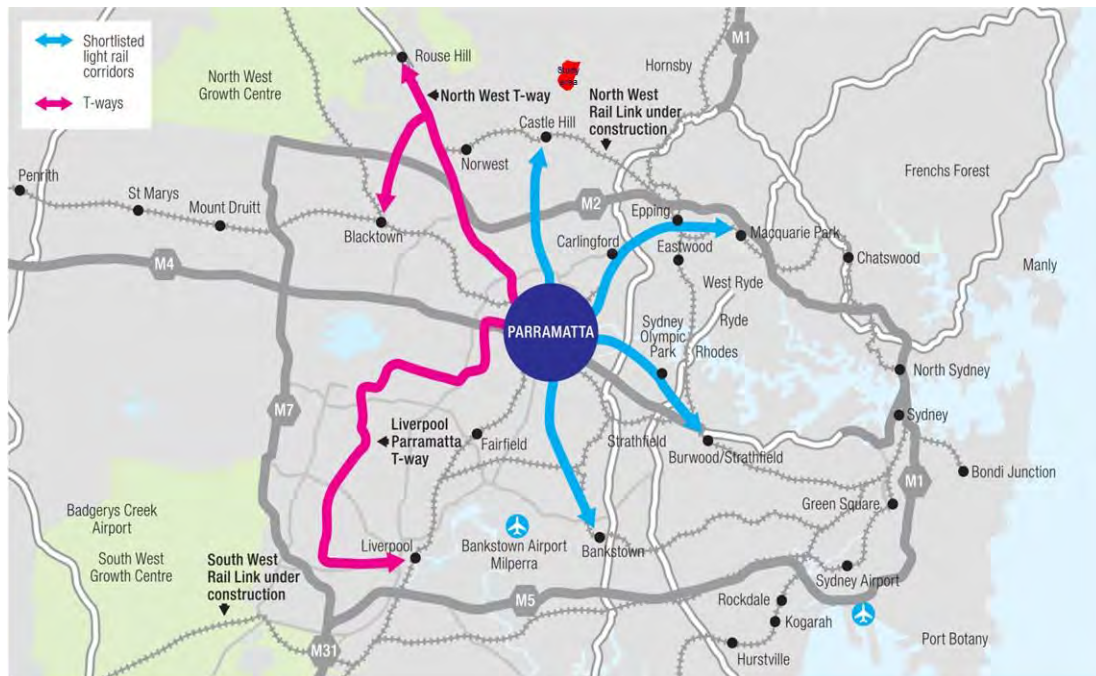
The LTTMP reinforces the need to develop and implement travel management plans as part of transit-oriented developments. These plans promote more sustainable travel practices such as walking, cycling, using public transport and car-pooling. They are encapsulated in travel access guides for residents and workplace travel plans for businesses. The South Dural study area is located north of and between two stations (Castle Hill and Cherrybrook). This requires consideration of improved public transport services to link the development to these stations and the implementation of the travel demand measures to improve the attractiveness of non-car travel.



### 3.1.4 State Infrastructure Strategy, 2014 Update

The State Infrastructure Strategy outlines the priorities for NSW Government infrastructure funding for the next 20 years. One of the Strategy's main goals is to support population and economic growth in Sydney. It recognises the additional pressure on infrastructure that population and employment growth in the outer areas of Sydney will create. Projects to assist in achieving this include the NorthWest Line and NorthConnex.

Improvements in the transport corridor from Castle Hill to Parramatta, shown in Figure 3.4, will improve the efficiency of public transport to Parramatta, Sydney's second CBD. Improved services from South Dural to Castle Hill will maximise the benefits this corridor would create.



Source: State Infrastructure Strategy 2014 Update (Infrastructure NSW, November 2014)

**Figure 3.4 Shortlisted light rail corridors for access to Parramatta CBD**

## 3.2 Sydney's transport mode plans

### 3.2.1 Sydney's Walking Future

Sydney's Walking Future (Transport for NSW, 2013) is an action plan aiming to promote more walking in Sydney. Strategies to achieve this include:

- Design and development principles for interchanges prioritising walking routes
- Provision for walking links from the surrounding suburbs
- A focus on safety and access for disabled persons or the mobility impaired
- Improved design of pedestrian infrastructure
- Improved trip planning information on the ground and online.

Sydney's Walking Future targets the removal of barriers to pedestrian movement within approximately 2 km of activity centres. Pedestrian improvements within these areas will be prioritised to cater for the increased number of pedestrians. The walking demand generated in South Dural, especially to facilities outside the area, will need to apply these planning principles.

### 3.2.2 Sydney's Cycling Future

Sydney's Cycling Future (Transport for NSW, 2013) is a long term plan for cycling in Sydney that proposes to create safe, connected cycling networks by:

- Creating new or improve existing infrastructure and facilities, particularly within 5 km of major centres or near key destinations;
- Fixing missing links;
- Creating a hierarchy of safe cycling routes;
- Delivering improvements with major infrastructure projects.

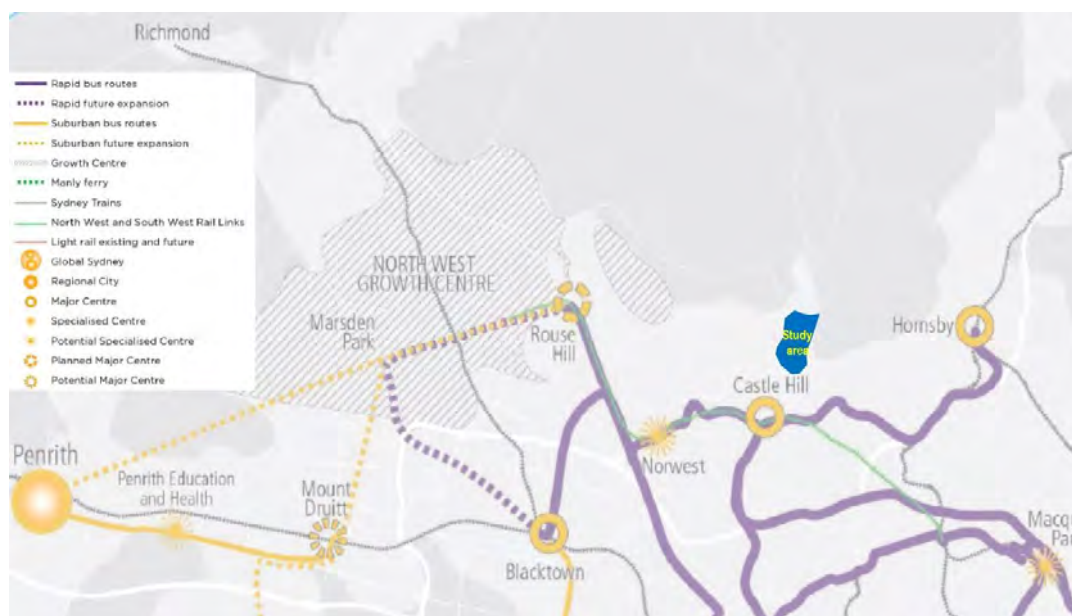
The plan identifies that cycling links which feel safe and match cyclists' abilities are key to promoting increased cycling trips. These links are required outwards from centres, connecting to key routes and destinations. The strategic centre and NorthWest Metro station at Castle Hill presents an opportunity to provide new or improved cycling infrastructure, promoting cycling as an alternative means than car travel.

### 3.2.3 Sydney's Bus Future

Sydney's Bus Future (Transport for NSW, 2013) is the NSW Government's long term plan to redesign Sydney city's bus network. It proposed a three-tiered bus network comprising:

- Rapid Bus routes (high frequency, all-day, linking centres)
- Suburban bus routes (high-frequency, more closely spaced stops, link suburban areas to major centres)
- Local bus routes (increased coverage, daytime services, less frequent, more closely spaced stops).

Figure 3.5 shows that while none of the proposed rapid or suburban routes currently proposed would directly serve South Dural, improving connections to Castle Hill allows interchange to rapid routes to Norwest, Parramatta and Hornsby.



Source: Sydney's Bus Future (Transport for NSW, 2013)

**Figure 3.5 Sydney's Bus future surrounding the study area**

Sydney's Bus Future includes short-term, medium and long term plans to improve servicing and infrastructure including specific provision around the study area. These improvements include:

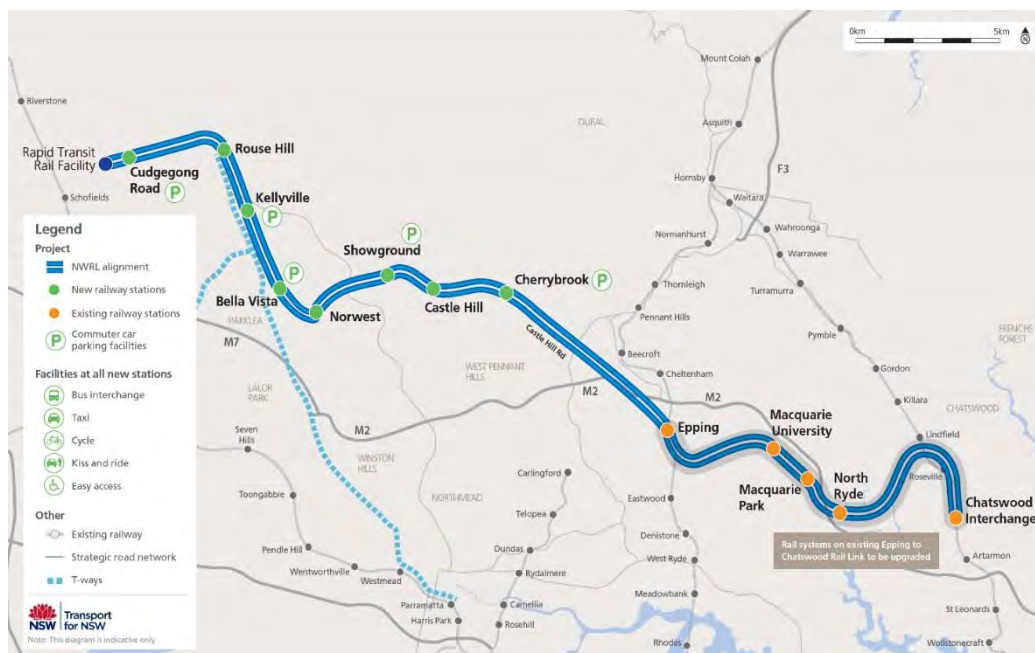
- Additional bus services along existing routes with extended operating hours;
- Bus Head Start Program, including travel options for new developments;
- New bus interchange facilities at each of the NorthWest Metro stations.

These improvements to the bus network will enhance the existing bus service surrounding the South Dural area via providing the dual benefits of linking people living outside the walking catchment of the station to the NorthWest Metro and connecting the new residents and employees within the station precincts to strategic centres. Both these benefits increase the competitiveness of other modes to influence travel decisions away from private vehicle use.

### 3.2.4 Sydney's Rail Future

Sydney's Rail Future (Transport for NSW, 2012) aims to 'transform and modernise Sydney's rail network' and improve the customer experience through a long term plan. A key element of *Sydney's Rail Future* is the Northwest Metro Line. The Line will deliver a reliable heavy rail public transport service to the North West area of Sydney. It will feature next generation reliable, safe, state-of-the-art single deck, automated rapid transit trains. An overview of the NorthWest Line is shown in Figure 3.6. The project includes:

- 23 kilometres (km) of new rapid transit line between Rouse Hill and Epping, including 15 km of tunnels and a 4 km skytrain viaduct.
- Eight new stations and parking for 4,000 cars (including 400 at Cherrybrook).
- Conversion of the existing Epping to Chatswood railway to rapid transit standards including new platform safety screen doors and better customer amenities.
- Customers will benefit from a train every four minutes in peak times, or 15 trains an hour. With rapid transit there will be no need for a timetable as customers can turn up and go.



Source: Transport for NSW, 2014

Figure 3.6 Project map showing alignment and stations



### 3.3 Local government development control plans

#### PARKING

Council's Development Control Plan (DCP) contains guidelines for developments occurring within the Hornsby Shire local government area (LGA). These guidelines may influence transport-related aspects of the development including the road hierarchy and the amount of parking. The current DCP stipulates the specific parking rates of residential developments as shown in Table 2.1.

**Table 3.1 Hornsby DCP parking requirements for residential development greater than 800 metres from a railway station**

Type of development and parking demand type	Minimum car parking	
Single-dwelling houses	0–2 Bedroom	1 space/dwelling
	3 or more Bedrooms	2 space/dwelling
Medium/high density dwellings	0–1 Bedroom	1 space/dwelling
	2 Bedroom	1.25 space/dwelling
	3 or more Bedrooms	2 space/dwelling
	Disability	1 for each accessible unit
	Visitors	1 space per 5 dwellings
	Motorcycle	1 space per 50 car parking spaces
	Bicycle (minimum spaces)	1 space per 5 units
	Visitor Bicycle (minimum spaces)	1 space per 10 units
	Car Share	-

Source: Hornsby Shire DCP Part 1: Table 1C.2.1(c) On Site Car Parking Rates and other articles of Section 1C.2.1

This parking requirement covers the car parking for dwelling houses and medium/high density residential development types. The proposed developments in South Dural are comprised of small-lot houses, town houses and apartments, which fall under the dwelling houses and medium/high density types.

In addition to tenant car parking, the requirements of parking also cover rates for visitor and disability car parking, bicycles parking for tenants and visitors, and for motorcycle parking.

The South Dural development is located on the border of Hornsby Shire and The Hills Shire Council. Parking rates for The Hills Shire (Section C1 of The Hills Development Control Plan 2012-Part C) are similar, with higher rates for 2 bedroom apartments (2 spaces versus 1.25) and higher visitor parking (2 spaces per 5 dwellings versus 1).

#### ROAD IMPROVEMENTS

The Hills Shire Council has proposed a number of plans to upgrade the road network within its LGA as part of a '*Traffic and transport blueprint*'. One project that affects the South Dural development is the signalisation of the intersection of Old Northern Road and Glenhaven Road, Glenhaven to improve safety. Discussions with Council indicate that work on this improvement will commence in the near future.

### 3.4 Other development

A number of developments in the area are in various stages of planning. A coordinated plan to accommodate the additional travel generated by them has the potential to deliver a transport system that can better accommodate their needs, rather than planning each development separately.

#### NORTH KELLYVILLE

The North Kellyville Precinct is bounded by Smalls Creek to the west, Cattai Creek along the east and north, and Samantha Riley Drive to the south. It comprises 4,500 dwellings which could house 14,000 people<sup>2</sup>. While it has close proximity to existing residential areas and the new Rouse Hill Town Centre, additional traffic may travel east via Annangrove Road and Kenthurst Road or Glenhaven Road, affecting the roads surrounding the South Dural area.

#### DERRIWONG DEVELOPMENT

The Derriwong development is located north of the South Dural area. Preliminary discussions have been held with Council, but no Planning Proposal has yet been lodged. Information released to date indicates it may comprise:

- 146 low density residences.
- 60 senior's Independent Living Units (ILU) and 150 beds for assisted living, and a medical precinct of approximately 3,000 m<sup>2</sup>.

#### NORTH GLENHAVEN

The 130 hectare area, made up of separate land holdings is located north of Glenhaven Road and west of Old Northern Road. There is the potential for a rezoning from rural to residential to open the path for development of approximately 1,620 houses<sup>3</sup>. While the Derriwong and North Glenhaven developments may happen, no approvals have been issued. The transport assessment for South Dural acknowledges their potential, but has not included them specifically in future trip forecasting. The North Kellyville Precinct, while further away, is approved and has been included in the assessment.

### 3.5 Consultation

The rezoning of the South Dural area is being managed by APP Corporation Pty Limited, on behalf of the South Dural Resident and Ratepayers' Association, including the Folkestone-Lyon Joint Venture as the lead proponent. As part of the planning proposal covering this rezoning application, consultation has been held with several NSW Government agencies and local councils on matters regarding the transport needs and impacts of the development:

- From an overall planning perspective, Hornsby Shire Council and the NSW Department of Planning and Education have provided oversight of the process.
- From a transport perspective, several discussions have been held with Transport for NSW and Roads and Maritime Services to agree an overall transport strategy for the site, and to agree the method of assessment of the transport impacts of the development.
- As the development is located adjacent to the border of Hornsby Shire Council and The Hills Shire Council, this Council has also been consulted to identify any planned road changes or other developments that should be taken into consideration as part of this assessment.

Minutes of meetings held with these agencies on the transport aspects of the site are included in Appendix E.

<sup>2</sup> NSW Department of Planning and Environment Growth Centres Commission website

<sup>3</sup> <http://2156landowners.com.au/home/north-glenhaven-precinct-proposal-hills-council/>

## 4 Proposed development

This planning proposal is submitted to Hornsby Shire Council (Council) in support of an amendment to the Hornsby Local Environmental Plan (LEP) 2013 to rezone a 240 hectare and parcel of land comprising of 135 allotments with frontages to New Line Road, The Old Northern Road and Hastings Road in Dural for residential purposes. The proposed new community will consist of approximately 2,900 new dwellings, active and passive open space, managed riparian corridors together with new roads and infrastructure.

The development has been divided into villages to enable a staged development. It is envisaged that masterplans would be developed for each precinct, which would guide the form of development, including the location of higher density, and details such as the road dimensions and layout. It is envisaged that the new residents would make use of surrounding retail and community facilities such as the Round Corner village centre and surrounding schools.

### DEVELOPMENT AREA

The South Dural site is divided by Georges Creek and its riparian corridor. The proposed development reserves the riparian corridors and areas on the site with high ecological value. As a result, the majority of development is planned adjacent to Old Northern Road and New Line Road, and along the existing local roads – Wayfield Road and Franlee Road.

Figure 4.1 shows the indicative layout plan, including the developable area, reserved ecological areas and significant internal roads.

### ROAD ACCESS

Given the topography and impact on the riparian corridor that new roads would have, access is proposed from the arterial roads without any vehicle access across the site from one side to the other. Development would gain access from local streets, reducing the impact on the arterial roads.

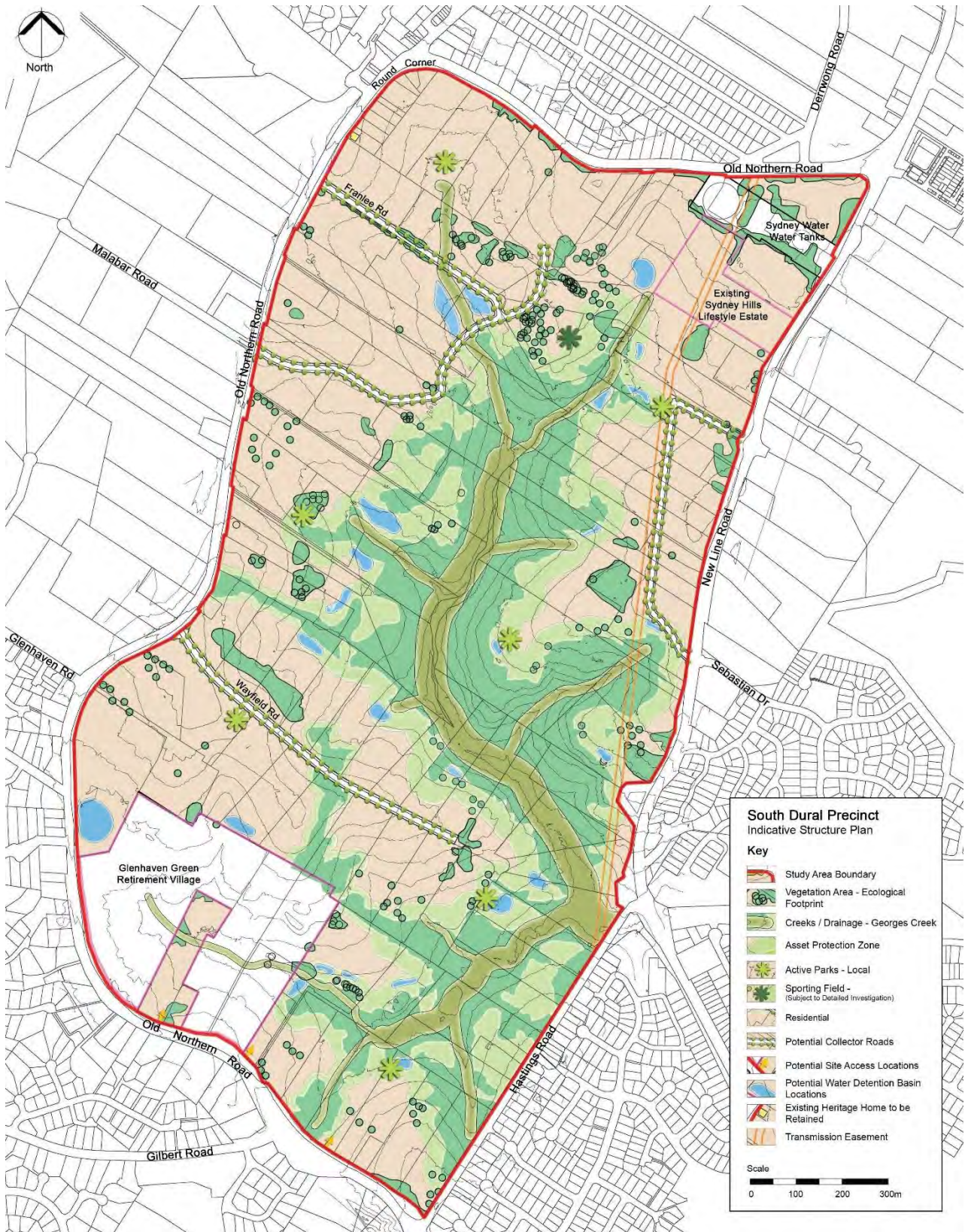
- The North West and Mid-West villages would gain access from Old Northern Road at a new road opposite Malabar Road, and via the existing Franlee Road.
- The Southern village would gain access via the existing Wayfield Road. The Hills Shire Council has advised that the proposed layout of the signalised intersection of Old Northern Road and Glenhaven Road could accommodate a fourth approach from the Southern village. However, this would affect an area with ecological value.
- The South East village is split into two areas. Local roads would provide access to Old Northern Road. However, it is planned that these intersections would not interrupt flow on Old Northern Road.
- The Eastern village would have access to New Line Road. A connection is proposed as a fourth (west) approach to the signalised intersection of New Line Road and Sebastian Drive, as well as a fourth (west) approach to the two-lane roundabout giving access to 252 New Line Road (including the Dural Bunnings Warehouse).

Other local accesses may be required to small lots within the area that are not covered by these road connections. These accesses would be in the form of left-in/left-out accessways.

### DEVELOPMENT YIELD

A preliminary assessment of the potential yield resulting from the rezoning has been made for the purposes of the Planning Proposal. The proposed development yield, based on the indicative layout plan, is shown in Figure 4.2, and is detailed in Table 4.1.





Source: Design IQ, 2016

Figure 4.1 South Dural indicative structure plan

**Table 4.1 Proposed South Dural development yield**

Village	Apartments	Houses	Total dwellings
North West	286	630	916
Mid-West	89	187	286
Eastern	262	365	627
South East	53	158	211
Southern	215	490	705
Total	905	1,840	2,745

Source: APP Corporation, 2016

The proposed allotment sizes are relatively small. This is expected to limit the size of the dwellings that can be constructed, resulting in fewer residents and less space for garages compared to dwellings on larger block sizes. The North West and Mid-West villages have average lot sizes of 350 m<sup>2</sup>, while the Eastern, Southern and South East villages would have an average lot sizes of 282 m<sup>2</sup>.

For the purposes of this transport assessment, and to be consistent with previous planning proposals for the site, the number of dwellings is assumed to be a total of 2,900. This is assumed to comprise:

- One, two and three bedroom apartments – Approximately 1,050; and (assumed 5% are 3 bedroom)
- Dwellings on small allotments – Approximately 1,850; average 282 m<sup>2</sup>.

In addition, the following assumptions have been made about the proposed residential development:

- 50 of the 1,050 apartments will have 3 bedrooms
- 400 of the 1,850 of the allotments will be constructed in the form of attached town houses.

## STAGING

The development is to be constructed in stages, potentially starting with the North West village, due to its consolidated land ownership and proximity to the existing town centre at Round Corner. Planning for the staging of the South Dural development is still in a preliminary state. However, current estimates are based on first lots being released mid-way through 2019 and proceeding at approximately 200 lots per year with completion by 2033. The approximate milestones are outlined in Table 4.2. The impact of the development has been assessed at 2026 (partially complete) and 2036 (100% complete).

**Table 4.2 Assumptions of staging for traffic modelling purposes**

Year	Cumulative lots	Comments
2018	0	Construction
2024	1,100	North West Precinct complete
2025	1,300	Mid-West Precinct complete
2029	2,100	Southern Precinct commenced
2030	2,300	South East Precinct complete
2033	2,900	Eastern Precinct complete

Source: APP Corporation, July 2016



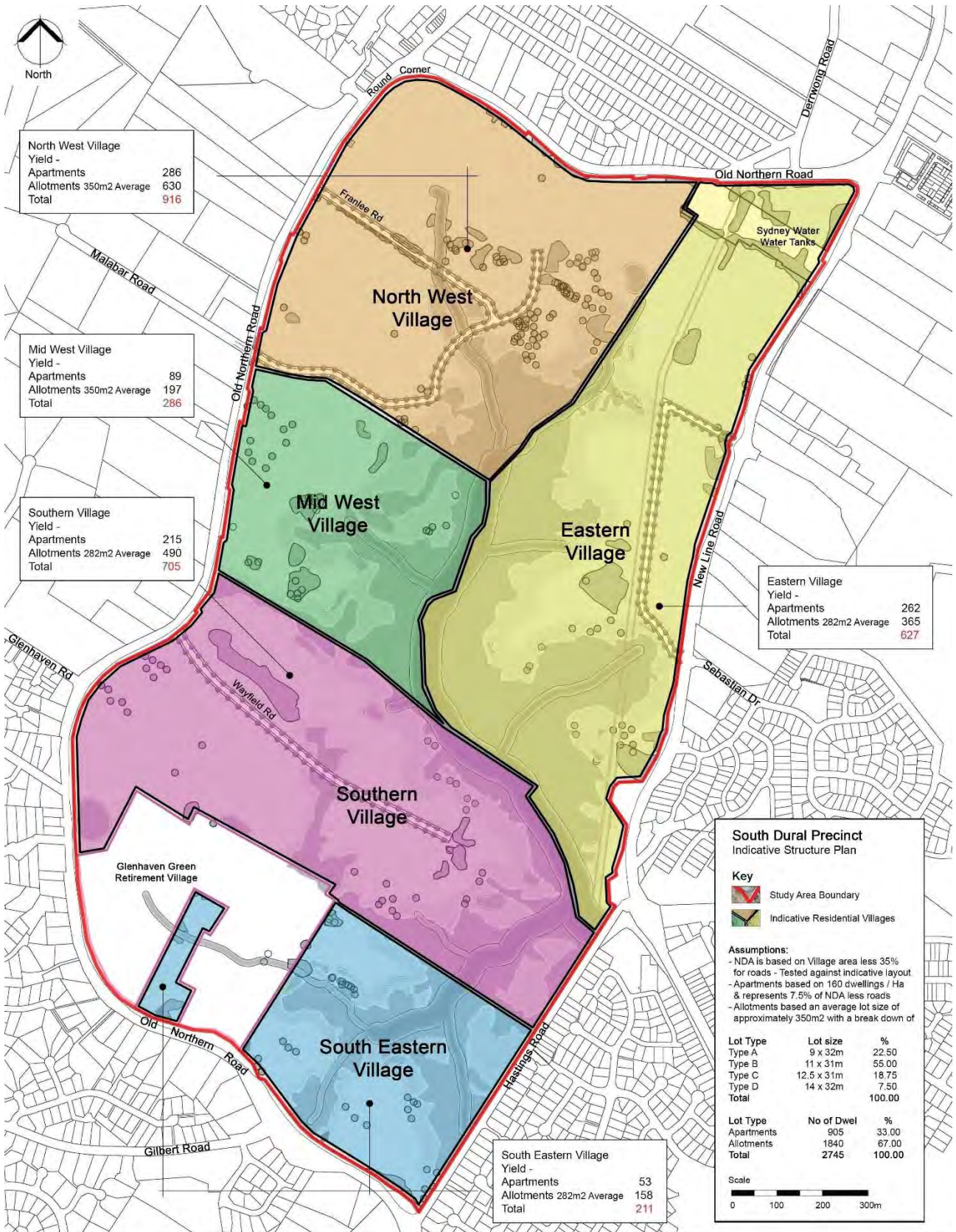


Figure 4.2 South Dural potential yield by village

## 5 Transport impact

The residential development will result in an increase in trips over the existing land uses. This section estimates the amount of additional travel and assesses its impact on the transport network.

### 5.1 Trip generation

#### APARTMENTS

The trip generation rate adopted for this study for the new medium density apartments are based on the rates published in Roads and Maritime Services *Guide to Traffic Generating Developments (Version 2.2, October 2002)*. These rates have been converted to person trips assuming a mode share of 59% daily car driver for all trip purposes based on Transport for NSW's Household Travel Survey (HTS) 2012/13 results for The Hills Shire<sup>4</sup> local government area (LGA) and 62% peak hour car driver trips for all trip purposes (assuming a 50% work-related travel during the peak hour).

#### TOWNHOUSES AND FREESTANDING HOUSES

The South Dural development is anticipated to have relatively small lots which limits the size of dwelling possible on the land and its traffic generating potential. Traffic generation rates for houses and townhouses have been estimated using the data for Low Density Residential from Roads and Maritime Services *Technical Direction TDT13/04a Guide to Traffic Generating Developments Updated traffic surveys*.

The rate applied is based on the surveyed traffic generation for the nearby suburb of Beaumont Hills, with an adjustment of 75% applied to reflect the predominantly three bedroom dwellings to be built at South Dural (compared to four or more bedrooms in Beaumont Hills).

Due to the residential-only land use within the development, an adjustment for lower levels of internal trip containment has been made (additional 10% in the AM and PM peaks, 25% across the day). A lower increase for internal trip containment is applied for the AM and PM peaks, as many local trips (e.g. to local shops) can be re-timed to out of the peak traffic periods.

The resulting trip rates are shown in Table 5.1.

**Table 5.1 Estimated trip generation rates for apartments**

Apartment size	Vehicle trips			Person trips (All modes)		
	AM peak hour	PM peak hour	Daily	AM peak hour	PM peak hour	Daily
1 and 2 bedroom apartments	0.45	0.45	4.5	0.73	0.73	7.7
3 bedroom apartments	0.55	0.55	5.5	0.89	0.89	9.4
Houses	0.99	0.92	8.9	1.60	1.48	13.9

<sup>4</sup> Site is within Hornsby Shire Council area, on the border with The Hills Shire Council. Given the higher level of access to rail for Hornsby Shire, Data for The Hills Shire was considered more representative for the Study area.



## MODE SHARE CHANGE

The good levels of access of the South Dural area to bus services in the future, with access to the NorthWest Metro Line, plus the plans for improved pedestrian and cycle facilities to Castle Hill is expected to result in lower levels of car usage than the existing semi-rural residences. The estimated future mode share are shown in Table 5.2 for work and other purposes.

The adopted mode share covers both apartments and houses. Overall the improved transport options are estimated to result in a 7% reduction in car driver mode share during the AM and PM peaks compared to the existing rural-residential area. The estimated future mode shares shown in Tables 5.2 assume that work-related trips will experience the largest change due to the public and active transport infrastructure and service improvements.

**Table 5.2 Existing and estimated future transport by trip purpose**

Transport mode	Existing JTW	Other purposes	Work related
Vehicle driver	82%	51%	75%
Vehicle passenger	6%	30%	5%
Train	3%	2%	6%
Bus	6%	6%	11%
Walk	1%	12%	2%
Cycle	1%	2%	1%
<b>Total</b>	100%	100%	100%

The percentages of each purpose in the AM, PM and daily periods, corresponding to the work-related and other purposes mode shares are shown in Table 5.3.

**Table 5.3 Proportion of work-related and other purpose trips by time period**

	AM peak	PM peak	Daily
Work related	46%	32%	32%
Other purposes	54%	68%	68%

## ESTIMATED NUMBER OF TRIPS BY MODE

The resulting number of trips by mode by time period for the development is shown in Table 5.4.

**Table 5.4 Estimated South Dural trip generation by mode – full development**

Transport mode	AM peak hour	PM peak hour	Daily
Vehicle driver	2,300	2,180	19,820
Vehicle passenger	730	680	8,060
Train	110	120	700
Bus	260	270	2,100
Walk	250	260	2,800
Cycle	40	40	350
<b>Total</b>	3,690	3,550	33,830

## DIRECTIONAL SPLIT

The assumed directional split for the residential development are shown in Table 5.5.

**Table 5.5 Proportion of work-related and other purpose trips by time period**

In/Out	AM peak	PM peak	Daily
Trips in	20%	70%	50%
Trips out	80%	30%	50%

## ESTIMATED TRAFFIC VOLUMES BY VILLAGE AND YEAR

The traffic volumes in and out of each village in the two modelling years are shown in Table 5.6.

**Table 5.6 Estimated traffic volumes by precinct and modelling year**

Village	Development at 2026 (1,500 dwellings)				Full development (2,900 dwellings)			
	In	Out	In	Out	In	Out	In	Out
North West	160	630	510	210	160	630	510	210
Mid West	50	190	160	70	50	190	160	70
Eastern	0	0	0	0	100	400	340	140
South East	0	0	0	0	40	140	120	60
Southern	40	150	130	50	120	480	400	170
<b>Total</b>	<b>250</b>	<b>970</b>	<b>800</b>	<b>330</b>	<b>470</b>	<b>1,840</b>	<b>1,530</b>	<b>650</b>

## TRIP DISTRIBUTION

Trip distributions were estimated based on the existing Journey to Work trip distributions and first principles assumptions for other purposes. The same directional split has been applied to the traffic generation for the Study Site and adjacent development. The directional split is summarised in Table 5.7.

**Table 5.7 Breakdown of direction of travel to/from the site**

Direction	Percentage of commuter trips	Percentage of non-work trips
North (including Dural and Wisemans Ferry)	10%	10%
North East (including Hornsby)	4%	4%
North West	2%	3%
Round Corner	15%	22%
East (including Ku-ring-gai)	5%	5%
West (including Blacktown)	10%	8%
South East (including Sydney CBD, Ryde, Chatswood, North Sydney)	18%	14%
South West (including Norwest, The Hills Shire)	15%	13%
South (including Parramatta, Auburn)	20%	23%
<b>Total</b>	<b>100%</b>	<b>100%</b>

## 5.2 Walking

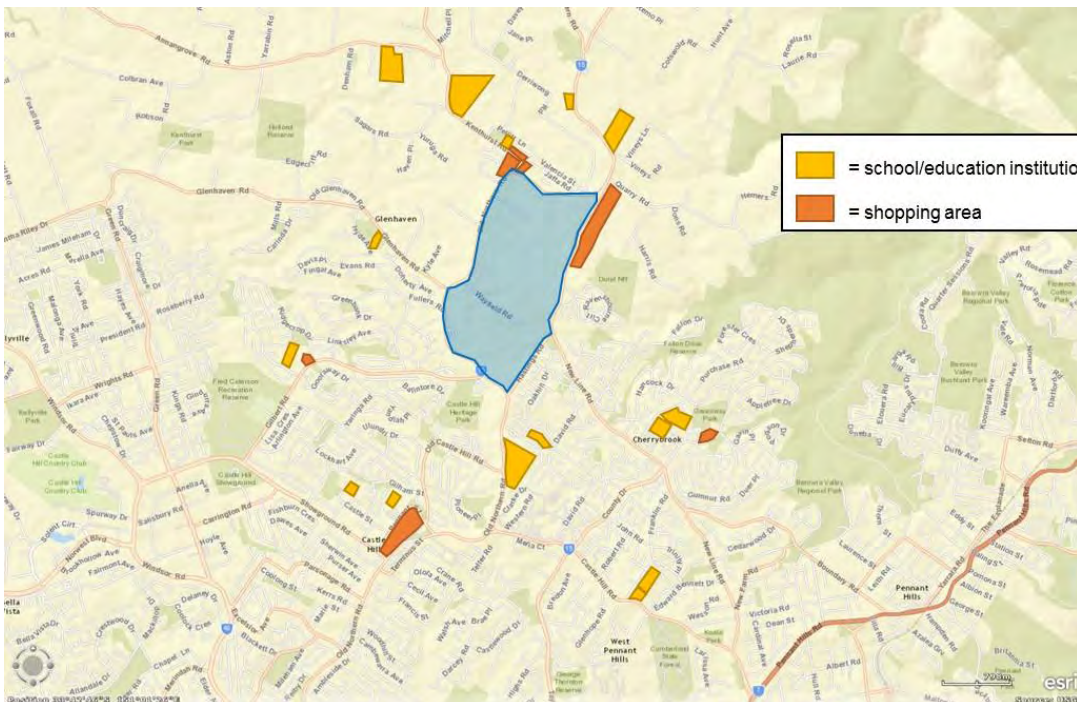
The proposed rezoning and residential development will significantly increase the amount of walking in the area compared to its current rural-residential land use. The current pedestrian facilities (mainly consisting of shared footpath/cycle path on the western side of Old Northern Road) will need augmentation to cater for this increase.

As the population of residents within the development increases, convenient pedestrian paths will become increasingly important. Whilst there is insufficient detail on the development structure to plan the internal pedestrian links at this stage, the following principles are proposed to maximise the walkability of the area:

- Focus walk links on key nodes such as signalised road crossings, the Round Corner village centre and bus stops.
- Provide safe crossing locations along Old Northern Road and New Line Road.
- Increased footpath provision within all areas, including both sides of street on key pedestrian connections and at least one side of the remaining streets.
- Reduce the separation impact of the riparian corridor by providing off-road walking and cycling paths between villages.

The pedestrian demand of the proposed South Dural development will be comprised of three key types of short trips:

1. Walking trips by residents to nearby shops which are outside the development area but located at the North West (i.e. Round Corner) and Eastern side along New Line Road (see Figure 5.1).
2. Walking trips by students to nearby schools (see Figure 5.1).
3. Walking trips to bus stops as the mode of access to bus services.



**Figure 5.1** Locations of nearby schools and retail areas

All three types of trips will increase the demand for safe pedestrian movement across Old Northern Road, New Line Road and Hastings Road. Currently, the only signalised crossings are located at the intersections of Old Northern Road with Hastings Road, Gilbert Road, Blue Gum Drive and Kenthurst Road, and the intersection of New Line Road and Sebastian Drive. This leaves large gaps where these arterial roads present a barrier to safe pedestrian movement.

Planned and proposed intersection upgrades will address some of the gaps at Glenhaven Road, Wayfield Road and Malabar Road. Considering the recommended position of bus stops (see section 5.4), additional crossing facilities will be required.

The recommended improvements to pedestrian facilities are shown in Figure 5.2 and are listed in Table 5.8.

**Table 5.8 Recommended improvements to pedestrian facilities**

Facility	Locations
Crossing facilities	<ul style="list-style-type: none"> <li>→ New refuge (or signalised pedestrian crossing) on:               <ul style="list-style-type: none"> <li>▪ Old Northern Road near the Lorien Novalis School</li> <li>▪ Old Northern Road at Franlee Road</li> <li>▪ Old Northern Road near the bend between Kenthurst Road and Derriwong Road; and</li> <li>▪ New Line Road north of the 252 New Line Road roundabout.</li> </ul> </li> <li>→ Pedestrian crossing facilities at newly signalised intersections:               <ul style="list-style-type: none"> <li>▪ Old Northern Road and Glenhaven Road</li> <li>▪ Old Northern Road and Wayfield Road</li> <li>▪ Old Northern Road and Malabar Road</li> <li>▪ Old Northern Road and New Line Road.</li> </ul> </li> <li>→ Add pedestrian crossing facility to the existing traffic signals at the intersection of New Line Road and Hastings Road, across the Hastings Road approach.</li> </ul>
Footpaths	<ul style="list-style-type: none"> <li>→ Along the South Dural development side of Old Northern Road and New Line Road around the boundary roads are proposed to provide continuous footpath</li> <li>→ Provide footpaths within the five villages on:               <ul style="list-style-type: none"> <li>▪ both sides of street on key pedestrian connections and areas with apartments; and</li> <li>▪ at least one side of all other local streets.</li> </ul> </li> </ul>
Off-road paths	<ul style="list-style-type: none"> <li>→ Provide paths (unsealed when passing through riparian corridors) between the:               <ul style="list-style-type: none"> <li>▪ North West and Eastern villages</li> <li>▪ Southern and Mid-West villages</li> <li>▪ Southern village and the recreational facilities (including tennis courts) to the south of the intersection of New Line Road and Hastings Road; and</li> <li>▪ Various areas of the South East village.</li> </ul> </li> </ul>



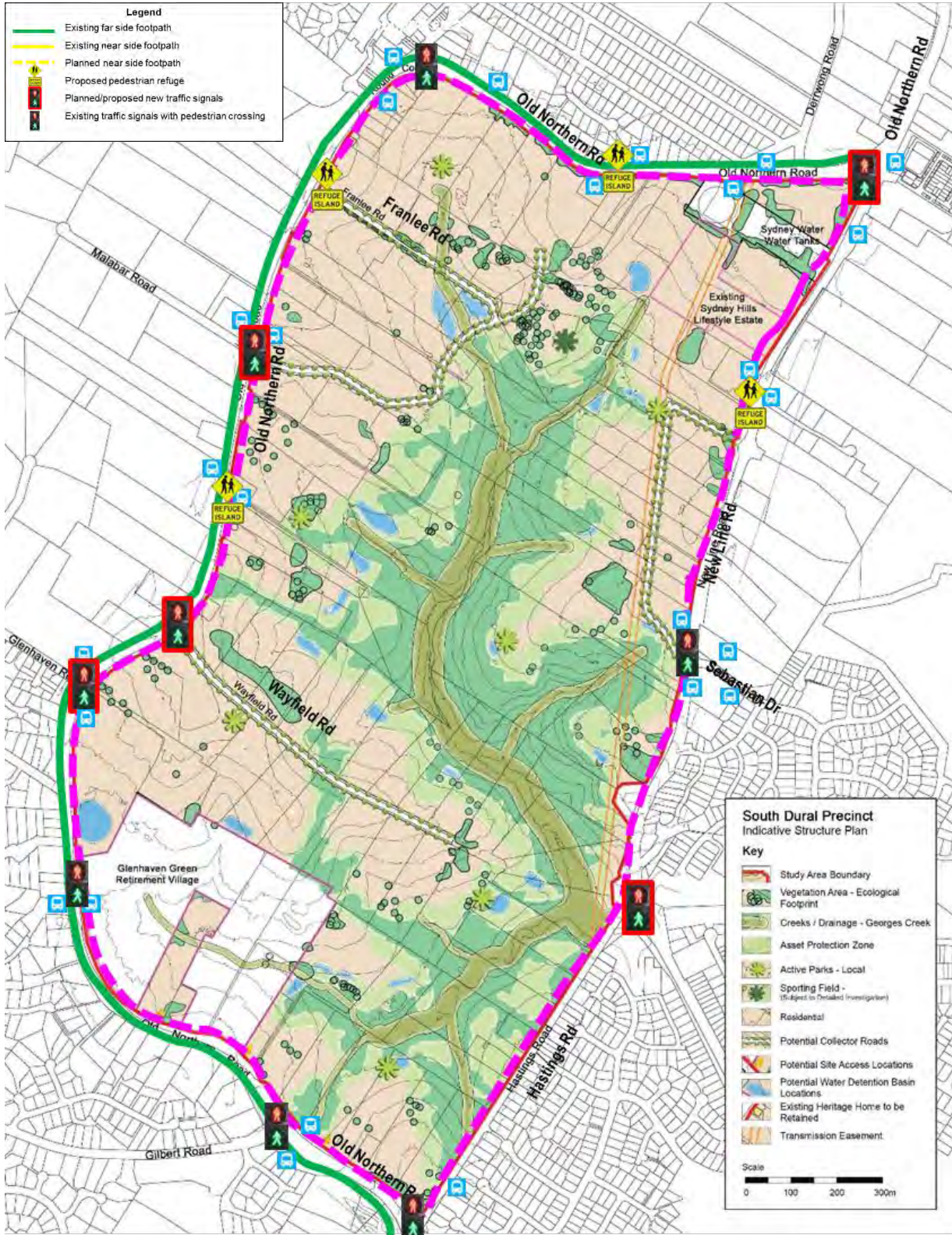


Figure 5.2 Proposed footpath and signalised crossings along boundary roads



## 5.3 Cycling

The major destination for cycle trips from the development is expected to include:

- Castle Hill strategic centre – for employment, education, and NorthWest Metro Line connections;
- Round Corner – for local shopping;
- Surrounding schools – for education; and
- Off-road recreation.

The current level of facilities for cyclists is low. There is the opportunity to improve local cycle facilities in line with Hornsby Shire and The Hills Shire bike plans as part of the upgrades proposed for the South Dural development. Key pedestrian corridors through the South Dural area should also provide local cycle routes to focus cycle movements at safe crossing locations, provide greater permeability for cycle movement (compared to car movement) and improve connections to public transport.

The recommended improvements include:

- Incorporate cycle facilities (either as kerbside lanes or a widened shared pedestrian path) as part of the proposed road widening of Old Northern Road and New Line Road (see section 5.5).
- Design the off-road paths listed in Table 5.8 as shared pedestrian and cycle recreational paths.
- Provide bicycle parking and visitor bicycle parking as per the recommended parking rates discussed in section 6.

## 5.4 Public transport

### RANGE OF DESTINATIONS

The bus routes on Old Northern Road and New Line Road already provide connections to the major destinations for future bus trips – i.e. Castle Hill, Sydney CBD, North Sydney, Macquarie Park, etc. (via the M2 Motorway). However, it is noted that there is a bias for Castle Hill services on Old Northern Road and M2 Motorway bus services on New Line Road. While the off-road paths will provide some connection between the South Dural villages, they have limited usefulness for time-conscious commuter trips. Interchange opportunities are required to enable both the eastern and western sides of South Dural to get access to both the Castle Hill and M2 Motorway services.

Route 637, 638 and 639 currently operate to Pennant Hills during the AM and PM peaks. However, bus routes will be reviewed prior to the opening of the NorthWest Metro. With the opening of the NorthWest Metro, the Old Northern Road buses to Castle Hill will offer the opportunity to transfer to the frequent citybound metro rail service, as well as services in the opposite direction to the Norwest strategic centre. Route 644 connects the New Line Road side of the development to Castle Hill. However, its frequency is low.

The South Dural site is located within a short bus ride of Castle Hill and Cherrybrook Stations. Bus services from the study area that connect to the future NorthWest Line stations include:

- Castle Hill Station: Routes 603, 637, 638, 639 and 644
- Cherrybrook Station: Route 642 (useful for New Line Road development).

## INCREASE IN PUBLIC TRANSPORT TRIPS

The proposed development is estimated to generate:

- Approximately 100 additional train (and metro) trips in the AM and PM peaks; and
- 250 to 270 additional bus trips in the AM and PM peaks.

It is anticipated that a number of the train and metro passengers may choose to use the bus services to get to Castle Hill or Cherrybrook Stations (assuming a high frequency bus service). This could increase the number of bus passengers to approximately 350.

## RECOMMENDED IMPROVEMENTS TO BUS SERVICE FREQUENCY

Bus service levels are set by Transport for NSW, who monitor bus patronage and develop service plans for future changes in bus patronage from land use changes. Assuming that all of the train passengers use the bus service to get access to the Metro stations, the potential increase in bus passengers have been overlaid on the existing bus network to estimate the potential need for new services.

A typical bus capacity of 50 passengers has been assumed. It has been assumed that all services are operating close to their capacity somewhere along their route and therefore there is no spare capacity for the additional trips generated by the South Dural development.

The additional bus trips generated by the development have been divided between the Old Northern Road corridor (North West, Mid-West, Southern and South East Precincts) and the New Line Road corridor (Eastern Precinct). The results indicate the need for an additional six services on the Old Northern Road corridor and an additional two services on the New Line Road corridor. These recommendations do not consider increases in bus passengers from other areas.

Recommendations for service level increases at full development are outlined below.

1. The Old Northern Road bus routes (637, 638 and 639) increase from a 30 minute frequency to a 15 minute frequency in the peak direction during the peak period – an increase of six services.
2. An additional two services per hour in the peak direction during the peak period on one or more of bus routes 620N, 620X, 622, 642 or 642X.
3. Improve Route 644 to a 15 minute frequency in the peak direction during the peak period.
4. Increase service levels during non-peak times – i.e. during the middle of the weekday, in the evening and on weekends.

Due to the anticipated staging of the development, it is likely that the Old Northern Road corridor would be impacted earlier than the New Line Road corridor, making improvements 1 and 4 a higher priority.

## BUS INFRASTRUCTURE

Bus stops are typically located at a spacing of approximately 400 m<sup>5</sup> to maintain a balance between walkable access and service efficiency. Old Northern Road currently has 14 bus stops within 4.4 km – i.e. 300 m between bus stops with mainly low density residential/rural residential land use. However, spacings of 150 m to 200 m exist. Many of these bus stops only comprise a bus stop plate bolted onto a power pole, and do not include facilities such as shelter and seating that makes for a more amenable experience for passengers whilst waiting for the bus.

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<sup>5</sup> Sydney's Bus Future (Transport for NSW, 2013)

Recommendations to consolidate the number of bus stops, relocate them to more favourable locations, and improve their facilities have been developed to match the additional residential development and increased number of passengers. The proposed future location of bus stops along with their approximate spacing is shown on Figure 5.3. The recommended additional bus infrastructure is listed below:

- Eight new bus shelters with seating and a bicycle rack.
- Three new bus stops U-Stems (where the stop is more likely to be used for set-down and passengers would not be waiting for long periods).
- Three new pedestrian refuges to provide a safe crossing opportunity where the stop is not located near existing of future planned traffic signals.

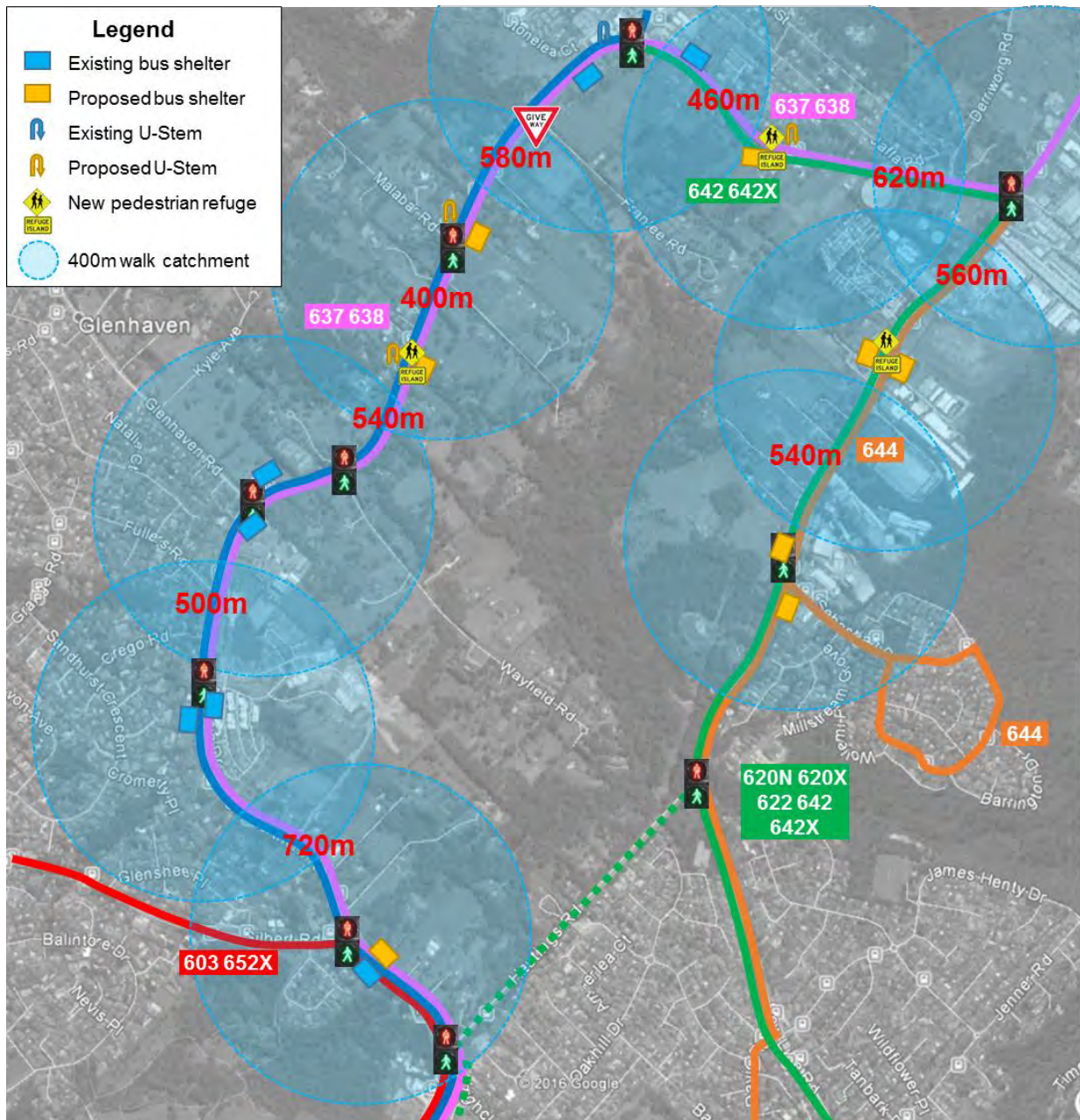


Figure 5.3 Proposed bus network and stop locations

The majority of the site is covered within the 400 m walk catchment of the proposed bus stop locations. The exception is the eastern end of Wayfield Road (in the Southern Precinct) which is located approximately 1 km from the bus stops. The diversion of one of the Old Northern Road routes (or the extension of another route) could be considered by Transport for NSW in the future to improve the accessibility of this area to bus services.

## 5.5 Traffic modelling

For the purposes of undertaking a traffic assessment of the South Dural area, Transport for NSW supplied an Aimsun mesoscopic traffic model, originally developed to assess traffic impacts resulting from additional development along the NorthWest Metro Corridor. While the model was in development, a preliminary assessment of future traffic conditions using assumed traffic growth and SIDRA intersection models was used to guide the inputs for the Aimsun model.

