

LandCorp

Karratha City Centre Infrastructure Works Project

Karratha Transport Modelling Report

221566-00

Finalv2 | 8 July 2013



View of Balmoral Road from Dampier Road (from east)

Arup
Arup Pty Ltd ABN 18 000 966 165

Arup
Level 7
Wellington Central
836 Wellington St
West Perth WA 6005
Australia
arup.com.au



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		Name	Christie McKinnon	Darryl Patterson	Darryl Patterson
		Signature			
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1 Introduction

1.1 Overview

LandCorp engaged Arup to undertake detailed transport planning for the Karratha City Centre. The Karratha City Centre Infrastructure Works (KCCIW) Project represents the implementation of the Karratha City of the North (KCN) Master Plan, developed in 2010 and endorsed by both the State and Shire of Roebourne. The current report summarises the following:

- The process of developing and the main outputs from the Karratha town-site Spreadsheet Model (KSM). Additional detail relating to the KSM is provided in an earlier report (Arup, September, 2011)
- The process of developing and the main outputs from the Karratha City Centre Micro-simulation (Paramics) Model
- The results of SIDRA analysis of key intersections in the Karratha City Centre
- Findings and recommendations regarding the transport network within and outside of the City Centre

The analysis covers three time periods; notionally the short term (year 2016), medium term (year 2021) and long term (year 2031). The data outlined in this report represents the most recent land use yield forecasts supplied to Arup by other members of the project team and Mirvac as a development proponent. It includes specific yield data for the City Core site (supplied by Mirvac) and Health Campus in the future City Centre.

Significantly, the modelling process ran over a time period of approximately 14 months, as each model was developed and tested. Additionally, the Paramics and SIDRA outputs were referred to in the refinement of the network design, which led to subsequent modelling iterations. On these bases, the models and finalised network design are considered robust.

At the request of the Shire of Roebourne, an alternative network scenario was also tested to understand potential relative impacts on network performance and the performance of individual intersections. This test is discussed further in **Section 2**.

1.2 Specific considerations in transport modelling

- Analysis of the wider road network relief (e.g. new links and added capacity outside of the Karratha City Centre), required to make sure that non-city centre bound traffic has alternative routes, particularly between the residential areas of Karratha and the expanded Karratha Industrial Area. A bypass route to the south of Dampier Road, between the Karratha Industrial Area and Madigan Road, is likely to be critical as a bypass route and required in the short-medium term
- Consideration of travel demand management measures (TDM) that may be employed to make sure that engineering solutions are not required to maintain accessibility to the City Centre, particularly in the medium-long term.

Detailed transport modelling is likely to show that some undesirable network upgrades may be required within the Karratha City Centre if TDM measures are not employed, to alleviate congestion. These upgrades may include dual right turn pockets and slip lanes on Sharpe Avenue and provision of multiple turning lanes on other roads. Appropriate TDM measures are likely to include provision of a transit service in Karratha, which may be aligned via O’Keefe Road-Karratha Terrace-Wellard Way; implementation of an enhanced Shire Bike Plan that requires high quality end of trip facilities in the City Centre; and application of the Karratha City Centre Parking Supply and Management Strategy

- Increasing the eminence of Karratha Terrace as an access to the City Centre, by connecting westwards to O’Keefe Road, with future potential traffic signals at the intersection of O’Keefe Road and Dampier Road

1.3 Relationship between traffic modelling and detailed design for Works Packages A & B

Works Packages A & B represent the first set of civil infrastructure works to be undertaken for the KCCIW Project. Works Packages A & B are shown in **Figure 1**. Civil works commenced in 2012.

The project team including the Shire of Roebourne has worked through an iterative process to develop a network design for the City Centre, which meets several key objectives. These include:

- Creation of a City Centre first and foremost for people, with intimate streetscapes that are pedestrian-friendly and slow traffic
- A street network that is well-connected and befitting a highly urbanised context without significant road reserve widths being retained that create opportunities for future widening and therefore detract from the amenity of place
- Active imposition of limitations on street and intersection capacity for vehicles so that over time, travel demand management is facilitated and people are discouraged from undertaking vehicle trips when such trips are discretionary and they may make alternative travel provisions
- Creating a context for development of additional road links through and around Karratha – particularly east-west – given the current concentration of traffic on Dampier Road is unsustainable

While the traffic modelling shows performance issues within the Karratha City Centre and potential for vehicle queues to impact on adjacent intersections, it is not proposed to extend pockets or otherwise add capacity compared to the current detailed design plans. In the view of the project team, an appropriate urban design outcome is being pursued with transport (vehicle and non-vehicle transport) being planned to support this. This is typical of a city centre environment where there needs to be a fine balance between:

- Provision of sufficient road capacity and route choices (achieved through development of a highly connected street network)

- Facilitation of non-car transport through activity intensity and development of a high quality public realm (providing opportunities to walk and cycle) and establishment of a future transit route
- Traffic calming (speed control and constraints to road geometry) to facilitate some congestion and encourage people out of cars for discretionary trips
- Provision of higher capacity external connections to draw regional traffic away from the city centre network

These bullet points all signpost critical strategies for mitigating demand flows in the city centre and the importance of pursuing them will increase if growth in traffic exceeds forecasts. In particular, investigation of alternative external routes should proceed in the near term.

1.4 Additional project reporting

The current report is part of a suite of transport planning deliverables prepared as part of the KCCIW Project. Other reports include:

- Arup's Phase 1 Transport Report relating to the project (KARTC 2011-04-01 Phase 1 Report_FINAL)
- The Parking Supply and Management Strategy developed for the Karratha City Centre (KACIP 2013-07-09 Parking Strategy_FINALv3)
- The longer term Transit Plan for Karratha (KACIP 2013-07-02 Transit Plan_FINAL)
- The explanatory report associated with the Karratha Townsite Spreadsheet Model (KARTC 2011-11-28 Karratha Townsite Spreadsheet Model Report_FINAL)
- The road safety audit of the detailed design for Works Packages A and B (Karratha Close Out_RSA-1)
- The project summary report (KACIP 2013-07-09 Project Summary Report_FINAL)



Accordingly, it is acknowledged that by constraining capacity in the Karratha City Centre, the Shire, LandCorp and other stakeholders will need to consider other strategic transport investments to both increase the appeal of non-car modes and add road capacity external to the city centre for through trips. Key opportunities are articulated in **Section 6** of this report.

1.5 Overview of consultation

Arup's transport planning commission began in February 2011. Since this time, Arup and other members of the project team have regularly engaged with relevant approval agencies. In particular, the Shire of Roebourne is a member of the project team and the end client, and has been actively involved in transport planning decisions and model development.

Main Roads WA has been engaged with on numerous occasions (both Metropolitan and Pilbara staff) with the most recent consultation (meeting with Metropolitan officers) occurring on Monday 5 November. The Karratha City Centre road network scenarios ultimately modelled and discussed in this report are based on feedback received from Main Roads WA. The specific design characteristics requested by Main Roads WA and specifically incorporated into SIDRA intersection assessment include:

- Priority control rather than traffic signals at the intersection of Sharpe Avenue and Welcome Road (also modelled using Paramics)
- Added capacity at the intersection of Sharpe Avenue and Dampier Road
- Longer turning pockets at select intersections that are proposed to be signalised

Results of this analysis are discussed in **Section 5** of this report. Particular modifications to the network design prepared by the project team, based on feedback from Main Roads WA, are discussed in **Section 6**.

1.6 Safety in Design (SiD)

Safety in Design (SiD) issues and potential hazards have been identified within the scope of Arup's traffic engineering activities. Due to Arup's limited and upfront role on this project, it is not considered reasonable to identify all potential hazards, which may occur throughout the life of a project, including during construction activities. For any current and ensuing design stages, it is strongly recommended that any advice issued in relation to SiD is reviewed and implemented as required.

It is noted that a road safety audit has now been completed in relation to the detailed design for Works Packages A and B, and further road safety audits are proposed to occur in the future.

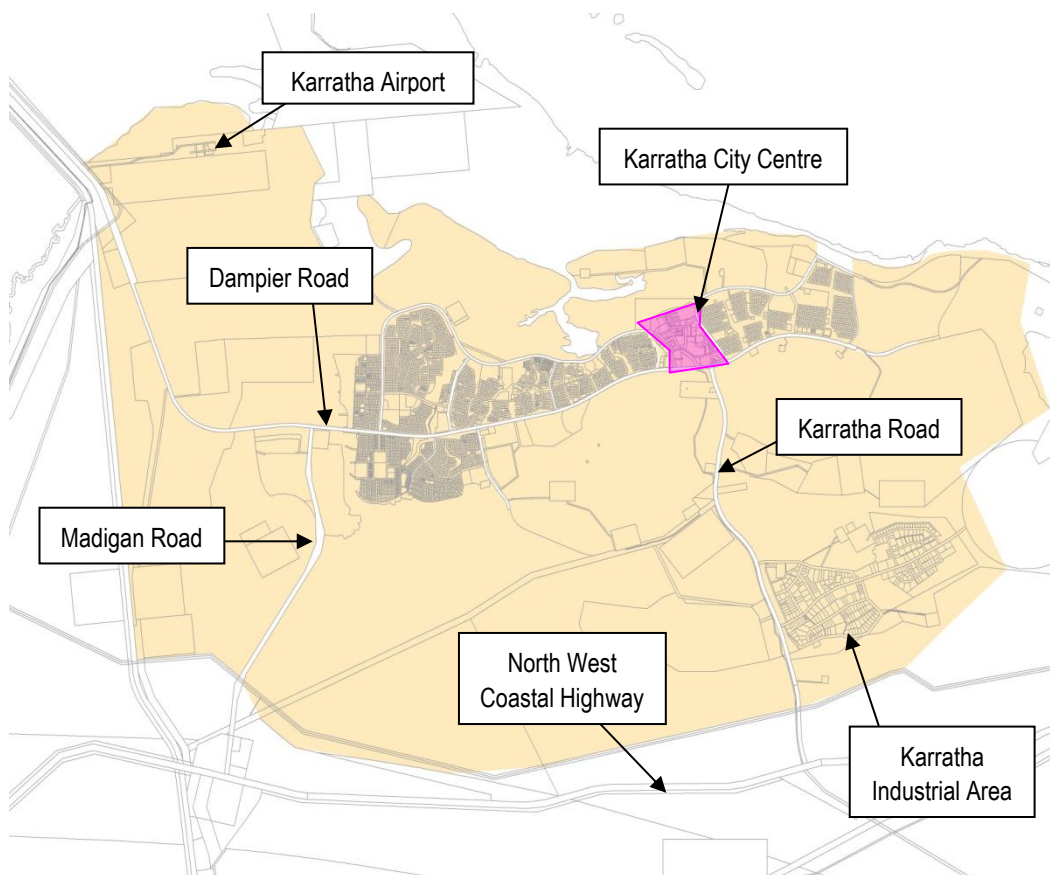
2 Modelling Structure

2.1 Traffic analysis

Three levels of traffic analysis have been undertaken. These include:

- Karratha town-site Spreadsheet Model (gravity distribution model for the entire town-site – refer to **Figure 2**)
- Karratha City Centre Micro-simulation Model (applicable only to City Centre Zone – refer to **Figure 3**)
- Detailed intersection analysis using SIDRA software (applicable only to key intersections within the City Centre Zone)

A summary of each analysis model and the associated outputs from each is provided in **Figure 4**.



■ **Figure 2 - Karratha town-site Spreadsheet Model coverage**



Figure 3 - Karratha City Centre Model coverage

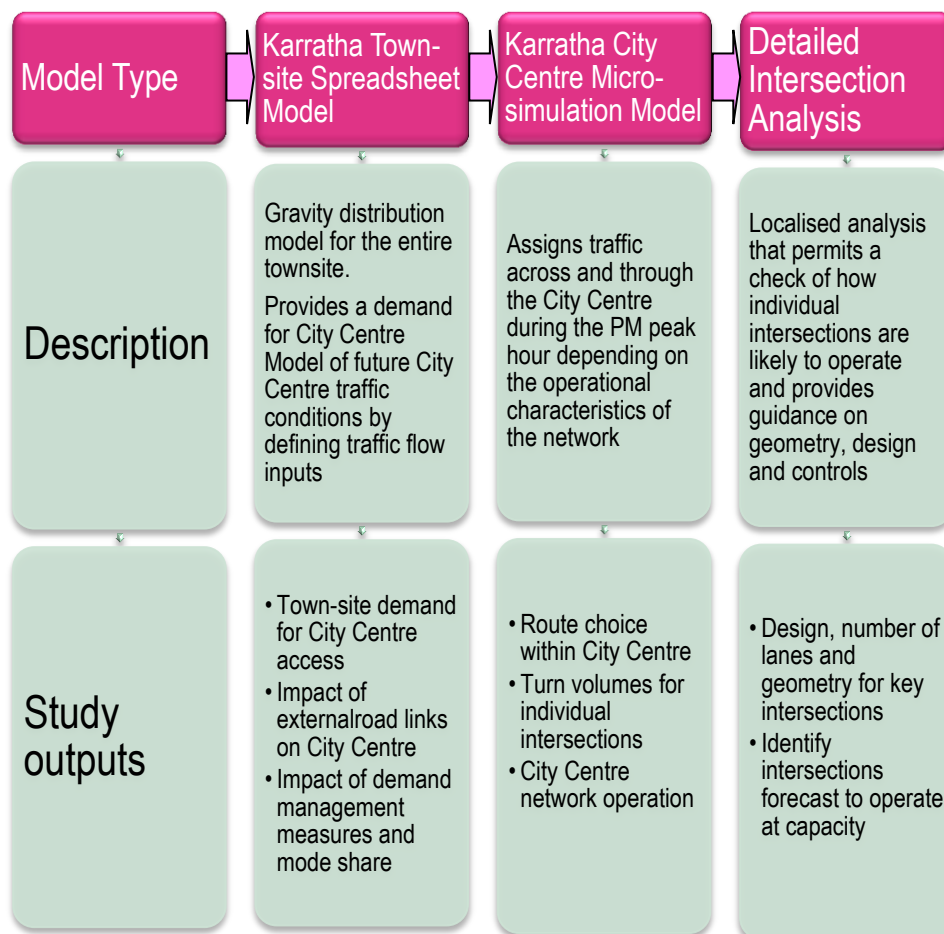


Figure 4 - Modelling structure/ process

2.2 Assumed network upgrades

Assumptions have been made in relation to the timing of network upgrades within the Karratha City Centre. The timings for network upgrades adopted in the modelling are detailed in **Table 1**. The assumptions are generally based on Volume 3 of the KCN Plan and have been refined based on discussions with the KCCIW Project team. The upgrades have been ordered based on timing and works that will no longer apply have been excluded. Town-site upgrades were assumed as per the stipulations in the KCN Plan Volume 2.

The alternative network scenario tested incorporated the following differences relative to the base case:

1. Severance of Balmoral Road from Dampier Road (rather than conversion of the existing roundabout to a left-in/ left-out treatment)
2. Retention of the existing roundabout treatment at Hillview Road/ Balmoral Road/ Welcome Road (rather than conversion to priority control with priority to Balmoral Road)
3. Upgrade of Hillview Road/ Dampier Road to traffic signal control (rather than retention of the current priority control treatment)

The network changes did not affect the Karratha townsite Spreadsheet Model, which is discussed in the next section. However, they were accounted for in the Paramics model (**Section 4**) and analysis of selected intersections (**Section 5**).

▪ **Table 1 - Adopted timing of City Centre network upgrades**

Project	Time horizon		
	Short term (2016)	Medium term (2021)	Long term (2031)
Sharpe Avenue reinforced as city main street with direct link to Dampier Road (following relocation of the retirement village)	✓		
Karratha Road linked to Welcome Road to provide direct city centre access	✓		
Klenk Street realigned as a secondary main street fronting Centro Shopping Centre and linked to Searipple Road	✓		
Karratha Terrace created as a new east-west main street with public transport provisions and safe pedestrian and cycle environment with traffic calming	✓		
Morse Court relocated to create a direct east-west connection through the city	✓		
Welcome Road realigned to connect directly to Balmoral Road	✓		
Bus, caravan and large vehicle layover areas established on DeGrey Place with access from Searipple Road	✓		

Project	Time horizon		
	Short term (2016)	Medium term (2021)	Long term (2031)
Old Welcome Road connected from Sharpe Avenue to Pegs Creek	✓		
Balmoral Road and Searipple Road realigned at City North Boulevard to improve traffic management and frame the City Centre		✓	
City North Boulevard constructed as a new east-west link between Balmoral Road and Searipple Road		✓	
Sharpe Avenue connected through to the new City North Boulevard (deferred to the long rather than medium term compared to the KCN Plan)			✓

(Source: LandCorp and Shire of Roebourne, 2010: p121)

3 Karratha town-site Spreadsheet Model (KSM)

Arup has developed the KSM to provide an understanding of future traffic demands in and around the City Centre and thereby help to make decisions on transport infrastructure provisions. The KSM is a three-step model encompassing trip generation, trip distribution and assignment. Mode choice is not explicitly determined as the trip generation module only generates car trips.

Prior to assessing network requirements, a fitness for purpose assessment was undertaken on the base year model comparing modelled and observed traffic flows over a series of screen-lines and on individual links. The screen-line assessment demonstrated some moderate differences between modelled and observed traffic volumes but that overall, the KSM provides a good representation of the traffic volume to/ from the Karratha City Centre.

The KSM has limited accuracy when forecasts for individual links are considered given the constraints of traffic assignment within the spreadsheet model environment. The KSM was not intended to be used to make design decisions; instead, it was applied in the production of the more detailed Karratha City Centre traffic network model and otherwise provides a good overall snapshot of future traffic flows throughout the town-site.

3.1 Base year

Figure 5 details the flows estimated for the base year by the KSM. Summary statistics from the base year assignment are given in **Table 2**.

The data indicates that the majority of vehicles travel less than five kilometres and generally within the confines of residential areas in Karratha. A secondary peak generally occurs within a trip distance range of 11 to 16 kilometres. This is likely associated with trips to/ from the Karratha Industrial Area (KIA) and outlying residential areas.

▪ **Table 2 - Base year assignment summary statistics**

Variable	Value
Vehicles	56,628
Vehicle hours	6,338
Vehicle kilometres	381,492
Average trip length (km)	6.7

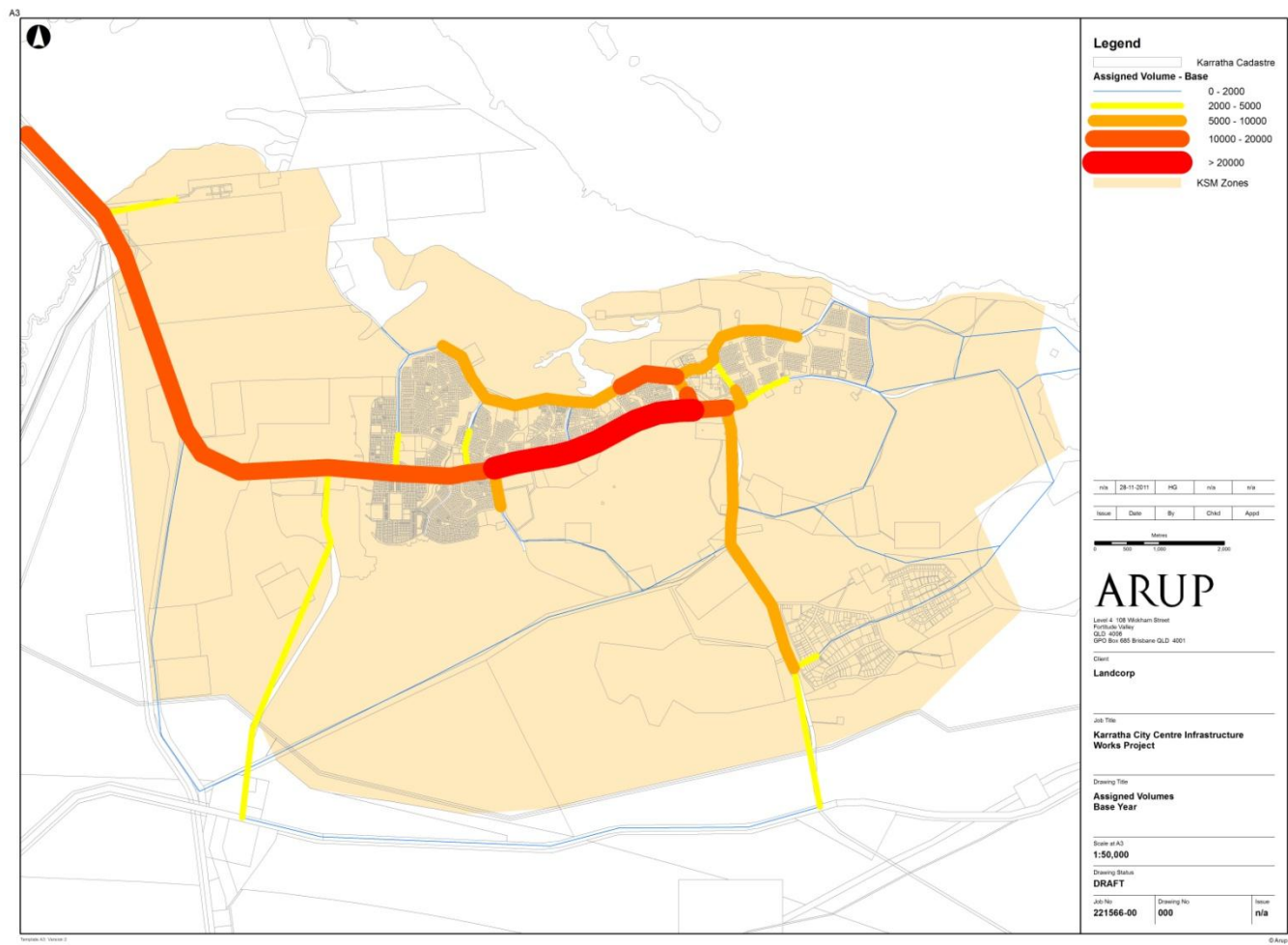


Figure 5 - Assigned volumes, base year

3.2 Assignment

Trips were assigned initially across the network using an all-or-nothing process, adopting uncongested travel time as the fixed cost of travel. This generally translates to drivers choosing the quickest and shortest route (in terms of distance). This approach led to differences when comparing modelled and observed traffic data.

Consequently, further assumptions were made regarding the routes that traffic might take between origin destination pairs and demand was assigned via multiple paths. The weighting applied to each path was based on a qualitative assessment of the route choices available.

The model network has five link types, each with a default speed and capacity (deficiency volume) as shown in **Table 3**.

▪ **Table 3 - Link types**

Link Type	Free Flow Speed (km/hr)	Two Lane, Two way Deficiency Volume (vehicles/day)
Highway	100	17,000
Urban Arterial	70	13,000
Collector	50	10,000
Connectors	50	10,000
Local	40	9,000
Unsealed roads	15	250

The default speeds in **Table 3** are used to calculate the time taken to travel between origin and destination zones while the capacity is used to gauge how the planned infrastructure is coping with the anticipated demand.

3.3 Forecast scenarios

The three future scenarios analysed were:

- Short term: 2016
- Medium term: 2021
- Long term: 2031

3.3.1 Land use

The land use inputs for the forecast year scenarios were obtained from various data sources provided to Arup by the project team and Mirvac as the proponent

for the City Core development in the Karratha City Centre. Data supplied by Mirvac in mid-2012 replaced some land use assumptions for the relevant City Centre zone in the model adopted in an earlier iteration of the model¹. The final model version also included data associated with the Karratha Health Campus, which is proposed to be located in the City Centre zone.

With the exception of the enrolment land use category, the data sources contained all of the information required for the derivation of future year land use values for each trip generation category. The total yields for each land use category and forecast year derived from the source data (and calculated for enrolment data) are given in **Table 4**.

The land use forecasts show considerable growth in the number of households and non-retail employment. Most employment growth is associated with the Karratha Industrial Area while there is predicted to be considerable growth in permanent households compared to temporary worker accommodation.

¹ Land use data associated with the KSM City Centre zone is an aggregate of values assigned to a set of sub-zones (relevant during more detailed analysis such as micro-simulation). City Core is located within one of these sub-zones as is the Karratha Health Campus.

▪ **Table 4 - Base and forecast year land use inputs**

Period	Households	Temporary worker accommodation	Retail employment area (100m ²)	Non-retail employment area (100m ²)	School enrolments	Community purpose area (100m ²)	Hotel/entertainment area (100m ²)
Base case	9,311	1,235	422	306	2,836	181	115
Short term	14,301	2,480	938	998	4,558	420	473
Medium term	20,538	3,660	1,556	6,626	7,205	2,079	718
Long term	28,436	4,085	2,012	11,833	10,556	3,081	801

3.3.2 Network statistics

Summary network statistics for each development year are shown in **Table 5**.

▪ **Table 5 - Forecast scenario assignment summary statistics (daily values)**

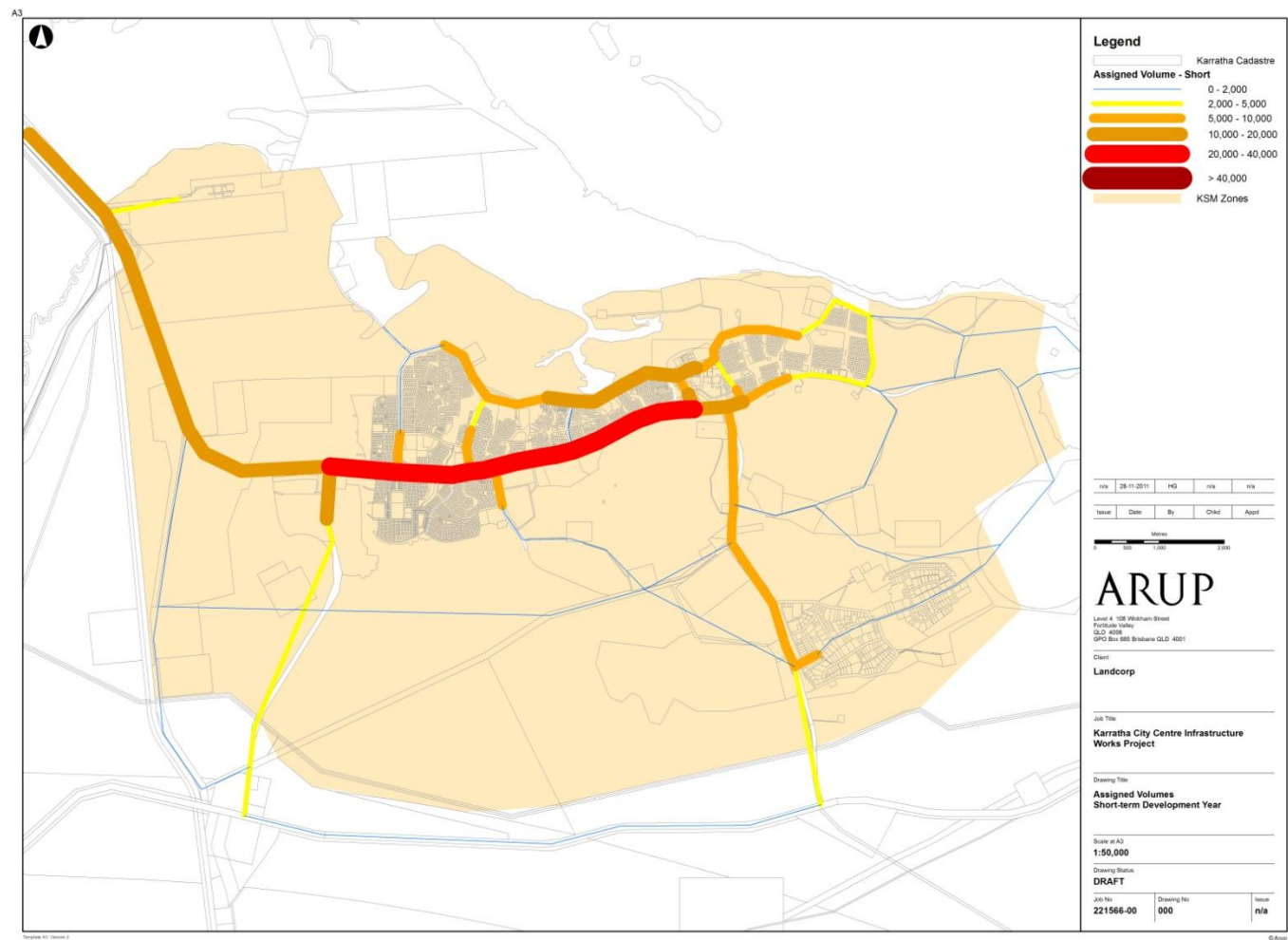
Variable	Forecast period		
	Short term	Medium term	Long term
Total vehicles	86,343	131,257	182,560
Total vehicle hours	9,131	16,234	22,612
Total vehicle kilometres	545,311	849,223	1,272,287
Average trip length (km)	6.3	6.5	7.0

3.3.3 Traffic volumes

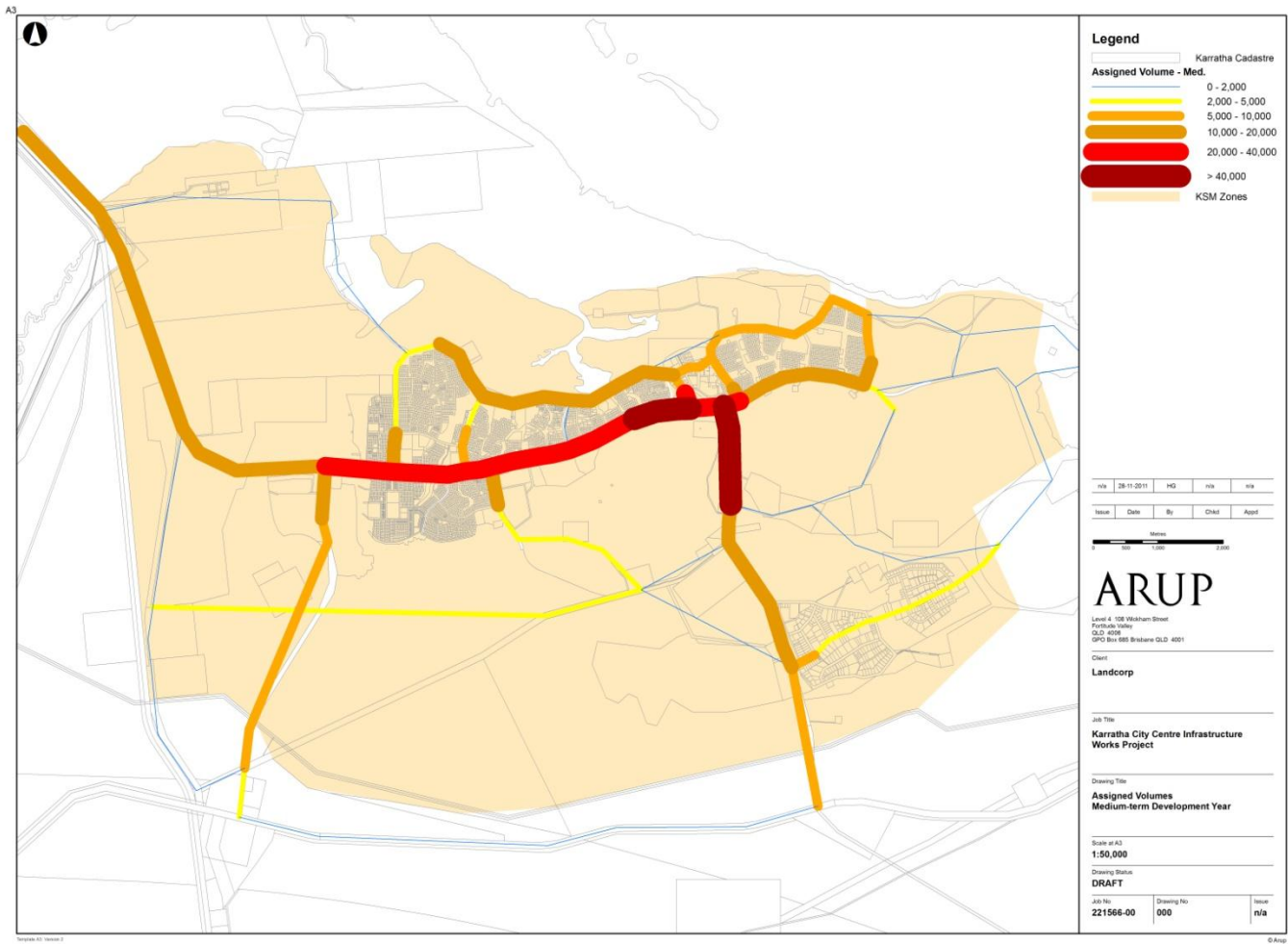
The estimated traffic volumes for the short, medium and long-term development forecast years are summarised in **Table 6** and shown in **Figures 6 to 8**. Data is expressed in vehicles per day (vpd). The findings demonstrate considerable growth in traffic along both Dampier Road and Karratha Road to a level commensurate with the ultimate capacity of a four lane road. Under these conditions, duplication of some other key links, including Balmoral Road, may also need to be considered.

▪ **Table 6 - Forecast traffic volumes**

Location	Forecast Period		
	Short term	Medium term	Long term
Dampier Road, between Balmoral Road and Karratha Road	17,600 vpd	36,400 vpd	43,100 vpd
Karratha Road, between Dampier Road and Mooligunn Road	9,700 vpd	42,600 vpd	47,200 vpd
Balmoral Road, between Warambie Road and Dampier Road	17,900 vpd	22,700 vpd	27,000 vpd
Searipple Road, between Warambie Road and Dampier Road	9,500 vpd	15,800 vpd	24,100 vpd



■ **Figure 6 - Short term development modelled flows**



■ Figure 7 - Medium term development modelled flows

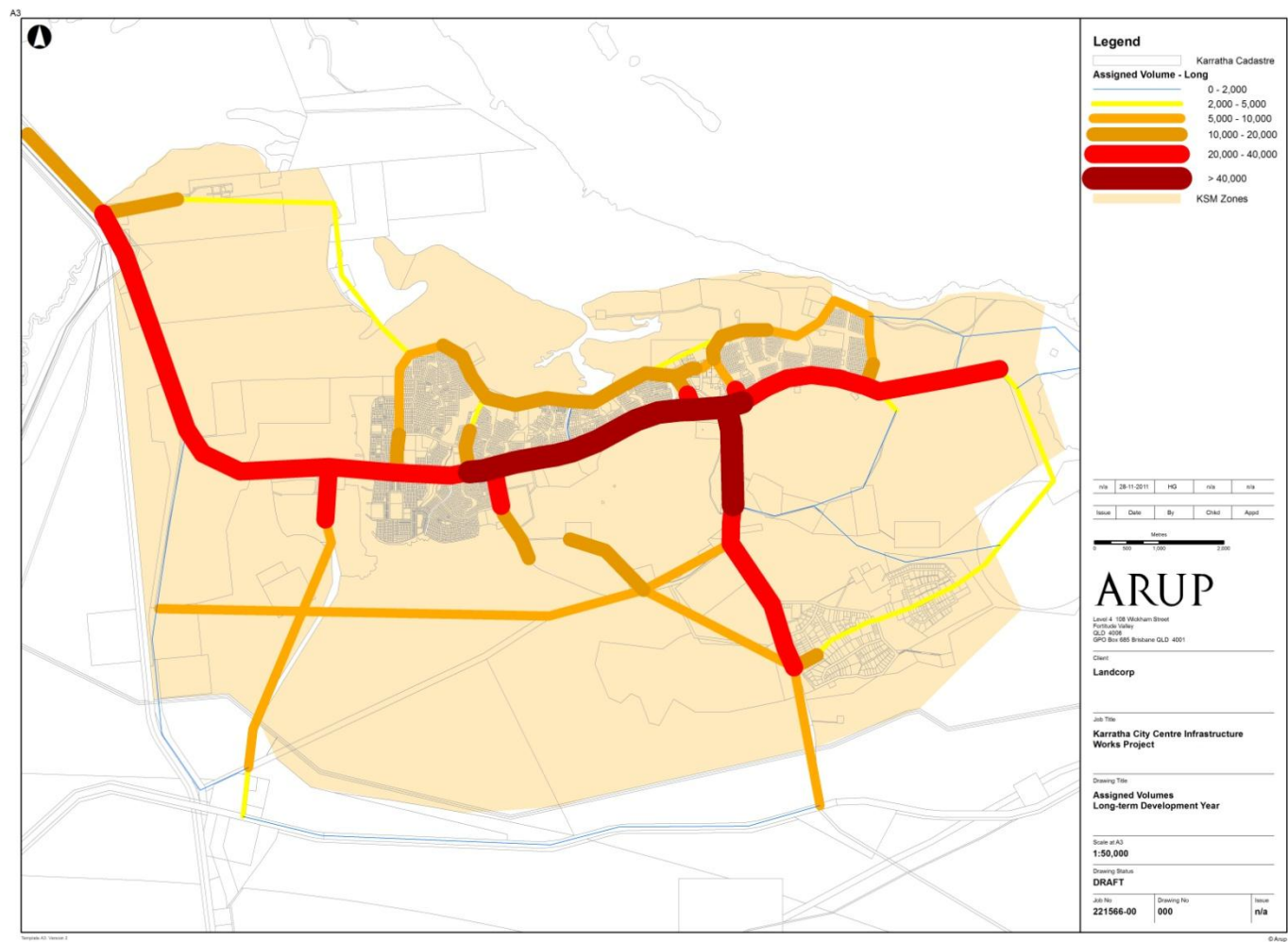


Figure 8 - Long term development modelled flow

3.4 Network requirements

Tables 7 to 10 identify links that may need to be upgraded prior to the specified development year. In particular, the data in Table 7 demonstrate that some key links are already experiencing capacity issues. Plots of volume to capacity ratios are included as **Figures 9 to 12**.

Volumes forecast on individual links depend on route assignment and choice. In the KSM, drivers are assumed to know and will take the quickest route between origins and destinations. Accordingly, the information reported in this section is subject to the limitations of the spreadsheet approach and should only be used to highlight where links within the network should be subject to more detailed investigations. This work may include sensitivity testing on impacts of traffic redistribution, mode shift and/ or reduced discretionary trip making.

Impacts on the network within the City Centre were subject to more detailed modelling that is described in later sections of this report.

▪ **Table 7 - Links exceeding deficiency volume, base year**

Location
Dampier Road (between western external boundary and Balmoral Road West)
Balmoral Road (between Gawthorne Drive and Warambie Road)
Balmoral Road (between Welcome Road and Dampier Road)
Warambie Road (between Balmoral Road and Sharpe Avenue)

▪ **Table 8 - Links exceeding deficiency volume, short-term development year**

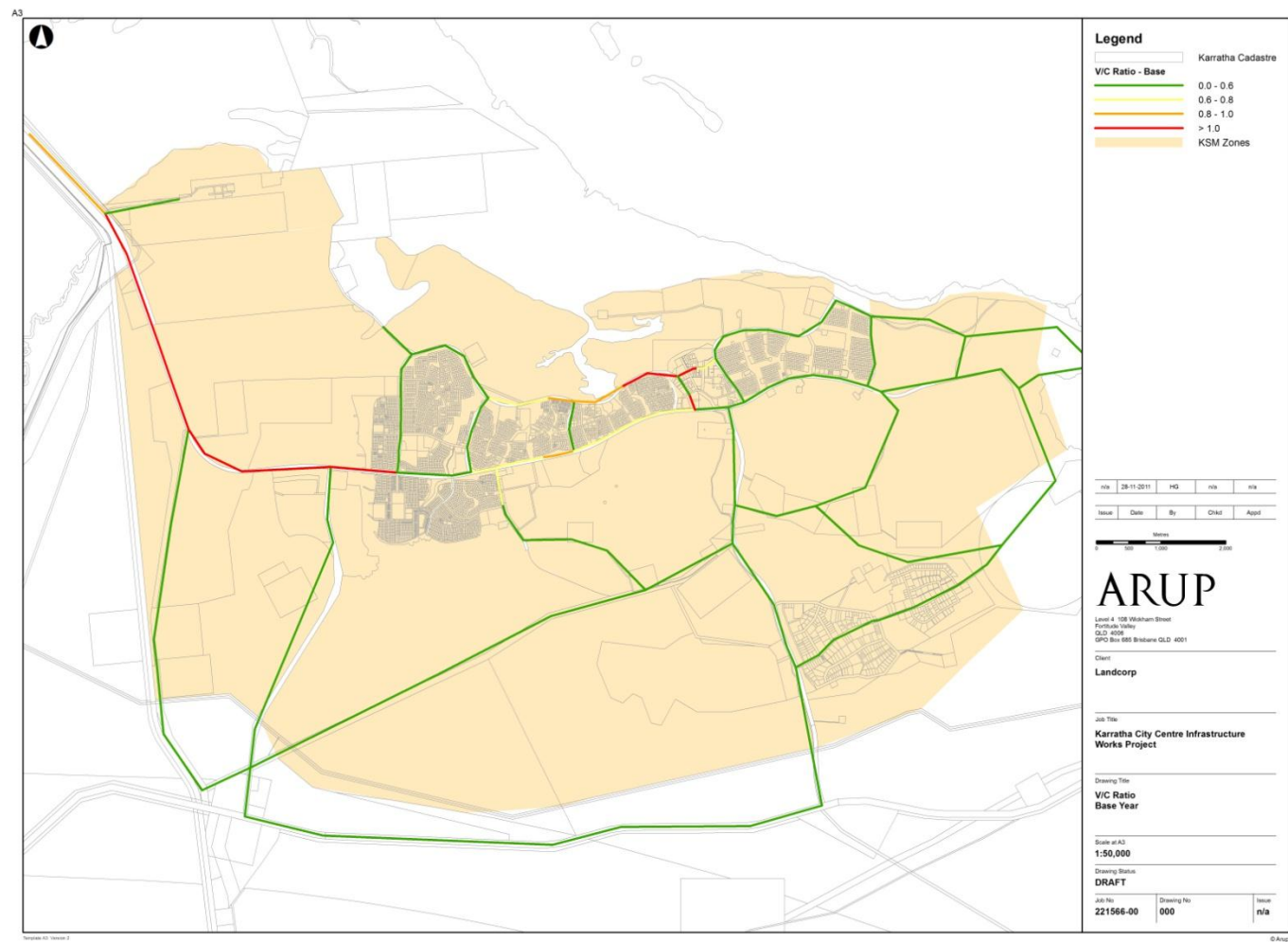
Location
Dampier Road (between Bathgate Road and Balmoral Road East)
Dampier Road (between western external boundary and Balmoral Road West)
Balmoral Road (between Gawthorne Drive and Warambie Road)
Balmoral Road (between Welcome Road and Dampier Road)
Madigan Road (between Dampier Road and Gap Ridge Road)
Warambie Road (between Balmoral Road and Sharpe Avenue)
Mulataga (South Access Road)

■ **Table 9 - Links exceeding deficiency volume, medium-term development year**

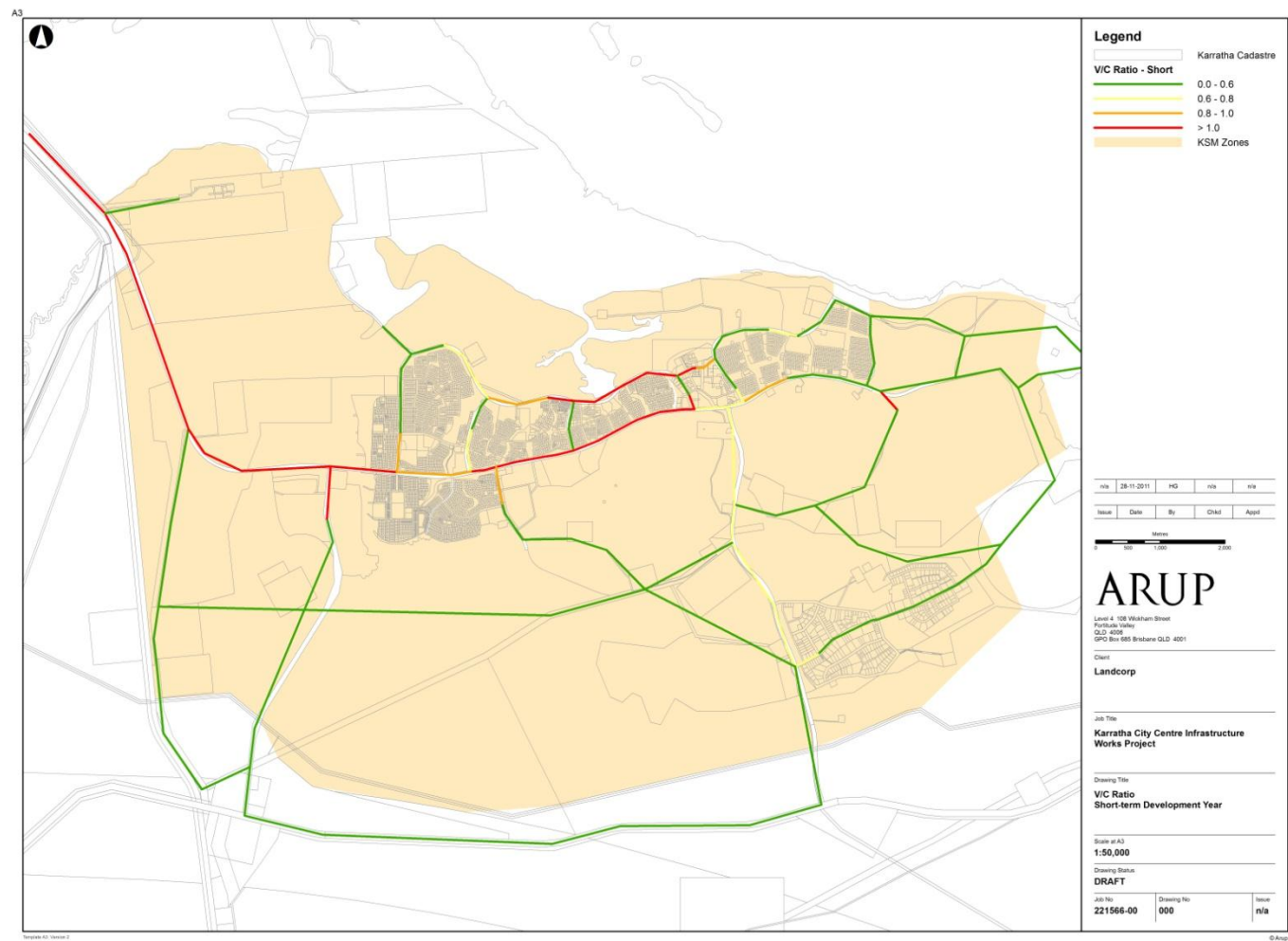
Location
Balmoral Road (between Millars Road and Warambie Road)
Regals Access Road (between Madigan Road and Rosemary Road)
Karratha Road (between Mooligunn Road and Dampier Road)
Searipple Road (between Millstream Road and Welcome Road)
Maitland Road (between Clarkson Way and Millstream Road)
Millstream Road (between Karratha Road and Maitland Road)
Warambie Road (between Balmoral Road and Sharpe Avenue)
Dampier Road (between western external boundary and Balmoral Road West)
Balmoral Road (between Dampier Road and Tambrey Drive)
Madigan Road (between Dampier Rd and Gap Ridge Road)
Dampier Road (between Bathgate Road and Karratha Road)

■ **Table 10 - Links exceeding deficiency volume, long-term development year**

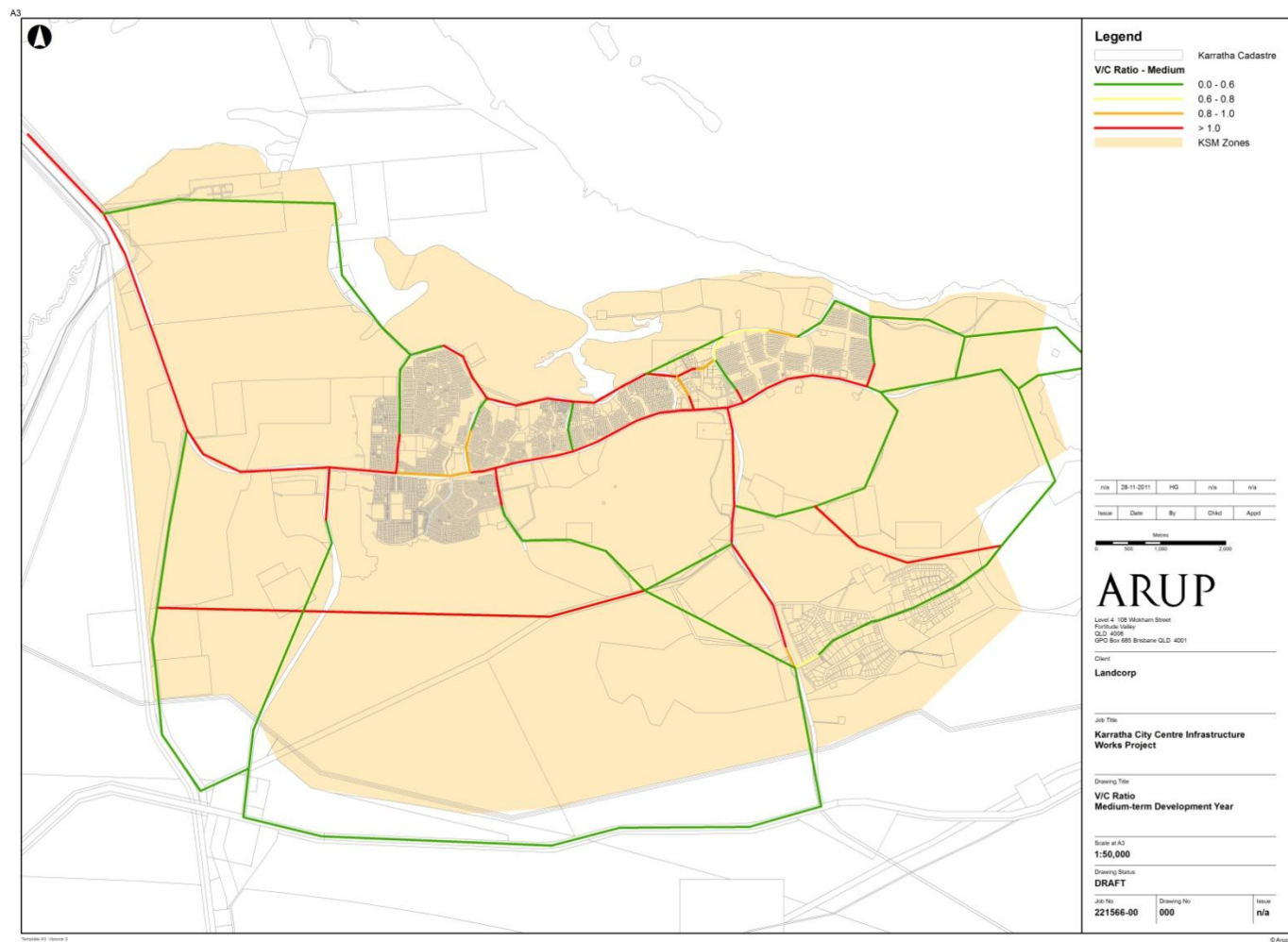
Location
Dampier Road (between western external boundary and Karratha Road)
Madigan Road (between Dampier Road and Gap Ridge Road)
Balmoral Road (between Dampier Road and Tambrey Drive)
Balmoral Road (between Millars Road and Dampier Road)
Warambie Road (between Balmoral Road and Searipple Avenue)
Bathgate Road (between Dampier Road and Gawthorne Drive)
Searipple Road (between Millstream Road and Welcome Road)
Millstream Road (between Karratha Road and Maitland Road)
Millstream Road extension from Maitland Road to Mulataga East
Maitland Road (between Millstream Road and Andover Way)
Karratha Road (between Dampier Road and Coolawanyah Road)
Coolawanyah Road (between Karratha Road and Mooligunn Road)
Bayley Avenue (between Airport and Dampier Road)
Rosemary Road (between Radley Drive and Regals Valley Access Road)



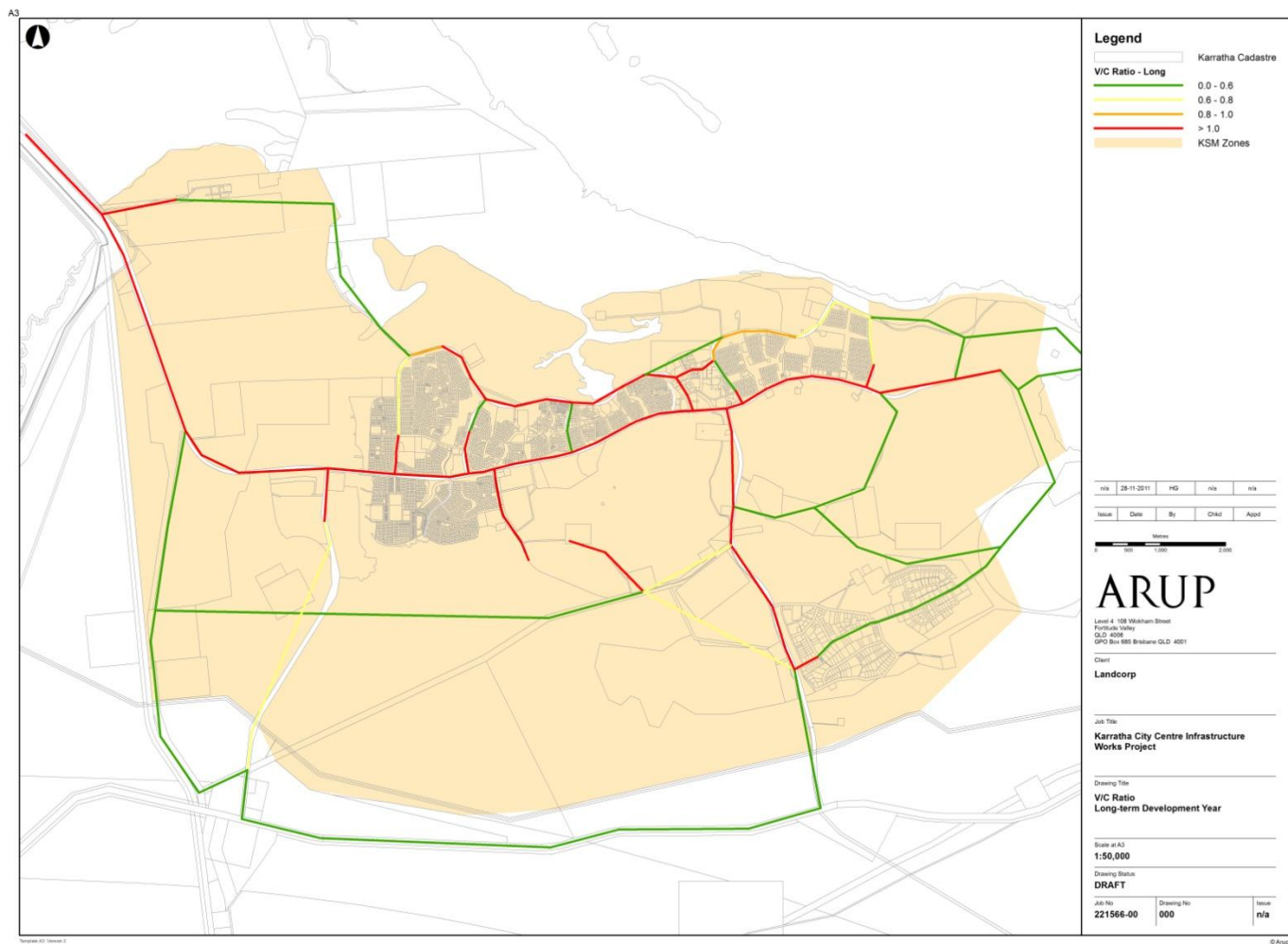
■ **Figure 9 - Plot of volume to capacity ratios, base year**



■ **Figure 10 - Plot of volume to capacity ratios, short term development year**



■ Figure 11 - Plot of volume to capacity ratios, medium term development year



■ Figure 12 - Plot of volume to capacity ratios, long term development year

3.5 Sensitivity tests

Sensitivity testing was conducted to investigate the impacts of varying model parameters on the capacity of the Karratha road network. The comparative scenario assumed that future transport and land use planning in Karratha will facilitate an annual 5% reduction in the car driver mode share. This may be facilitated through measures such as activity intensification of local centres to increase walking trips, enhancement of the walking and cycling network as per the Karratha Bike Plan, provision of town-site bus services, traffic-calming of various streets and implementation of the Karratha City Centre Parking Supply and Management Strategy. The base and sensitivity test car driver mode shares are given in **Table 11**.