### 5.5.1 Preliminary assessment

A preliminary analysis was undertaken using SIDRA Intersection modelling and spreadsheet assessment of road capacities using assumed capacities, to provide preliminary estimates for potential road network upgrades. The models used traffic data from 2016 traffic surveys and future growth estimates calculated from recent strategic transport models and historical growth:

- 2016 to 2021: 1.4% p.a. in the AM peak and 1.8% p.a. in the PM peak
- 2021 to 2031: 1.3% p.a. in the AM peak and 1.4% p.a. in the PM peak.

The assessment calculated trip generation based on 3,055 dwellings for South Dural, with adjustments applied to reduce this down to 2,900. It also assumed a higher proportion of apartments within the development compared to houses (56% apartments compared to the currently proposed 36%), which would generate fewer trips.

Trip generation rates were based on an initial understanding of the development, which assumed that there would be a mixture of local land uses within the development, and hence did not apply the internal trip containment factor. The trip generation assumed a rate between a low-density and medium density developments, due to the size of the houses that can be accommodated in the small lots proposed for the development (larger reduction than assumed for this analysis). It also assumed a lower mode share for car driver trips and a different in/out split assumption in the PM peak. The overall trip generation was approximately 1,640 vehicles in the AM and PM peaks, approximately 29% lower in the AM peak, than the estimates outlined in Section 5.1 and 25% lower in the PM peak.

Other differences included a slightly different access arrangement and the inclusion of an internal connection between north-west and north-east areas of the development.

The preliminary analysis indicated that the majority of road links bordering the site were at or just below their capacity. It found that some road sections would already meet the criteria for road upgrades based on current traffic volumes, while many others can only support a small amount of background traffic growth. The South Dural development would potentially bring forward the upgrade of links that currently have more spare capacity, such as Old Northern Road south of Kenthurst Road. A summary of the road upgrades and indicative timings, based on the preliminary assessment, is:

- Old Northern Road between Kenthurst Road and New Line Road – within the next 3 years
- Old Northern Road from Glenhaven Road to Kenthurst Road – as development in this precinct develops
- Old Northern Road from Gilbert Road to Glenhaven Road – within the next 3 to 4 years for southbound, as development in this precinct develops for northbound



- Old Northern Road south of Gilbert Road – within the next 3 years
- New Line Road from Old Northern Road to Sebastian Drive – within the next 3 years
- New Line Road from Sebastian Drive to Hastings Road – as development in this precinct develops
- New Line Road from Hastings Road to James Henry Road – within the next 4 to 5 years.

Intersection upgrades in addition to the road upgrades were tested for the 2031 Future Base and 2031 with South Dural development scenarios. Excluding intersection upgrades to provide access to the South Dural development, intersections requiring additional upgrades in the preliminary assessment included.

- Old Northern Road and Hastings Road
- Old Northern Road and Gilbert Road
- Old Northern Road and Glenhaven Road
- Old Northern Road and Kenthurst Road
- Old Northern Road and New Line Road
- New Line Road and Hastings Road.

### 5.5.2 Transport for NSW consultation

During the time the North West Metro Aimsun model was being developed, consultation was undertaken with Transport for NSW regarding the trip generation assumptions for the South Dural development. During this consultation, Transport for NSW expressed the opinion that the traffic generation rates for the residential development could be higher than those originally assumed for the development.

At a meeting in May 2016, in principle comments were provided by Transport for NSW that trip generation rates based in-part on the medium density rate were not appropriate for freestanding house residential development in the location proposed. As a consequence, trip generation rates were revised to be based solely on the low density traffic generation rate. This resulted in an increase in the number of trips for houses within the development. These revised rates were documented and provided to Transport for NSW at a meeting on 16 June 2016 to confirm the appropriateness of the rates for input into the Aimsun model prior to the modelling of the development being undertaken. Comments were provided by Transport for NSW on the revised trip generation calculations on 5 August 2016, including:

- The position of the South Dural area north of the existing residential areas north of Castle Hill would result in higher traffic generation due to the distance to a range of services, schools, shopping and employment.
- Traffic generation data for the nearby suburb of Beaumont Hills indicated a higher generation rate. While the size of dwellings in Beaumont Hills is higher, the reduction in trip numbers is not directly proportional to car ownership or lot size.

The trip generation rates assumed had been based on assessment of trip generation rates at a number of sites around Sydney to reflect anticipated future changes in travel behaviour as the South Dural area is developed over time. It is noted that when the Beaumont Hills area was developed, public transport service levels were significantly lower, resulting in higher private car use, as opposed to the South Dural development which will be within reasonable proximity to the NorthWest Metro. The block sizes in Beaumont Hills are typically 600 m<sup>2</sup> to 800 m<sup>2</sup> – approximately 250% to 300% of what is proposed for South Dural, providing more space for off-street parking and wider lot frontages for garages.



To provide a conservatively high assessment of the potential traffic generation for the South Dural development with which to assess its impact on the road network, the recommended Transport for NSW trip generation rates have been adopted for this assessment. It is worth noting that they represent a 12% increase in the traffic generation rates compared to the revised rates provided in June.

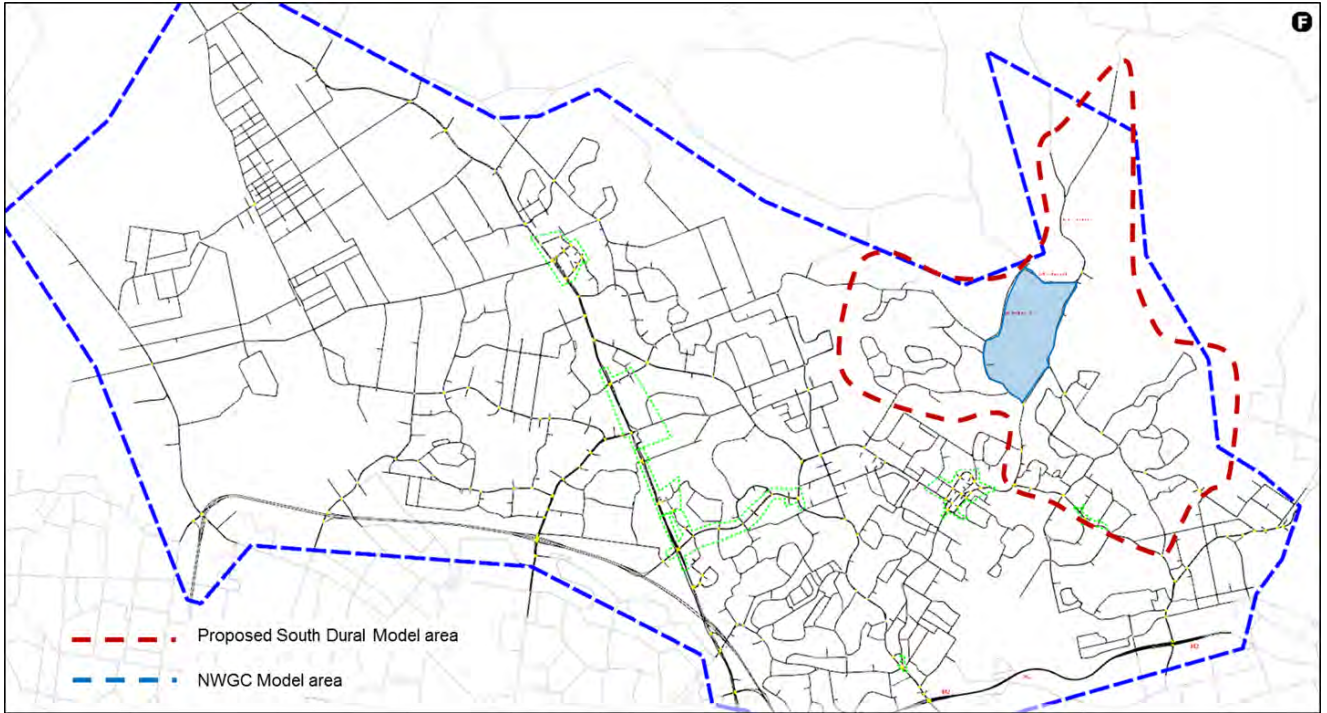
The consultation with Transport for NSW also resulted in agreement to the trip distribution for the South Dural development (as outlined in Table 5.7) and the methodology for using the Aimsun traffic model, supplied by Transport for NSW, outlined in section 5.5.3.

### 5.5.3 Agreed road network modelling process

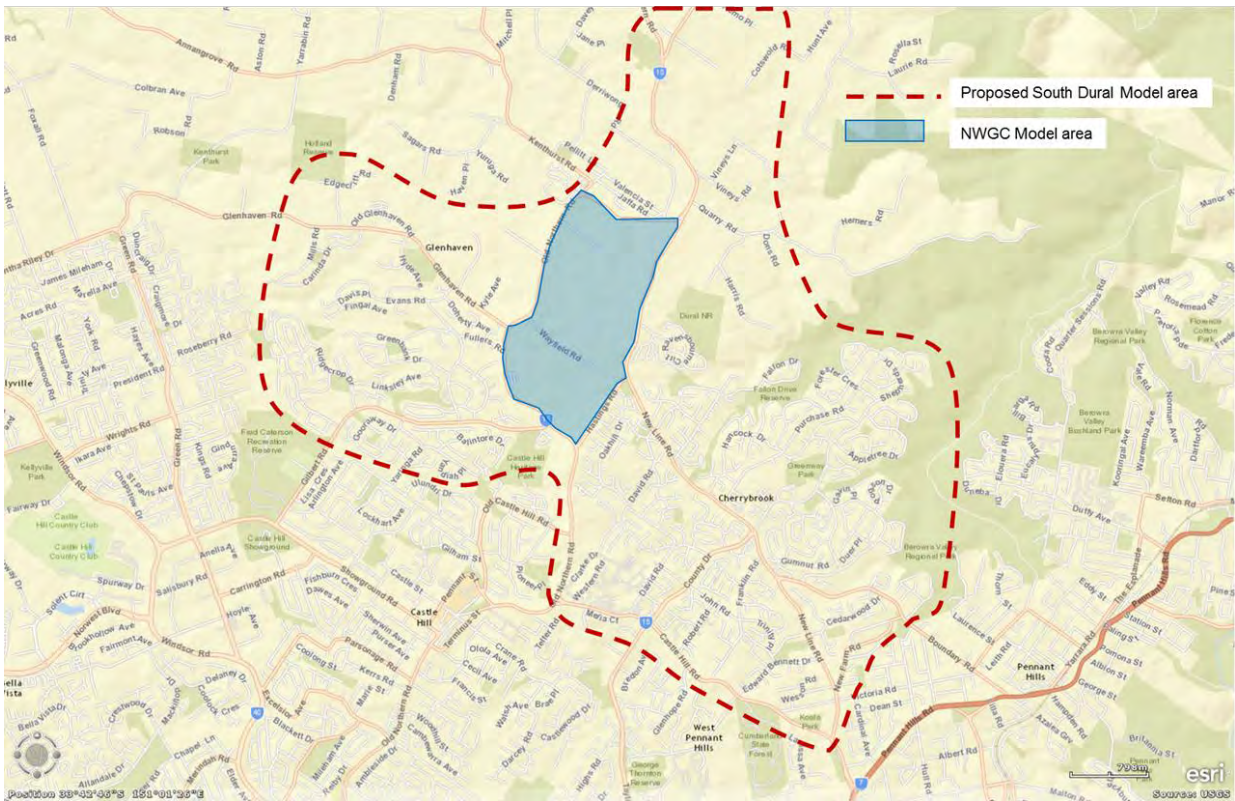
As the NorthWest Metro Corridor model was developed to assess a larger area, the Aimsun model was modified for use to assess the South Dural development using a process agreed with Transport for NSW. The process included:

1. **Model familiarisation.** This included running some of the supplied model scenarios to confirm all files needed to run the model for South Dural were correctly identified.
2. **Trip distribution.** The trip distribution for the South Dural area in the AIMSUN model was checked against that from the JTW and HTS data, as well as the first-principles assessment. It was agreed to use the trip distribution shown in Table 5.6 for the additional traffic generated by the development only.
3. **Model cut.** The NorthWest Metro Corridor model covers a wide area, the majority of which is not relevant to the South Dural study and is affected by traffic congestion. To avoid the assessment of traffic conditions around South Dural from being affected by other traffic congestion, it was agreed to make a cut of the model at the boundary shown in Figure 5.4, where route choice is essentially fixed.
4. **Future base.** Adjustments were made to the smaller South Dural area to include more detail relevant to the study. This included:
  - a) Adding Sebastian Drive and splitting the zone covering Sebastian Drive to get traffic on the street at the right level.
  - b) Splitting the zones within the existing South Dural area to ensure that its traffic is loading in a representative way.
5. **Add the South Dural Development.** New zones were coded to represent the villages in the South Dural development and internal roads for the South Dural Development for the 2026 and 2036 scenarios. The vehicle trip numbers shown in Table 5.6 were added to the 2026 and 2036 AM and PM peaks. Adjustments to traffic signal timings were made to accommodate the higher traffic volumes.
6. **Future with development scenarios.** The 2026 and 2036 AM and PM peaks with the future base plus the development were run to determine whether the preliminary assessment of road upgrades could adequately accommodate the development traffic.
7. **SIDRA Intersection models.** Confirm performance in previously developed SIDRA models.

The model boundary, shown in Figures 5.4 and 5.5, follows natural valleys - minimising the number of roads cut, while maintaining route choice for vehicles between Old Northern Road/Castle Hill Road and New Line Road. The route choice is essentially fixed at the other boundary roads proposed to be cut.



**Figure 5.4** Cut of the NorthWest Metro Aimsun model to cover the area surrounding the South Dural Development



**Figure 5.5** Model boundary for the South Dural development Aimsun model

### 5.5.4 Impact on road capacity

The North West Metro Aimsun model has been developed and calibrated for a base year of 2014, and future years including 2026 and 2036. These future years use growth forecasts from Transport for NSW's Sydney Strategic Travel Model (STM), which include projections of the location and magnitude of future changes in population and employment. For the South Dural land rezoning, they represent a 'without development' scenario.

The Aimsun model results for 2026 and 2036 without adding the South Dural development traffic were analysed to determine the impact on the road network of background traffic growth. For this analysis, the road capacities and maximum service flow thresholds shown in Table 5.9 have been assumed based on the method of analysis given in the Austroads Guide to Traffic Management and US Transportation Research Board's Highway Capacity Manual. The threshold between Level of Service D and E has been taken as the point at which a road section would be upgraded (at approximately 90% of full capacity).

**Table 5.9 Assumed road capacities**

Level of service	Urban divided/Undivided highways with clearways and signal coordination		Urban divided/Undivided highways with interruptions		Urban undivided collector	
	Volume to capacity ratio	Maximum service flow (veh/hr)	Volume to capacity ratio	Maximum service flow (veh/hr)	Volume to capacity ratio	Maximum service flow (veh/hr)
A	0.35	560	0.35	420	0.35	315
B	0.50	800	0.50	600	0.5	450
C	0.75	1,200	0.75	900	0.75	675
D	0.90	1,440	0.90	1,080	0.9	810
E	1.00	1,600	1.00	1,200	1	900
F	> 1.00	>1,600	> 1.00	> 1,200	> 1.00	> 900

Using the capacities above, the road network capacity for the 2016 existing situation, and 2026 and 2036 with and without the development are summarised in this section, with details presented in Appendix D.

#### CURRENT CAPACITY ISSUES

The analysis indicated that, in theory, sections of the road network will require upgrading in the near future. Some sections are currently operating in 2016 above the LoS E thresholds based on the 2016 traffic surveys. These include:

- Old Northern Road, west of New Line Road – eastbound
- Old Northern Road, east of Kenthurst Road – eastbound
- Old Northern Road, north of Hastings Road – northbound and southbound
- Old Northern Road, south of Hastings Road – southbound
- New Line Road, south of Old Northern Road – northbound and southbound
- New Line Road, north of Sebastian Drive – northbound and southbound
- New Line Road, south of David Road/James Henty Drive – southbound
- New Line Road, south of Boundary Road – northbound and southbound



- New Line Road, north of Victoria Road – northbound and southbound
- New Line Road, north of Castle Hill Road – northbound.

While the abovementioned road sections have been identified as being above the threshold for the existing situation, much of the rest of the road network is currently operating close to the capacity of the road. Future growth in traffic, from developments and background growth will be constrained by this road network capacity in the future unless upgrades are made to increase the capacity – i.e. widen to two lanes each way where required.

## FUTURE WITHOUT DEVELOPMENT

When the future growth forecast by the Aimsun model is added to the road network, the number of links at or over capacity increases. The southern sections of New Line Road that are one lane in each direction to Boundary Road, come under substantial pressure. The list of links over capacity in each of the assessment years are listed in Table 5.10. By 2036 the majority of the road network surrounding the South Dural development will require upgrading in one or both directions regardless of whether the development proceeds.

**Table 5.10 Progression of road widening required for 2016, 2026 and 2036 road networks without South Dural development**

2016	2026	2036
<ul style="list-style-type: none"> <li>→ Old Northern Road               <ul style="list-style-type: none"> <li>▪ west of New Line Road</li> <li>▪ east of Kenthurst Road</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>→ Old Northern Road               <ul style="list-style-type: none"> <li>▪ west of New Line Road</li> <li>▪ east of Kenthurst Road</li> <li>▪ south of Glenhaven Road</li> <li>▪ south of Blue Gum Drive</li> <li>▪ north of Gilbert Road</li> <li>▪ north of Hastings Road</li> <li>▪ south of Hastings Road</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>→ Old Northern Road               <ul style="list-style-type: none"> <li>▪ west of New Line Road</li> <li>▪ east of Kenthurst Road</li> <li>▪ south of Kenthurst Road</li> <li>▪ south of Franlee Road</li> <li>▪ north of Glenhaven Road</li> <li>▪ south of Glenhaven Road</li> <li>▪ south of Blue Gum Drive</li> <li>▪ north of Gilbert Road</li> <li>▪ north of Hastings Road</li> <li>▪ south of Hastings Road</li> </ul> </li> </ul>
<ul style="list-style-type: none"> <li>→ New Line Road               <ul style="list-style-type: none"> <li>▪ south of Old Northern Road</li> <li>▪ north of Sebastian Drive</li> <li>▪ south of David Road/ James Henty Drive</li> <li>▪ New Line Road, south of Boundary Road</li> <li>▪ New Line Road, north of Victoria Road</li> <li>▪ New Line Road, north of Castle Hill Road</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>→ New Line Road               <ul style="list-style-type: none"> <li>▪ south of Old Northern Road</li> <li>▪ north of Sebastian Drive</li> <li>▪ south of David Road/ James Henty Drive</li> <li>▪ New Line Road, south of Boundary Road</li> <li>▪ New Line Road, north of Victoria Road</li> <li>▪ New Line Road, north of Castle Hill Road</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>→ New Line Road               <ul style="list-style-type: none"> <li>▪ south of Old Northern Road</li> <li>▪ north of Sebastian Drive</li> <li>▪ south of Hastings Road</li> <li>▪ south of David Road/ James Henty Drive</li> <li>▪ New Line Road, south of Boundary Road</li> <li>▪ New Line Road, north of Victoria Road</li> <li>▪ New Line Road, north of Castle Hill Road</li> </ul> </li> </ul>

The number of links over capacity becomes substantial over time, requiring upgrading of a number of sections. The dominant flows are on Old Northern Road between Kenthurst Road and New Line Road, and down New Line Road to Boundary Road. Old Northern Road south of Glenhaven Road and Gilbert Road also experiences significant demand.



FUTURE WITH DEVELOPMENT

The traffic from the development places additional pressure on links around the network. In many locations around the network, this brings forward the need to upgrade the road by a year or more. In others, links that did not need upgrading before 2036 in the without development scenario do need upgrading. This includes the northbound direction on Old Northern Road for the sections: south of Kenthurst Road, south of Franlee Road and north of Glenhaven Road. The earlier development on the western side, affects Old Northern Road sooner than New Line Road. The only sections that do not appear to need to be upgraded include the sections that already have two lanes in one direction and:

- New Line Road, north of Hastings Road
- Hastings Road, between Old Northern Road and New Line Road.

Hastings Road is potentially wide enough to be marked as four lanes without the need for widening. From a network viewpoint, leaving New Line Road southbound between Sebastian Drive as the only link with one lane may not be desirable. However, the Aimsun model is indicating that its flow can be accommodated in its current configuration.

ROAD UPGRADES AND TIMINGS

The indicative year that the road links require upgrade is shown in Figure 5.6. The additional traffic from the development accelerates the need for the upgrading of a number of the road links in the area. These are highlighted in red text. The yellow line indicates road link that is required to be upgraded in the ‘with South Dural development’ scenario but not in the ‘without development’ scenario.

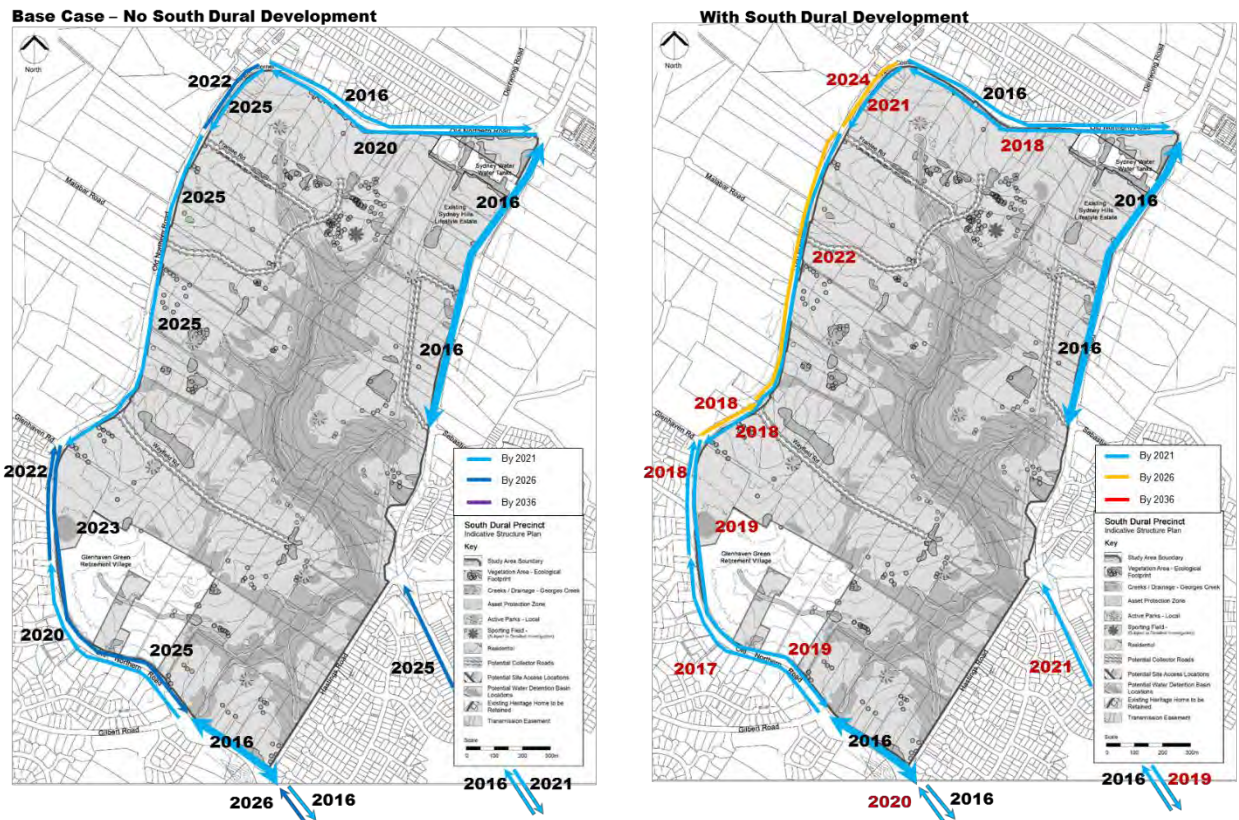


Figure 5.6 Comparison of road upgrades and approximate timings with and without the South Dural development

### 5.5.5 Impact on intersection performance

Intersection upgrades are required regardless of whether the South Dural Development proceeds. This includes the signalisation of the intersection of Old Northern Road and Glenhaven Road, which is already planned by The Hills Shire Council.

#### FUTURE WITHOUT DEVELOPMENT

Assuming upgrading of Old Northern Road and New Line Road to two lanes in each direction, improves the performance of some intersections. However, this is not sufficient in some locations, where additional upgrades are required. Table 5.11 shows the performance of intersections with the road widening and signalisation of Old Northern and Glenhaven Road but no other upgrades.

**Table 5.11 Summary of 2036 future without development intersection performance with road widening**

Site id	Intersection	Peak period	Degree of Saturation	Average Delay (s)	Level of Service	95th percentile queue (m)
I-01	Old Northern Road and Hastings Road	AM	1.68	94	F	624
		PM	0.91	32	C	241
I-02	Old Northern Road and Gilbert Road	AM	0.86	20	B	185
		PM	0.89	23	B	216
I-03	Old Northern Road and Blue Gum Drive	AM	0.71	10	A	191
		PM	0.71	8	A	75
I-04	Old Northern Road and Glenhaven Road	AM	0.81	20	B	116
		PM	0.73	11	A	94
I-07	Old Northern Road and Kenthurst Road	AM	1.26	123	F	819
		PM	1.06	58	E	441
I-09	Old Northern Road and New Line Road	AM	1.40	388	F	>1,000
		PM	1.35	340	F	>1,000
I-11	New Line Road and Sebastian Drive	AM	0.73	11	A	145
		PM	0.68	5	A	67
I-12	New Line Road and Hastings Road	AM	1.18	151	F	884
		PM	1.16	60	E	481
I-13	New Line Road, James Henty Drive and David Road	AM	0.87	28	C	242
		PM	1.23	79	F	728
I-14	New Line Road and Purchase Road	AM	0.87	23	B	398
		PM	0.72	15	B	115
I-15	New Line Road, Shepherds Road and Country Drive	AM	1.69	> 500	F	>1,000
		PM	1.37	> 500	F	>1,000
I-16	New Line Road and Boundary Road	AM	1.42	418	F	985
		PM	1.25	256	F	629
I-17	New Line Road and Victoria Road	AM	0.61	18	B	44
		PM	1.08	93	F	668
I-18	New Line Road and Castle Hill Road	AM	1.05	60	E	471
		PM	1.18	99	F	891

Note: Intersection of Old Northern Road and Glenhaven Road upgraded based on plans from The Hills Shire Council  
 Intersection modelling for New Line Road intersections south of Hastings Road undertaken based on Aimsun model without corresponding 2016 traffic surveys  
 Average delay for sign and roundabout controlled intersections reported for the most delayed movement

Intersections requiring upgrades in the future in addition to the road widening include:

- Old Northern Road and Hastings Road
- Old Northern Road and Kenthurst Road
- Old Northern Road and New Line Road
- New Line Road and Hastings Road
- New Line Road, James Henty Drive and David Road
- New Line Road and Boundary Road
- New Line Road and Victoria Road
- New Line Road and Castle Hill Road.

#### FUTURE WITH DEVELOPMENT

New intersections are planned to enable access to and from the development including:

- Signalised intersection of Old Northern Road and Wayfield Road
- Signalised intersection of Old Northern Road and Malabar Road
- Give-way controlled intersection of Old Northern Road and Franlee Road
- Additional approach to the roundabout at 252 New Line Road
- Additional approach to the signalised intersection of New Line Road and Sebastian Drive.

In addition to these intersections, the upgrades listed in Table 5.12 are proposed to other intersections.

**Table 5.12 Proposed intersection upgrades (in addition to road widening)**

Site ID	Intersection	Proposed additional upgrade
I-01	Old Northern Road and Hastings Road	<ul style="list-style-type: none"> <li>→ Additional 110 m right-turn bay from Old Northern Road into Hastings Road</li> <li>→ Additional 75 m right-turn bay from Hastings Road into Old Northern Road</li> <li>→ Extended left-turn bay from Old Northern Road into Hastings Road from 100 m to 200 m long</li> <li>→ Convert departure side of Hastings Road to two lanes</li> </ul>
I-02	Old Northern Road and Gilbert Road	<ul style="list-style-type: none"> <li>→ Additional 50 m long left-turn bay from Gilbert Road into Old Northern Road</li> <li>→ Convert shared left-right lane to right only</li> </ul>
I-03	Old Northern Road and Blue Gum Drive	No additional upgrades
I-04	Old Northern Road and Glenhaven Road (Compared to planned upgrade)	No additional upgrades
I-07	Old Northern Road and Kenthurst Road	<ul style="list-style-type: none"> <li>→ Additional 60 m long right-turn bay from Kenthurst Road into Old Northern Road from</li> </ul>

Site ID	Intersection	Proposed additional upgrade
I-09	Old Northern Road and New Line Road	<ul style="list-style-type: none"> <li>→ Conversion from roundabout to traffic signals</li> <li>→ Additional southbound lane on Old Northern Road from Quarry Road to New Line Road</li> <li>→ Additional 130 m long right-turn bay from Old Northern Road into Old Northern Road</li> <li>→ Additional 120 m long right-turn bay from Old Northern Road into New Line Road</li> <li>→ Additional 30 m long through lane on Old Northern Road into property access</li> <li>→ Additional 50 m long right-turn lane on New Line Road into property access</li> </ul>
I-11	New Line Road and Sebastian Drive	<ul style="list-style-type: none"> <li>→ Additional 30 m right-turn bay from New Line Road into South Dural site</li> </ul>
I-12	New Line Road and Hastings Road	<ul style="list-style-type: none"> <li>→ Signalise southbound approach to intersection (currently free-flow)</li> <li>→ Extend right-turn bay from New Line Road into Hastings Road from 100 m to 160 m</li> <li>→ Additional 90 m long right-turn lane from Hastings Road into New Line Road</li> <li>→ Additional 50 m long left-turn bay from New Line Road into Hastings Road</li> </ul>
I-13	New Line Road, James Henty Drive and David Road	No additional upgrades
I-14	New Line Road and Purchase Road	→ No additional upgrades
I-15	New Line Road, County Drive and Shepherds Road	<ul style="list-style-type: none"> <li>→ Signalise southbound approach to intersection (currently two-lane roundabout)</li> <li>→ Additional three turn bays on New Line Road southbound (225 m combined additional length)</li> <li>→ Additional two turn bays on Shepherds Drive westbound (90 m combined additional length)</li> <li>→ Additional three turn bays on New Line Road northbound (185 m combined additional length)</li> <li>→ Additional two turn bays on County Drive eastbound (180 m combined additional length)</li> </ul>
I-16	New Line Road and Boundary Road	<ul style="list-style-type: none"> <li>→ Signalise southbound approach to intersection (currently two-lane roundabout)</li> <li>→ Additional two turn bays on New Line Road southbound (155 m combined additional length)</li> <li>→ Additional 70 m left-turn bay on Boundary Road westbound</li> <li>→ Additional 80 m right-turn bays on New Line Road northbound</li> </ul>
I-17	New Line Road and Victoria Road	→ Signalise southbound approach to intersection (currently one/two lane roundabout)
I-18	New Line Road and Castle Hill Road	<ul style="list-style-type: none"> <li>→ Additional 120 m right-turn lane on Castle Hill Road</li> <li>→ Additional 80 m right-turn bay on New Line Road southbound</li> <li>→ Additional 60 m left-turn lane on Castle Hill Road</li> </ul>



Based on these upgrades and the road widening, the resulting intersection performance has been checked using SIDRA intersection analysis. The intersection performance, summarised in Table 5.13, indicates that all intersections would operate at Level of Service D or better.

**Table 5.13 Summary of 2036 future with development intersection performance with road widening and intersection upgrades**

Site ID	Intersection	Peak period	Degree of Saturation	Average Delay (s)	Level of Service	95th percentile queue (m)
I-01	Old Northern Road and Hastings Road	AM	1.12	46	D	411
		PM	0.88	20	B	123
I-02	Old Northern Road and Gilbert Road	AM	0.88	24	B	222
		PM	1.05	33	C	381
I-03	Old Northern Road and Blue Gum Drive	AM	0.76	5	A	229
		PM	0.59	4	A	139
I-04	Old Northern Road and Glenhaven Road	AM	1.01	54	D	413
		PM	0.89	21	B	234
I-07	Old Northern Road and Kenthurst Road	AM	0.98	41	C	366
		PM	0.87	22	B	186
I-09	Old Northern Road and New Line Road	AM	0.90	41	D	352
		PM	0.91	47	D	216
I-11	New Line Road and Sebastian Drive	AM	0.91	26	B	256
		PM	0.96	13	A	196
I-12	New Line Road and Hastings Road	AM	0.96	22	B	189
		PM	0.85	15	B	112
I-13	New Line Road, James Henty Drive and David Road	AM	0.86	27	B	263
		PM	0.87	23	B	206
I-14	New Line Road and Purchase Road	AM	0.93	31	C	572
		PM	0.79	16	B	134
I-15	New Line Road, Shepherds Road and Country Drive	AM	0.99	50	D	579
		PM	0.96	46	D	412
I-16	New Line Road and Boundary Road	AM	0.98	42	C	340
		PM	0.89	28	B	231
I-17	New Line Road and Victoria Road	AM	0.89	14	A	62
		PM	0.70	11	B	80
I-18	New Line Road and Castle Hill Road	AM	0.87	28	C	318
		PM	1.04	54	D	314

*Note: Intersection of Old Northern Road and Glenhaven Road upgraded based on plans from The Hills Shire Council  
Intersection modelling for New Line Road intersections south of Hastings Road undertaken based on Aimsun model without corresponding 2016 traffic surveys  
Average delay for sign and roundabout controlled intersections reported for the most delayed movement*

## 5.6 Sustainable transport measures

Improvements in transport alternatives to private car travel are proposed to reduce the impact of the development on the road system and improve its sustainability. While the site is still at the rezoning stage, it is envisaged that sustainable transport measures would be incorporated into the development at master plan stage. To increase the acceptance of the improved alternative transport measures, a travel plan would be developed to tailor information on transport to the new residents making them aware of the travel choices available. It is envisaged that a travel plan would be included in a 'welcome pack' given to new residents, which will include information on public transport, walking and cycling.



## 6 Parking and access

### 6.1 Parking spaces

The current DCP parking rates for Hornsby Shire and The Hills Shire have been compared and considered for their suitability for application to the South Dural development. The parking rates for Hornsby Shire Council are considered sufficient to cater for the parking demands of the future residents. However, considering the recommendations for improved public services and walking and cycling facilities, and to provide incentive for the use of non-car based modes of transport, these rates are recommended to be applied as maximum rates rather than minimums.

The parking rates recommended are outlined in Table 6.1.

**Table 6.1 Recommended Parking Provision Policy of residential developments in South Dural**

Development and parking type	Maximum off-street car parking provision
<b>Dwelling Houses</b>	
0–2 Bedroom	1 space/dwelling
3 or more Bedrooms	2 spaces/dwelling
<b>Apartments</b>	
0–1 Bedroom	1 space/dwelling
2 Bedroom	1.25 space/dwelling
3 or more Bedrooms	2 space/dwelling
Disability	1 for each accessible unit (included as one space in maximum spaces per apartment)
Visitors	1 space per 5 dwellings
Motorcycle	1 space per 50 car parking spaces
Carwash space	1 per multi-unit development
Bicycle (minimum spaces)	1 space per 5 units
Visitor Bicycle (minimum spaces)	1 space per 10 units

On street parking on local roads within the five villages is proposed to supplement these off-street rates and to avoid parking overspill into neighbouring areas. This parking would be untimed unless localised issues of parking over-spill from adjacent retail is encountered. On collector roads, on-street parking could be considered on both sides. On local residential roads, the road width should encourage parking on one side only / staggered parking on both sides.

Parking spaces should be designed to comply with the requirements of:

- *Australian Standard AS2890.1-2004 Parking Facilities Part 1: Off-street car parking; and*
- *Australian Standard AS2890.6-2009 Parking Facilities Part 6: Off-street parking for people with disabilities.*



## 6.2 Access

Access to the five villages is planned to provide safe and efficient movement into and out of the development and minimise disruption to traffic on Old Northern Road. Access is proposed via new roads, with no direct driveway access to properties. Where possible all-movements would be permitted at new/existing intersections on Old Northern Road and New Line Road.

The North West and Mid-West villages would share access, with a loop road connecting the two main access points. The Eastern village would also have two main accesses with a loop road connecting the two. The Southern village would have access in and out via Wayfield Road only. The South East village would have access via access-ways connecting to Old Northern Road between signalised intersections.

The proposed access arrangements are listed in Table 6.2.

**Table 6.2 Proposed access arrangements for the five villages**

Village	Location	Intersection control
North West and Mid-West	Old Northern Road at a new road opposite Malabar Road	Traffic signals, all movements permitted
	Old Northern Road at Franlee Road	Give-way control, all movements permitted
	Old Northern Road access-way between Kenthurst Road and Derriwong Road	Give-way control, left-in/left-out movement only
Southern	Old Northern Road at Wayfield Road	Traffic signals, all movements permitted
South East	Old Northern Road access-way between Blue Gum Drive and Gilbert Road	Give-way control, all movements permitted apart from right-turn out of access-way
	Old Northern Road access-way between Gilbert Road and Hastings Road	Give-way control, all movements permitted apart from right-turn out of access-way
Eastern	New Line Road at a new road opposite road into 252 New Line Road	Roundabout, all movements permitted
	New Line Road at a new road opposite Sebastian Drive	Traffic signals, all movements permitted
	New Line Road access-way between Sebastian Drive and Hastings Road	Give-way control, left-in/left-out movement only

Other local accesses may be required to small lots within the area that are not covered by these road connections. These accesses would be in the form of left-in/left-out access-ways.

## 6.3 Street design

Given the current level of detail at rezoning, specific details regarding street designed have not been provided. Each of the five villages would be developed with their own master plan that guides these design details. However, the following principles should be incorporated in each master plan:

- The higher order local collector roads are identified in Figure 4.1. These roads should provide a wider carriageway with one lane in each direction and parking on both sides. They should be designed to accommodate 12.5 m long rigid vehicles with 3.2 m wide lanes and 5 km/h to 15 km/h turning radii.
- All streets and intersections should be designed to permit NSW Fire Brigade aerial appliances.

- The width of local streets can be narrower than collector roads to reduce speeds, but should be designed to accommodate Hornsby Shire Council's nominated garbage truck (9.7 m long, see Hornsby Shire Council Waste Minimisation and Management Guide Appendix 5.02).
- Based on the requirements of Hornsby Shire Council's Civil Works Specification, it is recommended that the internal roads be designed with the following dimensions:
  - Collector roads:
    - 20 m wide road reservation
    - 11 m wide carriageway
    - 4.5 m wide verges (each side), one with 1.2 m wide footpath, the other with a 2.5 m wide shared pedestrian/cycle path.
  - Local roads:
    - 14.5 m (culs-de-sac) or 16.0 m (through) road reservation
    - 7.5 m (culs-de-sac) or 9.0 m (through) wide carriageway
    - 3.5 m wide verges (each side), at least one with 1.2 m wide footpath.

Streets within the South Dural area should be designed to comply with the requirements of:

- Hornsby Shire Council DCP
- Hornsby Shire Council Civil Works Specification (AUS-SPEC)
- Austroads Road Design Guide
- Australian Standard AS2890.5: On-street parking.



## 7 Transport infrastructure

The transport assessment for this study has identified several pieces of infrastructure to provide for future development within the South Dural development and attempt to change travel behaviour to reduce road network upgrades. It is envisaged that the development would contribute to the cost of this infrastructure. In some instances, where the infrastructure provides a regional benefit, this contribution may be for only a part of the full cost.

### 7.1 Transport infrastructure to support development

A list of the transport infrastructure projects suggested for the South Dural development has been compiled from section 5. The list does not include local infrastructure such as internal roads, footpaths and internal intersection treatments, as these will be dealt with at the master plan stage. The list shown in Table 7.1 is based on the assessment for the development outlined in Section 4 and used the traffic modelling results from the Aimsun traffic model.

**Table 7.1 List of transport infrastructure suggestions for the South Dural development**

Transport mode	Transport infrastructure
<b>Pedestrian</b>	<ul style="list-style-type: none"> <li>→ Additional crossing facilities:               <ul style="list-style-type: none"> <li>▪ New refuge (or signalised pedestrian crossing) on:                   <ul style="list-style-type: none"> <li>– Old Northern Road near the Lorien Novalis School</li> <li>– Old Northern Road at Franlee Road</li> <li>– Old Northern Road near the bend between Kenthurst Road and Derriwong Road</li> <li>– New Line Road north of the 252 New Line Road roundabout.</li> </ul> </li> <li>▪ Pedestrian crossing facilities at newly signalised intersections.</li> <li>▪ Add pedestrian crossing facility to the existing traffic signals at the intersection of New Line Road and Hastings Road, across the Hastings Road approach.</li> </ul> </li> <li>→ Footpaths around the development as part of the proposed road widening of Old Northern Road and New Line Road</li> </ul>
<b>Cycle</b>	<ul style="list-style-type: none"> <li>→ Incorporate cycle facilities (either as kerbside lanes or a widened shared pedestrian path) as part of the proposed road widening of Old Northern Road and New Line Road.</li> </ul>
<b>Bus</b>	<ul style="list-style-type: none"> <li>→ Eight new bus shelters with seating and a bicycle rack.</li> <li>→ Three new bus stops with U-Stems.</li> </ul>



Transport mode	Transport infrastructure
<b>Road network</b>	<ul style="list-style-type: none"> <li>→ Road widening to two lanes in each direction: <ul style="list-style-type: none"> <li>▪ Old Northern Road between New Line Road and Castle Hill Road</li> <li>▪ New Line Road between Old Northern Road and Sebastian Drive</li> <li>▪ New Line Road between Hastings Road and Purchase Road</li> <li>▪ New Line Road between Boundary Road and Castle Hill Road</li> </ul> </li> <li>→ Intersection upgrades to: <ul style="list-style-type: none"> <li>▪ Old Northern Road and Hastings Road</li> <li>▪ Old Northern Road and Gilbert Road</li> <li>▪ Old Northern Road and Glenhaven Road ( in addition to planned upgrade)</li> <li>▪ Old Northern Road and Kenthurst Road</li> <li>▪ Old Northern Road and New Line Road</li> <li>▪ New Line Road and Sebastian Drive</li> <li>▪ New Line Road and Hastings Road</li> <li>▪ New Line Road, County Drive and Shepherds Road</li> <li>▪ New Line Road and Boundary Road</li> <li>▪ New Line Road and Victoria Road</li> <li>▪ New Line Road and Castle Hill Road</li> </ul> </li> </ul>

## 7.2 Infrastructure timing

An assessment potential timeframes for the suggested transport upgrades is shown in Table 7.2. These are approximate, based on the strategic nature of the assessment. This list requires further consultation with the relevant agencies and are not current government policy.

**Table 7.2 Indicative timing of infrastructure**

By year	Transport mode	Infrastructure upgrades
2026	Pedestrian	<ul style="list-style-type: none"> <li>→ Additional crossing facilities: <ul style="list-style-type: none"> <li>▪ New refuge (or signalised pedestrian crossing) on: <ul style="list-style-type: none"> <li>– Old Northern Road near the Lorient Novalis School</li> <li>– Old Northern Road at Franlee Road</li> <li>– Old Northern Road near the bend between Kenthurst Road and Derriwong Road.</li> </ul> </li> </ul> </li> <li>→ Footpaths on the southern/eastern side of Old Northern Road from New Line Road to Glenhaven Road.</li> </ul>
	Cycle	→ Incorporate cycle facilities on Old Northern Road and New Line Road.
	Bus	<ul style="list-style-type: none"> <li>→ Three (3) new bus shelters with seating and a bicycle rack.</li> <li>→ Three (3) new bus stops with U-Stems.</li> </ul>

By year	Transport mode	Infrastructure upgrades
2036	Road network	<ul style="list-style-type: none"> <li>→ Road widening to two lanes in each direction:               <ul style="list-style-type: none"> <li>▪ Old Northern Road between New Line Road and Castle Hill Road</li> <li>▪ New Line Road between Old Northern Road and Sebastian Drive</li> <li>▪ New Line Road between Hastings Road and Purchase Road.</li> </ul> </li> <li>→ Intersection upgrades to:               <ul style="list-style-type: none"> <li>▪ Old Northern Road and Hastings Road</li> <li>▪ Old Northern Road and Kenthurst Road</li> <li>▪ Old Northern Road and New Line Road</li> <li>▪ New Line Road and Hastings Road</li> <li>▪ New Line Road, Shepherds Road and Country Drive</li> <li>▪ New Line Road and Boundary Road</li> <li>▪ New Line Road and Castle Hill Road.</li> </ul> </li> </ul>
	Pedestrian	<ul style="list-style-type: none"> <li>→ Additional crossing facilities:               <ul style="list-style-type: none"> <li>▪ New refuge (or signalised pedestrian crossing) on New Line Road north of the 252 New Line Road roundabout.</li> <li>▪ Add pedestrian crossing facility to the existing traffic signals at the intersection of New Line Road and Hastings Road, across the Hastings Road approach.</li> </ul> </li> <li>→ Footpaths around the development as part of the proposed road widening of Old Northern Road and New Line Road.</li> </ul>
	Cycle	Completed by 2026
	Bus	→ Five new bus shelters with seating and a bicycle rack.
	Road network	<ul style="list-style-type: none"> <li>→ Upgrade to intersection of:               <ul style="list-style-type: none"> <li>▪ Old Northern Road and Gilbert Road</li> <li>▪ New Line Road and Sebastian Drive</li> <li>▪ New Line Road and Victoria Road.</li> </ul> </li> </ul>

### 7.3 Road upgrade cost estimate

A high-level strategic costing of the proposed road and intersection upgrades has been undertaken for the purpose of providing an initial order of magnitude estimate of the road upgrade costs for planning purposes. These estimates have been prepared using standard unit costs based on previous projects. The estimated road widening and intersection costs are shown in Table 7.3.

The following assumptions have been included in these estimates:

- The estimates include allowances for:
  - project management,
  - client representation,
  - concept development,
  - detailed design and documentation
  - property acquisition (assuming \$1,000 per square metre)
  - utility/services adjustment – assumed to be 12% of the infrastructure construction cost
  - infrastructure construction

- project finalisation.
- Infrastructure construction rates:
  - Road widening in a semi-rural environment with a small amount of earthworks. Based on a preliminary assessment of corridor width, it appears that the existing road reservation is generally sufficient to accommodate the widened road.
  - Intersection upgrades include a higher unit cost for road widening due to the smaller size of the project. They also include higher allowances for property acquisition (50% and 100% of the additional space required).
  - New traffic signals
  - Additional widening to the culvert/structure over Georges Creek on Hastings Road and Pyes Creek on New Line Road.
- A contingency of 65% has been added on top of the estimated project cost (including allowances).

These estimates are high-level strategic costing, for planning purposes only. They are based upon information made available to WSP | Parsons Brinckerhoff at the time of preparation. The estimates have been prepared for this specific Client and Project, and should not be used or relied on for any other use. Parsons Brinckerhoff accepts no liability for actual costs varying from those estimated.

## 7.4 Apportionment

Apportionment has been based on the principle that developments should contribute to the cost of transport infrastructure upgrades to the extent that they contribute to need for that upgrade. Each upgrade has had one of the three types of apportionment (shown in Figure 7.1) applied, based on its performance in 2016 and 2036 as the basis for apportionment of costs:

1. Existing traffic congestion problems (road or intersection performance assessed as Level of Service E or F for the 2016 scenario) are contributed to by the existing traffic, future growth traffic and the development traffic based on their % of the total traffic for the with development scenario in 2036. The method assumes that only the component of the existing traffic that is above the existing capacity contributes to the need for the upgrade.
2. Locations that are not currently a significant issue that would be tipped over the threshold for upgrade regardless of whether the development proceeds or not are contributed to by the future growth traffic and the development traffic based on their % of the total future traffic growth in 2036.
3. Locations that only require upgrading if the development proceeds or upgrades that are required for access to the development are 100% attributable to the development.

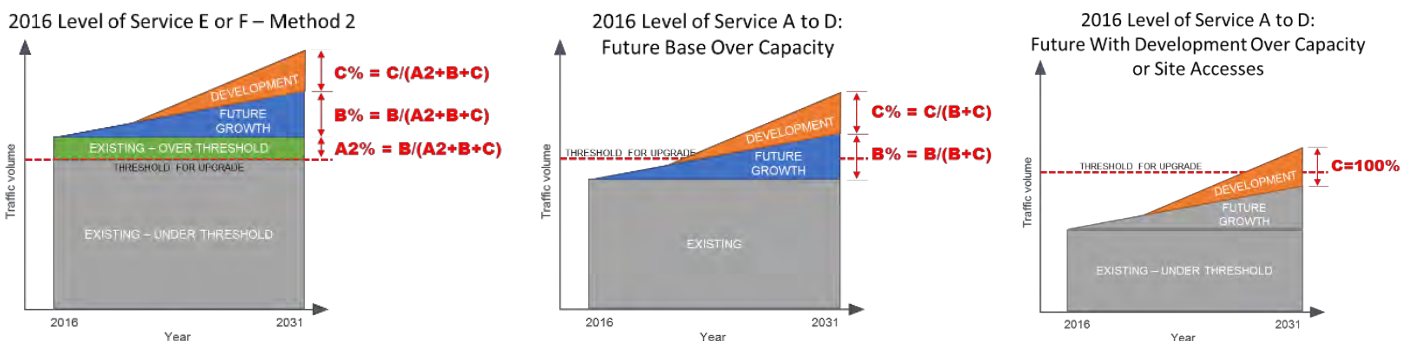


Figure 7.1 Methods of apportionment of upgrade costs

The estimated upgrade costs, contribution from the South Dural development and apportionment are shown in Table 7.3.

Table 7.3 Estimates of road and intersection upgrade costs, South Dural contribution and apportionment

		Item	Cost estimate (\$2016)	South Dural contribution	South Dural apportionment
Roads	Old Northern Road	New Line Road to Glenhaven Road	\$46,800,000	\$29,470,000	63%
		Glenhaven Road to Hastings Road	\$17,820,000	\$10,310,000	58%
		Hastings Road to Castle Hill Road	\$16,460,000	\$8,850,000	54%
		Sub-total	\$81,080,000	\$48,640,000	60%
	New Line Road	Old Northern Road to Sebastian Drive	\$10,370,000	\$3,350,000	32%
		Sebastian Drive to Hastings Road	\$0	\$0	0%
		Hastings Road to Purchase Road	\$27,720,000	\$9,680,000	35%
		Purchase Road to Boundary Road	\$0	\$0	0%
		Boundary Road to Castle Hill Road	\$520,000	\$190,000	37%
	Sub-total	\$33,610,000	\$11,410,000	34%	
	Roads Sub-total		\$114,690,000	\$60,050,000	52%
Intersections	Old Northern Road and Hastings Road		\$5,065,000	\$1,730,000	34%
	Old Northern Road and Gilbert Road		\$700,000	\$700,000	100%
	Old Northern Road and Kenthurst Road		\$1,020,000	\$300,000	29%
	Old Northern Road and New Line Road		\$9,050,000	\$2,160,000	24%
	New Line Road and Sebastian Drive		\$420,000	\$420,000	100%
	New Line Road and Hastings Road		\$5,660,000	\$2,280,000	40%
	New Line Road, County Drive, Shepherds Road		\$11,285,000	\$3,250,000	29%
	New Line Road and Boundary Road		\$5,270,000	\$1,010,000	19%
	New Line Road and Victoria Road		\$500,000	\$130,000	26%
	New Line Road and Castle Hill Road		\$4,330,000	\$1,310,000	30%
			\$43,300,000	\$13,280,000	31%
<b>Total</b>		<b>\$157,990,000</b>	<b>\$73,330,000</b>	<b>46%</b>	

Notes All estimates are in \$2016.

These estimates are high-level strategic costing, for planning purposes only. They are based upon information made available to WSP | Parsons Brinckerhoff at the time of preparation. The estimates have been prepared for this specific Client and Project, and should not be used or relied on for any other use. Parsons Brinckerhoff accepts no liability for actual costs varying from those estimated.



The contributions outlined in Table 7.3 assume that funding for the remainder of the road and intersection upgrades will be found from other sources, potentially the NSW Government (addressing existing road capacity issues and future background growth) or contributions from other developments in the area contributing to the traffic increase. It is noted that if the South Dural Development does not proceed, while the total cost of road network upgrades is likely to be smaller, without the funding delivered by the South Dural contributions, the cost of road network upgrades to be found from other sources is likely to be higher than if the South Dural development does proceed. This is demonstrated in Table 7.4.

**Table 7.4 Summary of NSW Government and South Dural apportionment for road and intersections**

Year	Future without South Dural		Future with South Dural	
	Other sources of funding	Other sources of funding	South Dural developers	Total
2026	\$109,790,000	\$82,310,000 (\$27,480,000 less than Future without South Dural)	\$62,500,000	\$144,810,000
2036	\$122,510,000	\$84,660,000 (\$37,850,000 less than Future without South Dural)	\$73,330,000	\$157,990,000

## 8 Conclusions and recommendations

WSP | Parsons Brinckerhoff has undertaken a traffic and parking assessment to support a development application for the proposed rezoning of the South Dural development. The residential development would be progressed in five precincts, each of which will have a master plan that further develops the transport concept.

The conclusions of this study are that improved transport facilities are required to support the development and to mitigate the impact of the additional trips generated by the development on the surrounding transport network:

- Walking and cycling facilities need to be upgraded to accommodate the transition from the existing rural residential to a medium density residential development. This should include:
  - Footpaths within the development and on the boundary of the area
  - Off-road paths connecting the five precincts of the development
  - Additional opportunities to safely cross Old Northern Road and New Line Road
  - Cycle lanes on Old Northern Road and New Line Road.
- Improvements to the bus services which connect the development to Castle Hill and the NorthWest Metro including:
  - New and improved bus stop facilities including bus shelters, seating, bike racks and bus stop signs
  - Increased frequency on selected bus routes and expanded hours of operation.
- Road network upgrades to mitigate the impact of the additional traffic generated by the development:
  - Road widening to two lanes in each direction:
    - Old Northern Road between New Line Road and Castle Hill Road
    - New Line Road between Old Northern Road and Sebastian Drive
    - New Line Road between Hastings Road and Purchase Road
    - New Line Road between Boundary Road and Castle Hill Road.
  - Intersection upgrades to:
    - Old Northern Road and Hastings Road
    - Old Northern Road and Gilbert Road
    - Old Northern Road and Glenhaven Road (in addition to planned upgrade)
    - Old Northern Road and Kenthurst Road
    - Old Northern Road and New Line Road
    - New Line Road and Sebastian Drive
    - New Line Road and Hastings Road
    - New Line Road, County Drive and Shepherds Road
    - New Line Road and Boundary Road
    - New Line Road and Victoria Road
    - New Line Road and Castle Hill Road.