▪ **Table 11 - Car driver mode share percentage: base case compared to sensitivity test scenario**

Scenario	Time horizon			
	Base year	Short term	Medium term	Long term
Base case	72%	72%	72%	72%
Sensitivity test scenario	72%	67%	62%	57%

The results of the sensitivity test show that even with a significant reduction in car mode share, infrastructure requirements will be virtually the same as in the base case model. This implies that the land use changes forecast for the Karratha town-site will have a significant impact on traffic flows and accordingly, a more detailed investigation should be undertaken into network provisions, zone connectivity and route assumptions for the wider Karratha town-site area.

3.6 Strategic outcomes

The following key findings are evident from the development of the KSM:

- There is a strong case for a high-standard east west route, south of Dampier Road, to service Karratha Industrial Area (KIA) and remove traffic from Dampier Road in the vicinity of the Karratha City Centre. The link should also have legible, higher order connections to Rosemary Road and Bayton Drive. Based on the KSM output, this link would be needed in the short to medium term but ultimately this will be triggered by development growth at the KIA
- Links to the east of KIA through to Millstream Road should be improved concurrent to increases in activity at KIA and east of Bulgarra
- There should be investigation of additional travel demand management (TDM) measures for the Karratha City Centre and wider town to reduce dependence on the private motor vehicle
- Consideration should be given to servicing KIA with bus public transport. This would be subject to further investigation and discussion with TransWA

4 Karratha City Centre Network Model

The Karratha City Centre Network Model (KCCNM) was developed to assess the City Centre network at a broad and visual level, provide information on the likely routes of traffic within the City Centre and produce inputs for the City Centre intersection analysis. The modelling was undertaken using the industry-recognised software package Paramics for the following reasons:

- Existing Paramics modelling data existed; and
- The software could produce a route assignment model that was reasonably robust in nature.

The KCCNM was developed to represent the critical PM peak hour. However, AM demand matrices were run through the PM models to make sure any congestion issues in the AM peak were captured. In relative terms, AM peak conditions were less congested than those in the PM peak hour.

4.1 Base year

The KCCNM focused on the forecast years and a base year model was therefore not considered in detail. The KSM, which inputs to the KCCNM, was calibrated to offer a reasonable reflection of actual traffic conditions around the City Centre area. Given the significant changes to City Centre road network anticipated in the future, base year validation for individual intersections was considered of lesser importance than the KSM strategic validation exercise.

4.2 Forecast scenarios

Paramics models were developed to reflect short, medium and long term road network (see **Figures 13 to Figure 15**) and traffic conditions. Assumed network upgrades and high-level traffic performance of each scenario are discussed in subsequent sections.

4.2.1 Short term

A review of the performance of the short term network was undertaken. In addition to those specified in Table 1, the following network modifications were assumed:

- Removal of all roundabouts and replacement with priority control;
- Restriction of intersection of Balmoral Road and Dampier Road to left in / left out (LiLo);
- Deterrence of heavy vehicles (greater than eight metres in length) from Sharpe Avenue; and
- Deterrence of through traffic from Hillview Road and Sharpe Avenue (between Welcome Road and Dampier Road) through introduction of cost factors.

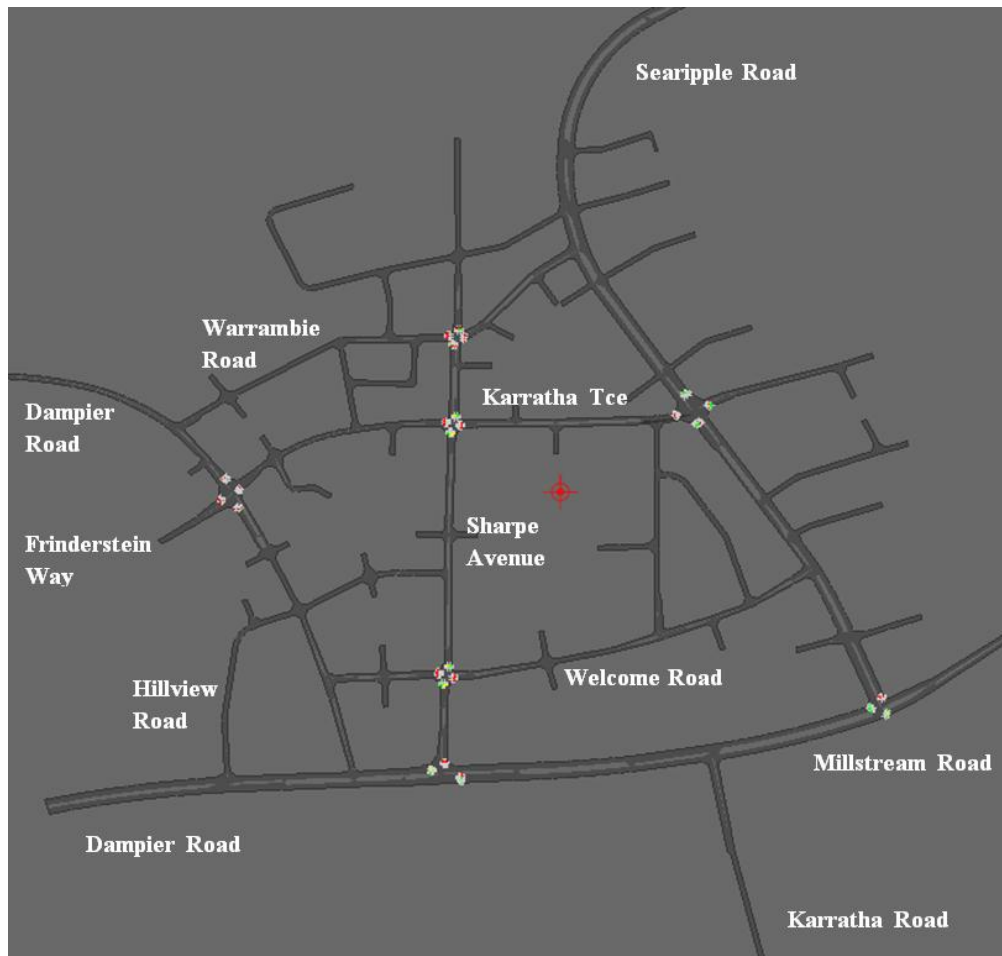
Observations of the model in operation indicated the following:

- Intersections of Karratha Terrace with Balmoral Road and Searipple Road will likely require signals;
- The Millstream Road/ Searipple Road intersection will require signals; and
- The right turn from Hillview Road to Dampier Road should be restricted in peak hours or banned (limited capacity for the movement as a priority control), at least from the medium term onwards.

Paramics was also used specifically to test whether or not the intersection of Welcome Road and Sharpe Avenue could function acceptably under priority control in the short term. The analysis found there to be considerable queuing issues with traffic generally unable to turn right from Welcome Road (minor legs) on to or cross Sharpe Avenue. The alternative short term scenario – Welcome Road and Sharpe Avenue under traffic signal control – was found to operate significantly better.

However, Main Roads WA prefers for this intersection to operate under priority control due to its proximity to the Dampier Road signalised intersection so conditions should be monitored into the future. Arup has advised the project engineer, Wood & Grieve, to make provision in the detailed design plans for future signalisation (e.g. installation of conduits), should this be required. It is also noted that priority control may turn out to be a less suitable treatment for pedestrians than traffic signals, given the strong pedestrian link that will be established along Sharpe Avenue. In practice, these issues may bring forward signalisation.

The updated KCCNM, with the upgrades listed above in addition to the relevant upgrades specified in Table 1, was shown to operate satisfactorily.

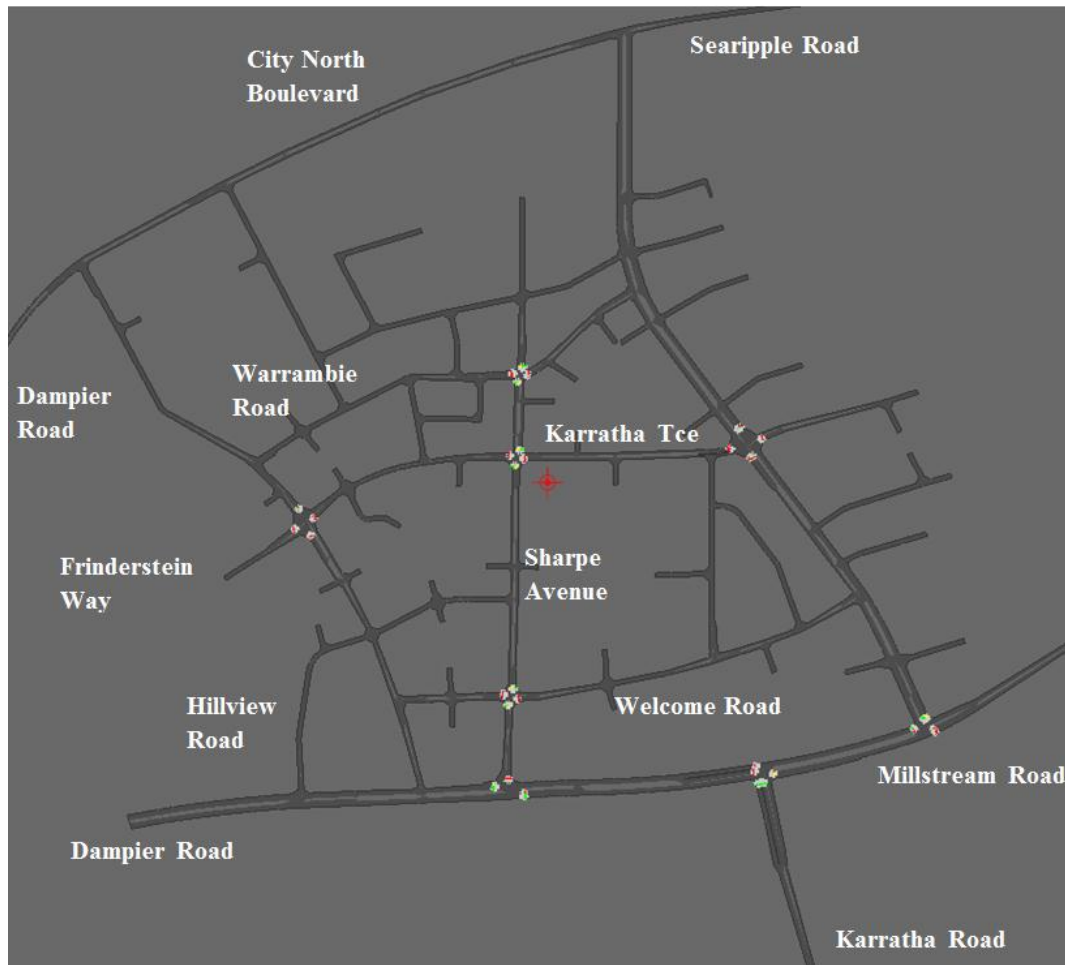


▪ **Figure 13 - KCCNM: short term City Centre network**

4.2.2 Medium term

Using an iterative process, upgrades were required in the KCCNM in order for the network to operate satisfactorily when subject to medium term demand matrices extracted from the KSM. These are in addition to those specified in Table 1 and for the short term network. Observations of the model indicated the following:

- Signalisation of the Dampier Road/ Karratha Road intersection will be required with the following attributes:
 - double turn pockets for each right turn movement and the left turn out of Karratha Road; and
 - a dedicated left turn slip lane from Dampier Road on to Karratha Road
- Each key intersection along Dampier Road (Sharpe Avenue, Karratha Road and Searipple Road) with the upgrades previously specified are either approaching or at capacity. Construction of City North Boulevard should be considered by this time to alleviate demands in these locations; and
- All other key intersections appear to operate within practical limits.

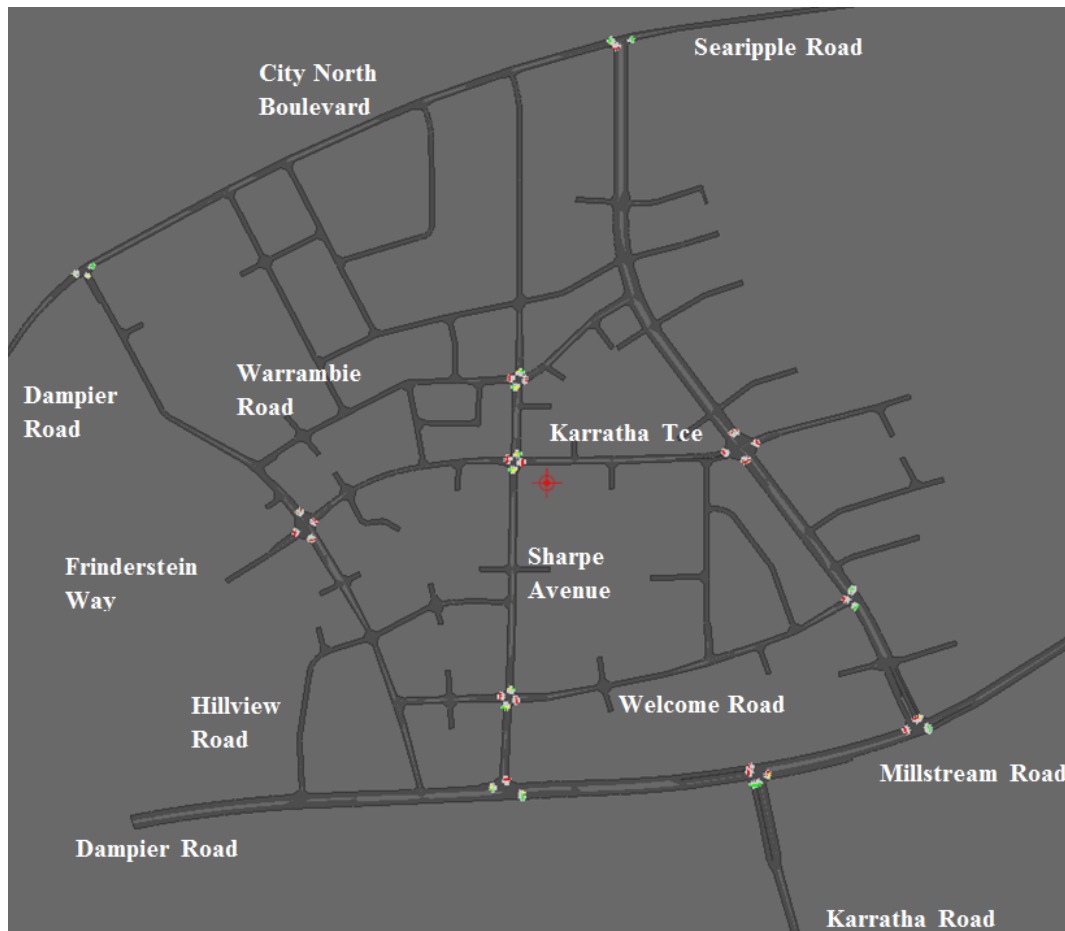


▪ **Figure 14 - KCCNM: medium term City Centre network**

4.2.3 Long term

As per the approach applied for the medium term scenario, further upgrades were required in the KCCNM in order for the network to operate satisfactorily when subject to long term demands. Observations of the model indicate the following:

- Signalisation of intersections of City North Boulevard and Balmoral Road, and City North Boulevard and Searipple Road are required;
- Signalisation of the Searipple Road/ Welcome Road intersection is required;
- All key signalised intersections on Dampier Road are forecast to be over capacity and require upgrades in order to meet traffic demand. Alternatively, new routes for through traffic would be required; and
- Other key intersections in Karratha City Centre and on Balmoral and Searipple Roads generally operate within capacity.



▪ **Figure 15 - KCCNM: long term City Centre network**

4.3 City Centre network performance

In general, the KCCNM forecasts that the highest levels of congestion will be apparent for:

- Movements from the north on to Dampier Road; and
- Movements to and from Karratha Road.

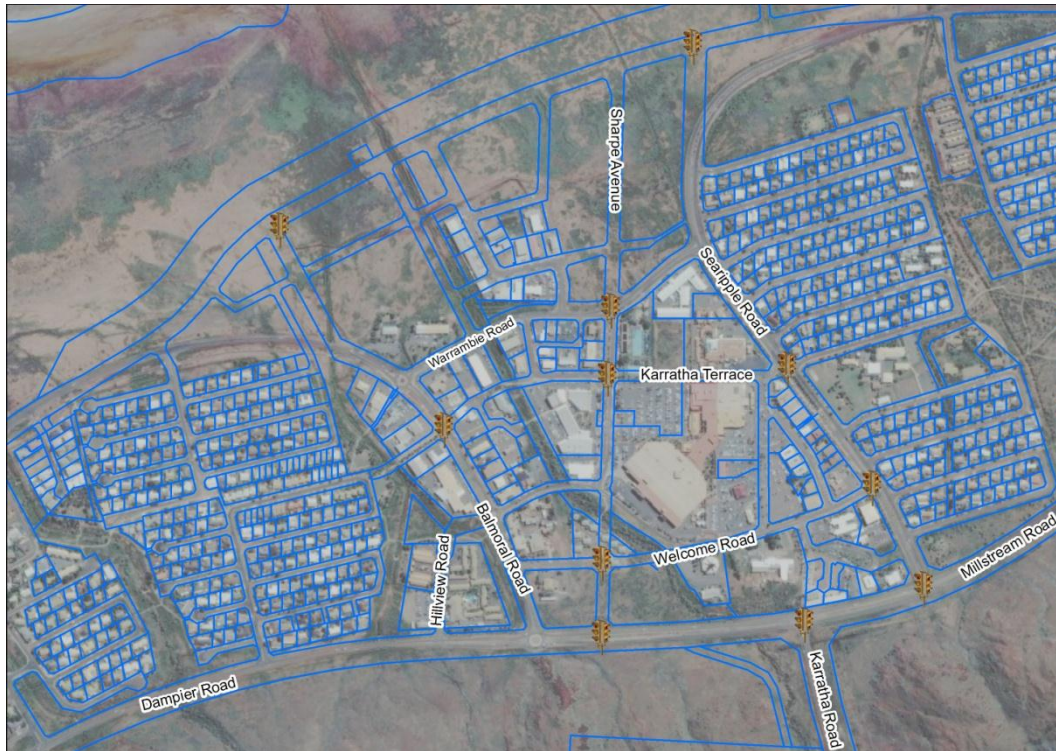
Congestion on the road network is likely to be minimal in the short term, notwithstanding delays on Dampier Road, which are already experienced in peak hours. In the medium term, congestion is likely to worsen during the PM peak, particularly at Dampier Road's intersections with Sharpe Avenue and Karratha Road. In the long term, congestion issues along Dampier Road are likely to become acute.

Congestion, represented by long queues of vehicles, is forecast at key intersections along Dampier Road. However, it is hypothesised that a degree of redistribution may occur as people react to delays. This redistribution may include re-routing of wider-network trips from Dampier Road and Karratha Road to alternate routes to the south. Balmoral Road-City North Boulevard-Searipple Road is also likely to attract more through trips from the medium term.

The intersection of Balmoral Road and Dampier Road is proposed to be converted to left in/ left out operation when Sharpe Avenue is extended to Dampier Road

and remain under this control in the long term. It should be noted that if upgrades are not rolled out in accordance with the modelled recommendations, congestion, queuing issues, delays and other negative performance metrics are likely to worsen.

The road network with intersections proposed to be signalised before 2031, is shown in **Figure 16**. Figure 16 shows traffic signals at the intersection of Sharpe Avenue and Welcome Road on the assumption that the upgrade from priority control is required by this time.



▪ **Figure 16 - Long term traffic control in the Karratha City Centre**

5 City Centre Intersection Analysis

5.1 Intersections analysed

The functionality of ten key intersections in the City Centre was analysed using SIDRA. These included:

- Karratha Terrace and Balmoral Road
- Dampier Road and Karratha Road
- Searipple Road and Millstream Road
- Welcome Road and Sharpe Avenue
- Dampier Road and Sharpe Avenue
- Dampier Road and Hillview Road
- Warambie Road and Sharpe Avenue
- Karratha Terrace and Sharpe Avenue
- Searipple Road and Karratha Terrace
- Searipple Road and Warambie Road

The intersections that were tested under the alternative network scenario were:

- Welcome Road and Sharpe Avenue
- Dampier Road and Sharpe Avenue
- Dampier Road and Hillview Road
- Balmoral Road/ Hillview Road/ Welcome Road (not modelled for the base case)

5.2 Forecast base case scenarios

The intersections were analysed initially for the future time horizons (short, medium and long term), with the same basic geometry assumed in the KCCNM. If necessary, geometry was revised as part of an iterative process to improve the functionality of the intersection and to reflect feedback received from Main Roads WA.

The particular intersection modifications requested by Main Roads WA included the following:

- Welcome Road/ Sharpe Avenue to operate under priority control in the short term, despite Paramics indicating performance issues associated with movements on the Welcome Road approaches and the better level of service possible should traffic signals be installed
- Increased capacity at the intersection of Sharpe Avenue and Dampier Road. The KCCIW Project team had previously planned to limit the Sharpe Avenue approach to two stand-up lanes (a right turn lane, and shared left and right turn lane based on modelled turning demand). A third stand-up lane was added,

meaning dual right turn and a single left turn lane were modelled on this approach

- Provision of a deceleration lane on the western approach to Sharpe Avenue on Dampier Road (63 metres assumed) with a left turn slip lane
- Extended turning pockets on approaches to proposed signalised intersections within the City Centre to either accommodate the forecast 95th percentile back of queue or to the maximum extent possible based on site constraints (e.g. lot boundaries). The KCCIW Project team had previously planned to limit right turn pocket lengths to 18 metres plus taper on City Centre streets and 50 metres plus taper on Searipple Road and Balmoral Road (excepting at the intersection of Searipple Road and Dampier Road)

A summary of the results of the SIDRA analysis can be seen in **Tables 12 to 14**. Specific provisions - geometric changes relative to the KCCNM and appropriate phasing details - at each intersection are specified where relevant. Tested geometry, movement and phasing summaries for each of the finalised scenarios are provided in **Appendix A**.

To assist with the interpretation of the SIDRA output, the Degree of Saturation (DoS) is defined as the ratio of demand flow to intersection capacity. A DoS of 0.85 for a particular turning movement is generally understood to represent practical capacity having been reached for roundabout and priority controlled intersections and 0.90 for a signalised intersection.

The DoS at intersections in the City Centre is likely to exceed current conditions, in some cases by a considerable margin. However, the level of performance should be considered within the context of the scale of development proposed and the need to balance the scale of the road network to its environment.

The more detailed analysis using SIDRA compared to Paramics demonstrates that the intersection of Karratha Road and Dampier Road is approaching practical capacity in the short term. Thus, signalisation may be considered at this time. The geometry should be built initially to match ultimate requirements rather than being developed in stages to minimise disruption to later stages of construction. Generally, if possible, all intersections should be upgraded once to avoid the added cost of short term retrofit.

▪ **Table 12 - Results of intersection analysis: short term**

Intersection performance and recommended design detail			
Intersection	LOS	DoS	Comment
Karratha Terrace/ Balmoral Road	C (Scramble Phase) B (Parallel Walk)	1.00 (Scramble Phase) 0.81 (Parallel Walk)	<p>Under signalised control with a pedestrian scramble phase, the majority of movements operating at 0.75 DOS or less. However right turn movements from Karratha Terrace (E) and Balmoral Road (N) require longer storage lengths than proposed. In practice, the 95th percentile queue lengths will spill back into adjacent lanes but traffic will generally clear. The longest queue length is on Balmoral Road (S): 150m. This could impact upstream at Karratha Terrace.</p> <p>Assuming parallel walking, all movements operate below 0.81 DOS with the largest queue being 89m on Balmoral Road (S) which should not impact on other intersections.</p>
Dampier Road/ Karratha Road	E/F (Priority) C (Signals)	0.93 (Priority) 0.49 (Signals)	<p>The right turn movement from Karratha Road is over practical capacity, indicating that signalisation of the intersection is likely to be required.</p> <p>Assuming signals, the intersection operates well within capacity with manageable queue lengths.</p>
Searipple Road/ Millstream Road	C	0.47	Queue lengths on Searipple Road (N) at 95m for right turn. Traffic exiting from Gregory Way would require gaps to get to right turn lanes.

Intersection performance and recommended design detail			
Intersection	LOS	DoS	Comment
Welcome Road/ Sharpe Avenue	F (Priority) C (Signals)	1.68 (Priority) 1.00 (Signals)	Under priority control, saturation levels for vehicles turning out of Welcome Road are anticipated to be over practical limits and long delays will be experienced. Traffic will reroute to alternative intersections (e.g. Sharpe/ Karratha), potentially worsening performance in those locations. Pedestrians also have a less safe environment under priority control. Under signalised operation, pedestrian crossings are introduced and average delays are reduced. The forecast 95 th percentile back of queue on Sharpe Avenue (N) is 434m, which is not forecast to impact on the upstream intersection of Karratha Terrace/ Sharpe Avenue. On Sharpe Avenue (S), the forecast back of queue is 84m, which is clear of the intersection of Sharpe Avenue and Dampier Road.
Dampier Road/ Sharpe Avenue	C	0.68	Within capacity with manageable queue lengths.
Dampier Road/ Hillview Road	F	1.07	The right turn from Hillview Road is anticipated to be over capacity. Banning of this movement during peak periods should be considered in the short term depending on whether the intersection of Dampier Road and O'Keefe Road is signalised. If it is, there are likely to be gaps in traffic (eastbound), increasing the level of service for right turning movements out of Hillview Road.

Intersection performance and recommended design detail			
Intersection	LOS	DoS	Comment
Warambie Road/ Sharpe Avenue	D (Scramble Phase) C (Parallel Walk)	1.00 (Scramble Phase) 1.00 (Parallel Walk)	<p>This intersection is anticipated to operate at capacity. Assuming scramble pedestrian phases are incorporated, the majority of movements are forecast to operate with a DoS below 0.85 and LoS D or better. Assuming parallel walking for pedestrians, the majority of movements are forecast to operate with a DoS below 0.65 and LoS C or better. Right turns from Warambie Road (W) are forecast to cause the greatest problems, given the turning pockets proposed (thus, the backs of queues will occasionally spill into the adjacent through lane). In reality, these movements are forecast to clear without causing significant queuing issues.</p> <p>The most significant queuing issue that is predicted to occur is on Sharpe Avenue (N): 210m (scramble phase), 146m (parallel walk). It is likely that this queuing can be mitigated through appropriate coordination of signals.</p> <p>The major upgrade that will provide relief to this intersection is the introduction of City North Boulevard. As such, implementation of this connection may need to be brought forward in the planning program.</p>
Karratha Terrace/ Sharpe Avenue	C (Scramble Phase) B (Parallel Walk)	0.73 (Scramble Phase) 0.58 (Parallel Walk)	<p>Forecast to operate within capacity. The lowest level of service is forecast for right turning movements. The longest forecast back of queue is on Sharpe Avenue (N): 202m (scramble phase), 129m (parallel walk). This would impact on the upstream intersection of Warambie Road and Sharpe Avenue. It is likely that this queuing can be mitigated through appropriate coordination of signals.</p> <p>The major upgrade that will provide relief to this intersection is the introduction of City North Boulevard. As such, implementation of this connection may need to be brought forward in the planning program.</p>

Intersection performance and recommended design detail			
Intersection	LOS	DoS	Comment
Searipple Road/ Karratha Terrace	C (Scramble Phase)	0.45 (Scramble Phase)	Forecast to operate well within capacity.
	C (Parallel Walk)	0.37 (Parallel Walk)	
Searipple Road/ Warambie Road	B	0.68	Forecast to operate well within capacity assuming priority control.

▪ **Table 13 - Results of intersection analysis: medium term**

Intersection	Intersection performance and recommended design detail		
	LOS	DoS	Comment
Karratha Terrace/ Balmoral Road	C (Scramble Phase) B (Parallel Walk)	1.00 (Scramble Phase) 0.85 (Parallel Walk)	<p>Assuming a scramble phase, the right turn movements from both Balmoral Road (N) and Karratha Terrace (W) are anticipated to have queue lengths longer than short turn pockets proposed. However, queues are likely to clear.</p> <p>The longest forecast queues are on Balmoral Road: north 121m and south 218m. These may occasionally impact on upstream intersections.</p> <p>Assuming pedestrians parallel walk, most movements operate below a 0.85 DoS. It is anticipated there will be queuing on the Balmoral Road (S) approach of 150m.</p>
Dampier Road/ Karratha Road	D	1.01	<p>This intersection is at capacity, even with double-lane turn pockets for each turning movement. The greatest delays and queuing issues are forecast on Karratha Road. The 95th percentile back of queue on Dampier Road (E) – 203m - is forecast to impact on the upstream intersection of Dampier Road/ Searipple Road.</p> <p>This increases the case for investigation of an alternative district east-west route to Dampier Road.</p>
Searipple Road/ Millstream Road	C	0.92	<p>This intersection is approaching capacity. The 95th percentile back of queue on Searipple Road is 263m, which would push it back past Welcome Road.</p>

Intersection performance and recommended design detail			
Intersection	LOS	DoS	Comment
Welcome Road/ Sharpe Avenue	C	0.93 (traffic signal control)	The right turn movements from both Sharpe Road (S) and Welcome Road (W) are anticipated to have queue lengths longer than short turn pockets proposed. However, queues are likely to clear. The 95 th percentile back of queue on Sharpe Road (N) is 157m which is not forecast to impact on adjacent intersections.
Dampier Road/ Sharpe Avenue	C	0.83	This intersection is approaching capacity. Long queue lengths are beginning to be observed, including 111m forecast back of queue on Sharpe Avenue. This would extend to Welcome Road.
Dampier Road/ Hillview Road	F	0.96	Right turn out of Hillview Road banned. The right turn into Hillview Road is over practical capacity. Banning of this turn during peak hours may also need to be considered. However, sufficient gaps in traffic may be created for the turning movement to be retained if the intersection of Dampier Road and O'Keefe Road is signalised.
Warambie Road/ Sharpe Avenue	C (Scramble Phase) C (Parallel Walk)	0.69 (Scramble Phase) 0.57 (Parallel Walk)	Intersection performance has improved significantly compared with the short term. In particular, 95 th percentile queue lengths are manageable. This is likely due to the construction of City North Boulevard (assumed complete by the medium timepoint).

Intersection performance and recommended design detail			
Intersection	LOS	DoS	Comment
Karratha Terrace/ Sharpe Avenue	C (Scramble Phase) C (Parallel Walk)	0.91 (Scramble Phase) 0.77 (Parallel Walk)	Intersection performance has improved significantly compared with the short term. Assuming a scramble phase, the 95 th percentile queue length on Sharpe Avenue (N) is 119m, which means that there may be occasions where queues extend back to Warambie Road/ Sharpe Avenue. It is likely that this queuing can be mitigated through appropriate coordination of signals. This is reduced to 102m with parallel walking.
Searipple Road/ Karratha Terrace	D (Scramble Phase) C (Parallel Walk)	1.00 (Scramble Phase) 0.75 (Parallel Walk)	Forecast to operate within capacity with parallel walking. Assuming a scramble phase, the right turn from Karratha Terrace (W) is anticipated to have queues which are longer than the turn pocket. These queues clear. The right turn from Searipple Road (S) also operates above theoretical capacity when a scramble phase is assumed.
Searipple Road/ Warambie Road	A	0.30	Forecast to operate well within capacity assuming priority control.

■ **Table 14 - Results of intersection analysis: long term**

Intersection	Intersection performance and recommended design detail		
	LOS	DoS	Comment
Karratha Terrace/ Balmoral Road	D (Scramble Phase) B (Parallel Walk)	1.00 (Scramble Phase) 0.69 (Parallel Walk)	Traffic conditions are forecast to generally worsen compared to the medium term. However, the intersection is forecast to clear.
Dampier Road/ Karratha Road	E	1.14	Traffic conditions are forecast to generally worsen compared to the medium term.
Searipple Road/ Millstream Road	F	1.12	This intersection is over capacity, under the proposed configuration. Addition of a second right turn pocket on Millstream Road, and a long left turn slip lane on the eastbound carriageway, give this intersection a LOS D.
Welcome Road/ Sharpe Avenue	C	1.00 (traffic signal control)	The right turn movements from both Sharpe Road (S) and Welcome Road (W) are anticipated to have queue lengths longer than short turn pockets proposed. However, queues are likely to clear. The 95 th percentile back of queue on Sharpe Road (N) is 172m and on Welcome Road (W) is 132m, both of which are not forecast to impact on adjacent intersections.
Dampier Road/ Sharpe Avenue	D	0.95	This intersection is approaching capacity. Long queue lengths are beginning to be observed, including 192m forecast back of queue on Sharpe Avenue. This would extend to Welcome Road.
Dampier Road/ Hillview Road	F	1.39	Right turns would need to have been banned if signals are not installed at the intersection of Dampier Road and O'Keefe Road.

Intersection performance and recommended design detail			
Intersection	LOS	DoS	Comment
Warambie Road/ Sharpe Avenue	C (Scramble Phase) C (Parallel Walk)	0.63 (Scramble Phase) 0.51 (Parallel Walk)	Forecast to operate within capacity. Queue lengths have cleared given connection of Sharpe Avenue to City North Boulevard.
Karratha T errace/ Sharpe Avenue	C (Scramble Phase) C (Parallel Walk)	0.84 (Scramble Phase) 0.70 (Parallel Walk)	Forecast to operate within capacity. Queue lengths have reduced given connection of Sharpe Avenue to City North Boulevard. The 95 th percentile queue length on Sharpe Avenue (N) is 125m when there is a scramble phase, which means that there may be occasions where queues extend back to Warambie Road/ Sharpe Avenue. It is likely that this queuing can be mitigated through appropriate coordination of signals. This queuing reduces to 105m when pedestrians parallel walk.
Searipple Road/ Karratha Terrace	D (Scramble Phase) C (Parallel Walk)	1.00 (Scramble Phase) 0.92 (Parallel Walk)	Forecast to operate within capacity when pedestrians parallel walk. The only movement exceeding DoS 0.85 is right turn from Karratha Terrace (W). This queue is still forecast to clear. With a scramble phase, the right turns from Searipple Road (S) and Karratha Terrace (W) operate above 0.85 DoS.
Searipple Road/ Warambie Road	B	0.45	Forecast to operate well within capacity assuming priority control.

5.3 Impacts on key intersections within the City Centre

A review of the SIDRA results (see Appendix A) reveals that queuing experienced at several intersections in the long term could impact on adjacent upstream/ downstream intersections. The observed issues include:

- The intersection of Balmoral Road and Karratha Terrace is likely to experience queuing that will adversely affect adjacent intersections
- Congestion and queuing issues are anticipated without further upgrades. Queuing on Searipple Road is also likely to impact on Welcome Road, Gregory Way and Padbury Way
- The intersection of Dampier Road and Sharpe Avenue is likely to experience queuing that will adversely affect adjacent intersections
- At the intersection of Sharpe Avenue and Dampier Road, queues on Sharpe Avenue (southbound) are likely to extend beyond Welcome Road, and queues on Dampier Road (eastbound) are likely to extend back to Balmoral Road

It is possible for these performance issues to be mitigated by travel demand management strategies. Moreover, constraints within the network may lead to some trip reassignment, reduction in discretionary trips and mode switch. These effects are not necessarily controlled for in the modelling undertaken.

More immediate issues that may eventuate include:

- Welcome Road/ Sharpe Avenue has been modelled as a priority controlled intersection in the short term scenario. However, analysis reveals that traffic on the Welcome Road approaches may have difficulty in undertaking turning movements. This issue has been raised with Main Roads WA; however, it is Main Roads WA's preference for this intersection to be priority controlled
- Impacts on the Searipple Road/ Millstream Road intersection as a result of queuing on Dampier Road east of the Karratha Road intersection in the medium term. Further investigations are required to establish how impacts may be ameliorated by provision of alternative east-west links to Dampier Road

5.4 Alternative network scenarios

Results of analysis of the alternative network scenarios are provided in **Appendix B**. The appended Technical Note includes comparative performance metrics (base case and alternative network) generated by SIDRA.

General observations include that the tested intersections are forecast to operate with less saturation and delay (on average), under scenario 2, particularly in the short term. This is influenced by higher order traffic control at Hillview Road/ Dampier Road, which improves performance at this location. Additionally, these traffic signals would be likely to attract some traffic assigning north-south from Sharpe Avenue, with consequent improvements in performance at Welcome Road/ Sharpe Avenue and Dampier Road/ Sharpe Avenue. It may be concluded that traffic signals may be ultimately required at the intersection of Hillview Road/ Dampier Road under any circumstances to improve overall network performance.

6 Implementation Plan

6.1 Overview

The transport modelling undertaken for the KCCIW Project was based originally on the staging programme articulated in the KCN Plan. Arup has used an iterative process to prepare a schedule of recommended infrastructure upgrades that more accurately reflects the traffic conditions forecast within the Karratha City Centre. This follows refinement of the City Centre movement network and development of new traffic models. The infrastructure upgrades relate to network connections, and intersection controls and geometries.

Analysis has attempted to balance the functional requirements of the Karratha City Centre street network with the intent for it to be an activity intense, urban environment that supports non-car access. As with any urbanised area where traffic capacity is constrained, there is a need for a transport ‘back up plan’. In Karratha, this is not going to come in the form of additional road reserve set aside for potential future capacity upgrades. Instead, further investigations are needed regarding:

- What wider road network relief is required to make sure that non-city centre bound traffic has alternative routes, particularly between the residential areas of Karratha and the expanded Karratha Industrial Area. A bypass route to the south of Dampier Road will be particularly important, between the Karratha Industrial Area and Madigan Road, likely in the short-medium term
- What travel demand management measures (TDM) may be employed to make sure that engineering solutions are not required to maintain accessibility to the City Centre, particularly in the medium-long term. The more detailed modelling of the City Centre demonstrates that some undesirable network upgrades may be required if TDM measures are not employed, to alleviate congestion. These upgrades may include dual right turn pockets and slip lanes on Sharpe Avenue and provision of multiple turning lanes on other roads. Appropriate TDM measures are likely to include provision of a transit service in Karratha, which may be aligned via O’Keefe Road-Karratha Terrace-Wellard Way; implementation of an enhanced Shire Bike Plan that requires high quality end of trip facilities in the City Centre; and application of the Karratha City Centre Parking Supply and Management Strategy
- Increasing the eminence of Karratha Terrace as an access to the City Centre, by connecting westwards to O’Keefe Road. However, the residential amenity of surrounding residential area will require close scrutiny

Additionally, the analysis shows that some parts of the network are forecast to operate with spare capacity even in the longer term. For example, in practice, there is likely to be reassignment of traffic to the northern end of the City Centre, parts of Balmoral Road and Searipple Road, and City North Boulevard when greater congestion is experienced on Dampier Road and towards the southern end of the City Centre. The northern connections can potentially provide a good level of access external to the City Centre and this is not necessarily well accounted for in the traffic modelling.

6.2 Key strategic actions and outcomes

The proposed upgrades shown in **Table 15** should be considered in conjunction with the recommendations in the KCN Plan.