- An apportionment based on traffic volumes contributing to the need for these road upgrades has indicated a contribution of \$73,330,000 (46%) from the South Dural development to the total upgrade cost of \$157,990,000.
  - The remaining \$84,660,000 (54%) would be required from other funding sources. However, it is noted that this cost is \$37,850,000 less than would be required if the South Dural development doesn't proceed and traffic volumes increase as indicated in the Aimsun model supplied by Transport for NSW.
- New access intersections including:
- Signalised intersection of Old Northern Road and Wayfield Road
  - Signalised intersection of Old Northern Road and Malabar Road
  - Give-way controlled intersection of Old Northern Road and Franlee Road
  - Additional approach capacity to the roundabout at 252 New Line Road
  - Additional approach to the signalised intersection of New Line Road and Sebastian Drive.
- Parking rates based on the Hornsby Shire Council DCP applied as maximum rates rather than minimums.
- Parking spaces should be designed to comply with the requirements of:
- Australian Standard AS2890.1-2004 Parking Facilities Part 1 Off-street car parking; and
  - Australian Standard AS2890.6-2009 Parking Facilities Part 6 Off-street car parking for people with disabilities.
- Streets within the South Dural area should be designed to comply with the requirements of:
- Hornsby Shire Council DCP
  - Hornsby Shire Council Civil Works Specification (AUS-SPEC)
  - Austroads Road Design Guide
  - Australian Standard AS2890.5: On-street parking.
- Local collector roads should provide a wider carriageway with one lane in each direction and parking on both sides, and should be designed to accommodate 12.5 m long rigid vehicles.
- All streets and intersections should be designed to permit NSW Fire Brigade aerial appliances and Hornsby Shire Council's nominated garbage truck.

# Appendix A

**TRAFFIC SURVEYS**





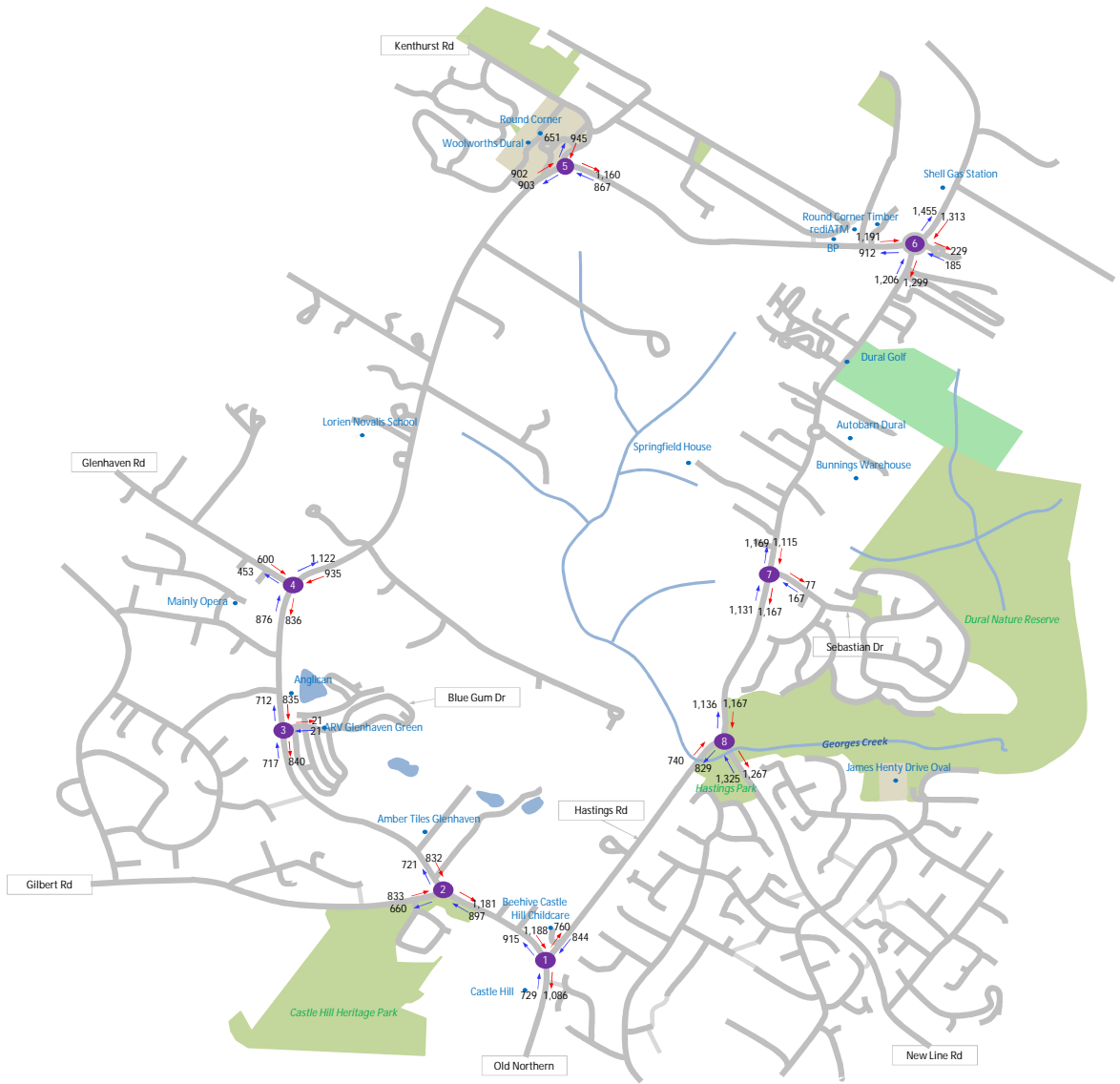
South Dural - Traffic Flows



Search By Time and Classification

AM / PM	Start Time	End Time	Classification
AM	7:45	8:45	All Vehicles

1 Site No.



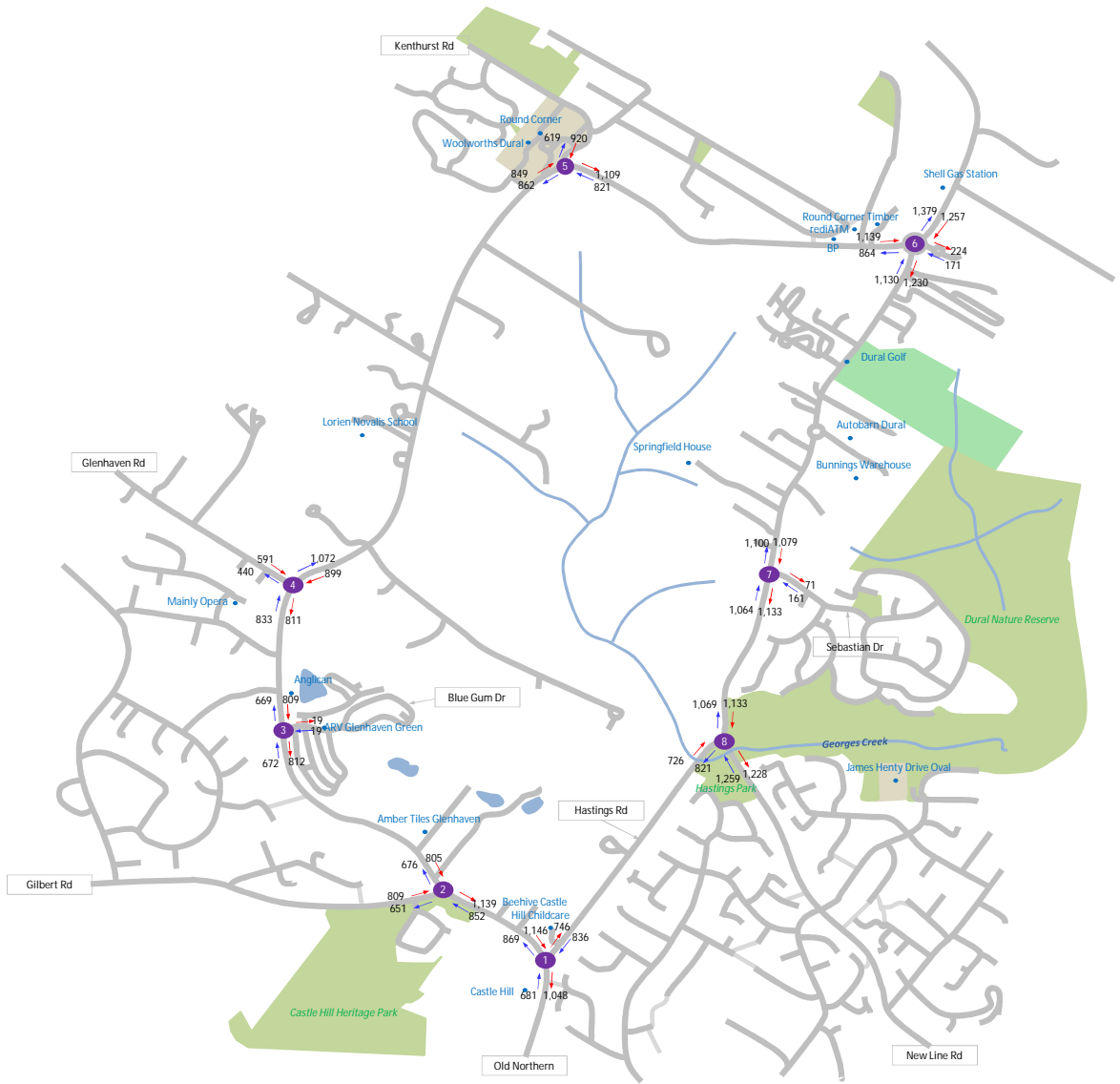
South Dural - Traffic Flows



Search By Time and Classification

AM / PM	Start Time	End Time	Classification
AM	7:45	8:45	Case

1 Site No.



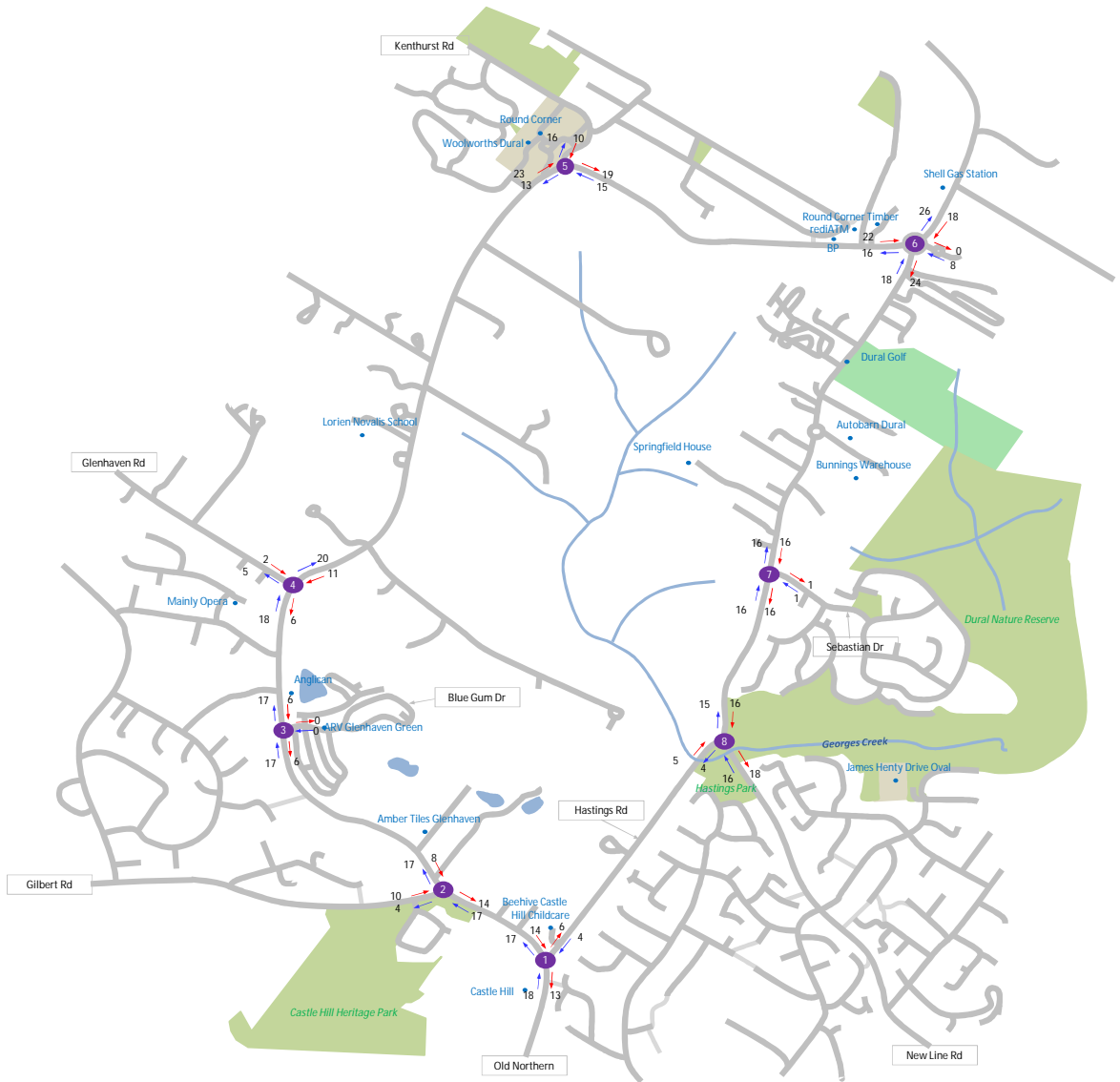
South Dural - Traffic Flows



Search By Time and Classification

AM / PM	Start Time	End Time	Classification
AM	7:45	8:45	Busies

1 Site No.



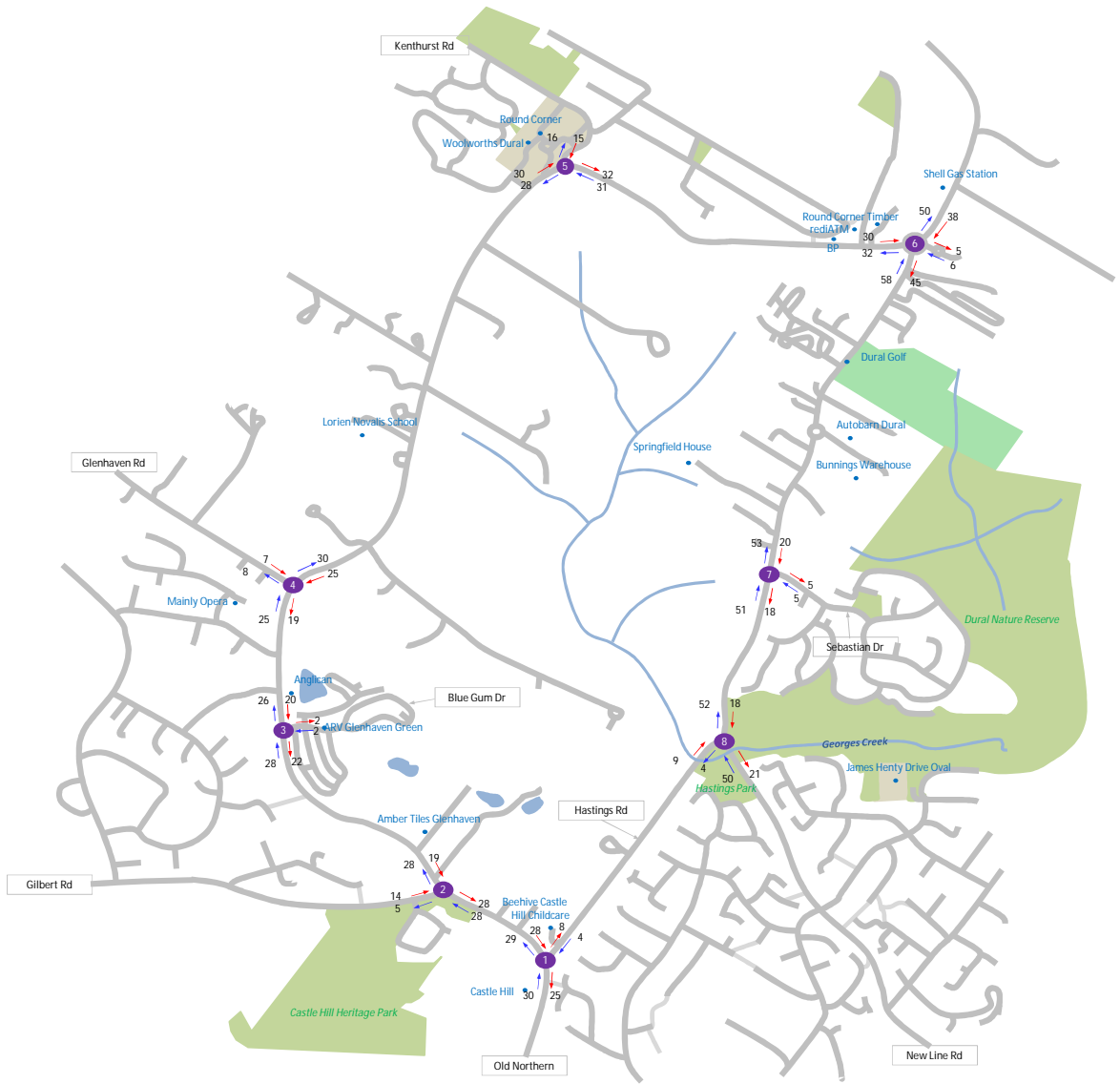
South Dural - Traffic Flows



Search By Time and Classification

AM / PM	Start Time	End Time	Classification
AM	7:45	8:45	Trucks

1 Site No.





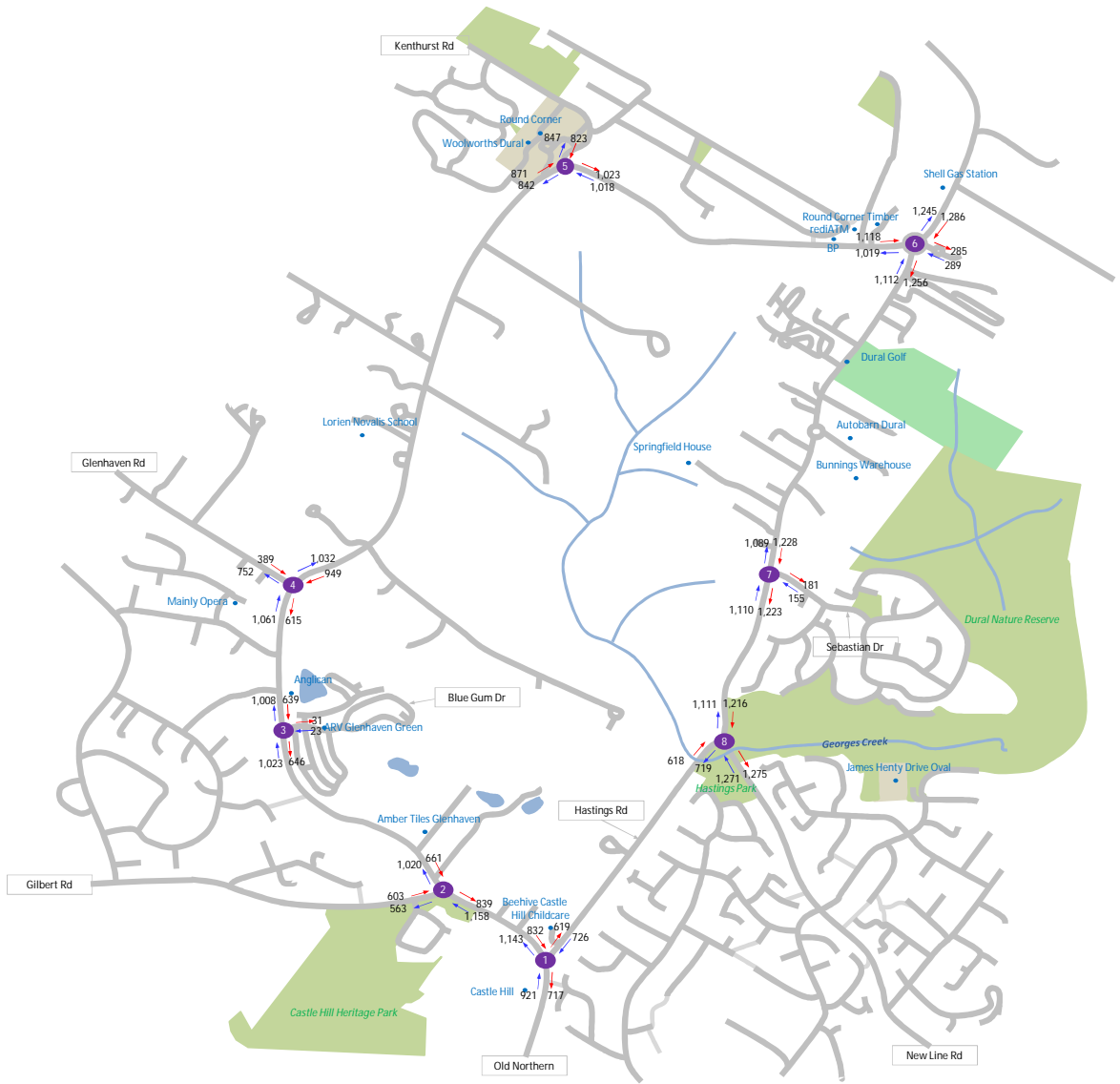
South Dural - Traffic Flows



Search By Time and Classification

AM / PM	Start Time	End Time	Classification
PM	18:00	18:00	All Vehicles

1 Site No.



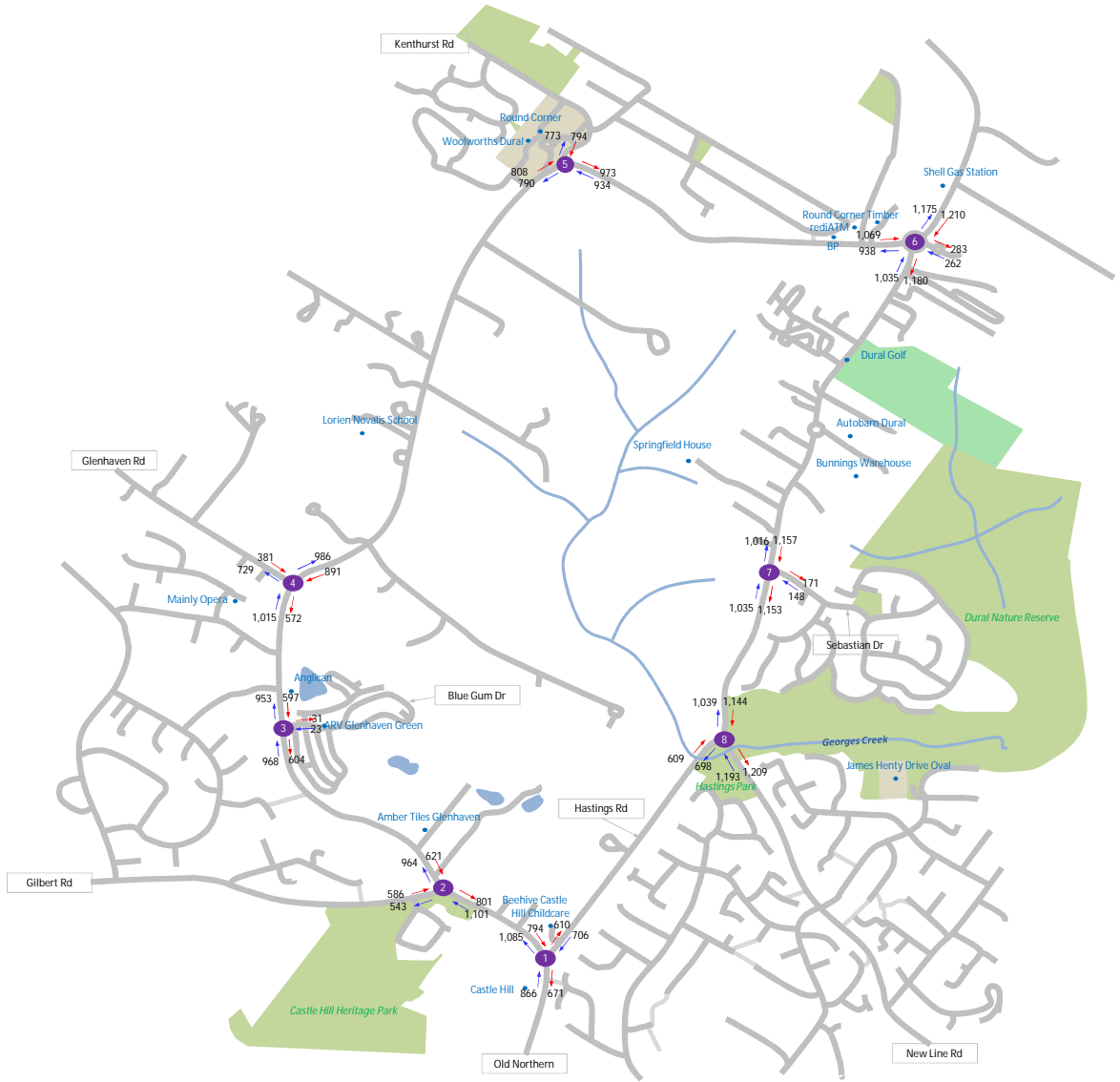
South Dural - Traffic Flows



Search By Time and Classification

AM / PM	Start Time	End Time	Classification
PM	18:00	18:00	Car

1 Site No.



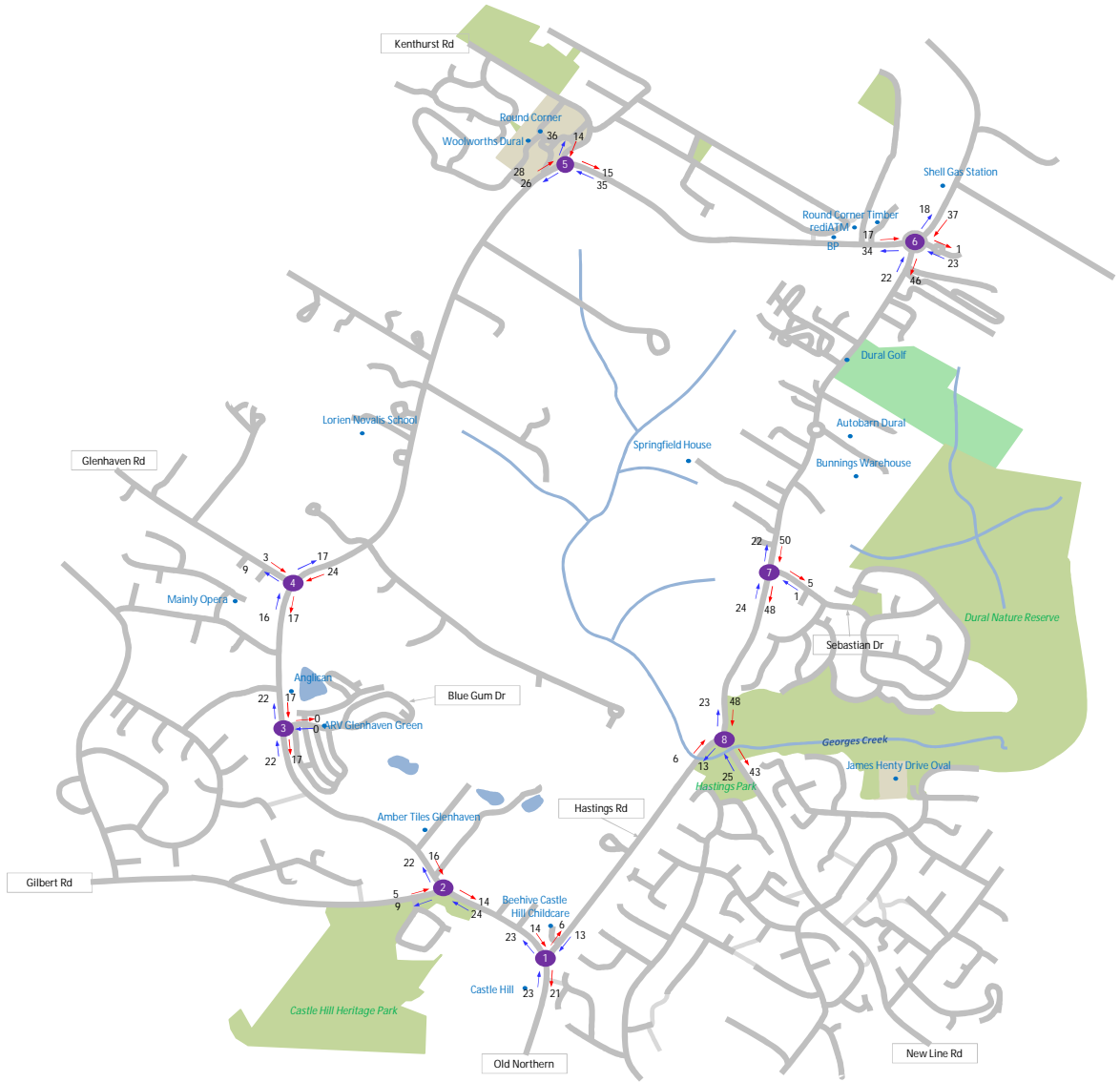
South Dural - Traffic Flows



Search By Time and Classification

AM / PM	Start Time	End Time	Classification
PM	18:00	18:00	Buses

1 Site No.



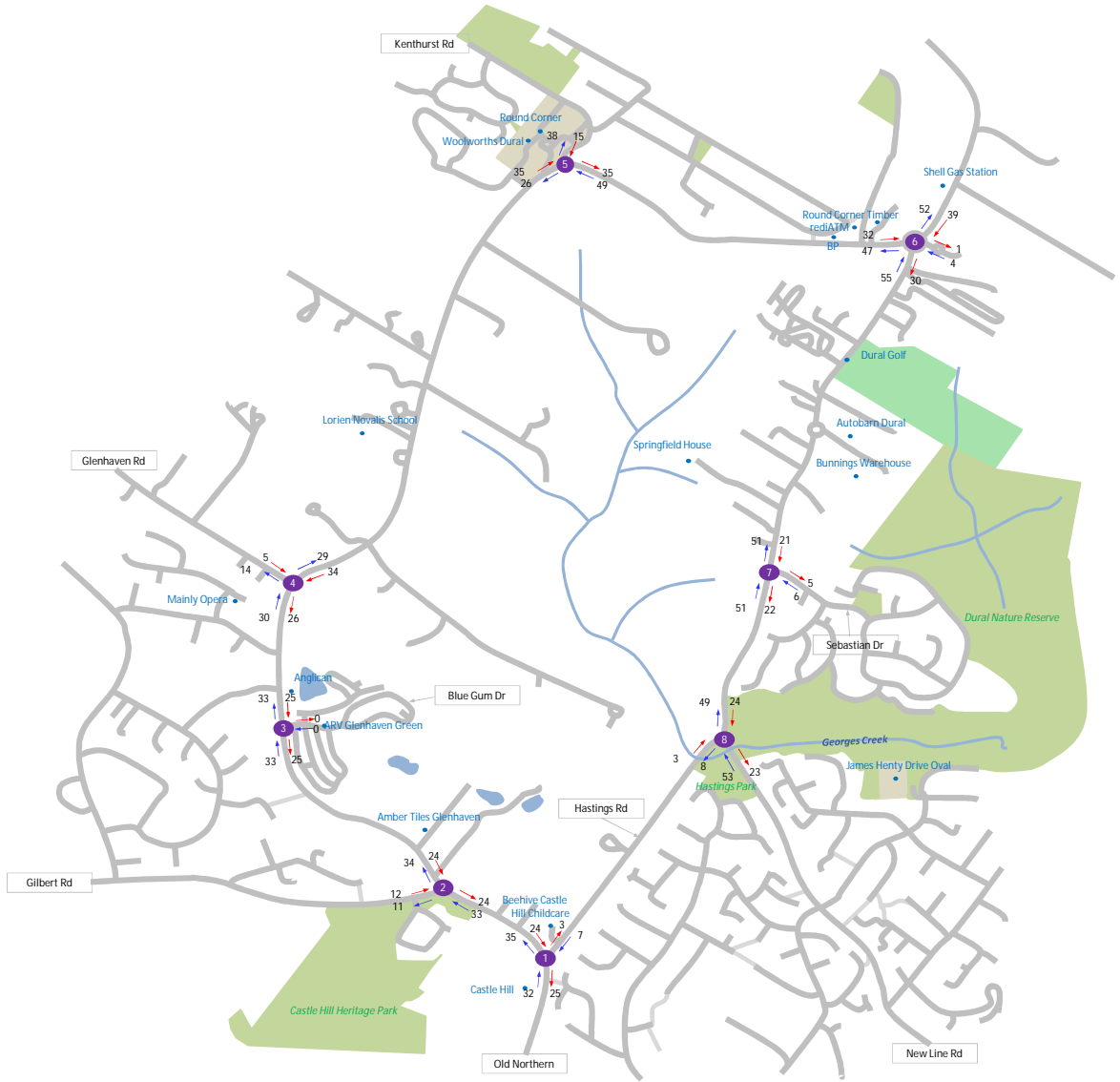
South Dural - Traffic Flows



Search By Time and Classification

AM / PM	Start Time	End Time	Classification
PM	18:00	18:00	Trucks

1 Site No.



# Appendix B

**INTERSECTION PERFORMANCE CRITERIA**





# INTERSECTION PERFORMANCE CRITERIA

## LEVEL OF SERVICE (LOS)

Level of Service (Los) is a basic performance parameter used to describe the operation of an intersection. Levels of service range from A (indicating good intersection operation) to F (indicating over-saturated conditions with long delays and queues). At signalised intersections, the LoS criteria are related to average intersection delay (seconds per vehicle). At priority controlled (give-way and stop controlled) and roundabout intersections, the LoS is based on the modelled delay (seconds per vehicle) for the most delayed movement.

**Table B.1 Level of Service criteria for intersections**

Level of Service	Average Delay (seconds per vehicle)	Traffic Signals, Roundabout	Give Way and Stop Signs
A	Less than 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity. At signals, incidents would cause excessive delays. Roundabouts require other control mode.	At capacity; requires other control mode
F	Greater than 71	Unsatisfactory with excessive queuing	Unsatisfactory with excessive queuing; requires other control mode

Source: RMS Guide to Traffic Generating Developments, 2002

## DEGREE OF SATURATION (DOS)

The Degree of Saturation (DoS) is the ratio of demand flow to capacity, and therefore has no unit. As it approaches 1.0, extensive queues and delays could be expected. For a satisfactory situation, DoS should be less than the nominated practical degree of saturation, usually 0.9. The intersection DoS is based on the movement with the highest value.

## AVERAGE VEHICLE DELAY

This is the difference between interrupted and uninterrupted travel times through the intersection and is measured in seconds per vehicle. At signalised intersections and roundabouts, the average intersection delay is usually reported. At priority controlled intersections, the average delay for the most delayed movement is usually reported.

## QUEUE LENGTH

Queue length is measured in metres reflecting the number of vehicles waiting at the stop line and is usually quoted as the 95<sup>th</sup> percentile back of queue, which is the value below which 95% of all observed queue lengths fall. It reflects the number of vehicles per traffic lane at the start of the green period, when traffic starts moving again after a red signal. The intersection queue length is usually taken from the movement with the longest queue length.



# Appendix C

**SIDRA INTERSECTION RESULTS**





## C.1: 2016 EXISTING SITUATION

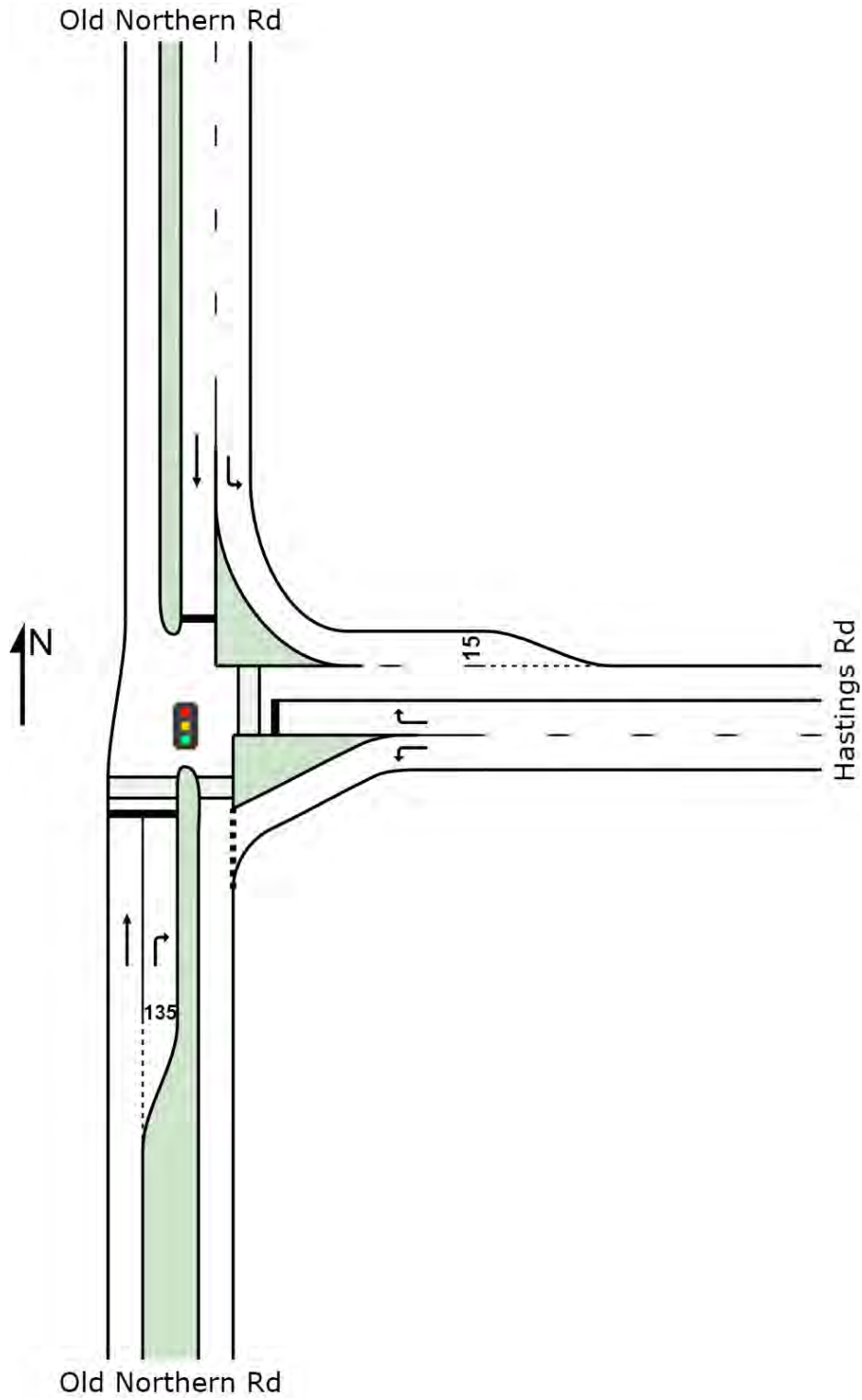
- I-01 Old Northern Road and Hastings Road
- I-02 Old Northern Road and Gilbert Road
- I-03 Old Northern Road and Blue Gum Drive
- I-04 Old Northern Road and Glenhaven Road
- I-07 Old Northern Road and Kenthurst Road
- I-09 Old Northern Road and New Line Road
- I-11 New Line Road and Sebastian Drive
- I-12 New Line Road and Hastings Road.

## C.2: 2036 FUTURE WITH DEVELOPMENT

- I-01 Old Northern Road and Hastings Road
- I-02 Old Northern Road and Gilbert Road
- I-03 Old Northern Road and Blue Gum Drive
- I-04 Old Northern Road and Glenhaven Road
- I-07 Old Northern Road and Kenthurst Road
- I-09 Old Northern Road and New Line Road
- I-11 New Line Road and Sebastian Drive
- I-12 New Line Road and Hastings Road
- I-13 New Line Road, James Henty Drive and David Road
- I-14 New Line Road and Purchase Road
- I-15 New Line Road, Shepherds Road and Country Drive
- I-16 New Line Road and Boundary Road
- I-17 New Line Road and Victoria Road
- I-18 New Line Road and Castle Hill Road.

# 2016 EXISTING SITUATION

Intersection of Old Northern Road and Hastings Road



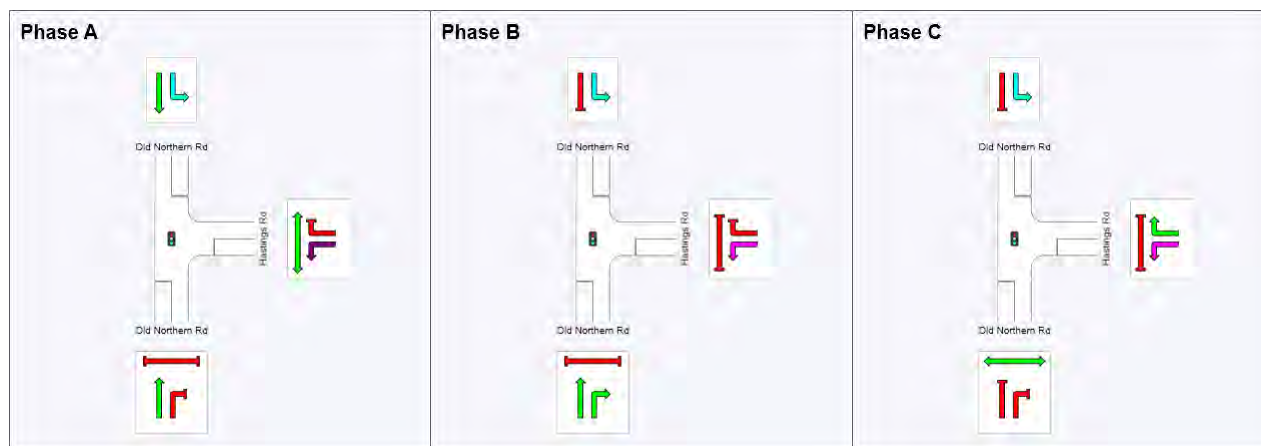
## AM Movement Summary for 2016 Existing Situation

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows Total veh/h	Deg. Satn 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: Old Northern Rd											
2	T1	497	9.3	0.427	5.6	LOS A	6.8	51.6	0.26	0.24	54.0
3	R2	271	1.6	0.862	65.7	LOS E	17.0	120.5	1.00	0.94	28.4
Approach		767	6.6	0.862	26.8	LOS B	17.0	120.5	0.52	0.48	39.7
East: Hastings Rd											
4	L2	422	1.5	0.469	15.8	LOS B	9.4	66.3	0.46	0.70	47.1
6	R2	466	0.5	0.951	72.7	LOS F	32.6	229.1	1.00	1.01	24.1
Approach		888	0.9	0.951	45.7	LOS D	32.6	229.1	0.74	0.86	32.5
North: Old Northern Rd											
7	L2	529	2.0	0.289	5.6	LOS A	0.0	0.0	0.00	0.53	53.9
8	T1	721	4.7	0.929	46.5	LOS D	45.8	333.4	0.99	1.05	31.1
Approach		1251	3.5	0.929	29.2	LOS C	45.8	333.4	0.57	0.83	38.0
All Vehicles		2906	3.5	0.951	33.6	LOS C	45.8	333.4	0.61	0.75	36.4

## AM Phasing Summary

### Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	54	80
Green Time (sec)	48	20	31
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	54	26	37
Phase Split	46 %	22 %	32 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

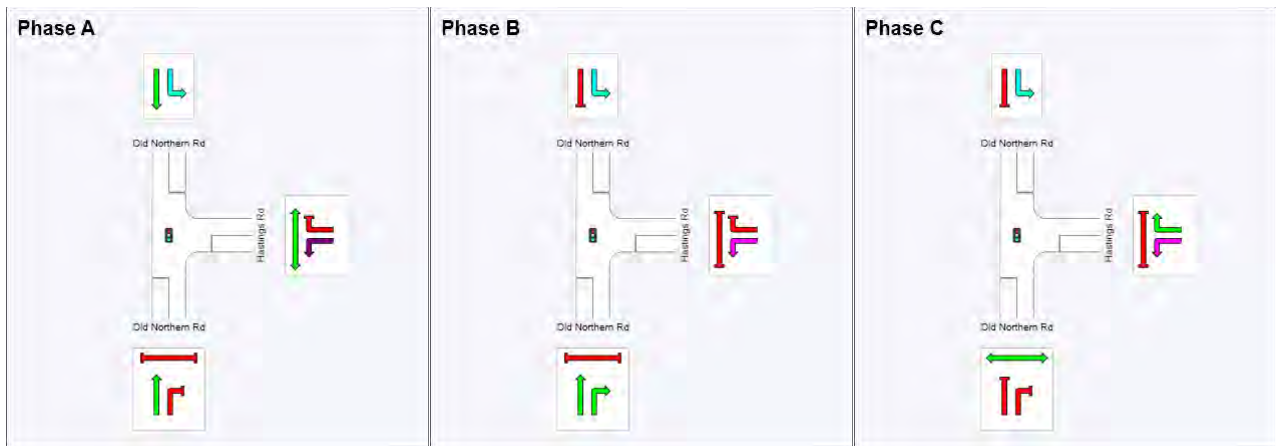
### PM Movement Summary for 2016 Existing Situation

Movement Performance - Vehicles											
Mov ID	ODMo	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
		Total	HV				Vehicles	Distance			
	v	veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Old Northern Rd											
2	T1	722	7.4	0.618	7.8	LOS A	15.1	112.2	0.37	0.34	52.0
3	R2	247	1.7	0.621	55.2	LOS D	14.2	101.0	0.96	0.83	30.9
Approach		969	6.0	0.621	19.9	LOS B	15.1	112.2	0.52	0.46	43.3
East: Hastings Rd											
4	L2	283	4.8	0.263	6.7	LOS A	1.0	7.4	0.07	0.57	53.3
6	R2	481	1.5	0.938	55.1	LOS D	33.2	235.7	1.00	0.96	28.1
Approach		764	2.8	0.938	37.2	LOS C	33.2	235.7	0.66	0.82	35.0
North: Old Northern Rd											
7	L2	404	1.3	0.220	5.6	LOS A	0.0	0.0	0.00	0.53	53.9
8	T1	472	7.4	0.696	34.8	LOS C	22.9	170.7	0.83	0.74	35.4
Approach		876	4.6	0.696	21.3	LOS B	22.9	170.7	0.45	0.64	42.2
All Vehicles		2609	4.6	0.938	25.4	LOS B	33.2	235.7	0.54	0.63	40.1

### PM Phasing Summary

#### Phase Timing Results

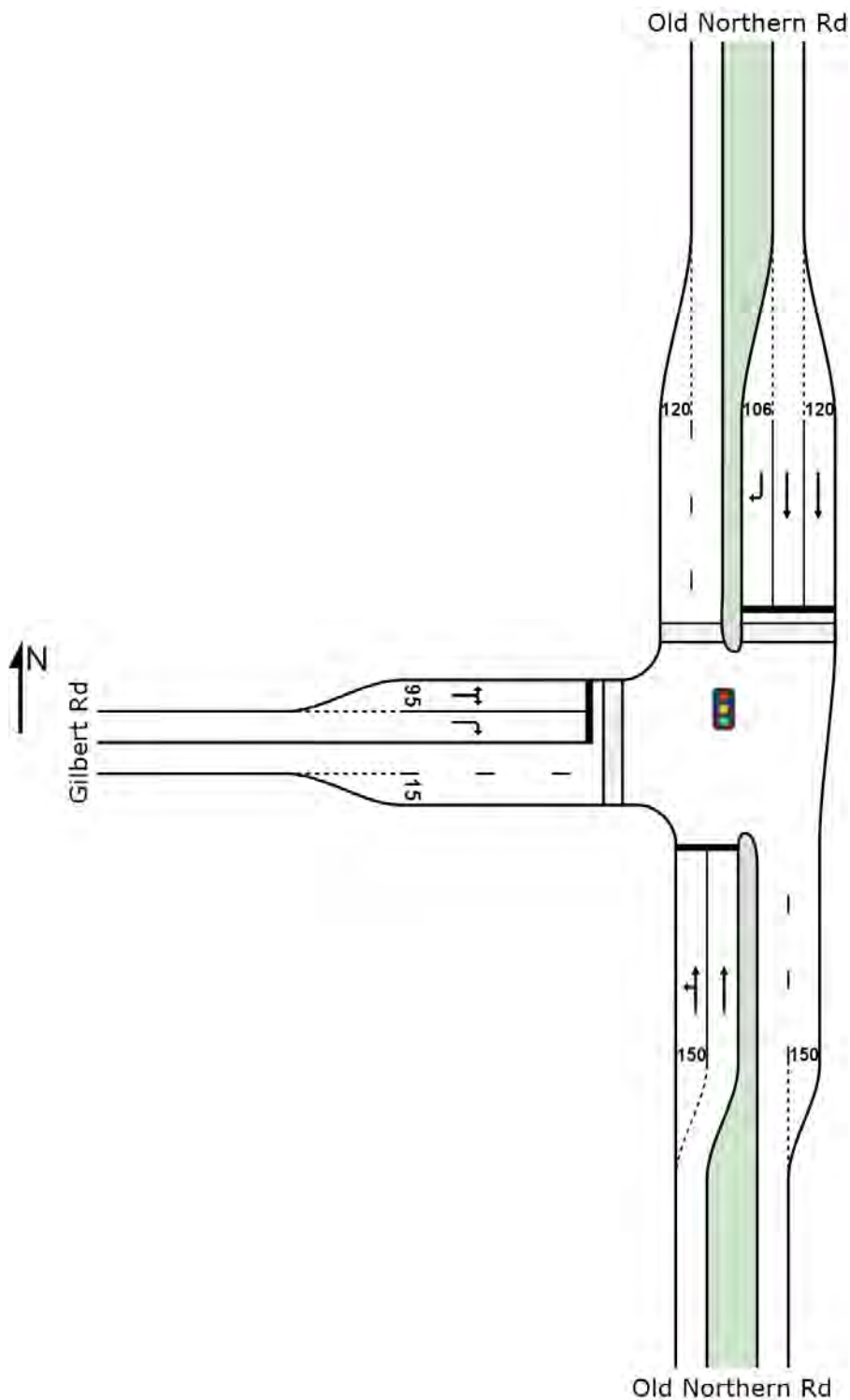
Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	53	87
Green Time (sec)	47	28	36
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	53	34	42
Phase Split	41 %	26 %	33 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

# 2016 EXISTING SITUATION

## Intersection of Old Northern Road and Gilbert Road





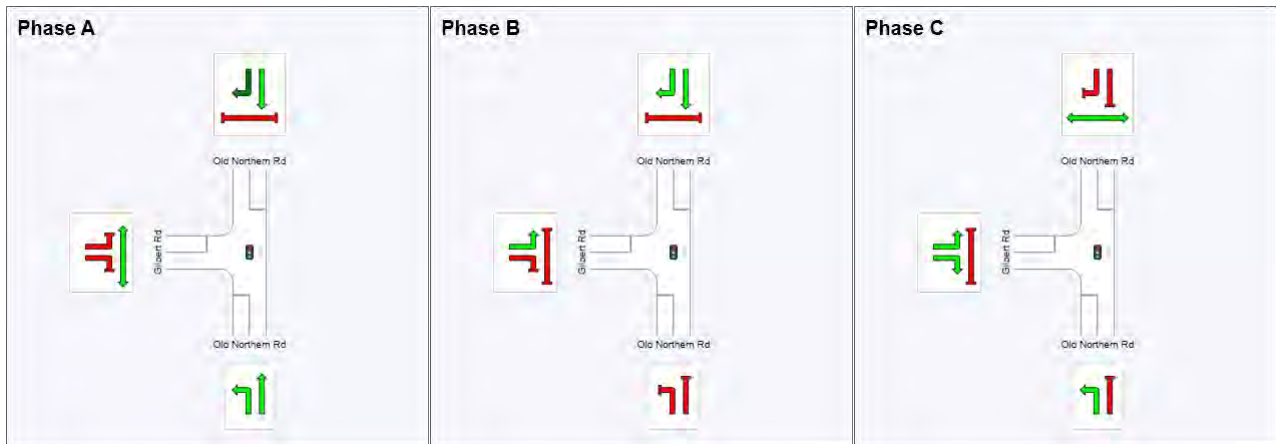
### AM Movement Summary for 2016 Existing Situation

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows Total veh/h	Deg. Satn 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: Old Northern Rd											
1	L2	379	1.7	0.515	15.1	LOS B	8.4	59.8	0.59	0.72	47.5
2	T1	565	7.3	0.784	28.6	LOS C	20.9	155.2	0.87	0.82	40.6
Approach		944	5.0	0.784	23.2	LOS B	20.9	155.2	0.76	0.78	43.1
North: Old Northern Rd											
8	T1	560	4.5	0.295	12.0	LOS A	7.6	55.5	0.56	0.48	50.1
9	R2	316	1.0	0.816	50.7	LOS D	14.5	102.4	1.00	1.08	32.2
Approach		876	3.2	0.816	26.0	LOS B	14.5	102.4	0.72	0.70	41.8
West: Gilbert Rd											
10	L2	194	3.3	0.651	34.5	LOS C	16.1	115.8	0.90	0.84	37.6
12	R2	683	2.8	0.803	39.4	LOS C	22.0	157.4	0.96	0.89	35.8
Approach		877	2.9	0.803	38.3	LOS C	22.0	157.4	0.94	0.88	36.2
All Vehicles		2697	3.7	0.816	29.0	LOS C	22.0	157.4	0.81	0.79	40.2

### AM Phasing Summary

#### Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	39	59
Green Time (sec)	33	14	31
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	39	20	37
Phase Split	41 %	21 %	39 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

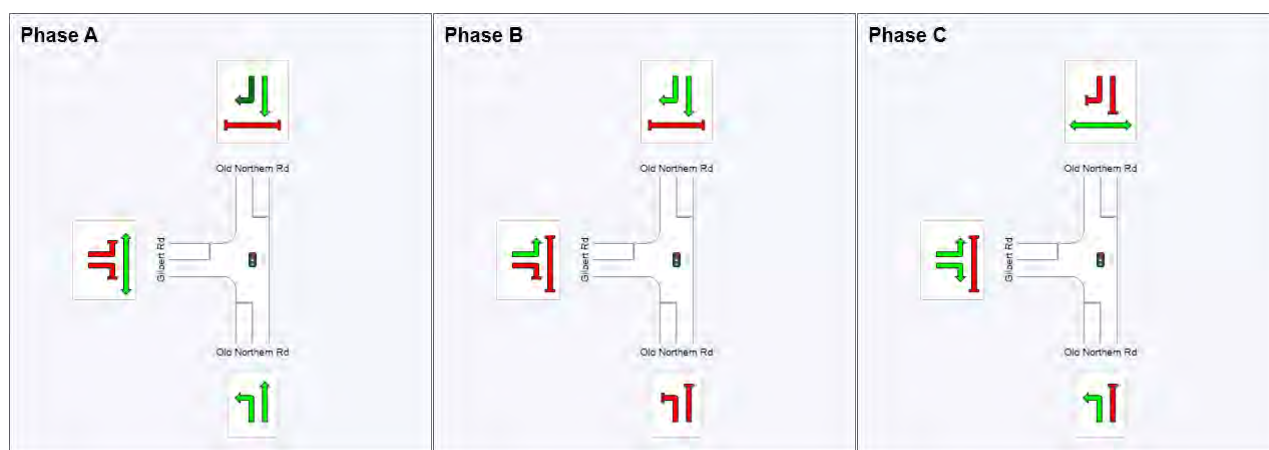
### PM Movement Summary for 2016 Existing Situation

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued per veh	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %				Vehicles veh	Distance m			
South: Old Northern Rd											
1	L2	363	2.6	0.615	24.1	LOS B	18.0	130.3	0.62	0.76	43.0
2	T1	856	5.9	0.937	42.6	LOS D	44.0	323.3	0.78	0.86	35.1
Approach		1219	4.9	0.937	37.1	LOS C	44.0	323.3	0.73	0.83	37.1
North: Old Northern Rd											
8	T1	466	6.5	0.199	8.2	LOS A	6.2	45.9	0.38	0.33	52.9
9	R2	229	5.0	0.526	55.7	LOS D	13.5	98.5	0.92	0.98	30.8
Approach		696	6.1	0.526	23.8	LOS B	13.5	98.5	0.56	0.54	42.8
West: Gilbert Rd											
10	L2	218	3.9	0.648	55.9	LOS D	18.8	135.7	0.95	0.84	30.8
12	R2	417	2.3	0.800	63.4	LOS E	22.7	161.9	0.99	0.88	29.0
Approach		635	2.8	0.800	60.8	LOS E	22.7	161.9	0.97	0.87	29.6
All Vehicles		2549	4.7	0.937	39.4	LOS C	44.0	323.3	0.74	0.76	36.1

### PM Phasing Summary

#### Phase Timing Results

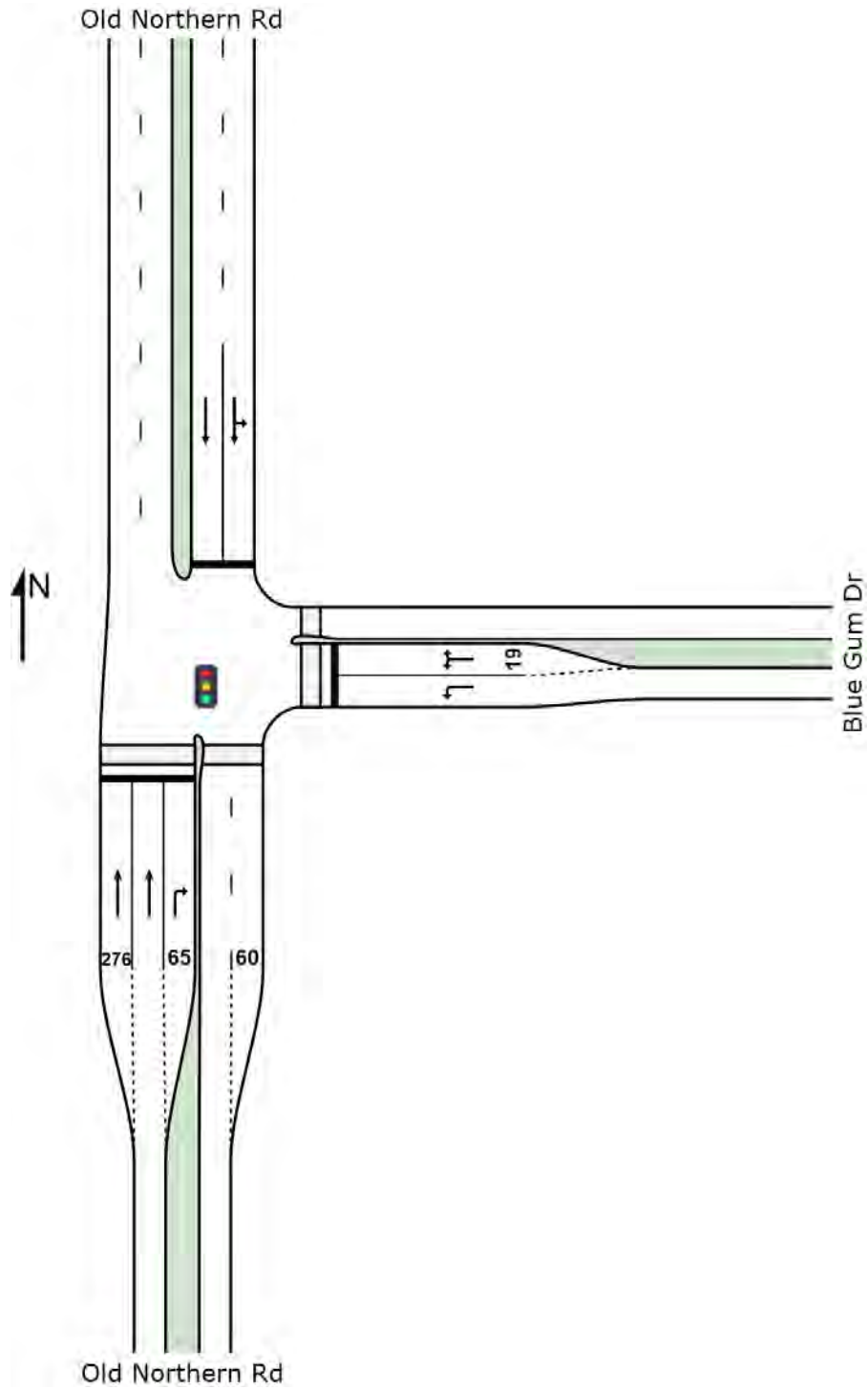
Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	39	59
Green Time (sec)	33	14	31
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	39	20	37
Phase Split	41 %	21 %	39 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

# 2016 EXISTING SITUATION

## Intersection of Old Northern Road and Blue Gum Drive



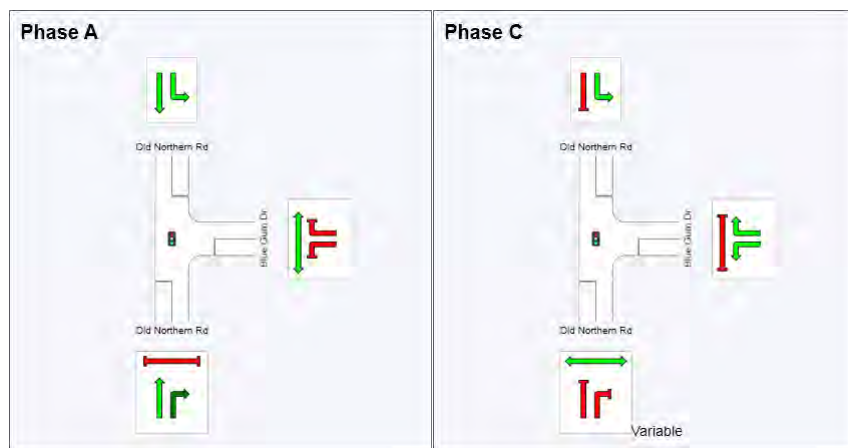
### AM Movement Summary for 2016 Existing Situation

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %				Vehicles veh	Distance m			
South: Old Northern Rd											
2	T1	742	6.1	0.434	11.9	LOS A	7.1	52.3	0.71	0.61	50.1
3	R2	13	16.7	0.043	15.7	LOS B	0.2	1.6	0.56	0.66	46.2
Approach		755	6.3	0.434	12.0	LOS A	7.1	52.3	0.70	0.61	50.1
East: Blue Gum Dr											
4	L2	15	14.3	0.028	19.9	LOS B	0.3	2.3	0.68	0.66	44.0
6	R2	7	0.0	0.028	19.8	LOS B	0.3	2.3	0.68	0.67	44.2
Approach		22	9.5	0.028	19.8	LOS B	0.3	2.3	0.68	0.66	44.0
North: Old Northern Rd											
7	L2	9	0.0	0.264	16.2	LOS B	3.9	28.1	0.64	0.55	49.7
8	T1	869	3.1	0.744	13.6	LOS A	15.1	108.8	0.81	0.71	49.0
Approach		879	3.1	0.744	13.6	LOS A	15.1	108.8	0.81	0.71	49.0
All Vehicles		1656	4.6	0.744	13.0	LOS A	15.1	108.8	0.76	0.66	49.4

### AM Phasing Summary

#### Phase Timing Results

Phase	A	C
Reference Phase	Yes	No
Phase Change Time (sec)	0	32
Green Time (sec)	26	19
Yellow Time (sec)	4	4
All-Red Time (sec)	2	2
Phase Time (sec)	32	25
Phase Split	56 %	44 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

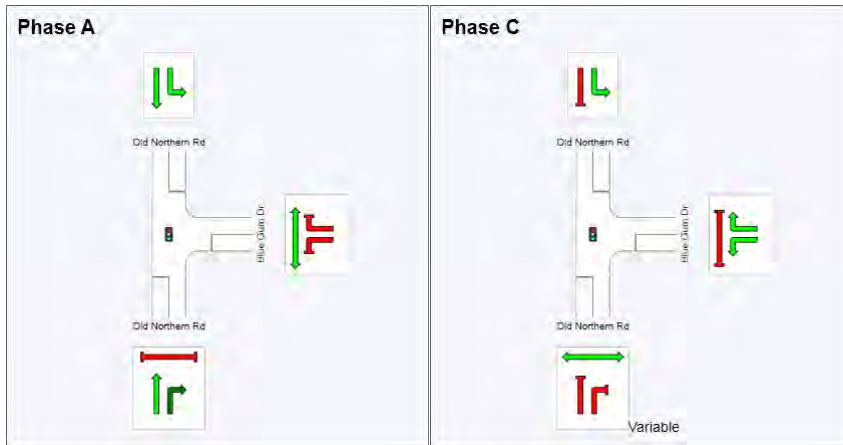
### PM Movement Summary for 2016 Existing Situation

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %				Vehicles veh	Distance m			
South: Old Northern Rd											
2	T1	1055	5.5	0.675	14.5	LOS A	11.4	83.3	0.85	0.75	48.5
3	R2	22	0.0	0.059	16.2	LOS B	0.4	2.5	0.61	0.68	46.3
Approach		1077	5.4	0.675	14.5	LOS B	11.4	83.3	0.85	0.74	48.4
East: Blue Gum Dr											
4	L2	18	0.0	0.027	17.7	LOS B	0.3	2.1	0.65	0.66	45.5
6	R2	6	0.0	0.027	17.8	LOS B	0.3	2.1	0.65	0.67	45.3
Approach		24	0.0	0.027	17.7	LOS B	0.3	2.1	0.65	0.66	45.4
North: Old Northern Rd											
7	L2	11	0.0	0.227	16.4	LOS B	2.9	21.2	0.66	0.56	49.5
8	T1	662	6.7	0.639	13.3	LOS A	10.5	77.5	0.79	0.69	49.1
Approach		673	6.6	0.639	13.4	LOS A	10.5	77.5	0.79	0.68	49.1
All Vehicles		1774	5.8	0.675	14.1	LOS A	11.4	83.3	0.82	0.72	48.6

### PM Phasing Summary

#### Phase Timing Results

Phase	A	C
Reference Phase	Yes	No
Phase Change Time (sec)	0	32
Green Time (sec)	26	19
Yellow Time (sec)	4	4
All-Red Time (sec)	2	2
Phase Time (sec)	32	25
Phase Split	56 %	44 %

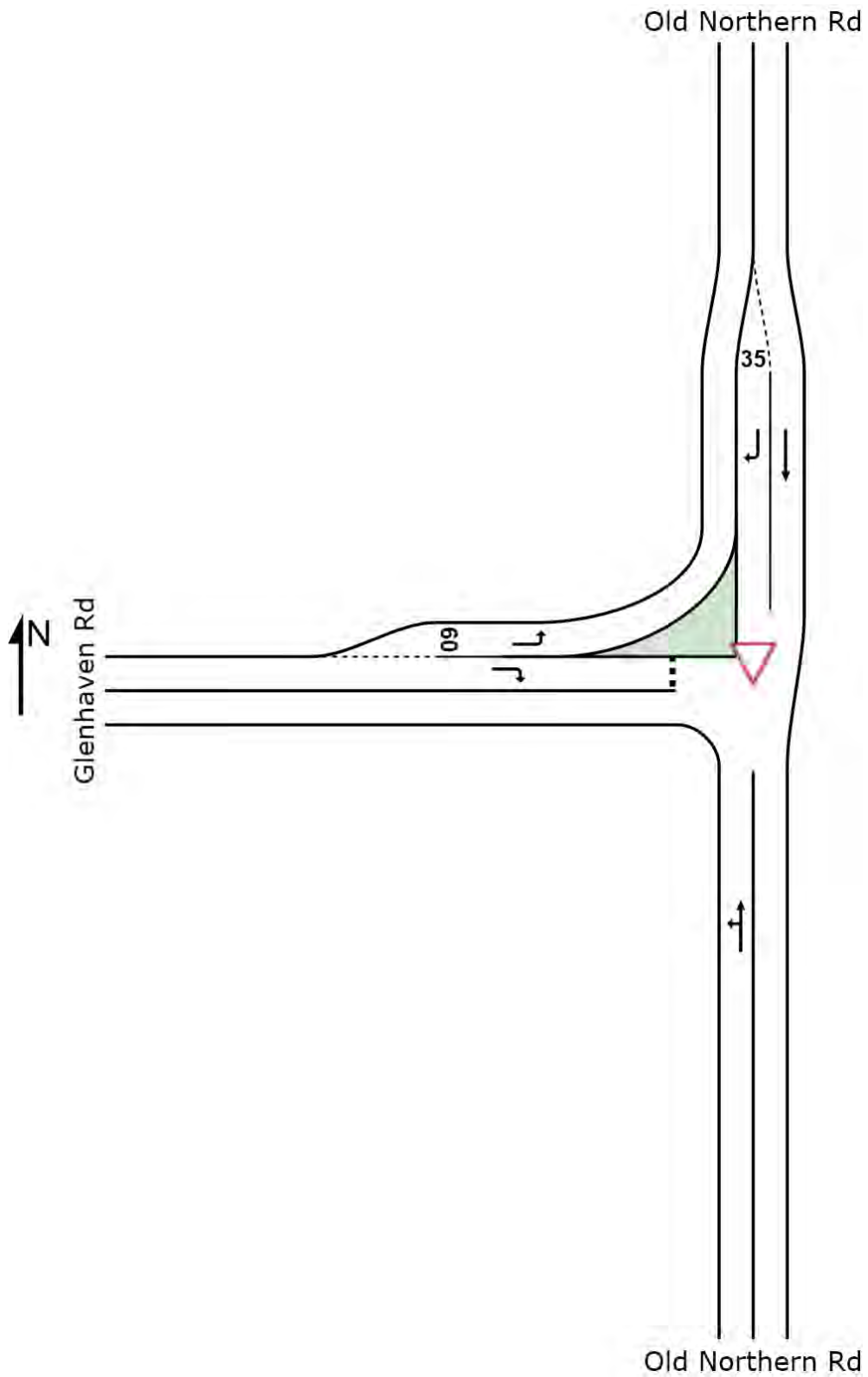


	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied



# 2016 EXISTING SITUATION

## Intersection of Old Northern Road and Glenhaven Road



## AM Movement Summary for 2016 Existing Situation

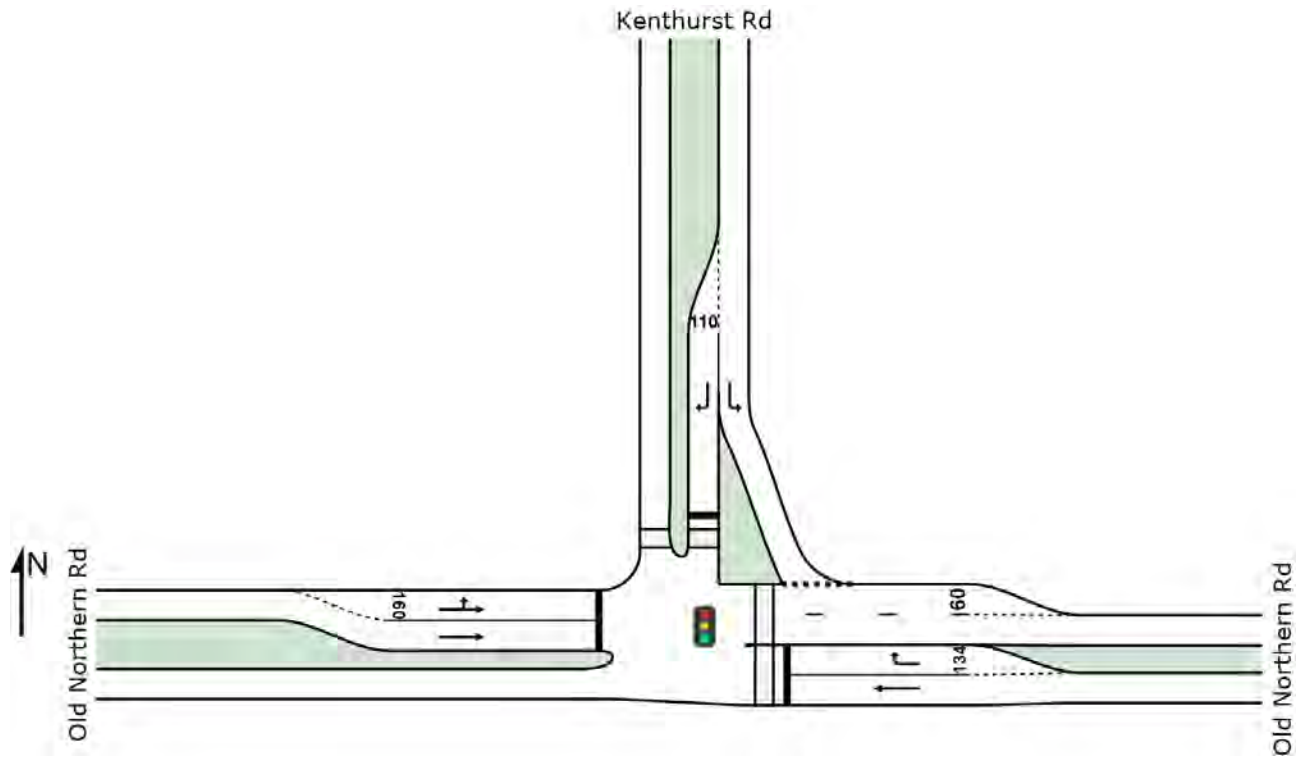
Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %				Vehicles veh	Distance m			
South: Old Northern Rd											
1	L2	237	0.4	0.494	5.6	LOS A	0.0	0.0	0.00	0.15	56.9
2	T1	685	6.5	0.494	0.1	LOS A	0.0	0.0	0.00	0.15	58.4
Approach		922	4.9	0.494	1.5	NA	0.0	0.0	0.00	0.15	58.0
North: Old Northern Rd											
8	T1	744	3.4	0.390	0.1	LOS A	0.0	0.0	0.00	0.00	59.9
9	R2	240	5.3	0.479	15.8	LOS B	2.4	17.7	0.83	1.04	46.3
Approach		984	3.9	0.479	3.9	NA	2.4	17.7	0.20	0.25	55.9
West: Glenhaven Rd											
10	L2	496	1.7	0.270	5.7	LOS A	0.0	0.0	0.00	0.53	54.8
12	R2	136	0.8	1.067	193.9	LOS F	13.2	93.1	1.00	1.86	14.2
Approach		632	1.5	1.067	46.1	LOS D	13.2	93.1	0.22	0.82	34.1
All Vehicles		2538	3.6	1.067	13.5	NA	13.2	93.1	0.13	0.36	48.7

## PM Movement Summary for 2016 Existing Situation

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %				Vehicles veh	Distance m			
South: Old Northern Rd											
1	L2	384	1.6	0.599	5.7	LOS A	0.0	0.0	0.00	0.20	56.3
2	T1	733	5.7	0.599	0.1	LOS A	0.0	0.0	0.00	0.20	57.9
Approach		1117	4.3	0.599	2.0	NA	0.0	0.0	0.00	0.20	57.3
North: Old Northern Rd											
8	T1	592	7.3	0.318	0.0	LOS A	0.0	0.0	0.00	0.00	59.9
9	R2	407	4.4	0.951	42.7	LOS D	11.0	80.0	0.98	1.92	34.5
Approach		999	6.1	0.951	17.5	NA	11.0	80.0	0.40	0.78	46.1
West: Glenhaven Rd											
10	L2	354	1.8	0.193	5.6	LOS A	0.0	0.0	0.00	0.53	54.9
12	R2	56	3.8	0.646	94.4	LOS F	2.6	18.6	0.98	1.09	23.1
Approach		409	2.1	0.646	17.7	LOS B	2.6	18.6	0.13	0.60	46.3
All Vehicles		2525	4.7	0.951	10.7	NA	11.0	80.0	0.18	0.50	50.5

# 2016 EXISTING SITUATION

## Intersection of Old Northern Road and Kenthurst Road



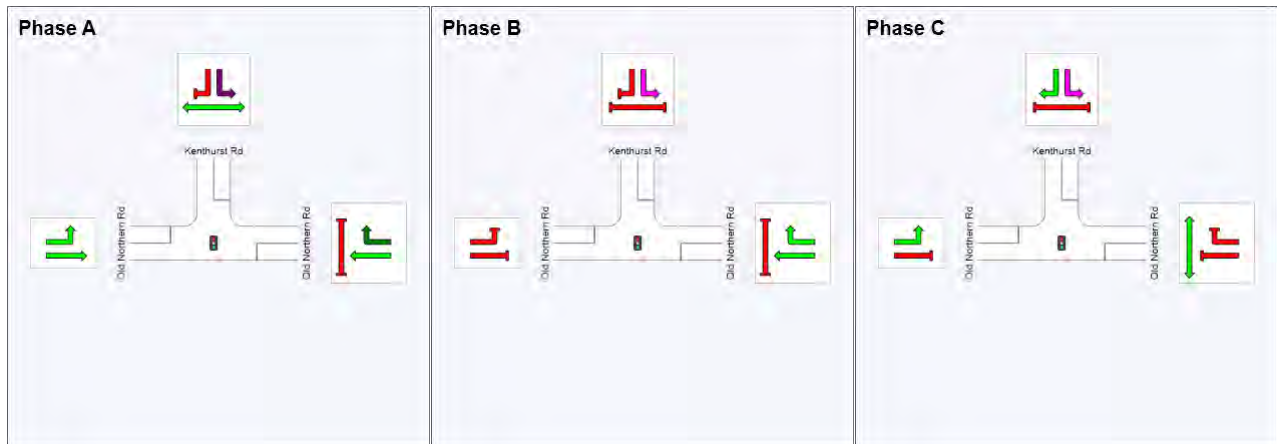
### AM Movement Summary for 2016 Existing Situation

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %				Vehicles veh	Distance m			
East: Old Northern Rd											
5	T1	515	6.1	0.454	15.8	LOS B	18.6	137.3	0.59	0.53	47.6
6	R2	398	4.2	0.980	109.1	LOS F	34.3	249.0	1.00	1.26	21.3
Approach		913	5.3	0.980	56.5	LOS D	34.3	249.0	0.77	0.85	30.9
North: Kenthurst Rd											
7	L2	559	2.6	0.538	17.1	LOS B	19.4	139.1	0.60	0.76	46.3
9	R2	436	2.7	0.767	52.5	LOS D	27.0	193.3	0.97	0.88	31.6
Approach		995	2.6	0.767	32.6	LOS C	27.0	193.3	0.76	0.81	38.5
West: Old Northern Rd											
10	L2	287	5.9	0.265	6.1	LOS A	0.6	4.8	0.03	0.47	53.9
11	T1	662	5.9	0.747	16.9	LOS B	24.9	183.2	0.61	0.60	46.6
Approach		949	5.9	0.747	13.6	LOS A	24.9	183.2	0.43	0.56	48.6
All Vehicles		2857	4.6	0.980	33.9	LOS C	34.3	249.0	0.65	0.74	38.1

### AM Phasing Summary

#### Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	63	90
Green Time (sec)	57	21	43
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	63	27	49
Phase Split	45 %	19 %	35 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

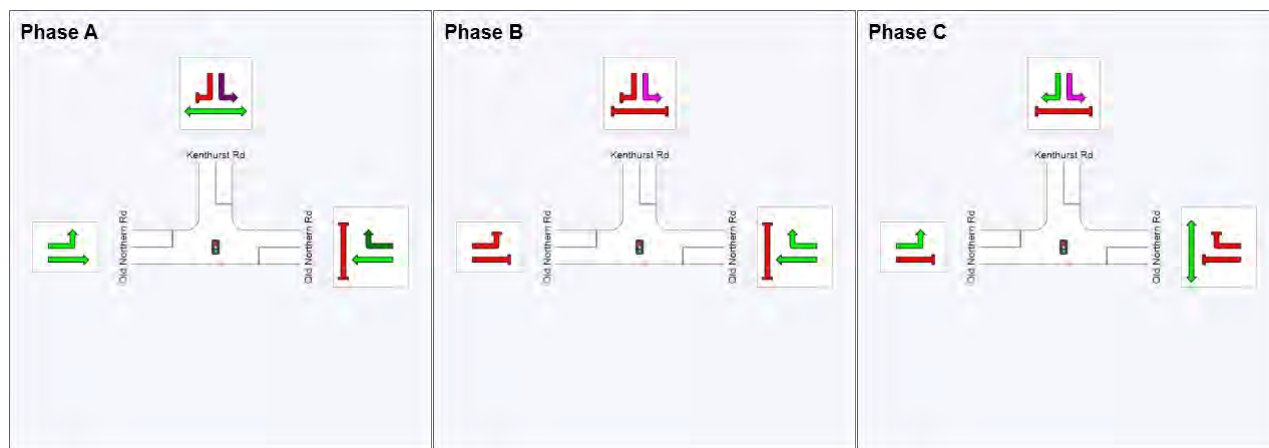
### PM Movement Summary for 2016 Existing Situation

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %				Vehicles veh	Distance m			
East: Old Northern Rd											
5	T1	551	7.1	0.450	8.1	LOS A	11.7	86.7	0.53	0.47	53.0
6	R2	521	9.5	0.969	76.7	LOS F	29.6	223.8	1.00	1.29	26.2
Approach		1072	8.3	0.969	41.4	LOS C	29.6	223.8	0.76	0.87	35.3
North: Kenthurst Rd											
7	L2	531	2.8	0.538	12.9	LOS A	11.2	80.5	0.61	0.76	48.8
9	R2	336	4.7	0.899	56.6	LOS E	17.7	128.9	1.00	1.00	30.5
Approach		866	3.5	0.899	29.9	LOS C	17.7	128.9	0.76	0.85	39.6
West: Old Northern Rd											
10	L2	371	7.7	0.338	6.1	LOS A	0.5	3.6	0.03	0.58	52.9
11	T1	546	6.9	0.850	22.9	LOS B	21.7	161.3	0.89	0.86	43.6
Approach		917	7.2	0.850	16.1	LOS B	21.7	161.3	0.54	0.75	46.9
All Vehicles		2855	6.5	0.969	29.8	LOS C	29.6	223.8	0.69	0.82	39.8

### PM Phasing Summary

#### Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	37	65
Green Time (sec)	31	22	19
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	37	28	25
Phase Split	41 %	31 %	28 %

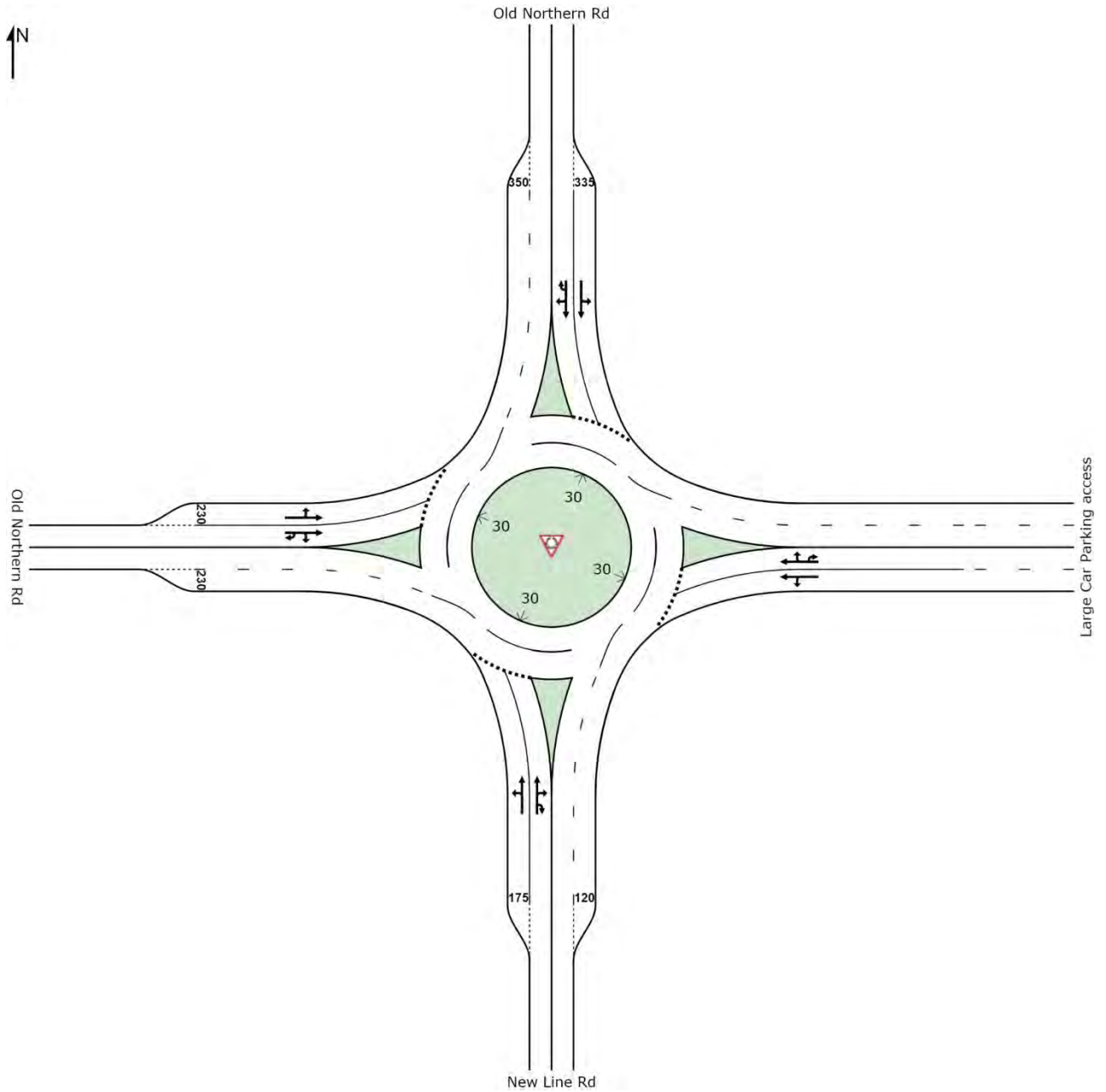


	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied



# 2016 EXISTING SITUATION

## Intersection of Old Northern Road and New Line Road



## AM Movement Summary for 2016 Existing Situation

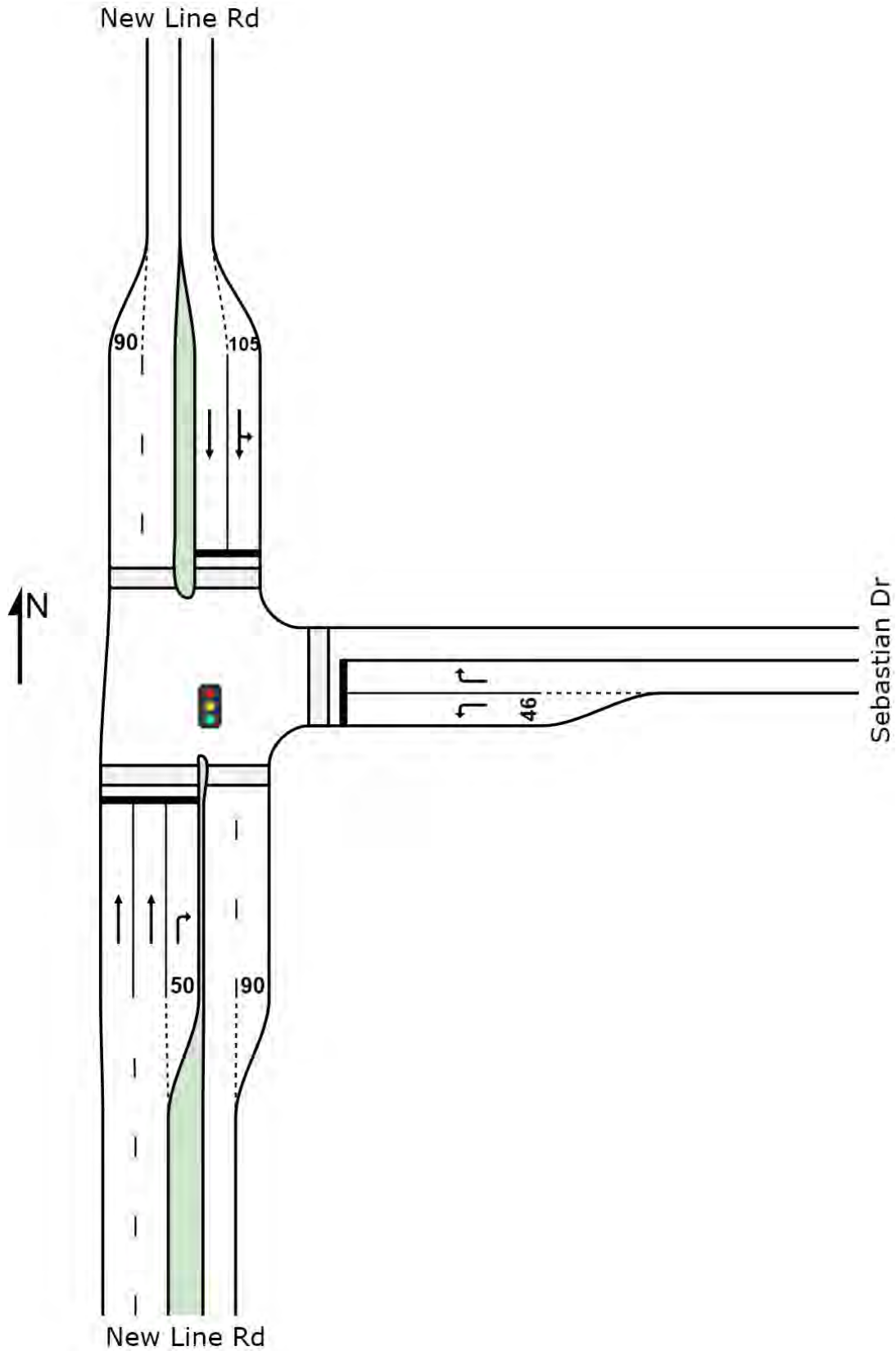
Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %				Vehicles veh	Distance m			
South: New Line Rd											
1	L2	311	6.4	0.786	12.1	LOS A	9.8	72.2	0.97	1.14	50.0
2	T1	775	5.7	0.786	12.7	LOS A	9.8	72.2	0.97	1.16	50.5
3	R2	84	1.3	0.786	19.0	LOS B	9.1	67.3	0.97	1.17	35.6
3u	U	100	14.7	0.786	21.6	LOS B	9.1	67.3	0.97	1.17	50.5
Approach		1269	6.3	0.786	13.7	LOS A	9.8	72.2	0.97	1.15	49.6
East: Large Car Parking access											
4	L2	75	9.9	0.298	11.8	LOS A	1.9	14.5	0.96	0.98	43.8
5	T1	72	7.4	0.298	13.4	LOS A	1.9	14.5	0.94	0.98	43.7
6	R2	48	4.3	0.298	20.0	LOS B	1.7	12.2	0.92	0.97	41.5
6u	U	1	0.0	0.298	22.4	LOS B	1.7	12.2	0.92	0.97	11.0
Approach		196	7.5	0.298	14.5	LOS A	1.9	14.5	0.94	0.98	43.0
North: Old Northern Rd											
7	L2	83	2.5	0.865	24.2	LOS B	13.9	100.3	1.00	1.37	28.2
8	T1	738	4.3	1.057	47.4	LOS D	56.5	410.8	1.00	1.90	34.4
9	R2	558	4.5	1.057	93.7	LOS F	56.5	410.8	1.00	2.83	25.0
9u	U	3	0.0	1.057	96.0	LOS F	56.5	410.8	1.00	2.83	25.3
Approach		1382	4.3	1.057	64.8	LOS E	56.5	410.8	1.00	2.25	29.5
West: Old Northern Rd											
10	L2	705	4.8	0.946	25.0	LOS B	16.5	120.3	1.00	1.54	42.5
11	T1	74	2.9	0.926	24.9	LOS B	12.8	92.8	1.00	1.44	28.6
12	R2	455	4.2	0.926	30.6	LOS C	12.8	92.8	1.00	1.44	42.0
12u	U	20	0.0	0.926	32.9	LOS C	12.8	92.8	1.00	1.44	42.9
Approach		1254	4.4	0.946	27.1	LOS B	16.5	120.3	1.00	1.50	41.6
All Vehicles		4101	5.1	1.057	35.0	LOS C	56.5	410.8	0.99	1.62	38.1

## PM Movement Summary for 2016 Existing Situation

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %				Vehicles veh	Distance m			
South: New Line Rd											
1	L2	337	7.8	0.832	16.6	LOS B	11.6	86.0	1.00	1.27	47.1
2	T1	671	5.8	0.832	17.6	LOS B	11.6	86.0	1.00	1.27	47.3
3	R2	76	1.4	0.832	24.2	LOS B	10.5	77.9	1.00	1.27	32.8
3u	U	87	16.9	0.832	26.7	LOS B	10.5	77.9	1.00	1.27	47.3
Approach		1171	6.9	0.832	18.4	LOS B	11.6	86.0	1.00	1.27	46.5
East: Large Car Parking access											
4	L2	135	13.3	0.475	17.3	LOS B	3.5	27.0	0.99	1.08	39.0
5	T1	111	9.5	0.475	19.8	LOS B	3.5	27.0	0.96	1.07	38.4
6	R2	59	0.0	0.475	26.1	LOS B	3.0	21.9	0.94	1.06	37.6
6u	U	1	0.0	0.475	28.5	LOS B	3.0	21.9	0.94	1.06	9.5
Approach		305	9.3	0.475	19.9	LOS B	3.5	27.0	0.97	1.07	38.4
North: Old Northern Rd											
7	L2	87	1.2	0.772	14.0	LOS A	8.1	59.1	0.94	1.15	32.8
8	T1	645	4.9	0.943	17.7	LOS B	21.0	154.1	0.96	1.29	47.2
9	R2	593	6.2	0.943	31.8	LOS C	21.0	154.1	1.00	1.60	41.7
9u	U	18	0.0	0.943	34.1	LOS C	21.0	154.1	1.00	1.60	42.6
Approach		1343	5.2	0.943	23.9	LOS B	21.0	154.1	0.98	1.42	43.8
West: Old Northern Rd											
10	L2	563	6.2	0.819	12.8	LOS A	9.1	66.3	0.97	1.18	49.4
11	T1	137	0.0	0.819	13.4	LOS A	9.1	66.3	0.96	1.19	34.6
12	R2	455	3.5	0.819	20.2	LOS B	8.3	59.8	0.96	1.19	47.3
12u	U	22	4.8	0.819	22.6	LOS B	8.3	59.8	0.96	1.19	48.3
Approach		1177	4.4	0.819	15.9	LOS B	9.1	66.3	0.96	1.19	47.1
All Vehicles		3996	5.8	0.943	19.6	LOS B	21.0	154.1	0.98	1.28	45.3

# 2016 EXISTING SITUATION

## Intersection of New Line Road and Sebastian Drive



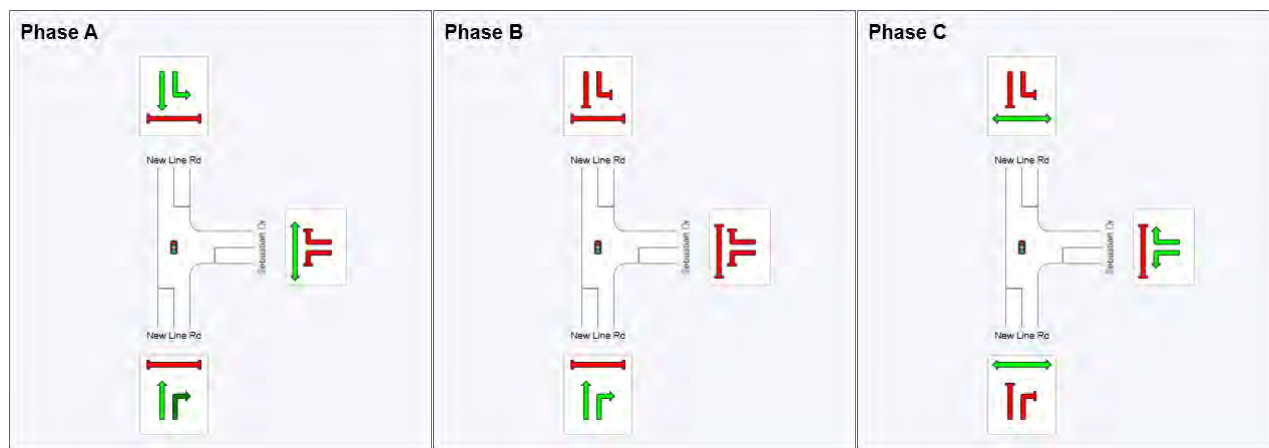
### AM Movement Summary for 2016 Existing Situation

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %				Vehicles veh	Distance m			
South: New Line Rd											
2	T1	1156	5.9	0.578	1.0	LOS A	3.1	22.6	0.10	0.09	59.0
3	R2	35	6.1	0.100	24.2	LOS B	0.9	6.8	0.76	0.72	41.9
Approach		1191	5.9	0.578	1.7	LOS A	3.1	22.6	0.12	0.11	58.3
East: Sebastian Dr											
4	L2	101	2.1	0.425	40.5	LOS C	3.7	26.2	0.96	0.77	35.4
6	R2	75	5.6	0.322	40.0	LOS C	2.7	19.7	0.95	0.76	35.4
Approach		176	3.6	0.425	40.3	LOS C	3.7	26.2	0.96	0.77	35.4
North: New Line Rd											
7	L2	46	9.1	0.390	17.6	LOS B	8.7	62.6	0.64	0.59	48.2
8	T1	1127	3.0	0.795	16.6	LOS B	26.0	186.6	0.81	0.77	47.0
Approach		1174	3.2	0.795	16.7	LOS B	26.0	186.6	0.81	0.76	47.0
All Vehicles		2540	4.5	0.795	11.3	LOS A	26.0	186.6	0.49	0.45	50.5

### AM Phasing Summary

#### Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	46	61
Green Time (sec)	40	9	10
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	46	15	16
Phase Split	60 %	19 %	21 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

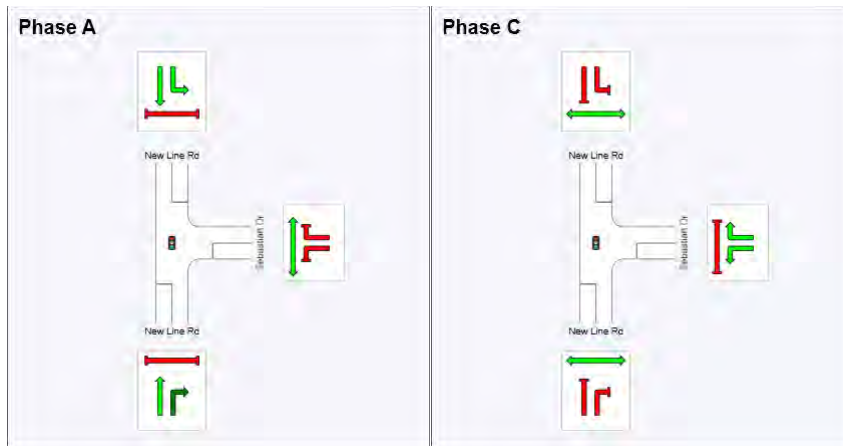
### PM Movement Summary for 2016 Existing Situation

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %				Vehicles veh	Distance m			
South: New Line Rd											
2	T1	1076	6.7	0.530	0.5	LOS A	1.5	10.8	0.06	0.05	59.5
3	R2	93	8.0	0.473	19.1	LOS B	2.3	16.9	0.69	0.76	44.5
Approach		1168	6.8	0.530	2.0	LOS A	2.3	16.9	0.11	0.11	58.0
East: Sebastian Dr											
4	L2	93	2.3	0.507	40.1	LOS C	3.2	23.0	0.99	0.77	35.5
6	R2	71	7.5	0.400	39.7	LOS C	2.4	18.1	0.98	0.76	35.5
Approach		163	4.5	0.507	40.0	LOS C	3.2	23.0	0.98	0.76	35.5
North: New Line Rd											
7	L2	98	3.2	0.312	9.1	LOS A	5.0	36.9	0.38	0.42	54.0
8	T1	1195	6.0	0.636	4.7	LOS A	14.9	110.0	0.50	0.48	55.4
Approach		1293	5.8	0.636	5.1	LOS A	14.9	110.0	0.49	0.47	55.3
All Vehicles		2624	6.1	0.636	5.9	LOS A	14.9	110.0	0.35	0.33	54.5

### PM Phasing Summary

#### Phase Timing Results

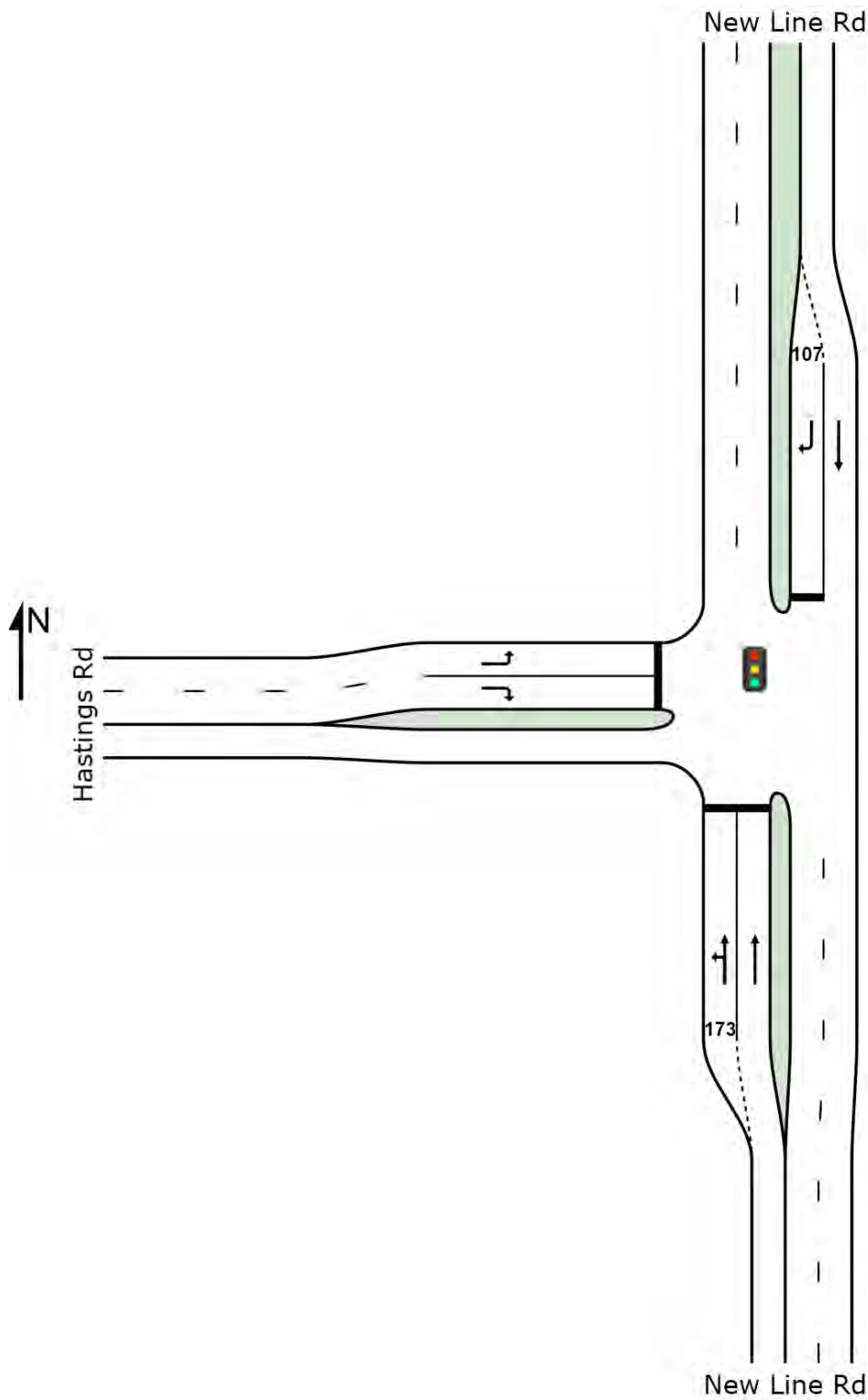
Phase	A	C
Reference Phase	Yes	No
Phase Change Time (sec)	0	57
Green Time (sec)	51	7
Yellow Time (sec)	4	4
All-Red Time (sec)	2	2
Phase Time (sec)	57	13
Phase Split	81 %	19 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

# 2016 EXISTING SITUATION

## Intersection of New Line Road and Hastings Road





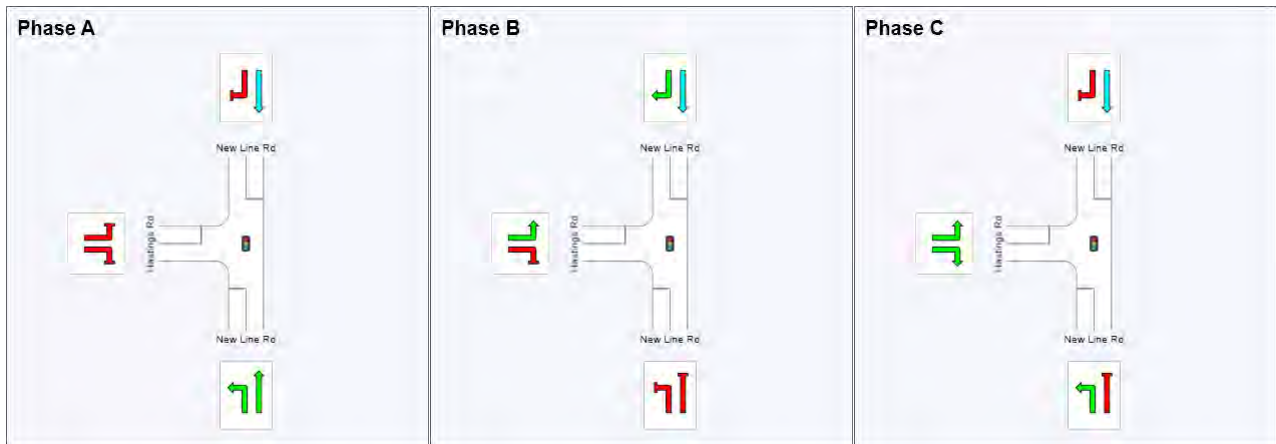
### AM Movement Summary for 2016 Existing Situation

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %				Vehicles veh	Distance m			
South: New Line Rd											
1	L2	508	1.2	0.802	14.7	LOS B	19.6	140.4	0.57	0.76	48.2
2	T1	886	7.1	0.802	13.1	LOS A	24.6	182.5	0.65	0.66	48.8
Approach		1395	5.0	0.802	13.7	LOS A	24.6	182.5	0.62	0.69	48.6
North: New Line Rd											
8	T1	864	3.9	0.454	0.1	LOS A	0.0	0.0	0.00	0.00	59.9
9	R2	364	0.6	1.010	87.4	LOS F	28.7	202.1	1.00	1.06	24.4
Approach		1228	2.9	1.010	26.0	LOS B	28.7	202.1	0.30	0.31	41.8
West: Hastings Rd											
10	L2	309	2.4	0.370	27.8	LOS B	11.5	82.2	0.70	0.78	40.4
12	R2	469	1.6	1.160	202.7	LOS F	57.1	405.3	1.00	1.35	13.7
Approach		779	1.9	1.160	133.2	LOS F	57.1	405.3	0.88	1.12	18.6
All Vehicles		3402	3.5	1.160	45.5	LOS D	57.1	405.3	0.56	0.65	34.0

### AM Phasing Summary

#### Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	59	87
Green Time (sec)	53	22	25
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	59	28	31
Phase Split	50 %	24 %	26 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

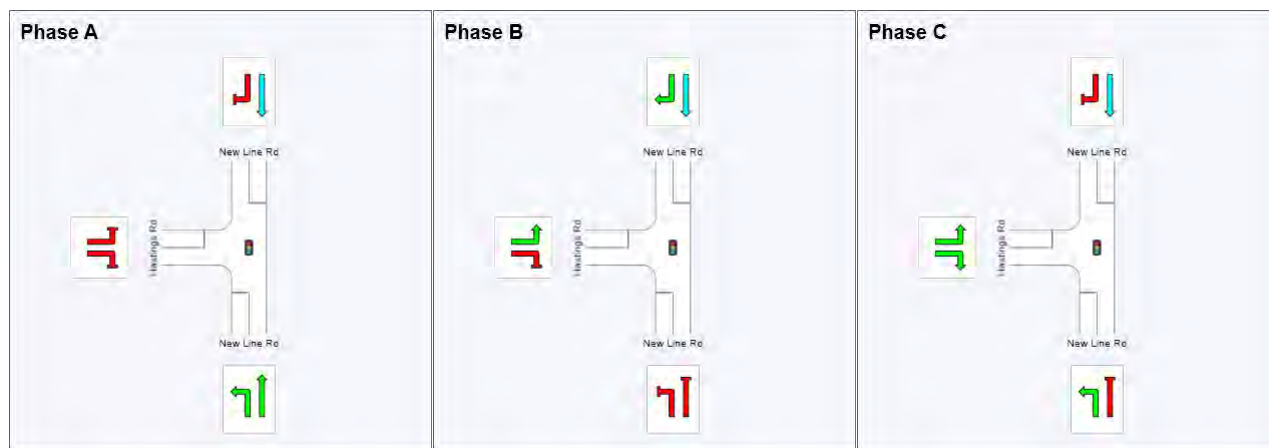
### PM Movement Summary for 2016 Existing Situation