▪ **Table 15 - Detailed transport implementation plan for Karratha City Centre**

Recommended upgrade	Timing
Sharpe Avenue reinforced as 'Main Street' with a direct connection to Dampier Road	Short term
Balmoral Road intersection with Dampier Road converted to left-in left-out operation	Short term
Removal of roundabouts at Balmoral Road/ Welcome Road and Balmoral Road/ Warambie Road in favour of priority control (configured for future upgrade to traffic signals)	Short term
Heavy vehicles deterred from using Sharpe Avenue	Short term
Traffic signals at intersection of Karratha Terrace and Balmoral Road; Karratha Terrace extended westwards to O'Keefe Road	Short term
Traffic signals at intersection of Karratha Terrace and Sharpe Avenue	Short term
Traffic signals at intersection of Dampier Road and Sharpe Avenue	Short term
Traffic signals at intersection of Warambie Road and Sharpe Avenue	Short term
Traffic signals at intersection of Searipple Road and Millstream Road	Short term
Traffic signals at intersection of Searipple Road and Karratha Terrace	Short term
Retain opportunity for upgrade of intersection of Sharpe Avenue and Welcome Road to traffic signal control	Short term
Investigate feasibility of Southern Karratha City Centre Bypass linking KIA with Madigan Road/ Madigan Road bypass. Strong links to Dampier Road to be provided from this bypass	Short term
Investigate demand management measures to reduce dependence on private vehicle travel. This will include provision of a public transport service in Karratha (consultation required with the Public Transport Authority)	Short term

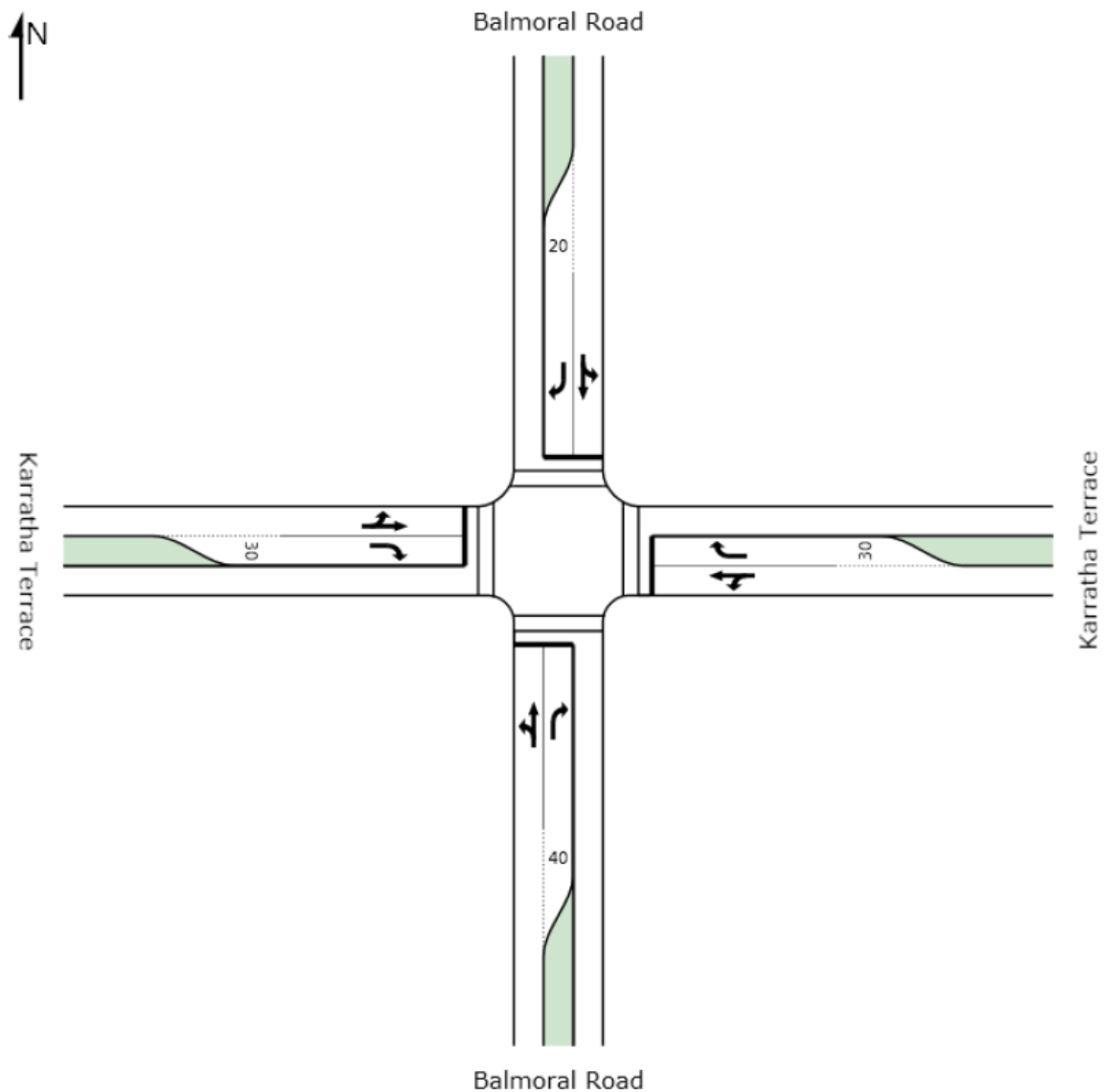
Recommended upgrade	Timing
Investigate upgrade requirements of O'Keefe Road and Dampier Road	Medium term
Investigate linking Frinderstein Way to Cossack Road	Medium term
Investigate linking Wellard Way to Viveash Road	Medium term
City North Boulevard constructed including signalisation of intersections with Balmoral Road and Searipple Road	Medium term
Traffic signals at intersection of Dampier Road and Karratha Road (requirements for this upgrade will need to be monitored)	Medium term
Traffic signals at intersection of Welcome Road and Searipple Road	Long term
Upgrade traffic signals at intersection of Searipple Road and Millstream Road (e.g. add capacity)	Long term

Appendix A

SIDRA outputs

A1 Short term

A1.1 Karratha Terrace/ Balmoral Road - Scramble phase



MOVEMENT SUMMARY**Site: 1. Karratha Tce_Balmoral (4 to 5pm)**

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn w/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Balmoral Road											
1	L	176	8.1	0.630	27.4	LOS C	19.9	149.3	0.80	0.87	31.0
2	T	375	8.1	0.630	20.8	LOS C	19.9	149.3	0.80	0.72	31.6
3	R	88	8.1	0.372	28.2	LOS C	2.9	21.5	0.70	0.73	29.0
Approach		639	8.1	0.630	23.6	LOS C	19.9	149.3	0.79	0.76	31.1
East: Karratha Terrace											
4	L	93	8.1	0.673	45.9	LOS D	11.9	88.9	0.98	0.85	21.7
5	T	164	8.1	0.673	40.4	LOS D	11.9	88.9	0.98	0.83	21.5
6	R	135 ³	8.1	1.000 ³	52.0	LOS D	6.5	49.0	0.99	0.79	20.2
Approach		392	8.1	1.000	45.7	LOS D	11.9	88.9	0.98	0.82	21.1
North: Balmoral Road											
7	L	57	8.1	0.364	23.3	LOS C	9.8	73.1	0.67	0.86	32.2
8	T	263	8.1	0.364	17.5	LOS B	9.8	73.1	0.67	0.58	33.7
9	R	106 ³	8.1	1.000 ³	43.7	LOS D	4.4	32.6	0.95	0.79	24.4
Approach		426	8.1	1.000	24.8	LOS C	9.8	73.1	0.74	0.67	30.5
West: Karratha Terrace											
10	L	78	8.1	0.460	44.5	LOS D	7.6	56.9	0.92	0.81	24.6
11	T	97	8.1	0.460	39.2	LOS D	7.6	56.9	0.92	0.77	24.2
12	R	96	8.1	0.748	59.4	LOS E	5.0	37.2	1.00	0.88	20.6
Approach		271	8.1	0.748	47.9	LOS D	7.6	56.9	0.95	0.82	22.9
All Vehicles		1727	8.1	1.000	32.7	LOS C	19.9	149.3	0.85	0.76	26.6

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

3 x = 1.00 due to short lane. Refer to the Lane Summary report for information about excess flow and related conditions.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P3	Across E approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P5	Across N approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P7	Across W approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
All Pedestrians		212	44.2	LOS E			0.94	0.94

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY

Site: 1. Karratha Tce_Balmoral (4 to 5pm)

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

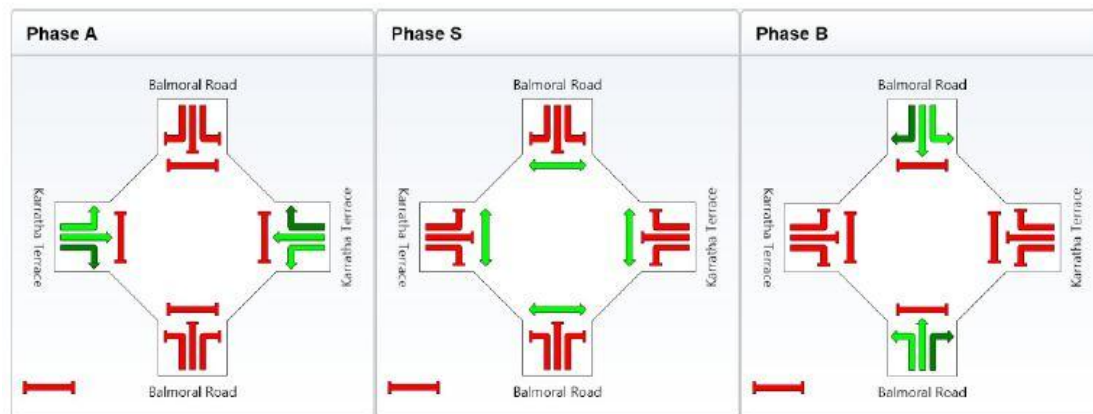
Sequence: Two-Phase

Input Sequence: A, S, B

Output Sequence: A, S, B

Phase Timing Results

Phase	A	S	B
Green Time (sec)	21	13	48
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	27	19	54
Phase Split	27 %	19 %	54 %



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**SIDRA
INTERSECTION**

A1.2 Karratha Terrace/ Balmoral Road – Parallel Walk

Note: Geometry will be identical to A1.1

MOVEMENT SUMMARY

Site: 1. Karratha Tce Balmoral (4 to 5pm) - Parallel Walk

Three-way intersection with 2 & 3-lane approaches (Signals)
Signals - Fixed Time Cycle Time = 40 seconds (Practical Cycle Time)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. 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: Balmoral Road											
1	L	176	8.1	0.806	23.4	LOS C	11.8	88.6	0.96	1.04	33.1
2	T	375	8.1	0.806	16.8	LOS B	11.8	88.6	0.96	1.01	33.3
3	R	88	8.1	0.211	18.7	LOS B	1.4	10.5	0.81	0.75	33.7
Approach		639	8.1	0.806	18.9	LOS B	11.8	88.6	0.94	0.98	33.3
East: Karratha Terrace											
4	L	93	8.1	0.416	17.3	LOS B	3.9	29.3	0.82	0.80	30.9
5	T	153	8.1	0.416	11.9	LOS B	3.9	29.3	0.82	0.68	31.1
6	R	146	8.1	0.424	18.8	LOS B	2.4	18.0	0.84	0.76	29.9
Approach		392	8.1	0.424	15.7	LOS B	3.9	29.3	0.83	0.74	30.6
North: Balmoral Road											
7	L	57	8.1	0.441	16.3	LOS B	4.6	34.5	0.79	0.85	36.6
8	T	246	8.1	0.441	10.5	LOS B	4.6	34.5	0.79	0.67	37.8
9	R	123	8.1	0.558	26.7	LOS C	2.5	19.0	0.98	0.81	30.5
Approach		426	8.1	0.558	15.9	LOS B	4.6	34.5	0.85	0.73	35.2
West: Karratha Terrace											
10	L	78	8.1	0.297	17.9	LOS B	2.7	19.9	0.79	0.80	35.8
11	T	97	8.1	0.297	12.6	LOS B	2.7	19.9	0.79	0.66	36.2
12	R	96	8.1	0.290	21.3	LOS C	1.6	12.2	0.86	0.75	33.1
Approach		271	8.1	0.297	17.2	LOS B	2.7	19.9	0.81	0.74	34.9
All Vehicles		1727	8.1	0.806	17.2	LOS B	11.8	88.6	0.87	0.83	33.3

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	14.5	LOS B	0.1	0.1	0.85	0.85
P3	Across E approach	53	12.8	LOS B	0.0	0.0	0.80	0.80
P5	Across N approach	53	14.5	LOS B	0.1	0.1	0.85	0.85
P7	Across W approach	53	12.8	LOS B	0.0	0.0	0.80	0.80
All Pedestrians		212	13.6	LOS B			0.83	0.83

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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**SIDRA
INTERSECTION**

PHASING SUMMARY**Site: 1. Karratha Tce_Balmoral (4 to 5pm) - Parallel Walk**Three-way intersection with 2 & 3-lane approaches (Signals)
Signals - Fixed Time Cycle Time = 40 seconds (Practical Cycle Time)

Phase times determined by the program

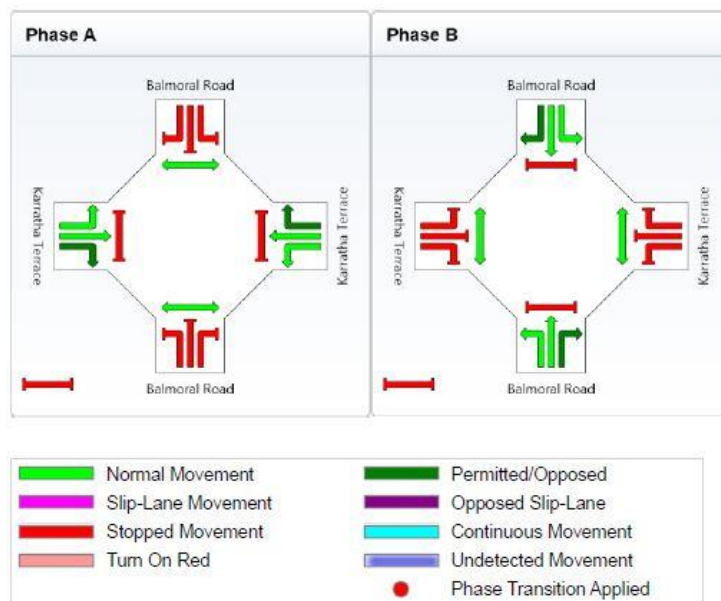
Sequence: Parallel Walk

Input Sequence: A, B

Output Sequence: A, B

Phase Timing Results

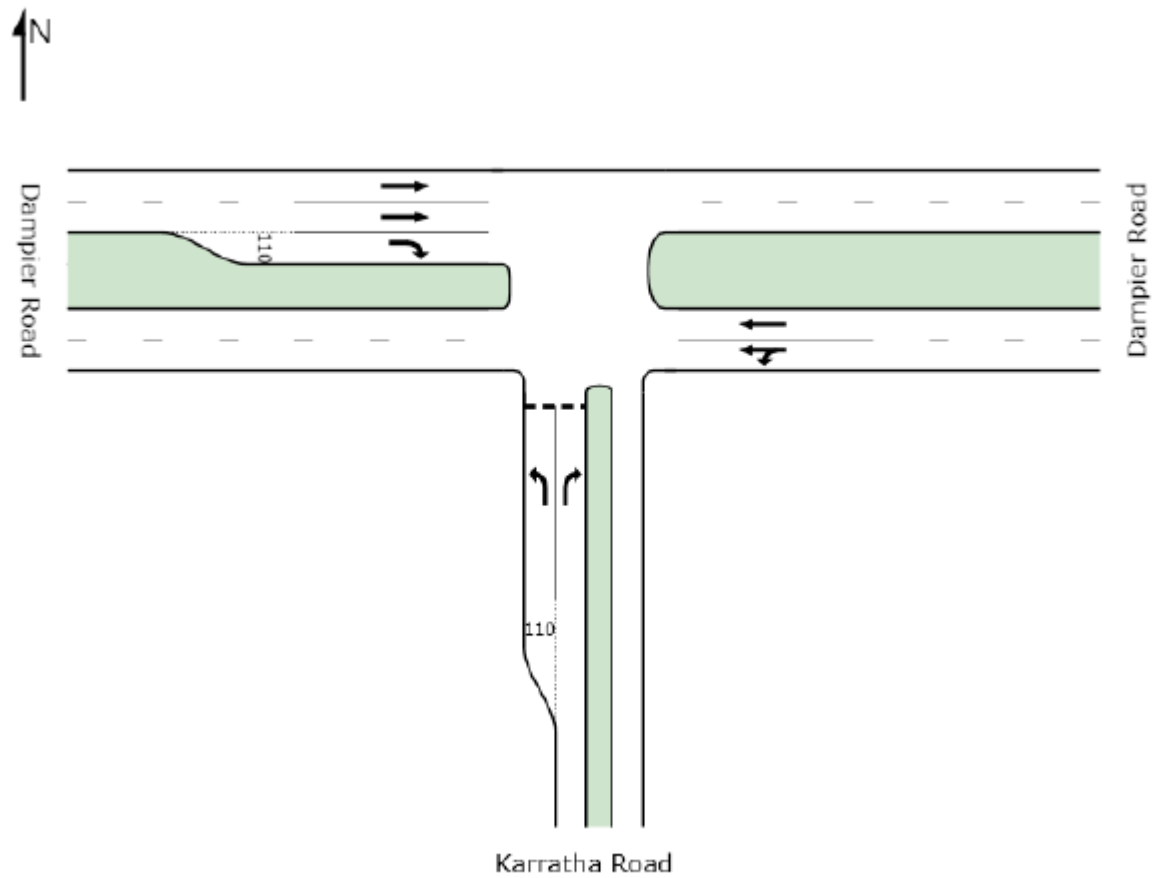
Phase	A	B
Green Time (sec)	13	15
Yellow Time (sec)	4	4
All-Red Time (sec)	2	2
Phase Time (sec)	19	21
Phase Split	48 %	53 %



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SIDRA
INTERSECTION

A1.3 Dampier Road/ Karratha Road – Priority Control



MOVEMENT SUMMARY**Site: 2. Dampier_Karratha Rd (4 to 5pm) - Conversion**Three-way intersection with 2 & 3-lane approaches (Signals)
Giveaway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Karratha Road											
1	L	406	8.1	0.835	28.4	LOS D	9.2	69.0	0.89	1.50	33.8
3	R	122	8.1	0.928	98.9	LOS F	6.8	51.2	0.99	1.51	16.2
Approach		528	8.1	0.928	44.7	LOS E	9.2	69.0	0.92	1.50	27.0
East: Dampier Road											
4	L	144	8.1	0.239	8.4	LOS A	0.0	0.0	0.00	0.90	49.0
5	T	733	8.1	0.239	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		877	8.1	0.239	1.4	NA	0.0	0.0	0.00	0.15	57.9
West: Dampier Road											
11	T	234	8.1	0.063	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
12	R	300	8.1	0.523	16.7	LOS C	2.8	20.9	0.75	1.03	41.3
Approach		534	8.1	0.523	9.4	NA	2.8	20.9	0.42	0.58	47.8
All Vehicles		1939	8.1	0.928	15.4	NA	9.2	69.0	0.37	0.64	42.2

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

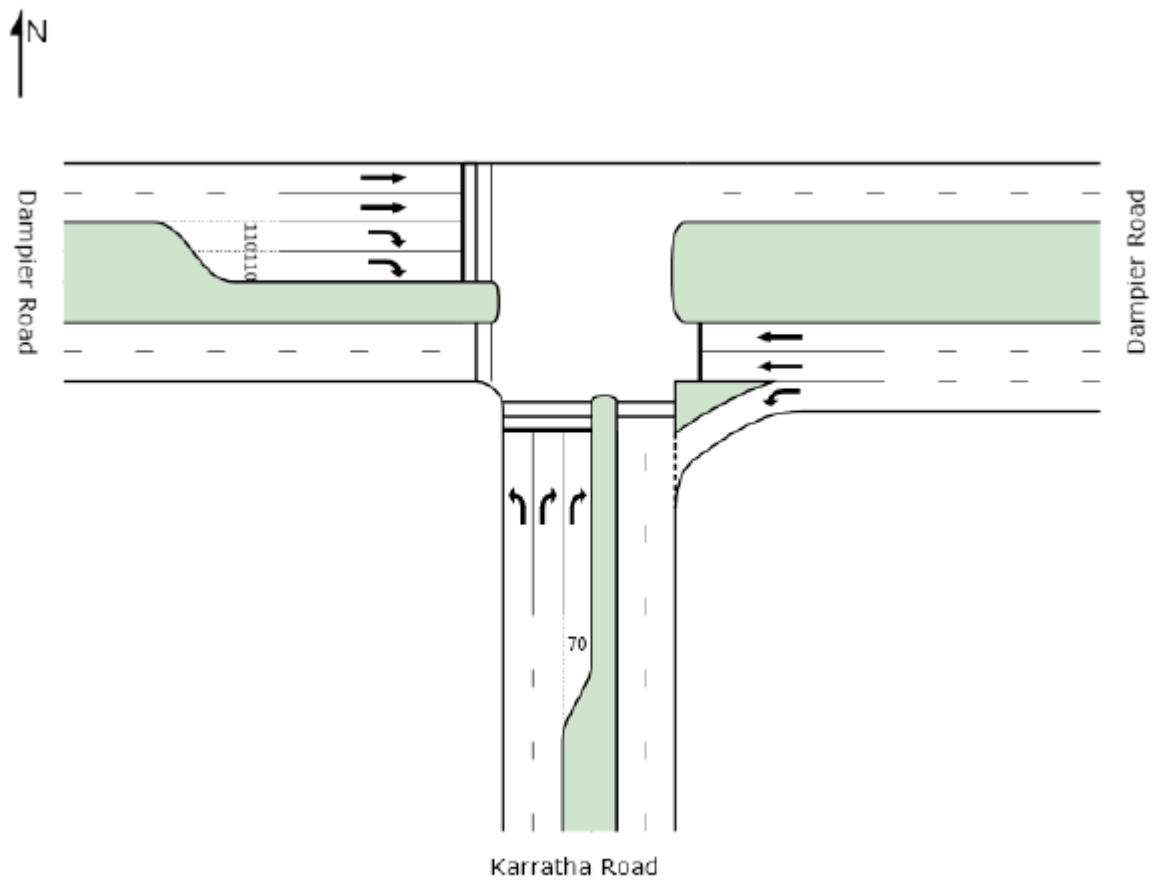
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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A1.4 Dampier Road/ Karratha Road – Traffic Signal Control



MOVEMENT SUMMARY**Site: 2. Dampier_Karratha Rd (4 to 5pm)**

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Karratha Road											
1	L	406	8.1	0.492	28.0	LOS C	13.6	102.0	0.74	0.82	34.0
3	R	122	8.1	0.290	52.7	LOS D	2.8	21.1	0.95	0.75	24.7
Approach		528	8.1	0.492	33.7	LOS C	13.6	102.0	0.79	0.81	31.2
East: Dampier Road											
4	L	144	8.1	0.109	8.7	LOS A	0.9	6.8	0.20	0.64	48.6
5	T	733	8.1	0.482	12.5	LOS B	8.4	63.0	0.50	0.44	43.1
Approach		877	8.1	0.482	11.9	LOS B	8.4	63.0	0.45	0.47	43.9
West: Dampier Road											
11	T	234	8.1	0.154	10.6	LOS B	2.0	15.0	0.37	0.30	45.2
12	R	300	8.1	0.295	29.8	LOS C	4.4	33.2	0.64	0.75	33.2
Approach		534	8.1	0.295	21.4	LOS C	4.4	33.2	0.52	0.55	37.5
All Vehicles		1939	8.1	0.492	20.4	LOS C	13.6	102.0	0.56	0.59	37.9

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	27.4	LOS C	0.1	0.1	0.74	0.74
P7	Across W approach	53	18.0	LOS B	0.1	0.1	0.60	0.60
All Pedestrians		106	22.7	LOS C			0.67	0.67

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY

Site: 2. Dampier_Karratha Rd (4 to 5pm)

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

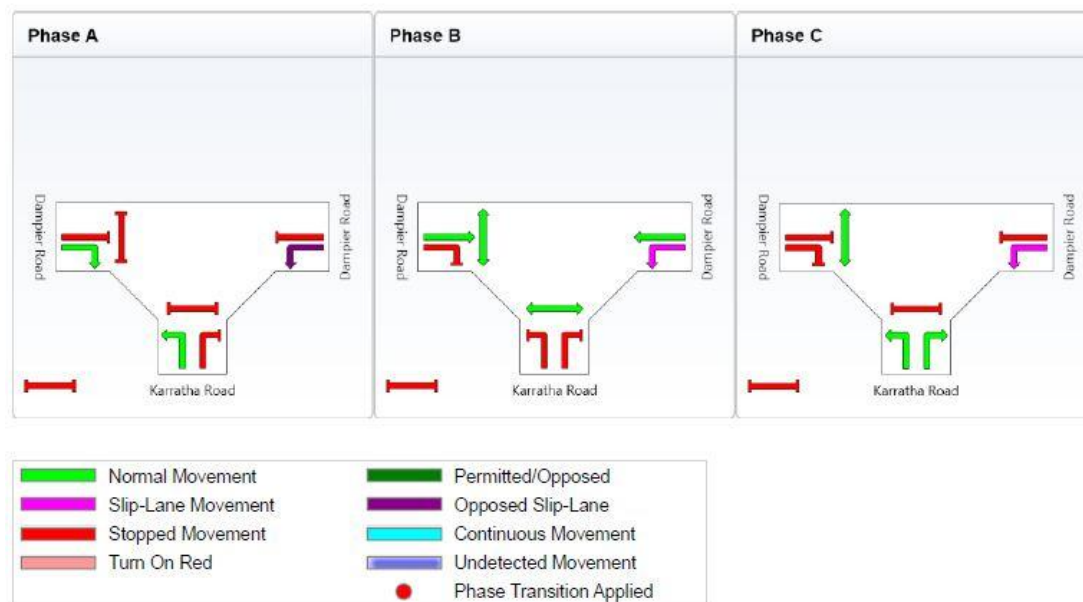
Sequence: Leading Right Turn

Input Sequence: A, B, C

Output Sequence: A, B, C

Phase Timing Results

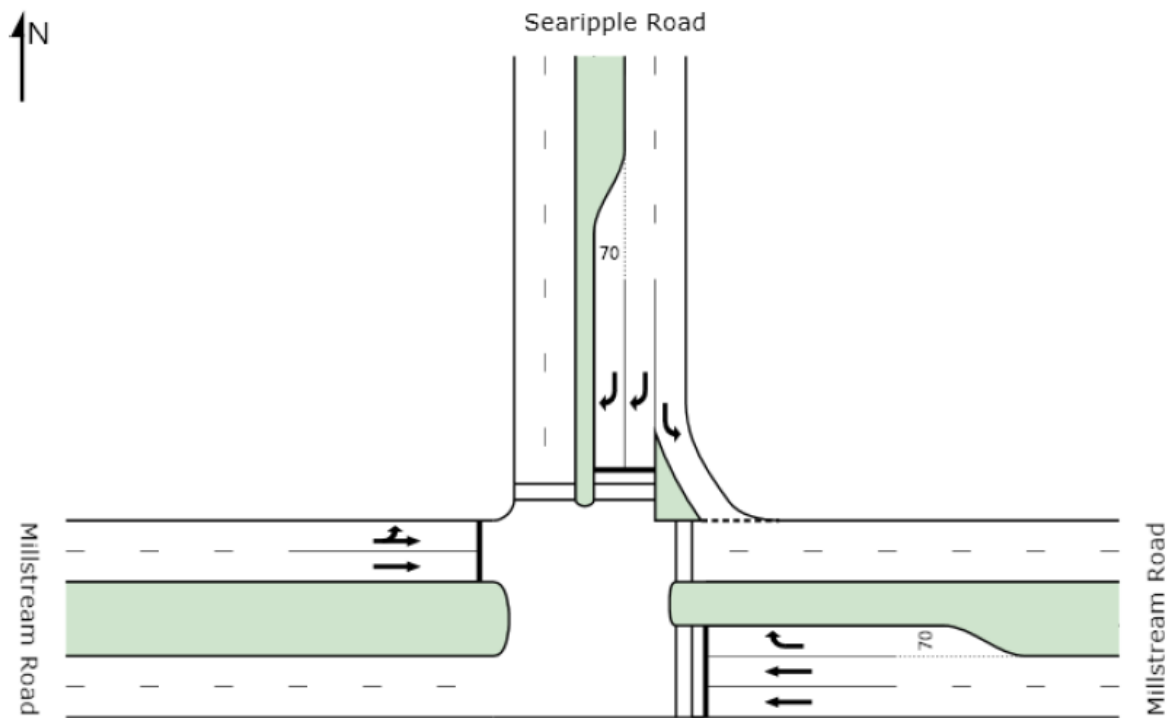
Phase	A	B	C
Green Time (sec)	29	41	12
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	35	47	18
Phase Split	35 %	47 %	18 %



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SIDRA
INTERSECTION

A1.5 Searipple Road/ Millstream Road



MOVEMENT SUMMARY**Site: 3. Searipple_Millstream (4 to 5pm)**

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Millstream Road											
11	T	269	8.1	0.186	21.4	LOS C	4.3	32.1	0.69	0.57	36.2
12	R	98	8.1	0.465	53.4	LOS D	4.6	34.8	0.98	0.78	23.5
Approach		367	8.1	0.465	29.9	LOS C	4.6	34.8	0.77	0.62	31.8
North: Searipple Road											
1	L	269	8.1	0.199	8.3	LOS A	2.5	18.5	0.26	0.63	43.1
3	R	608	8.1	0.462	24.2	LOS C	12.7	95.1	0.67	0.78	32.9
Approach		878	8.1	0.462	19.3	LOS B	12.7	95.1	0.55	0.73	35.4
West: Millstream Road											
4	L	89	8.1	0.442	43.7	LOS D	7.8	58.1	0.91	0.82	27.0
5	T	265	8.1	0.442	37.1	LOS D	7.8	58.1	0.91	0.75	28.2
Approach		355	8.1	0.442	38.8	LOS D	7.8	58.1	0.91	0.77	27.9
All Vehicles		1600	8.1	0.465	26.1	LOS C	12.7	95.1	0.68	0.72	32.7

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P7	Across E approach	53	21.8	LOS C	0.1	0.1	0.66	0.66
P1	Across N approach	53	41.4	LOS E	0.1	0.1	0.91	0.91
All Pedestrians		106	31.6	LOS D			0.79	0.79

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY**Site: 3. Searipple_Millstream (4 to 5pm)**

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

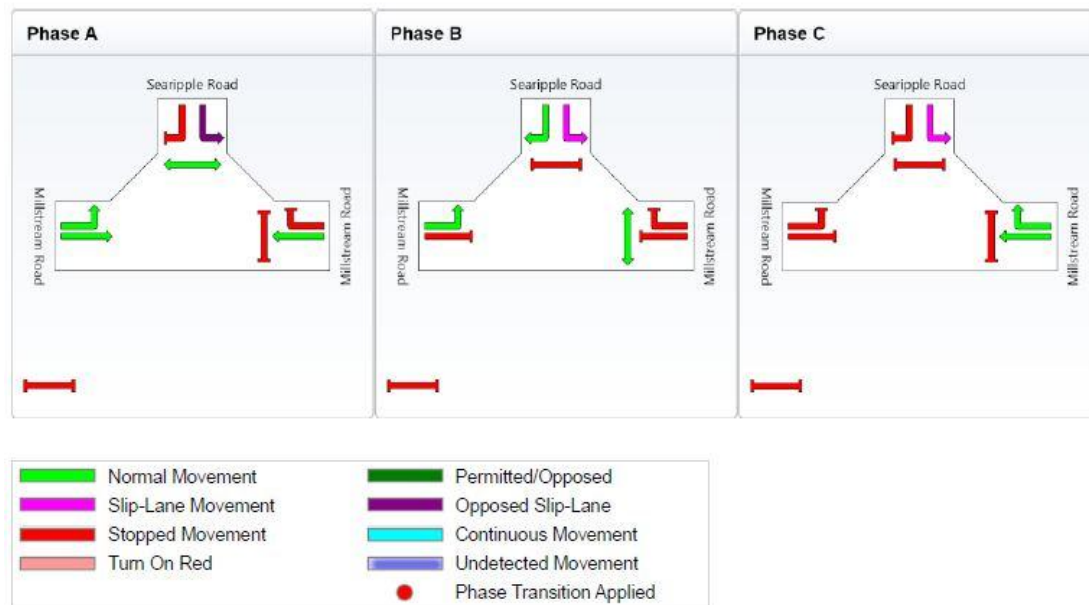
Sequence: Two-Phase

Input Sequence: A, B, C

Output Sequence: A, B, C

Phase Timing Results

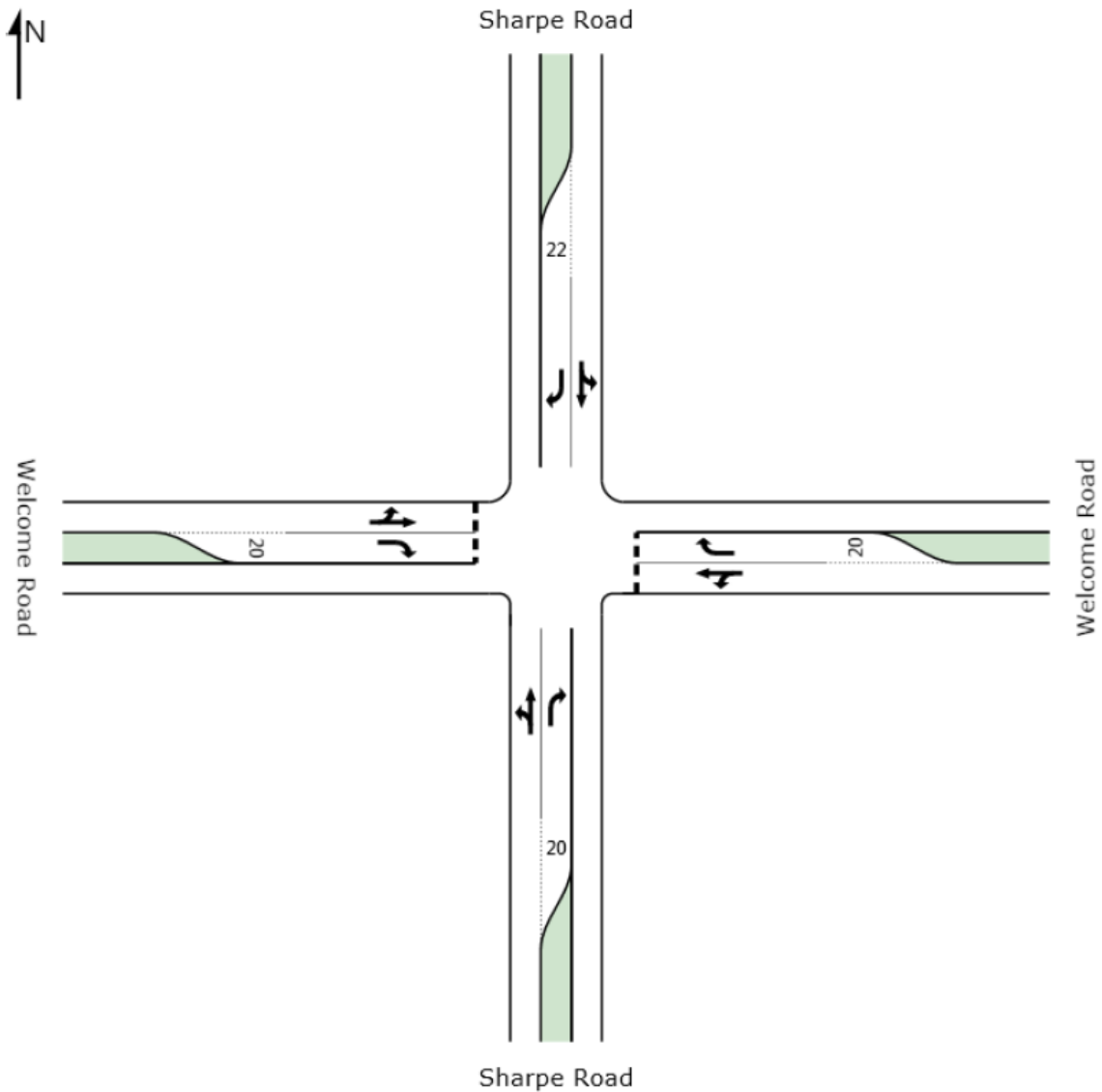
Phase	A	B	C
Green Time (sec)	21	49	12
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	27	55	18
Phase Split	27 %	55 %	18 %



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**SIDRA
INTERSECTION**

A1.6 Welcome Road/ Sharpe Avenue – Priority Control



MOVEMENT SUMMARY**Site: 4. Welcome_Sharpe (4 to 5pm)**New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn w/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Sharpe Road											
1	L	49	0.0	0.155	4.5	LOS A	0.0	0.0	0.00	0.66	36.7
2	T	251	0.0	0.155	0.0	LOS A	0.0	0.0	0.00	0.00	40.0
3	R	65	0.0	0.164	13.2	LOS B	0.5	3.4	0.76	0.89	31.6
Approach		365	0.0	0.164	3.0	NA	0.5	3.4	0.14	0.25	37.7
East: Welcome Road											
4	L	73	0.0	0.721	42.6	LOS E	3.9	28.3	0.94	1.31	21.6
5	T	68	8.1	0.721	41.4	LOS E	3.9	28.3	0.94	1.28	21.7
6	R	34	0.0	0.440	68.4	LOS F	1.5	10.4	0.95	1.05	16.8
Approach		175	3.2	0.721	47.1	LOS E	3.9	28.3	0.94	1.25	20.5
North: Sharpe Road											
7	L	57	0.0	0.492	4.5	LOS A	0.0	0.0	0.00	0.69	36.7
8	T	899	0.0	0.492	0.0	LOS A	0.0	0.0	0.00	0.00	40.0
9	R	1	0.0	0.001	5.8	LOS A	0.0	0.0	0.33	0.50	35.7
Approach		957	0.0	0.492	0.3	NA	0.0	0.0	0.00	0.04	39.8
West: Welcome Road											
10	L	48	0.0	1.680	666.5	LOS F	80.2	587.1	1.00	8.95	2.8
11	T	233	8.1	1.680	665.3	LOS F	80.2	587.1	1.00	5.50	2.8
12	R	96	0.0	1.000 ³	132.1	LOS F	7.1	49.7	1.00	1.60	10.9
Approach		378	4.0	1.680	529.8	LOS F	80.2	587.1	1.00	4.95	3.4
All Vehicles		1875	1.1	1.680	111.9	NA	80.2	587.1	0.32	1.18	12.2

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

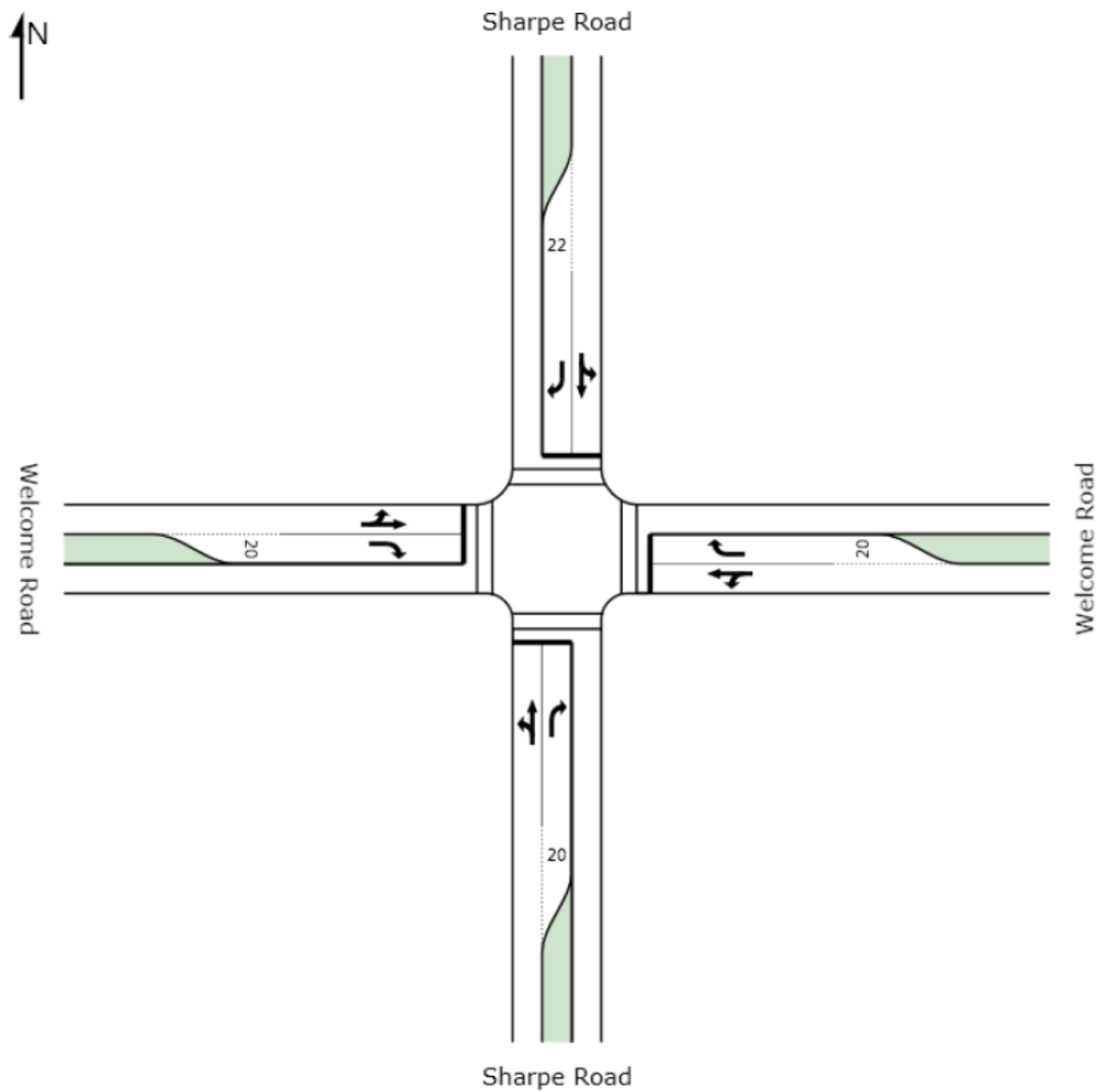
SIDRA Standard Delay Model used.

³ x = 1.00 due to short lane. Refer to the Lane Summary report for information about excess flow and related conditions.

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A1.7 Welcome Road/ Sharpe Avenue – Traffic Signal Control



MOVEMENT SUMMARY**Site: 4. Welcome_Sharpe (4 to 5pm)**

New Site

Signals - Fixed Time Cycle Time = 175 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Sharpe Road											
1	L	49	0.0	0.262	21.8	LOS C	11.9	83.5	0.51	0.77	28.1
2	T	254	0.0	0.262	17.4	LOS B	11.9	83.5	0.51	0.44	29.0
3	R	82	0.0	1.000 ³	72.7	LOS E	4.7	32.6	0.95	0.78	16.2
Approach		365	0.0	1.000	27.4	LOS C	11.9	83.5	0.58	0.55	25.4
East: Welcome Road											
4	L	73	0.0	0.718	88.8	LOS F	12.1	87.3	1.00	0.85	14.4
5	T	68	8.1	0.718	84.3	LOS F	12.1	87.3	1.00	0.85	14.4
6	R	34	0.0	0.744	106.3	LOS F	3.1	22.0	1.00	0.81	12.7
Approach		175	3.2	0.744	90.4	LOS F	12.1	87.3	1.00	0.84	14.0
North: Sharpe Road											
7	L	57	0.0	0.816	32.7	LOS C	62.0	434.0	0.85	0.90	24.6
8	T	899	0.0	0.816	28.2	LOS C	62.0	434.0	0.85	0.80	24.7
9	R	1	0.0	0.009	24.5	LOS C	0.0	0.3	0.48	0.57	26.8
Approach		957	0.0	0.816	28.5	LOS C	62.0	434.0	0.85	0.80	24.7
West: Welcome Road											
10	L	48	0.0	0.530	56.3	LOS E	21.6	157.6	0.88	0.83	18.9
11	T	265	8.1	0.530	51.8	LOS D	21.6	157.6	0.88	0.76	19.0
12	R	65	0.0	1.000 ³	65.8	LOS E	4.7	32.7	0.86	0.72	17.2
Approach		378	4.0	1.000	54.8	LOS D	21.6	157.6	0.87	0.76	18.6
All Vehicles		1875	1.1	1.000	39.3	LOS D	62.0	434.0	0.82	0.75	21.9

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

3 x = 1.00 due to short lane. Refer to the Lane Summary report for information about excess flow and related conditions.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	73.1	LOS F	0.2	0.2	0.91	0.91
P3	Across E approach	53	16.5	LOS B	0.1	0.1	0.43	0.43
P5	Across N approach	53	73.1	LOS F	0.2	0.2	0.91	0.91
P7	Across W approach	53	16.5	LOS B	0.1	0.1	0.43	0.43
All Pedestrians		212	44.8	LOS E			0.67	0.67

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY**Site: 4. Welcome_Sharpe (4 to 5pm)**

New Site

Signals - Fixed Time Cycle Time = 175 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

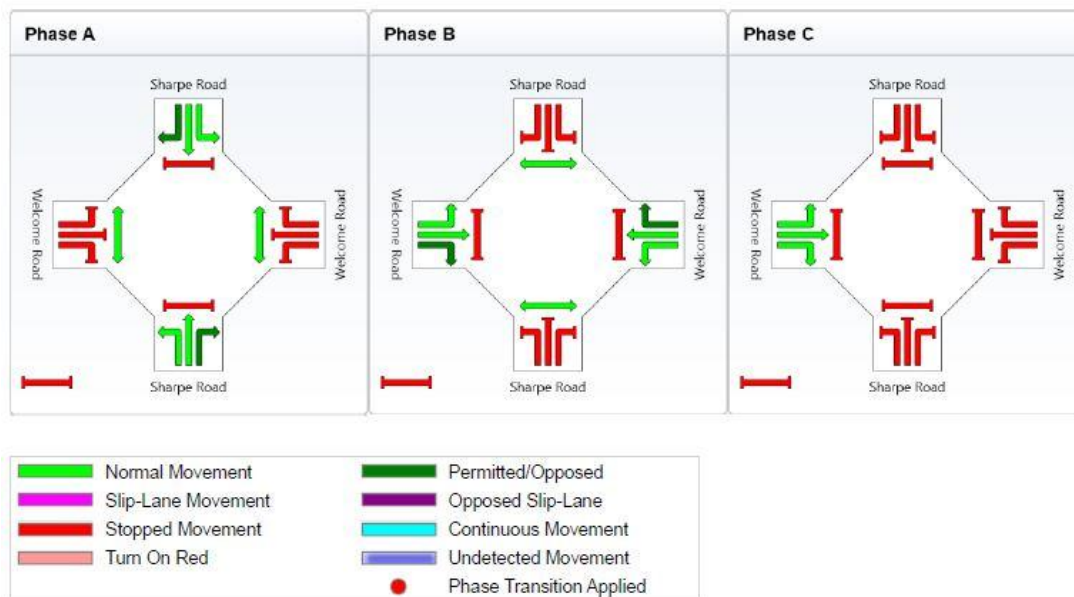
Sequence: Split Phasing

Input Sequence: A, B, C

Output Sequence: A, B, C

Phase Timing Results

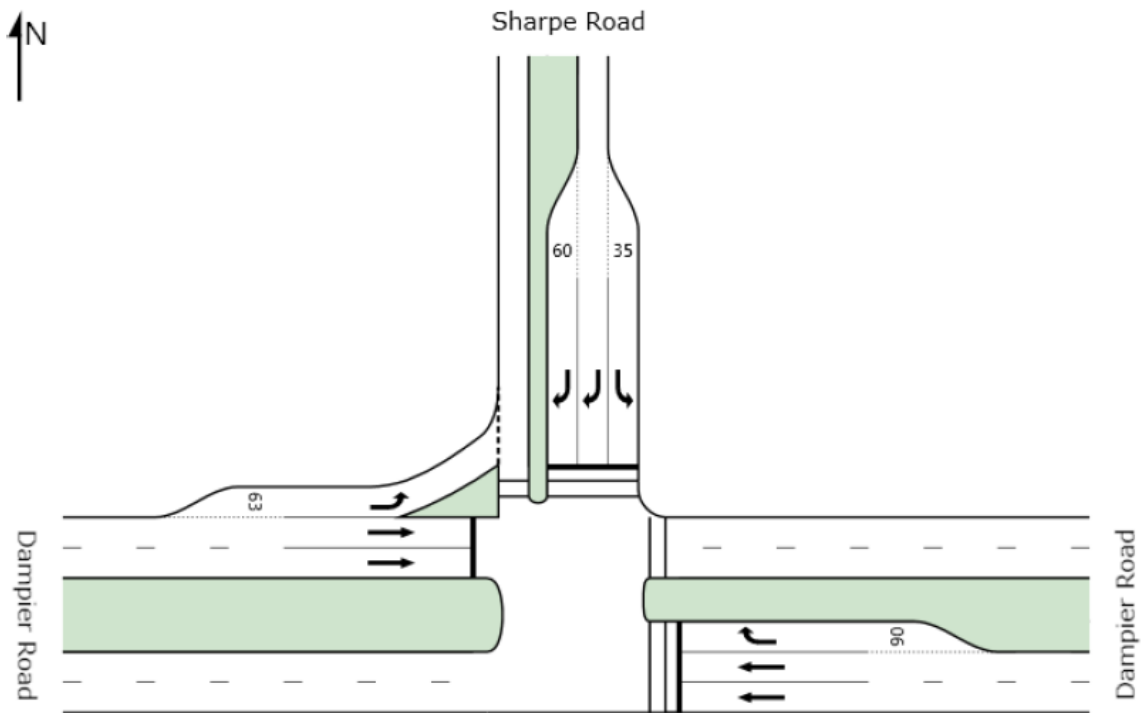
Phase	A	B	C
Green Time (sec)	106	22	29
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	112	28	35
Phase Split	64 %	16 %	20 %



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**SIDRA
INTERSECTION**

A1.8 Dampier Road/ Sharpe Avenue



MOVEMENT SUMMARY**Site: 5. Dampier_Sharpe (4 to 5pm)**

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Dampier Road											
11	T	1027	8.1	0.676	25.9	LOS C	20.5	153.2	0.88	0.78	33.4
12	R	116	0.0	0.445	50.6	LOS D	5.4	37.5	0.96	0.79	23.7
Approach		1143	7.3	0.676	28.4	LOS C	20.5	153.2	0.89	0.78	32.1
North: Sharpe Road											
1	L	57	0.0	0.049	6.8	LOS A	0.1	1.0	0.06	0.60	37.0
3	R	1054	0.0	0.684	15.6	LOS B	13.5	94.8	0.54	0.72	32.3
Approach		1111	0.0	0.684	15.2	LOS B	13.5	94.8	0.51	0.72	32.5
West: Dampier Road											
4	L	254	0.0	0.230	7.3	LOS A	1.7	11.9	0.21	0.61	48.2
5	T	478	8.1	0.614	39.4	LOS D	10.8	80.8	0.96	0.80	27.6
Approach		732	5.3	0.614	28.3	LOS C	10.8	80.8	0.70	0.74	32.1
All Vehicles		2985	4.1	0.684	23.5	LOS C	20.5	153.2	0.70	0.74	32.3

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P7	Across E approach	53	24.5	LOS C	0.1	0.1	0.70	0.70
P1	Across N approach	53	41.4	LOS E	0.1	0.1	0.91	0.91
All Pedestrians		106	33.0	LOS D			0.81	0.81

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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SIDRA
INTERSECTION

PHASING SUMMARY**Site: 5. Dampier_Sharpe (4 to 5pm)**

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

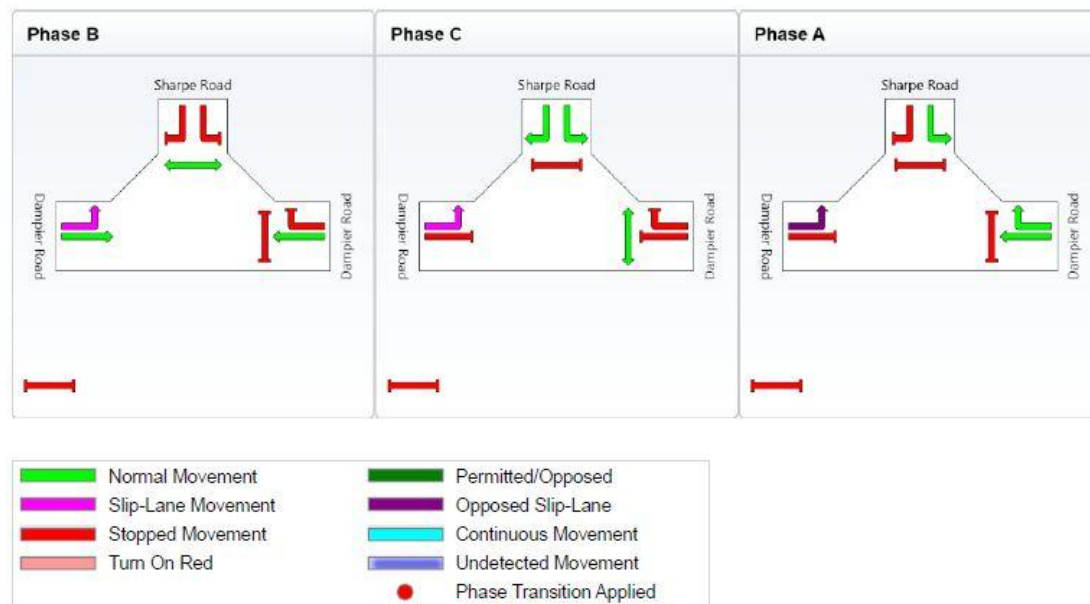
Sequence: Leading Right Turn

Input Sequence: B, C, A

Output Sequence: B, C, A

Phase Timing Results

Phase	B	C	A
Green Time (sec)	21	47	14
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	27	53	20
Phase Split	27 %	53 %	20 %



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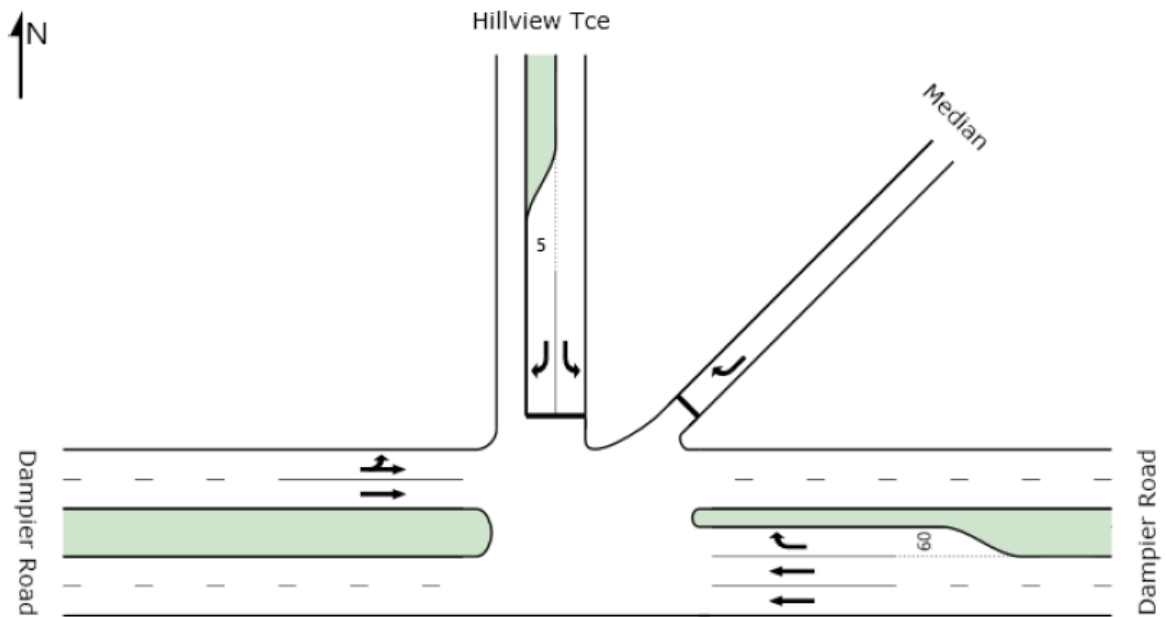
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**SIDRA
INTERSECTION**

A1.9 Dampier Road/ Hillview Road



MOVEMENT SUMMARY**Site: 6. Dampier_Hillview (4 to 5pm)**Staged crossing at three-way intersection with 4-lane major road (Stop control)
Stop (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Dampier Road											
11	T	2043	8.1	0.551	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
12	R	39	8.1	0.283	36.9	LOS E	0.8	5.9	0.91	0.99	29.9
Approach		2082	8.1	0.551	0.7	NA	0.8	5.9	0.02	0.02	58.9
North East: Median											
32	R	48	8.1	1.069	363.2	LOS F	7.4	48.1	1.00	1.92	1.1
Approach		48	8.1	1.069	363.2	LOS F	7.4	48.1	1.00	1.92	1.1
North: Hillview Tce											
1	L	29	8.1	0.195	35.1	LOS E	0.6	4.4	0.89	1.01	31.5
3	R	48	8.1	0.855	70.9	LOS F	1.7	12.4	0.94	1.08	19.7
Approach		78	8.1	0.855	57.3	LOS F	1.7	12.4	0.92	1.05	23.4
West: Dampier Road											
4	L	85	8.1	0.369	8.4	LOS A	0.0	0.0	0.00	1.02	49.0
5	T	1277	8.1	0.369	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		1362	8.1	0.369	0.5	NA	0.0	0.0	0.00	0.06	59.2
All Vehicles		3571	8.1	1.069	6.8	NA	7.4	48.1	0.04	0.08	50.6

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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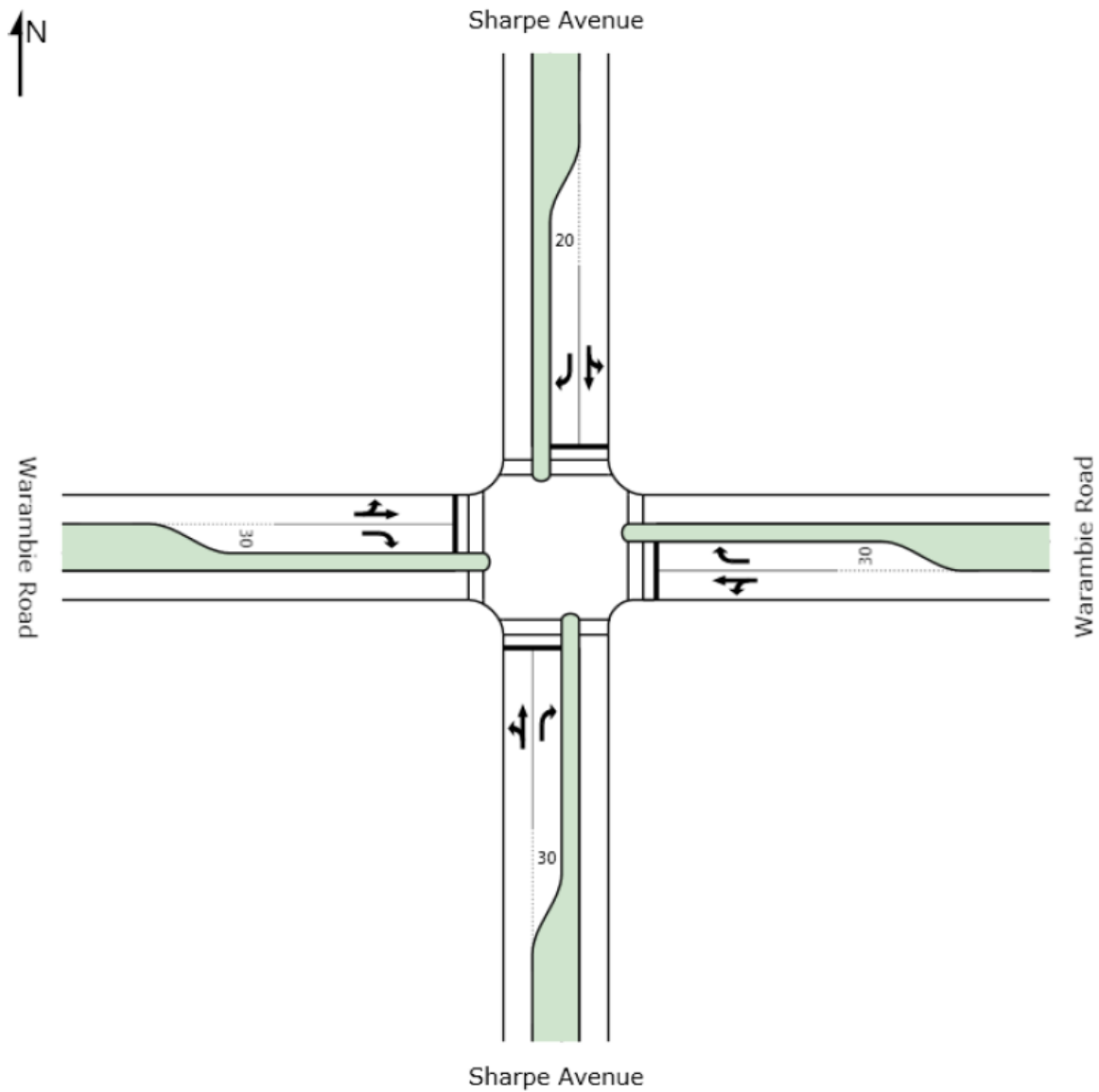
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**SIDRA
INTERSECTION**

A1.10 Warambie Road/ Sharpe Avenue - Scramble Phase



MOVEMENT SUMMARY**Site: 7. Warambie_Sharpe (4 to 5pm)**

Warambie Road / Sharpe Road 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn w/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Sharpe Avenue											
1	L	86	0.0	0.267	30.2	LOS C	6.1	43.0	0.77	0.78	25.2
2	T	107	0.0	0.267	25.7	LOS C	6.1	43.0	0.77	0.63	25.4
3	R	51	0.0	0.386	54.6	LOS D	2.5	17.5	0.99	0.75	19.1
Approach		224	0.0	0.386	33.6	LOS C	6.1	43.0	0.82	0.70	23.6
East: Warambie Road											
4	L	207	0.0	0.827	42.8	LOS D	25.8	180.3	0.99	0.96	21.7
5	T	315	0.0	0.827	38.3	LOS D	25.8	180.3	0.99	0.95	21.7
6	R	49	0.0	0.311	39.8	LOS D	2.0	14.1	0.85	0.72	22.2
Approach		572	0.0	0.827	40.1	LOS D	25.8	180.3	0.98	0.93	21.8
North: Sharpe Avenue											
7	L	71	0.0	0.867	46.3	LOS D	29.9	209.5	1.00	1.02	21.0
8	T	499	0.0	0.867	41.8	LOS D	29.9	209.5	1.00	1.02	21.0
9	R	122	0.0	1.000 ³	40.4	LOS D	4.7	32.6	0.97	0.78	22.1
Approach		692	0.0	1.000	42.1	LOS D	29.9	209.5	0.99	0.97	21.2
West: Warambie Road											
10	L	104	0.0	0.549	34.1	LOS C	13.9	97.0	0.87	0.83	24.0
11	T	242	0.0	0.549	29.6	LOS C	13.9	97.0	0.87	0.75	24.1
12	R	130	0.0	1.000 ³	60.1	LOS E	7.0	49.0	1.00	0.82	18.1
Approach		476	0.0	1.000	38.9	LOS D	13.9	97.0	0.91	0.79	22.1
All Vehicles		1963	0.0	1.000	39.8	LOS D	29.9	209.5	0.95	0.89	21.8

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

³ x = 1.00 due to short lane. Refer to the Lane Summary report for information about excess flow and related conditions.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P3	Across E approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P5	Across N approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P7	Across W approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
All Pedestrians		212	44.2	LOS E			0.94	0.94

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY**Site: 7. Warambie_Sharpe (4 to 5pm)**

Warambie Road / Sharpe Road 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

Sequence: Scramble

Input Sequence: A, B, C

Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Green Time (sec)	34	15	33
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	40	21	39
Phase Split	40 %	21 %	39 %



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INTERSECTION

A1.11 Warambie Road/ Sharpe Avenue - Parallel Walk

Note: Geometry will be identical to A1.10

MOVEMENT SUMMARY

Site: 7. Warambie_Sharpe (4 to 5pm) - Parallel Walk

Warambie Road / Sharpe Road 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Sharpe Avenue											
1	L	66	0.0	0.206	22.8	LOS C	5.2	36.2	0.65	0.76	27.7
2	T	107	0.0	0.206	18.4	LOS B	5.2	36.2	0.65	0.54	28.3
3	R	51	0.0	0.320	38.6	LOS D	2.0	14.2	0.84	0.73	22.5
Approach		224	0.0	0.320	24.3	LOS C	5.2	36.2	0.69	0.65	26.6
East: Warambie Road											
4	L	207	0.0	0.621	27.6	LOS C	19.6	136.9	0.83	0.84	26.0
5	T	315	0.0	0.621	23.1	LOS C	19.6	136.9	0.83	0.73	26.3
6	R	49	0.0	0.262	28.7	LOS C	1.6	11.5	0.71	0.69	25.4
Approach		572	0.0	0.621	25.2	LOS C	19.6	136.9	0.82	0.77	26.1
North: Sharpe Avenue											
7	L	71	0.0	0.644	27.9	LOS C	20.8	145.9	0.84	0.85	26.1
8	T	478	0.0	0.644	23.5	LOS C	20.8	145.9	0.84	0.75	26.3
9	R	143	0.0	1.000 ³	34.9	LOS C	4.7	32.6	0.98	0.80	23.5
Approach		692	0.0	1.000	26.3	LOS C	20.8	145.9	0.87	0.77	25.6
West: Warambie Road											
10	L	104	0.0	0.379	24.6	LOS C	10.4	72.6	0.72	0.79	27.1
11	T	214	0.0	0.379	20.1	LOS C	10.4	72.6	0.72	0.62	27.5
12	R	157	0.0	1.000 ³	42.9	LOS D	7.0	49.0	0.95	0.80	21.5
Approach		476	0.0	1.000	28.6	LOS C	10.4	72.6	0.79	0.72	25.1
All Vehicles		1963	0.0	1.000	26.3	LOS C	20.8	145.9	0.82	0.74	25.7

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

3 x = 1.00 due to short lane. Refer to the Lane Summary report for information about excess flow and related conditions.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	21.1	LOS C	0.1	0.1	0.65	0.65
P3	Across E approach	53	21.1	LOS C	0.1	0.1	0.65	0.65
P5	Across N approach	53	21.1	LOS C	0.1	0.1	0.65	0.65
P7	Across W approach	53	21.1	LOS C	0.1	0.1	0.65	0.65
All Pedestrians		212	21.1	LOS C			0.65	0.65

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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SIDRA
INTERSECTION

PHASING SUMMARY

Site: 7. Warambie_Sharpe (4 to 5pm) - Parallel Walk

Warambie Road / Sharpe Road 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

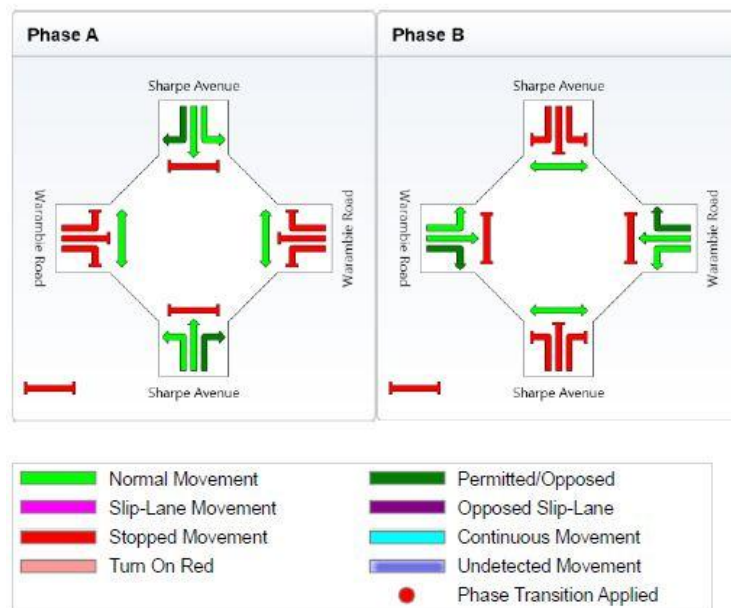
Sequence: Two-Phase

Input Sequence: A, B

Output Sequence: A, B

Phase Timing Results

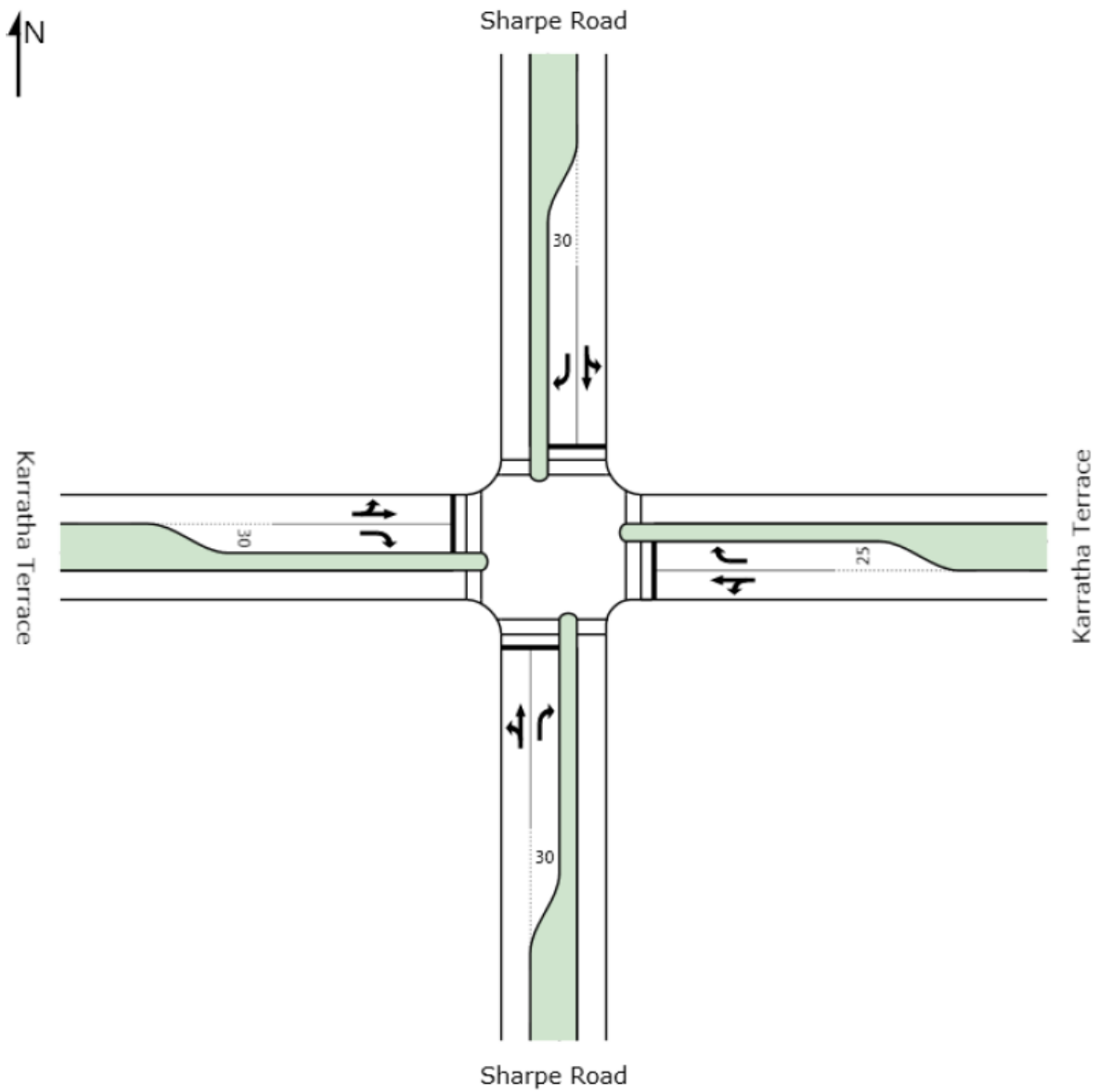
Phase	A	B
Green Time (sec)	44	44
Yellow Time (sec)	4	4
All-Red Time (sec)	2	2
Phase Time (sec)	50	50
Phase Split	50 %	50 %



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INTERSECTION

A1.12 Karratha Terrace/ Sharpe Avenue - Scramble Phase



MOVEMENT SUMMARY**Site: 8. Karratha Tce _ Sharpe (4 to 5pm)**

Karratha Terrace / Sharpe Road 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn w/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Sharpe Road											
1	L	23	0.0	0.251	16.2	LOS B	6.7	46.8	0.52	0.78	31.4
2	T	260	0.0	0.251	10.9	LOS B	6.7	46.8	0.52	0.45	32.0
3	R	31	0.0	0.190	34.9	LOS C	1.1	8.0	0.78	0.71	24.2
Approach		314	0.0	0.251	13.7	LOS B	6.7	46.8	0.55	0.50	31.0
East: Karratha Terrace											
4	L	28	0.0	0.554	55.1	LOS E	4.7	33.1	1.00	0.78	21.3
5	T	67	0.0	0.554	49.5	LOS D	4.7	33.1	1.00	0.78	21.8
6	R	46	0.0	0.521	60.9	LOS E	2.4	16.9	1.00	0.74	19.6
Approach		142	0.0	0.554	54.3	LOS D	4.7	33.1	1.00	0.77	21.0
North: Sharpe Road											
7	L	69	0.0	0.728	21.6	LOS C	28.8	201.6	0.79	0.87	29.2
8	T	751	0.0	0.728	16.3	LOS B	28.8	201.6	0.79	0.72	29.2
9	R	33	0.0	0.132	18.3	LOS B	0.8	5.5	0.52	0.66	30.1
Approach		853	0.0	0.728	16.8	LOS B	28.8	201.6	0.78	0.73	29.2
West: Karratha Terrace											
10	L	20	0.0	0.623	55.9	LOS E	5.4	38.0	1.00	0.81	21.3
11	T	88	0.0	0.623	50.3	LOS D	5.4	38.0	1.00	0.81	21.7
12	R	68	0.0	0.687	61.3	LOS E	3.6	25.4	1.00	0.82	19.6
Approach		177	0.0	0.687	55.2	LOS E	5.4	38.0	1.00	0.82	20.8
All Vehicles		1485	0.0	0.728	24.3	LOS C	28.8	201.6	0.78	0.70	27.2

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P3	Across E approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P5	Across N approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P7	Across W approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
All Pedestrians		212	44.2	LOS E			0.94	0.94

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY**Site: 8. Karratha Tce_Sharpe (4 to 5pm)**

Karratha Terrace / Sharpe Road 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

Sequence: Scramble

Input Sequence: A, B, C

Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Green Time (sec)	58	15	9
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	64	21	15
Phase Split	64 %	21 %	15 %



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SIDRA
INTERSECTION

A1.13 Karratha Terrace/ Sharpe Avenue - Parallel Walk

Note: Geometry will be identical to A1.12

MOVEMENT SUMMARY

Site: 8. Karratha Tce, Sharpe (4 to 5pm) - Parallel Walk

Karratha Terrace / Sharpe Road 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn w/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Sharpe Road											
1	L	23	0.0	0.200	9.8	LOS A	4.3	29.9	0.34	0.75	34.6
2	T	260	0.0	0.200	4.5	LOS A	4.3	29.9	0.34	0.29	36.1
3	R	31	0.0	0.134	17.1	LOS B	0.7	5.0	0.50	0.66	30.6
Approach		314	0.0	0.200	6.1	LOS A	4.3	29.9	0.35	0.36	35.3
East: Karratha Terrace											
4	L	28	0.0	0.332	47.7	LOS D	4.3	30.0	0.94	0.79	23.2
5	T	67	0.0	0.332	42.0	LOS D	4.3	30.0	0.94	0.73	23.7
6	R	46	0.0	0.387	52.0	LOS D	2.2	15.2	0.96	0.73	21.5
Approach		142	0.0	0.387	46.4	LOS D	4.3	30.0	0.94	0.74	22.9
North: Sharpe Road											
7	L	69	0.0	0.578	12.0	LOS B	18.4	128.7	0.51	0.81	33.5
8	T	751	0.0	0.578	6.7	LOS A	18.4	128.7	0.51	0.47	34.4
9	R	33	0.0	0.091	10.4	LOS B	0.5	3.5	0.33	0.62	33.9
Approach		853	0.0	0.578	7.3	LOS A	18.4	128.7	0.50	0.50	34.3
West: Karratha Terrace											
10	L	20	0.0	0.374	48.0	LOS D	4.9	34.3	0.94	0.79	23.2
11	T	88	0.0	0.374	42.3	LOS D	4.9	34.3	0.94	0.75	23.7
12	R	68	0.0	0.479	51.7	LOS D	3.2	22.5	0.96	0.75	21.6
Approach		177	0.0	0.479	46.6	LOS D	4.9	34.3	0.95	0.75	22.8
All Vehicles		1485	0.0	0.578	15.4	LOS B	18.4	128.7	0.57	0.52	31.1

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P3	Across E approach	53	6.5	LOS A	0.1	0.1	0.36	0.36
P5	Across N approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P7	Across W approach	53	6.5	LOS A	0.1	0.1	0.36	0.36
All Pedestrians		212	25.3	LOS C			0.65	0.65

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY**Site: 8. Karratha Tce_Sharpe (4 to 5pm) - Parallel Walk**

Karratha Terrace / Sharpe Road 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

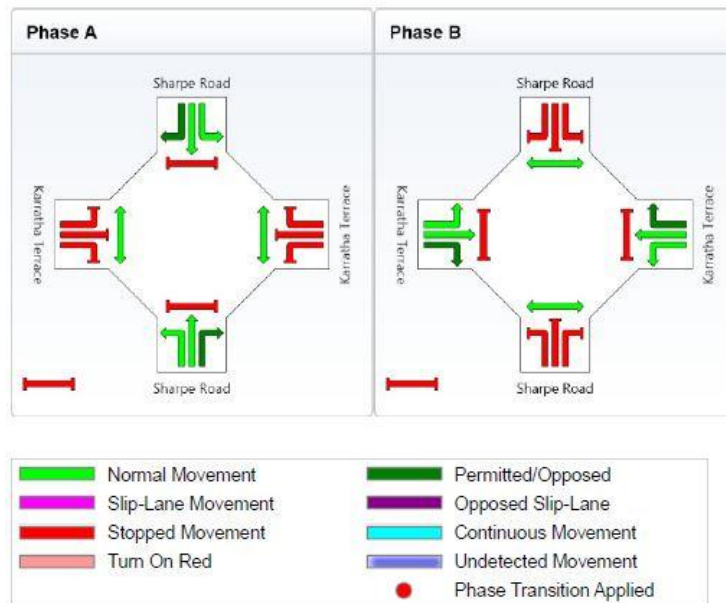
Sequence: Two-Phase

Input Sequence: A, B

Output Sequence: A, B

Phase Timing Results

Phase	A	B
Green Time (sec)	73	15
Yellow Time (sec)	4	4
All-Red Time (sec)	2	2
Phase Time (sec)	79	21
Phase Split	79 %	21 %



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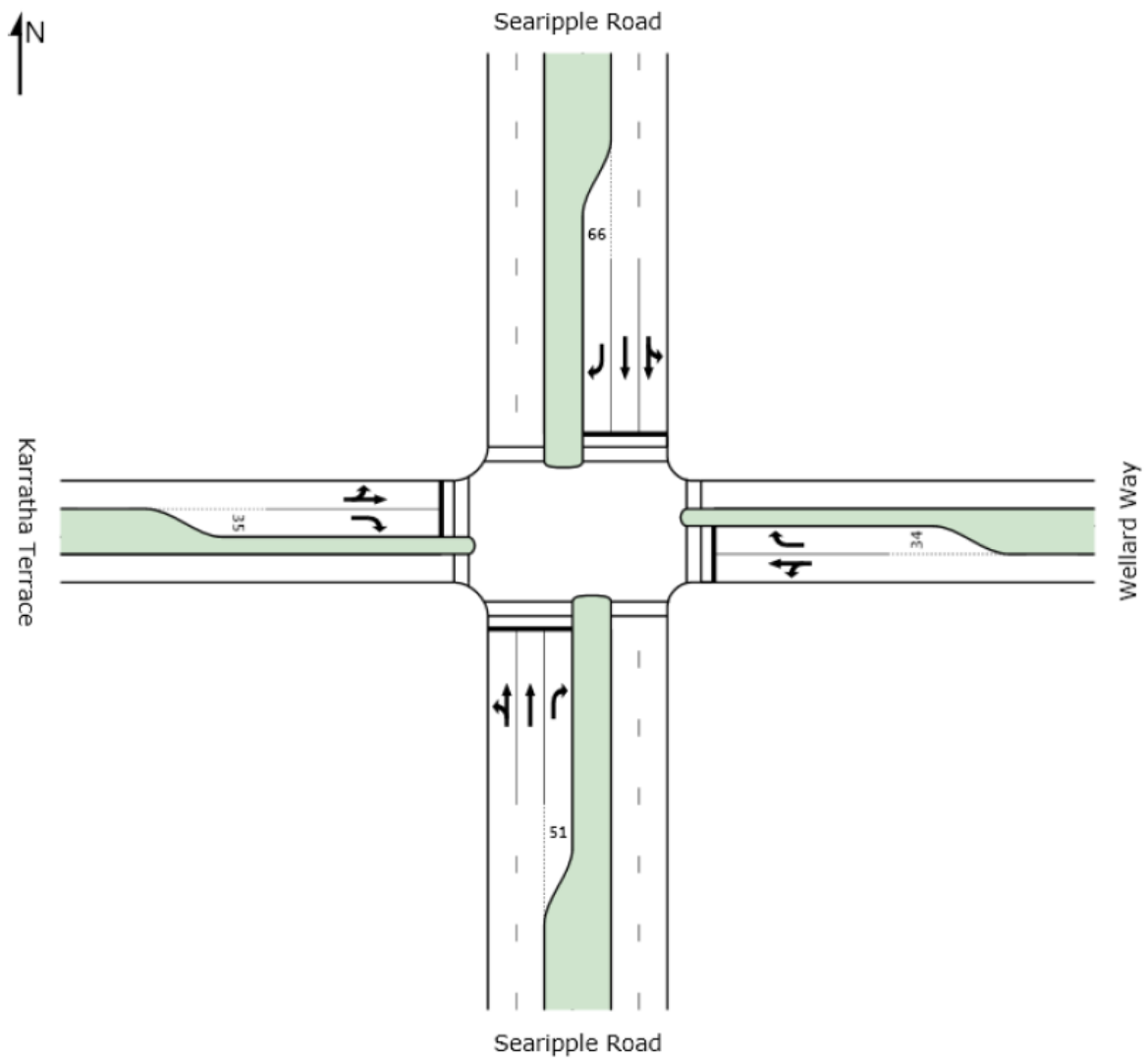
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INTERSECTION

A1.14 Searipple Road/ Karratha Terrace - Scramble Phase



MOVEMENT SUMMARY**Site: 9. Searipple_Karratha Tce (4 to 5pm)**

Searipple Road / Karratha Terrace 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Searipple Road											
1	L	34	0.0	0.140	32.3	LOS C	3.0	20.7	0.75	0.78	28.6
2	T	139	0.0	0.140	25.9	LOS C	3.0	21.1	0.75	0.59	29.6
3	R	24	0.0	0.097	40.0	LOS D	1.0	6.7	0.83	0.71	25.5
Approach		197	0.0	0.140	28.7	LOS C	3.0	21.1	0.76	0.64	28.8
East: Wellard Way											
4	L	43	0.0	0.096	35.8	LOS D	1.8	12.4	0.78	0.73	26.9
5	T	5	0.0	0.096	29.4	LOS C	1.8	12.4	0.78	0.60	27.4
6	R	16	0.0	0.081	36.4	LOS D	0.6	4.1	0.78	0.67	26.7
Approach		64	0.0	0.096	35.4	LOS D	1.8	12.4	0.78	0.71	26.9
North: Searipple Road											
7	L	20	0.0	0.401	35.0	LOS D	9.5	66.6	0.83	0.85	28.0
8	T	480	0.0	0.401	28.6	LOS C	9.6	66.9	0.83	0.70	28.5
9	R	154	0.0	0.441	36.3	LOS D	5.9	41.4	0.83	0.78	26.7
Approach		654	0.0	0.441	30.6	LOS C	9.6	66.9	0.83	0.72	28.0
West: Karratha Terrace											
10	L	21	0.0	0.116	36.0	LOS D	2.2	15.4	0.79	0.77	27.3
11	T	39	0.0	0.116	29.6	LOS C	2.2	15.4	0.79	0.61	27.8
12	R	91	0.0	0.454	37.3	LOS D	3.5	24.3	0.82	0.74	26.4
Approach		151	0.0	0.454	35.1	LOS D	3.5	24.3	0.81	0.71	26.9
All Vehicles		1065	0.0	0.454	31.2	LOS C	9.6	66.9	0.81	0.70	27.9

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P3	Across E approach	53	37.0	LOS D	0.1	0.1	0.86	0.86
P5	Across N approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P7	Across W approach	53	37.0	LOS D	0.1	0.1	0.86	0.86
All Pedestrians		212	40.6	LOS E			0.90	0.90

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY**Site: 9. Searipple_Karratha Tce (4 to 5pm)**

Searipple Road / Karratha Terrace 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

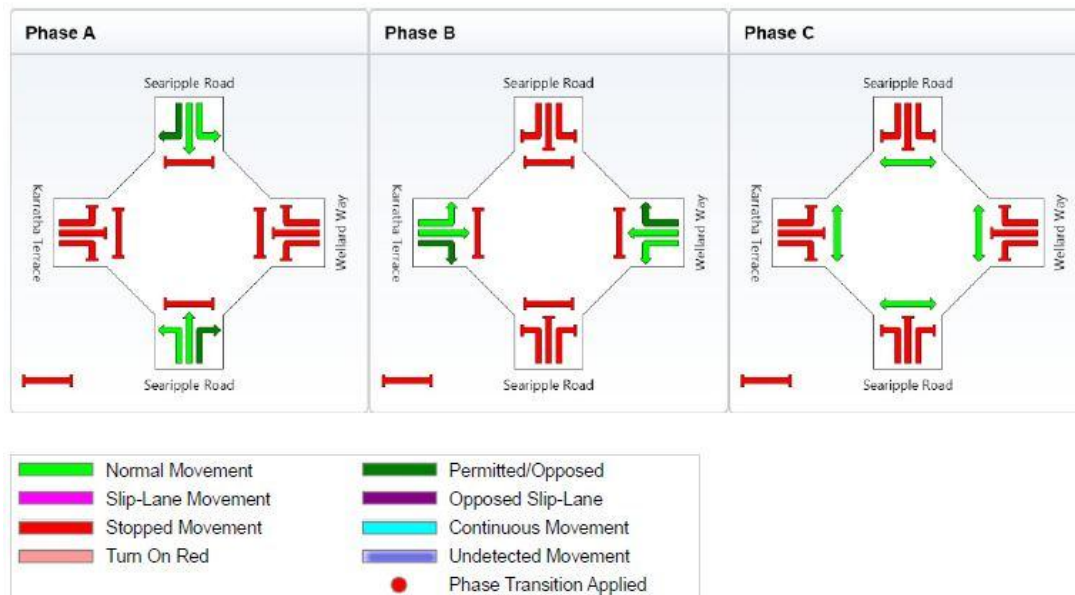
Sequence: Scramble

Input Sequence: A, B, C

Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Green Time (sec)	32	27	23
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	38	33	29
Phase Split	38 %	33 %	29 %

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A1.15 Searipple Road/ Karratha Terrace - Parallel Walk

Note: Geometry will be identical to A1.14

MOVEMENT SUMMARY

Site: 9. Searipple_Karratha Tce (4 to 5pm) - Parallel Walk

Searipple Road / Karratha Terrace 4pm to 5pm
Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Searipple Road											
1	L	34	0.0	0.097	22.6	LOS C	2.3	16.2	0.59	0.78	33.0
2	T	139	0.0	0.097	16.2	LOS B	2.4	16.6	0.59	0.47	34.7
3	R	24	0.0	0.080	26.5	LOS C	0.7	5.1	0.65	0.69	30.6
Approach		197	0.0	0.097	18.5	LOS B	2.4	16.6	0.60	0.55	33.8
East: Wellard Way											
4	L	43	0.0	0.062	24.7	LOS C	1.4	9.7	0.62	0.72	31.4
5	T	5	0.0	0.062	18.3	LOS B	1.4	9.7	0.62	0.48	32.6
6	R	16	0.0	0.065	24.6	LOS C	0.5	3.2	0.62	0.66	31.5
Approach		64	0.0	0.065	24.2	LOS C	1.4	9.7	0.62	0.68	31.5
North: Searipple Road											
7	L	20	0.0	0.279	24.2	LOS C	7.5	52.3	0.66	0.86	32.5
8	T	480	0.0	0.279	17.8	LOS B	7.5	52.5	0.66	0.56	33.8
9	R	154	0.0	0.366	24.7	LOS C	4.6	32.3	0.66	0.74	31.4
Approach		654	0.0	0.366	19.6	LOS B	7.5	52.5	0.66	0.61	33.1
West: Karratha Terrace											
10	L	21	0.0	0.075	24.8	LOS C	1.7	12.1	0.63	0.78	31.9
11	T	39	0.0	0.075	18.4	LOS B	1.7	12.1	0.63	0.49	33.1
12	R	91	0.0	0.367	25.6	LOS C	2.7	19.0	0.65	0.71	31.0
Approach		151	0.0	0.367	23.6	LOS C	2.7	19.0	0.64	0.66	31.6
All Vehicles		1065	0.0	0.367	20.3	LOS C	7.5	52.5	0.64	0.61	32.9

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	28.1	LOS C	0.1	0.1	0.75	0.75
P3	Across E approach	53	19.8	LOS B	0.1	0.1	0.63	0.63
P5	Across N approach	53	28.1	LOS C	0.1	0.1	0.75	0.75
P7	Across W approach	53	19.8	LOS B	0.1	0.1	0.63	0.63
All Pedestrians		212	24.0	LOS C			0.69	0.69

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

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PHASING SUMMARY**Site: 9. Searipple_Karratha Tce (4 to 5pm) - Parallel Walk**

Searipple Road / Karratha Terrace 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

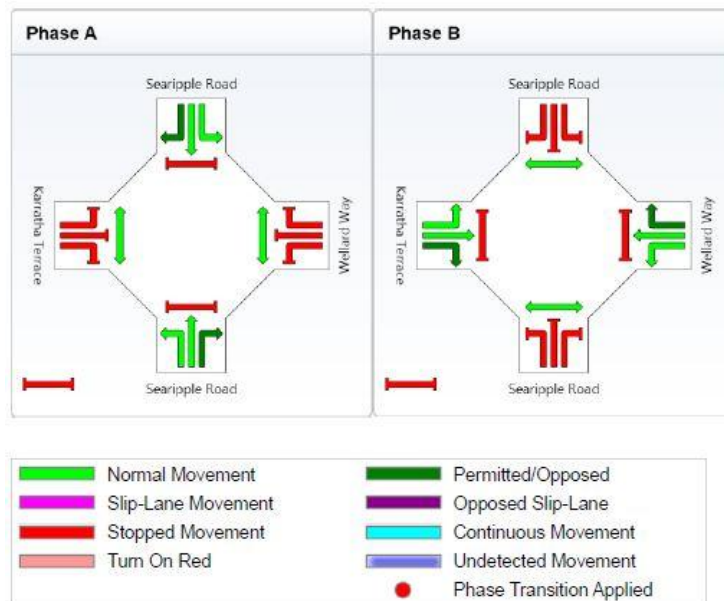
Sequence: Two-Phase

Input Sequence: A, B

Output Sequence: A, B

Phase Timing Results

Phase	A	B
Green Time (sec)	46	42
Yellow Time (sec)	4	4
All-Red Time (sec)	2	2
Phase Time (sec)	52	48
Phase Split	52 %	48 %



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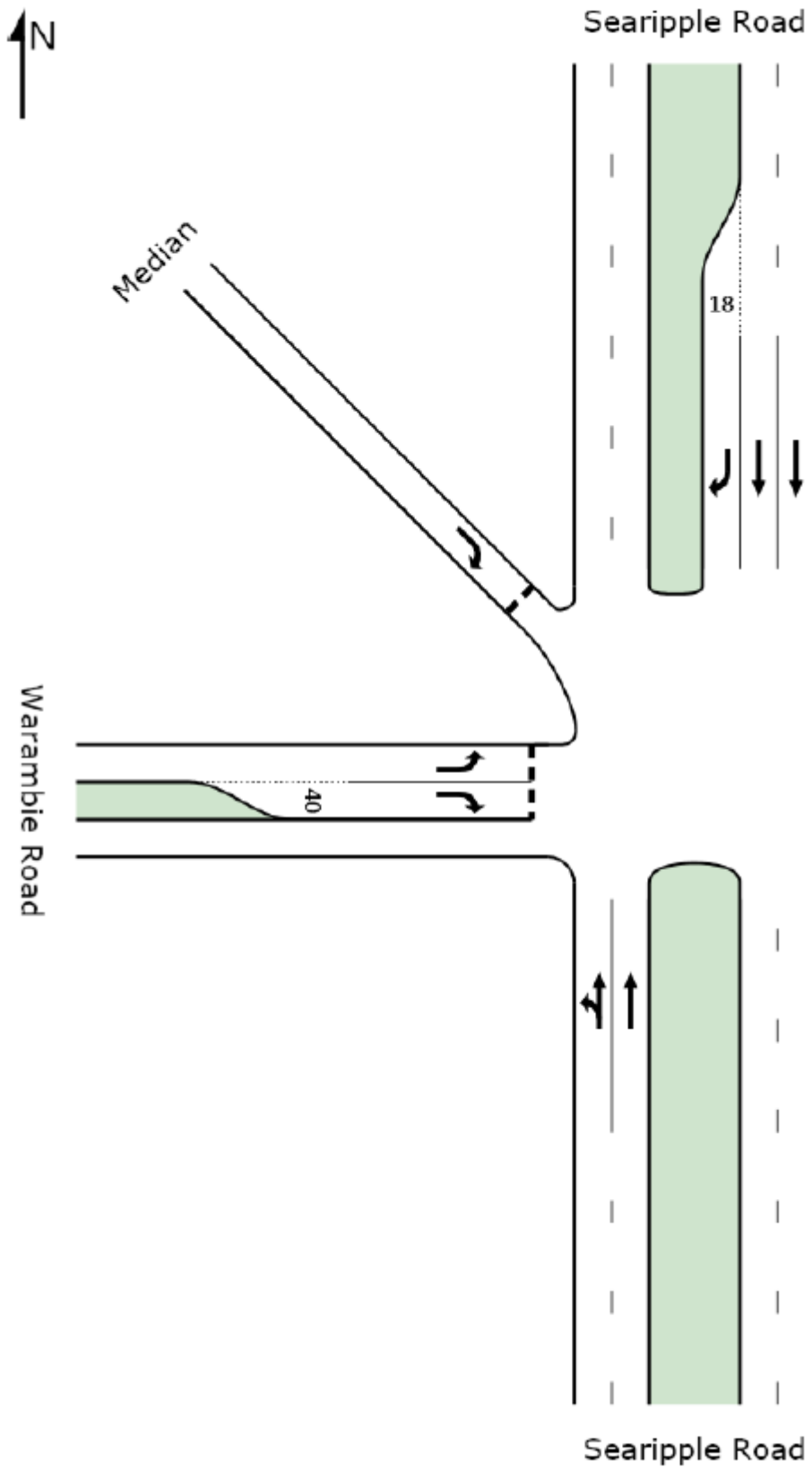
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INTERSECTION

A1.16 Searipple Road/ Warambie Road



MOVEMENT SUMMARY**Site: 10. Searipple_Warambie (4 to 5pm)**Searipple Road / Warambie Road 4pm to 5pm
Giveaway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. 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: Searipple Road											
1	L	68	0.0	0.053	5.6	LOS A	0.0	0.0	0.00	0.66	43.2
2	T	135	0.0	0.053	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		203	0.0	0.053	1.9	NA	0.0	0.0	0.00	0.22	47.5
North: Searipple Road											
8	T	219	0.0	0.056	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
9	R	499	0.0	0.684	9.8	LOS A	5.5	38.7	0.62	0.75	39.6
Approach		718	0.0	0.684	6.8	NA	5.5	38.7	0.43	0.52	42.4
North West: Median											
29	R	94	0.0	0.067	1.8	LOS A	0.4	2.8	0.41	0.30	20.8
Approach		94	0.0	0.067	1.8	LOS A	0.4	2.8	0.41	0.30	20.8
West: Warambie Road											
10	L	198	0.0	0.192	6.2	LOS A	0.7	5.0	0.25	0.57	36.4
12	R	94	0.0	0.193	10.9	LOS B	0.7	5.1	0.65	0.82	32.5
Approach		292	0.0	0.193	7.7	LOS A	0.7	5.1	0.38	0.65	35.1
All Vehicles		1306	0.0	0.684	5.9	NA	5.5	38.7	0.35	0.49	38.3

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

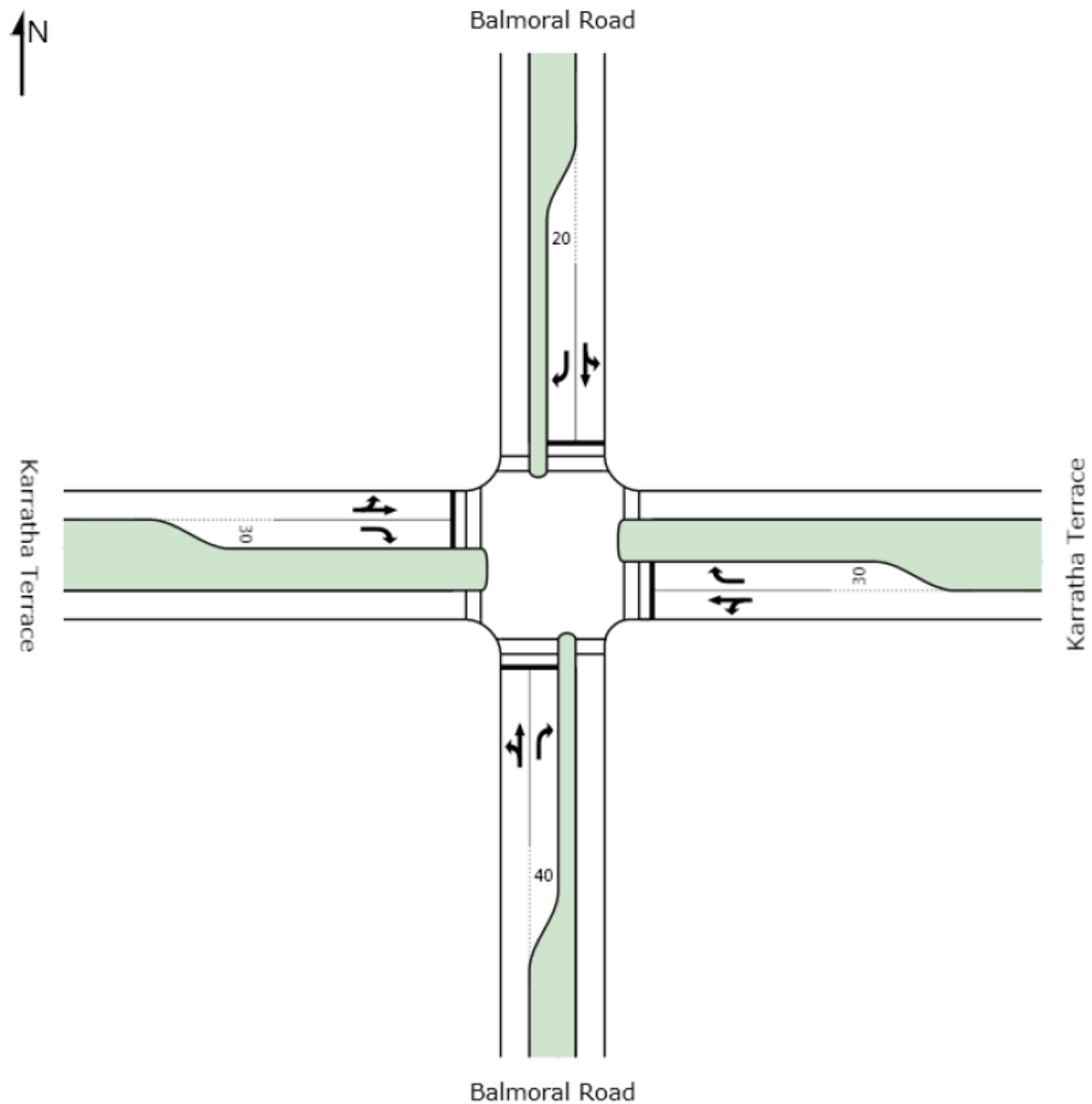
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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INTERSECTION

A2 Medium Term

A2.1 Karratha Terrace/ Balmoral Road - Scramble phase



MOVEMENT SUMMARY**Site: 1. Karratha Tce_Balmoral (3 to 4pm)**

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 105 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn w/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Balmoral Road											
1	L	176	8.1	0.763	28.4	LOS C	29.2	218.3	0.86	0.90	30.7
2	T	541	8.1	0.763	21.8	LOS C	29.2	218.3	0.86	0.79	31.1
3	R	75	8.1	0.349	31.1	LOS C	2.7	20.0	0.73	0.73	27.9
Approach		792	8.1	0.763	24.1	LOS C	29.2	218.3	0.85	0.80	30.7
East: Karratha Terrace											
4	L	53	8.1	0.737	54.6	LOS D	10.7	80.1	1.00	0.90	20.0
5	T	153	8.1	0.737	49.2	LOS D	10.7	80.1	1.00	0.90	19.8
6	R	51	8.1	0.414	59.3	LOS E	2.7	19.8	1.00	0.74	18.9
Approach		256	8.1	0.737	52.3	LOS D	10.7	80.1	1.00	0.87	19.6
North: Balmoral Road											
7	L	74	8.1	0.511	23.7	LOS C	16.1	120.6	0.71	0.88	32.1
8	T	408	8.1	0.511	17.9	LOS B	16.1	120.6	0.71	0.63	33.4
9	R	92	8.1	1.000 ³	48.0	LOS D	4.4	32.6	0.93	0.78	23.2
Approach		574	8.1	1.000	23.5	LOS C	16.1	120.6	0.74	0.69	31.0
West: Karratha Terrace											
10	L	78	8.1	0.634	53.2	LOS D	8.7	65.3	0.99	0.83	22.3
11	T	97	8.1	0.634	48.0	LOS D	8.7	65.3	0.99	0.82	21.8
12	R	96	8.1	0.987	89.8	LOS F	6.5	49.0	1.00	1.14	15.8
Approach		271	8.1	0.987	64.3	LOS E	8.7	65.3	0.99	0.94	19.3
All Vehicles		1892	8.1	1.000	33.5	LOS C	29.2	218.3	0.86	0.80	26.5

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

³ x = 1.00 due to short lane. Refer to the Lane Summary report for information about excess flow and related conditions.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	44.8	LOS E	0.1	0.1	0.92	0.92
P3	Across E approach	53	46.7	LOS E	0.1	0.1	0.94	0.94
P5	Across N approach	53	44.8	LOS E	0.1	0.1	0.92	0.92
P7	Across W approach	53	44.8	LOS E	0.1	0.1	0.92	0.92
All Pedestrians		212	45.3	LOS E			0.93	0.93

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY**Site: 1. Karratha Tce_Balmoral (3 to 4pm)**

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 105 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