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %				Vehicles veh	Distance m			
South: New Line Rd											
1	L2	435	2.2	0.798	16.6	LOS B	20.4	148.1	0.61	0.76	47.3
2	T1	903	8.0	0.798	13.9	LOS A	24.0	179.5	0.67	0.67	48.2
Approach		1338	6.1	0.798	14.8	LOS B	24.0	179.5	0.65	0.70	47.9
North: New Line Rd											
8	T1	958	6.6	0.512	0.1	LOS A	0.0	0.0	0.00	0.00	59.8
9	R2	322	3.9	0.940	61.1	LOS E	20.7	150.1	1.00	0.96	29.5
Approach		1280	5.9	0.940	15.4	LOS B	20.7	150.1	0.25	0.24	47.5
West: Hastings Rd											
10	L2	266	1.2	0.311	14.2	LOS A	4.4	31.1	0.31	0.66	47.6
12	R2	384	1.6	0.899	50.3	LOS D	22.7	161.3	1.00	0.93	32.2
Approach		651	1.5	0.899	35.5	LOS C	22.7	161.3	0.72	0.82	37.1
All Vehicles		3268	5.1	0.940	19.2	LOS B	24.0	179.5	0.51	0.54	45.1

### PM Phasing Summary

#### Phase Timing Results

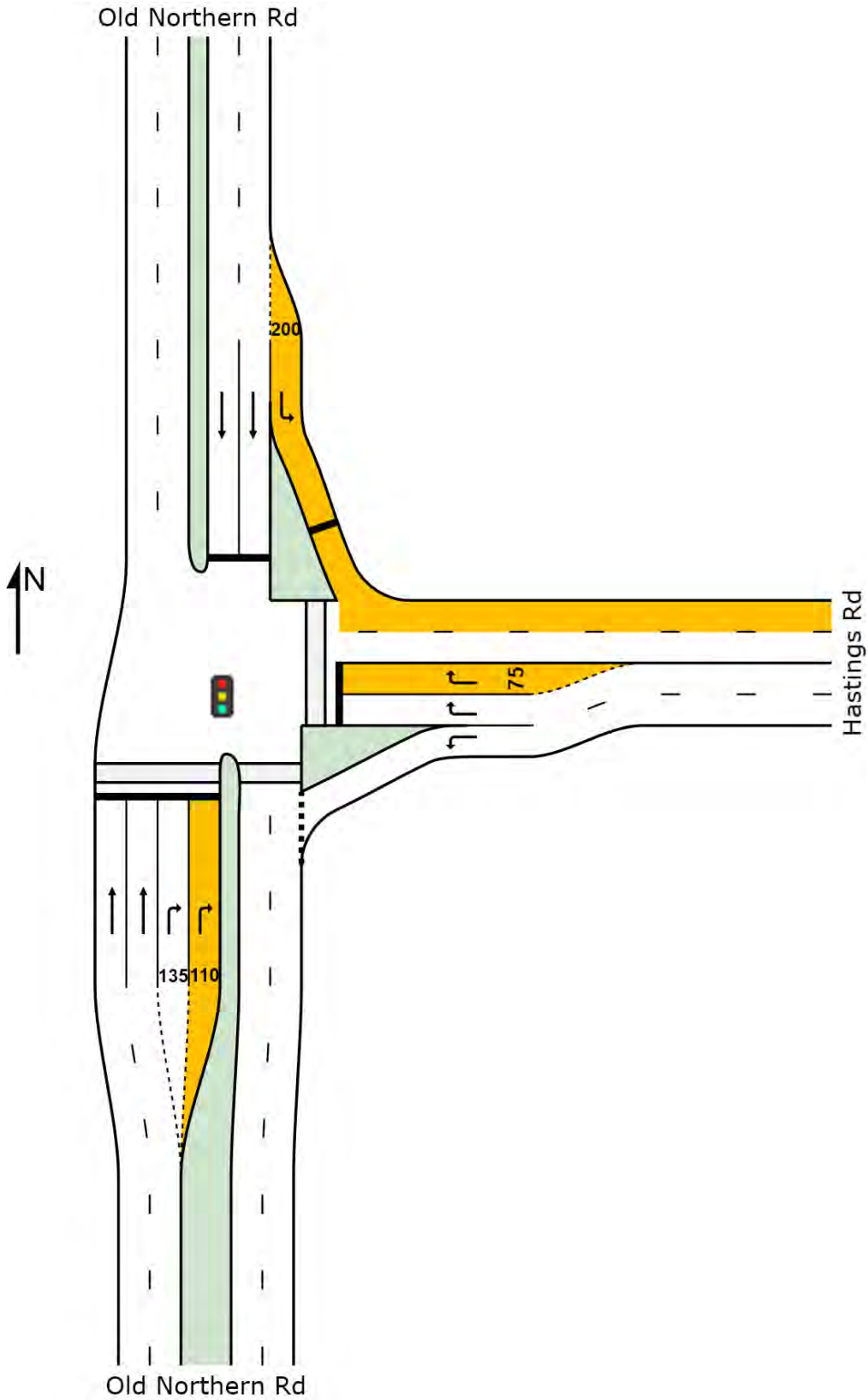
Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	57	84
Green Time (sec)	51	21	26
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	57	27	32
Phase Split	49 %	23 %	28 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

# 2036 FUTURE WITH DEVELOPMENT

## Intersection of Old Northern Road and Hastings Road



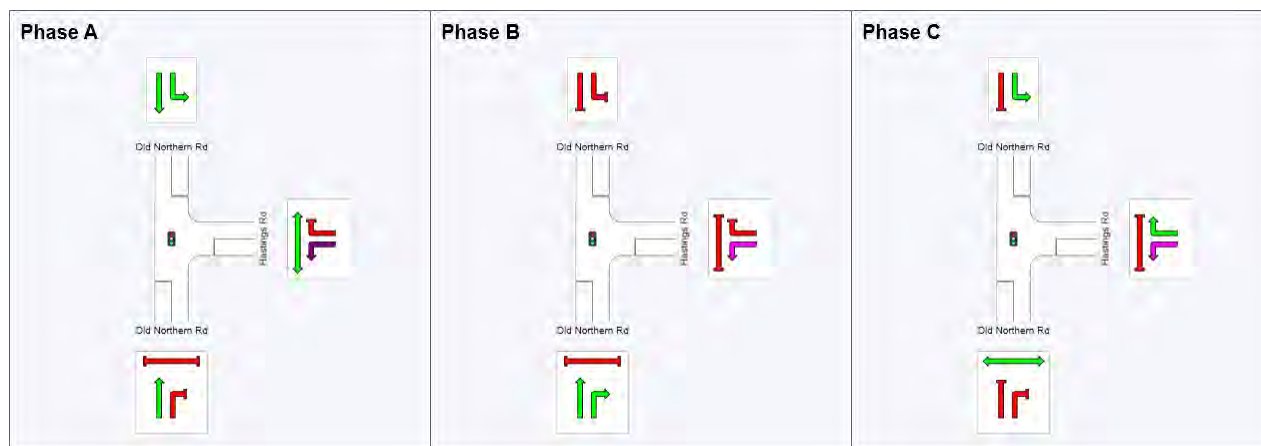
### AM Movement Summary for 2036 Future Base with Development

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %				Vehicles veh	Distance m			
South: Old Northern Rd											
2	T1	726	8.4	0.269	0.7	LOS A	0.8	5.9	0.04	0.03	59.2
3	R2	412	1.4	1.119	197.7	LOS F	24.6	174.2	1.00	1.33	14.1
Approach		1138	5.9	1.119	71.9	LOS F	24.6	174.2	0.39	0.50	25.7
East: Hastings Rd											
4	L2	634	1.5	1.036	95.1	LOS F	58.0	410.9	1.00	1.20	23.4
6	R2	595	0.4	0.908	74.3	LOS F	21.0	147.5	1.00	0.96	23.9
Approach		1228	1.0	1.036	85.1	LOS F	58.0	410.9	1.00	1.08	23.6
North: Old Northern Rd											
7	L2	748	1.9	0.506	9.9	LOS A	15.1	107.1	0.35	0.68	49.4
8	T1	2003	3.2	0.897	21.3	LOS B	51.0	366.7	0.80	0.79	42.2
Approach		2752	2.9	0.897	18.2	LOS B	51.0	366.7	0.68	0.76	43.9
All Vehicles		5118	3.1	1.119	46.2	LOS D	58.0	410.9	0.69	0.78	31.8

### AM Phasing Summary

#### Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	82	101
Green Time (sec)	76	13	23
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	82	19	29
Phase Split	63 %	15 %	22 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

### PM Movement Summary for 2036 Future Base with Development

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %				Vehicles veh	Distance m			
South: Old Northern Rd											
2	T1	1474	6.1	0.786	12.4	LOS A	16.7	122.8	0.75	0.73	48.1
3	R2	487	1.3	0.883	42.4	LOS C	8.7	61.8	1.00	1.06	34.9
Approach		1961	4.9	0.883	19.9	LOS B	16.7	122.8	0.82	0.81	43.4
East: Hastings Rd											
4	L2	360	4.8	0.356	8.2	LOS A	2.4	17.2	0.30	0.64	52.1
6	R2	668	1.5	0.606	19.9	LOS B	7.2	51.4	0.76	0.78	42.1
Approach		1028	2.7	0.606	15.8	LOS B	7.2	51.4	0.60	0.73	45.6
North: Old Northern Rd											
7	L2	526	1.2	0.440	11.2	LOS A	7.6	53.5	0.53	0.73	48.5
8	T1	833	5.6	0.885	31.8	LOS C	14.1	103.7	1.00	1.05	36.8
Approach		1359	3.9	0.885	23.8	LOS B	14.1	103.7	0.82	0.92	40.6
All Vehicles		4348	4.1	0.885	20.1	LOS B	16.7	122.8	0.76	0.83	43.0

### PM Phasing Summary

#### Phase Timing Results

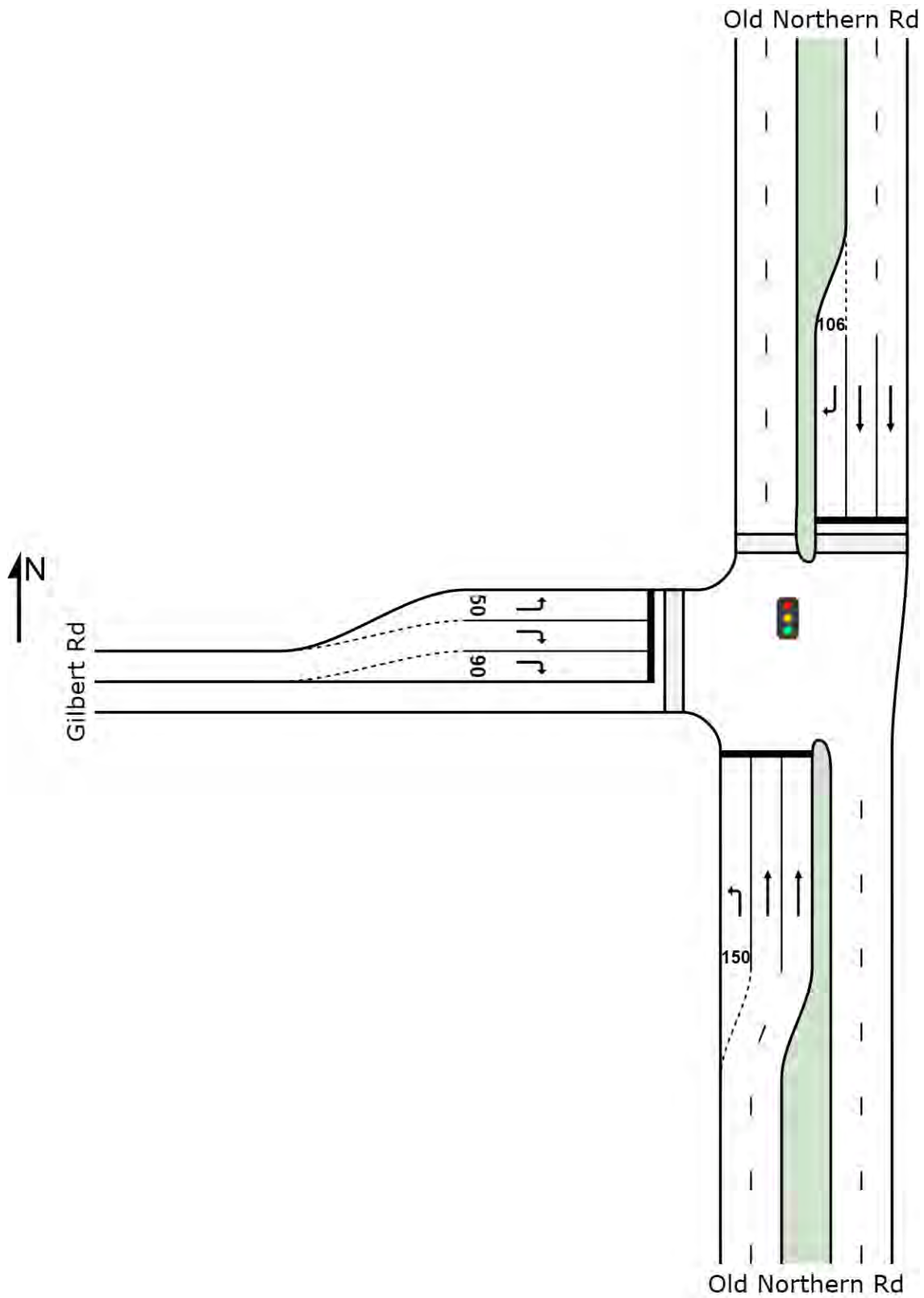
Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	21	36
Green Time (sec)	15	9	18
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	21	15	24
Phase Split	35 %	25 %	40 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

# 2036 FUTURE WITH DEVELOPMENT

## Intersection of Old Northern Road and Gilbert Road





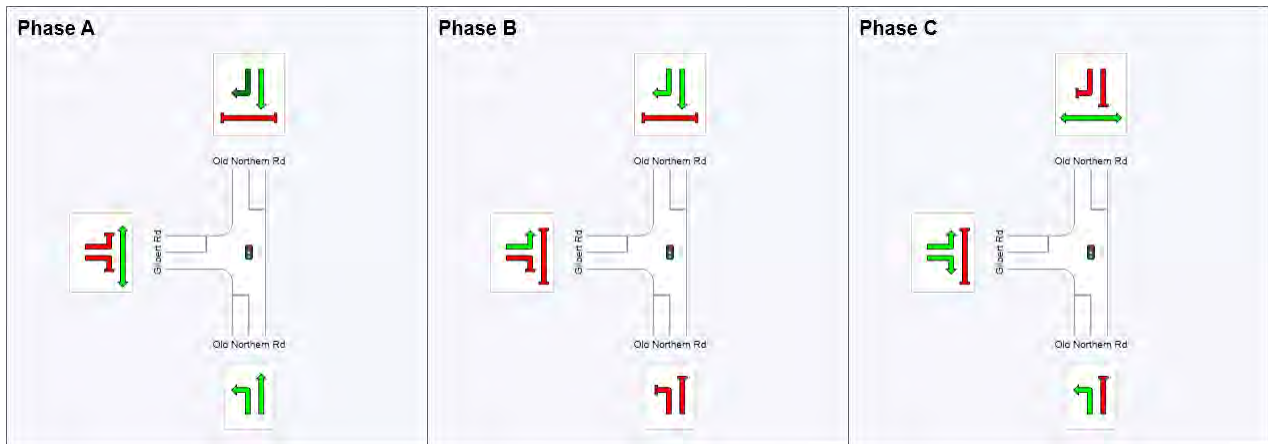
### AM Movement Summary for 2036 Future Base with Development

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows Total veh/h	Deg. Satn 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: Old Northern Rd											
1	L2	511	1.7	0.525	15.6	LOS B	9.9	70.1	0.50	0.73	46.7
2	T1	774	7.3	0.803	35.5	LOS C	15.8	117.6	0.96	0.90	37.9
Approach		1284	5.0	0.803	27.6	LOS B	15.8	117.6	0.78	0.84	41.0
North: Old Northern Rd											
8	T1	2001	4.5	0.802	12.0	LOS A	30.5	222.0	0.79	0.74	50.1
9	R2	539	1.0	0.758	32.6	LOS C	16.2	114.3	0.93	1.01	38.5
Approach		2540	3.8	0.802	16.4	LOS B	30.5	222.0	0.82	0.80	47.1
West: Gilbert Rd											
10	L2	269	3.3	0.247	14.1	LOS A	5.2	37.4	0.50	0.72	47.6
12	R2	638	2.8	0.876	51.6	LOS D	15.3	109.9	1.00	0.99	32.0
Approach		907	2.9	0.876	40.5	LOS C	15.3	109.9	0.85	0.91	35.5
All Vehicles		4732	3.9	0.876	24.0	LOS B	30.5	222.0	0.81	0.83	42.7

### AM Phasing Summary

#### Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	28	62
Green Time (sec)	22	28	17
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	28	34	23
Phase Split	33 %	40 %	27 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

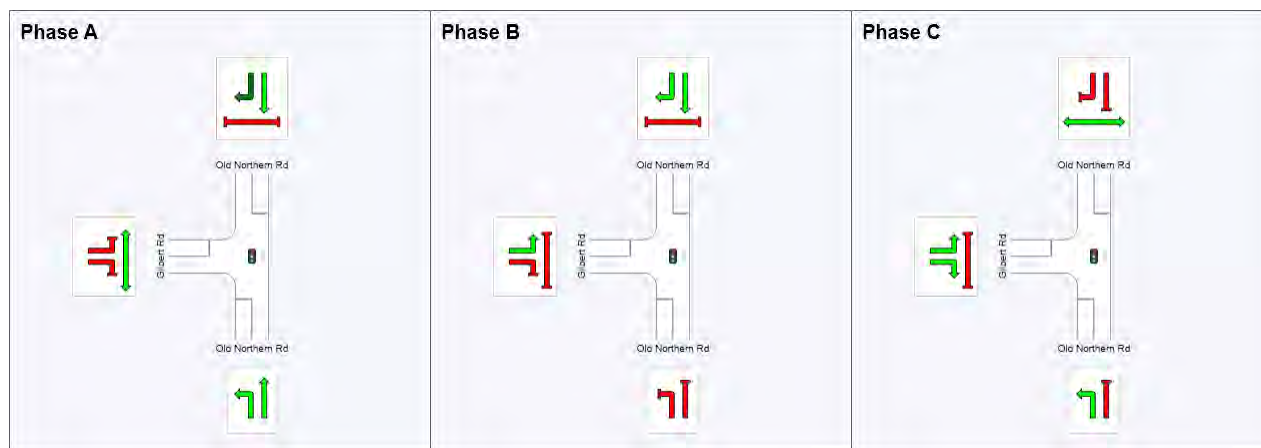
### PM Movement Summary for 2036 Future Base with Development

Movement Performance - Vehicles											
Mov ID	ODMo	Demand Flows	Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Prop. Queued	Effective Stop Rate	Average Speed		
	v	Total	HV	sec		Vehicles		per veh	km/h		
		veh/h	%	v/c		veh	m				
South: Old Northern Rd											
1	L2	478	2.6	0.378	8.4	LOS A	4.0	28.4	0.13	0.62	51.4
2	T1	1621	5.9	0.820	22.6	LOS B	40.9	300.7	0.76	0.70	43.8
Approach		2099	5.2	0.820	19.4	LOS B	40.9	300.7	0.62	0.68	45.3
North: Old Northern Rd											
8	T1	967	6.5	0.326	4.5	LOS A	9.6	70.8	0.30	0.27	55.9
9	R2	487	5.0	1.048	107.0	LOS F	52.1	380.5	1.00	1.16	21.6
Approach		1455	6.0	1.048	38.9	LOS C	52.1	380.5	0.54	0.57	36.5
West: Gilbert Rd											
10	L2	254	3.9	0.416	39.6	LOS C	12.9	93.4	0.75	0.78	35.7
12	R2	382	2.3	0.834	81.9	LOS F	15.0	106.9	1.00	0.90	25.3
Approach		636	2.9	0.834	65.1	LOS E	15.0	106.9	0.90	0.86	28.6
All Vehicles		4189	5.1	1.048	33.1	LOS C	52.1	380.5	0.63	0.67	38.6

### PM Phasing Summary

#### Phase Timing Results

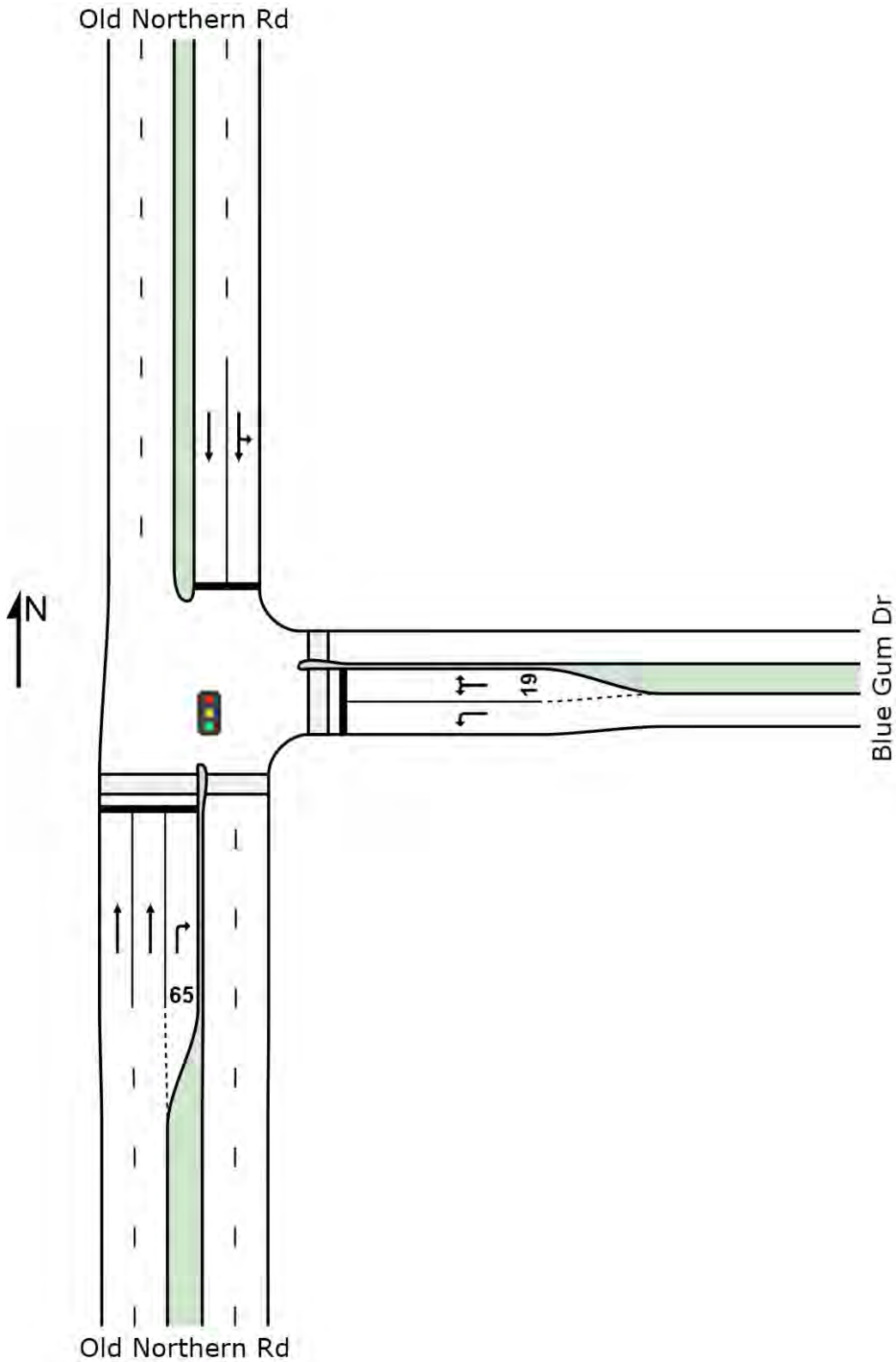
Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	85	125
Green Time (sec)	79	34	19
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	85	40	25
Phase Split	57 %	27 %	17 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

# 2036 FUTURE WITH DEVELOPMENT

## Intersection of Old Northern Road and Blue Gum Drive



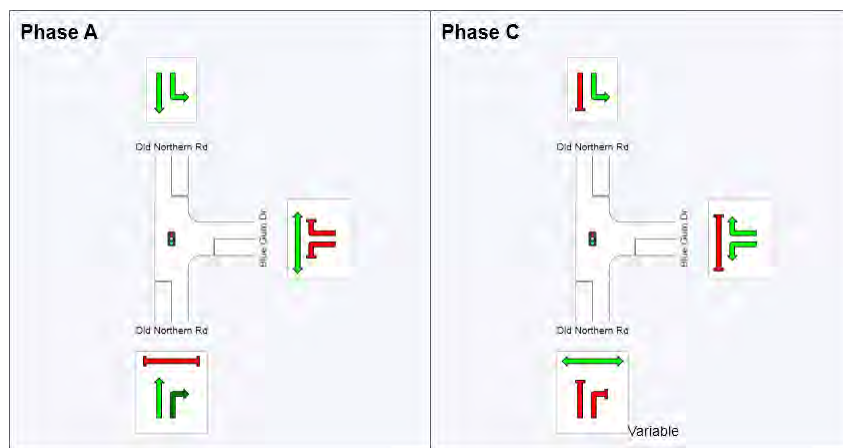
### AM Movement Summary for 2036 Future Base with Development

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows Total veh/h	Deg. Satn HV %	Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Old Northern Rd											
2	T1	1009	5.7	0.314	2.1	LOS A	6.2	45.7	0.21	0.19	58.0
3	R2	36	16.7	0.590	26.9	LOS B	1.6	13.1	0.65	0.76	40.5
Approach		1045	6.1	0.590	2.9	LOS A	6.2	45.7	0.23	0.21	57.2
East: Blue Gum Dr											
4	L2	60	14.3	0.362	75.6	LOS F	2.2	16.8	0.98	0.72	26.3
6	R2	6	0.0	0.362	75.4	LOS F	2.2	16.8	0.98	0.72	26.4
Approach		66	12.9	0.362	75.6	LOS F	2.2	16.9	0.98	0.72	26.3
North: Old Northern Rd											
7	L2	23	0.0	0.757	9.9	LOS A	31.7	226.3	0.45	0.43	54.5
8	T1	2461	2.3	0.757	4.3	LOS A	31.8	226.9	0.45	0.43	56.0
Approach		2484	2.3	0.757	4.4	LOS A	31.8	226.9	0.45	0.43	55.9
All Vehicles		3596	3.6	0.757	5.3	LOS A	31.8	226.9	0.39	0.37	55.1

### AM Phasing Summary

#### Phase Timing Results

Phase	A	C
Reference Phase	Yes	No
Phase Change Time (sec)	0	117
Green Time (sec)	111	7
Yellow Time (sec)	4	4
All-Red Time (sec)	2	2
Phase Time (sec)	117	13
Phase Split	90 %	10 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

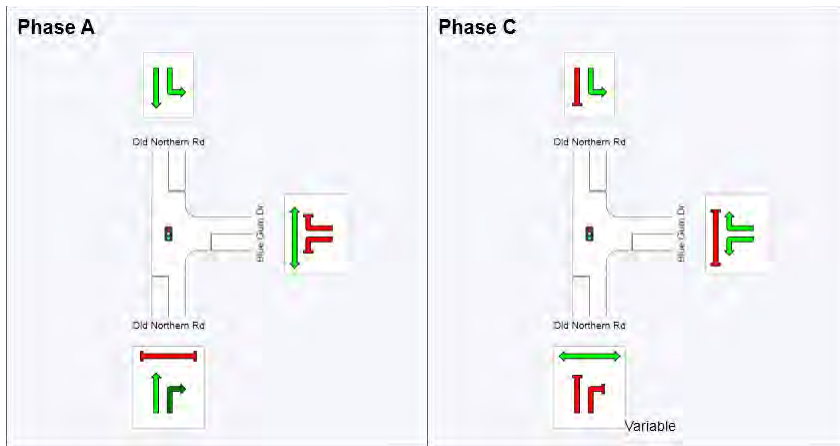
### PM Movement Summary for 2036 Future Base with Development

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows Total veh/h	Deg. Satn HV %	Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Old Northern Rd											
2	T1	1881	4.9	0.586	3.2	LOS A	19.1	139.4	0.30	0.28	57.0
3	R2	14	0.0	0.074	10.2	LOS A	0.2	1.7	0.25	0.63	50.2
Approach		1895	4.8	0.586	3.2	LOS A	19.1	139.4	0.30	0.28	57.0
East: Blue Gum Dr											
4	L2	12	0.0	0.104	81.6	LOS F	0.8	5.8	0.95	0.68	25.3
6	R2	16	0.0	0.142	82.0	LOS F	1.1	7.9	0.96	0.69	25.2
Approach		27	0.0	0.142	81.9	LOS F	1.1	7.9	0.95	0.69	25.3
North: Old Northern Rd											
7	L2	17	0.0	0.455	8.2	LOS A	12.0	87.5	0.24	0.24	55.8
8	T1	1457	5.4	0.455	2.7	LOS A	12.0	88.1	0.25	0.23	57.4
Approach		1474	5.3	0.455	2.7	LOS A	12.0	88.1	0.25	0.23	57.4
All Vehicles		3396	5.0	0.586	3.6	LOS A	19.1	139.4	0.28	0.27	56.6

### PM Phasing Summary

#### Phase Timing Results

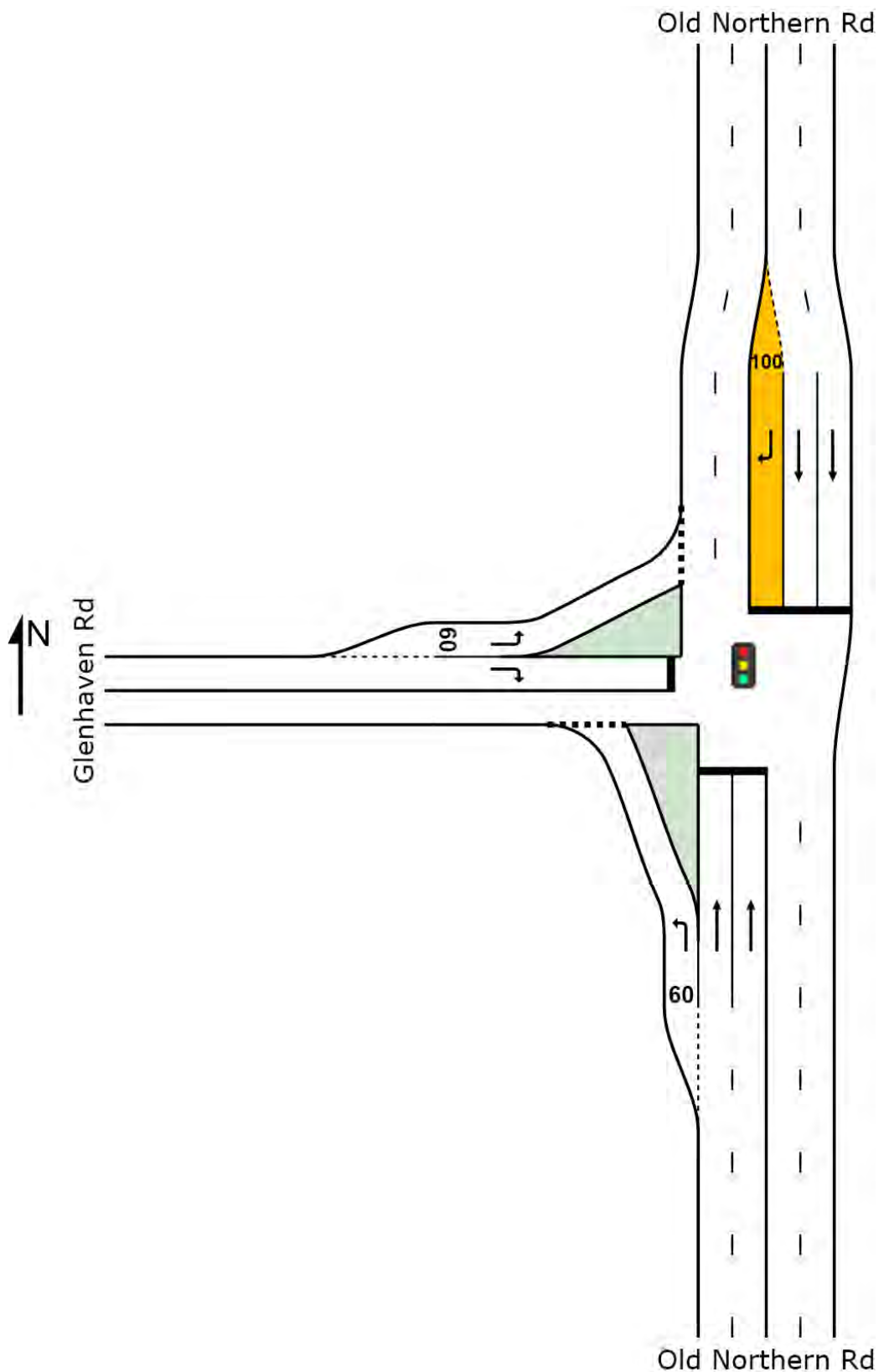
Phase	A	C
Reference Phase	Yes	No
Phase Change Time (sec)	0	135
Green Time (sec)	129	9
Yellow Time (sec)	4	4
All-Red Time (sec)	2	2
Phase Time (sec)	135	15
Phase Split	90 %	10 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

# 2036 FUTURE WITH DEVELOPMENT

Intersection of Old Northern Road and Glenhaven Road





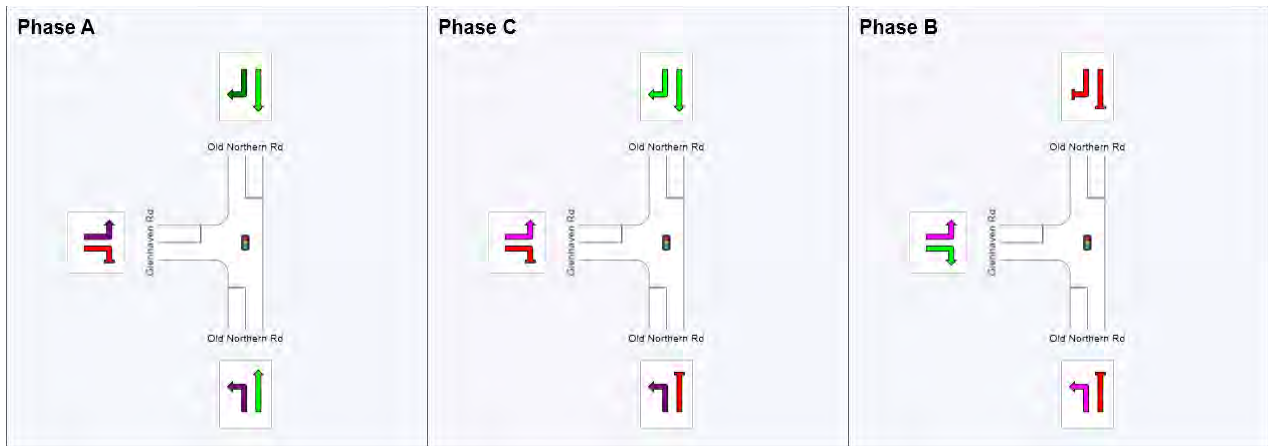
### AM Movement Summary for 2036 Future Base with Development

Movement Performance - Vehicles											
Mov ID	ODMo	Demand Flows	Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Prop. Queued	Effective Stop Rate	Average Speed		
	v	Total	HV	sec		Vehicles		per veh	km/h		
		veh/h	%	v/c		veh	m				
South: Old Northern Rd											
1	L2	307	0.4	0.283	8.9	LOS A	2.6	18.6	0.52	0.70	51.8
2	T1	868	6.1	0.942	43.2	LOS D	17.5	128.9	1.00	1.26	35.1
Approach		1176	4.6	0.942	34.2	LOS C	17.5	128.9	0.87	1.11	38.3
North: Old Northern Rd											
8	T1	1961	2.4	1.015	71.7	LOS F	57.8	412.6	1.00	1.69	27.5
9	R2	408	4.3	0.969	55.3	LOS D	15.5	112.2	1.00	1.32	31.0
Approach		2369	2.7	1.015	68.9	LOS E	57.8	412.6	1.00	1.62	28.1
West: Glenhaven Rd											
10	L2	549	1.7	0.550	11.0	LOS A	7.7	54.3	0.67	0.77	50.1
12	R2	525	0.8	1.013	78.6	LOS F	28.7	202.5	1.00	1.38	25.9
Approach		1075	1.2	1.013	44.0	LOS D	28.7	202.5	0.83	1.06	34.4
All Vehicles		4620	2.8	1.015	54.3	LOS D	57.8	412.6	0.93	1.36	31.6

### AM Phasing Summary

#### Phase Timing Results

Phase	A	C	B
Reference Phase	No	No	Yes
Phase Change Time (sec)	22	42	0
Green Time (sec)	14	9	16
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	20	15	22
Phase Split	35 %	26 %	39 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

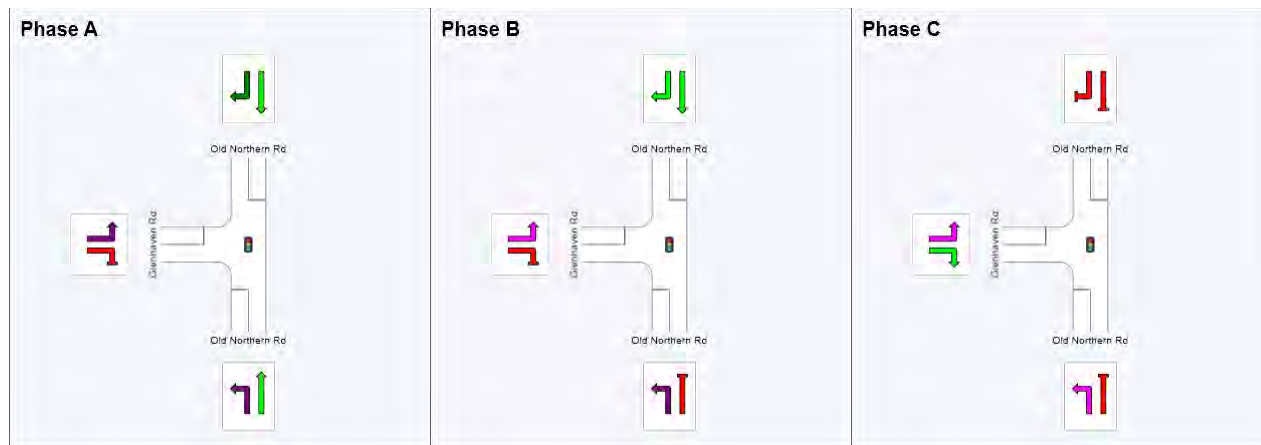
### PM Movement Summary for 2036 Future Base with Development

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows Total veh/h	Deg. Satn 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: Old Northern Rd											
1	L2	632	1.6	0.566	10.5	LOS A	7.9	55.9	0.66	0.77	50.6
2	T1	1444	4.9	0.885	28.7	LOS C	32.0	233.6	0.91	1.02	40.7
Approach		2076	3.9	0.885	23.2	LOS B	32.0	233.6	0.84	0.94	43.3
North: Old Northern Rd											
8	T1	1321	5.8	0.473	3.8	LOS A	8.9	65.3	0.43	0.39	56.5
9	R2	382	4.1	0.890	46.4	LOS D	14.3	103.5	1.00	1.16	33.5
Approach		1703	5.4	0.890	13.4	LOS A	14.3	103.5	0.56	0.56	48.9
West: Glenhaven Rd											
10	L2	533	1.6	0.830	27.5	LOS B	17.6	125.2	0.96	0.96	41.0
12	R2	131	3.5	0.841	47.1	LOS D	5.2	37.3	1.00	0.97	33.3
Approach		663	2.0	0.841	31.4	LOS C	17.6	125.2	0.97	0.96	39.2
All Vehicles		4442	4.2	0.890	20.6	LOS B	32.0	233.6	0.75	0.80	44.6

### PM Phasing Summary

#### Phase Timing Results

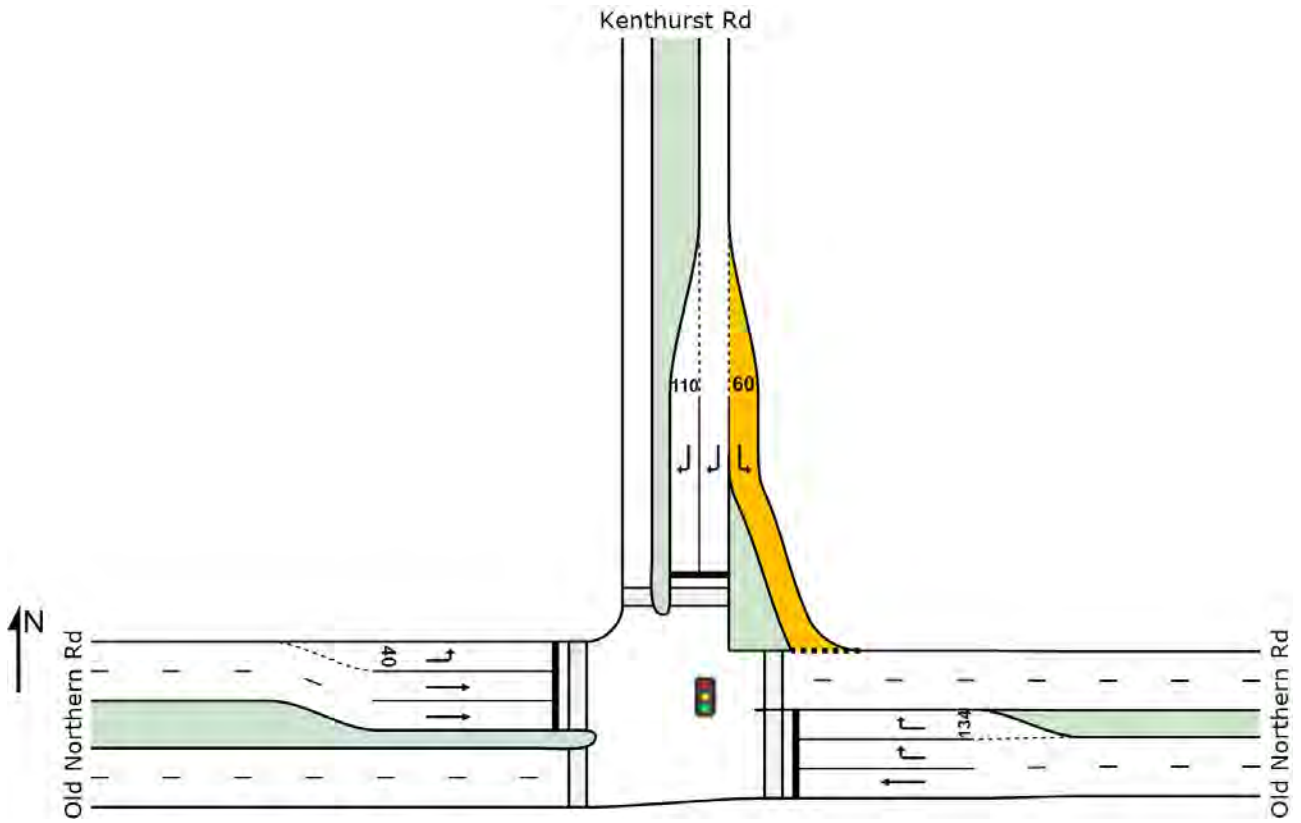
Phase	A	B	C
Reference Phase	No	No	Yes
Phase Change Time (sec)	12	52	0
Green Time (sec)	34	12	6
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	40	18	12
Phase Split	57 %	26 %	17 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

# 2036 FUTURE WITH DEVELOPMENT

## Intersection of Old Northern Road and Kenthurst Road



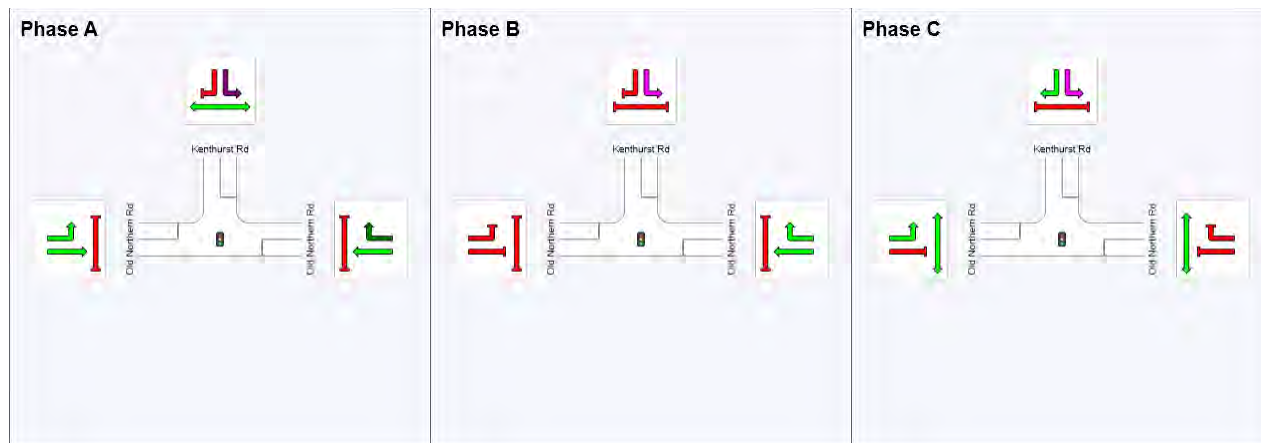
### AM Movement Summary for 2036 Future Base with Development

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows Total veh/h	Deg. Satn 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
East: Old Northern Rd											
5	T1	751	4.9	0.620	17.2	LOS B	32.6	238.0	0.65	0.60	46.8
6	R2	656	3.7	0.977	98.2	LOS F	50.6	365.5	0.94	1.18	22.8
Approach		1406	4.4	0.977	55.0	LOS D	50.6	365.5	0.78	0.87	31.4
North: Kenthurst Rd											
7	L2	582	2.6	0.441	6.8	LOS A	6.4	46.1	0.21	0.62	53.2
9	R2	720	2.5	0.948	90.2	LOS F	40.3	288.4	0.96	1.00	23.9
Approach		1302	2.5	0.948	52.9	LOS D	40.3	288.4	0.62	0.83	31.8
West: Old Northern Rd											
10	L2	906	4.2	0.872	11.4	LOS A	15.3	110.8	0.22	0.66	49.2
11	T1	459	5.5	0.327	21.9	LOS B	8.0	58.8	0.51	0.43	44.1
Approach		1365	4.7	0.872	15.0	LOS B	15.3	110.8	0.32	0.58	47.4
All Vehicles		4074	3.9	0.977	40.9	LOS C	50.6	365.5	0.58	0.76	35.5

### AM Phasing Summary

#### Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	63	103
Green Time (sec)	57	34	44
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	63	40	50
Phase Split	41 %	26 %	33 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

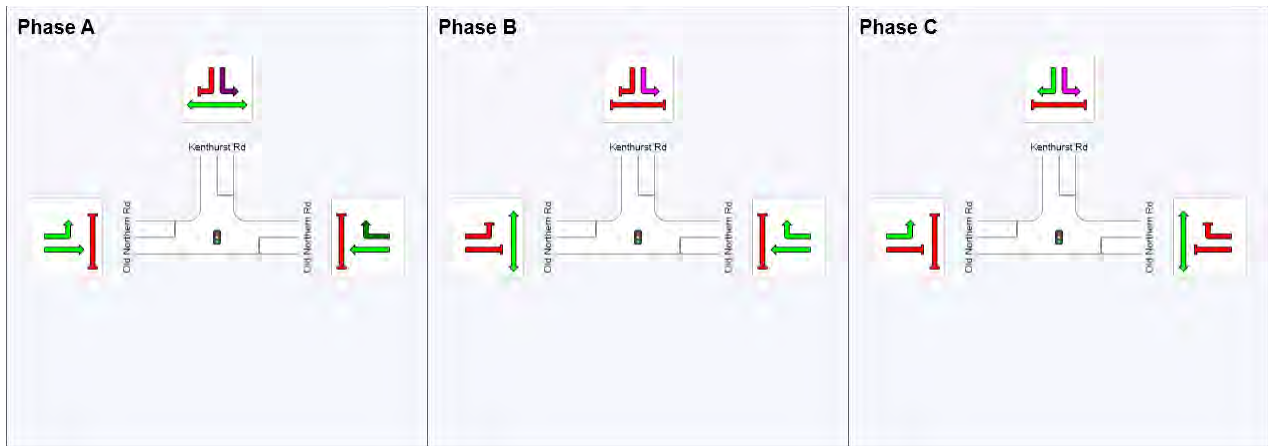
### PM Movement Summary for 2036 Future Base with Development

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows Total veh/h	Deg. Satn 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
East: Old Northern Rd											
5	T1	966	5.8	0.413	9.2	LOS A	10.7	78.4	0.55	0.49	52.1
6	R2	587	9.0	0.874	46.0	LOS D	24.7	186.5	0.99	1.13	33.7
Approach		1554	7.0	0.874	23.1	LOS B	24.7	186.5	0.72	0.73	43.2
North: Kenthurst Rd											
7	L2	558	2.6	0.466	8.1	LOS A	6.7	47.8	0.40	0.68	52.1
9	R2	679	3.8	0.780	43.7	LOS D	15.1	109.3	0.99	0.90	34.4
Approach		1237	3.2	0.780	27.7	LOS B	15.1	109.3	0.72	0.80	40.6
West: Old Northern Rd											
10	L2	718	6.7	0.744	9.0	LOS A	9.0	66.3	0.31	0.68	50.8
11	T1	503	6.6	0.577	26.8	LOS B	8.9	65.8	0.83	0.70	41.7
Approach		1221	6.7	0.744	16.3	LOS B	9.0	66.3	0.52	0.69	46.6
All Vehicles		4012	5.7	0.874	22.4	LOS B	24.7	186.5	0.66	0.74	43.3

### PM Phasing Summary

#### Phase Timing Results

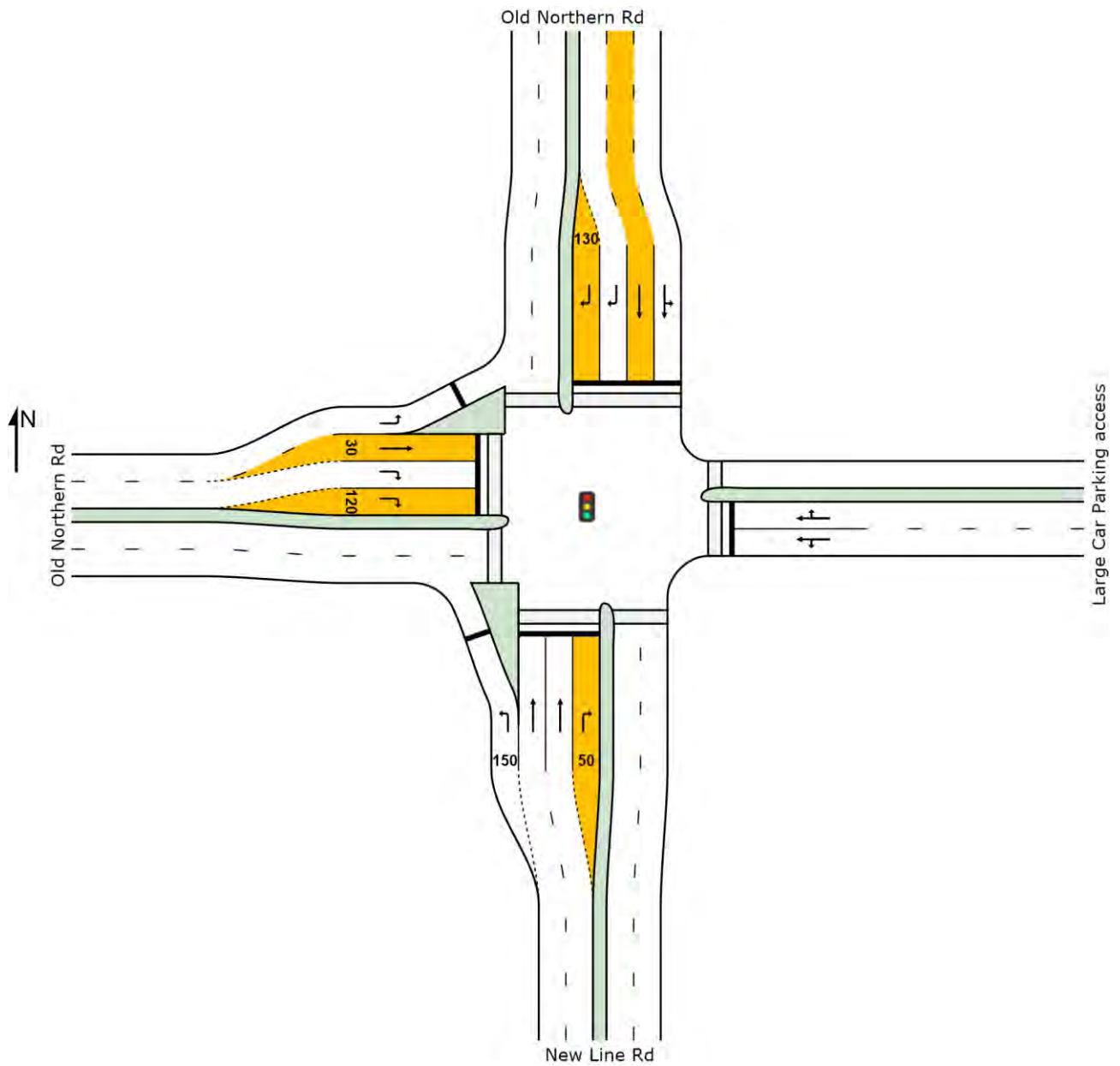
Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	27	62
Green Time (sec)	21	29	22
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	27	35	28
Phase Split	30 %	39 %	31 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