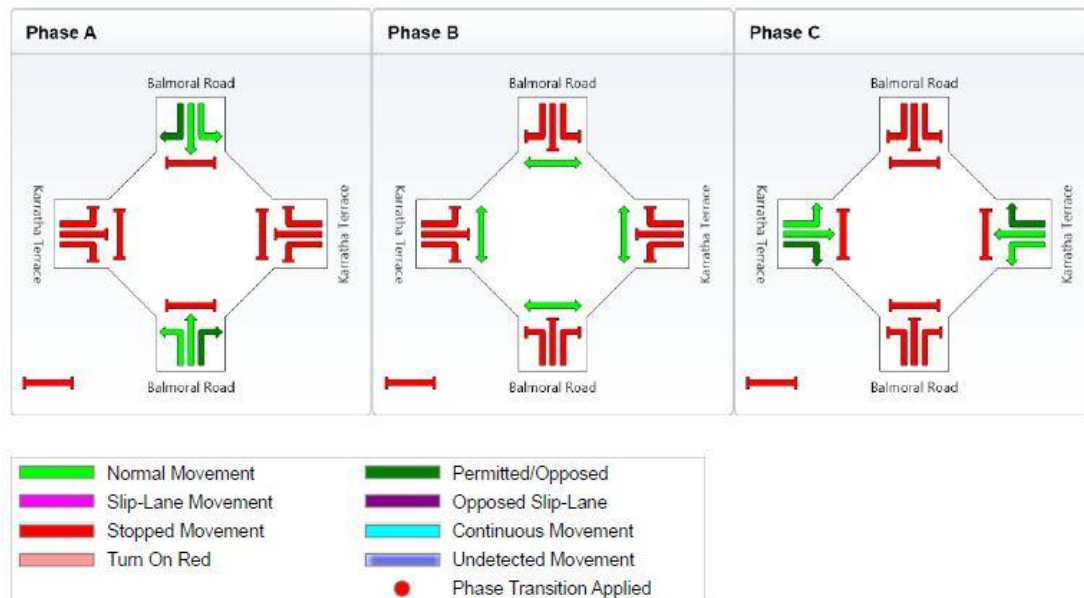
Sequence: Scramble

Input Sequence: A, B, C

Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Green Time (sec)	54	17	16
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	60	23	22
Phase Split	57 %	22 %	21 %



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SIDRA
INTERSECTION

A2.2 Karratha Terrace/ Balmoral Road – Parallel Walk

Note: Geometry will be identical to A2.1

MOVEMENT SUMMARY

Site: 1. Karratha Tce Balmoral (3 to 4pm) - Parallel Walk

Three-way intersection with 2 & 3-lane approaches (Signals)
Signals - Fixed Time Cycle Time = 50 seconds (Practical Cycle Time)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn w/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Balmoral Road											
1	L	176	8.1	0.853	27.3	LOS C	20.0	149.6	0.95	1.08	31.3
2	T	541	8.1	0.853	20.7	LOS C	20.0	149.6	0.95	1.05	31.4
3	R	75	8.1	0.210	20.2	LOS C	1.4	10.6	0.78	0.73	32.9
Approach		792	8.1	0.853	22.1	LOS C	20.0	149.6	0.94	1.03	31.5
East: Karratha Terrace											
4	L	53	8.1	0.375	20.8	LOS C	4.1	30.7	0.83	0.80	29.5
5	T	153	8.1	0.375	15.4	LOS B	4.1	30.7	0.83	0.68	29.6
6	R	51	8.1	0.180	21.9	LOS C	1.0	7.5	0.82	0.71	28.6
Approach		256	8.1	0.375	17.8	LOS B	4.1	30.7	0.83	0.71	29.4
North: Balmoral Road											
7	L	74	8.1	0.533	16.4	LOS B	8.0	60.3	0.76	0.87	36.5
8	T	377	8.1	0.533	10.6	LOS B	8.0	60.3	0.76	0.66	37.8
9	R	123	8.1	0.645	32.3	LOS C	3.2	24.3	1.00	0.86	28.2
Approach		574	8.1	0.645	16.0	LOS B	8.0	60.3	0.81	0.73	35.1
West: Karratha Terrace											
10	L	78	8.1	0.322	21.7	LOS C	3.4	25.6	0.82	0.80	33.7
11	T	97	8.1	0.322	16.4	LOS B	3.4	25.6	0.82	0.69	33.8
12	R	96	8.1	0.350	24.8	LOS C	2.0	15.2	0.87	0.75	31.4
Approach		271	8.1	0.350	20.9	LOS C	3.4	25.6	0.83	0.74	32.8
All Vehicles		1892	8.1	0.853	19.5	LOS B	20.0	149.6	0.87	0.85	32.4

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	19.4	LOS B	0.1	0.1	0.88	0.88
P3	Across E approach	53	14.4	LOS B	0.1	0.1	0.76	0.76
P5	Across N approach	53	19.4	LOS B	0.1	0.1	0.88	0.88
P7	Across W approach	53	13.0	LOS B	0.1	0.1	0.72	0.72
All Pedestrians		212	16.5	LOS B			0.81	0.81

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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**SIDRA
INTERSECTION**

PHASING SUMMARY

Site: 1. Karratha Tce_Balmoral (3 to 4pm) - Parallel WalkThree-way intersection with 2 & 3-lane approaches (Signals)
Signals - Fixed Time Cycle Time = 50 seconds (Practical Cycle Time)

Phase times determined by the program

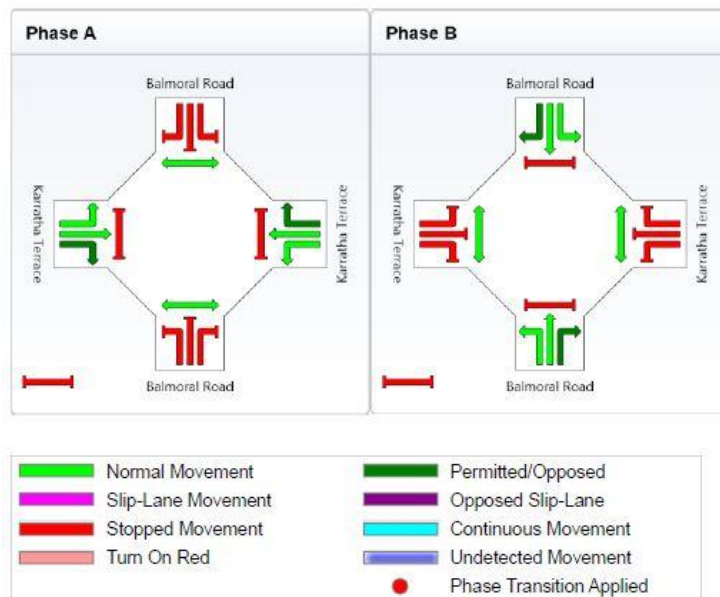
Sequence: Parallel Walk

Input Sequence: A, B

Output Sequence: A, B

Phase Timing Results

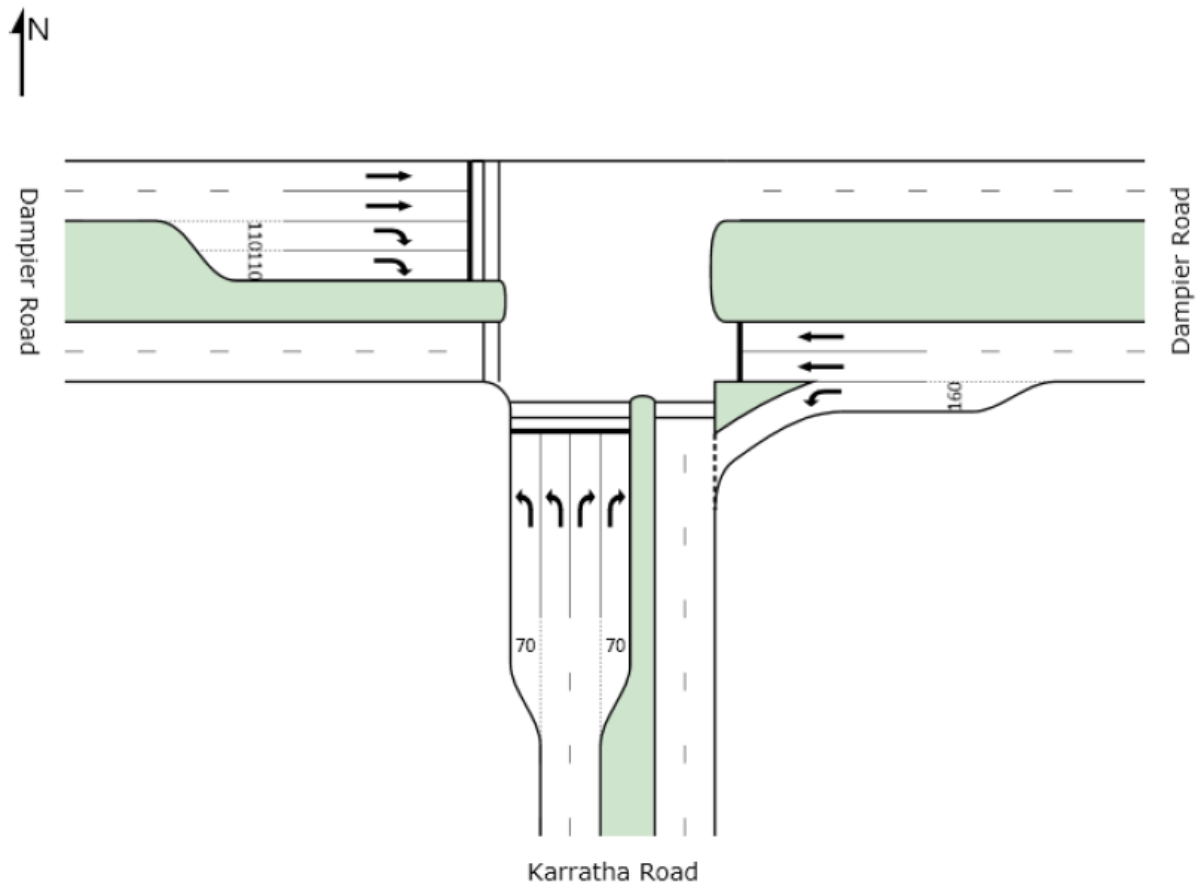
Phase	A	B
Green Time (sec)	15	23
Yellow Time (sec)	4	4
All-Red Time (sec)	2	2
Phase Time (sec)	21	29
Phase Split	42 %	58 %



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SIDRA
INTERSECTION

A2.3 Dampier Road/ Karratha Road



MOVEMENT SUMMARY**Site: 2. Dampier_Karratha Rd (4 to 5pm)**

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	85% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Karratha Road											
1	L	1344	8.1	0.786	23.8	LOS C	31.0	231.7	0.76	0.86	38.4
3	R	1020	8.1	1.012	77.3	LOS E	51.3	384.3	1.00	1.10	19.3
Approach		2364	8.1	1.012	48.9	LOS D	51.3	384.3	0.86	0.96	26.3
East: Dampier Road											
4	L	917	8.1	0.851	22.8	LOS C	27.1	202.8	0.66	0.90	37.2
5	T	546	8.1	0.614	37.1	LOS D	12.1	90.4	0.95	0.80	28.4
Approach		1463	8.1	0.851	28.1	LOS C	27.1	202.8	0.77	0.86	33.4
West: Dampier Road											
11	T	546	8.1	0.289	14.4	LOS B	7.6	56.8	0.60	0.52	40.6
12	R	772	8.1	1.000 ³	73.2	LOS E	24.0	179.5	1.00	1.03	20.1
Approach		1319	8.1	1.000	48.8	LOS D	24.0	179.5	0.84	0.82	25.4
All Vehicles		5146	8.1	1.012	42.1	LOS D	51.3	384.3	0.83	0.90	27.7

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

3 x = 1.00 due to short lane. Refer to the Lane Summary report for information about excess flow and related conditions.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P7	Across W approach	53	34.4	LOS D	0.1	0.1	0.83	0.83
All Pedestrians		106	39.3	LOS D			0.89	0.89

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY**Site: 2. Dampier_Karratha Rd (4 to 5pm)**

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

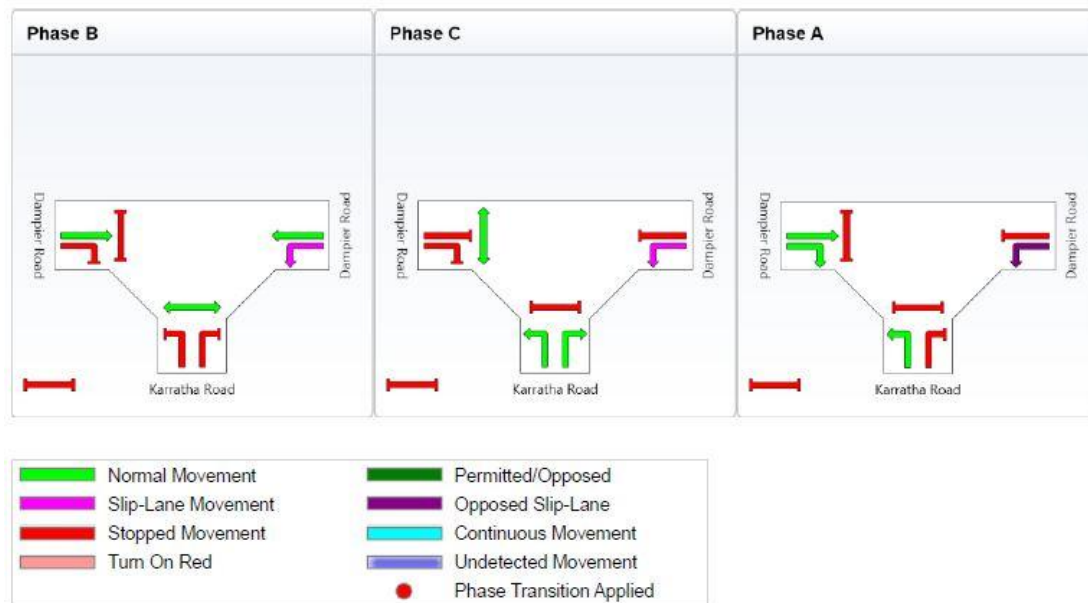
Sequence: Three-Phase

Input Sequence: B, C, A

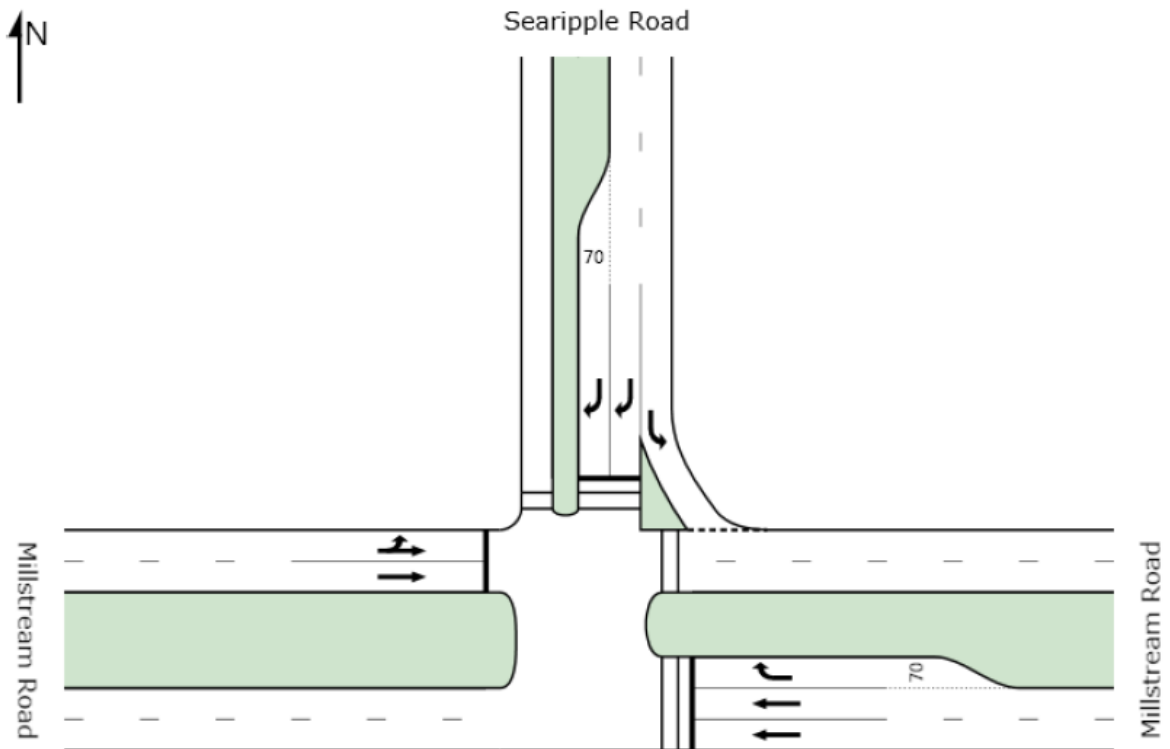
Output Sequence: B, C, A

Phase Timing Results

Phase	B	C	A
Green Time (sec)	24	36	22
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	30	42	28
Phase Split	30 %	42 %	28 %

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INTERSECTION**

A2.4 Searipple Road/ Millstream Road



MOVEMENT SUMMARY**Site: 3. Searipple_Millstream (4 to 5pm)**

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn w/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Millstream Road											
11	T	532	8.1	0.276	14.3	LOS B	7.2	53.8	0.60	0.51	41.3
12	R	112	8.1	0.908	70.8	LOS E	6.5	48.7	1.00	1.02	19.7
Approach		643	8.1	0.908	24.1	LOS C	7.2	53.8	0.67	0.60	34.9
North: Searipple Road											
1	L	205	8.1	0.213	16.3	LOS B	4.9	36.5	0.53	0.70	37.3
3	R	933	8.1	0.921	52.9	LOS D	35.0	262.2	0.96	0.99	23.0
Approach		1138	8.1	0.921	46.3	LOS D	35.0	262.2	0.88	0.94	24.7
West: Millstream Road											
4	L	528	8.1	0.912	29.2	LOS C	32.8	245.4	0.85	0.95	32.8
5	T	853	8.1	0.912	25.4	LOS C	32.8	245.4	0.91	0.92	33.3
Approach		1381	8.1	0.912	26.8	LOS C	32.8	245.4	0.89	0.93	33.1
All Vehicles		3162	8.1	0.921	33.3	LOS C	35.0	262.2	0.84	0.87	29.7

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P7	Across E approach	53	34.4	LOS D	0.1	0.1	0.83	0.83
P1	Across N approach	53	25.2	LOS C	0.1	0.1	0.71	0.71
All Pedestrians		106	29.8	LOS C			0.77	0.77

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY**Site: 3. Searipple_Millstream (4 to 5pm)**

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

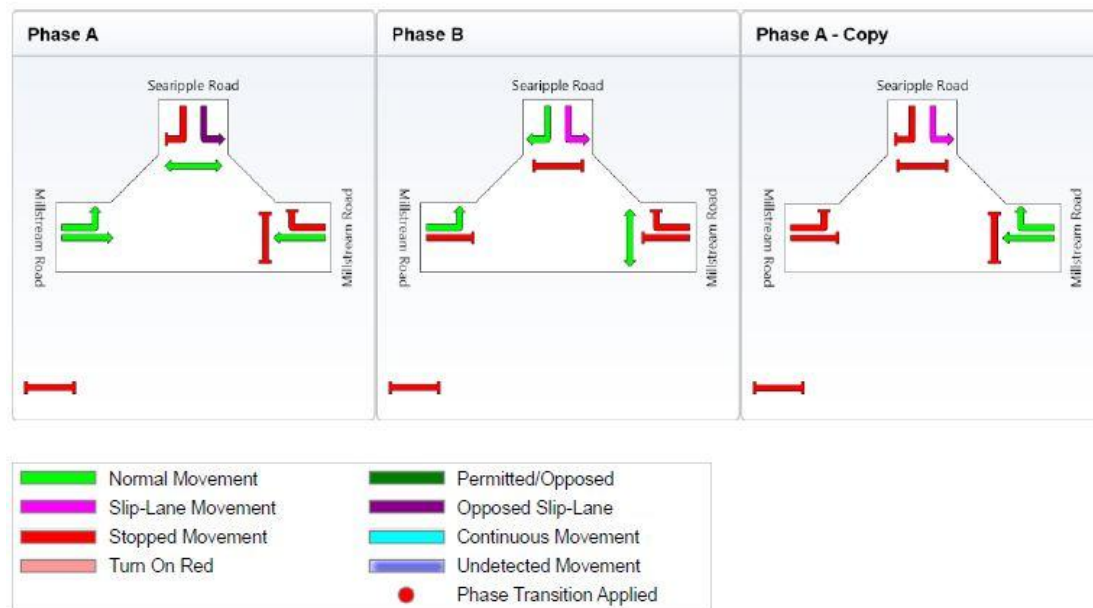
Sequence: Split

Input Sequence: A, B, A - Copy

Output Sequence: A, B, A - Copy

Phase Timing Results

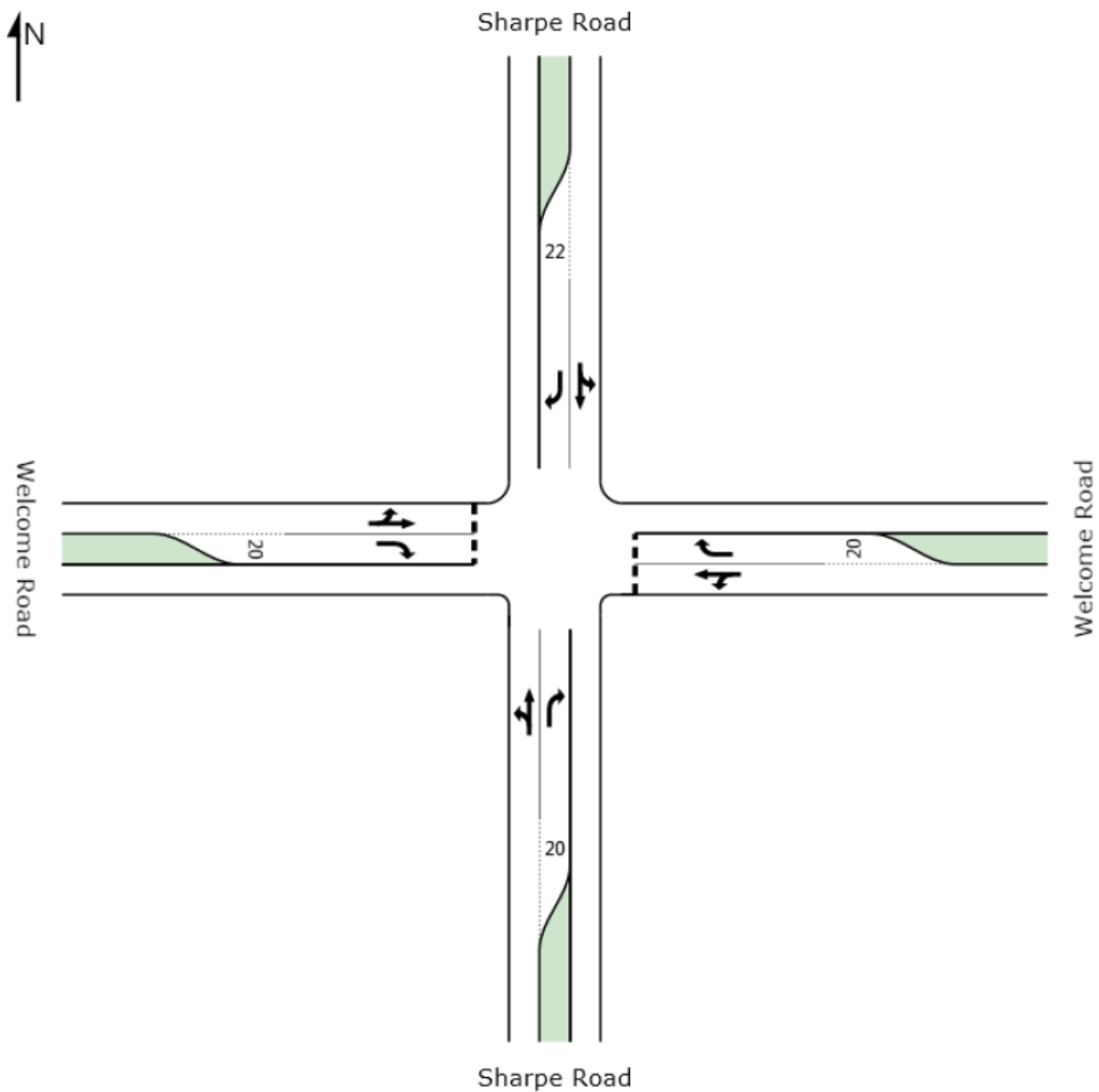
Phase	A	B	A - Copy
Green Time (sec)	39	36	7
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	45	42	13
Phase Split	45 %	42 %	13 %



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**SIDRA
INTERSECTION**

A2.5 Welcome Road/ Sharpe Avenue – Priority Control



MOVEMENT SUMMARY**Site: 4. Welcome_Sharpe (3 to 4pm)**

New Site

Giveaway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn w/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Sharpe Road											
1	L	129	0.0	0.163	4.5	LOS A	0.0	0.0	0.00	0.61	36.7
2	T	182	0.0	0.163	0.0	LOS A	0.0	0.0	0.00	0.00	40.0
3	R	94	0.0	0.106	6.9	LOS A	0.3	2.4	0.43	0.65	35.1
Approach		405	0.0	0.163	3.0	NA	0.3	2.4	0.10	0.35	37.7
East: Welcome Road											
4	L	118	0.0	0.516	14.4	LOS B	3.3	24.3	0.72	1.08	31.2
5	T	153	8.1	0.516	13.2	LOS B	3.3	24.3	0.72	1.01	31.5
6	R	67	0.0	0.226	16.7	LOS C	0.8	5.9	0.76	0.91	29.9
Approach		338	3.7	0.516	14.3	LOS B	3.3	24.3	0.72	1.01	31.1
North: Sharpe Road											
7	L	97	0.0	0.285	4.5	LOS A	0.0	0.0	0.00	0.66	36.7
8	T	454	0.0	0.285	0.0	LOS A	0.0	0.0	0.00	0.00	40.0
9	R	22	0.0	0.022	5.7	LOS A	0.1	0.5	0.33	0.53	35.7
Approach		573	0.0	0.285	1.0	NA	0.1	0.5	0.01	0.13	39.2
West: Welcome Road											
10	L	39	0.0	0.405	13.9	LOS B	2.2	16.2	0.64	0.81	31.5
11	T	153	8.1	0.405	12.7	LOS B	2.2	16.2	0.64	0.88	31.8
12	R	134	0.0	0.522	25.1	LOS D	2.5	17.3	0.86	1.10	26.5
Approach		325	3.8	0.522	17.9	LOS C	2.5	17.3	0.73	0.96	29.4
All Vehicles		1641	1.5	0.522	7.6	NA	3.3	24.3	0.32	0.53	34.7

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

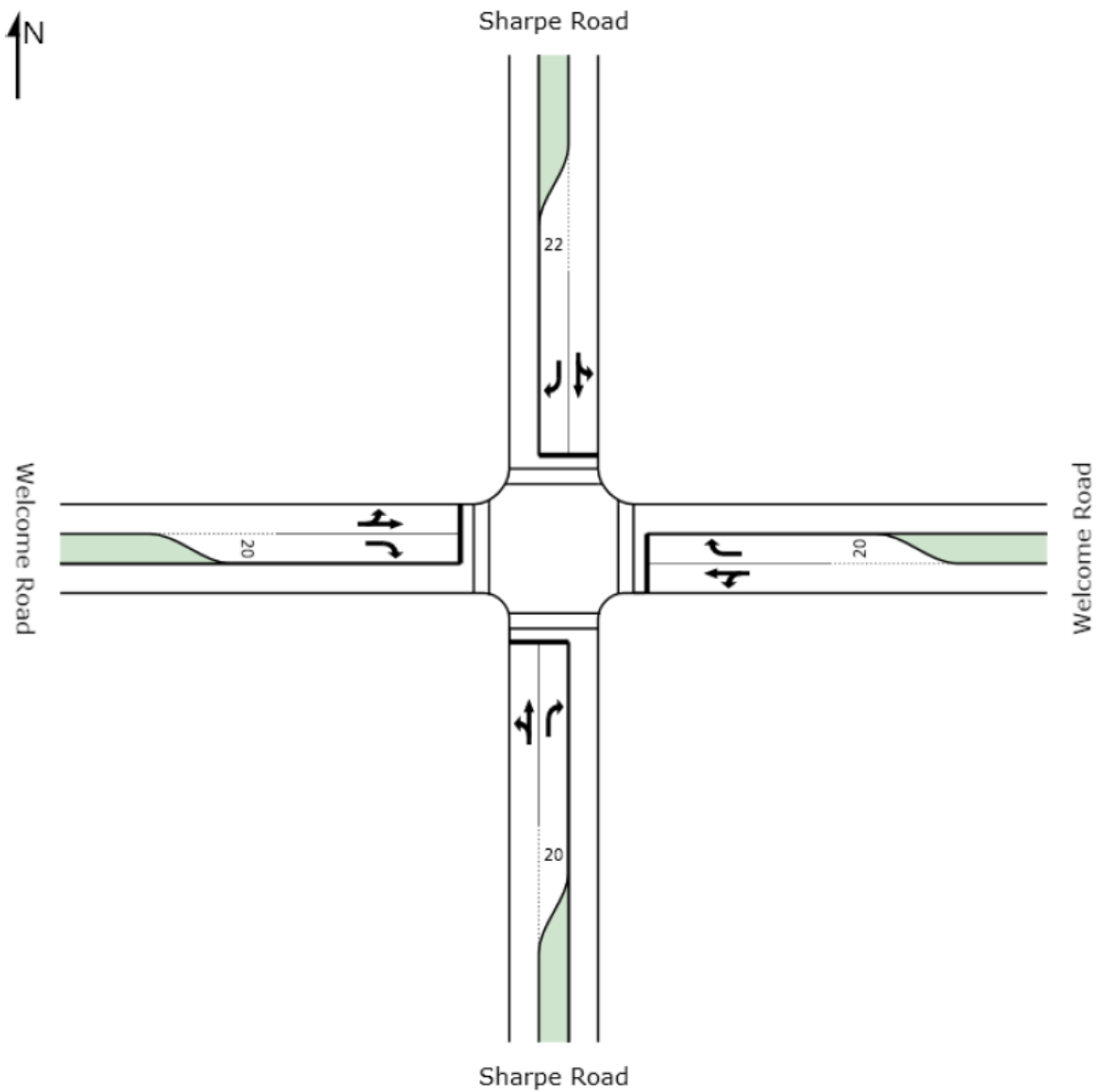
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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SIDRA
INTERSECTION

A2.6 Welcome Road/ Sharpe Avenue – Traffic Signal Control



MOVEMENT SUMMARY**Site: 4. Welcome_Sharpe (3 to 4pm)**

New Site

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn w/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Sharpe Road											
1	L	129	0.0	0.408	17.3	LOS B	6.9	48.5	0.49	0.73	29.9
2	T	182	0.0	0.408	12.8	LOS B	6.9	48.5	0.49	0.42	31.0
3	R	94	0.0	0.887	56.8	LOS E	4.7	32.6	0.90	0.95	18.6
Approach		405	0.0	0.887	24.4	LOS C	6.9	48.5	0.58	0.64	26.6
East: Welcome Road											
4	L	118	0.0	0.304	21.4	LOS C	8.0	57.9	0.65	0.77	28.2
5	T	153	8.1	0.304	16.9	LOS B	8.0	57.9	0.65	0.55	28.9
6	R	67	0.0	0.442	22.8	LOS C	1.9	13.6	0.63	0.68	27.4
Approach		338	3.7	0.442	19.6	LOS B	8.0	57.9	0.64	0.66	28.3
North: Sharpe Road											
7	L	97	0.0	0.712	31.6	LOS C	22.5	157.7	0.90	0.86	24.9
8	T	454	0.0	0.712	27.1	LOS C	22.5	157.7	0.90	0.80	25.0
9	R	22	0.0	0.159	29.3	LOS C	0.7	5.2	0.71	0.67	25.1
Approach		573	0.0	0.712	27.9	LOS C	22.5	157.7	0.89	0.81	25.0
West: Welcome Road											
10	L	39	0.0	0.215	20.5	LOS C	5.4	39.6	0.62	0.77	28.7
11	T	153	8.1	0.215	16.0	LOS B	5.4	39.6	0.62	0.52	29.4
12	R	134	0.0	0.932	37.1	LOS D	4.7	32.6	0.91	0.82	22.9
Approach		325	3.8	0.932	25.2	LOS C	5.4	39.6	0.74	0.67	26.2
All Vehicles		1641	1.5	0.932	24.8	LOS C	22.5	157.7	0.73	0.71	26.3

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	17.4	LOS B	0.1	0.1	0.59	0.59
P3	Across E approach	53	22.4	LOS C	0.1	0.1	0.67	0.67
P5	Across N approach	53	17.4	LOS B	0.1	0.1	0.59	0.59
P7	Across W approach	53	22.4	LOS C	0.1	0.1	0.67	0.67
All Pedestrians		212	19.9	LOS B			0.63	0.63

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY**Site: 4. Welcome_Sharpe (3 to 4pm)**

New Site

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

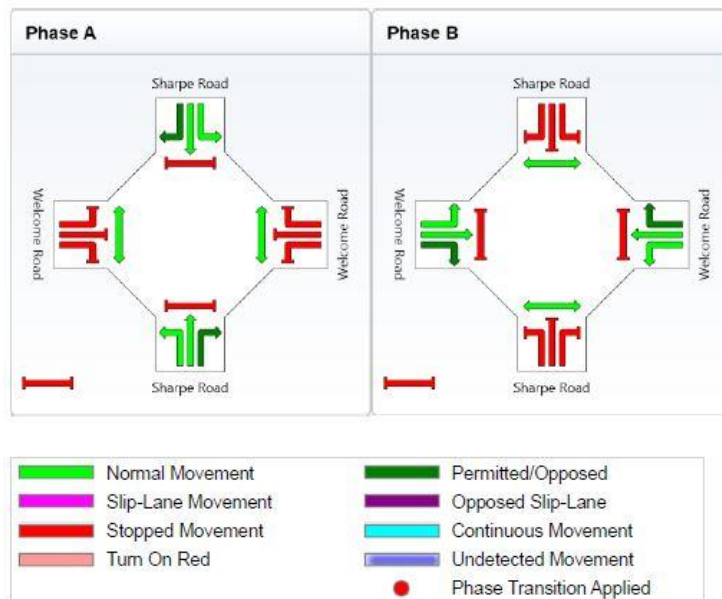
Sequence: Two-Phase

Input Sequence: A, B

Output Sequence: A, B

Phase Timing Results

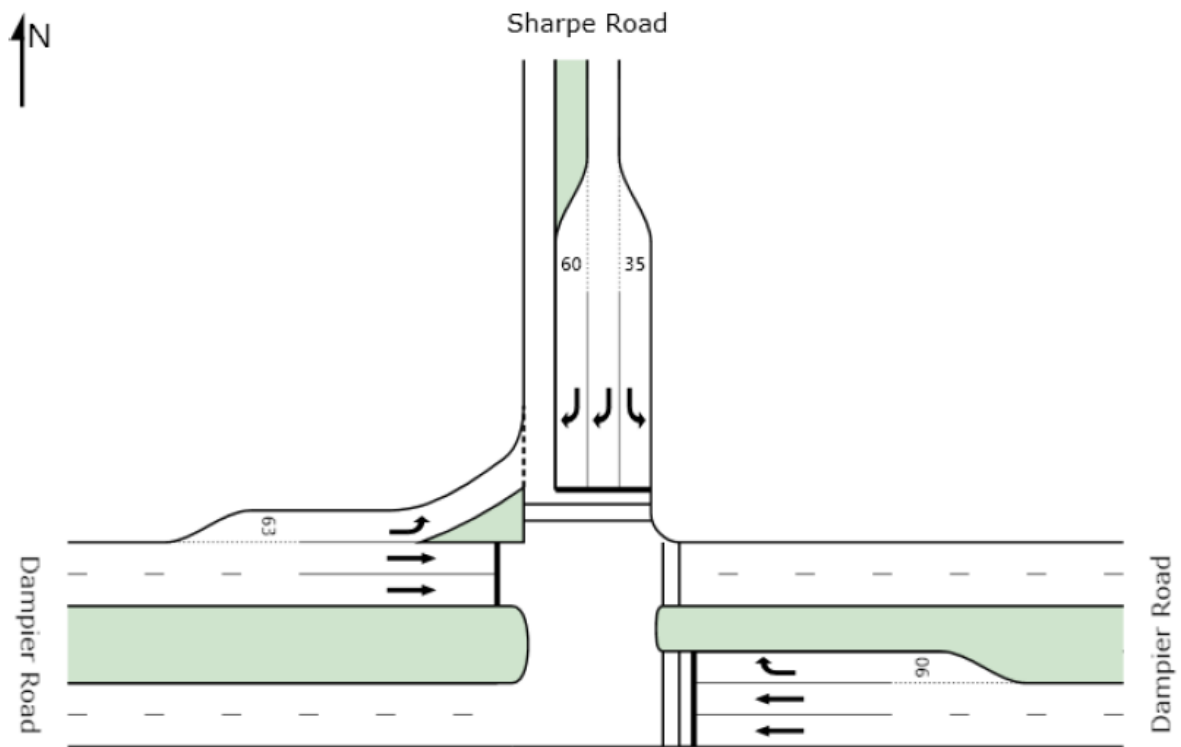
Phase	A	B
Green Time (sec)	40	48
Yellow Time (sec)	4	4
All-Red Time (sec)	2	2
Phase Time (sec)	46	54
Phase Split	46 %	54 %



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SIDRA
INTERSECTION

A2.7 Dampier Road/ Sharpe Avenue



MOVEMENT SUMMARY**Site: 5. Dampier_Sharpe (4 to 5pm)**

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 100 seconds (User-Given Phase Times)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn w/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Dampier Road											
11	T	1645	8.1	0.753	16.1	LOS B	29.3	219.7	0.80	0.73	39.4
12	R	248	0.0	0.818	39.8	LOS D	8.4	59.0	1.00	0.96	27.1
Approach		1894	7.0	0.818	19.2	LOS B	29.3	219.7	0.83	0.76	37.4
North: Sharpe Road											
1	L	27	0.0	0.052	12.5	LOS B	0.3	2.2	0.25	0.62	33.7
3	R	678	0.0	0.735	30.7	LOS C	15.8	110.8	0.81	0.81	26.5
Approach		705	0.0	0.735	30.0	LOS C	15.8	110.8	0.78	0.80	26.7
West: Dampier Road											
4	L	157	0.0	0.170	7.9	LOS A	1.2	8.2	0.26	0.62	47.7
5	T	1292	8.1	0.830	32.4	LOS C	30.6	229.2	0.96	0.93	30.2
Approach		1448	7.2	0.830	29.8	LOS C	30.6	229.2	0.88	0.90	31.4
All Vehicles		4047	5.9	0.830	24.9	LOS C	30.6	229.2	0.84	0.82	32.8

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P7	Across E approach	53	38.7	LOS D	0.1	0.1	0.88	0.88
P1	Across N approach	53	23.1	LOS C	0.1	0.1	0.68	0.68
All Pedestrians		106	30.9	LOS D			0.78	0.78

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY**Site: 5. Dampier_Sharpe (4 to 5pm)**

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 100 seconds (User-Given Phase Times)

Phase times specified by the user

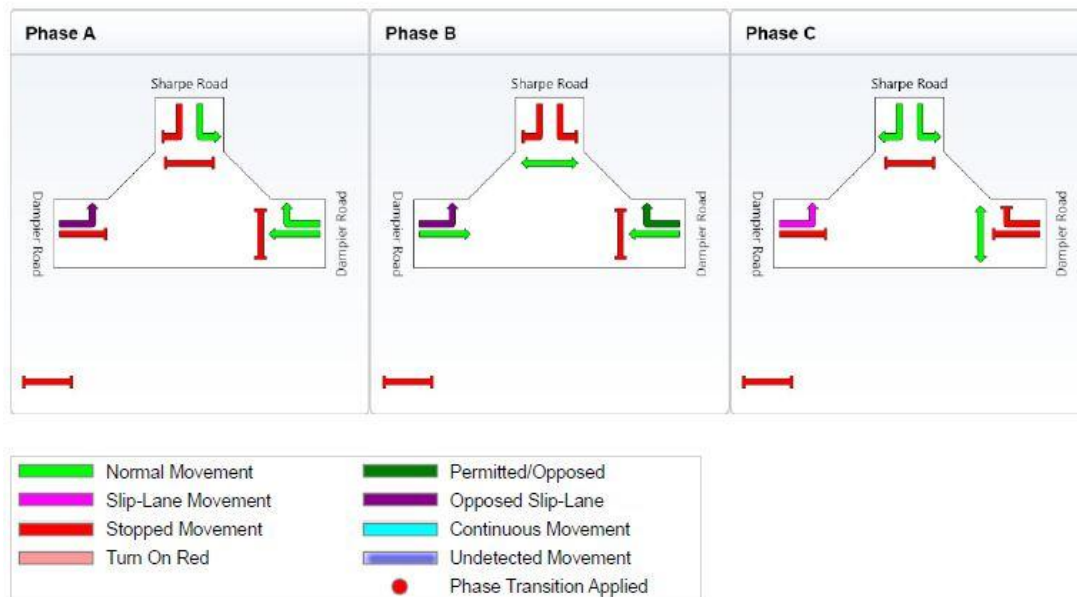
Sequence: Two-Phase

Input Sequence: A, B, C

Output Sequence: A, B, C

Phase Timing Results

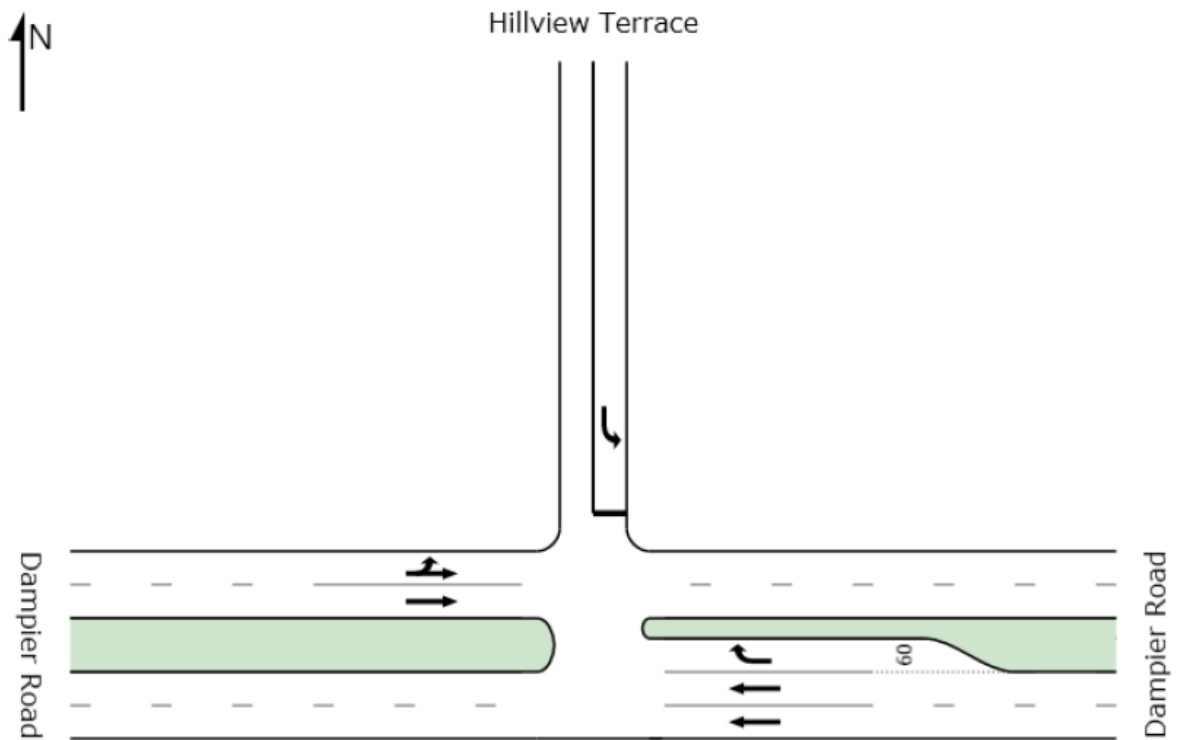
Phase	A	B	C
Green Time (sec)	11	42	29
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	17	48	35
Phase Split	17 %	48 %	35 %



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**SIDRA
INTERSECTION**

A2.8 Dampier Road/ Hillview Road



MOVEMENT SUMMARY**Site: 6. Dampier_Hillview (4 to 5pm)**Staged crossing at three-way intersection with 4-lane major road (Stop control)
Stop (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Dampier Road											
11	T	2227	8.1	0.601	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
12	R	95	8.1	0.960	131.9	LOS F	5.3	40.0	1.00	1.39	12.4
Approach		2322	8.1	0.960	5.4	NA	5.3	40.0	0.04	0.06	52.2
North: Hillview Terrace											
1	L	21	8.1	0.323	73.3	LOS F	0.9	6.9	0.96	1.03	19.2
Approach		21	8.1	0.323	73.3	LOS F	0.9	6.9	0.96	1.03	19.2
West: Dampier Road											
4	L	38	8.1	0.453	7.6	LOS A	0.0	0.0	0.00	1.16	48.6
5	T	1639	8.1	0.453	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		1677	8.1	0.453	0.2	NA	0.0	0.0	0.00	0.03	59.7
All Vehicles		4020	8.1	0.960	3.6	NA	5.3	40.0	0.03	0.05	54.6

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

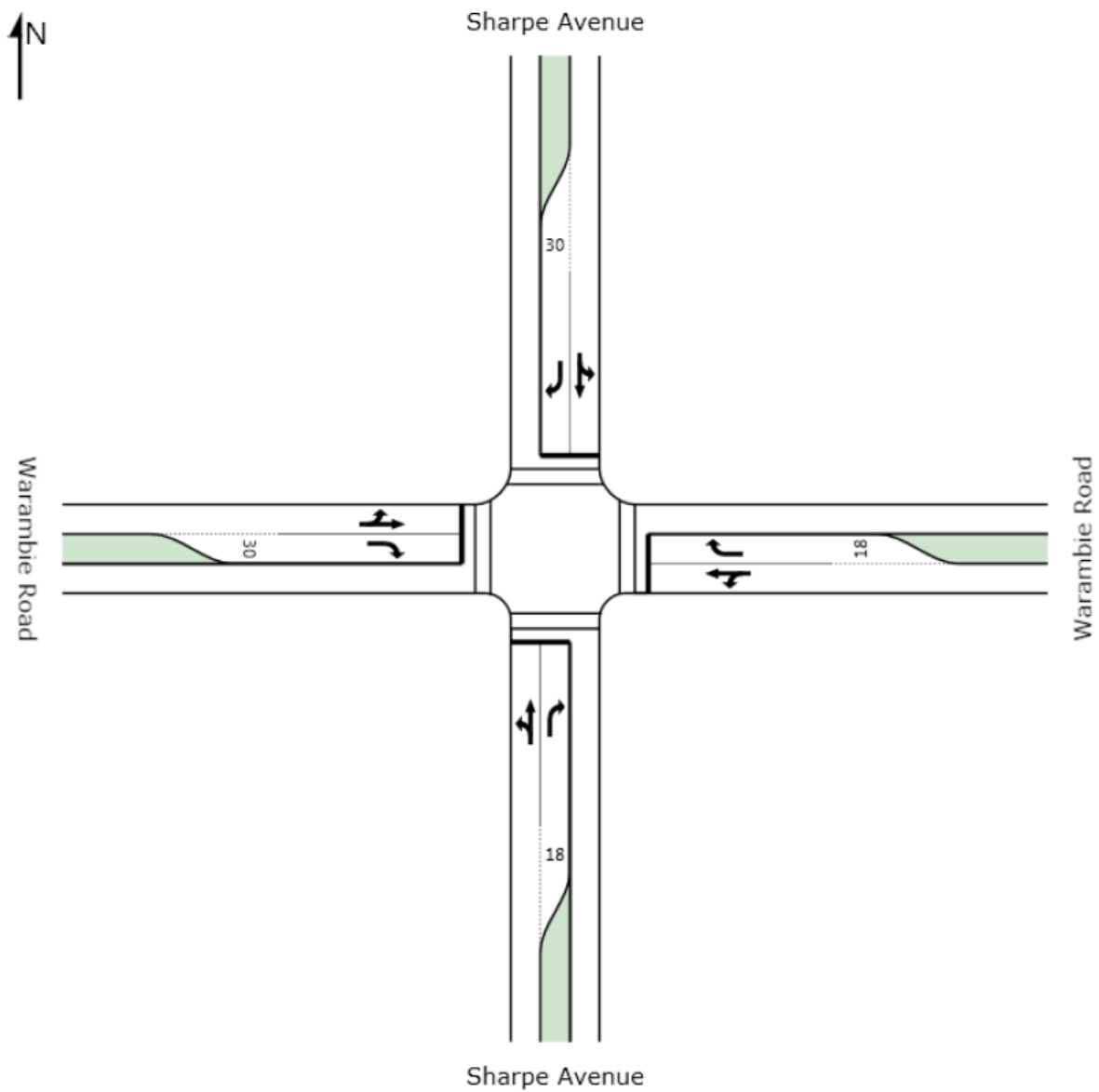
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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A2.9 Warambie Road/ Sharpe Avenue - Scramble Phase



MOVEMENT SUMMARY**Site: 7. Warambie_Sharpe (4 to 5pm)**

Warambie Road / Sharpe Road 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Sharpe Avenue											
1	L	54	0.0	0.385	42.4	LOS D	6.3	44.4	0.91	0.79	21.8
2	T	94	0.0	0.385	38.0	LOS D	6.3	44.4	0.91	0.74	21.9
3	R	54	0.0	0.621	53.0	LOS D	2.6	18.2	0.97	0.80	19.3
Approach		201	0.0	0.621	43.2	LOS D	6.3	44.4	0.93	0.77	21.1
East: Warambie Road											
4	L	155	0.0	0.315	20.9	LOS C	8.6	59.9	0.64	0.76	28.4
5	T	139	0.0	0.315	16.4	LOS B	8.6	59.9	0.64	0.55	29.0
6	R	29	0.0	0.208	21.6	LOS C	0.8	5.7	0.59	0.65	27.8
Approach		323	0.0	0.315	19.0	LOS B	8.6	59.9	0.64	0.66	28.6
North: Sharpe Avenue											
7	L	59	0.0	0.593	44.4	LOS D	10.3	72.3	0.96	0.82	21.4
8	T	169	0.0	0.593	39.9	LOS D	10.3	72.3	0.96	0.80	21.4
9	R	35	0.0	0.234	46.3	LOS D	1.5	10.7	0.91	0.72	20.7
Approach		263	0.0	0.593	41.7	LOS D	10.3	72.3	0.95	0.79	21.3
West: Warambie Road											
10	L	32	0.0	0.192	19.7	LOS B	4.9	34.5	0.60	0.76	29.0
11	T	151	0.0	0.192	15.2	LOS B	4.9	34.5	0.60	0.50	29.8
12	R	141	0.0	0.687	29.8	LOS C	5.0	35.1	0.70	0.80	25.0
Approach		323	0.0	0.687	22.1	LOS C	5.0	35.1	0.64	0.65	27.4
All Vehicles		1111	0.0	0.687	29.7	LOS C	10.3	72.3	0.77	0.71	24.7

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P3	Across E approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P5	Across N approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P7	Across W approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
All Pedestrians		212	44.2	LOS E			0.94	0.94

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY**Site: 7. Warambie_Sharpe (4 to 5pm)**

Warambie Road / Sharpe Road 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

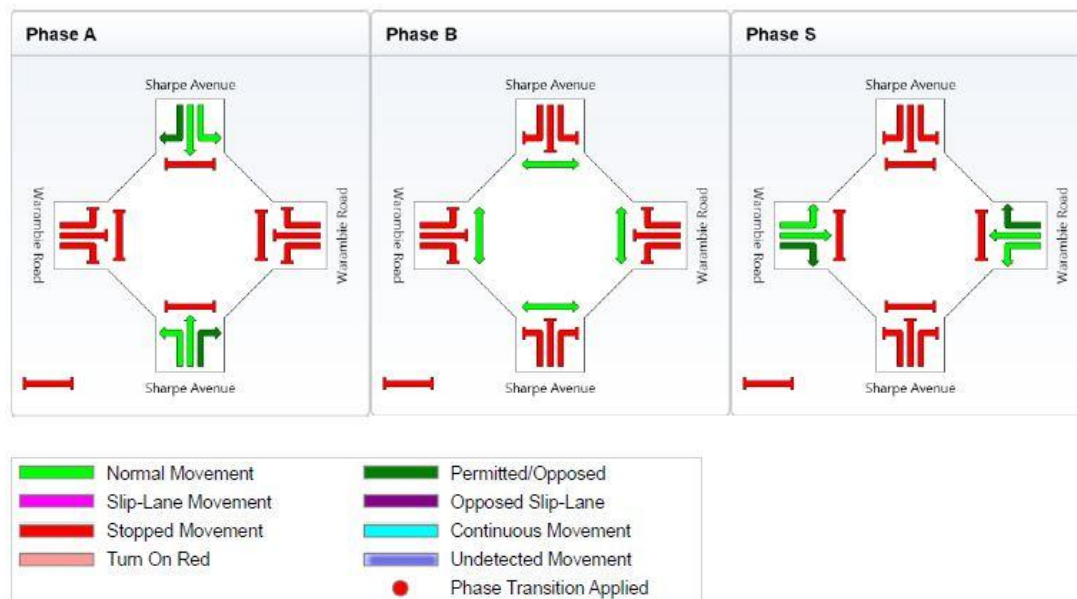
Sequence: Scramble

Input Sequence: A, B, S

Output Sequence: A, B, S

Phase Timing Results

Phase	A	B	S
Green Time (sec)	20	13	49
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	26	19	55
Phase Split	26 %	19 %	55 %



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**SIDRA
INTERSECTION**

A2.10 Warambie Road/ Sharpe Avenue - Parallel Walk

Note: Geometry will be identical to A2.9

MOVEMENT SUMMARY

Site: 7. Warambie_Sharpe (4 to 5pm) - Parallel Walk

Warambie Road / Sharpe Road 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Sharpe Avenue											
1	L	54	0.0	0.265	33.9	LOS C	5.5	38.8	0.81	0.78	24.0
2	T	94	0.0	0.265	29.5	LOS C	5.5	38.8	0.81	0.66	24.2
3	R	54	0.0	0.542	41.5	LOS D	2.2	15.6	0.86	0.75	21.8
Approach		201	0.0	0.542	33.9	LOS C	5.5	38.8	0.83	0.72	23.5
East: Warambie Road											
4	L	155	0.0	0.262	15.0	LOS B	6.8	47.9	0.52	0.73	30.9
5	T	139	0.0	0.262	10.5	LOS B	6.8	47.9	0.52	0.45	32.0
6	R	29	0.0	0.170	15.6	LOS B	0.6	4.5	0.48	0.64	30.4
Approach		323	0.0	0.262	13.1	LOS B	6.8	47.9	0.51	0.60	31.3
North: Sharpe Avenue											
7	L	59	0.0	0.409	35.4	LOS D	9.0	63.2	0.85	0.81	23.7
8	T	169	0.0	0.409	30.9	LOS C	9.0	63.2	0.85	0.71	23.8
9	R	35	0.0	0.206	36.6	LOS D	1.3	9.3	0.81	0.70	23.0
Approach		263	0.0	0.409	32.7	LOS C	9.0	63.2	0.85	0.73	23.7
West: Warambie Road											
10	L	32	0.0	0.160	14.3	LOS B	3.9	27.6	0.48	0.75	31.4
11	T	151	0.0	0.160	9.8	LOS A	3.9	27.6	0.48	0.40	32.6
12	R	141	0.0	0.566	18.3	LOS B	3.6	25.4	0.56	0.70	29.2
Approach		323	0.0	0.566	14.0	LOS B	3.9	27.6	0.52	0.56	30.9
All Vehicles		1111	0.0	0.566	21.8	LOS C	9.0	63.2	0.65	0.64	27.5

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	11.5	LOS B	0.1	0.1	0.48	0.48
P3	Across E approach	53	30.4	LOS D	0.1	0.1	0.78	0.78
P5	Across N approach	53	11.5	LOS B	0.1	0.1	0.48	0.48
P7	Across W approach	53	30.4	LOS D	0.1	0.1	0.78	0.78
All Pedestrians		212	21.0	LOS C			0.63	0.63

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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**SIDRA
INTERSECTION**

PHASING SUMMARY**Site: 7. Warambie_Sharpe (4 to 5pm) - Parallel Walk**

Warambie Road / Sharpe Road 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

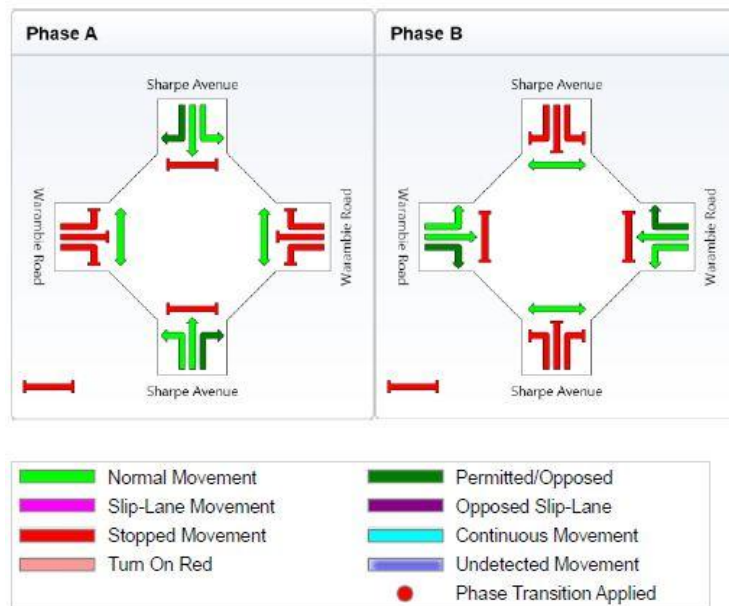
Sequence: Two-Phase

Input Sequence: A, B

Output Sequence: A, B

Phase Timing Results

Phase	A	B
Green Time (sec)	29	59
Yellow Time (sec)	4	4
All-Red Time (sec)	2	2
Phase Time (sec)	35	65
Phase Split	35 %	65 %

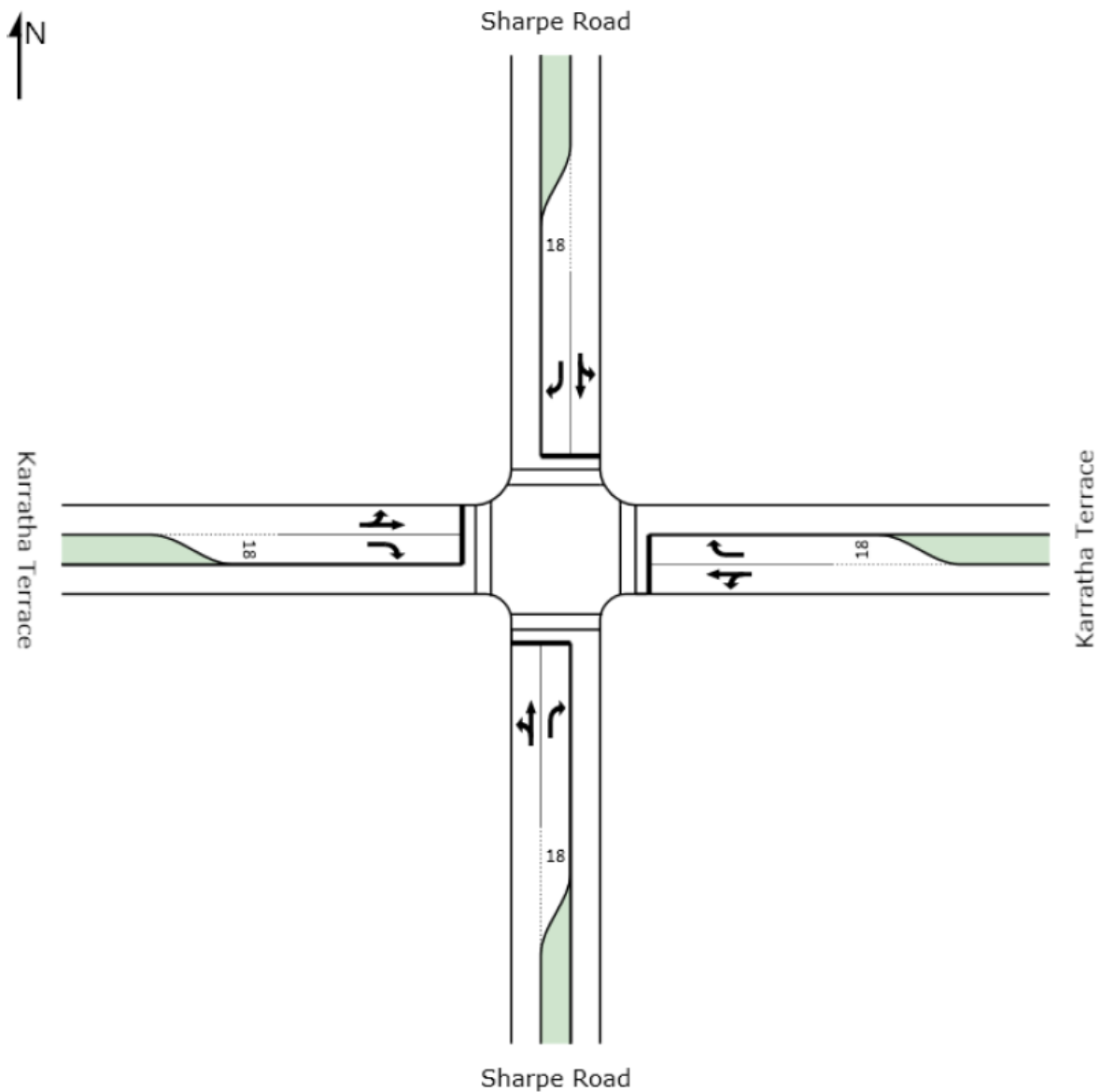


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INTERSECTION

A2.11 Karratha Terrace/ Sharpe Avenue - Scramble Phase



MOVEMENT SUMMARY**Site: 8. Karratha Tce_Sharpe (4 to 5pm)**

Karratha Terrace / Sharpe Road 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	85% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Sharpe Road											
1	L	46	0.0	0.248	29.4	LOS C	5.9	41.0	0.74	0.79	26.2
2	T	125	0.0	0.248	24.1	LOS C	5.9	41.0	0.74	0.81	26.1
3	R	84	0.0	0.887	55.5	LOS E	4.2	29.4	0.91	0.93	19.5
Approach		256	0.0	0.887	35.4	LOS D	5.9	41.0	0.80	0.75	23.4
East: Karratha Terrace											
4	L	51	0.0	0.354	33.0	LOS C	8.3	58.4	0.80	0.84	27.9
5	T	175	0.0	0.354	27.4	LOS C	8.3	58.4	0.80	0.87	28.8
6	R	74	0.0	0.715	45.0	LOS D	3.2	22.6	0.85	0.85	23.2
Approach		299	0.0	0.715	32.7	LOS C	8.3	58.4	0.81	0.75	27.1
North: Sharpe Road											
7	L	132	0.0	0.614	33.6	LOS C	17.0	119.3	0.88	0.85	24.9
8	T	293	0.0	0.614	28.4	LOS C	17.0	119.3	0.88	0.77	24.5
9	R	59	0.0	0.516	33.0	LOS C	2.1	14.7	0.76	0.72	24.7
Approach		483	0.0	0.614	30.4	LOS C	17.0	119.3	0.86	0.78	24.7
West: Karratha Terrace											
10	L	35	0.0	0.394	33.4	LOS C	9.5	66.2	0.82	0.85	27.9
11	T	217	0.0	0.394	27.8	LOS C	9.5	66.2	0.82	0.69	28.7
12	R	96	0.0	0.908	47.2	LOS D	4.2	29.4	0.87	0.83	22.7
Approach		347	0.0	0.908	33.7	LOS C	9.5	66.2	0.83	0.75	26.7
All Vehicles		1385	0.0	0.908	32.6	LOS C	17.0	119.3	0.83	0.76	25.4

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P3	Across E approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P5	Across N approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P7	Across W approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
All Pedestrians		212	44.2	LOS E			0.94	0.94

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY**Site: 8. Karratha Tce_Sharpe (4 to 5pm)**

Karratha Terrace / Sharpe Road 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

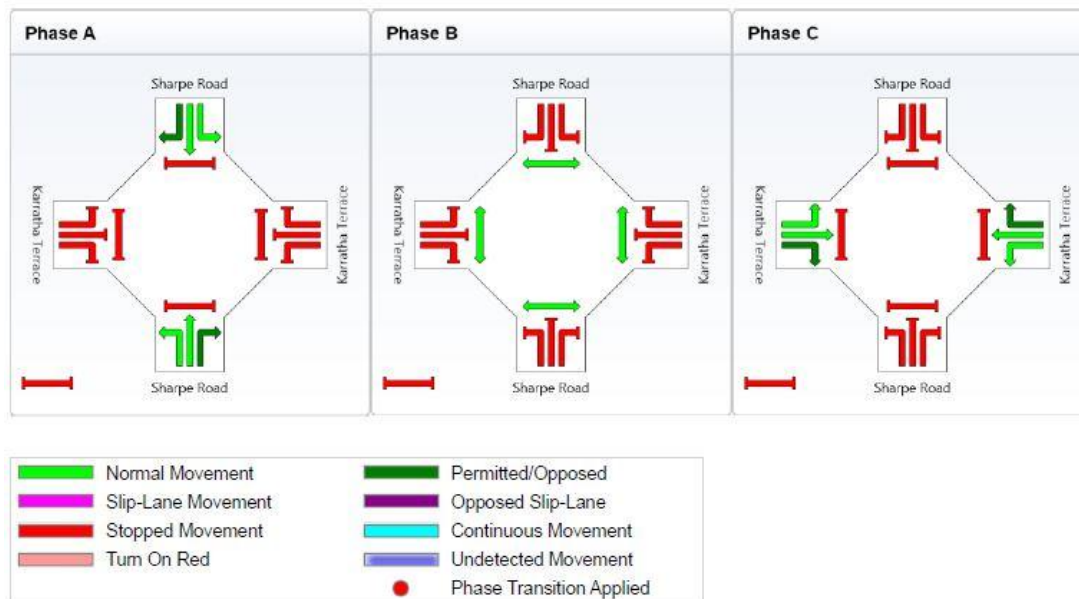
Sequence: Scramble

Input Sequence: A, B, C

Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Green Time (sec)	36	13	33
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	42	19	39
Phase Split	42 %	19 %	39 %



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SIDRA
INTERSECTION

A2.12 Karratha Terrace/ Sharpe Avenue - Parallel Walk

Note: Geometry will be identical to A2.11

MOVEMENT SUMMARY

Site: 8. Karratha Tce Sharpe (4 to 5pm) - Parallel Walk

Karratha Terrace / Sharpe Road 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn w/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Sharpe Road											
1	L	46	0.0	0.198	23.0	LOS C	5.0	35.0	0.64	0.77	28.5
2	T	125	0.0	0.198	17.7	LOS B	5.0	35.0	0.64	0.53	28.6
3	R	84	0.0	0.757	43.4	LOS D	3.7	25.7	0.78	0.92	22.0
Approach		256	0.0	0.757	27.1	LOS C	5.0	35.0	0.69	0.70	26.0
East: Karratha Terrace											
4	L	51	0.0	0.272	25.3	LOS C	7.0	49.2	0.69	0.84	31.2
5	T	175	0.0	0.272	19.6	LOS B	7.0	49.2	0.69	0.58	32.5
6	R	74	0.0	0.605	31.8	LOS C	2.6	18.1	0.72	0.77	27.5
Approach		299	0.0	0.605	23.6	LOS C	7.0	49.2	0.69	0.67	30.9
North: Sharpe Road											
7	L	132	0.0	0.491	26.1	LOS C	14.5	101.7	0.76	0.82	27.3
8	T	293	0.0	0.491	20.8	LOS C	14.5	101.7	0.76	0.66	27.2
9	R	59	0.0	0.444	25.4	LOS C	1.8	12.4	0.65	0.70	27.2
Approach		483	0.0	0.491	22.8	LOS C	14.5	101.7	0.74	0.71	27.3
West: Karratha Terrace											
10	L	35	0.0	0.302	25.6	LOS C	8.0	55.8	0.70	0.86	31.1
11	T	217	0.0	0.302	19.9	LOS B	8.0	55.8	0.70	0.59	32.4
12	R	96	0.0	0.774	42.5	LOS D	4.0	28.1	0.74	0.90	24.0
Approach		347	0.0	0.774	26.7	LOS C	8.0	55.8	0.71	0.70	29.5
All Vehicles		1385	0.0	0.774	24.7	LOS C	14.5	101.7	0.71	0.70	28.3

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	20.5	LOS C	0.1	0.1	0.64	0.64
P3	Across E approach	53	19.2	LOS B	0.1	0.1	0.62	0.62
P5	Across N approach	53	20.5	LOS C	0.1	0.1	0.64	0.64
P7	Across W approach	53	19.2	LOS B	0.1	0.1	0.62	0.62
All Pedestrians		212	19.9	LOS B			0.63	0.63

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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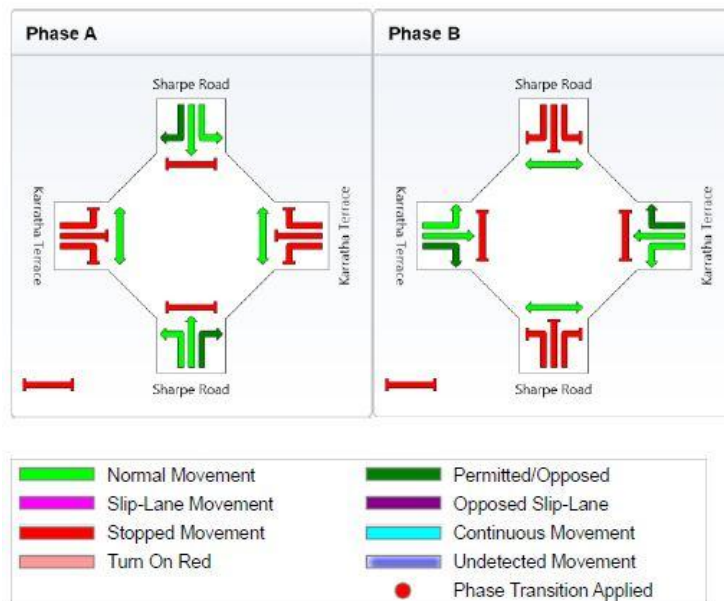
SIDRA
INTERSECTION

Site: 8. Karratha Tce_Sharpe (4 to 5pm) - Parallel Walk

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Output Sequence: A, B

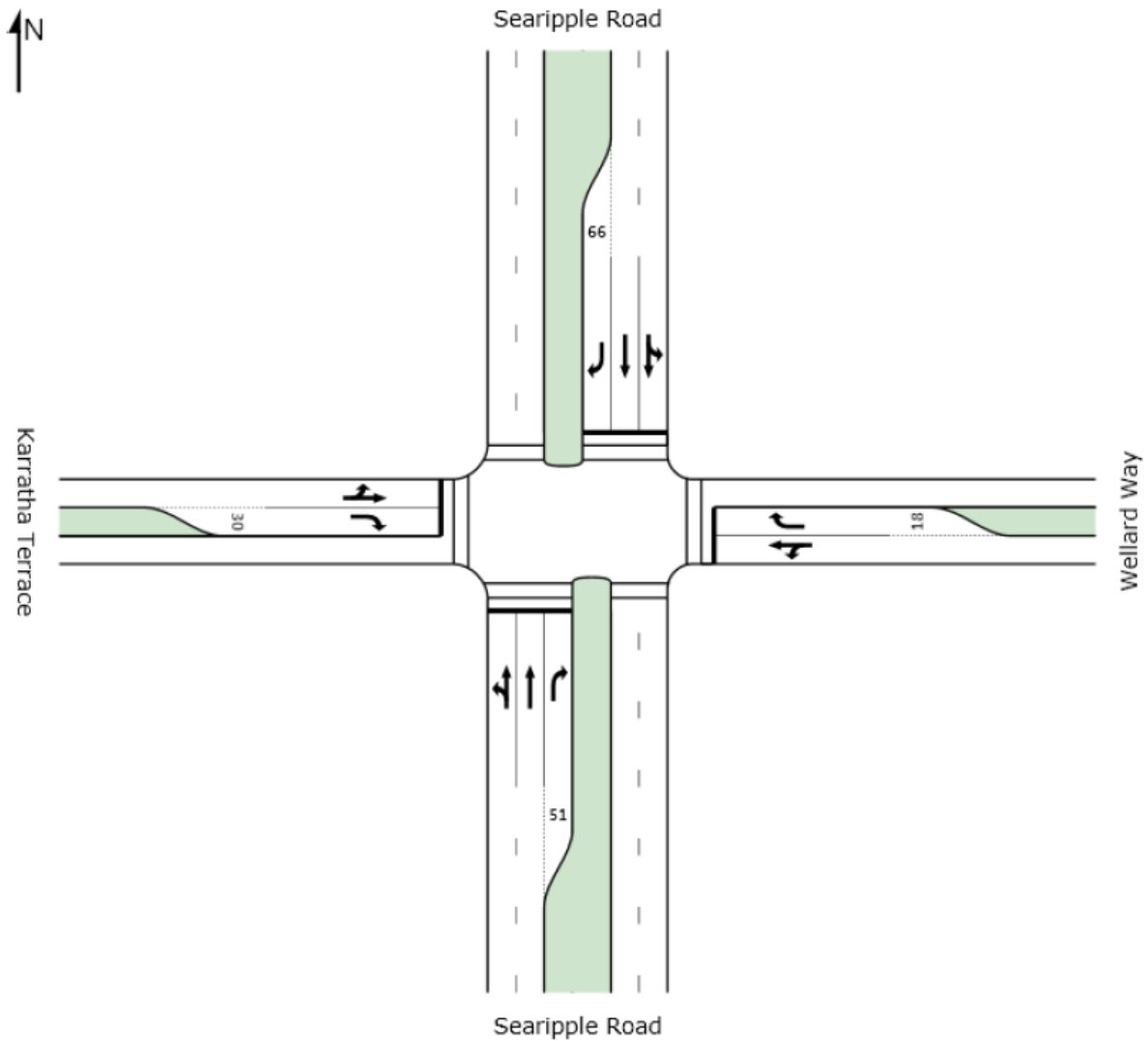
Phase	A	B
Green Time (sec)	45	43
Yellow Time (sec)	4	4
All-Red Time (sec)	2	2
Phase Time (sec)	51	49
Phase Split	51 %	49 %



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SIDRA
INTERSECTION

A2.13 Searipple Road/ Karratha Terrace - Scramble Phase



MOVEMENT SUMMARY**Site: 9. Searipple_Karratha Tce (4 to 5pm)**

Searipple Road / Karratha Terrace 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Searipple Road											
1	L	43	0.0	0.343	39.0	LOS D	6.8	47.9	0.86	0.82	26.4
2	T	302	0.0	0.343	32.6	LOS C	6.9	48.5	0.86	0.70	26.9
3	R	174	0.0	0.955	80.9	LOS F	11.4	79.9	1.00	1.18	17.0
Approach		519	0.0	0.955	49.3	LOS D	11.4	79.9	0.91	0.87	22.5
East: Wellard Way											
4	L	138	0.0	0.375	34.0	LOS C	8.8	61.4	0.81	0.82	27.8
5	T	97	0.0	0.375	27.6	LOS C	8.8	61.4	0.81	0.68	28.3
6	R	72	0.0	0.656	39.7	LOS D	2.9	20.2	0.80	0.80	25.6
Approach		306	0.0	0.656	33.3	LOS C	8.8	61.4	0.81	0.77	27.4
North: Searipple Road											
7	L	96	0.0	0.594	41.7	LOS D	12.8	89.7	0.93	0.84	25.5
8	T	502	0.0	0.594	35.3	LOS D	13.0	91.1	0.93	0.79	25.9
9	R	154	0.0	0.527	46.7	LOS D	7.0	48.8	0.95	0.81	23.6
Approach		752	0.0	0.594	38.4	LOS D	13.0	91.1	0.93	0.80	25.3
West: Karratha Terrace											
10	L	20	0.0	0.316	33.4	LOS C	7.3	51.3	0.79	0.83	28.5
11	T	181	0.0	0.316	27.0	LOS C	7.3	51.3	0.79	0.66	29.0
12	R	165	0.0	1.000 ³	44.1	LOS D	7.0	49.0	0.96	0.80	24.3
Approach		366	0.0	1.000	35.1	LOS D	7.3	51.3	0.87	0.73	26.6
All Vehicles		1943	0.0	1.000	39.9	LOS D	13.0	91.1	0.89	0.80	25.0

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

3 x = 1.00 due to short lane. Refer to the Lane Summary report for information about excess flow and related conditions.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P3	Across E approach	53	35.3	LOS D	0.1	0.1	0.84	0.84
P5	Across N approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P7	Across W approach	53	35.3	LOS D	0.1	0.1	0.84	0.84
All Pedestrians		212	39.7	LOS D			0.89	0.89

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY**Site: 9. Searipple_Karratha Tce (4 to 5pm)**

Searipple Road / Karratha Terrace 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

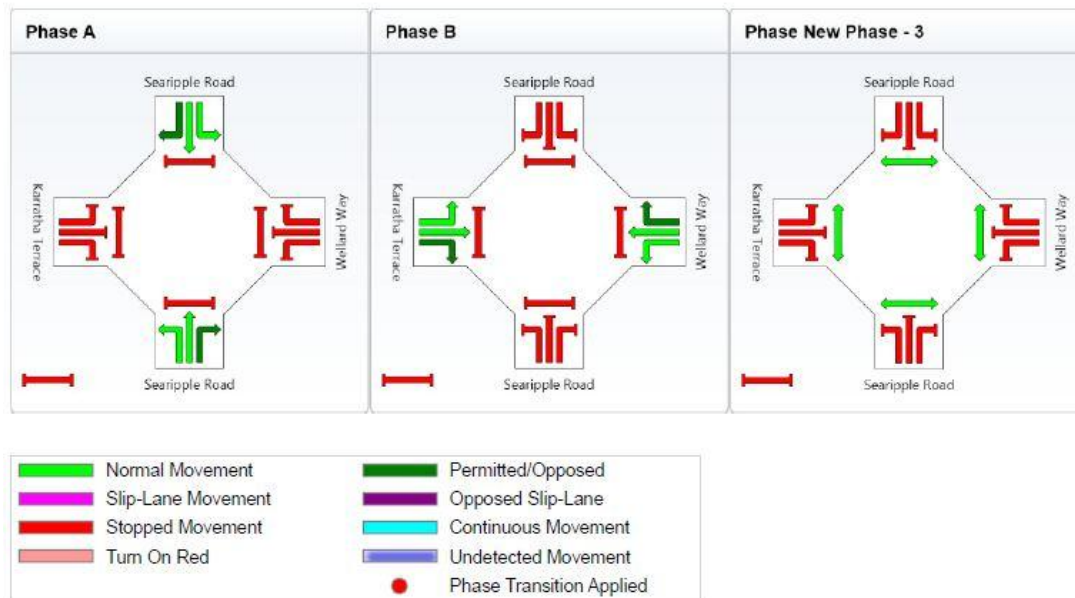
Sequence: Scramble

Input Sequence: A, B, New Phase - 3

Output Sequence: A, B, New Phase - 3

Phase Timing Results

Phase	A	B	New Phase - 3
Green Time (sec)	26	33	23
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	32	39	29
Phase Split	32 %	39 %	29 %



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INTERSECTION

A2.14 Searipple Road/ Karratha Terrace - Parallel Walk

Note: Geometry will be identical to A2.13

MOVEMENT SUMMARY

Site: 9. Searipple_Karratha Tce (4 to 5pm) - Parallel Walk

Searipple Road / Karratha Terrace 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Searipple Road											
1	L	43	0.0	0.297	35.4	LOS D	6.4	45.1	0.81	0.82	27.7
2	T	302	0.0	0.297	29.0	LOS C	6.5	45.7	0.81	0.67	28.3
3	R	174	0.0	0.745	53.0	LOS D	8.8	61.8	1.00	0.91	22.0
Approach		519	0.0	0.745	37.6	LOS D	8.8	61.8	0.88	0.76	25.8
East: Wellard Way											
4	L	138	0.0	0.214	17.1	LOS B	5.4	37.8	0.51	0.78	35.8
5	T	97	0.0	0.214	10.7	LOS B	5.4	37.8	0.51	0.43	37.9
6	R	72	0.0	0.421	17.9	LOS B	1.7	11.6	0.51	0.68	35.0
Approach		306	0.0	0.421	15.2	LOS B	5.4	37.8	0.51	0.65	36.2
North: Searipple Road											
7	L	96	0.0	0.515	37.8	LOS D	12.1	84.4	0.88	0.84	26.8
8	T	502	0.0	0.515	31.4	LOS C	12.2	85.7	0.88	0.75	27.3
9	R	154	0.0	0.484	41.8	LOS D	6.5	45.7	0.90	0.80	25.0
Approach		752	0.0	0.515	34.3	LOS C	12.2	85.7	0.88	0.77	26.7
West: Karratha Terrace											
10	L	20	0.0	0.157	16.7	LOS B	3.9	27.4	0.49	0.85	36.5
11	T	157	0.0	0.157	10.3	LOS B	3.9	27.4	0.49	0.41	38.8
12	R	189	0.0	0.744	30.4	LOS C	6.1	42.8	0.70	0.84	28.9
Approach		366	0.0	0.744	21.0	LOS C	6.1	42.8	0.60	0.66	32.9
All Vehicles		1943	0.0	0.745	29.7	LOS C	12.2	85.7	0.77	0.73	28.6

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	17.4	LOS B	0.1	0.1	0.59	0.59
P3	Across E approach	53	29.6	LOS C	0.1	0.1	0.77	0.77
P5	Across N approach	53	17.4	LOS B	0.1	0.1	0.59	0.59
P7	Across W approach	53	29.6	LOS C	0.1	0.1	0.77	0.77
All Pedestrians		212	23.5	LOS C			0.68	0.68

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY**Site: 9. Searipple_Karratha Tce (4 to 5pm) - Parallel Walk**

Searipple Road / Karratha Terrace 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

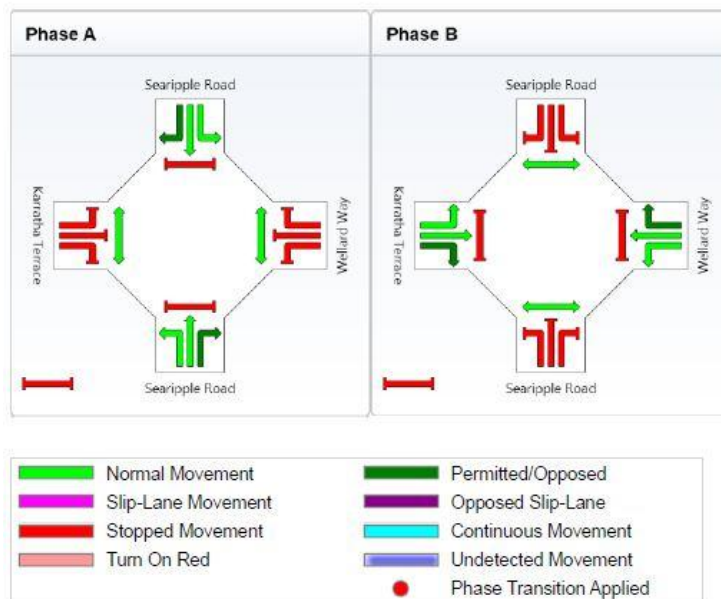
Sequence: Two-Phase

Input Sequence: A, B

Output Sequence: A, B

Phase Timing Results

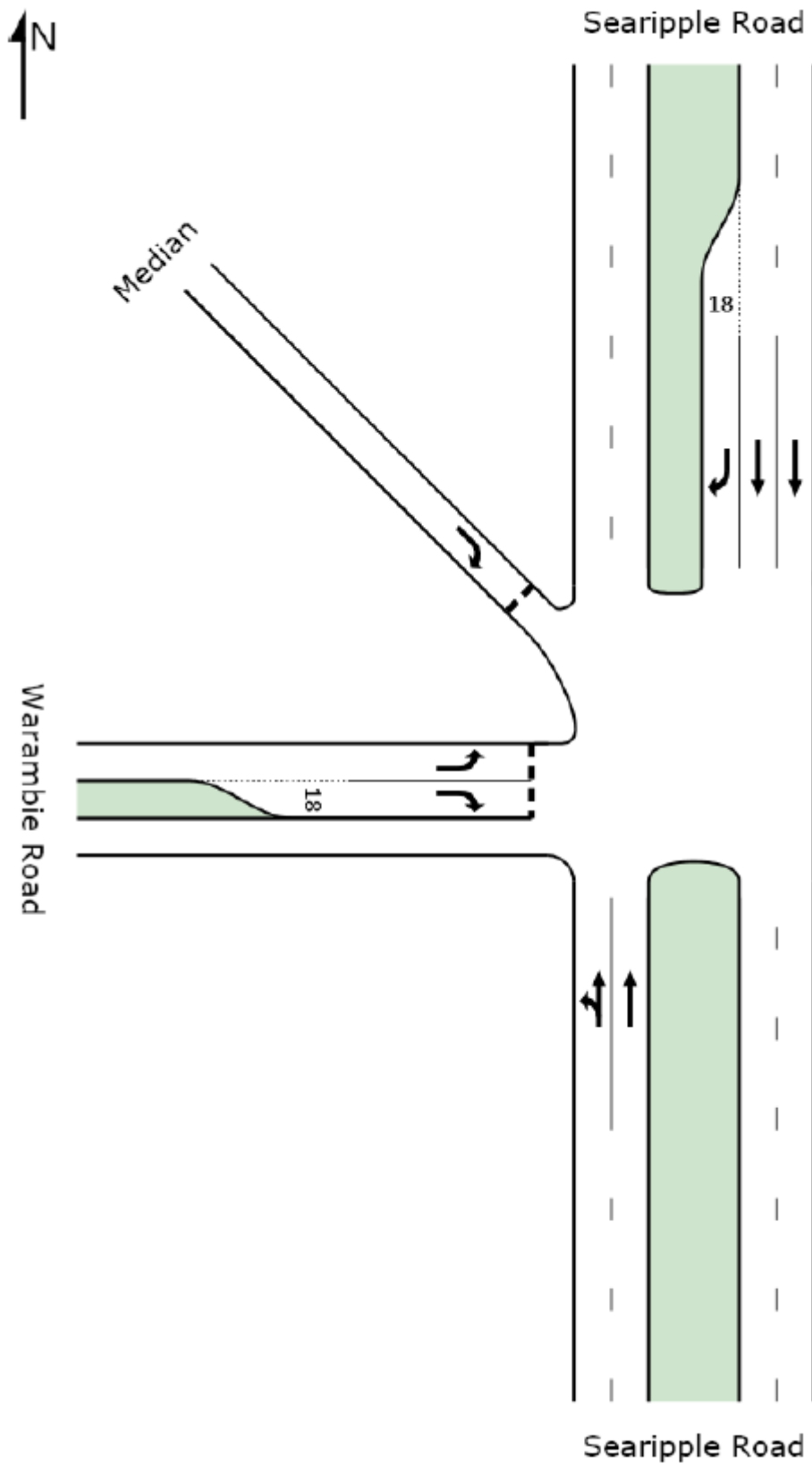
Phase	A	B
Green Time (sec)	30	58
Yellow Time (sec)	4	4
All-Red Time (sec)	2	2
Phase Time (sec)	36	64
Phase Split	36 %	64 %



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INTERSECTION

A2.15 Searipple Road/ Warambie Road



MOVEMENT SUMMARY**Site: 10. Searipple_Warambie (4 to 5pm)**Searipple Road / Warambie Road 4pm to 5pm
Giveaway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. 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: Searipple Road											
1	L	125	0.0	0.125	5.6	LOS A	0.0	0.0	0.00	0.71	43.2
2	T	356	0.0	0.125	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		481	0.0	0.125	1.5	NA	0.0	0.0	0.00	0.19	48.1
North: Searipple Road											
8	T	354	0.0	0.091	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
9	R	161	0.0	0.251	8.3	LOS A	0.9	6.0	0.51	0.73	40.8
Approach		515	0.0	0.251	2.6	NA	0.9	6.0	0.16	0.23	46.8
North West: Median											
29	R	215	0.0	0.183	2.8	LOS A	1.1	7.7	0.56	0.46	20.6
Approach		215	0.0	0.183	2.8	LOS A	1.1	7.7	0.56	0.46	20.6
West: Warambie Road											
10	L	87	0.0	0.076	7.4	LOS A	0.4	2.7	0.46	0.61	35.7
12	R	215	0.0	0.301	7.7	LOS A	1.2	8.3	0.56	0.70	34.5
Approach		302	0.0	0.301	7.6	LOS A	1.2	8.3	0.53	0.67	34.8
All Vehicles		1513	0.0	0.301	3.3	NA	1.2	8.3	0.24	0.34	37.7

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

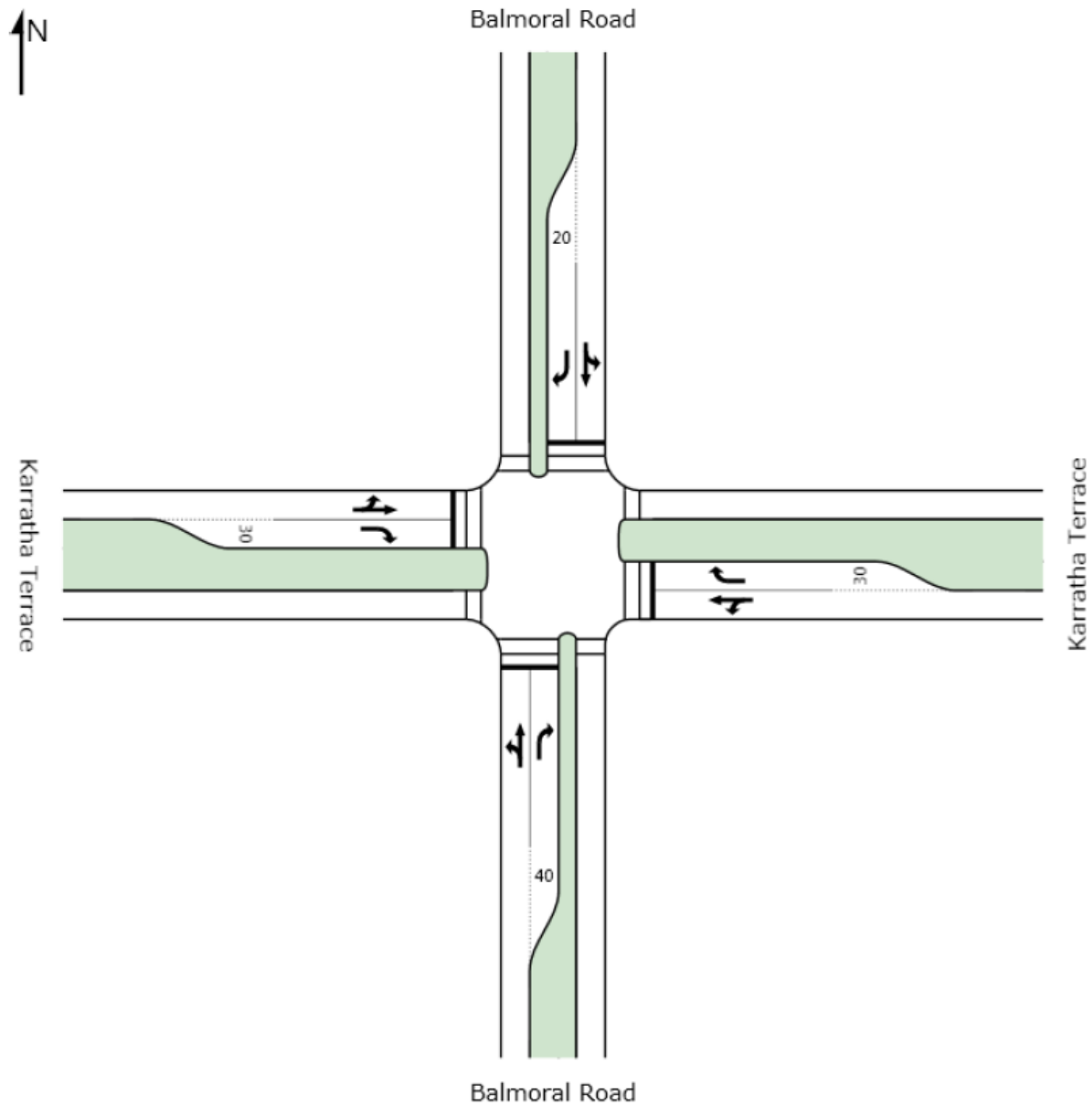
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SIDRA
INTERSECTION

A3 Long Term

A3.1 Karratha Terrace/ Balmoral Road - Scramble phase



MOVEMENT SUMMARY**Site: 1. Karratha Tce_Balmoral (3 to 4pm)**

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Balmoral Road											
1	L	118	8.1	0.801	35.1	LOS D	28.7	214.8	0.93	0.93	28.0
2	T	528	8.1	0.801	28.5	LOS C	28.7	214.8	0.93	0.87	28.2
3	R	120	8.1	0.648	44.9	LOS D	5.4	40.8	0.92	0.83	23.4
Approach		766	8.1	0.801	32.1	LOS C	28.7	214.8	0.93	0.88	27.3
East: Karratha Terrace											
4	L	115	8.1	0.798	50.7	LOS D	15.4	115.2	1.00	0.95	20.7
5	T	189	8.1	0.798	45.2	LOS D	15.4	115.2	1.00	0.95	20.5
6	R	100	8.1	0.738	53.6	LOS D	4.9	37.0	0.97	0.91	19.9
Approach		404	8.1	0.798	48.9	LOS D	15.4	115.2	0.99	0.94	20.4
North: Balmoral Road											
7	L	68	8.1	0.683	29.9	LOS C	21.5	160.9	0.86	0.89	29.4
8	T	483	8.1	0.683	24.1	LOS C	21.5	160.9	0.86	0.77	30.2
9	R	90	8.1	1.000 ³	52.5	LOS D	4.4	32.6	0.98	0.78	22.1
Approach		641	8.1	1.000	28.7	LOS C	21.5	160.9	0.88	0.78	28.6
West: Karratha Terrace											
10	L	65	8.1	0.467	44.5	LOS D	7.8	58.0	0.92	0.82	24.7
11	T	113	8.1	0.467	39.3	LOS D	7.8	58.0	0.92	0.77	24.3
12	R	94	8.1	0.899	69.8	LOS E	5.4	40.5	1.00	1.03	18.7
Approach		272	8.1	0.899	51.1	LOS D	7.8	58.0	0.95	0.87	22.0
All Vehicles		2083	8.1	1.000	36.8	LOS D	28.7	214.8	0.93	0.86	25.2

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

³ x = 1.00 due to short lane. Refer to the Lane Summary report for information about excess flow and related conditions.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	42.3	LOS E	0.1	0.1	0.92	0.92
P3	Across E approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P5	Across N approach	53	42.3	LOS E	0.1	0.1	0.92	0.92
P7	Across W approach	53	42.3	LOS E	0.1	0.1	0.92	0.92
All Pedestrians		212	42.8	LOS E			0.93	0.93

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY**Site: 1. Karratha Tce_Balmoral (3 to 4pm)**

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

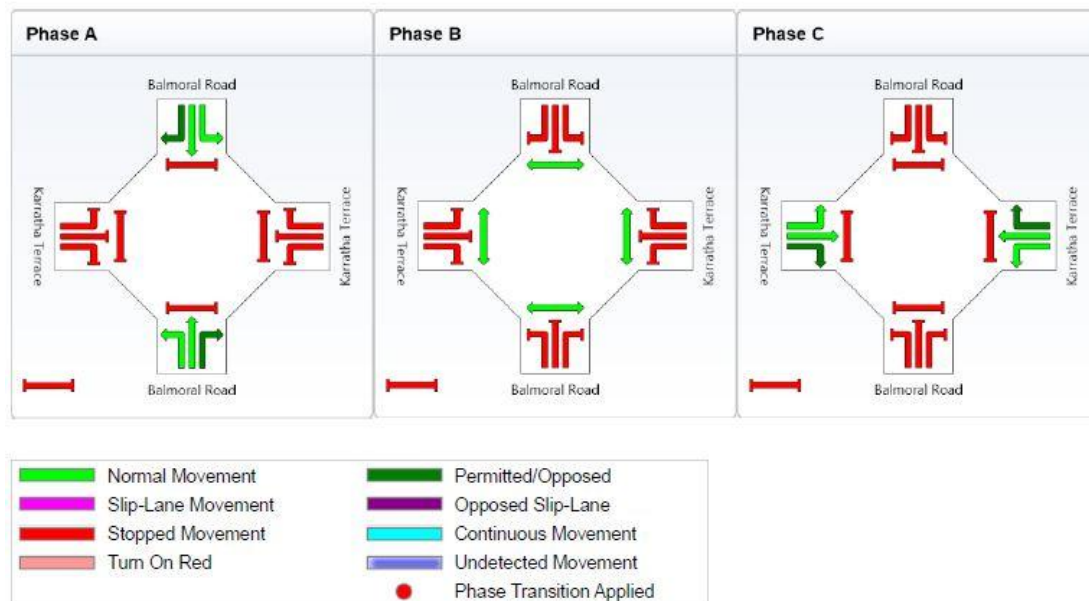
Sequence: Scramble

Input Sequence: A, B, C

Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Green Time (sec)	44	17	21
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	50	23	27
Phase Split	50 %	23 %	27 %

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INTERSECTION**

A3.2 Karratha Terrace/ Balmoral Road – Parallel Walk

Note: Geometry will be identical to A3.1

MOVEMENT SUMMARY

Site: 1. Karratha Tce Balmoral (3 to 4pm) - Parallel Walk

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 55 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn w/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Balmoral Road											
1	L	118	8.1	0.692	18.0	LOS B	13.5	101.1	0.81	0.89	36.3
2	T	528	8.1	0.692	11.4	LOS B	13.5	101.1	0.81	0.73	37.1
3	R	120	8.1	0.360	21.2	LOS C	2.5	18.9	0.79	0.76	32.4
Approach		766	8.1	0.692	14.0	LOS B	13.5	101.1	0.81	0.76	36.2
East: Karratha Terrace											
4	L	115	8.1	0.615	25.2	LOS C	7.5	55.9	0.93	0.84	27.7
5	T	189	8.1	0.615	19.7	LOS B	7.5	55.9	0.93	0.79	27.6
6	R	100	8.1	0.403	26.4	LOS C	2.4	17.9	0.89	0.75	27.0
Approach		404	8.1	0.615	22.9	LOS C	7.5	55.9	0.92	0.79	27.5
North: Balmoral Road											
7	L	68	8.1	0.558	15.9	LOS B	9.8	73.0	0.73	0.88	36.9
8	T	454	8.1	0.558	10.1	LOS B	9.8	73.0	0.73	0.65	38.3
9	R	119	8.1	0.687	28.8	LOS C	3.1	23.0	0.87	0.88	29.6
Approach		641	8.1	0.687	14.2	LOS B	9.8	73.0	0.76	0.72	36.2
West: Karratha Terrace											
10	L	65	8.1	0.359	24.6	LOS C	4.0	29.9	0.85	0.81	32.3
11	T	113	8.1	0.359	19.3	LOS B	4.0	29.9	0.85	0.71	32.3
12	R	94	8.1	0.401	32.1	LOS C	2.5	18.6	0.96	0.77	28.3
Approach		272	8.1	0.401	25.0	LOS C	4.0	29.9	0.89	0.75	30.7
All Vehicles		2083	8.1	0.692	17.2	LOS B	13.5	101.1	0.83	0.75	33.3