# 2036 FUTURE WITH DEVELOPMENT

## Intersection of Old Northern Road and New Line Road





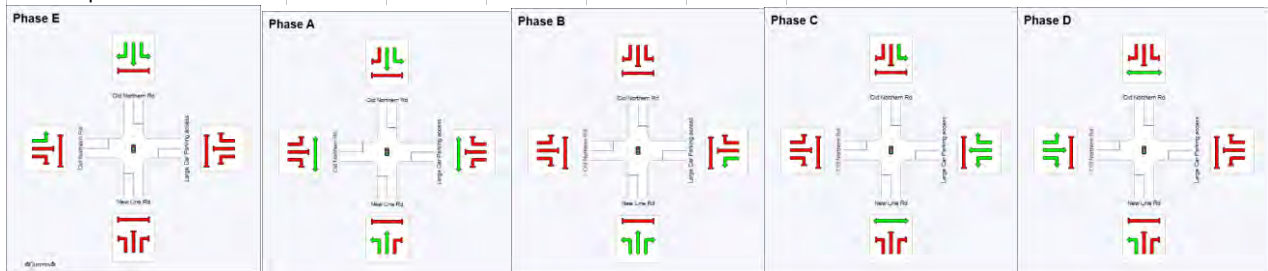
### AM Movement Summary for 2036 Future Base with Development

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows Total veh/h	Deg. Satn HV %	Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: New Line Rd											
1	L2	687	5.8	0.814	23.8	LOS B	23.0	169.1	0.93	0.89	42.7
2	T1	767	5.4	0.871	50.7	LOS D	22.9	167.7	1.00	1.02	32.9
3	R2	89	8.5	0.518	56.8	LOS E	4.6	34.4	0.99	0.77	21.6
Approach		1544	5.8	0.871	39.1	LOS C	23.0	169.1	0.97	0.95	36.1
East: Large Car Parking access											
4	L2	88	12.8	0.818	60.6	LOS E	7.6	58.3	1.00	0.94	20.9
5	T1	94	5.7	0.818	59.0	LOS E	7.6	58.3	1.00	0.92	21.2
6	R2	43	3.3	0.818	63.7	LOS E	5.1	37.1	1.00	0.90	20.8
Approach		225	8.0	0.818	60.5	LOS E	7.6	58.3	1.00	0.92	21.0
North: Old Northern Rd											
7	L2	85	2.0	0.538	31.9	LOS C	16.0	116.0	0.81	0.76	21.6
8	T1	762	4.3	0.538	26.0	LOS B	16.5	119.7	0.82	0.73	41.9
9	R2	786	4.2	0.818	50.4	LOS D	20.7	150.3	1.00	0.93	32.8
Approach		1634	4.1	0.818	38.1	LOS C	20.7	150.3	0.90	0.83	36.0
West: Old Northern Rd											
10	L2	894	4.1	0.896	40.4	LOS C	48.6	352.3	0.97	0.97	35.9
11	T1	40	1.9	0.091	35.1	LOS C	1.6	11.6	0.83	0.62	29.3
12	R2	619	4.2	0.779	50.7	LOS D	16.4	119.2	0.99	0.90	32.7
Approach		1553	4.1	0.896	44.4	LOS D	48.6	352.3	0.98	0.94	34.4
All Vehicles		4956	4.8	0.896	41.4	LOS C	48.6	352.3	0.95	0.90	34.9

### AM Phasing Summary

#### Phase Timing Results

Phase	E	A	B	C	D
Reference Phase	No	Yes	No	No	No
Phase Change Time (sec)	72	0	15	31	43
Green Time (sec)	27	9	10	6	23
Yellow Time (sec)	4	4	4	4	4
All-Red Time (sec)	2	2	2	2	2
Phase Time (sec)	33	15	16	12	29
Phase Split	31 %	14 %	15 %	11 %	28 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

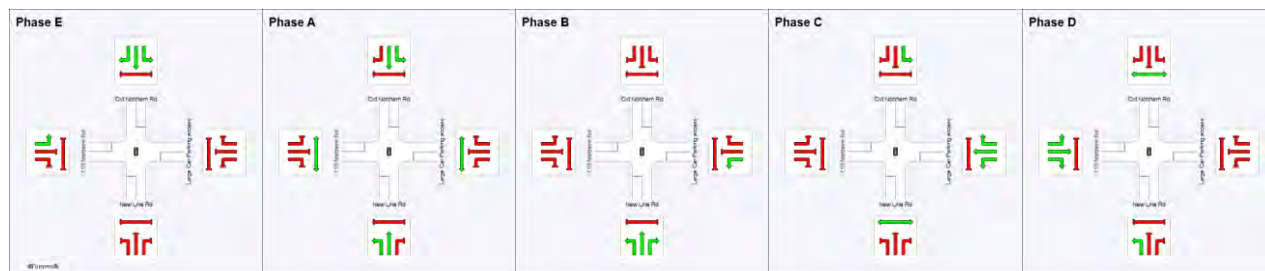
### PM Movement Summary for 2036 Future Base with Development

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows Total veh/h	Deg. Satn 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: New Line Rd											
1	L2	700	7.4	0.859	29.4	LOS C	27.1	201.7	0.97	0.93	40.1
2	T1	811	5.6	0.887	53.7	LOS D	26.5	194.6	0.99	1.04	32.1
3	R2	139	9.7	0.531	54.0	LOS D	7.1	54.0	0.97	0.80	22.3
Approach		1649	6.7	0.887	43.4	LOS D	27.1	201.7	0.98	0.97	34.4
East: Large Car Parking access											
4	L2	68	14.7	0.906	70.8	LOS F	9.3	71.3	1.00	1.04	19.0
5	T1	176	8.9	0.906	67.8	LOS E	9.3	71.3	1.00	1.03	19.5
6	R2	28	0.0	0.906	71.3	LOS F	7.9	58.7	1.00	1.02	19.5
Approach		273	9.4	0.906	68.9	LOS E	9.3	71.3	1.00	1.03	19.4
North: Old Northern Rd											
7	L2	87	0.8	0.421	32.6	LOS C	11.6	83.7	0.79	0.74	21.3
8	T1	532	4.8	0.421	27.3	LOS B	12.2	89.1	0.79	0.71	41.2
9	R2	886	6.7	0.915	65.1	LOS E	28.5	210.8	1.00	1.03	29.0
Approach		1505	5.7	0.915	49.9	LOS D	28.5	210.8	0.91	0.90	32.0
West: Old Northern Rd											
10	L2	701	5.5	0.744	28.4	LOS B	29.5	216.2	0.85	0.86	40.5
11	T1	37	0.5	0.096	39.5	LOS C	1.6	11.5	0.86	0.64	27.5
12	R2	609	3.5	0.875	62.6	LOS E	18.9	136.0	1.00	0.98	29.6
Approach		1347	4.5	0.875	44.2	LOS D	29.5	216.2	0.92	0.91	34.4
All Vehicles		4775	5.9	0.915	47.1	LOS D	29.5	216.2	0.94	0.93	32.8

### PM Phasing Summary

#### Phase Timing Results

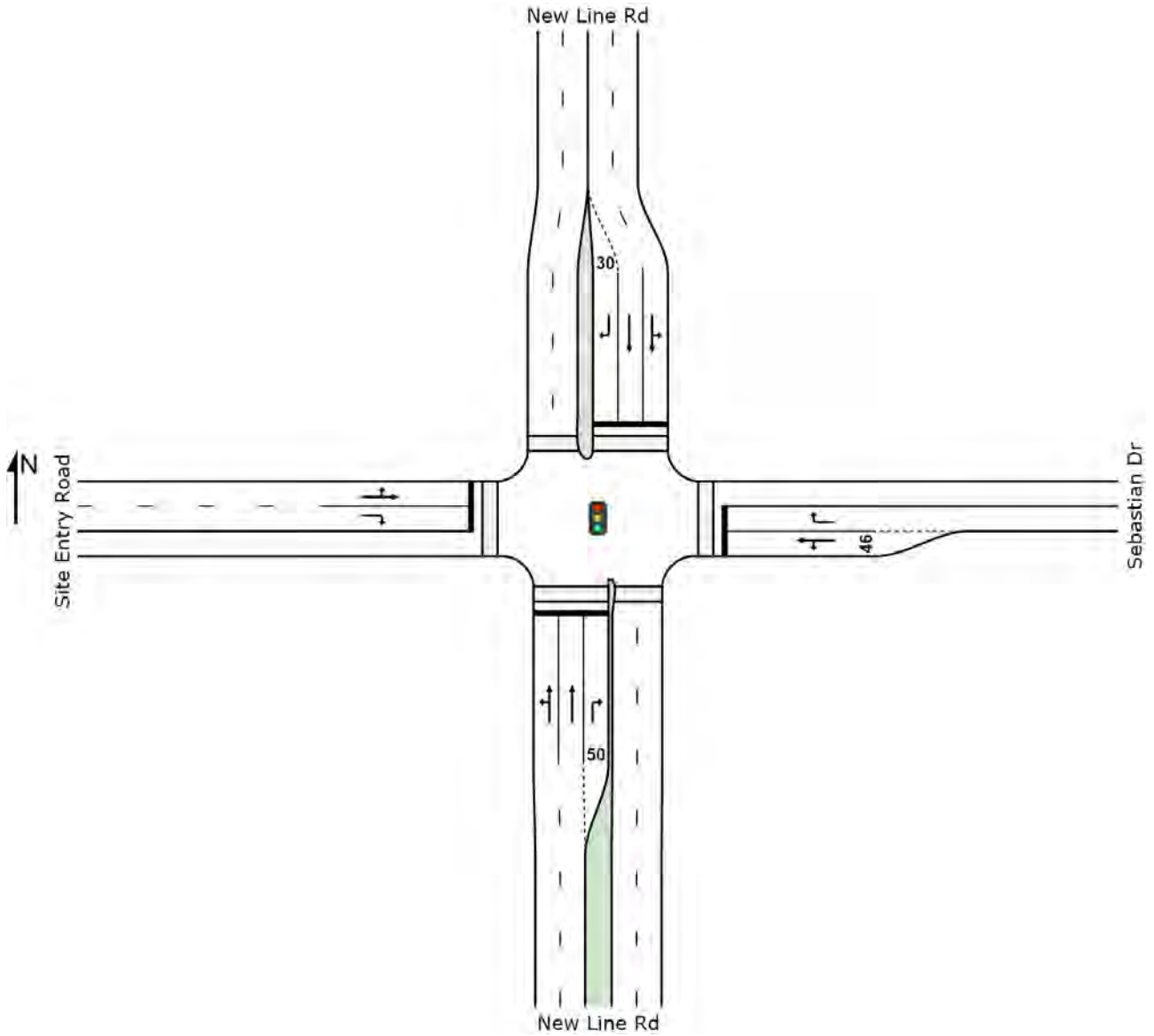
Phase	E	A	B	C	D
Reference Phase	No	Yes	No	No	No
Phase Change Time (sec)	75	0	12	34	48
Green Time (sec)	29	6	16	8	21
Yellow Time (sec)	4	4	4	4	4
All-Red Time (sec)	2	2	2	2	2
Phase Time (sec)	35	12	22	14	27
Phase Split	32 %	11 %	20 %	13 %	25 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

# 2036 FUTURE WITH DEVELOPMENT

## Intersection of New Line Road and Sebastian Drive



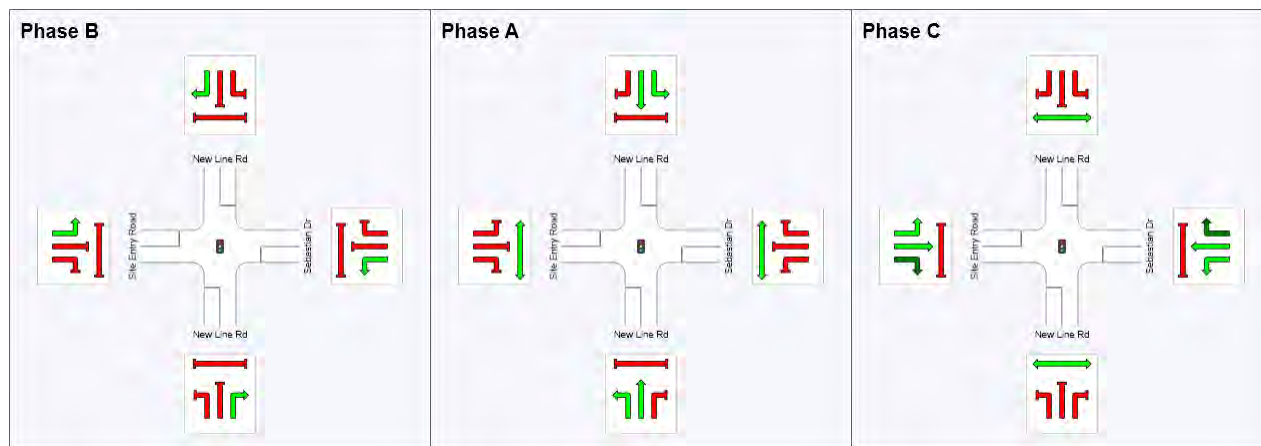
### AM Movement Summary for 2036 Future Base with Development

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows Total veh/h	Deg. Satn HV %	Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: New Line Rd											
1	L2	69	0.0	0.878	28.2	LOS B	34.7	255.9	0.86	0.88	42.6
2	T1	1604	6.7	0.878	22.3	LOS B	34.7	255.9	0.82	0.85	43.8
3	R2	54	8.0	0.458	52.7	LOS D	2.5	18.4	1.00	0.75	31.6
Approach		1727	6.4	0.878	23.5	LOS B	34.7	255.9	0.83	0.84	43.2
East: Sebastian Dr											
4	L2	131	2.3	0.211	28.1	LOS B	4.1	29.2	0.75	0.75	40.3
5	T1	1	0.0	0.211	22.5	LOS B	4.1	29.2	0.75	0.75	41.1
6	R2	75	7.5	0.240	38.3	LOS C	2.8	20.9	0.87	0.76	36.2
Approach		206	4.1	0.240	31.7	LOS C	4.1	29.2	0.79	0.75	38.7
North: New Line Rd											
7	L2	46	3.2	0.807	27.0	LOS B	30.2	222.2	0.89	0.85	43.2
8	T1	1529	6.0	0.807	21.4	LOS B	30.2	222.2	0.89	0.85	44.3
9	R2	5	0.0	0.043	49.8	LOS D	0.2	1.6	0.96	0.64	32.5
Approach		1581	5.9	0.807	21.6	LOS B	30.2	222.2	0.89	0.85	44.2
West: Site Entry Road											
10	L2	11	0.0	0.033	32.5	LOS C	0.5	3.6	0.78	0.64	39.2
11	T1	5	0.0	0.033	27.0	LOS B	0.5	3.6	0.78	0.64	39.9
12	R2	221	0.0	0.912	62.8	LOS E	12.2	85.3	1.00	1.06	29.2
Approach		237	0.0	0.912	60.6	LOS E	12.2	85.3	0.99	1.03	29.7
All Vehicles		3752	5.7	0.912	25.5	LOS B	34.7	255.9	0.86	0.85	42.1

### AM Phasing Summary

#### Phase Timing Results

Phase	B	A	C
Reference Phase	No	Yes	No
Phase Change Time (sec)	78	0	53
Green Time (sec)	6	47	19
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	12	53	25
Phase Split	13 %	59 %	28 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

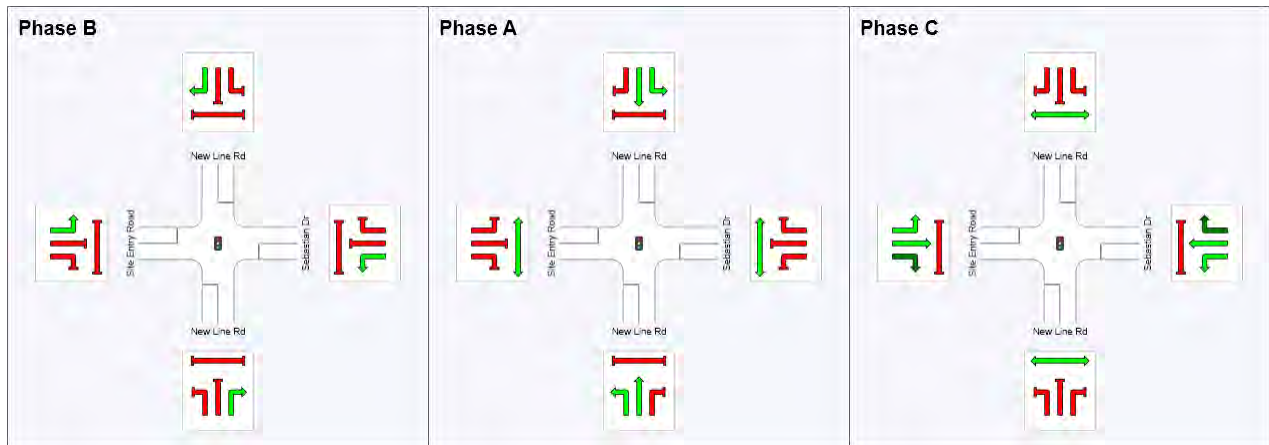
### PM Movement Summary for 2036 Future Base with Development

Movement Performance - Vehicles											
Mov ID	ODMo	Demand Flows	Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Prop. Queued	Effective Stop Rate	Average Speed		
	v	Total	HV	sec		Vehicles		per veh	km/h		
		veh/h	%	v/c		veh	m				
South: New Line Rd											
1	L2	240	0.0	0.847	15.1	LOS B	26.9	196.3	0.57	0.62	49.7
2	T1	1808	6.7	0.847	8.6	LOS A	26.9	196.3	0.48	0.51	52.1
3	R2	74	8.0	0.629	54.1	LOS D	3.5	25.9	1.00	0.80	31.2
Approach		2122	5.9	0.847	10.9	LOS A	26.9	196.3	0.51	0.53	50.7
East: Sebastian Dr											
4	L2	118	2.3	0.332	39.6	LOS C	4.6	32.7	0.90	0.78	35.8
5	T1	1	0.0	0.332	34.0	LOS C	4.6	32.7	0.90	0.78	36.4
6	R2	71	7.5	0.591	53.6	LOS D	3.3	24.5	1.00	0.79	31.4
Approach		189	4.2	0.591	44.8	LOS D	4.6	32.7	0.94	0.78	34.0
North: New Line Rd											
7	L2	98	3.2	0.520	13.7	LOS A	14.3	105.1	0.55	0.54	50.9
8	T1	1195	6.0	0.520	8.1	LOS A	14.3	105.1	0.55	0.52	52.6
9	R2	5	0.0	0.043	49.8	LOS D	0.2	1.6	0.96	0.64	32.5
Approach		1298	5.8	0.520	8.7	LOS A	14.3	105.1	0.55	0.52	52.4
West: Site Entry Road											
10	L2	11	0.0	0.079	45.4	LOS D	0.6	4.5	0.93	0.68	34.4
11	T1	5	0.0	0.079	39.9	LOS C	0.6	4.5	0.93	0.68	35.0
12	R2	84	0.0	0.957	68.7	LOS E	4.6	32.1	1.00	1.03	27.9
Approach		100	0.0	0.957	64.7	LOS E	4.6	32.1	0.99	0.97	28.8
All Vehicles		3709	5.6	0.957	13.3	LOS A	26.9	196.3	0.56	0.55	49.0

### PM Phasing Summary

#### Phase Timing Results

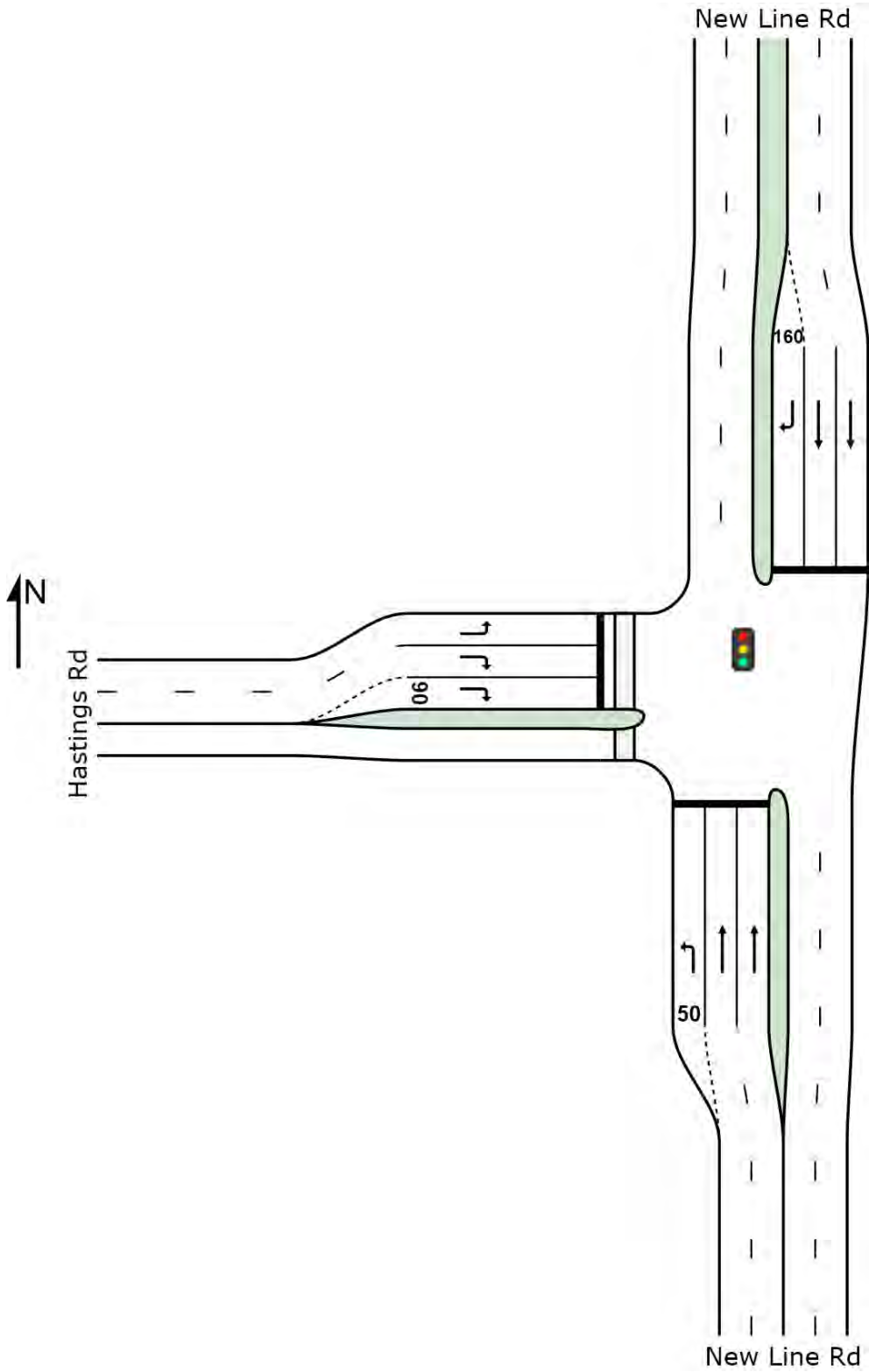
Phase	B	A	C
Reference Phase	No	Yes	No
Phase Change Time (sec)	78	0	66
Green Time (sec)	6	60	6
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	12	66	12
Phase Split	13 %	73 %	13 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

# 2036 FUTURE WITH DEVELOPMENT

## Intersection of New Line Road and Hastings Road





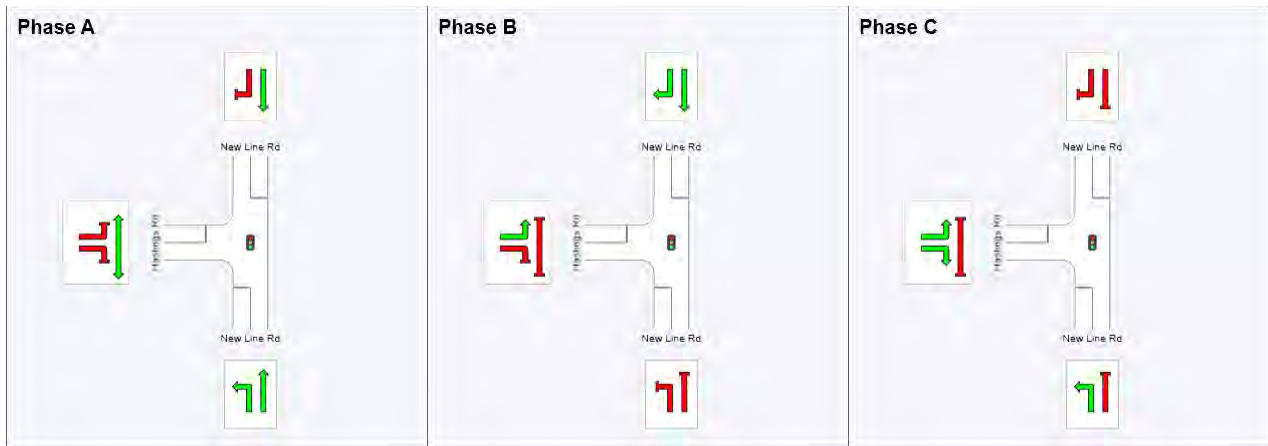
### AM Movement Summary for 2036 Future Base with Development

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows Total	Deg. Satn HV %	Average Delay v/c	Level of Service	95% Back of Queue Vehicles	Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed	
		veh/h	%	sec		veh	m		per veh	km/h	
<b>South: New Line Rd</b>											
1	L2	717	1.2	0.649	6.2	LOS A	1.7	12.2	0.06	0.60	53.1
2	T1	886	6.8	0.791	24.2	LOS B	17.0	125.6	0.88	0.81	43.0
Approach		1603	4.3	0.791	16.1	LOS B	17.0	125.6	0.52	0.71	47.0
<b>North: New Line Rd</b>											
8	T1	976	3.3	0.397	0.5	LOS A	0.7	5.0	0.04	0.03	59.6
9	R2	494	0.6	0.961	49.3	LOS D	26.8	188.5	1.00	1.02	32.8
Approach		1469	2.4	0.961	16.9	LOS B	26.8	188.5	0.36	0.37	46.7
<b>West: Hastings Rd</b>											
10	L2	301	2.0	0.285	15.8	LOS B	6.6	47.1	0.54	0.73	46.6
12	R2	839	1.6	0.934	45.6	LOS D	21.2	150.2	1.00	0.98	33.8
Approach		1140	1.7	0.934	37.8	LOS C	21.2	150.2	0.88	0.91	36.4
All Vehicles		4213	2.9	0.961	22.2	LOS B	26.8	188.5	0.56	0.65	43.5

### AM Phasing Summary

#### Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	33	63
Green Time (sec)	27	24	21
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	33	30	27
Phase Split	37 %	33 %	30 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

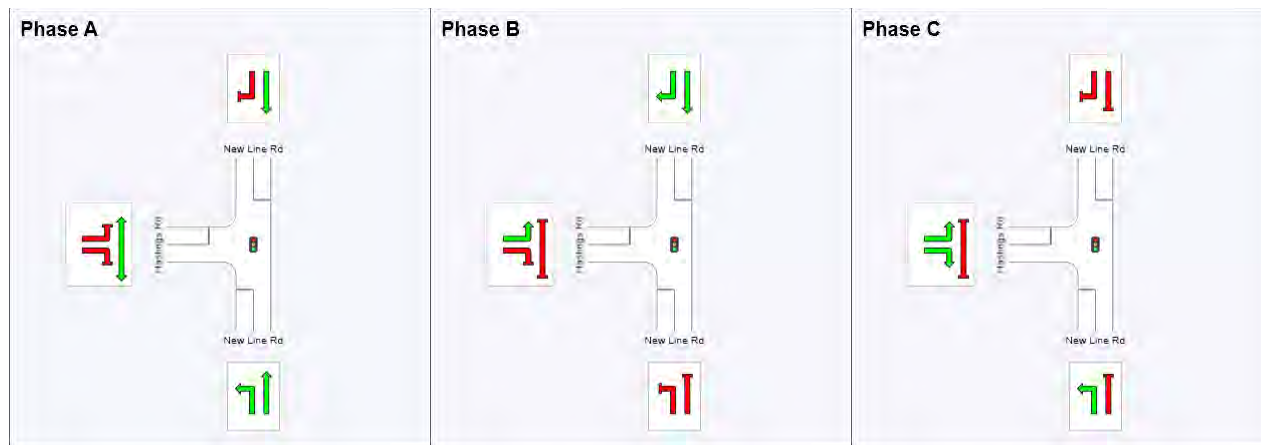
### PM Movement Summary for 2036 Future Base with Development

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %				Vehicles veh	Distance m			
<b>South: New Line Rd</b>											
1	L2	701	2.2	0.599	6.0	LOS A	1.2	8.8	0.05	0.59	53.2
2	T1	1107	7.2	0.769	13.8	LOS A	15.0	111.5	0.76	0.69	48.9
Approach		1808	5.2	0.769	10.8	LOS A	15.0	111.5	0.48	0.65	50.5
<b>North: New Line Rd</b>											
8	T1	735	6.1	0.288	0.3	LOS A	0.4	2.7	0.03	0.03	59.7
9	R2	327	3.9	0.849	35.1	LOS C	12.3	89.1	0.98	0.91	37.5
Approach		1062	5.4	0.849	11.0	LOS A	12.3	89.1	0.32	0.30	50.5
<b>West: Hastings Rd</b>											
10	L2	424	0.8	0.492	11.8	LOS A	5.6	39.6	0.39	0.69	49.1
12	R2	579	1.6	0.845	36.8	LOS C	11.0	78.1	0.99	0.90	36.8
Approach		1003	1.3	0.845	26.2	LOS B	11.0	78.1	0.73	0.81	41.2
All Vehicles		3874	4.3	0.849	14.8	LOS B	15.0	111.5	0.50	0.60	47.7

### PM Phasing Summary

#### Phase Timing Results

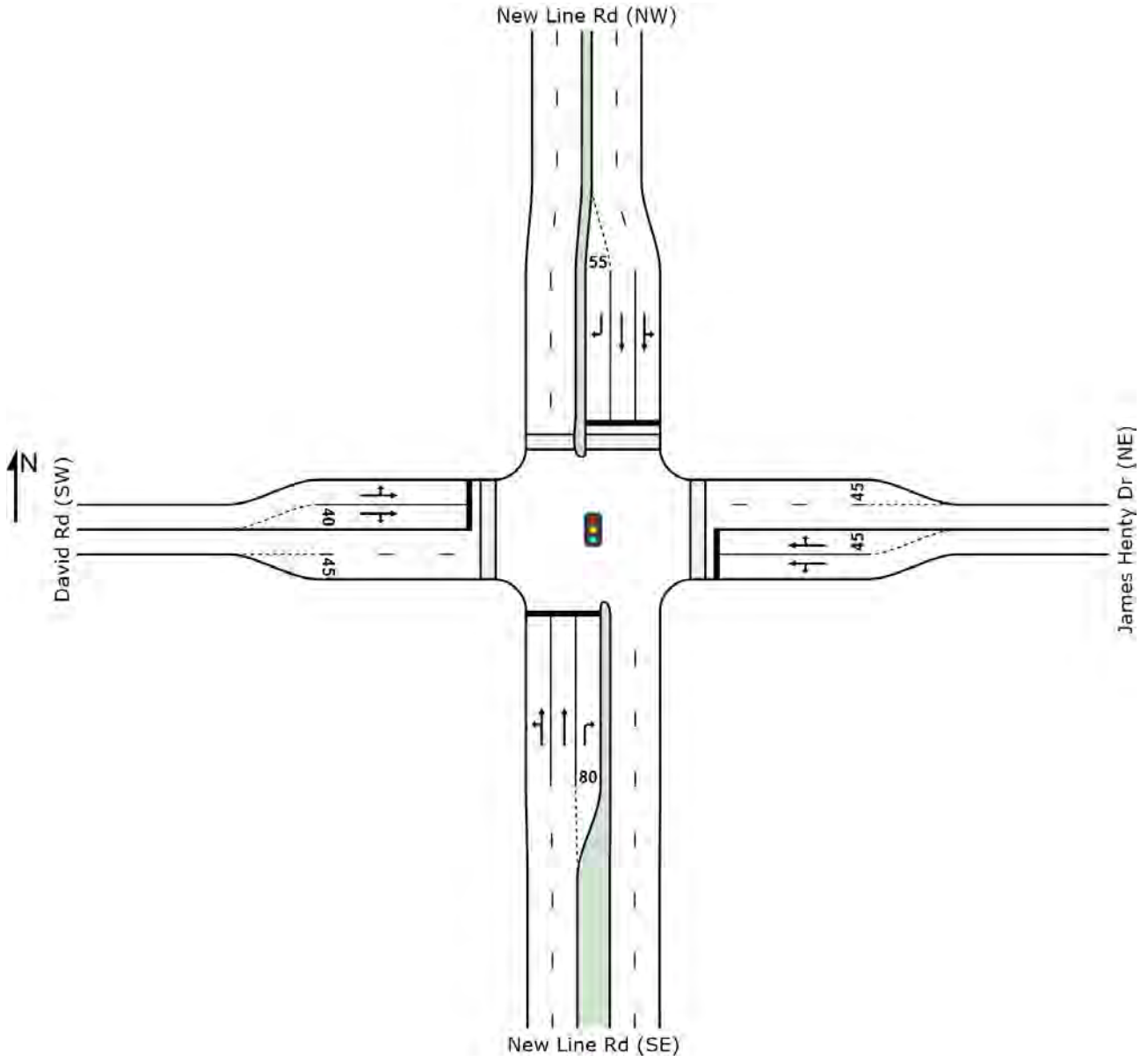
Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	35	56
Green Time (sec)	29	15	13
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	35	21	19
Phase Split	47 %	28 %	25 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

# 2036 FUTURE WITH DEVELOPMENT

Intersection of New Line Road, James Henty Drive and David Road



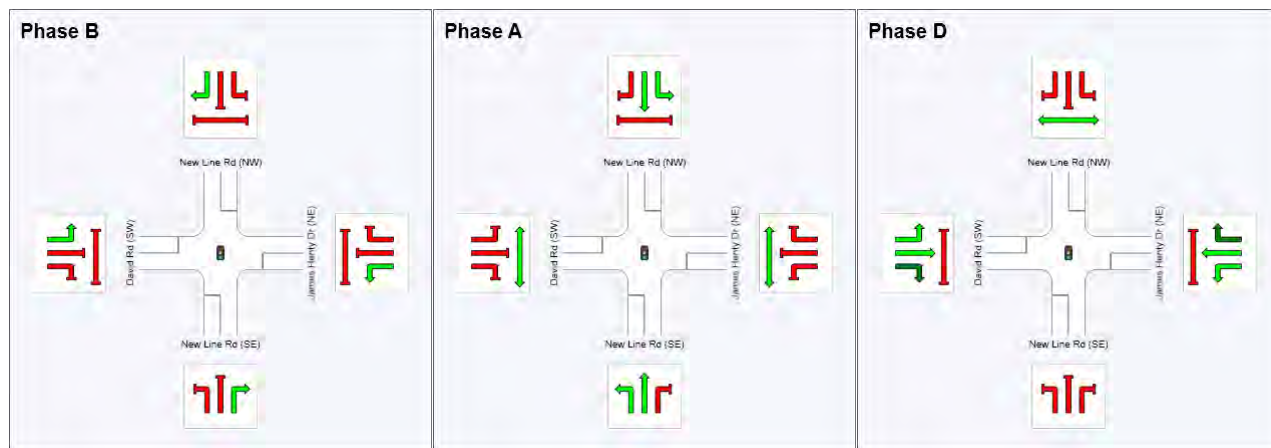
### AM Movement Summary for 2036 Future Base with Development

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %				Vehicles veh	Distance m			
South: New Line Rd (SE)											
21	L2	61	0.0	0.578	20.7	LOS C	17.5	122.8	0.73	0.67	36.6
22	T1	1136	0.0	0.578	15.2	LOS B	17.7	123.9	0.73	0.66	46.3
23	R2	73	0.0	0.354	47.3	LOS D	3.1	21.7	0.97	0.76	26.9
Approach		1270	0.0	0.578	17.3	LOS B	17.7	123.9	0.74	0.66	44.5
East: James Henty Dr (NE)											
24	L2	21	0.0	0.110	37.6	LOS D	1.4	9.8	0.86	0.68	30.3
25	T1	17	0.0	0.110	33.0	LOS C	1.4	9.8	0.86	0.68	23.5
26	R2	111	0.0	0.819	56.1	LOS E	5.5	38.4	1.00	0.96	27.2
Approach		149	0.0	0.819	50.8	LOS D	5.5	38.4	0.96	0.89	27.3
North: New Line Rd (NW)											
27	L2	117	0.0	0.855	30.9	LOS C	37.5	262.5	0.93	0.93	37.4
28	T1	1529	0.0	0.855	25.1	LOS C	37.5	262.5	0.88	0.89	40.3
29	R2	178	0.0	0.863	57.2	LOS E	8.9	62.6	1.00	0.99	22.8
Approach		1824	0.0	0.863	28.6	LOS C	37.5	262.5	0.89	0.90	38.1
West: David Rd (SW)											
30	L2	139	0.0	0.256	31.4	LOS C	5.1	35.4	0.81	0.76	30.9
31	T1	26	0.0	0.801	39.7	LOS D	8.9	62.6	0.94	0.89	20.9
32	R2	169	0.0	0.801	50.7	LOS D	8.9	62.6	1.00	0.96	20.5
Approach		334	0.0	0.801	41.8	LOS D	8.9	62.6	0.92	0.87	24.5
All Vehicles		3577	0.0	0.863	26.8	LOS C	37.5	262.5	0.84	0.81	38.2

### AM Phasing Summary

#### Phase Timing Results

Phase	B	A	D
Reference Phase	No	Yes	No
Phase Change Time (sec)	74	0	54
Green Time (sec)	10	48	14
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	16	54	20
Phase Split	18 %	60 %	22 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

### PM Movement Summary for 2036 Future Base with Development

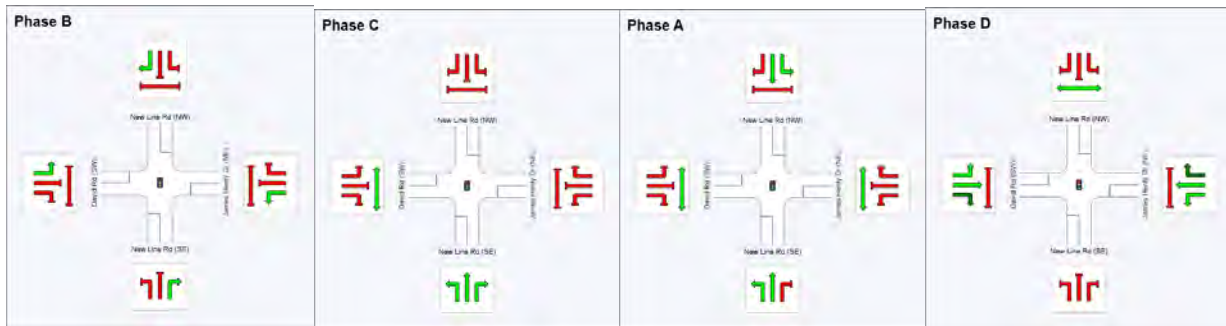
Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows Total veh/h	Deg. Satn HV %	Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: New Line Rd (SE)											
21	L2	106	0.0	0.848	27.9	LOS C	29.4	205.6	0.93	0.96	31.5
22	T1	1543	0.0	0.848	22.2	LOS C	29.4	205.6	0.91	0.95	41.9
23	R2	103	0.0	0.555	40.4	LOS D	3.6	25.3	1.00	0.79	29.0
Approach		1752	0.0	0.848	23.7	LOS C	29.4	205.6	0.92	0.94	40.6
East: James Henty Dr (NE)											
24	L2	6	0.0	0.115	32.8	LOS C	1.0	7.0	0.89	0.66	32.9
25	T1	27	0.0	0.115	28.2	LOS C	1.0	7.0	0.89	0.66	26.1
26	R2	93	0.0	0.822	46.4	LOS D	3.6	25.3	1.00	0.93	29.8
Approach		126	0.0	0.822	41.8	LOS D	3.6	25.3	0.97	0.86	29.4
North: New Line Rd (NW)											
27	L2	94	0.0	0.520	18.3	LOS B	11.5	80.6	0.72	0.67	44.0
28	T1	910	0.0	0.520	12.8	LOS B	11.7	82.2	0.72	0.65	47.9
29	R2	138	0.0	0.867	48.5	LOS D	5.6	39.0	1.00	1.02	25.1
Approach		1142	0.0	0.867	17.5	LOS B	11.7	82.2	0.76	0.70	44.1
West: David Rd (SW)											
30	L2	201	0.0	0.379	26.6	LOS C	5.6	39.3	0.85	0.78	33.0
31	T1	37	0.0	0.530	31.9	LOS C	4.1	28.8	0.97	0.78	23.7
32	R2	85	0.0	0.530	36.4	LOS D	4.1	28.8	0.97	0.78	25.3
Approach		323	0.0	0.530	29.8	LOS C	5.6	39.3	0.89	0.78	29.9
All Vehicles		3343	0.0	0.867	22.8	LOS C	29.4	205.6	0.86	0.84	40.2

### PM Phasing Summary

#### Phase Timing Results

Phase	B	C	A	D
Reference Phase	No	No	Yes	No
Phase Change Time (sec)	57	69	0	41
Green Time (sec)	6	***	35	10
Yellow Time (sec)	4	4	4	4
All-Red Time (sec)	2	2	2	2
Phase Time (sec)	12	1	41	16
Phase Split	17 %	1 %	59 %	23 %

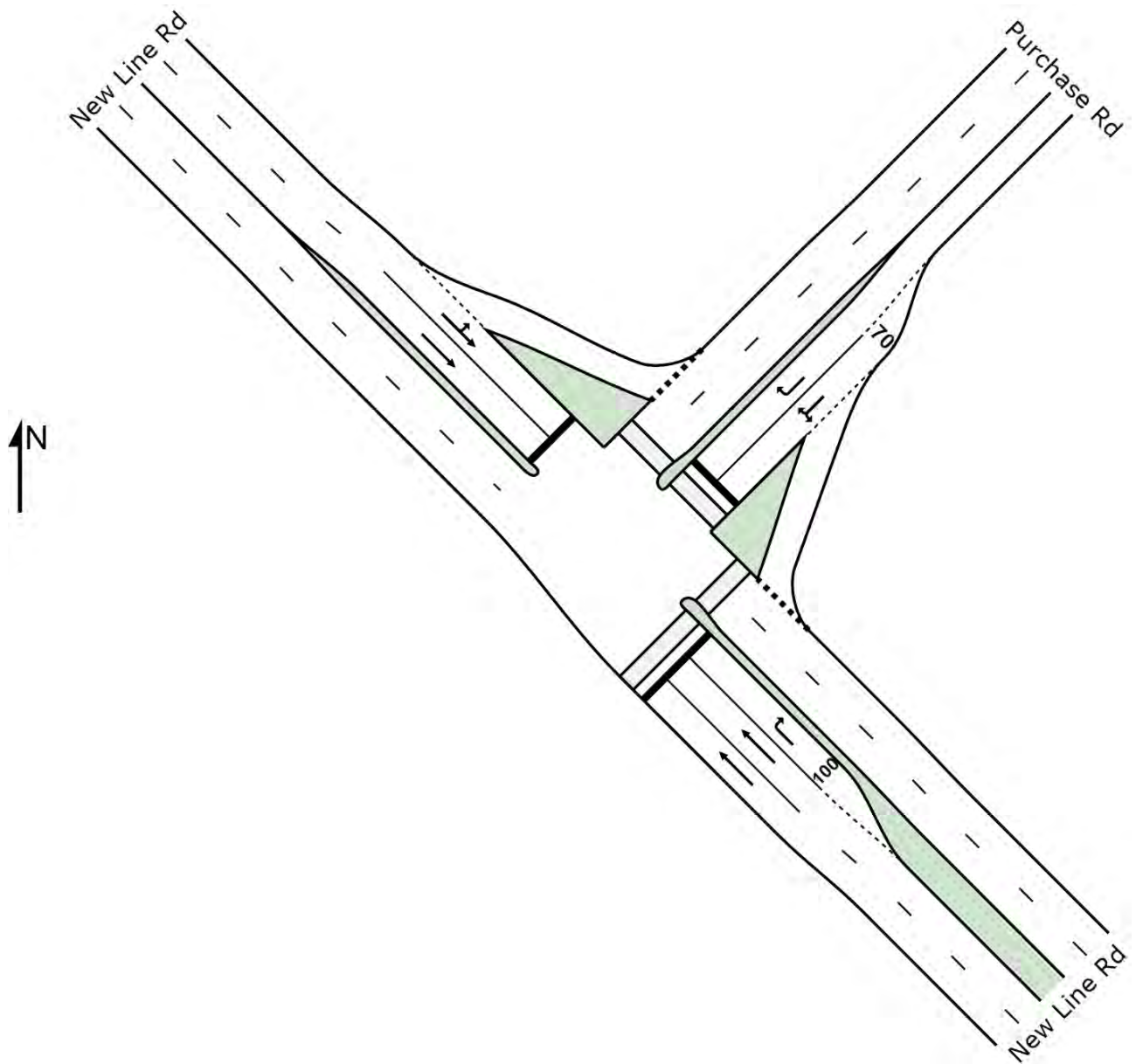
\*\*\* No green time has been calculated for this phase because the next phase starts during its intergreen time. This occurs with overlap phasing where there is no single movement connecting this phase to the next, or where the only such movement is a dummy movement with zero minimum green time specified.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



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

# 2036 FUTURE WITH DEVELOPMENT

## Intersection of New Line Road and Purchase Road





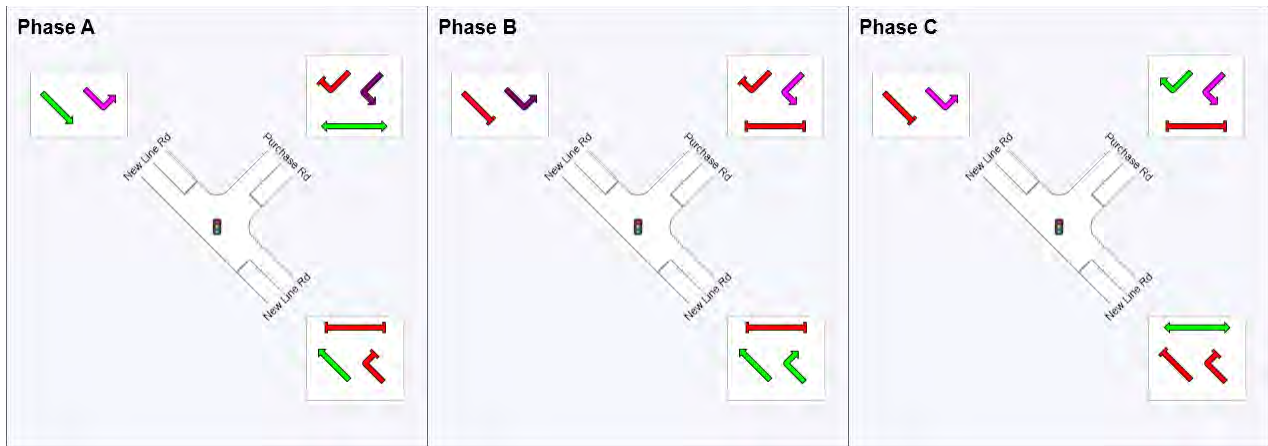
### AM Movement Summary for 2036 Future Base with Development

Movement Performance - Vehicles											
Mov ID	ODMo	Demand Flows	Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Prop. Queued	Effective Stop Rate	Average Speed		
	v	Total	HV	sec		Vehicles		per veh	km/h		
		veh/h	%	v/c		veh	m				
SouthEast: New Line Rd											
22	T1	1189	5.0	0.390	4.3	LOS A	11.9	87.0	0.31	0.28	55.6
23	R2	188	5.0	0.927	96.0	LOS F	16.2	117.9	1.00	0.99	16.9
Approach		1378	5.0	0.927	16.8	LOS B	16.2	117.9	0.40	0.38	45.1
NorthEast: Purchase Rd											
24	L2	385	5.0	0.767	47.7	LOS D	25.2	184.0	0.97	0.90	26.7
26	R2	157	5.0	0.767	79.6	LOS F	25.2	184.0	1.00	0.86	21.6
Approach		542	5.0	0.767	57.0	LOS E	25.2	184.0	0.98	0.89	24.8
NorthWest: New Line Rd											
27	L2	229	5.0	0.920	38.8	LOS C	77.6	566.8	0.95	0.96	33.8
28	T1	2034	5.0	0.920	32.5	LOS C	78.4	572.4	0.95	0.95	37.2
Approach		2263	5.0	0.920	33.2	LOS C	78.4	572.4	0.95	0.95	36.8
All Vehicles		4183	5.0	0.927	30.9	LOS C	78.4	572.4	0.77	0.75	37.2

### AM Phasing Summary

#### Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	104	127
Green Time (sec)	98	17	17
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	104	23	23
Phase Split	69 %	15 %	15 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

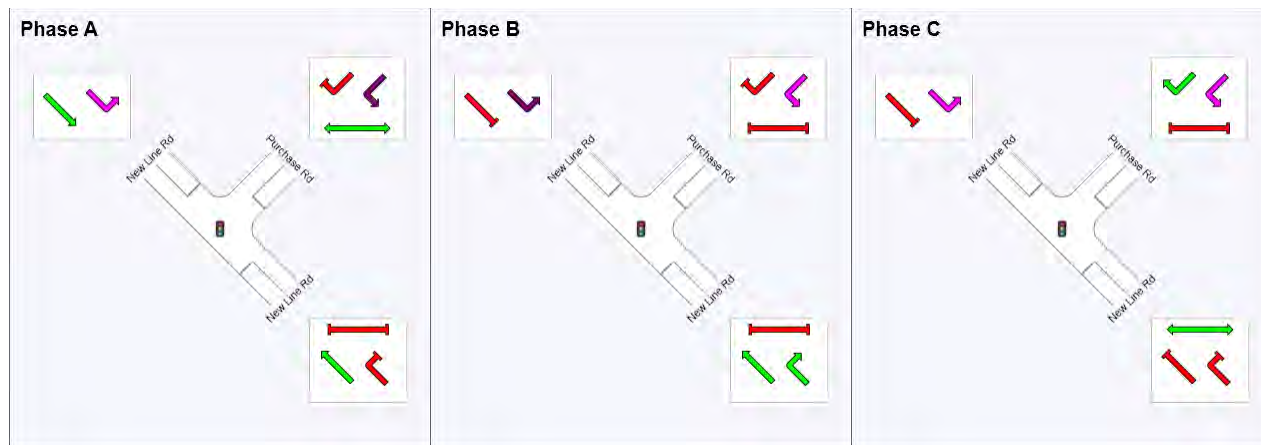
### PM Movement Summary for 2036 Future Base with Development

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows Total veh/h	Deg. Satn 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
SouthEast: New Line Rd											
22	T1	1687	5.0	0.651	6.7	LOS A	16.3	119.2	0.61	0.56	53.3
23	R2	262	5.0	0.787	39.7	LOS C	9.6	70.3	1.00	0.92	28.8
Approach		1949	5.0	0.787	11.1	LOS A	16.3	119.2	0.67	0.61	49.1
NorthEast: Purchase Rd											
24	L2	131	5.0	0.413	17.9	LOS B	2.6	19.3	0.87	0.78	40.4
26	R2	146	5.0	0.413	31.4	LOS C	3.5	25.3	0.93	0.78	34.8
Approach		277	5.0	0.413	25.0	LOS B	3.5	25.3	0.90	0.78	37.0
NorthWest: New Line Rd											
27	L2	125	5.0	0.756	26.7	LOS B	18.0	131.1	0.91	0.88	39.6
28	T1	1062	5.0	0.756	20.9	LOS B	18.4	134.1	0.91	0.87	42.9
Approach		1187	5.0	0.756	21.5	LOS B	18.4	134.1	0.91	0.87	42.6
All Vehicles		3414	5.0	0.787	15.9	LOS B	18.4	134.1	0.77	0.71	45.6

### PM Phasing Summary

#### Phase Timing Results

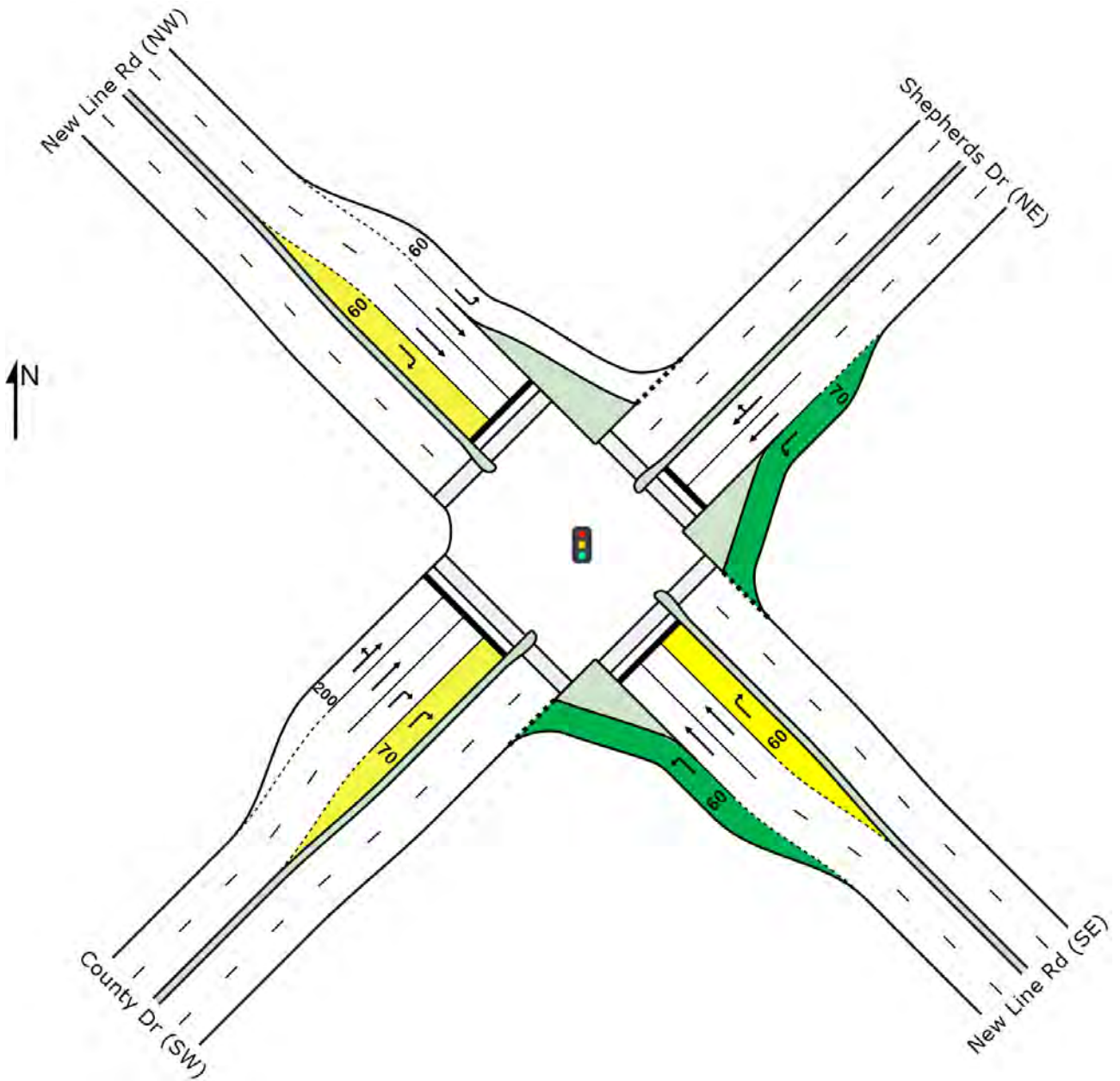
Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	35	54
Green Time (sec)	29	13	10
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	35	19	16
Phase Split	50 %	27 %	23 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