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	21.8	LOS C	0.1	0.1	0.89	0.89
P3	Across E approach	53	13.1	LOS B	0.1	0.1	0.69	0.69
P5	Across N approach	53	21.8	LOS C	0.1	0.1	0.89	0.89
P7	Across W approach	53	11.8	LOS B	0.1	0.1	0.65	0.65
All Pedestrians		212	17.1	LOS B			0.78	0.78

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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INTERSECTION**

PHASING SUMMARY

Site: 1. Karratha Tce_Balmoral (3 to 4pm) - Parallel Walk

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 55 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

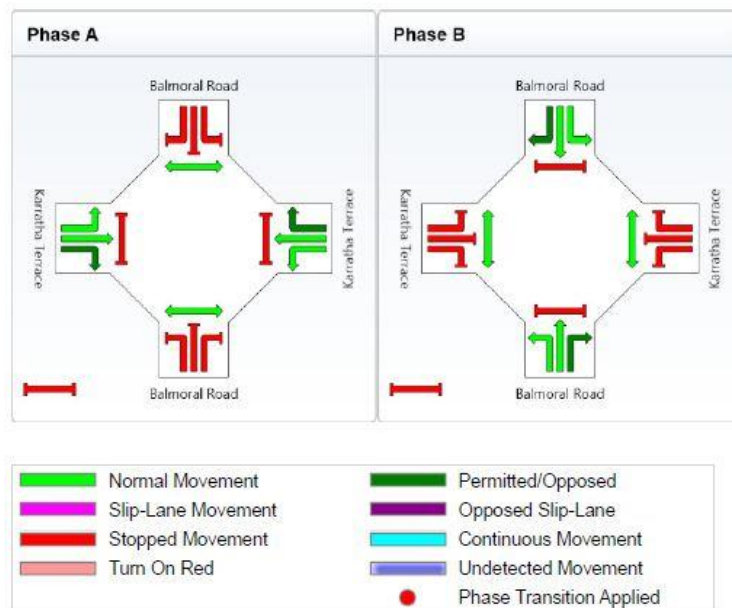
Sequence: Two-Phase

Input Sequence: A, B

Output Sequence: A, B

Phase Timing Results

Phase	A	B
Green Time (sec)	15	28
Yellow Time (sec)	4	4
All-Red Time (sec)	2	2
Phase Time (sec)	21	34
Phase Split	38 %	62 %



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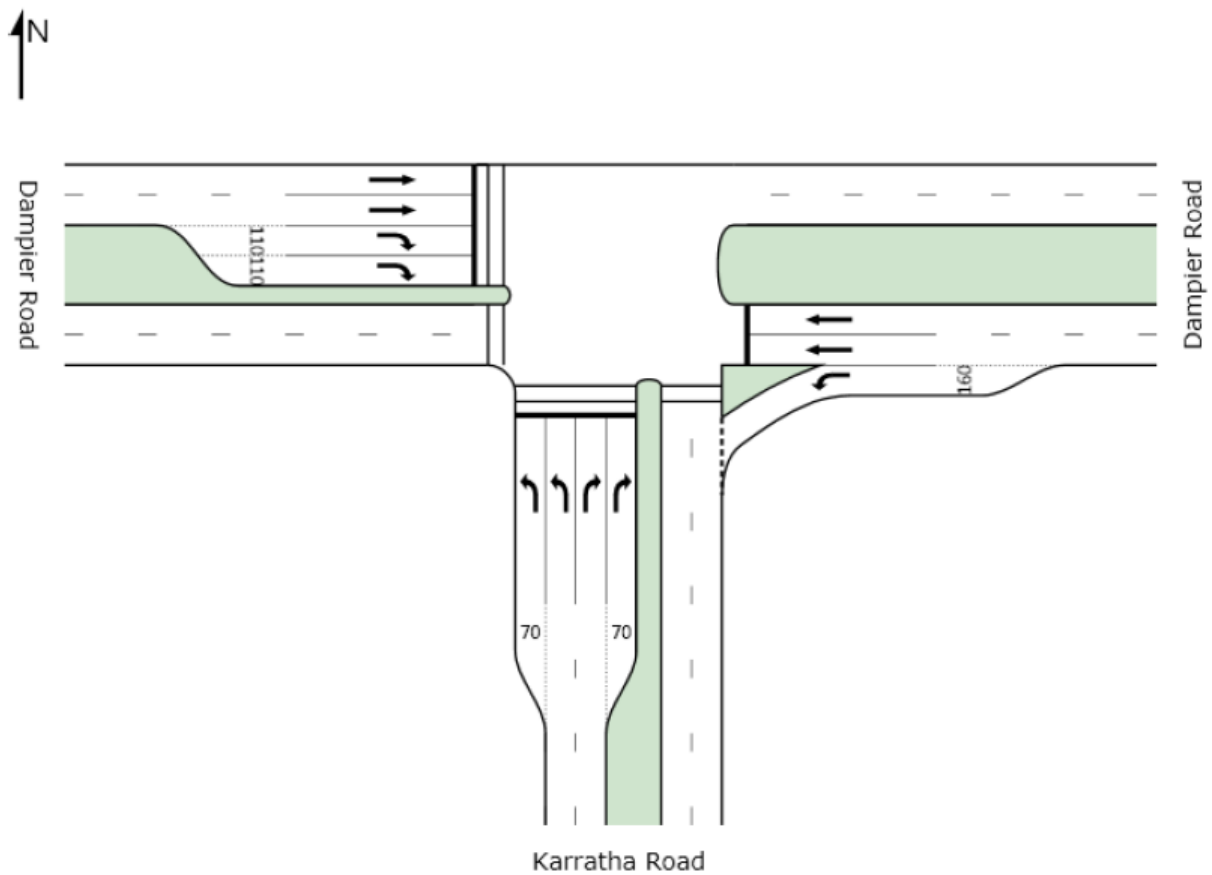
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**SIDRA
INTERSECTION**

A3.3 Dampier Road/ Karratha Road



MOVEMENT SUMMARY**Site: 2. Dampier_Karratha Rd (4 to 5pm)**

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 105 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Karratha Road											
1	L	974	8.1	0.559	18.1	LOS B	17.7	132.4	0.54	0.79	40.2
3	R	1331	8.1	1.135	142.4	LOS F	107.4	804.2	1.00	1.34	12.3
Approach		2304	8.1	1.135	89.8	LOS F	107.4	804.2	0.81	1.11	17.4
East: Dampier Road											
4	L	937	8.1	0.788	12.8	LOS B	17.1	127.9	0.49	0.79	44.6
5	T	849	8.1	1.003	92.5	LOS F	33.3	249.1	1.00	1.35	16.5
Approach		1786	8.1	1.003	50.7	LOS D	33.3	249.1	0.73	1.05	24.7
West: Dampier Road											
11	T	1080	8.1	0.692	26.2	LOS C	22.8	170.6	0.87	0.78	32.7
12	R	530	8.1	1.056	137.1	LOS F	23.8	178.5	1.00	1.34	12.7
Approach		1609	8.1	1.056	62.7	LOS E	23.8	178.5	0.91	0.96	21.5
All Vehicles		5700	8.1	1.135	69.9	LOS E	107.4	804.2	0.81	1.05	20.4

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	46.7	LOS E	0.1	0.1	0.94	0.94
P7	Across W approach	53	26.1	LOS C	0.1	0.1	0.70	0.70
All Pedestrians		106	36.4	LOS D			0.82	0.82

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY**Site: 2. Dampier_Karratha Rd (4 to 5pm)**

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 105 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

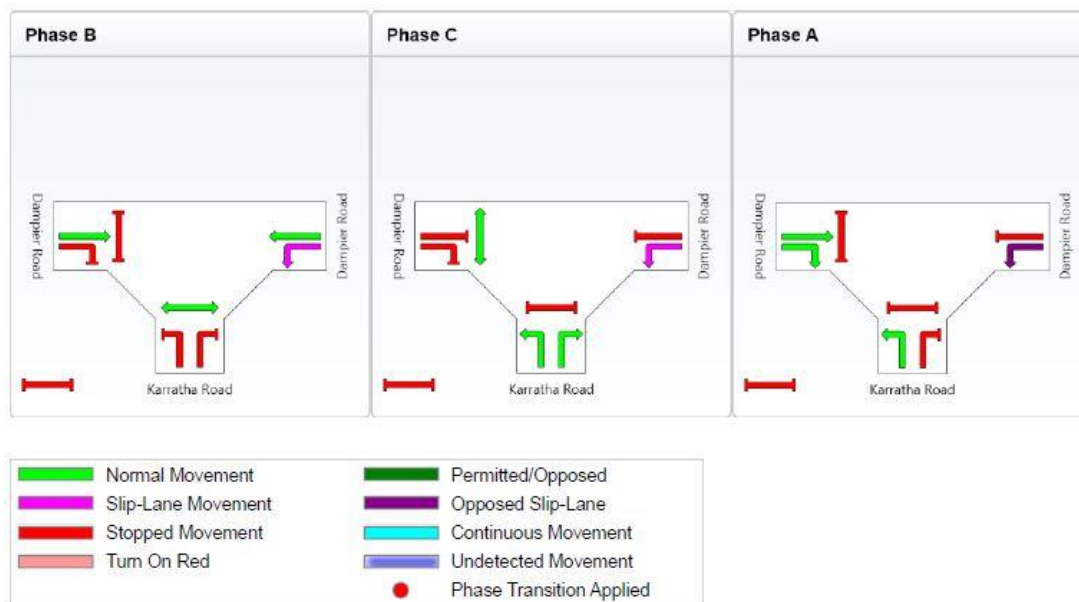
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Input Sequence: B, C, A

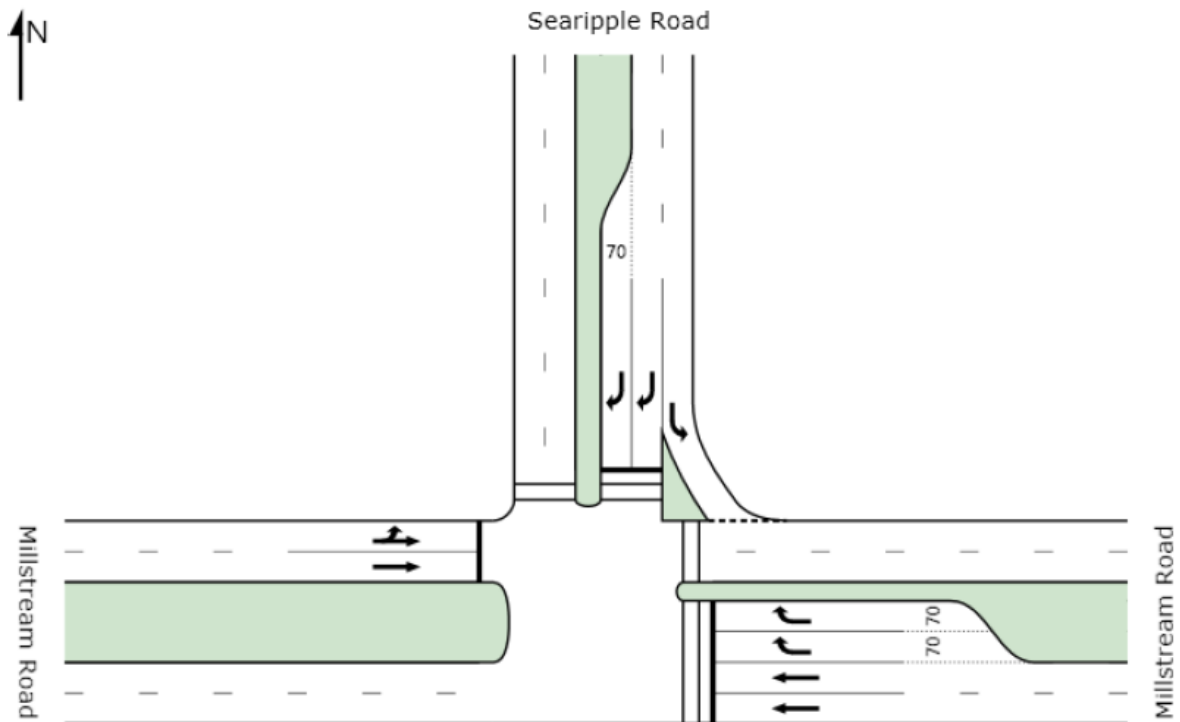
Output Sequence: B, C, A

Phase Timing Results

Phase	B	C	A
Green Time (sec)	24	48	15
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	30	54	21
Phase Split	29 %	51 %	20 %

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INTERSECTION**

A3.4 Searipple Road/ Millstream Road



MOVEMENT SUMMARY**Site: 3. Searipple_Millstream (4 to 5pm)**

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 105 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn w/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Millstream Road											
11	T	971	8.1	0.417	10.4	LOS B	12.3	92.3	0.54	0.48	44.8
12	R	297	8.1	1.109	177.3	LOS F	15.3	114.2	1.00	1.40	9.8
Approach		1267	8.1	1.109	49.5	LOS D	15.3	114.2	0.65	0.70	24.8
North: Searipple Road											
1	L	491	8.1	0.638	32.7	LOS C	15.7	117.3	0.83	0.97	29.2
3	R	826	8.1	1.116	128.4	LOS F	55.2	413.2	0.99	1.29	12.8
Approach		1317	8.1	1.116	92.7	LOS F	55.2	413.2	0.93	1.17	16.3
West: Millstream Road											
4	L	622	8.1	1.116	171.4	LOS F	118.7	888.3	1.00	1.61	10.1
5	T	1448	8.1	1.116	164.2	LOS F	118.7	888.3	1.00	1.79	10.7
Approach		2071	8.1	1.116	166.4	LOS F	118.7	888.3	1.00	1.73	10.5
All Vehicles		4655	8.1	1.116	113.7	LOS F	118.7	888.3	0.89	1.29	14.2

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P7	Across E approach	53	43.0	LOS E	0.1	0.1	0.90	0.90
P1	Across N approach	53	20.1	LOS C	0.1	0.1	0.62	0.62
All Pedestrians		106	31.5	LOS D			0.76	0.76

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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INTERSECTION**

PHASING SUMMARY**Site: 3. Searipple_Millstream (4 to 5pm)**

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 105 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

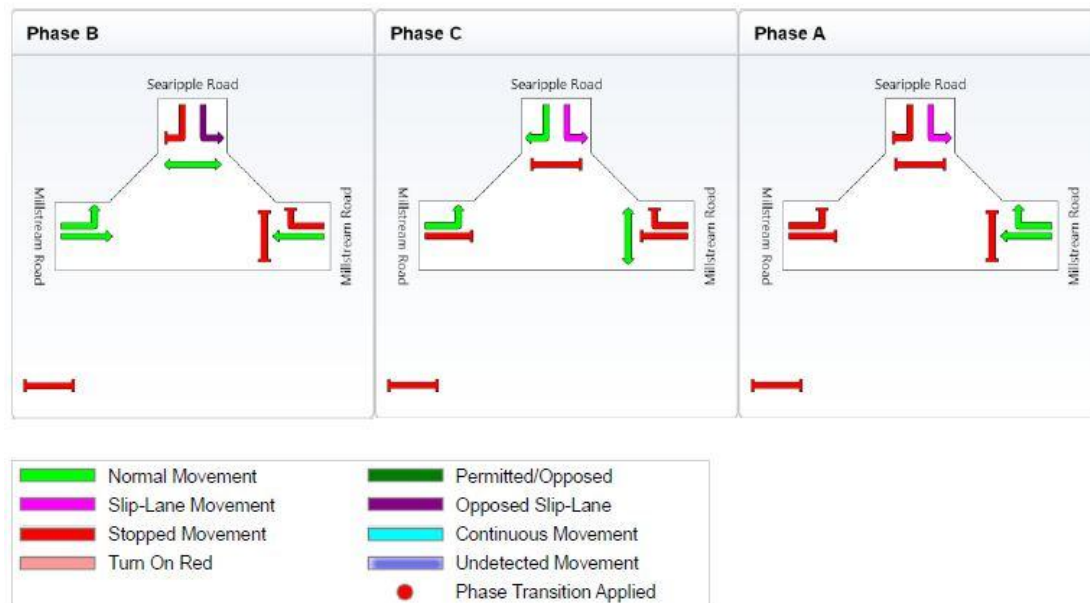
Sequence:

Input Sequence: B, C, A

Output Sequence: B, C, A

Phase Timing Results

Phase	B	C	A
Green Time (sec)	52	27	8
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	58	33	14
Phase Split	55 %	31 %	13 %



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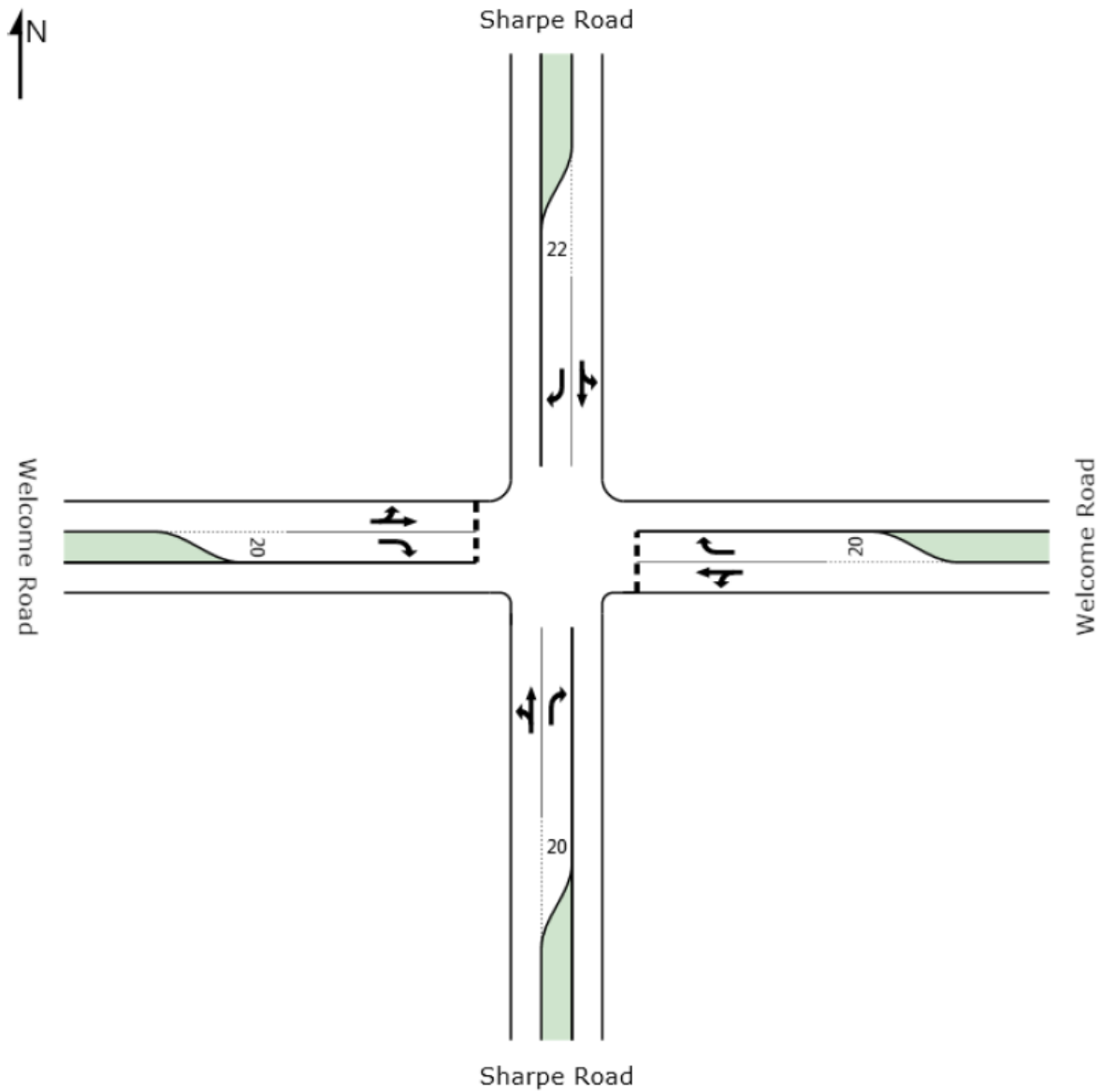
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**SIDRA
INTERSECTION**

A3.5 Welcome Road/ Sharpe Avenue – Priority Control



MOVEMENT SUMMARY**Site: 4. Welcome_Sharpe (3 to 4pm)**New Site
Giveaway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Sharpe Road											
1	L	112	0.0	0.131	4.5	LOS A	0.0	0.0	0.00	0.61	36.7
2	T	138	0.0	0.131	0.0	LOS A	0.0	0.0	0.00	0.00	40.0
3	R	103	0.0	0.120	7.4	LOS A	0.4	2.8	0.49	0.69	34.8
Approach		353	0.0	0.131	3.6	NA	0.4	2.8	0.14	0.39	37.3
East: Welcome Road											
4	L	113	0.0	0.405	12.8	LOS B	2.2	15.9	0.69	0.99	32.0
5	T	101	8.1	0.405	11.6	LOS B	2.2	15.9	0.69	0.91	32.3
6	R	49	0.0	0.185	17.7	LOS C	0.6	4.5	0.78	0.90	29.5
Approach		263	3.1	0.405	13.2	LOS B	2.2	15.9	0.71	0.94	31.6
North: Sharpe Road											
7	L	71	0.0	0.318	4.5	LOS A	0.0	0.0	0.00	0.67	36.7
8	T	545	0.0	0.318	0.0	LOS A	0.0	0.0	0.00	0.00	40.0
9	R	22	0.0	0.022	5.4	LOS A	0.1	0.5	0.29	0.52	35.8
Approach		638	0.0	0.318	0.7	NA	0.1	0.5	0.01	0.09	39.4
West: Welcome Road											
10	L	42	0.0	0.474	15.4	LOS C	2.8	20.7	0.63	0.83	30.8
11	T	175	8.1	0.474	14.2	LOS B	2.8	20.7	0.63	0.91	31.1
12	R	255	0.0	0.973	38.9	LOS E	7.1	49.7	0.99	1.42	22.4
Approach		472	3.0	0.973	27.6	LOS D	7.1	49.7	0.83	1.18	25.7
All Vehicles		1725	1.3	0.973	10.6	NA	7.1	49.7	0.37	0.58	33.0

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

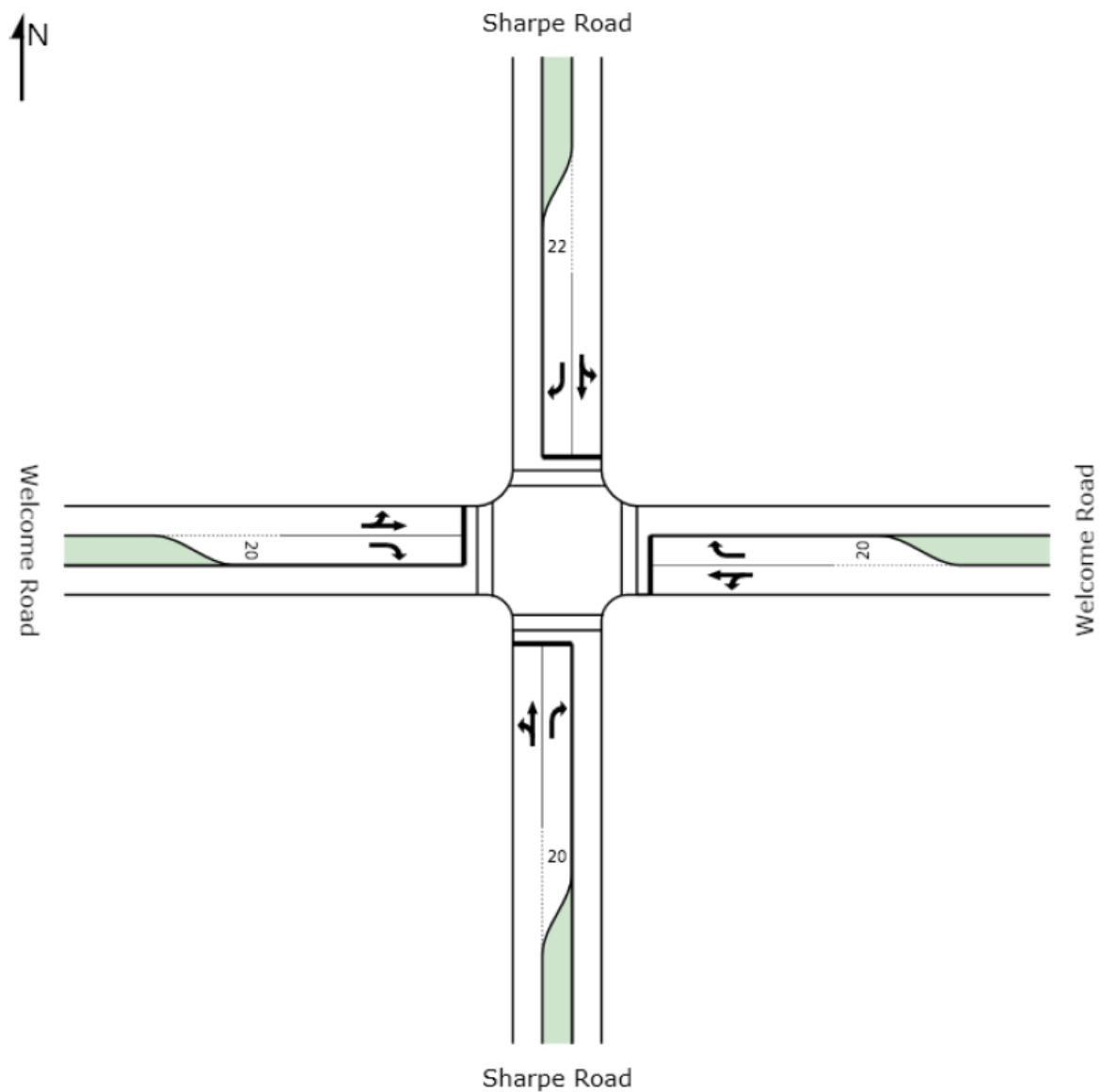
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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A3.6 Welcome Road/ Sharpe Avenue – Traffic Signal Control



MOVEMENT SUMMARY**Site: 4. Welcome_Sharpe (3 to 4pm)**

New Site

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Sharpe Road											
1	L	112	0.0	0.297	13.6	LOS B	4.1	28.8	0.36	0.69	31.6
2	T	138	0.0	0.297	9.2	LOS A	4.1	28.8	0.36	0.31	33.0
3	R	103	0.0	0.966	49.2	LOS D	4.7	32.6	0.90	0.80	20.1
Approach		353	0.0	0.966	22.3	LOS C	4.7	32.6	0.52	0.58	27.4
East: Welcome Road											
4	L	113	0.0	0.461	39.1	LOS D	8.9	64.7	0.90	0.81	22.6
5	T	101	8.1	0.461	34.6	LOS C	8.9	64.7	0.90	0.75	22.6
6	R	49	0.0	0.484	46.0	LOS D	2.2	15.3	0.91	0.73	20.7
Approach		263	3.1	0.484	38.7	LOS D	8.9	64.7	0.90	0.77	22.2
North: Sharpe Road											
7	L	71	0.0	0.722	29.1	LOS C	24.6	172.1	0.88	0.87	25.7
8	T	545	0.0	0.722	24.7	LOS C	24.6	172.1	0.88	0.79	25.8
9	R	22	0.0	0.142	24.2	LOS C	0.7	4.6	0.63	0.66	26.9
Approach		638	0.0	0.722	25.1	LOS C	24.6	172.1	0.87	0.79	25.9
West: Welcome Road											
10	L	42	0.0	0.795	46.4	LOS D	18.2	131.5	1.00	0.94	20.8
11	T	326	8.1	0.795	41.9	LOS D	18.2	131.5	1.00	0.93	20.8
12	R	103	0.0	1.000 ³	46.7	LOS D	4.7	32.6	0.94	0.77	20.6
Approach		472	3.0	1.000	43.4	LOS D	18.2	131.5	0.99	0.90	20.8
All Vehicles		1725	1.3	1.000	31.6	LOS C	24.6	172.1	0.84	0.77	23.9

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

3 x = 1.00 due to short lane. Refer to the Lane Summary report for information about excess flow and related conditions.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P3	Across E approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P5	Across N approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P7	Across W approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
All Pedestrians		212	44.2	LOS E			0.94	0.94

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY**Site: 4. Welcome_Sharpe (3 to 4pm)**

New Site

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

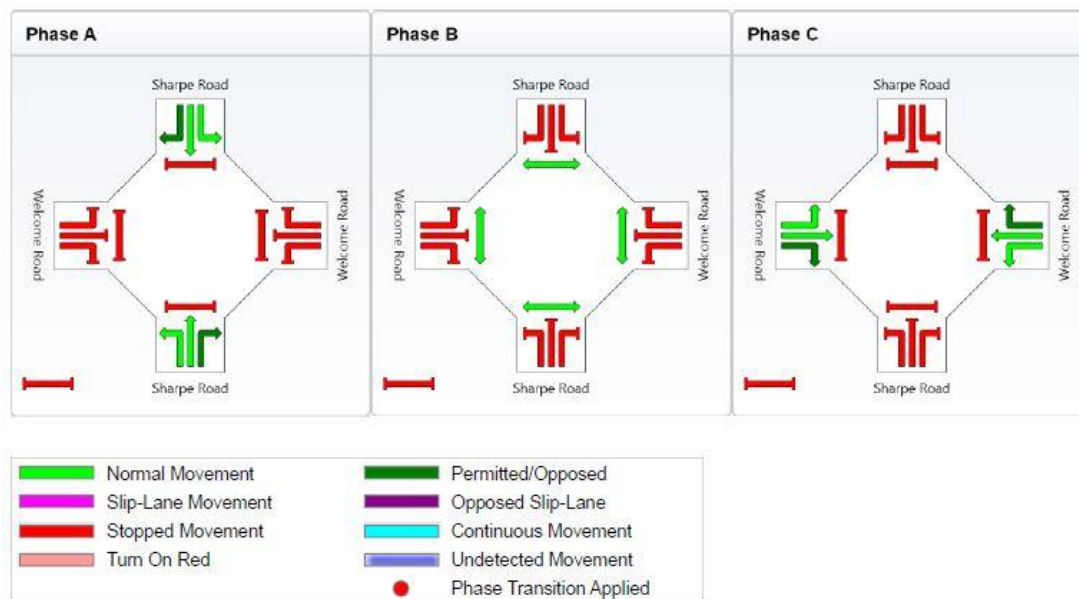
Sequence: Scramble

Input Sequence: A, B, C

Output Sequence: A, B, C

Phase Timing Results

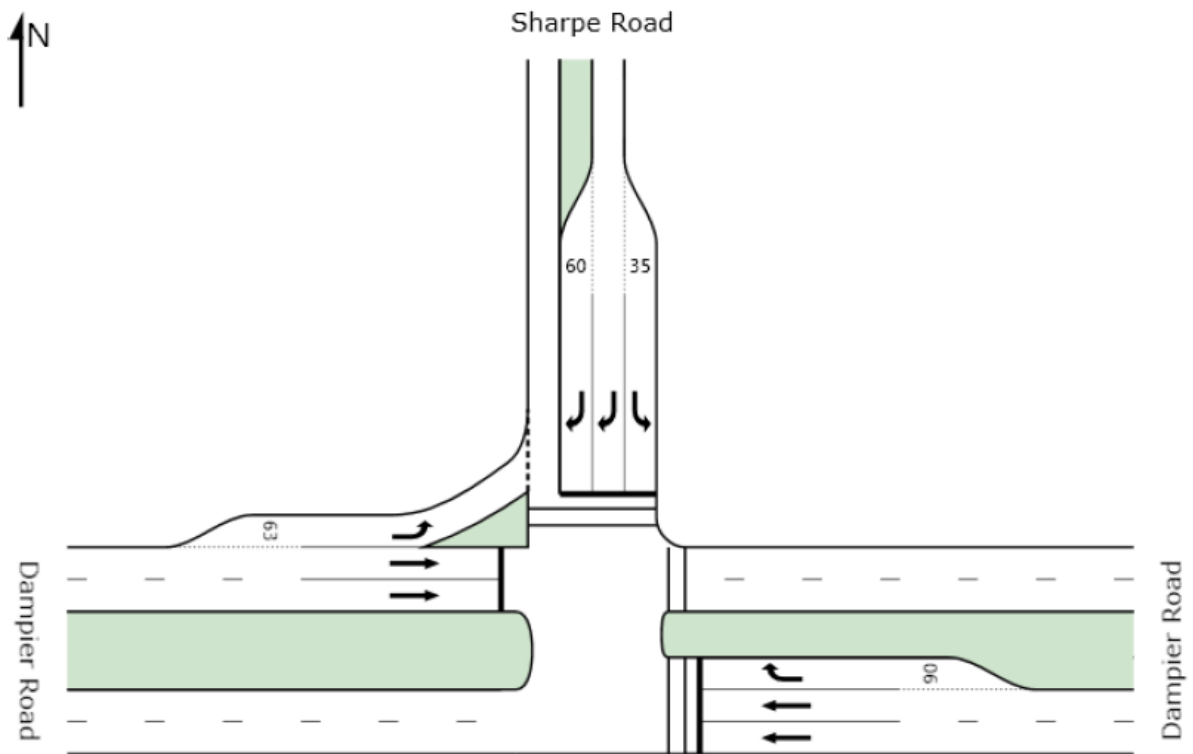
Phase	A	B	C
Green Time (sec)	44	13	25
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	50	19	31
Phase Split	50 %	19 %	31 %



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INTERSECTION

A3.7 Dampier Road/ Sharpe Avenue



MOVEMENT SUMMARY**Site: 5. Dampier_Sharpe (4 to 5pm)**

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Dampier Road											
11	T	1606	8.1	0.711	14.3	LOS B	26.7	200.0	0.75	0.68	40.9
12	R	211	0.0	0.945	75.2	LOS E	13.1	91.5	1.00	1.10	18.3
Approach		1817	7.2	0.945	21.4	LOS C	26.7	200.0	0.78	0.73	36.1
North: Sharpe Road											
1	L	99	0.0	0.392	28.7	LOS C	2.9	20.5	0.63	0.71	27.0
3	R	814	0.0	0.950	45.2	LOS D	27.4	191.5	0.97	0.98	22.5
Approach		913	0.0	0.950	43.4	LOS D	27.4	191.5	0.93	0.96	22.9
West: Dampier Road											
4	L	141	0.0	0.144	7.9	LOS A	1.2	8.4	0.23	0.61	47.6
5	T	1508	8.1	0.947	55.3	LOS E	48.4	362.4	1.00	1.18	22.9
Approach		1649	7.4	0.947	51.2	LOS D	48.4	362.4	0.93	1.13	23.9
All Vehicles		4379	5.8	0.950	37.2	LOS D	48.4	362.4	0.87	0.93	27.5

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P7	Across E approach	53	40.5	LOS E	0.1	0.1	0.90	0.90
P1	Across N approach	53	22.4	LOS C	0.1	0.1	0.67	0.67
All Pedestrians		106	31.5	LOS D			0.79	0.79

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY

Site: 5. Dampier_Sharpe (4 to 5pm)

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

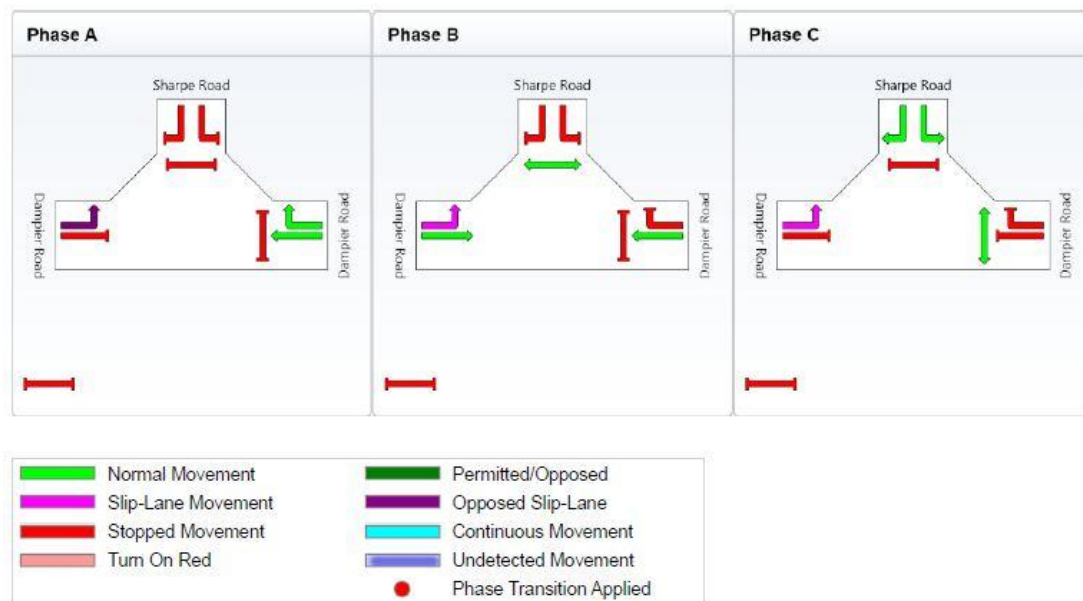
Sequence: Leading Right Turn

Input Sequence: A, B, C

Output Sequence: A, B, C

Phase Timing Results

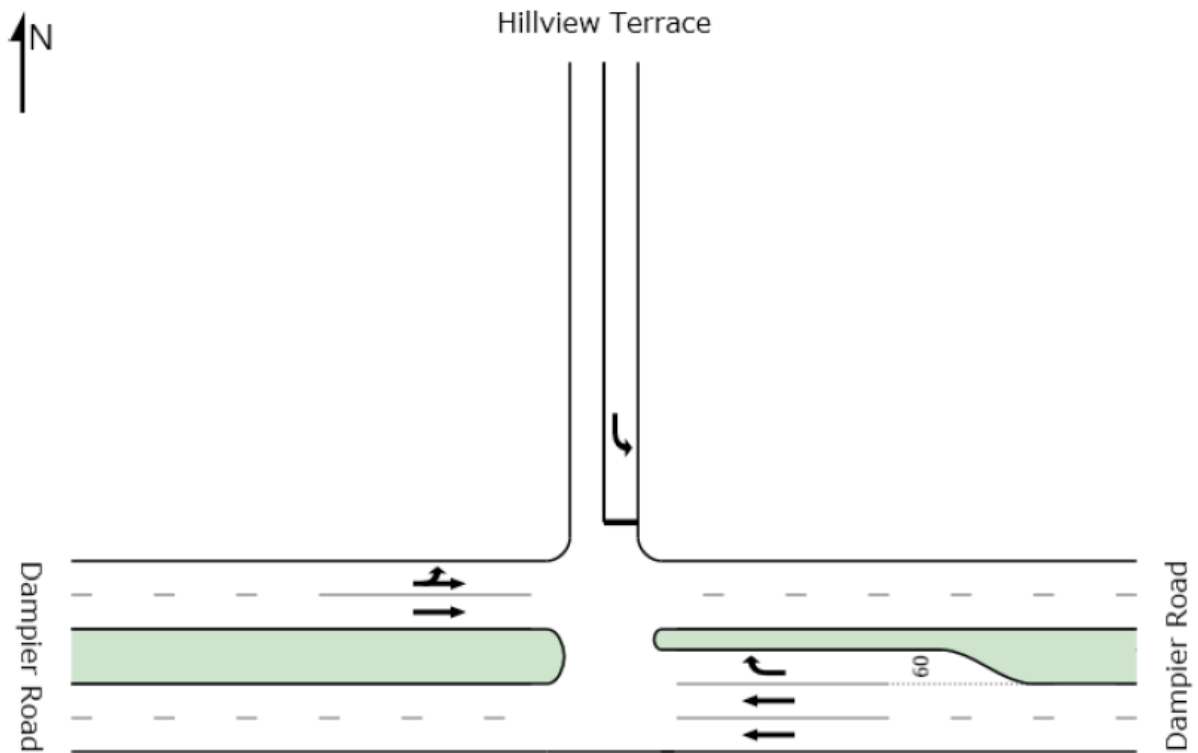
Phase	A	B	C
Green Time (sec)	12	43	27
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	18	49	33
Phase Split	18 %	49 %	33 %



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INTERSECTION

A3.8 Dampier Road/ Hillview Road



MOVEMENT SUMMARY**Site: 6. Dampier_Hillview (4 to 5pm)**Staged crossing at three-way intersection with 4-lane major road (Stop control)
Stop (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. 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
East: Dampier Road											
11	T	2336	8.1	0.630	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
12	R	83	8.1	1.386	473.9	LOS F	18.5	138.5	1.00	2.10	4.1
Approach		2419	8.1	1.386	16.3	NA	18.5	138.5	0.03	0.07	41.4
North: Hillview Terrace											
1	L	17	8.1	0.477	143.8	LOS F	1.3	9.8	0.98	1.04	11.8
Approach		17	8.1	0.477	143.8	LOS F	1.3	9.8	0.98	1.04	11.8
West: Dampier Road											
4	L	36	8.1	0.508	7.6	LOS A	0.0	0.0	0.00	1.17	48.6
5	T	1844	8.1	0.508	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		1880	8.1	0.508	0.1	NA	0.0	0.0	0.00	0.02	59.7
All Vehicles		4316	8.1	1.386	9.8	NA	18.5	138.5	0.02	0.05	47.3

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

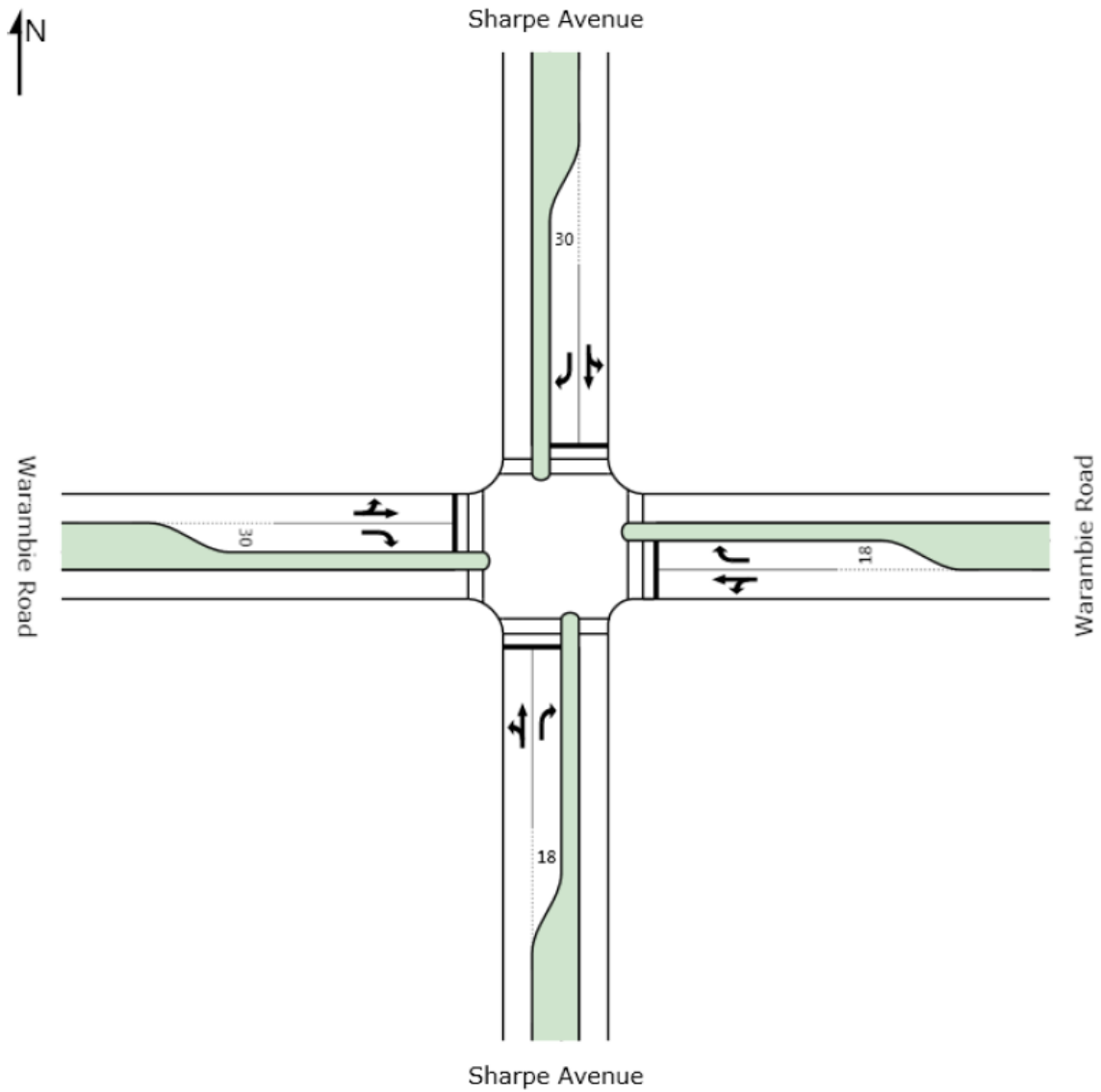
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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INTERSECTION**

A3.9 Warambie Road/ Sharpe Avenue - Scramble Phase



MOVEMENT SUMMARY**Site: 7. Warambie_Sharpe (4 to 5pm)**

Warambie Road / Sharpe Road 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Sharpe Avenue											
1	L	54	0.0	0.351	44.8	LOS D	5.0	35.0	0.93	0.78	21.2
2	T	60	0.0	0.351	40.3	LOS D	5.0	35.0	0.93	0.74	21.3
3	R	48	0.0	0.566	53.1	LOS D	2.3	16.4	0.97	0.77	19.3
Approach		162	0.0	0.566	45.6	LOS D	5.0	35.0	0.94	0.76	20.6
East: Warambie Road											
4	L	162	0.0	0.346	20.6	LOS C	9.6	67.3	0.65	0.77	28.5
5	T	167	0.0	0.346	16.1	LOS B	9.6	67.3	0.65	0.56	29.2
6	R	39	0.0	0.276	21.5	LOS C	1.1	7.5	0.60	0.65	27.9
Approach		368	0.0	0.346	18.6	LOS B	9.6	67.3	0.64	0.66	28.7
North: Sharpe Avenue											
7	L	60	0.0	0.555	46.5	LOS D	8.3	58.2	0.97	0.81	20.9
8	T	121	0.0	0.555	42.0	LOS D	8.3	58.2	0.97	0.79	20.9
9	R	33	0.0	0.224	48.1	LOS D	1.5	10.3	0.93	0.71	20.3
Approach		214	0.0	0.555	44.2	LOS D	8.3	58.2	0.96	0.78	20.8
West: Warambie Road											
10	L	42	0.0	0.222	19.4	LOS B	5.8	40.7	0.60	0.77	29.1
11	T	173	0.0	0.222	14.9	LOS B	5.8	40.7	0.60	0.50	29.9
12	R	127	0.0	0.626	27.2	LOS C	4.3	30.0	0.70	0.75	25.8
Approach		342	0.0	0.626	20.1	LOS C	5.8	40.7	0.63	0.63	28.2
All Vehicles		1086	0.0	0.626	28.1	LOS C	9.6	67.3	0.75	0.69	25.2

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P3	Across E approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P5	Across N approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P7	Across W approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
All Pedestrians		212	44.2	LOS E			0.94	0.94

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY**Site: 7. Warambie_Sharpe (4 to 5pm)**

Warambie Road / Sharpe Road 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

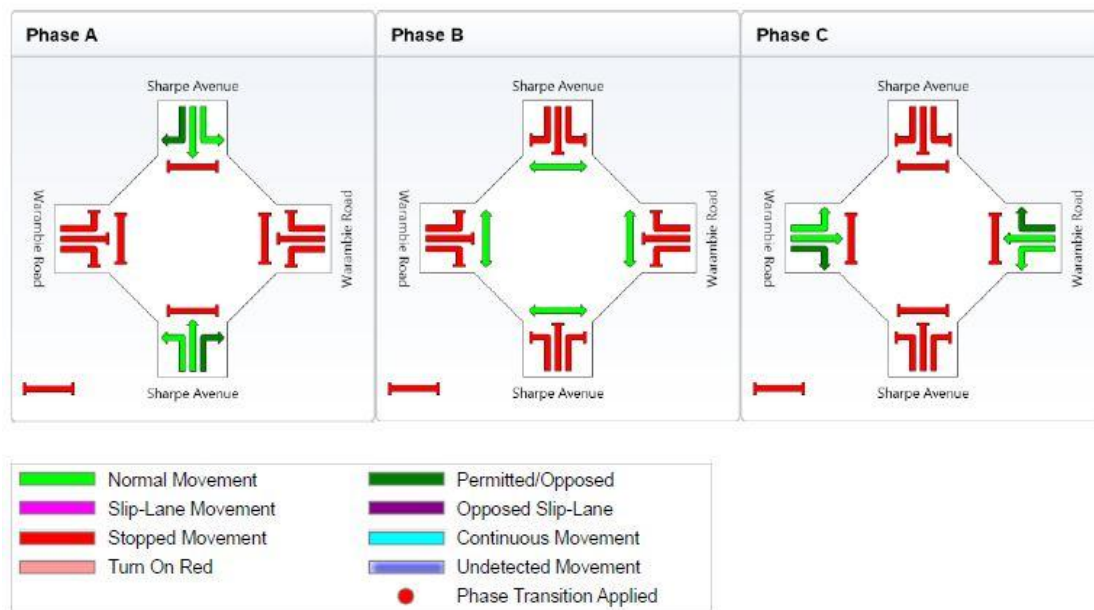
Sequence: Scramble

Input Sequence: A, B, C

Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Green Time (sec)	17	15	50
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	23	21	56
Phase Split	23 %	21 %	56 %