# 2036 FUTURE WITH DEVELOPMENT

Intersection of New Line Road, Shepherds Drive and Country Drive



### AM Movement Summary for 2036 Future Base with Development

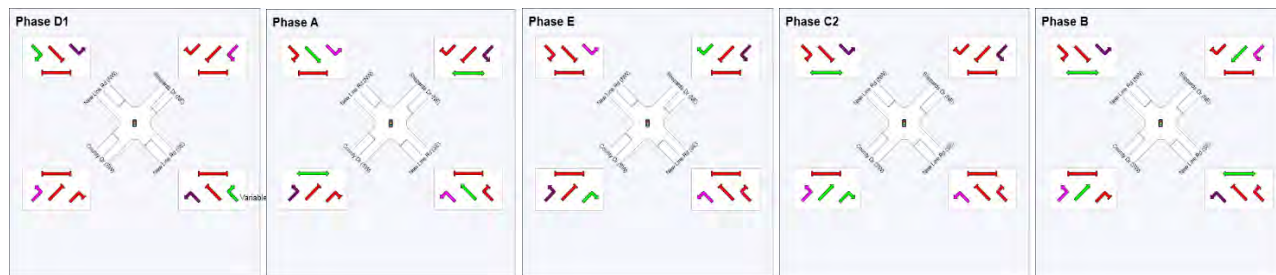
Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows Total veh/h	Deg. Satn HV %	Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: New Line Rd (SE)											
1	L2	506	0.0	0.337	8.3	LOS A	7.2	50.6	0.29	0.64	52.2
2	T1	987	0.0	0.603	19.1	LOS B	29.0	203.1	0.63	0.57	44.4
3	R2	94	0.0	0.618	86.9	LOS F	3.6	25.3	1.00	0.77	23.9
Approach		1587	0.0	0.618	19.7	LOS B	29.0	203.1	0.55	0.60	44.2
NorthEast: Shepherds Dr (NE)											
4	L2	293	0.0	0.562	45.1	LOS D	16.7	117.0	0.87	0.80	32.4
5	T1	243	0.0	0.994	126.1	LOS F	13.3	93.3	1.00	1.29	19.2
6	R2	164	0.0	0.808	80.2	LOS F	12.5	87.2	1.00	0.92	23.1
Approach		700	0.0	0.994	81.4	LOS F	16.7	117.0	0.95	1.00	24.3
NorthWest: New Line Rd (NW)											
7	L2	136	0.0	0.092	7.8	LOS A	1.6	10.9	0.24	0.61	48.0
8	T1	1997	0.0	0.946	52.4	LOS D	82.7	579.2	0.93	1.00	30.5
9	R2	136	0.0	0.894	95.6	LOS F	5.6	39.2	1.00	0.97	21.6
Approach		2269	0.0	0.946	52.3	LOS D	82.7	579.2	0.89	0.98	30.4
SouthWest: County Dr (SW)											
10	L2	457	0.0	0.569	19.6	LOS B	17.0	119.3	0.64	0.77	43.6
11	T1	162	0.0	0.761	74.5	LOS E	12.0	83.9	1.00	0.88	26.0
12	R2	538	0.0	0.964	110.1	LOS F	25.6	179.0	1.00	1.13	21.4
Approach		1157	0.0	0.964	69.4	LOS E	25.6	179.0	0.86	0.95	27.2
All Vehicles		5713	0.0	0.994	50.3	LOS D	82.7	579.2	0.80	0.87	31.4

### AM Phasing Summary

#### Phase Timing Results

Phase	D1	A	E	C2	B
Reference Phase	No	No	No	No	Yes
Phase Change Time (sec)	16	28	120	142	0
Green Time (sec)	6	86	16	***	10
Yellow Time (sec)	4	4	4	4	4
All-Red Time (sec)	2	2	2	2	2
Phase Time (sec)	12	92	22	6	16
Phase Split	8 %	62 %	15 %	4 %	11 %

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



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

### PM Movement Summary for 2036 Future Base with Development

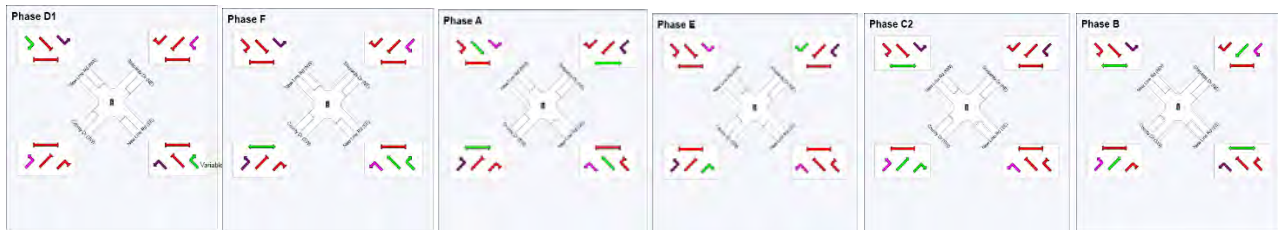
Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %				Vehicles veh	Distance m			
SouthEast: New Line Rd (SE)											
1	L2	544	0.0	0.369	8.2	LOS A	6.9	48.4	0.33	0.66	52.3
2	T1	1464	0.0	0.933	51.1	LOS D	58.8	411.6	0.83	0.98	30.9
3	R2	332	0.0	0.563	57.5	LOS E	9.3	64.8	0.97	0.81	29.5
Approach		2340	0.0	0.933	42.0	LOS D	58.8	411.6	0.73	0.88	34.2
NorthEast: Shepherds Dr (NE)											
4	L2	146	0.0	0.140	13.7	LOS B	3.4	23.5	0.47	0.65	44.8
5	T1	237	0.0	0.809	66.2	LOS E	7.6	53.0	1.00	0.93	27.9
6	R2	204	0.0	0.940	84.9	LOS F	15.1	105.6	1.00	1.17	22.3
Approach		587	0.0	0.940	59.6	LOS E	15.1	105.6	0.87	0.94	28.4
NorthWest: New Line Rd (NW)											
7	L2	162	0.0	0.125	9.7	LOS A	2.4	17.1	0.35	0.64	46.7
8	T1	834	0.0	0.558	26.7	LOS C	20.7	144.9	0.78	0.68	40.2
9	R2	162	0.0	0.871	78.1	LOS E	5.4	38.1	1.00	0.96	24.4
Approach		1158	0.0	0.871	31.5	LOS C	20.7	144.9	0.75	0.72	37.5
SouthWest: County Dr (SW)											
10	L2	260	0.0	0.426	29.6	LOS C	10.5	73.6	0.80	0.79	38.4
11	T1	187	0.0	0.957	88.0	LOS F	14.3	100.2	1.00	1.20	23.8
12	R2	482	0.0	0.914	78.0	LOS E	17.0	118.7	1.00	1.06	26.4
Approach		929	0.0	0.957	66.5	LOS E	17.0	118.7	0.94	1.01	28.0
All Vehicles		5014	0.0	0.957	46.2	LOS D	58.8	411.6	0.79	0.87	32.6

### PM Phasing Summary

#### Phase Timing Results

Phase	D1	F	A	E	C2	B
Reference Phase	No	No	No	No	No	Yes
Phase Change Time (sec)	15	27	40	98	118	0
Green Time (sec)	6	7	52	14	***	9
Yellow Time (sec)	4	4	4	4	4	4
All-Red Time (sec)	2	2	2	2	2	2
Phase Time (sec)	12	13	58	20	3	15
Phase Split	10 %	11 %	48 %	17 %	2 %	12 %

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

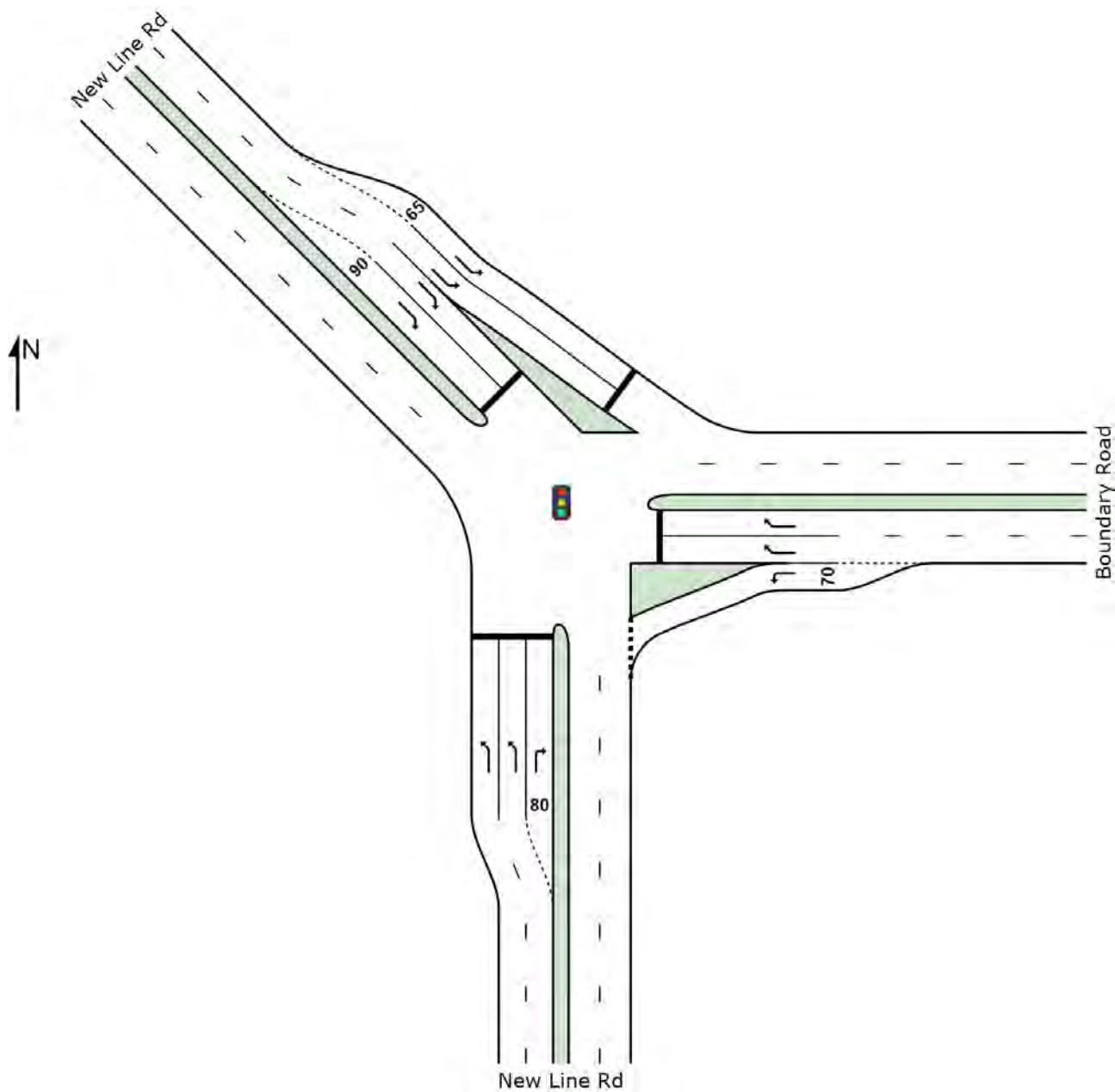


	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied



# 2036 FUTURE WITH DEVELOPMENT

## Intersection of New Line Road and Boundary Road





### AM Movement Summary for 2036 Future Base with Development

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %				Vehicles veh	Distance m			
South: New Line Rd											
1a	L1	601	5.0	0.288	19.2	LOS B	9.1	66.4	0.56	0.71	44.9
3	R2	41	5.0	0.453	69.8	LOS E	2.5	18.3	1.00	0.73	22.8
Approach		642	5.0	0.453	22.4	LOS B	9.1	66.4	0.59	0.71	42.9
East: Boundary Road											
4	L2	105	5.0	0.113	13.7	LOS A	2.4	17.7	0.44	0.67	44.9
6a	R1	1063	5.0	0.936	68.1	LOS E	42.6	311.0	0.98	1.04	23.1
Approach		1168	5.0	0.936	63.2	LOS E	42.6	311.0	0.93	1.01	24.2
NorthWest: New Line Rd											
27a	L1	1753	5.0	0.558	7.2	LOS A	14.3	104.4	0.31	0.65	49.5
29a	R1	1223	5.0	0.984	81.8	LOS F	46.5	339.7	0.87	1.08	25.3
Approach		2976	5.0	0.984	37.9	LOS C	46.5	339.7	0.54	0.83	33.6
All Vehicles		4786	5.0	0.984	42.0	LOS C	46.5	339.7	0.64	0.85	32.1

### AM Phasing Summary

#### Phase Timing Results

Phase	A	B	C
Reference Phase	No	No	Yes
Phase Change Time (sec)	47	59	0
Green Time (sec)	6	55	41
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	12	61	47
Phase Split	10 %	51 %	39 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

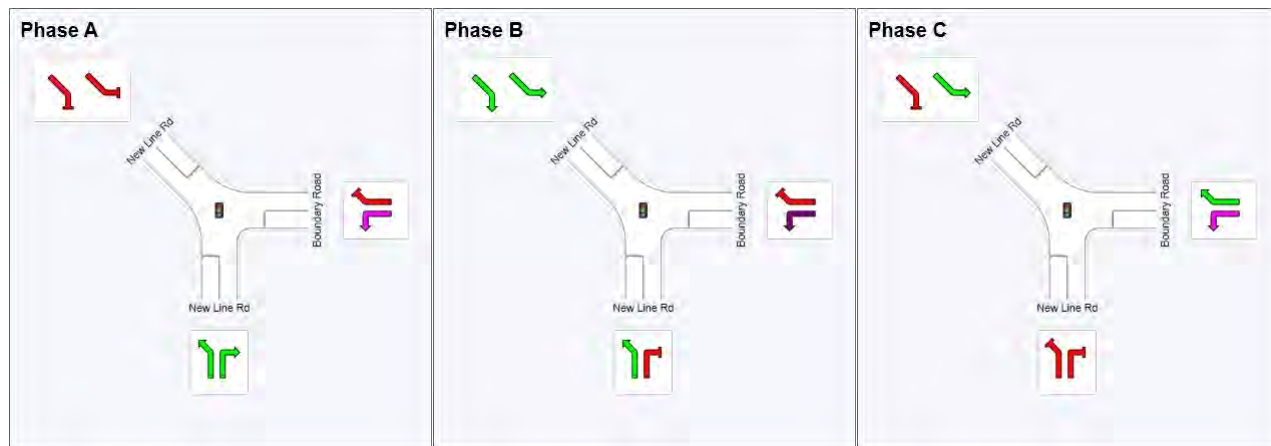
### PM Movement Summary for 2036 Future Base with Development

Movement Performance - Vehicles											
Mov ID	ODMo	Demand Flows	Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Prop. Queued	Effective Stop Rate	Average Speed		
	v	Total	HV	sec		Vehicles		per veh	km/h		
		veh/h	%	v/c		veh	m				
South: New Line Rd											
1a	L1	1046	5.0	0.818	32.3	LOS C	18.7	136.2	0.98	0.95	38.7
3	R2	138	5.0	0.761	43.6	LOS D	5.2	37.8	1.00	0.90	29.5
Approach		1184	5.0	0.818	33.6	LOS C	18.7	136.2	0.98	0.95	37.7
East: Boundary Road											
4	L2	53	5.0	0.039	7.6	LOS A	0.4	2.9	0.30	0.60	50.0
6a	R1	1584	5.0	0.887	33.5	LOS C	31.6	230.9	0.97	1.02	33.3
Approach		1637	5.0	0.887	32.7	LOS C	31.6	230.9	0.95	1.00	33.7
NorthWest: New Line Rd											
27a	L1	1047	5.0	0.389	8.4	LOS A	6.7	49.1	0.41	0.67	48.5
29a	R1	498	5.0	0.842	42.6	LOS D	9.8	71.7	1.00	1.00	34.8
Approach		1545	5.0	0.842	19.4	LOS B	9.8	71.7	0.60	0.78	41.9
All Vehicles		4366	5.0	0.887	28.2	LOS B	31.6	230.9	0.83	0.91	37.5

### AM Phasing Summary

#### Phase Timing Results

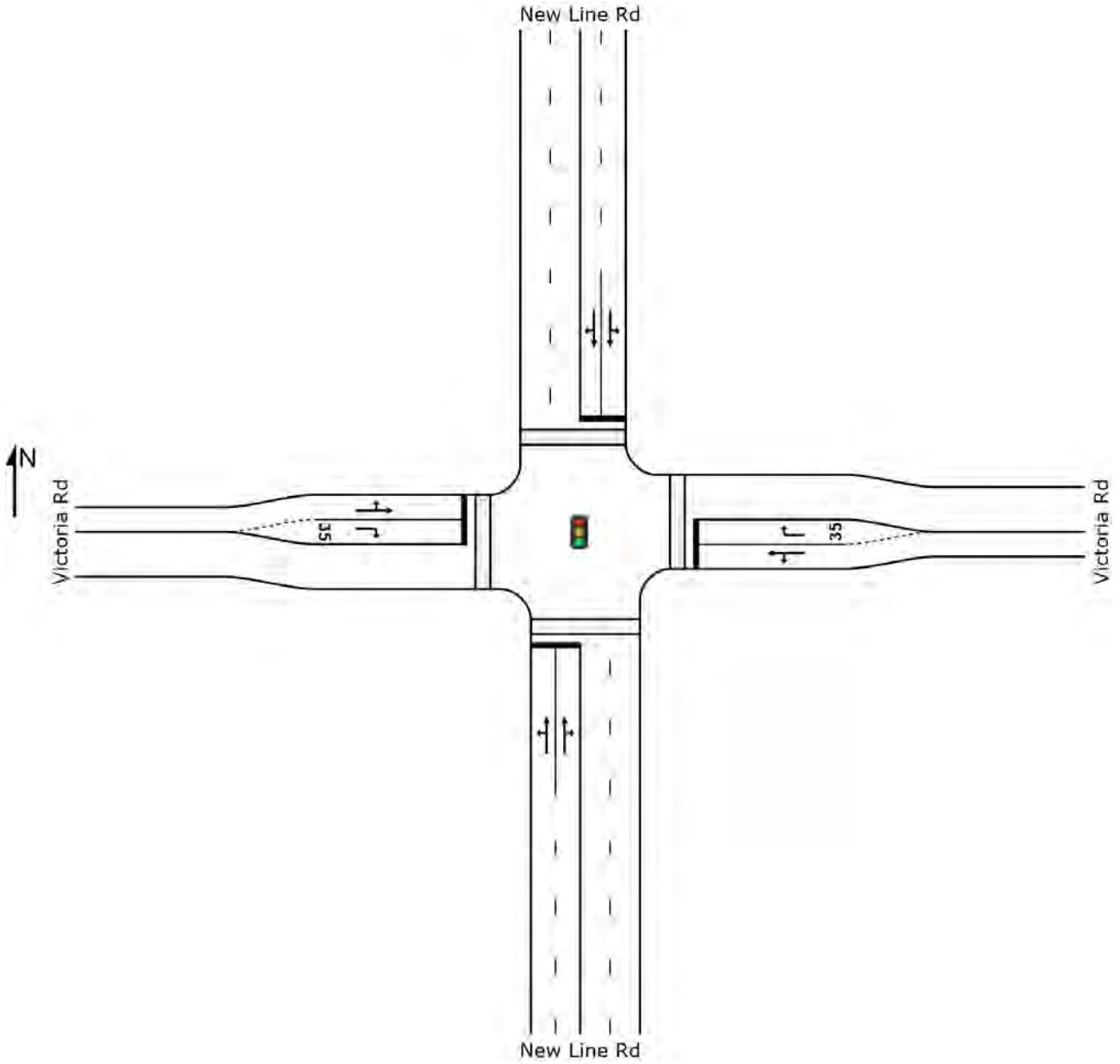
Phase	A	B	C
Reference Phase	No	No	Yes
Phase Change Time (sec)	40	53	0
Green Time (sec)	7	11	34
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	13	17	40
Phase Split	19 %	24 %	57 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

# 2036 FUTURE WITH DEVELOPMENT

## Intersection of New Line Road and Victoria Road



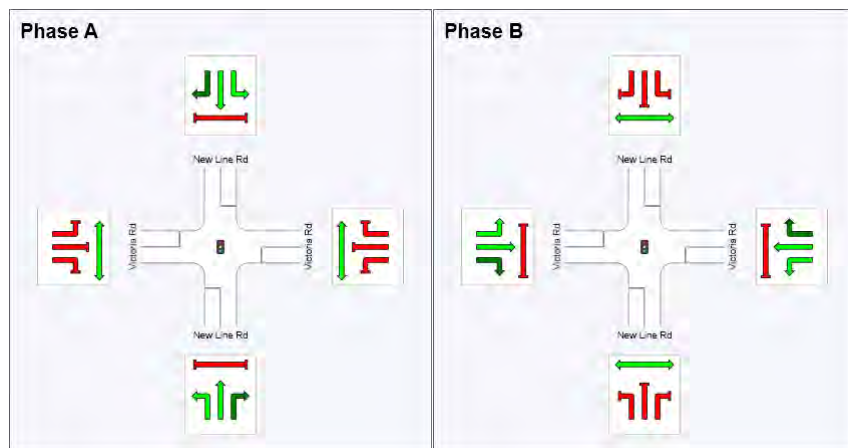
### AM Movement Summary for 2036 Future Base with Development

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows Total veh/h	Deg. Satn 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: New Line Rd											
1	L2	1	5.0	0.502	12.4	LOS A	6.4	47.0	0.69	0.60	51.6
2	T1	497	5.0	0.502	6.8	LOS A	6.4	47.0	0.69	0.60	53.3
3	R2	229	5.0	0.891	36.1	LOS C	6.7	49.1	1.00	1.19	35.3
Approach		727	5.0	0.891	16.0	LOS B	6.7	49.1	0.79	0.79	45.9
East: Victoria Rd											
4	L2	268	5.0	0.859	30.1	LOS C	6.5	47.8	1.00	1.07	37.6
5	T1	1	5.0	0.859	24.5	LOS B	6.5	47.8	1.00	1.07	40.2
6	R2	75	5.0	0.228	21.9	LOS B	1.3	9.8	0.90	0.74	43.2
Approach		344	5.0	0.859	28.3	LOS B	6.5	47.8	0.98	0.99	38.8
North: New Line Rd											
7	L2	391	5.0	0.619	13.0	LOS A	8.4	61.3	0.75	0.76	49.4
8	T1	798	5.0	0.619	7.4	LOS A	8.4	61.6	0.75	0.69	51.9
9	R2	1	5.0	0.619	13.1	LOS A	8.4	61.6	0.75	0.67	52.3
Approach		1189	5.0	0.619	9.3	LOS A	8.4	61.6	0.75	0.71	51.0
West: Victoria Rd											
10	L2	1	5.0	0.007	20.7	LOS B	0.0	0.3	0.84	0.56	45.3
11	T1	1	5.0	0.007	15.1	LOS B	0.0	0.3	0.84	0.56	46.4
12	R2	1	5.0	0.005	24.9	LOS B	0.0	0.1	0.94	0.57	40.2
Approach		3	5.0	0.007	20.2	LOS B	0.0	0.3	0.88	0.57	43.9
All Vehicles		2264	5.0	0.891	14.4	LOS A	8.4	61.6	0.80	0.78	47.1

### AM Phasing Summary

#### Phase Timing Results

Phase	A	B
Reference Phase	No	Yes
Phase Change Time (sec)	13	0
Green Time (sec)	21	7
Yellow Time (sec)	4	4
All-Red Time (sec)	2	2
Phase Time (sec)	27	13
Phase Split	68 %	33 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

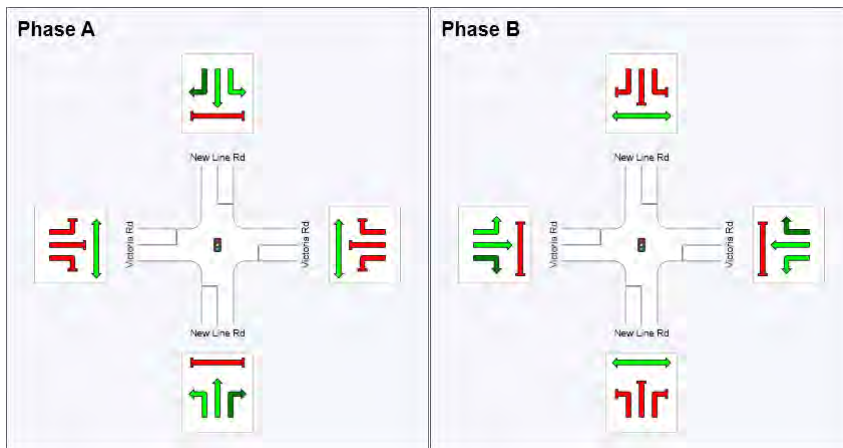
### PM Movement Summary for 2036 Future Base with Development

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows		Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
		Total veh/h	HV %				Vehicles veh	Distance m			
South: New Line Rd											
1	L2	1	5.0	0.691	13.4	LOS A	10.9	79.2	0.78	0.72	50.8
2	T1	1221	5.0	0.691	8.0	LOS A	10.9	79.2	0.78	0.73	51.9
3	R2	97	5.0	0.691	13.9	LOS A	9.4	68.3	0.78	0.75	50.0
Approach		1319	5.0	0.691	8.4	LOS A	10.9	79.2	0.78	0.73	51.8
East: Victoria Rd											
4	L2	186	5.0	0.696	25.9	LOS B	4.0	29.1	1.00	0.89	39.6
5	T1	1	5.0	0.696	20.3	LOS B	4.0	29.1	1.00	0.89	42.2
6	R2	182	5.0	0.619	24.8	LOS B	3.7	27.0	0.98	0.84	41.8
Approach		369	5.0	0.696	25.3	LOS B	4.0	29.1	0.99	0.86	40.7
North: New Line Rd											
7	L2	67	5.0	0.247	10.7	LOS A	2.6	19.1	0.55	0.53	52.6
8	T1	431	5.0	0.247	5.1	LOS A	2.6	19.1	0.55	0.49	54.2
9	R2	1	5.0	0.247	10.8	LOS A	2.6	18.6	0.55	0.46	54.0
Approach		499	5.0	0.247	5.9	LOS A	2.6	19.1	0.55	0.50	53.9
West: Victoria Rd											
10	L2	1	5.0	0.008	21.7	LOS B	0.0	0.3	0.87	0.57	44.7
11	T1	1	5.0	0.008	16.1	LOS B	0.0	0.3	0.87	0.57	45.8
12	R2	5	5.0	0.031	25.5	LOS B	0.1	0.7	0.95	0.63	39.9
Approach		7	5.0	0.031	23.6	LOS B	0.1	0.7	0.93	0.61	41.4
All Vehicles		2195	5.0	0.696	10.7	LOS A	10.9	79.2	0.76	0.70	49.8

### AM Phasing Summary

#### Phase Timing Results

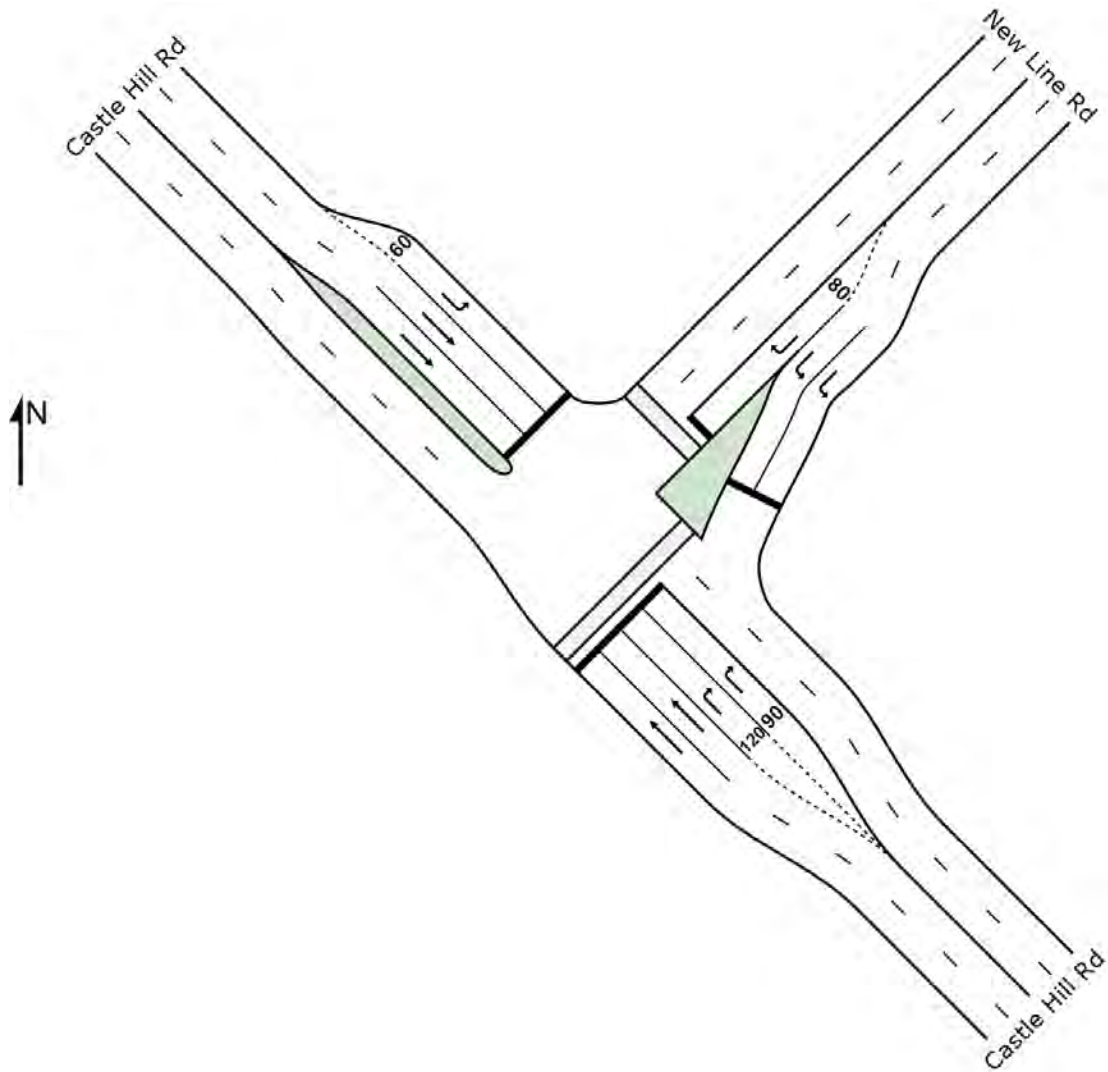
Phase	A	B
Reference Phase	No	Yes
Phase Change Time (sec)	12	0
Green Time (sec)	22	6
Yellow Time (sec)	4	4
All-Red Time (sec)	2	2
Phase Time (sec)	28	12
Phase Split	70 %	30 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

# 2036 FUTURE WITH DEVELOPMENT

## Intersection of New Line Road and Castle Hill Road





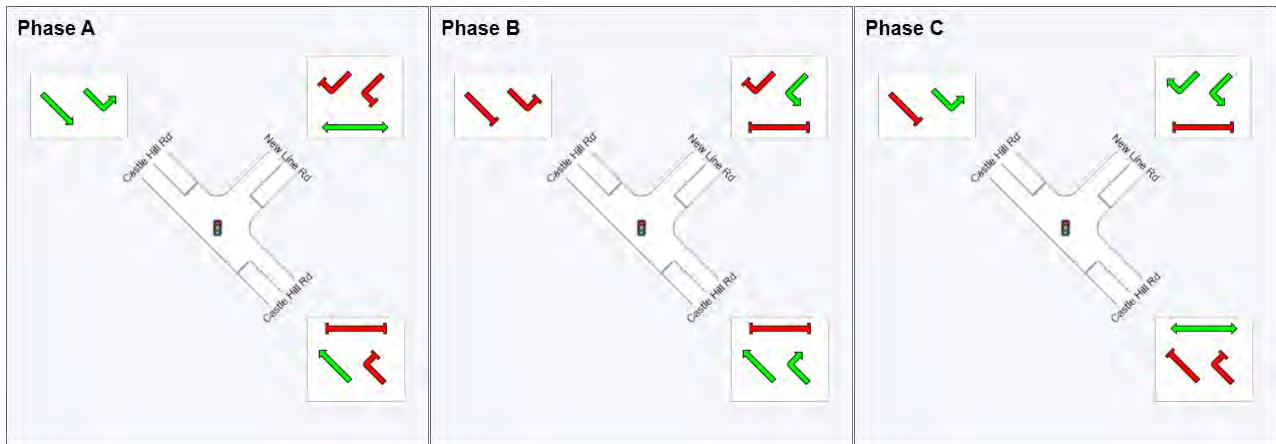
### AM Movement Summary for 2036 Future Base with Development

Movement Performance - Vehicles											
Mov ID	ODMo	Demand Flows	Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Prop. Queued	Effective Stop Rate	Average Speed		
	v	Total	HV	sec		Vehicles		per veh	km/h		
		veh/h	%	v/c		veh	m				
SouthEast: Castle Hill Rd											
22	T1	1216	5.0	0.418	4.1	LOS A	9.9	72.1	0.37	0.33	55.4
23	R2	487	5.0	0.849	58.0	LOS E	13.2	96.2	1.00	0.95	24.8
Approach		1703	5.0	0.849	19.5	LOS B	13.2	96.2	0.55	0.51	42.1
NorthEast: New Line Rd											
24	L2	893	5.0	0.768	40.2	LOS C	20.9	152.4	0.95	0.89	30.4
26	R2	168	5.0	0.854	61.7	LOS E	9.2	67.5	1.00	0.96	27.6
Approach		1061	5.0	0.854	43.6	LOS D	20.9	152.4	0.96	0.90	29.8
NorthWest: Castle Hill Rd											
27	L2	240	5.0	0.186	10.4	LOS A	3.7	27.1	0.34	0.67	48.8
28	T1	1666	5.0	0.872	28.1	LOS B	43.5	317.9	0.88	0.90	38.2
Approach		1906	5.0	0.872	25.9	LOS B	43.5	317.9	0.81	0.87	39.3
All Vehicles		4671	5.0	0.872	27.6	LOS B	43.5	317.9	0.75	0.75	37.7

### AM Phasing Summary

#### Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	61	83
Green Time (sec)	55	16	11
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	61	22	17
Phase Split	61 %	22 %	17 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied

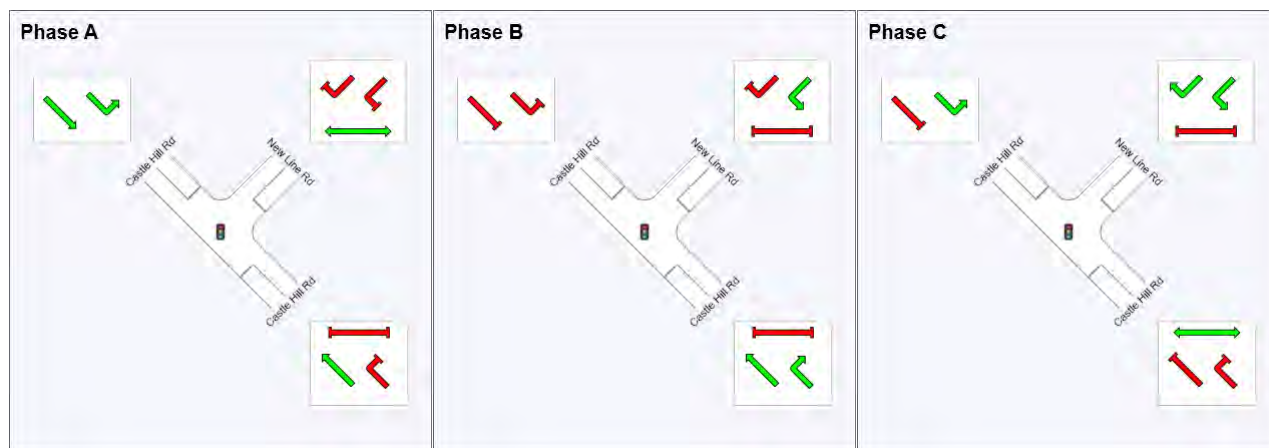
### PM Movement Summary for 2036 Future Base with Development

Movement Performance - Vehicles											
Mov ID	ODMo	Demand Flows	Deg. Satn	Average Delay	Level of Service	95% Back of Queue	Prop. Queued	Effective Stop Rate	Average Speed		
	v	Total	HV	sec		Vehicles		per veh	km/h		
		veh/h	%	v/c		veh	m				
SouthEast: Castle Hill Rd											
22	T1	1417	5.0	0.524	5.6	LOS A	12.6	92.0	0.49	0.45	53.9
23	R2	1141	5.0	1.036	105.9	LOS F	42.9	313.0	1.00	1.33	16.8
Approach		2558	5.0	1.036	50.3	LOS D	42.9	313.0	0.72	0.84	28.4
NorthEast: New Line Rd											
24	L2	459	5.0	0.247	17.2	LOS B	5.0	36.4	0.59	0.72	41.9
26	R2	164	5.0	0.674	44.3	LOS D	6.6	48.5	1.00	0.85	32.4
Approach		623	5.0	0.674	24.3	LOS B	6.6	48.5	0.70	0.76	38.4
NorthWest: Castle Hill Rd											
27	L2	173	5.0	0.177	15.6	LOS B	3.4	25.0	0.54	0.71	45.3
28	T1	1235	5.0	1.007	81.8	LOS F	43.0	314.2	1.00	1.47	22.5
Approach		1407	5.0	1.007	73.6	LOS F	43.0	314.2	0.94	1.38	24.1
All Vehicles		4588	5.0	1.036	54.0	LOS D	43.0	314.2	0.78	0.99	27.8

### AM Phasing Summary

#### Phase Timing Results

Phase	A	B	C
Reference Phase	Yes	No	No
Phase Change Time (sec)	0	33	64
Green Time (sec)	27	25	11
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	33	31	17
Phase Split	41 %	38 %	21 %



	Normal Movement		Permitted/Opposed
	Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane
	Stopped Movement		Turn On Red
	Other Movement Class Running		Other Movement Class Stopped
	Mixed Running & Stopped Movement Classes		
	Undetected Movement		Phase Transition Applied



# Appendix D

**ROAD NETWORK CAPACITY**



# South Dural Existing 2016 - AM Peak

Road & location	Direction	2016 Surveyed Traffic Volumes (veh/hour)	Number of Lanes	Road Type	Capacity	V/C	Level of Service
Old Northern Road, north of New Line Road	Northbound	1,452	2	2	2,400	61%	C
	Southbound	1,313	2	2	2,400	55%	C
Old Northern Road, west of New Line Road	Eastbound	1,191	1	2	1,200	99%	E
	Westbound	896	1	2	1,200	75%	C
Old Northern Road, east of Kenthurst Road	Eastbound	1,160	1	2	1,200	97%	E
	Westbound	867	1	2	1,200	72%	C
Old Northern Road, south of Kenthurst Road	Northbound	902	1	2	1,200	75%	D
	Southbound	903	1	2	1,200	75%	D
Old Northern Road, south of Franlee Road	Northbound	958	1	2	1,200	80%	D
	Southbound	903	1	2	1,200	75%	D
Old Northern Road, north of Glenhaven Road	Northbound	958	1	2	1,200	80%	D
	Southbound	903	1	2	1,200	75%	D
Old Northern Road, south of Glenhaven Road	Northbound	712	1	2	1,200	59%	C
	Southbound	836	1	2	1,200	70%	C
Old Northern Road, south of Blue Gum Drive	Northbound	717	1	2	1,200	60%	C
	Southbound	840	1	2	1,200	70%	C
Old Northern Road, north of Gilbert Road	Northbound	721	1	2	1,200	60%	C
	Southbound	832	1	2	1,200	69%	C
Old Northern Road, north of Hastings Road	Northbound	915	1	2	1,200	76%	D
	Southbound	1,188	1	2	1,200	99%	E
Old Northern Road, south of Hastings Road	Northbound	729	1	2	1,200	61%	C
	Southbound	1,086	1	2	1,200	91%	E
New Line Road, south of Old Northern Road	Northbound	1,206	1	2	1,200	101%	F
	Southbound	1,223	1	2	1,200	102%	F
New Line Road, north of Sebastian Drive	Northbound	1,169	1	2	1,200	97%	E
	Southbound	1,115	1	2	1,200	93%	E
New Line Road, north of Hastings Road	Eastbound	1,136	2	1	3,200	36%	B
	Westbound	1,167	1	1	1,600	73%	C
New Line Road, South of Hastings Road	Northbound	1,325	1	1	1,600	83%	D
	Southbound	1,267	2	1	3,200	40%	B
New Line Road, south of James Henty Drive	Northbound	1,780	1	1	1,600	111%	F
	Southbound	1,060	1	1	1,600	66%	C
New Line Road, south of Purchase Road	Northbound	980	2	1	3,200	31%	A
	Southbound	1,620	2	1	3,200	51%	C
New Line Road, south of Country Drive	Northbound	1,400	2	1	3,200	44%	B
	Southbound	1,870	2	1	3,200	58%	C
New Line Road, south of Boundary Road	Northbound	560	1	3	900	62%	C
	Southbound	970	1	3	900	108%	F
New Line Road, north of Victoria Road	Northbound	610	1	3	900	68%	C
	Southbound	990	1	3	900	110%	F
New Line Road, north of Castle Hill Road	Northbound	600	1	3	900	67%	C
	Southbound	440	1	3	900	49%	B
Hastings Road, between Old Northern Road and New Line Road	Eastbound	760	1	1	1,600	48%	B
	Westbound	844	1	1	1,600	53%	C

Road Type= 1 = Urban Road with Clearways  
 2 = Urban Road with Interruptions  
 3 = Local Road



# South Dural Existing 2016 - AM Peak

Road & location	Direction	2016 Surveyed Traffic Volumes (veh/hour)	Number of Lanes	Road Type	Capacity	V/C	Level of Service
Old Northern Road, north of New Line Road	Northbound	1,228	2	2	2,400	51%	C
	Southbound	1,286	2	2	2,400	54%	C
Old Northern Road, west of New Line Road	Eastbound	1,118	1	2	1,200	93%	E
	Westbound	1,015	1	2	1,200	85%	D
Old Northern Road, east of Kenthurst Road	Eastbound	1,023	1	2	1,200	85%	D
	Westbound	1,018	1	2	1,200	85%	D
Old Northern Road, south of Kenthurst Road	Northbound	871	1	2	1,200	73%	C
	Southbound	842	1	2	1,200	70%	C
Old Northern Road, south of Franlee Road	Northbound	970	1	2	1,200	81%	D
	Southbound	842	1	2	1,200	70%	C
Old Northern Road, north of Glenhaven Road	Northbound	970	1	2	1,200	81%	D
	Southbound	842	1	2	1,200	70%	C
Old Northern Road, south of Glenhaven Road	Northbound	999	1	2	1,200	83%	D
	Southbound	615	1	2	1,200	51%	C
Old Northern Road, south of Blue Gum Drive	Northbound	1,023	1	2	1,200	85%	D
	Southbound	646	1	2	1,200	54%	C
Old Northern Road, north of Gilbert Road	Northbound	1,020	1	2	1,200	85%	D
	Southbound	661	1	2	1,200	55%	C
Old Northern Road, north of Hastings Road	Northbound	1,143	1	2	1,200	95%	E
	Southbound	832	1	2	1,200	69%	C
Old Northern Road, south of Hastings Road	Eastbound	921	1	2	1,200	77%	D
	Westbound	717	1	2	1,200	60%	C
New Line Road, south of Old Northern Road	Eastbound	1,112	1	2	1,200	93%	E
	Westbound	1,194	1	2	1,200	100%	E
New Line Road, north of Sebastian Drive	Northbound	1,089	1	2	1,200	91%	E
	Southbound	1,228	1	2	1,200	102%	F
New Line Road, north of Hastings Road	Eastbound	1,111	2	1	3,200	35%	A
	Westbound	1,216	1	1	1,600	76%	D
New Line Road, South of Hastings Road	Northbound	1,271	1	1	1,600	79%	D
	Southbound	1,275	2	1	3,200	40%	B
New Line Road, south of James Henty Drive	Northbound	970	1	1	1,600	61%	C
	Southbound	1,370	1	1	1,600	86%	D
New Line Road, south of Purchase Road	Northbound	1,430	2	1	3,200	45%	B
	Southbound	1,170	2	1	3,200	37%	B
New Line Road, south of Country Drive	Northbound	1,960	2	1	3,200	61%	C
	Southbound	1,210	2	1	3,200	38%	B
New Line Road, south of Boundary Road	Northbound	1,060	1	3	900	118%	F
	Southbound	660	1	3	900	73%	C
New Line Road, north of Victoria Road	Northbound	1,140	1	3	900	127%	F
	Southbound	600	1	3	900	67%	C
New Line Road, north of Castle Hill Road	Northbound	1,010	1	3	900	112%	F
	Southbound	550	1	3	900	61%	C
Hastings Road, between Old Northern Road and New Line Road	Eastbound	619	1	1	1,600	39%	B
	Westbound	726	1	1	1,600	45%	B

Road Type= 1 = Urban Road with Clearways  
 2 = Urban Road with Interruptions  
 3 = Local Road

## South Dural Future Base 2026, existing network - PM Peak

Road & location	Direction	2026 Estimated Traffic Volumes (veh/hour)	Number of Lanes	Road Type	Capacity	V/C	Level of Service
Old Northern Road, north of New Line Road	Northbound	1,455	2	2	2,400	61%	C
	Southbound	1,353	2	2	2,400	56%	C
Old Northern Road, west of New Line Road	Eastbound	1,191	1	2	1,200	99%	E
	Westbound	972	1	2	1,200	81%	D
Old Northern Road, east of Kenthurst Road	Eastbound	1,160	1	2	1,200	97%	E
	Westbound	935	1	2	1,200	78%	D
Old Northern Road, south of Kenthurst Road	Northbound	902	1	2	1,200	75%	D
	Southbound	1,053	1	2	1,200	88%	D
Old Northern Road, south of Franlee Road	Northbound	958	1	2	1,200	80%	D
	Southbound	1,053	1	2	1,200	88%	D
Old Northern Road, north of Glenhaven Road	Northbound	958	1	2	1,200	80%	D
	Southbound	1,045	1	2	1,200	87%	D
Old Northern Road, south of Glenhaven Road	Northbound	712	1	2	1,200	59%	C
	Southbound	1,024	1	2	1,200	85%	D
Old Northern Road, south of Blue Gum Drive	Northbound	717	1	2	1,200	60%	C
	Southbound	1,028	1	2	1,200	86%	D
Old Northern Road, north of Gilbert Road	Northbound	721	1	2	1,200	60%	C
	Southbound	1,024	1	2	1,200	85%	D
Old Northern Road, north of Hastings Road	Northbound	918	1	2	1,200	77%	D
	Southbound	1,361	1	2	1,200	113%	F
Old Northern Road, south of Hastings Road	Northbound	729	1	2	1,200	61%	C
	Southbound	1,170	1	2	1,200	98%	E
New Line Road, south of Old Northern Road	Northbound	1,364	1	2	1,200	114%	F
	Southbound	1,223	1	2	1,200	102%	F
New Line Road, north of Sebastian Drive	Northbound	1,169	1	2	1,200	97%	E
	Southbound	1,115	1	2	1,200	93%	E
New Line Road, north of Hastings Road	Northbound	1,178	2	1	3,200	37%	B
	Southbound	1,167	1	1	1,600	73%	C
New Line Road, South of Hastings Road	Northbound	1,422	1	1	1,600	89%	D
	Southbound	1,267	2	1	3,200	40%	B
New Line Road, south of James Henty Drive	Northbound	1,190	1	1	1,600	74%	C
	Southbound	1,810	1	1	1,600	113%	F
New Line Road, south of Purchase Road	Northbound	1,180	2	1	3,200	37%	B
	Southbound	1,920	2	1	3,200	60%	C
New Line Road, south of Country Drive	Northbound	1,340	2	1	3,200	42%	B
	Southbound	2,360	2	1	3,200	74%	C
New Line Road, south of Boundary Road	Northbound	530	1	3	900	59%	C
	Southbound	1,070	1	3	900	119%	F
New Line Road, north of Victoria Road	Northbound	440	1	3	900	49%	B
	Southbound	920	1	3	900	102%	F
New Line Road, north of Castle Hill Road	Northbound	490	1	3	900	54%	C
	Southbound	630	1	3	900	70%	C
Hastings Road, between Old Northern Road and New Line Road	Eastbound	849	1	1	1,600	53%	C
	Westbound	852	1	1	1,600	53%	C

Road Type= 1 = Urban Road with Clearways  
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 3 = Local Road

## South Dural Future Base 2026, existing network - PM Peak

Road & location	Direction	2026 Estimated Traffic Volumes (veh/hour)	Number of Lanes	Road Type	Capacity	V/C	Level of Service
Old Northern Road, north of New Line Road	Northbound	1,269	2	2	2,400	53%	C
	Southbound	1,286	2	2	2,400	54%	C
Old Northern Road, west of New Line Road	Eastbound	1,118	1	2	1,200	93%	E
	Westbound	1,214	1	2	1,200	101%	F
Old Northern Road, east of Kenthurst Road	Eastbound	1,023	1	2	1,200	85%	D
	Westbound	1,206	1	2	1,200	101%	F
Old Northern Road, south of Kenthurst Road	Northbound	877	1	2	1,200	73%	C
	Southbound	1,015	1	2	1,200	85%	D
Old Northern Road, south of Franlee Road	Northbound	986	1	2	1,200	82%	D
	Southbound	1,016	1	2	1,200	85%	D
Old Northern Road, north of Glenhaven Road	Northbound	986	1	2	1,200	82%	D
	Southbound	1,025	1	2	1,200	85%	D
Old Northern Road, south of Glenhaven Road	Northbound	1,101	1	2	1,200	92%	E
	Southbound	844	1	2	1,200	70%	C
Old Northern Road, south of Blue Gum Drive	Northbound	1,166	1	2	1,200	97%	E
	Southbound	873	1	2	1,200	73%	C
Old Northern Road, north of Gilbert Road	Northbound	1,165	1	2	1,200	97%	E
	Southbound	888	1	2	1,200	74%	C
Old Northern Road, north of Hastings Road	Northbound	1,321	1	2	1,200	110%	F
	Southbound	1,051	1	2	1,200	88%	D
Old Northern Road, south of Hastings Road	Eastbound	1,039	1	2	1,200	87%	D
	Westbound	838	1	2	1,200	70%	C
New Line Road, south of Old Northern Road	Eastbound	1,367	1	2	1,200	114%	F
	Westbound	1,202	1	2	1,200	100%	F
New Line Road, north of Sebastian Drive	Northbound	1,166	1	2	1,200	97%	E
	Southbound	1,228	1	2	1,200	102%	F
New Line Road, north of Hastings Road	Eastbound	1,171	2	1	3,200	37%	B
	Westbound	1,216	1	1	1,600	76%	D
New Line Road, South of Hastings Road	Northbound	1,426	1	1	1,600	89%	D
	Southbound	1,275	2	1	3,200	40%	B
New Line Road, south of James Henty Drive	Northbound	1,480	1	1	1,600	93%	E
	Southbound	920	1	1	1,600	58%	C
New Line Road, south of Purchase Road	Northbound	1,600	2	1	3,200	50%	C
	Southbound	940	2	1	3,200	29%	A
New Line Road, south of Country Drive	Northbound	2,040	2	1	3,200	64%	C
	Southbound	1,320	2	1	3,200	41%	B
New Line Road, south of Boundary Road	Northbound	1,070	1	3	900	119%	F
	Southbound	500	1	3	900	56%	C
New Line Road, north of Victoria Road	Northbound	1,170	1	3	900	130%	F
	Southbound	440	1	3	900	49%	B
New Line Road, north of Castle Hill Road	Northbound	1,090	1	3	900	121%	F
	Southbound	560	1	3	900	62%	C
Hastings Road, between Old Northern Road and New Line Road	Eastbound	640	1	1	1,600	40%	B
	Westbound	726	1	1	1,600	45%	B

Road Type= 1 = Urban Road with Clearways  
 2 = Urban Road with Interruptions  
 3 = Local Road

## South Dural Future Base 2026 with road upgrades - AM Peak

Road & location	Direction	2026 Estimated Traffic Volumes (veh/hour)	Number of Lanes	Road Type	Capacity	V/C	Level of Service
Old Northern Road, north of New Line Road	Northbound	1,455	2	2	2,400	61%	C
	Southbound	1,353	2	2	2,400	56%	C
Old Northern Road, west of New Line Road	Eastbound	1,191	1	2	1,200	99%	E
	Westbound	972	2	2	2,400	40%	B
Old Northern Road, east of Kenthurst Road	Eastbound	1,160	1	2	1,200	97%	E
	Westbound	935	2	2	2,400	39%	B
Old Northern Road, south of Kenthurst Road	Northbound	902	1	2	1,200	75%	D
	Southbound	1,053	2	2	2,400	44%	B
Old Northern Road, south of Franlee Road	Northbound	958	1	2	1,200	80%	D
	Southbound	1,053	2	2	2,400	44%	B
Old Northern Road, north of Glenhaven Road	Northbound	958	1	2	1,200	80%	D
	Southbound	1,045	2	2	2,400	44%	B
Old Northern Road, south of Glenhaven Road	Northbound	712	1	2	1,200	59%	C
	Southbound	1,024	1	2	1,200	85%	D
Old Northern Road, south of Blue Gum Drive	Northbound	717	2	2	2,400	30%	A
	Southbound	1,028	1	2	1,200	86%	D
Old Northern Road, north of Gilbert Road	Northbound	721	2	2	2,400	30%	A
	Southbound	1,024	1	2	1,200	85%	D
Old Northern Road, north of Hastings Road	Northbound	918	2	2	2,400	38%	B
	Southbound	1,361	2	2	2,400	57%	C
Old Northern Road, south of Hastings Road	Northbound	729	2	2	2,400	30%	A
	Southbound	1,170	2	2	2,400	49%	B
New Line Road, south of Old Northern Road	Northbound	1,364	2	2	2,400	57%	C
	Southbound	1,223	2	2	2,400	51%	C
New Line Road, north of Sebastian Drive	Northbound	1,169	2	2	2,400	49%	B
	Southbound	1,115	1	2	1,200	93%	E
New Line Road, north of Hastings Road	Northbound	1,178	2	1	3,200	37%	B
	Southbound	1,167	1	1	1,600	73%	C
New Line Road, South of Hastings Road	Northbound	1,422	2	1	3,200	44%	B
	Southbound	1,267	2	1	3,200	40%	B
New Line Road, south of James Henty Drive	Northbound	1,190	2	1	3,200	37%	B
	Southbound	1,810	2	1	3,200	57%	C
New Line Road, south of Purchase Road	Northbound	1,180	2	1	3,200	37%	B
	Southbound	1,920	2	1	3,200	60%	C
New Line Road, south of Country Drive	Northbound	1,340	2	1	3,200	42%	B
	Southbound	2,360	2	1	3,200	74%	C
New Line Road, south of Boundary Road	Northbound	530	2	3	1,800	29%	A
	Southbound	1,070	2	3	1,800	59%	C
New Line Road, north of Victoria Road	Northbound	440	2	3	1,800	24%	A
	Southbound	920	2	3	1,800	51%	C
New Line Road, north of Castle Hill Road	Northbound	490	2	3	1,800	27%	A
	Southbound	630	1	3	900	70%	C
Hastings Road, between Old Northern Road and New Line Road	Eastbound	849	1	1	1,600	53%	C
	Westbound	852	1	1	1,600	53%	C

Road Type= 1 = Urban Road with Clearways  
 2 = Urban Road with Interruptions  
 3 = Local Road

## South Dural Future Base 2026 with road upgrades - PM Peak

Road & location	Direction	2026 Estimated Traffic Volumes (veh/hour)	Number of Lanes	Road Type	Capacity	V/C	Level of Service
Old Northern Road, north of New Line Road	Northbound	1,269	2	2	2,400	53%	C
	Southbound	1,286	2	2	2,400	54%	C
Old Northern Road, west of New Line Road	Eastbound	1,118	1	2	1,200	93%	E
	Westbound	1,214	2	2	2,400	51%	C
Old Northern Road, east of Kenthurst Road	Eastbound	1,023	1	2	1,200	85%	D
	Westbound	1,206	2	2	2,400	50%	C
Old Northern Road, south of Kenthurst Road	Northbound	877	1	2	1,200	73%	C
	Southbound	1,015	2	2	2,400	42%	B
Old Northern Road, south of Franlee Road	Northbound	986	1	2	1,200	82%	D
	Southbound	1,016	2	2	2,400	42%	B
Old Northern Road, north of Glenhaven Road	Northbound	986	1	2	1,200	82%	D
	Southbound	1,025	2	2	2,400	43%	B
Old Northern Road, south of Glenhaven Road	Northbound	1,101	1	2	1,200	92%	E
	Southbound	844	1	2	1,200	70%	C
Old Northern Road, south of Blue Gum Drive	Northbound	1,166	2	2	2,400	49%	B
	Southbound	873	1	2	1,200	73%	C
Old Northern Road, north of Gilbert Road	Northbound	1,165	2	2	2,400	49%	B
	Southbound	888	1	2	1,200	74%	C
Old Northern Road, north of Hastings Road	Northbound	1,321	2	2	2,400	55%	C
	Southbound	1,051	2	2	2,400	44%	B
Old Northern Road, south of Hastings Road	Eastbound	1,039	2	2	2,400	43%	B
	Westbound	838	2	2	2,400	35%	A
New Line Road, south of Old Northern Road	Eastbound	1,367	2	2	2,400	57%	C
	Westbound	1,202	2	2	2,400	50%	C
New Line Road, north of Sebastian Drive	Northbound	1,166	2	2	2,400	49%	B
	Southbound	1,228	1	2	1,200	102%	F
New Line Road, north of Hastings Road	Eastbound	1,171	2	1	3,200	37%	B
	Westbound	1,216	1	1	1,600	76%	D
New Line Road, South of Hastings Road	Northbound	1,426	2	1	3,200	45%	B
	Southbound	1,275	2	1	3,200	40%	B
New Line Road, south of James Henty Drive	Northbound	1,480	2	1	3,200	46%	B
	Southbound	920	2	1	3,200	29%	A
New Line Road, south of Purchase Road	Northbound	1,600	2	1	3,200	50%	C
	Southbound	940	2	1	3,200	29%	A
New Line Road, south of Country Drive	Northbound	2,040	2	1	3,200	64%	C
	Southbound	1,320	2	1	3,200	41%	B
New Line Road, south of Boundary Road	Northbound	1,070	2	3	1,800	59%	C
	Southbound	500	2	3	1,800	28%	A
New Line Road, north of Victoria Road	Northbound	1,170	2	3	1,800	65%	C
	Southbound	440	2	3	1,800	24%	A
New Line Road, north of Castle Hill Road	Northbound	1,090	2	3	1,800	61%	C
	Southbound	560	1	3	900	62%	C
Hastings Road, between Old Northern Road and New Line Road	Eastbound	640	1	1	1,600	40%	B
	Westbound	726	1	1	1,600	45%	B

Road Type= 1 = Urban Road with Clearways  
 2 = Urban Road with Interruptions  
 3 = Local Road

## South Dural Future Base 2036, existing network - AM Peak

Road & location	Direction	2036 Estimated Traffic Volumes (veh/hour)	Number of Lanes	Road Type	Capacity	V/C	Level of Service
Old Northern Road, north of New Line Road	Northbound	1,492	2	2	2,400	62%	C
	Southbound	1,466	2	2	2,400	61%	C
Old Northern Road, west of New Line Road	Eastbound	1,191	1	2	1,200	99%	E
	Westbound	1,061	1	2	1,200	88%	D
Old Northern Road, east of Kenthurst Road	Eastbound	1,160	1	2	1,200	97%	E
	Westbound	1,022	1	2	1,200	85%	D
Old Northern Road, south of Kenthurst Road	Northbound	920	1	2	1,200	77%	D
	Southbound	1,203	1	2	1,200	100%	F
Old Northern Road, south of Franlee Road	Northbound	976	1	2	1,200	81%	D
	Southbound	1,203	1	2	1,200	100%	F
Old Northern Road, north of Glenhaven Road	Northbound	985	1	2	1,200	82%	D
	Southbound	1,203	1	2	1,200	100%	F
Old Northern Road, south of Glenhaven Road	Northbound	712	1	2	1,200	59%	C
	Southbound	1,332	1	2	1,200	111%	F
Old Northern Road, south of Blue Gum Drive	Northbound	757	1	2	1,200	63%	C
	Southbound	1,336	1	2	1,200	111%	F
Old Northern Road, north of Gilbert Road	Northbound	758	1	2	1,200	63%	C
	Southbound	1,332	1	2	1,200	111%	F
Old Northern Road, north of Hastings Road	Northbound	991	1	2	1,200	83%	D
	Southbound	1,649	1	2	1,200	137%	F
Old Northern Road, south of Hastings Road	Northbound	804	1	2	1,200	67%	C
	Southbound	1,514	1	2	1,200	126%	F
New Line Road, south of Old Northern Road	Northbound	1,433	1	2	1,200	119%	F
	Southbound	1,334	1	2	1,200	111%	F
New Line Road, north of Sebastian Drive	Northbound	1,169	1	2	1,200	97%	E
	Southbound	1,115	1	2	1,200	93%	E
New Line Road, north of Hastings Road	Northbound	1,163	2	1	3,200	36%	B
	Southbound	1,167	1	1	1,600	73%	C
New Line Road, South of Hastings Road	Northbound	1,512	1	1	1,600	95%	E
	Southbound	1,402	2	1	3,200	44%	B
New Line Road, south of James Henty Drive	Northbound	1,270	1	1	1,600	79%	D
	Southbound	1,920	1	1	1,600	120%	F
New Line Road, south of Purchase Road	Northbound	1,300	2	1	3,200	41%	B
	Southbound	2,060	2	1	3,200	64%	C
New Line Road, south of Country Drive	Northbound	1,540	2	1	3,200	48%	B
	Southbound	2,580	2	1	3,200	81%	D
New Line Road, south of Boundary Road	Northbound	590	1	3	900	66%	C
	Southbound	1,090	1	3	900	121%	F
New Line Road, north of Victoria Road	Northbound	500	1	3	900	56%	C
	Southbound	950	1	3	900	106%	F
New Line Road, north of Castle Hill Road	Northbound	650	1	3	900	72%	C
	Southbound	840	1	3	900	93%	E
Hastings Road, between Old Northern Road and New Line Road	Eastbound	930	1	1	1,600	58%	C
	Westbound	971	1	1	1,600	61%	C

Road Type= 1 = Urban Road with Clearways  
 2 = Urban Road with Interruptions  
 3 = Local Road



## South Dural Future Base 2036, existing network - PM Peak

Road & location	Direction	2036 Estimated Traffic Volumes (veh/hour)	Number of Lanes	Road Type	Capacity	V/C	Level of Service
Old Northern Road, north of New Line Road	Northbound	1,327	2	2	2,400	55%	C
	Southbound	1,301	2	2	2,400	54%	C
Old Northern Road, west of New Line Road	Eastbound	1,159	1	2	1,200	97%	E
	Westbound	1,287	1	2	1,200	107%	F
Old Northern Road, east of Kenthurst Road	Eastbound	1,065	1	2	1,200	89%	D
	Westbound	1,278	1	2	1,200	107%	F
Old Northern Road, south of Kenthurst Road	Northbound	932	1	2	1,200	78%	D
	Southbound	1,113	1	2	1,200	93%	E
Old Northern Road, south of Franlee Road	Northbound	1,042	1	2	1,200	87%	D
	Southbound	1,123	1	2	1,200	94%	E
Old Northern Road, north of Glenhaven Road	Northbound	1,042	1	2	1,200	87%	D
	Southbound	1,123	1	2	1,200	94%	E
Old Northern Road, south of Glenhaven Road	Northbound	1,201	1	2	1,200	100%	F
	Southbound	947	1	2	1,200	79%	D
Old Northern Road, south of Blue Gum Drive	Northbound	1,252	1	2	1,200	104%	F
	Southbound	984	1	2	1,200	82%	D
Old Northern Road, north of Gilbert Road	Northbound	1,251	1	2	1,200	104%	F
	Southbound	999	1	2	1,200	83%	D
Old Northern Road, north of Hastings Road	Northbound	1,438	1	2	1,200	120%	F
	Southbound	1,144	1	2	1,200	95%	E
Old Northern Road, south of Hastings Road	Northbound	1,168	1	2	1,200	97%	E
	Southbound	958	1	2	1,200	80%	D
New Line Road, south of Old Northern Road	Northbound	1,445	1	2	1,200	120%	F
	Southbound	1,229	1	2	1,200	102%	F
New Line Road, north of Sebastian Drive	Northbound	1,173	1	2	1,200	98%	E
	Southbound	1,228	1	2	1,200	102%	F
New Line Road, north of Hastings Road	Northbound	1,176	2	1	3,200	37%	B
	Southbound	1,216	1	1	1,600	76%	D
New Line Road, South of Hastings Road	Northbound	1,522	1	1	1,600	95%	E
	Southbound	1,291	2	1	3,200	40%	B
New Line Road, south of James Henty Drive	Northbound	1,570	1	1	1,600	98%	E
	Southbound	990	1	1	1,600	62%	C
New Line Road, south of Purchase Road	Northbound	1,690	2	1	3,200	53%	C
	Southbound	1,010	2	1	3,200	32%	A
New Line Road, south of Country Drive	Northbound	2,110	2	1	3,200	66%	C
	Southbound	1,410	2	1	3,200	44%	B
New Line Road, south of Boundary Road	Northbound	990	1	3	900	110%	F
	Southbound	490	1	3	900	54%	C
New Line Road, north of Victoria Road	Northbound	1,200	1	3	900	133%	F
	Southbound	470	1	3	900	52%	C
New Line Road, north of Castle Hill Road	Northbound	1,110	1	3	900	123%	F
	Southbound	590	1	3	900	66%	C
Hastings Road, between Old Northern Road and New Line Road	Eastbound	714	1	1	1,600	45%	B
	Westbound	801	1	1	1,600	50%	C

Road Type= 1 = Urban Road with Clearways  
 2 = Urban Road with Interruptions  
 3 = Local Road

## South Dural Future Base 2036 with road upgrades - AM Peak

Road & location	Direction	2036 Estimated Traffic Volumes (veh/hour)	Number of Lanes	Road Type	Capacity	V/C	Level of Service
Old Northern Road, north of New Line Road	Northbound	1,492	2	2	2,400	62%	C
	Southbound	1,466	2	2	2,400	61%	C
Old Northern Road, west of New Line Road	Eastbound	1,191	2	2	2,400	50%	B
	Westbound	1,061	2	2	2,400	44%	B
Old Northern Road, east of Kenthurst Road	Eastbound	1,160	1	2	1,200	97%	E
	Westbound	1,022	2	2	2,400	43%	B
Old Northern Road, south of Kenthurst Road	Northbound	920	1	2	1,200	77%	D
	Southbound	1,203	2	2	2,400	50%	C
Old Northern Road, south of Franlee Road	Northbound	976	1	2	1,200	81%	D
	Southbound	1,203	2	2	2,400	50%	C
Old Northern Road, north of Glenhaven Road	Northbound	985	1	2	1,200	82%	D
	Southbound	1,203	2	2	2,400	50%	C
Old Northern Road, south of Glenhaven Road	Northbound	712	2	2	2,400	30%	A
	Southbound	1,332	2	2	2,400	56%	C
Old Northern Road, south of Blue Gum Drive	Northbound	757	2	2	2,400	32%	A
	Southbound	1,336	2	2	2,400	56%	C
Old Northern Road, north of Gilbert Road	Northbound	758	2	2	2,400	32%	A
	Southbound	1,332	2	2	2,400	56%	C
Old Northern Road, north of Hastings Road	Northbound	991	2	2	2,400	41%	B
	Southbound	1,649	2	2	2,400	69%	C
Old Northern Road, south of Hastings Road	Northbound	804	2	2	2,400	33%	A
	Southbound	1,514	2	2	2,400	63%	C
New Line Road, south of Old Northern Road	Northbound	1,433	2	2	2,400	60%	C
	Southbound	1,334	2	2	2,400	56%	C
New Line Road, north of Sebastian Drive	Northbound	1,169	2	2	2,400	49%	B
	Southbound	1,115	1	2	1,200	93%	E
New Line Road, north of Hastings Road	Northbound	1,163	2	1	3,200	36%	B
	Southbound	1,167	1	1	1,600	73%	C
New Line Road, South of Hastings Road	Northbound	1,512	2	1	3,200	47%	B
	Southbound	1,402	2	1	3,200	44%	B
New Line Road, south of James Henty Drive	Northbound	1,270	2	1	3,200	40%	B
	Southbound	1,920	2	1	3,200	60%	C
New Line Road, south of Purchase Road	Northbound	1,300	2	1	3,200	41%	B
	Southbound	2,060	2	1	3,200	64%	C
New Line Road, south of Country Drive	Northbound	1,540	2	1	3,200	48%	B
	Southbound	2,580	2	1	3,200	81%	D
New Line Road, south of Boundary Road	Northbound	590	2	3	1,800	33%	A
	Southbound	1,090	2	3	1,800	61%	C
New Line Road, north of Victoria Road	Northbound	500	2	3	1,800	28%	A
	Southbound	950	2	3	1,800	53%	C
New Line Road, north of Castle Hill Road	Northbound	650	2	3	1,800	36%	B
	Southbound	840	2	3	1,800	47%	B
Hastings Road, between Old Northern Road and New Line Road	Eastbound	930	1	1	1,600	58%	C
	Westbound	971	1	1	1,600	61%	C

Road Type= 1 = Urban Road with Clearways  
 2 = Urban Road with Interruptions  
 3 = Local Road

## South Dural Future Base 2036 with road upgrades - PM Peak

Road & location	Direction	2036 Estimated Traffic Volumes (veh/hour)	Number of Lanes	Road Type	Capacity	V/C	Level of Service
Old Northern Road, north of New Line Road	Northbound	1,327	2	2	2,400	55%	C
	Southbound	1,301	2	2	2,400	54%	C
Old Northern Road, west of New Line Road	Eastbound	1,159	2	2	2,400	48%	B
	Westbound	1,287	2	2	2,400	54%	C
Old Northern Road, east of Kenthurst Road	Eastbound	1,065	1	2	1,200	89%	D
	Westbound	1,278	2	2	2,400	53%	C
Old Northern Road, south of Kenthurst Road	Northbound	932	1	2	1,200	78%	D
	Southbound	1,113	2	2	2,400	46%	B
Old Northern Road, south of Franlee Road	Northbound	1,042	1	2	1,200	87%	D
	Southbound	1,123	2	2	2,400	47%	B
Old Northern Road, north of Glenhaven Road	Northbound	1,042	1	2	1,200	87%	D
	Southbound	1,123	2	2	2,400	47%	B
Old Northern Road, south of Glenhaven Road	Northbound	1,201	2	2	2,400	50%	C
	Southbound	947	2	2	2,400	39%	B
Old Northern Road, south of Blue Gum Drive	Northbound	1,252	2	2	2,400	52%	C
	Southbound	984	2	2	2,400	41%	B
Old Northern Road, north of Gilbert Road	Northbound	1,251	2	2	2,400	52%	C
	Southbound	999	2	2	2,400	42%	B
Old Northern Road, north of Hastings Road	Northbound	1,438	2	2	2,400	60%	C
	Southbound	1,144	2	2	2,400	48%	B
Old Northern Road, south of Hastings Road	Northbound	1,168	2	2	2,400	49%	B
	Southbound	958	2	2	2,400	40%	B
New Line Road, south of Old Northern Road	Northbound	1,445	2	2	2,400	60%	C
	Southbound	1,229	2	2	2,400	51%	C
New Line Road, north of Sebastian Drive	Northbound	1,173	2	2	2,400	49%	B
	Southbound	1,228	1	2	1,200	102%	F
New Line Road, north of Hastings Road	Northbound	1,176	2	1	3,200	37%	B
	Southbound	1,216	1	1	1,600	76%	D
New Line Road, South of Hastings Road	Northbound	1,522	2	1	3,200	48%	B
	Southbound	1,291	2	1	3,200	40%	B
New Line Road, south of James Henty Drive	Northbound	1,570	2	1	3,200	49%	B
	Southbound	990	2	1	3,200	31%	A
New Line Road, south of Purchase Road	Northbound	1,690	2	1	3,200	53%	C
	Southbound	1,010	2	1	3,200	32%	A
New Line Road, south of Country Drive	Northbound	2,110	2	1	3,200	66%	C
	Southbound	1,410	2	1	3,200	44%	B
New Line Road, south of Boundary Road	Northbound	990	2	3	1,800	55%	C
	Southbound	490	2	3	1,800	27%	A
New Line Road, north of Victoria Road	Northbound	1,200	2	3	1,800	67%	C
	Southbound	470	2	3	1,800	26%	A
New Line Road, north of Castle Hill Road	Northbound	1,110	2	3	1,800	62%	C
	Southbound	590	2	3	1,800	33%	A
Hastings Road, between Old Northern Road and New Line Road	Eastbound	714	1	1	1,600	45%	B
	Westbound	801	1	1	1,600	50%	C

Road Type= 1 = Urban Road with Clearways  
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## South Dural Future Base 2026 with Full Development, existing network - AM Peak

Road & location	Direction	2026 Estimated Traffic Volumes (veh/hour)	Number of Lanes	Road Type	Capacity	V/C	Level of Service
Old Northern Road, north of New Line Road	Northbound	1,555	2	2	2,400	65%	C
	Southbound	1,378	2	2	2,400	57%	C
Old Northern Road, west of New Line Road	Eastbound	1,215	1	2	1,200	101%	F
	Westbound	905	1	2	1,200	75%	D
Old Northern Road, east of Kenthurst Road	Eastbound	1,180	1	2	1,200	98%	E
	Westbound	868	1	2	1,200	72%	C
Old Northern Road, south of Kenthurst Road	Northbound	1,135	1	2	1,200	95%	E
	Southbound	1,020	1	2	1,200	85%	D
Old Northern Road, south of Franlee Road	Northbound	1,041	1	2	1,200	87%	D
	Southbound	1,045	1	2	1,200	87%	D
Old Northern Road, north of Glenhaven Road	Northbound	1,091	1	2	1,200	91%	E
	Southbound	1,503	1	2	1,200	125%	F
Old Northern Road, south of Glenhaven Road	Northbound	792	1	2	1,200	66%	C
	Southbound	1,399	1	2	1,200	117%	F
Old Northern Road, south of Blue Gum Drive	Northbound	812	1	2	1,200	68%	C
	Southbound	1,403	1	2	1,200	117%	F
Old Northern Road, north of Gilbert Road	Northbound	814	1	2	1,200	68%	C
	Southbound	1,399	1	2	1,200	117%	F
Old Northern Road, north of Hastings Road	Northbound	993	1	2	1,200	83%	D
	Southbound	1,594	1	2	1,200	133%	F
Old Northern Road, south of Hastings Road	Eastbound	789	1	2	1,200	66%	C
	Westbound	1,404	1	2	1,200	117%	F
New Line Road, south of Old Northern Road	Eastbound	1,348	1	2	1,200	112%	F
	Westbound	1,316	1	2	1,200	110%	F
New Line Road, north of Sebastian Drive	Northbound	1,169	1	2	1,200	97%	E
	Southbound	1,115	1	2	1,200	93%	E
New Line Road, north of Hastings Road	Eastbound	1,169	2	1	3,200	37%	B
	Westbound	1,167	1	1	1,600	73%	C
New Line Road, South of Hastings Road	Northbound	1,405	1	1	1,600	88%	D
	Southbound	1,341	2	1	3,200	42%	B
New Line Road, south of James Henty Drive	Northbound	1,170	1	1	1,600	73%	C
	Southbound	1,930	1	1	1,600	121%	F
New Line Road, south of Purchase Road	Northbound	1,150	2	1	3,200	36%	B
	Southbound	2,000	2	1	3,200	63%	C
New Line Road, south of Country Drive	Northbound	1,360	2	1	3,200	43%	B
	Southbound	2,450	2	1	3,200	77%	D
New Line Road, south of Boundary Road	Northbound	530	1	3	900	59%	C
	Southbound	1,130	1	3	900	126%	F
New Line Road, north of Victoria Road	Northbound	450	1	3	900	50%	C
	Southbound	980	1	3	900	109%	F
New Line Road, north of Castle Hill Road	Northbound	490	1	3	900	54%	C
	Southbound	700	1	3	900	78%	D
Hastings Road, between Old Northern Road and New Line Road	Eastbound	874	1	1	1,600	55%	C
	Westbound	877	1	1	1,600	55%	C

Road Type= 1 = Urban Road with Clearways  
 2 = Urban Road with Interruptions  
 3 = Local Road

## South Dural Future Base 2026 with Full Development, existing network - AM Peak

Road & location	Direction	2026 Estimated Traffic Volumes (veh/hour)	Number of Lanes	Road Type	Capacity	V/C	Level of Service
Old Northern Road, north of New Line Road	Northbound	1,319	2	2	2,400	55%	C
	Southbound	1,366	2	2	2,400	57%	C
Old Northern Road, west of New Line Road	Eastbound	1,139	1	2	1,200	95%	E
	Westbound	1,339	1	2	1,200	112%	F
Old Northern Road, east of Kenthurst Road	Eastbound	1,045	1	2	1,200	87%	D
	Westbound	1,331	1	2	1,200	111%	F
Old Northern Road, south of Kenthurst Road	Northbound	952	1	2	1,200	79%	D
	Southbound	1,257	1	2	1,200	105%	F
Old Northern Road, south of Franlee Road	Northbound	1,011	1	2	1,200	84%	D
	Southbound	1,091	1	2	1,200	91%	E
Old Northern Road, north of Glenhaven Road	Northbound	1,386	1	2	1,200	115%	F
	Southbound	1,208	1	2	1,200	101%	F
Old Northern Road, south of Glenhaven Road	Northbound	1,434	1	2	1,200	120%	F
	Southbound	1,003	1	2	1,200	84%	D
Old Northern Road, south of Blue Gum Drive	Northbound	1,408	1	2	1,200	117%	F
	Southbound	1,039	1	2	1,200	87%	D
Old Northern Road, north of Gilbert Road	Northbound	1,407	1	2	1,200	117%	F
	Southbound	1,054	1	2	1,200	88%	D
Old Northern Road, north of Hastings Road	Northbound	1,555	1	2	1,200	130%	F
	Southbound	1,151	1	2	1,200	96%	E
Old Northern Road, south of Hastings Road	Eastbound	1,231	1	2	1,200	103%	F
	Westbound	938	1	2	1,200	78%	D
New Line Road, south of Old Northern Road	Eastbound	1,459	1	2	1,200	122%	F
	Westbound	1,218	1	2	1,200	102%	F
New Line Road, north of Sebastian Drive	Northbound	1,249	1	2	1,200	104%	F
	Southbound	1,228	1	2	1,200	102%	F
New Line Road, north of Hastings Road	Eastbound	1,254	2	1	3,200	39%	B
	Westbound	1,216	1	1	1,600	76%	D
New Line Road, South of Hastings Road	Northbound	1,551	1	1	1,600	97%	E
	Southbound	1,275	2	1	3,200	40%	B
New Line Road, south of James Henty Drive	Northbound	1,620	1	1	1,600	101%	F
	Southbound	960	1	1	1,600	60%	C
New Line Road, south of Purchase Road	Northbound	1,730	2	1	3,200	54%	C
	Southbound	960	2	1	3,200	30%	A
New Line Road, south of Country Drive	Northbound	2,180	2	1	3,200	68%	C
	Southbound	1,320	2	1	3,200	41%	B
New Line Road, south of Boundary Road	Northbound	1,160	1	3	900	129%	F
	Southbound	500	1	3	900	56%	C
New Line Road, north of Victoria Road	Northbound	1,270	1	3	900	141%	F
	Southbound	440	1	3	900	49%	B
New Line Road, north of Castle Hill Road	Northbound	1,200	1	3	900	133%	F
	Southbound	560	1	3	900	62%	C
Hastings Road, between Old Northern Road and New Line Road	Eastbound	673	1	1	1,600	42%	B
	Westbound	778	1	1	1,600	49%	B

Road Type= 1 = Urban Road with Clearways  
 2 = Urban Road with Interruptions  
 3 = Local Road

## South Dural Future Base 2026 with Full Development and Upgrades - AM Peak

Road & location	Direction	2026 Estimated Traffic Volumes (veh/hour)	Number of Lanes	Road Type	Capacity	V/C	Level of Service
Old Northern Road, north of New Line Road	Northbound	1,555	2	2	2,400	65%	C
	Southbound	1,378	2	2	2,400	57%	C
Old Northern Road, west of New Line Road	Eastbound	1,215	2	2	2,400	51%	C
	Westbound	905	2	2	2,400	38%	B
Old Northern Road, east of Kenthurst Road	Eastbound	1,180	2	2	2,400	49%	B
	Westbound	868	2	2	2,400	36%	B
Old Northern Road, south of Kenthurst Road	Northbound	1,135	2	2	2,400	47%	B
	Southbound	1,020	2	2	2,400	42%	B
Old Northern Road, south of Franlee Road	Northbound	1,041	1	2	1,200	87%	D
	Southbound	1,045	2	2	2,400	44%	B
Old Northern Road, north of Glenhaven Road	Northbound	1,091	2	2	2,400	45%	B
	Southbound	1,503	2	2	2,400	63%	C
Old Northern Road, south of Glenhaven Road	Northbound	792	2	2	2,400	33%	A
	Southbound	1,399	2	2	2,400	58%	C
Old Northern Road, south of Blue Gum Drive	Northbound	812	2	2	2,400	34%	A
	Southbound	1,403	2	2	2,400	58%	C
Old Northern Road, north of Gilbert Road	Northbound	814	2	2	2,400	34%	A
	Southbound	1,399	2	2	2,400	58%	C
Old Northern Road, north of Hastings Road	Northbound	993	2	2	2,400	41%	B
	Southbound	1,594	2	2	2,400	66%	C
Old Northern Road, south of Hastings Road	Eastbound	789	2	2	2,400	33%	A
	Westbound	1,404	2	2	2,400	58%	C
New Line Road, south of Old Northern Road	Eastbound	1,348	2	2	2,400	56%	C
	Westbound	1,316	2	2	2,400	55%	C
New Line Road, north of Sebastian Drive	Northbound	1,169	2	2	2,400	49%	B
	Southbound	1,115	1	2	1,200	93%	E
New Line Road, north of Hastings Road	Eastbound	1,169	2	1	3,200	37%	B
	Westbound	1,167	1	1	1,600	73%	C
New Line Road, South of Hastings Road	Northbound	1,405	2	1	3,200	44%	B
	Southbound	1,341	2	1	3,200	42%	B
New Line Road, south of James Henty Drive	Northbound	1,170	2	1	3,200	37%	B
	Southbound	1,930	2	1	3,200	60%	C
New Line Road, south of Purchase Road	Northbound	1,150	2	1	3,200	36%	B
	Southbound	2,000	2	1	3,200	63%	C
New Line Road, south of Country Drive	Northbound	1,360	2	1	3,200	43%	B
	Southbound	2,450	2	1	3,200	77%	D
New Line Road, south of Boundary Road	Northbound	530	2	3	1,800	29%	A
	Southbound	1,130	2	3	1,800	63%	C
New Line Road, north of Victoria Road	Northbound	450	2	3	1,800	25%	A
	Southbound	980	2	3	1,800	54%	C
New Line Road, north of Castle Hill Road	Northbound	490	2	3	1,800	27%	A
	Southbound	700	1	3	900	78%	D
Hastings Road, between Old Northern Road and New Line Road	Eastbound	874	1	1	1,600	55%	C
	Westbound	877	1	1	1,600	55%	C

Road Type= 1 = Urban Road with Clearways  
 2 = Urban Road with Interruptions  
 3 = Local Road



## South Dural Future Base 2026 with Full Development and Upgrades - AM Peak

Road & location	Direction	2026 Estimated Traffic Volumes (veh/hour)	Number of Lanes	Road Type	Capacity	V/C	Level of Service
Old Northern Road, north of New Line Road	Northbound	1,319	2	2	2,400	55%	C
	Southbound	1,366	2	2	2,400	57%	C
Old Northern Road, west of New Line Road	Eastbound	1,139	2	2	2,400	47%	B
	Westbound	1,339	2	2	2,400	56%	C
Old Northern Road, east of Kenthurst Road	Eastbound	1,045	2	2	2,400	44%	B
	Westbound	1,331	2	2	2,400	55%	C
Old Northern Road, south of Kenthurst Road	Northbound	952	2	2	2,400	40%	B
	Southbound	1,257	2	2	2,400	52%	C
Old Northern Road, south of Franlee Road	Northbound	1,011	1	2	1,200	84%	D
	Southbound	1,091	2	2	2,400	45%	B
Old Northern Road, north of Glenhaven Road	Northbound	1,386	2	2	2,400	58%	C
	Southbound	1,208	2	2	2,400	50%	C
Old Northern Road, south of Glenhaven Road	Northbound	1,434	2	2	2,400	60%	C
	Southbound	1,003	2	2	2,400	42%	B
Old Northern Road, south of Blue Gum Drive	Northbound	1,408	2	2	2,400	59%	C
	Southbound	1,039	2	2	2,400	43%	B
Old Northern Road, north of Gilbert Road	Northbound	1,407	2	2	2,400	59%	C
	Southbound	1,054	2	2	2,400	44%	B
Old Northern Road, north of Hastings Road	Northbound	1,555	2	2	2,400	65%	C
	Southbound	1,151	2	2	2,400	48%	B
Old Northern Road, south of Hastings Road	Eastbound	1,231	2	2	2,400	51%	C
	Westbound	938	2	2	2,400	39%	B
New Line Road, south of Old Northern Road	Eastbound	1,459	2	2	2,400	61%	C
	Westbound	1,218	2	2	2,400	51%	C
New Line Road, north of Sebastian Drive	Northbound	1,249	2	2	2,400	52%	C
	Southbound	1,228	1	2	1,200	102%	F
New Line Road, north of Hastings Road	Eastbound	1,254	2	1	3,200	39%	B
	Westbound	1,216	1	1	1,600	76%	D
New Line Road, South of Hastings Road	Northbound	1,551	2	1	3,200	48%	B
	Southbound	1,275	2	1	3,200	40%	B
New Line Road, south of James Henty Drive	Northbound	1,620	2	1	3,200	51%	C
	Southbound	960	2	1	3,200	30%	A
New Line Road, south of Purchase Road	Northbound	1,730	2	1	3,200	54%	C
	Southbound	960	2	1	3,200	30%	A
New Line Road, south of Country Drive	Northbound	2,180	2	1	3,200	68%	C
	Southbound	1,320	2	1	3,200	41%	B
New Line Road, south of Boundary Road	Northbound	1,160	2	3	1,800	64%	C
	Southbound	500	2	3	1,800	28%	A
New Line Road, north of Victoria Road	Northbound	1,270	2	3	1,800	71%	C
	Southbound	440	2	3	1,800	24%	A
New Line Road, north of Castle Hill Road	Northbound	1,200	2	3	1,800	67%	C
	Southbound	560	1	3	900	62%	C
Hastings Road, between Old Northern Road and New Line Road	Eastbound	673	1	1	1,600	42%	B
	Westbound	778	1	1	1,600	49%	B

Road Type= 1 = Urban Road with Clearways  
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## South Dural Future Base 2036 with Full Development, existing network - AM Peak

Road & location	Direction	2036 Estimated Traffic Volumes (veh/hour)	Number of Lanes	Road Type	Capacity	V/C	Level of Service
Old Northern Road, north of New Line Road	Northbound	1,710	2	2	2,400	71%	C
	Southbound	1,520	2	2	2,400	63%	C
Old Northern Road, west of New Line Road	Eastbound	1,299	1	2	1,200	108%	F
	Westbound	1,161	1	2	1,200	97%	E
Old Northern Road, east of Kenthurst Road	Eastbound	1,264	1	2	1,200	105%	F
	Westbound	1,122	1	2	1,200	94%	E
Old Northern Road, south of Kenthurst Road	Northbound	1,257	1	2	1,200	105%	F
	Southbound	1,267	1	2	1,200	106%	F
Old Northern Road, south of Franlee Road	Northbound	1,149	1	2	1,200	96%	E
	Southbound	1,303	1	2	1,200	109%	F
Old Northern Road, north of Glenhaven Road	Northbound	1,149	1	2	1,200	96%	E
	Southbound	2,012	1	2	1,200	168%	F
Old Northern Road, south of Glenhaven Road	Northbound	854	1	2	1,200	71%	C
	Southbound	1,969	1	2	1,200	164%	F
Old Northern Road, south of Blue Gum Drive	Northbound	893	1	2	1,200	74%	C
	Southbound	1,973	1	2	1,200	164%	F
Old Northern Road, north of Gilbert Road	Northbound	895	1	2	1,200	75%	C
	Southbound	1,987	1	2	1,200	166%	F
Old Northern Road, north of Hastings Road	Northbound	1,164	1	2	1,200	97%	E
	Southbound	2,203	1	2	1,200	184%	F
Old Northern Road, south of Hastings Road	Northbound	913	1	2	1,200	76%	D
	Southbound	1,969	1	2	1,200	164%	F
New Line Road, south of Old Northern Road	Northbound	1,633	1	2	1,200	136%	F
	Southbound	1,443	1	2	1,200	120%	F
New Line Road, north of Sebastian Drive	Northbound	1,197	1	2	1,200	100%	E
	Southbound	1,160	1	2	1,200	97%	E
New Line Road, north of Hastings Road	Northbound	1,281	2	1	3,200	40%	B
	Southbound	1,407	1	1	1,600	88%	D
New Line Road, South of Hastings Road	Northbound	1,503	1	1	1,600	94%	E
	Southbound	1,621	2	1	3,200	51%	C
New Line Road, south of James Henty Drive	Northbound	1,280	1	1	1,600	80%	D
	Southbound	2,150	1	1	1,600	134%	F
New Line Road, south of Purchase Road	Northbound	1,310	2	1	3,200	41%	B
	Southbound	2,300	2	1	3,200	72%	C
New Line Road, south of Country Drive	Northbound	1,580	2	1	3,200	49%	B
	Southbound	2,820	2	1	3,200	88%	D
New Line Road, south of Boundary Road	Northbound	610	1	3	900	68%	C
	Southbound	1,260	1	3	900	140%	F
New Line Road, north of Victoria Road	Northbound	540	1	3	900	60%	C
	Southbound	1,130	1	3	900	126%	F
New Line Road, north of Castle Hill Road	Northbound	690	1	3	900	77%	D
	Southbound	1,010	1	3	900	112%	F
Hastings Road, between Old Northern Road and New Line Road	Eastbound	1,085	1	1	1,600	68%	C
	Westbound	1,080	1	1	1,600	68%	C

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## South Dural Future Base 2036 with Full Development, existing network - PM Peak

Road & location	Direction	2036 Estimated Traffic Volumes (veh/hour)	Number of Lanes	Road Type	Capacity	V/C	Level of Service
Old Northern Road, north of New Line Road	Northbound	1,409	2	2	2,400	59%	C
	Southbound	1,482	2	2	2,400	62%	C
Old Northern Road, west of New Line Road	Eastbound	1,313	1	2	1,200	109%	F
	Westbound	1,505	1	2	1,200	125%	F
Old Northern Road, east of Kenthurst Road	Eastbound	1,210	1	2	1,200	101%	F
	Westbound	1,496	1	2	1,200	125%	F
Old Northern Road, south of Kenthurst Road	Northbound	1,077	1	2	1,200	90%	D
	Southbound	1,477	1	2	1,200	123%	F
Old Northern Road, south of Franlee Road	Northbound	1,124	1	2	1,200	94%	E
	Southbound	1,314	1	2	1,200	109%	F
Old Northern Road, north of Glenhaven Road	Northbound	1,687	1	2	1,200	141%	F
	Southbound	1,414	1	2	1,200	118%	F
Old Northern Road, south of Glenhaven Road	Northbound	1,728	1	2	1,200	144%	F
	Southbound	1,201	1	2	1,200	100%	F
Old Northern Road, south of Blue Gum Drive	Northbound	1,670	1	2	1,200	139%	F
	Southbound	1,239	1	2	1,200	103%	F
Old Northern Road, north of Gilbert Road	Northbound	1,660	1	2	1,200	138%	F
	Southbound	1,226	1	2	1,200	102%	F
Old Northern Road, north of Hastings Road	Northbound	1,865	1	2	1,200	155%	F
	Southbound	1,389	1	2	1,200	116%	F
Old Northern Road, south of Hastings Road	Northbound	1,577	1	2	1,200	131%	F
	Southbound	1,058	1	2	1,200	88%	D
New Line Road, south of Old Northern Road	Northbound	1,572	1	2	1,200	131%	F
	Southbound	1,384	1	2	1,200	115%	F
New Line Road, north of Sebastian Drive	Northbound	1,245	1	2	1,200	104%	F
	Southbound	1,228	1	2	1,200	102%	F
New Line Road, north of Hastings Road	Northbound	1,440	2	1	3,200	45%	B
	Southbound	1,216	1	1	1,600	76%	D
New Line Road, South of Hastings Road	Northbound	1,676	1	1	1,600	105%	F
	Southbound	1,410	2	1	3,200	44%	B
New Line Road, south of James Henty Drive	Northbound	1,740	1	1	1,600	109%	F
	Southbound	1,120	1	1	1,600	70%	C
New Line Road, south of Purchase Road	Northbound	1,850	2	1	3,200	58%	C
	Southbound	1,130	2	1	3,200	35%	B
New Line Road, south of Country Drive	Northbound	2,330	2	1	3,200	73%	C
	Southbound	1,470	2	1	3,200	46%	B
New Line Road, south of Boundary Road	Northbound	1,120	1	3	900	124%	F
	Southbound	520	1	3	900	58%	C
New Line Road, north of Victoria Road	Northbound	1,340	1	3	900	149%	F
	Southbound	480	1	3	900	53%	C
New Line Road, north of Castle Hill Road	Northbound	1,240	1	3	900	138%	F
	Southbound	590	1	3	900	66%	C
Hastings Road, between Old Northern Road and New Line Road	Eastbound	914	1	1	1,600	57%	C
	Westbound	864	1	1	1,600	54%	C

Road Type= 1 = Urban Road with Clearways  
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 3 = Local Road

## South Dural Future Base 2036 with Full Development and Upgrades - AM Peak

Road & location	Direction	2036 Estimated Traffic Volumes (veh/hour)	Number of Lanes	Road Type	Capacity	V/C	Level of Service
Old Northern Road, north of New Line Road	Northbound	1,710	2	2	2,400	71%	C
	Southbound	1,520	2	2	2,400	63%	C
Old Northern Road, west of New Line Road	Eastbound	1,299	2	2	2,400	54%	C
	Westbound	1,161	2	2	2,400	48%	B
Old Northern Road, east of Kenthurst Road	Eastbound	1,264	2	2	2,400	53%	C
	Westbound	1,122	2	2	2,400	47%	B
Old Northern Road, south of Kenthurst Road	Northbound	1,257	2	2	2,400	52%	C
	Southbound	1,267	2	2	2,400	53%	C
Old Northern Road, south of Franlee Road	Northbound	1,149	2	2	2,400	48%	B
	Southbound	1,303	2	2	2,400	54%	C
Old Northern Road, north of Glenhaven Road	Northbound	1,149	2	2	2,400	48%	B
	Southbound	2,012	2	2	2,400	84%	D
Old Northern Road, south of Glenhaven Road	Northbound	854	2	2	2,400	36%	B
	Southbound	1,969	2	2	2,400	82%	D
Old Northern Road, south of Blue Gum Drive	Northbound	893	2	2	2,400	37%	B
	Southbound	1,973	2	2	2,400	82%	D
Old Northern Road, north of Gilbert Road	Northbound	895	2	2	2,400	37%	B
	Southbound	1,987	2	2	2,400	83%	D
Old Northern Road, north of Hastings Road	Northbound	1,164	2	2	2,400	49%	B
	Southbound	2,203	2	2	2,400	92%	E
Old Northern Road, south of Hastings Road	Northbound	913	2	2	2,400	38%	B
	Southbound	1,969	2	2	2,400	82%	D
New Line Road, south of Old Northern Road	Northbound	1,633	2	2	2,400	68%	C
	Southbound	1,443	2	2	2,400	60%	C
New Line Road, north of Sebastian Drive	Northbound	1,197	2	2	2,400	50%	B
	Southbound	1,160	2	2	2,400	48%	B
New Line Road, north of Hastings Road	Northbound	1,281	2	1	3,200	40%	B
	Southbound	1,407	1	1	1,600	88%	D
New Line Road, South of Hastings Road	Northbound	1,503	2	1	3,200	47%	B
	Southbound	1,621	2	1	3,200	51%	C
New Line Road, south of James Henty Drive	Northbound	1,280	2	1	3,200	40%	B
	Southbound	2,150	2	1	3,200	67%	C
New Line Road, south of Purchase Road	Northbound	1,310	2	1	3,200	41%	B
	Southbound	2,300	2	1	3,200	72%	C
New Line Road, south of Country Drive	Northbound	1,580	2	1	3,200	49%	B
	Southbound	2,820	2	1	3,200	88%	D
New Line Road, south of Boundary Road	Northbound	610	2	3	1,800	34%	A
	Southbound	1,260	2	3	1,800	70%	C
New Line Road, north of Victoria Road	Northbound	540	2	3	1,800	30%	A
	Southbound	1,130	2	3	1,800	63%	C
New Line Road, north of Castle Hill Road	Northbound	690	2	3	1,800	38%	B
	Southbound	1,010	2	3	1,800	56%	C
Hastings Road, between Old Northern Road and New Line Road	Eastbound	1,085	1	1	1,600	68%	C
	Westbound	1,080	1	1	1,600	68%	C

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## South Dural Future Base 2036 with Full Development and Upgrades - PM Peak

Road & location	Direction	2036 Estimated Traffic Volumes (veh/hour)	Number of Lanes	Road Type	Capacity	V/C	Level of Service
Old Northern Road, north of New Line Road	Northbound	1,409	2	2	2,400	59%	C
	Southbound	1,482	2	2	2,400	62%	C
Old Northern Road, west of New Line Road	Eastbound	1,313	2	2	2,400	55%	C
	Westbound	1,505	2	2	2,400	63%	C
Old Northern Road, east of Kenthurst Road	Eastbound	1,210	2	2	2,400	50%	C
	Westbound	1,496	2	2	2,400	62%	C
Old Northern Road, south of Kenthurst Road	Northbound	1,077	2	2	2,400	45%	B
	Southbound	1,477	2	2	2,400	62%	C
Old Northern Road, south of Franlee Road	Northbound	1,124	2	2	2,400	47%	B
	Southbound	1,314	2	2	2,400	55%	C
Old Northern Road, north of Glenhaven Road	Northbound	1,687	2	2	2,400	70%	C
	Southbound	1,414	2	2	2,400	59%	C
Old Northern Road, south of Glenhaven Road	Northbound	1,728	2	2	2,400	72%	C
	Southbound	1,201	2	2	2,400	50%	C
Old Northern Road, south of Blue Gum Drive	Northbound	1,670	2	2	2,400	70%	C
	Southbound	1,239	2	2	2,400	52%	C
Old Northern Road, north of Gilbert Road	Northbound	1,660	2	2	2,400	69%	C
	Southbound	1,226	2	2	2,400	51%	C
Old Northern Road, north of Hastings Road	Northbound	1,865	2	2	2,400	78%	D
	Southbound	1,389	2	2	2,400	58%	C
Old Northern Road, south of Hastings Road	Northbound	1,577	2	2	2,400	66%	C
	Southbound	1,058	2	2	2,400	44%	B
New Line Road, south of Old Northern Road	Northbound	1,572	2	2	2,400	66%	C
	Southbound	1,384	2	2	2,400	58%	C
New Line Road, north of Sebastian Drive	Northbound	1,245	2	2	2,400	52%	C
	Southbound	1,228	2	2	2,400	51%	C
New Line Road, north of Hastings Road	Northbound	1,440	2	1	3,200	45%	B
	Southbound	1,216	1	1	1,600	76%	D
New Line Road, South of Hastings Road	Northbound	1,676	2	1	3,200	52%	C
	Southbound	1,410	2	1	3,200	44%	B
New Line Road, south of James Henty Drive	Northbound	1,120	2	1	3,200	35%	B
	Southbound	1,120	2	1	3,200	35%	B
New Line Road, south of Purchase Road	Northbound	1,850	2	1	3,200	58%	C
	Southbound	1,130	2	1	3,200	35%	B
New Line Road, south of Country Drive	Northbound	2,330	2	1	3,200	73%	C
	Southbound	1,470	2	1	3,200	46%	B
New Line Road, south of Boundary Road	Northbound	1,120	2	3	1,800	62%	C
	Southbound	520	2	3	1,800	29%	A
New Line Road, north of Victoria Road	Northbound	1,340	2	3	1,800	74%	C
	Southbound	480	2	3	1,800	27%	A
New Line Road, north of Castle Hill Road	Northbound	1,240	2	3	1,800	69%	C
	Southbound	590	2	3	1,800	33%	A
Hastings Road, between Old Northern Road and New Line Road	Eastbound	914	1	1	1,600	57%	C
	Westbound	864	1	1	1,600	54%	C

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# Appendix E

**MEETING MINUTES**





# Meeting notes

Subject	South Dural Development Transport Assessment
Date	5 April 2016
Time	9:30am
Venue	TfNSW Offices
Present	Mark Ozinga, Transport for NSW (MO) Edmond Platon, Transport for NSW (EP) Allison Smith, APP Corporation (AS) Peter Alevizos, APP Corporation (PA) Tom van Drempt, WSP   Parsons Brinckerhoff (TvD)

## Meeting Summary

- AS provided an overview of where the South Dural project has progressed to and discussed the agenda for the meeting.
- MO advised that he understand the development of the Aimsum mesoscopic model is on track for handover to the South Dural project team in late May.
- MO indicated that the program to have South Dural complete including agreed transport modelling and infrastructure delivery responsibilities for June/July is ambitious. TfNSW have internal processes for decision making that need time. AS specified the intent is to make sure that we get inputs into the model early, agree principles for which decisions can be made concerning the no additional cost to government requirements early and during the assessment rather than at the end of the studies.
- MO queried whether a STM/BTS model will be used to assess demand. TvD advised that WSP | PB will be forming their own assessment independent of STM or Aimsum models.
- TvD introduced the preliminary investigations which have been conducted to date.
- TvD advised that WSP | PB would be using SIDRA modelling to look at impact on key external intersections surrounding South Dural. MO advised that in addition to intersections link flows should be investigated for potential mid-block upgrades.
- TvD advised that surveys are being conducted on 6 April which will include queue lengths.
- AS advised that the likely yield is 3,000 dwellings for the precinct
- MO advised that any queries relating to the mesoscopic model may be directed to Transport for NSW. These queries include:
  - Whether surrounding developments are included in the model.
  - Base future network upgrade assumptions.
- TvD outlined the surrounds of South Dural and advised the modelling and assessment would focus on these areas. MO advised the area of influence may extend to the network further downstream i.e. New Line Rd, Old Northern Rd.
- Bus route options could include keeping the bus routes on the external roads rather than on internal roads to maintain efficiency in the service.
- AS identified that getting east west cross connections through the mid area of the site is unlikely due to the conservations significance of the vegetation on site
- AS advised a meeting would be taking place 11 May with Department of Planning and Environment and Hornsby Council to outlay likely findings of the transport work and principals for which infrastructure agreements will need to be based upon.

# Meeting notes

Subject	South Dural Development Transport Assessment
Date	11 May 2016
Time	10:00am
Venue	Department of Planning and Education Parramatta Offices
Present	Representatives of: Department of Planning and Education Transport for NSW Roads and Maritime Services Hornsby Shire Council Lyon Group Folkestone APP Corporation WSP   Parsons Brinckerhoff

## Meeting Summary – Transport Issues

- Discussed preliminary modelling results and extent and timing of road upgrades.
- Roads and Maritime Services have been undertaking an assessment of the New Line Road Corridor.
- Transport for NSW and Roads and Maritime expressed concern that the traffic generation rates used were too low for the type and location of development.
- Transport for NSW had done preliminary calculations and were concerned about the numbers of bus passengers generated by the site, and the expectation that additional bus services would be required to accommodate them.
- Roads and Maritime will be interested to see the overall impact on new Line Road. The assessment needs to make sure that there is no worsening of traffic conditions.
- The extent of the assessment was discussed. Road links and intersections surrounding the site have been analysed. Road links to the north and south of the site on New Line Road and Old Northern Road have also been assessed.

# Meeting notes

Subject	South Dural Development Transport Assessment
Date	08 July 2016
Time	2:00pm
Venue	TfNSW Offices
Present	Andrew King, The Hills Shire Council (AK) Stewart Searle, The Hills Shire Council (SS) Janelle Atkins, The Hills Shire Council (JA) Peter Alevizos, APP Corporation (PA) Tom van Drempt, WSP   Parsons Brinckerhoff (TvD)

## Meeting Summary

### Introduction

- PA briefly introduced the South Dural project.
  - Planning proposal and associated studies for rezoning
  - Rezoning to predominantly residential
  - Up to 2,900 dwellings (allotments and apartments)

### Surrounding Road Network and Upgrades

- TvD advised Council on the internal road design for South Dural.
- Works on signalised intersection at Glenfield Rd (including signalisation) are ready to commence. Total cost approx. \$7-8M with The Hills Council to contribute half.

### Surrounding Developments

- The North Glenhaven development comprises 169ha of developable land and a total of 1,640 dwellings.
- Supermarket and apartment development opposite Franlee Rd. This includes a signalise intersection opposite Franlee.
- Derriwong Rd development has been deferred by Council pending a decision on the Round Corner bypass route. All preferred routes impact the Derriwong Rd sites.
- A planning proposal for rezoning for a small terrace/townhouse development adjacent to the Old Northern Rd/New Line Rd intersection has been deferred. Council preference for a B6 zone.

# Meeting notes

Subject	South Dural Development Transport Assessment
Date	29 July 2016
Time	9:30am
Venue	TfNSW Offices
Present	Mark Ozinga, Transport for NSW (MO) Neill Miller, Transport for NSW (NM) Martin Reason, Department of Planning and Education (MR) Allison Smith, APP Corporation (AS) Peter Alevizos, APP Corporation (PA) Tom van Drempt, WSP   Parsons Brinckerhoff (TvD)

## Meeting Summary

TvD provided an update on modelling progress and outlined the three key items for TfNSW consideration:

- Traffic generation
- Trip distribution
- Modelling methodology

## Traffic Generation

- Traffic generation was assumed at medium density for apartments and low density for detached houses/townhouses.
- Traffic generation assumptions and inputs generally higher than previous advice to TfNSW.
- NM/MO questioned the relationship between car ownership and traffic generation. TvD to consider.
- TfNSW questioned the split of traffic leaving and entering the site for AM/PM peaks. TvD to consider.

## Trip Distribution

- WSP considered STM, Aimsun and Journey to Work data in their assessment.
- It was noted that the Aimsun model showed a significant employment draw to Bella Vista/Norwest but also Blacktown.
- NM noted that due to inconvenient public transport links most people would probably drive to Bella Vista/Norwest.

## Modelling Methodology

- TvD outlined results and advised that even without the South Dural development most upgrades would be required by 2026 although to date no works have been commenced/scheduled.
- TvD advised that due to free flow of traffic capacity of New Line Rd adjacent to Hastings Road has been assumed at 1600 rather than 1200. TfNSW to provide comment.
- Due to the early stages of development being in the North West village, the early impacts of South Dural will be predominantly on Old Northern Rd rather than New Line Rd or Hastings Rd.
- NM suggested it would be useful to outline what spare capacity would exist on the new upgraded roads post development.