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INTERSECTION**

A3.10 Warambie Road/ Sharpe Avenue - Parallel Walk

Note: Geometry will be identical to A3.9

MOVEMENT SUMMARY

Site: 7. Warambie_Sharpe (4 to 5pm) - Parallel Walk

Warambie Road / Sharpe Road 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn w/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Sharpe Avenue											
1	L	54	0.0	0.221	35.1	LOS D	4.3	30.2	0.82	0.77	23.7
2	T	60	0.0	0.221	30.6	LOS C	4.3	30.2	0.82	0.65	23.9
3	R	48	0.0	0.487	40.5	LOS D	2.0	13.8	0.86	0.71	22.0
Approach		162	0.0	0.487	35.0	LOS D	4.3	30.2	0.83	0.71	23.2
East: Warambie Road											
4	L	162	0.0	0.284	14.2	LOS B	7.5	52.2	0.50	0.74	31.3
5	T	167	0.0	0.284	9.7	LOS A	7.5	52.2	0.50	0.44	32.5
6	R	39	0.0	0.217	14.5	LOS B	0.8	5.8	0.46	0.62	31.0
Approach		368	0.0	0.284	12.2	LOS B	7.5	52.2	0.50	0.59	31.8
North: Sharpe Avenue											
7	L	60	0.0	0.350	36.4	LOS D	7.2	50.2	0.85	0.80	23.4
8	T	121	0.0	0.350	31.9	LOS C	7.2	50.2	0.85	0.70	23.5
9	R	33	0.0	0.195	37.1	LOS D	1.3	8.8	0.82	0.69	22.9
Approach		214	0.0	0.350	33.9	LOS C	7.2	50.2	0.85	0.73	23.4
West: Warambie Road											
10	L	42	0.0	0.182	13.5	LOS B	4.5	31.6	0.47	0.74	31.8
11	T	173	0.0	0.182	9.0	LOS A	4.5	31.6	0.47	0.39	33.1
12	R	127	0.0	0.507	17.4	LOS B	3.2	22.4	0.55	0.68	29.6
Approach		342	0.0	0.507	12.7	LOS B	4.5	31.6	0.50	0.54	31.5
All Vehicles		1086	0.0	0.507	20.0	LOS C	7.5	52.2	0.62	0.62	28.2

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	11.5	LOS B	0.1	0.1	0.48	0.48
P3	Across E approach	53	33.6	LOS D	0.1	0.1	0.82	0.82
P5	Across N approach	53	11.5	LOS B	0.1	0.1	0.48	0.48
P7	Across W approach	53	33.6	LOS D	0.1	0.1	0.82	0.82
All Pedestrians		212	22.6	LOS C			0.65	0.65

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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**SIDRA
INTERSECTION**

PHASING SUMMARY**Site: 7. Warambie_Sharpe (4 to 5pm) - Parallel Walk**

Warambie Road / Sharpe Road 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

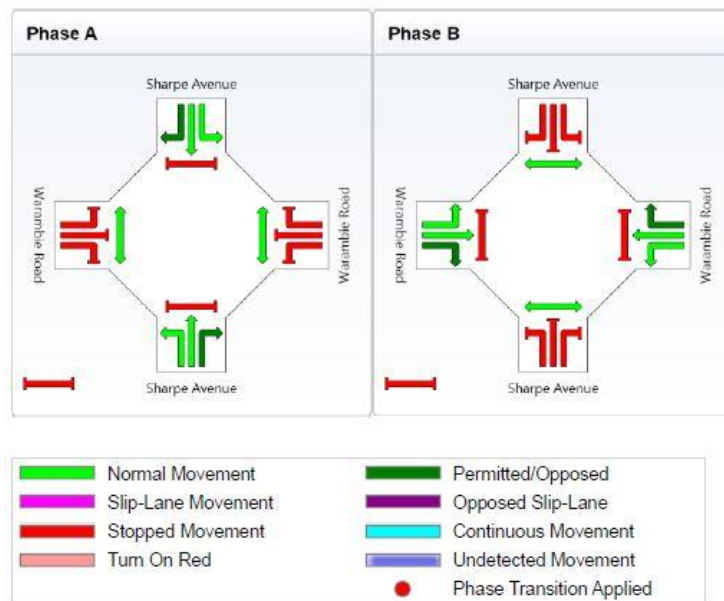
Sequence: Two-Phase

Input Sequence: A, B

Output Sequence: A, B

Phase Timing Results

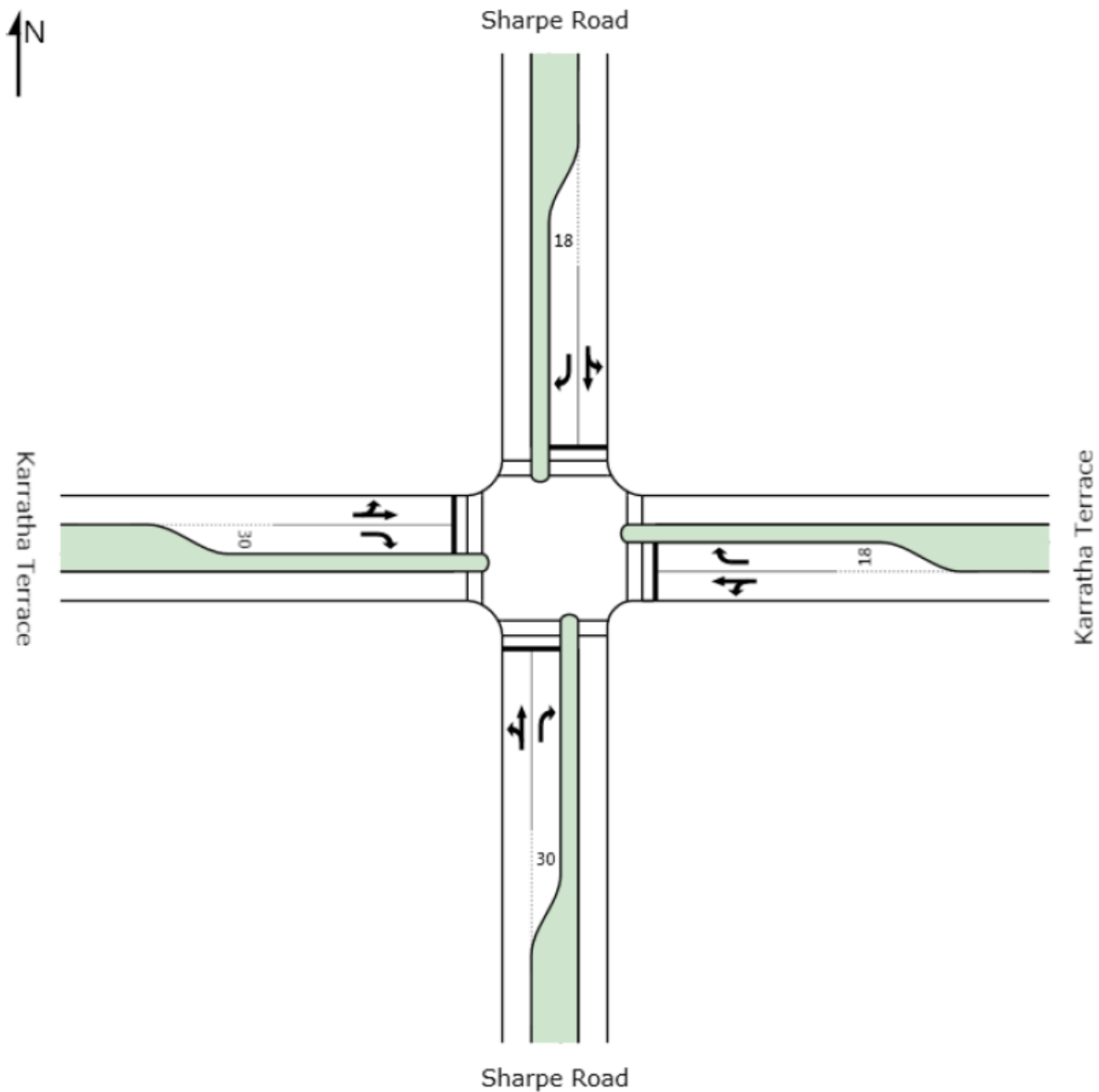
Phase	A	B
Green Time (sec)	27	61
Yellow Time (sec)	4	4
All-Red Time (sec)	2	2
Phase Time (sec)	33	67
Phase Split	33 %	67 %



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SIDRA
INTERSECTION

A3.11 Karratha Terrace/ Sharpe Avenue - Scramble Phase



MOVEMENT SUMMARY**Site: 8. Karratha Tce_Sharpe (4 to 5pm)**

Karratha Terrace / Sharpe Road 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn w/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Sharpe Road											
1	L	40	0.0	0.251	34.6	LOS C	5.2	36.7	0.81	0.78	24.6
2	T	100	0.0	0.251	29.3	LOS C	5.2	36.7	0.81	0.66	24.3
3	R	109	0.0	0.790	58.0	LOS E	5.7	40.2	1.00	0.96	19.1
Approach		249	0.0	0.790	42.8	LOS D	5.7	40.2	0.89	0.81	21.7
East: Karratha Terrace											
4	L	63	0.0	0.429	30.3	LOS C	11.4	79.5	0.79	0.86	29.0
5	T	252	0.0	0.429	24.7	LOS C	11.4	79.5	0.79	0.68	30.0
6	R	55	0.0	0.521	37.7	LOS D	2.1	14.9	0.81	0.73	25.4
Approach		369	0.0	0.521	27.6	LOS C	11.4	79.5	0.79	0.72	29.1
North: Sharpe Road											
7	L	124	0.0	0.716	40.4	LOS D	17.8	124.7	0.96	0.87	23.1
8	T	275	0.0	0.716	35.1	LOS D	17.8	124.7	0.96	0.84	22.6
9	R	42	0.0	0.399	37.3	LOS D	1.6	11.3	0.81	0.70	23.6
Approach		441	0.0	0.716	36.8	LOS D	17.8	124.7	0.94	0.84	22.8
West: Karratha Terrace											
10	L	34	0.0	0.464	30.7	LOS C	12.5	87.8	0.80	0.87	29.0
11	T	308	0.0	0.464	25.1	LOS C	12.5	87.8	0.80	0.69	29.9
12	R	142	0.0	0.841	51.7	LOS D	7.0	49.0	0.86	0.96	21.6
Approach		484	0.0	0.841	33.3	LOS C	12.5	87.8	0.82	0.78	26.9
All Vehicles		1544	0.0	0.841	34.4	LOS C	17.8	124.7	0.86	0.79	25.1

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P3	Across E approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P5	Across N approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P7	Across W approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
All Pedestrians		212	44.2	LOS E			0.94	0.94

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY**Site: 8. Karratha Tce_Sharpe (4 to 5pm)**

Karratha Terrace / Sharpe Road 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

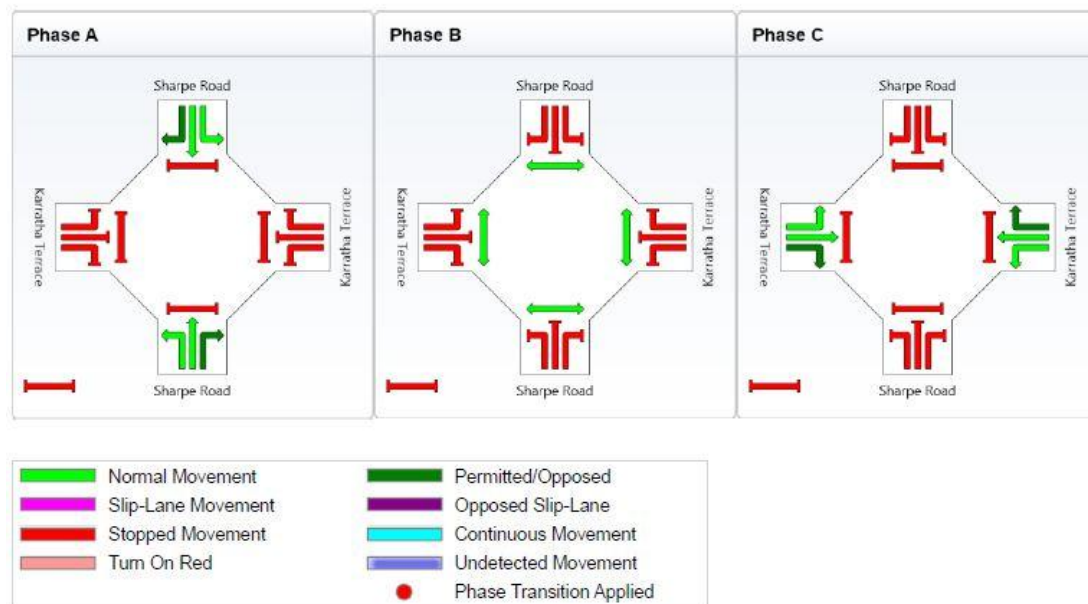
Sequence: Scramble

Input Sequence: A, B, C

Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Green Time (sec)	29	15	38
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	35	21	44
Phase Split	35 %	21 %	44 %



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**SIDRA
INTERSECTION**

A3.12 Karratha Terrace/ Sharpe Avenue - Parallel Walk

Note: Geometry will be identical to A3.11

MOVEMENT SUMMARY

Site: 8. Karratha Tce_Sharpe (4 to 5pm)

Karratha Terrace / Sharpe Road 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn w/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Sharpe Road											
1	L	40	0.0	0.251	34.6	LOS C	5.2	36.7	0.81	0.78	24.6
2	T	100	0.0	0.251	29.3	LOS C	5.2	36.7	0.81	0.66	24.3
3	R	109	0.0	0.790	58.0	LOS E	5.7	40.2	1.00	0.96	19.1
Approach		249	0.0	0.790	42.8	LOS D	5.7	40.2	0.89	0.81	21.7
East: Karratha Terrace											
4	L	63	0.0	0.429	30.3	LOS C	11.4	79.5	0.79	0.86	29.0
5	T	252	0.0	0.429	24.7	LOS C	11.4	79.5	0.79	0.68	30.0
6	R	55	0.0	0.521	37.7	LOS D	2.1	14.9	0.81	0.73	25.4
Approach		369	0.0	0.521	27.6	LOS C	11.4	79.5	0.79	0.72	29.1
North: Sharpe Road											
7	L	124	0.0	0.716	40.4	LOS D	17.8	124.7	0.96	0.87	23.1
8	T	275	0.0	0.716	35.1	LOS D	17.8	124.7	0.96	0.84	22.6
9	R	42	0.0	0.399	37.3	LOS D	1.6	11.3	0.81	0.70	23.6
Approach		441	0.0	0.716	36.8	LOS D	17.8	124.7	0.94	0.84	22.8
West: Karratha Terrace											
10	L	34	0.0	0.464	30.7	LOS C	12.5	87.8	0.80	0.87	29.0
11	T	308	0.0	0.464	25.1	LOS C	12.5	87.8	0.80	0.69	29.9
12	R	142	0.0	0.841	51.7	LOS D	7.0	49.0	0.86	0.96	21.6
Approach		484	0.0	0.841	33.3	LOS C	12.5	87.8	0.82	0.78	26.9
All Vehicles		1544	0.0	0.841	34.4	LOS C	17.8	124.7	0.86	0.79	25.1

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P3	Across E approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P5	Across N approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P7	Across W approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
All Pedestrians		212	44.2	LOS E			0.94	0.94

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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**SIDRA
INTERSECTION**

PHASING SUMMARY**Site: 8. Karratha Tce_Sharpe (4 to 5pm)**

Karratha Terrace / Sharpe Road 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

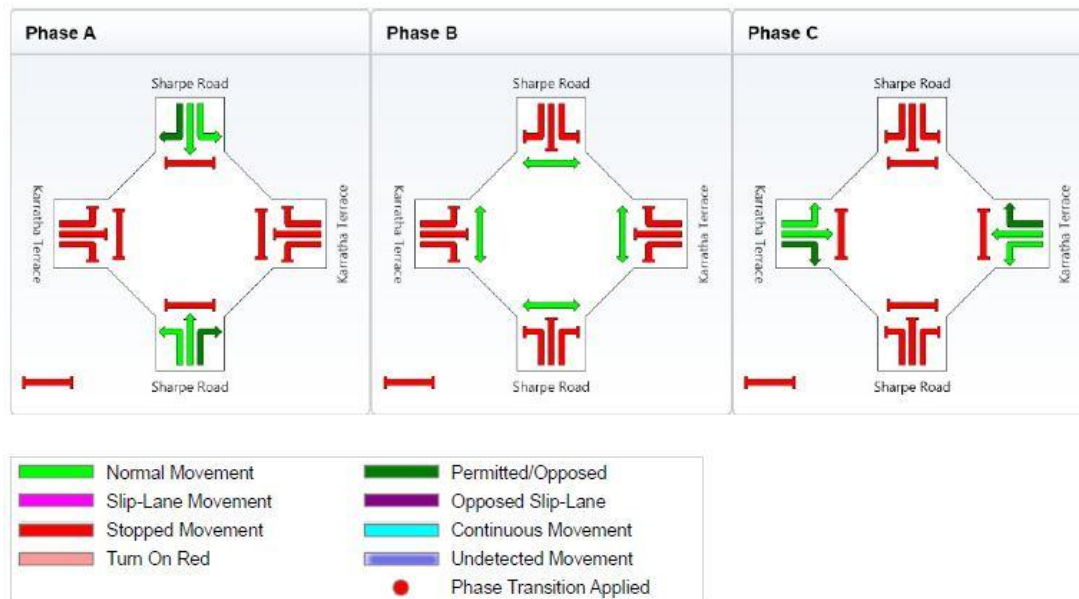
Sequence: Scramble

Input Sequence: A, B, C

Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Green Time (sec)	29	15	38
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	35	21	44
Phase Split	35 %	21 %	44 %



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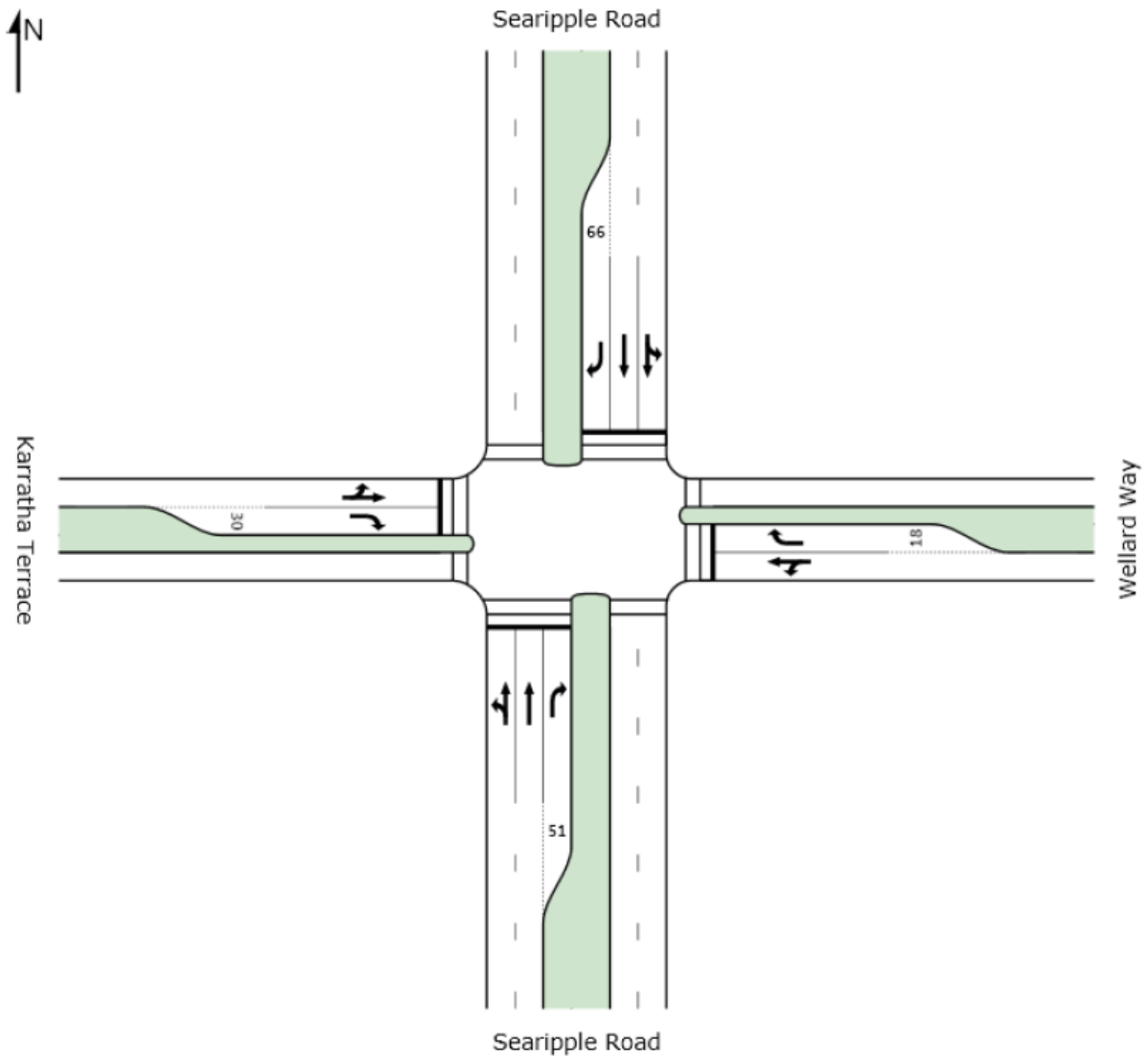
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**SIDRA
INTERSECTION**

A3.13 Searipple Road/ Karratha Terrace - Scramble Phase



MOVEMENT SUMMARY**Site: 9. Searipple_Karratha Tce (4 to 5pm)**

Searipple Road / Karratha Terrace 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Searipple Road											
1	L	58	0.0	0.472	38.0	LOS D	10.7	74.6	0.87	0.84	26.8
2	T	473	0.0	0.472	31.6	LOS C	10.8	75.4	0.87	0.74	27.2
3	R	129	0.0	0.979	90.1	LOS F	9.0	62.7	1.00	1.21	15.8
Approach		660	0.0	0.979	43.7	LOS D	10.8	75.4	0.90	0.84	23.8
East: Wellard Way											
4	L	141	0.0	0.455	37.1	LOS D	10.3	72.1	0.86	0.83	26.8
5	T	118	0.0	0.455	30.7	LOS C	10.3	72.1	0.86	0.73	27.1
6	R	66	0.0	0.679	46.9	LOS D	3.0	20.7	0.88	0.83	23.5
Approach		325	0.0	0.679	36.8	LOS D	10.3	72.1	0.87	0.79	26.2
North: Searipple Road											
7	L	133	0.0	0.734	42.1	LOS D	18.5	129.5	0.96	0.89	25.4
8	T	691	0.0	0.734	35.7	LOS D	18.8	131.4	0.96	0.86	25.7
9	R	117	0.0	0.474	47.3	LOS D	5.3	37.2	0.94	0.79	23.4
Approach		940	0.0	0.734	38.0	LOS D	18.8	131.4	0.96	0.85	25.4
West: Karratha Terrace											
10	L	34	0.0	0.566	38.4	LOS D	13.5	94.5	0.90	0.85	26.6
11	T	292	0.0	0.566	32.0	LOS C	13.5	94.5	0.90	0.77	26.9
12	R	155	0.0	1.000 ³	46.6	LOS D	7.0	49.0	0.95	0.79	23.6
Approach		481	0.0	1.000	37.1	LOS D	13.5	94.5	0.91	0.78	25.7
All Vehicles		2406	0.0	1.000	39.2	LOS D	18.8	131.4	0.92	0.83	25.1

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

3 x = 1.00 due to short lane. Refer to the Lane Summary report for information about excess flow and related conditions.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P3	Across E approach	53	37.0	LOS D	0.1	0.1	0.86	0.86
P5	Across N approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P7	Across W approach	53	37.0	LOS D	0.1	0.1	0.86	0.86
All Pedestrians		212	40.6	LOS E			0.90	0.90

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY**Site: 9. Searipple_Karratha Tce (4 to 5pm)**

Searipple Road / Karratha Terrace 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

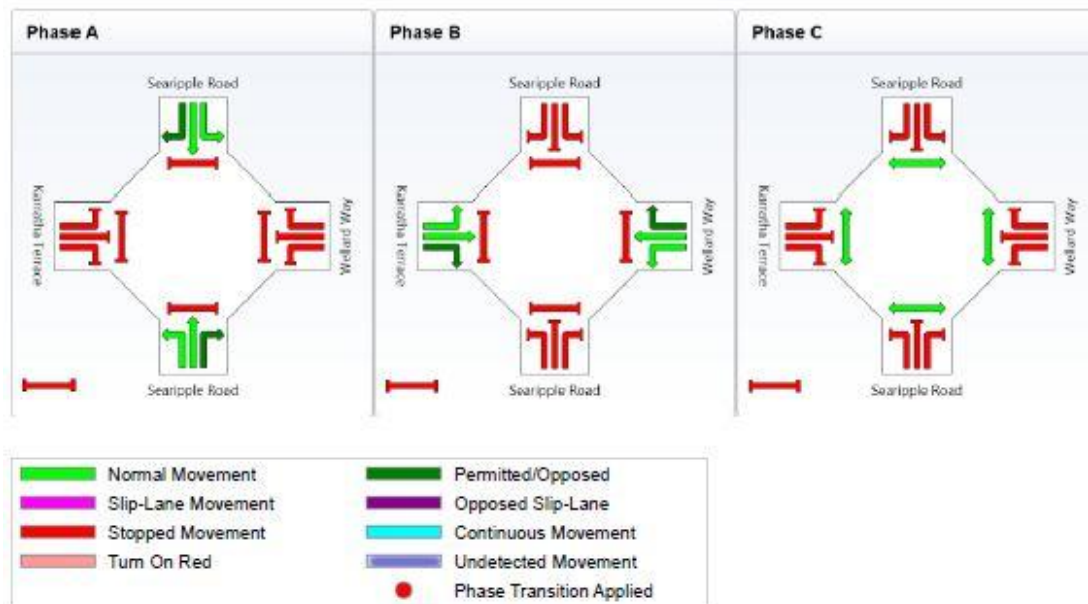
Sequence: Scramble

Input Sequence: A, B, C

Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Green Time (sec)	29	30	23
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	35	36	29
Phase Split	35 %	36 %	29 %



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**SIDRA
INTERSECTION**

A3.14 Searipple Road/ Karratha Terrace - Parallel Walk

Note: Geometry will be identical to A3.13

MOVEMENT SUMMARY

Site: 9. Searipple_Karratha Tce (4 to 5pm)

Searipple Road / Karratha Terrace 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Searipple Road											
1	L	58	0.0	0.441	36.2	LOS D	10.3	72.3	0.85	0.84	27.4
2	T	473	0.0	0.441	29.8	LOS C	10.4	73.1	0.85	0.72	27.9
3	R	129	0.0	0.851	63.9	LOS E	7.4	51.5	1.00	1.02	19.8
Approach		660	0.0	0.851	37.0	LOS D	10.4	73.1	0.88	0.79	25.8
East: Wellard Way											
4	L	141	0.0	0.239	17.8	LOS B	6.2	43.4	0.53	0.79	35.5
5	T	118	0.0	0.239	11.3	LOS B	6.2	43.4	0.53	0.45	37.4
6	R	66	0.0	0.418	19.4	LOS B	1.6	11.5	0.54	0.68	34.1
Approach		325	0.0	0.418	15.8	LOS B	6.2	43.4	0.53	0.65	35.8
North: Searipple Road											
7	L	133	0.0	0.686	39.2	LOS D	17.6	123.1	0.94	0.86	26.4
8	T	691	0.0	0.686	32.8	LOS C	17.9	125.0	0.94	0.81	26.7
9	R	117	0.0	0.429	44.3	LOS D	5.1	35.9	0.91	0.79	24.2
Approach		940	0.0	0.686	35.1	LOS D	17.9	125.0	0.93	0.82	26.3
West: Karratha Terrace											
10	L	34	0.0	0.232	17.7	LOS B	6.1	42.6	0.53	0.86	35.9
11	T	222	0.0	0.232	11.3	LOS B	6.1	42.6	0.53	0.45	38.0
12	R	225	0.0	0.921	33.1	LOS C	7.0	49.0	0.90	0.85	27.9
Approach		481	0.0	0.921	21.9	LOS C	7.0	49.0	0.70	0.66	32.3
All Vehicles		2406	0.0	0.921	30.4	LOS C	17.9	125.0	0.82	0.78	28.2

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	18.0	LOS B	0.1	0.1	0.60	0.60
P3	Across E approach	53	30.4	LOS D	0.1	0.1	0.78	0.78
P5	Across N approach	53	18.0	LOS B	0.1	0.1	0.60	0.60
P7	Across W approach	53	30.4	LOS D	0.1	0.1	0.78	0.78
All Pedestrians		212	24.2	LOS C			0.69	0.69

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY**Site: 9. Searipple_Karratha Tce (4 to 5pm)**

Searipple Road / Karratha Terrace 4pm to 5pm

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program

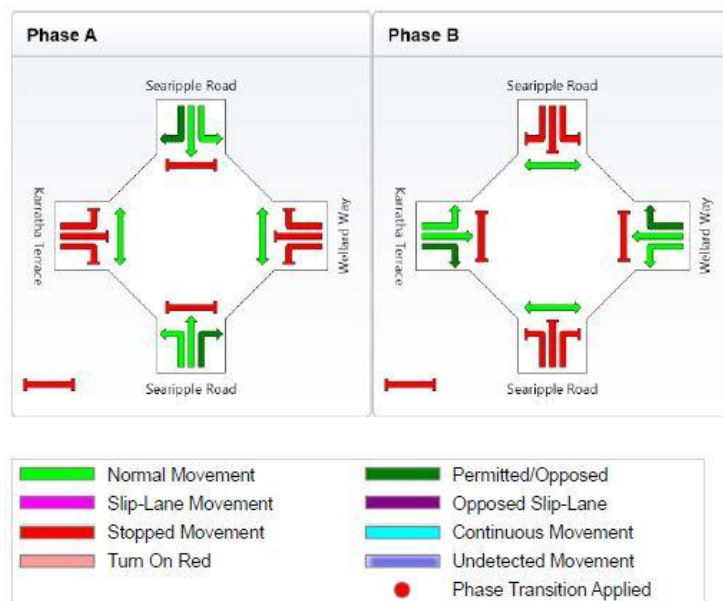
Sequence: Two-Phase

Input Sequence: A, B

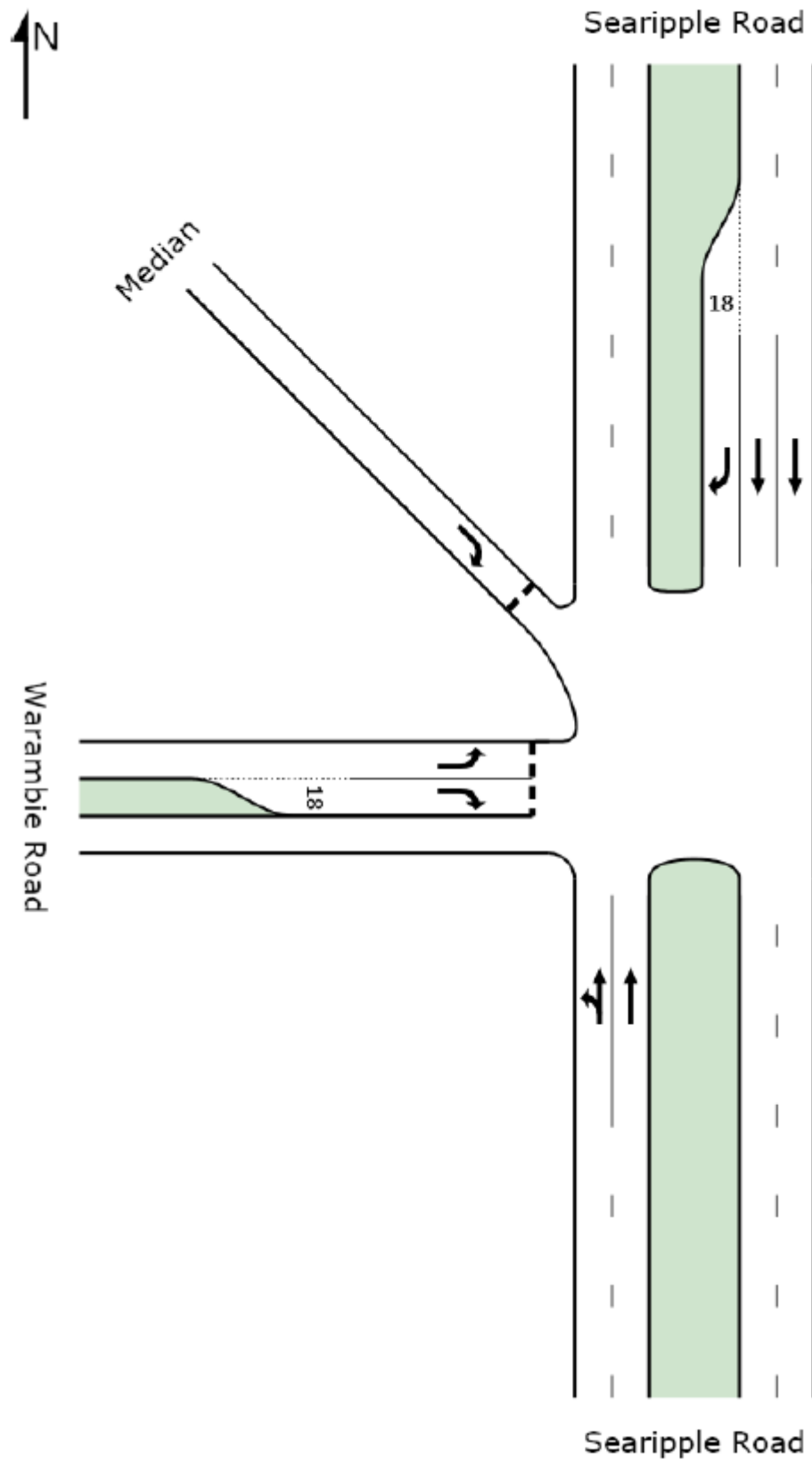
Output Sequence: A, B

Phase Timing Results

Phase	A	B
Green Time (sec)	31	57
Yellow Time (sec)	4	4
All-Red Time (sec)	2	2
Phase Time (sec)	37	63
Phase Split	37 %	63 %

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INTERSECTION**

A3.15 Searipple Road/ Warambie Road



MOVEMENT SUMMARY**Site: 10. Searipple_Warambie (4 to 5pm)**Searipple Road / Warambie Road 4pm to 5pm
Giveaway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. 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: Searipple Road											
1	L	143	0.0	0.164	5.6	LOS A	0.0	0.0	0.00	0.74	43.2
2	T	488	0.0	0.164	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		632	0.0	0.164	1.3	NA	0.0	0.0	0.00	0.17	48.3
North: Searipple Road											
8	T	577	0.0	0.148	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
9	R	193	0.0	0.305	10.2	LOS B	1.4	9.7	0.59	0.85	39.3
Approach		769	0.0	0.305	2.5	NA	1.4	9.7	0.15	0.21	46.9
North West: Median											
29	R	206	0.0	0.238	4.8	LOS A	1.3	9.3	0.69	0.66	20.3
Approach		206	0.0	0.238	4.8	LOS A	1.3	9.3	0.69	0.66	20.3
West: Warambie Road											
10	L	98	0.0	0.142	8.6	LOS A	0.5	3.3	0.47	0.72	35.0
12	R	206	0.0	0.450	14.7	LOS B	2.4	16.7	0.75	1.00	30.5
Approach		304	0.0	0.450	12.7	LOS B	2.4	16.7	0.66	0.91	31.9
All Vehicles		1912	0.0	0.450	4.0	NA	2.4	16.7	0.24	0.36	38.9

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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Appendix B

Proposed Network Changes - Modelling Results

Level 7 Wellington Central
836 Wellington Street
West Perth 6005
Australia
www.arup.com

t +61 8 9327 8300
f +61 8 9481 1334

Project title	Karratha City Centre Infrastructure Works	Job number
		221566
cc	Andrew Lewis	File reference
Prepared by	Suan Guo/ Ryan Falconer	Date
		2 July 2013
Subject	Proposed network changes (severance of Balmoral Road and signalisation of the intersection of Hillview Road and Dampier Road) - modelling results	

1 Introduction

This Technical Note overviews and discusses the implications of key network changes relative to the original network proposed and tested as part of the Karratha City Centre Infrastructure Works Project. The changes were a potential design response to obviate the need for a new, long slip lane on approach to Balmoral Road (Dampier Road West). The following detail is provided in the note:

- Tested changes to the Karratha City Centre road network
- Revised intersection performance results
- Comparison of key metrics

The note should be reviewed in conjunction with the Karratha City Centre Infrastructure Works Project Transport Modelling Report (final, version 2). The results and discussion are for reference purposes, only.

2 Road Network Changes

The following changes to the City Centre network were tested in the proposed Karratha City Centre Paramics model. Relevant data was then extracted from Paramics and incorporated into SIDRA intersection analysis:

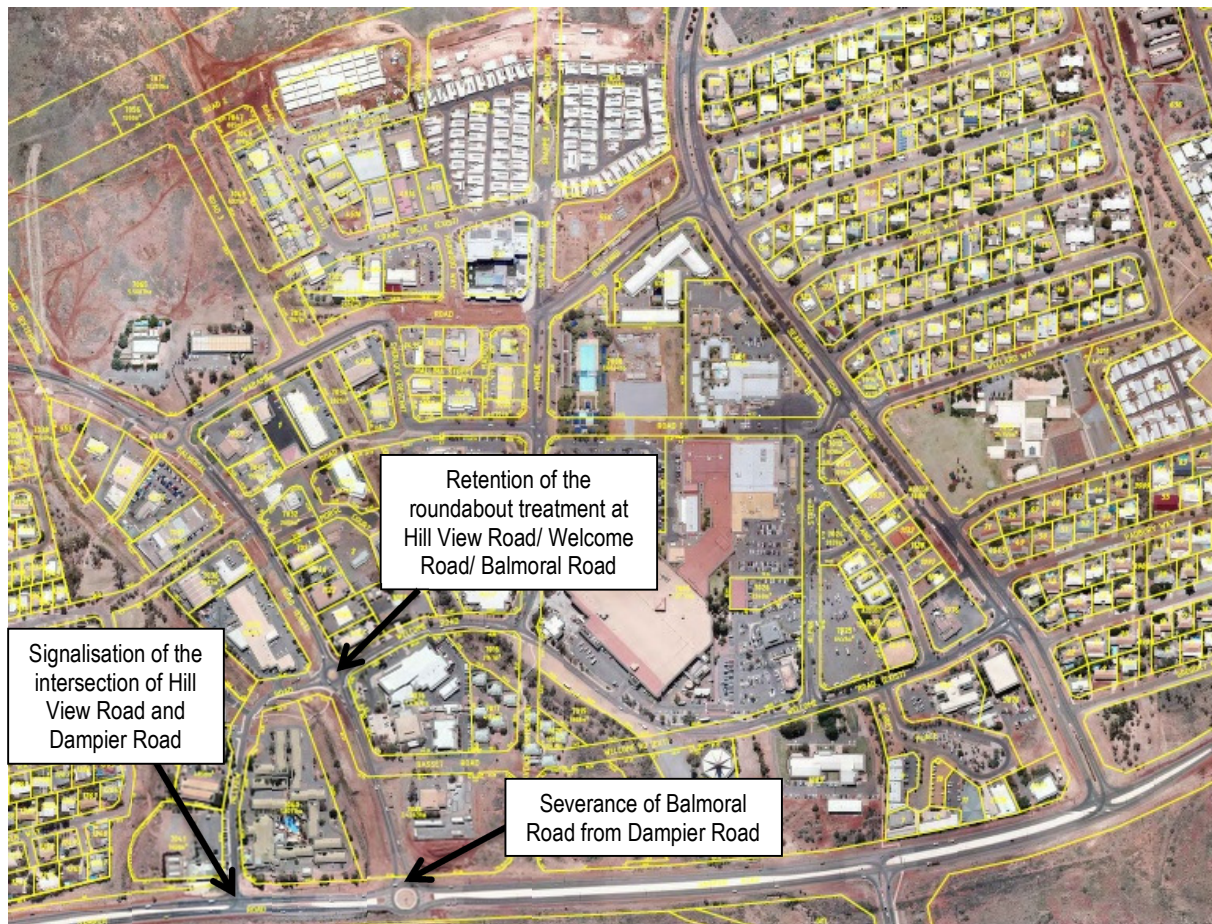
1. Severance of Balmoral Road from Dampier Road (rather than conversion of the existing roundabout to a left-in/ left-out treatment)
2. Retention of the existing roundabout treatment at Hill View Road/ Balmoral Road/ Welcome Road (rather than conversion to priority control with priority to Balmoral Road)
3. Upgrade of Hill View Road/ Dampier Road to traffic signal control (rather than retention of the current priority control treatment)

The network changes are shown in **Figure 1**.

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■ **Figure 1 – Karratha City Centre road network changes**

(Source: Whelans, March 2013)

3 Modelling Results

Additional, finer-grained adjustments were made to the SIDRA test scenarios as implications of the key network changes outlined in Section 2. These included restriction of the right turn pocket length on the Hill View Road approach to 50 metres. This would permit access to Lot 7041 to be preserved along the lot's northern boundary. The southernmost access to Lot 7040 would need to be converted to left-in/ left-out

Furthermore, 50% of vehicles forecast in Paramics to turn right on to Dampier Road were manually reassigned from Hill View Road to Sharpe Avenue. This balanced demand flows with capacity on alternative north-south connections to Dampier Road.

The intersections analysed in SIDRA to gauge impacts of the network modifications were:

- Welcome Road/ Sharpe Avenue
- Dampier Road/ Sharpe Avenue
- Dampier Road/ Hill View Road

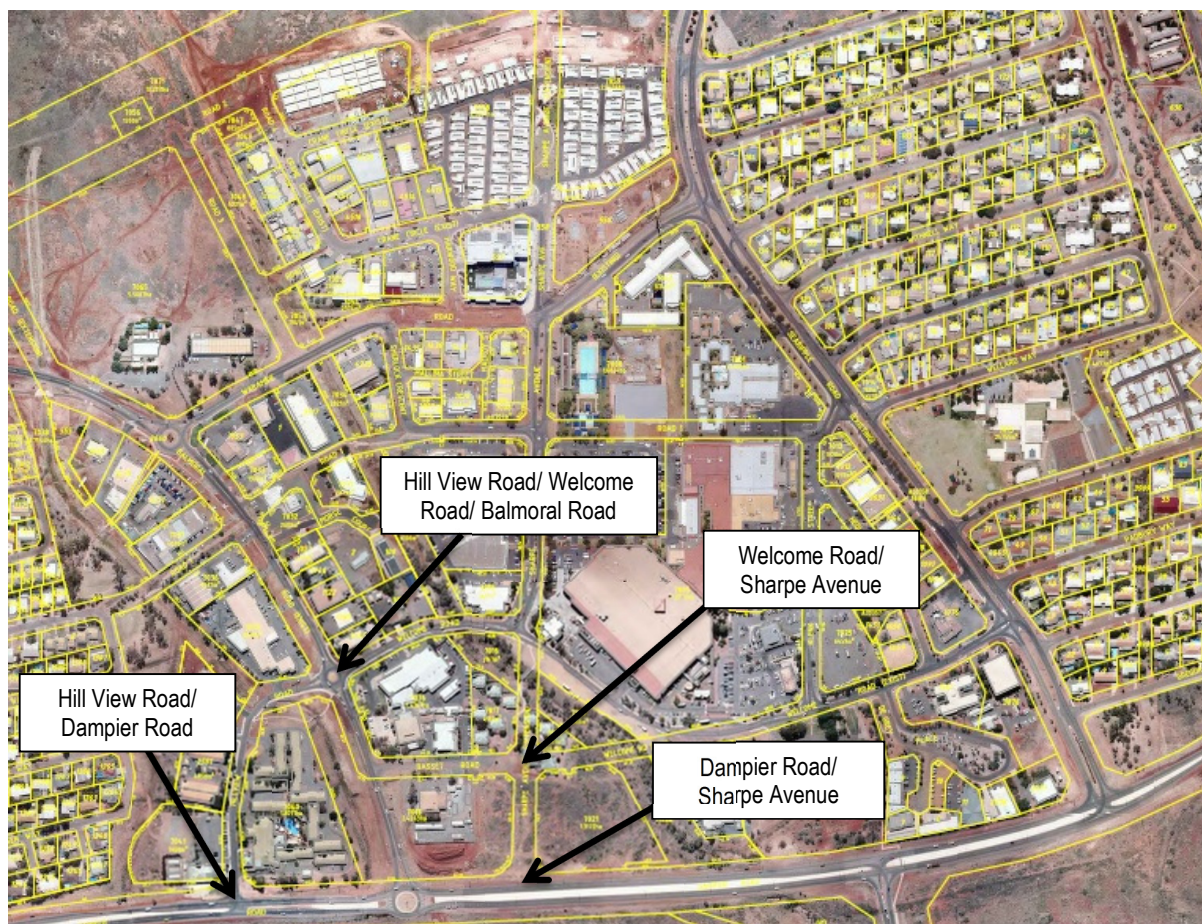
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- Balmoral Road/ Hill View Road/ Welcome Road

The locations of each intersection are shown in **Figure 2**. Results summaries are provided in **Tables 1 to 3**. Detailed results and tested geometries are shown in **Appendix A**.



▪ **Figure 2 – Intersections analysed in SIDRA**

(Source: Whelans, March 2013)

▪ **Table 1 – SIDRA results summary: short term**

Intersection location	Control type	DoS	Average delay (sec)	Total no. vehicles - all approaches (peak factored)	LoS
Welcome Road/ Sharpe Avenue	Priority	0.44	6.3	1,496	N/A
Dampier Road/ Sharpe Avenue	Signalised	0.59	20.9	2,571	C
Dampier Road/ Hill View Road	Signalised	0.74	12.8	3,433	B
Balmoral Road/ Hill View Road/ Welcome Road	Roundabout	0.41	9.1	1,355	A

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Table 2 – SIDRA results summary: medium term

Intersection location	Control type	DoS	Average delay (sec)	Total no. vehicles - all approaches (peak factored)	LoS
Welcome Road/ Sharpe Avenue	Priority	0.35	6.3	1,468	N/A
Dampier Road/ Sharpe Avenue	Signalised	0.77	23.8	3,969	C
Dampier Road/ Hill View Road	Signalised	0.82	16.2	4,066	B
Balmoral Road/ Hill View Road/ Welcome Road	Roundabout	0.49	9.5	1,715	A

Table 3 – SIDRA results summary: long term

Intersection location	Control type	DoS	Average delay (sec)	Total no. vehicles - all approaches (peak factored)	LoS
Welcome Road/ Sharpe Avenue	Priority	0.97	14.6	1,735	N/A
Dampier Road/ Sharpe Avenue	Signalised	0.96	36.1	4,223	D
Dampier Road/ Hill View Road	Signalised	0.98	31	4,275	C
Balmoral Road/ Hill View Road/ Welcome Road	Roundabout	0.51	10.5	1,842	B

4 Results Comparisons

Comparative performance metrics (original and modified network) generated by SIDRA are shown in Tables 4 to 6. The adjustments refer to scenario 2 (modified network). Explanatory comments are provided where relevant.

The data show that the tested intersections are forecast to operate with less saturation and delay (on average), under scenario 2, particularly in the short term. This is influenced by higher order traffic control at Hill View Road/ Dampier Road, which improves performance at this location. Additionally, these traffic signals would be likely to attract some traffic assigning north-south from Sharpe Avenue, with consequent improvements in performance at Welcome Road/ Sharpe Avenue and Dampier Road/ Sharpe Avenue. It may be concluded that traffic signals may be ultimately required at the intersection of Hill View Road/ Dampier Road under any circumstances to improve overall network performance.

Short Term	Scenario 1 - Intersection Metrics					Scenario 2 (Balmoral Rd link to Dampier Severed) - Intersection Metrics						
Intersection	Intersection Type	DoS	Average Delay (sec)	Total No. Vehicles - All Approaches (Peak Factored)	LoS	Intersection Type	DoS	Average Delay (sec)	Total No. Vehicles - All Approaches (Peak Factored)	LoS	Adjustments	Comments
Welcome/Sharpe	Priority	1.68	111.9	1,875	N/A	Priority	0.44	6.3	1,496	N/A	N/A	All approaches forecast to operate well within capacity. This has been modelled as a priority-controlled (give way) intersection. Sizeable delays are forecast for Basset Road at Sharpe Avenue in Scenario 1. This is not evident in Scenario 2, which exhibits a 75% reduction in total traffic from Basset Road due to reassignment to other, more attractive routes (especially Welcome Road West)
Dampier/Sharpe	Signalised	0.68	23.5	2,985	C	Signalised	0.59	20.9	2,571	C	50% of right turning vehicles reassigned from Hillview to Sharpe at Dampier Road . This balances demand flows with excess capacity	All approaches are operating within capacity. Marginal improvement in intersection performance in Scenario 2, despite the manual adjustment (reassigned traffic) described
Dampier/Hillview	Priority	1.07	6.8	3,571	N/A	Signalised	0.74	12.8	3,433	B	50% of right tuming vehicles reassigned from Hillview to Sharpe at Dampier Road . This balances demand flows with excess capacity. To preserve access to Lot 7041 along its northern boundary, the right turn pocket on Hillview Road is limited to 50m. A 50m slip lane on the Dampier (West) has been adopted into the geometry	In Scenario 2, all approaches are forecast to operate within capacity. Right turn queues on Hillview Road are forecast to occasionally spill out of the turn pocket, with 95% back of queues of 54m. Significant improvements to intersection performance are forecast in Scenario 2 compared to Scenario 1 although there has been some manual adjustment to demand flows
Balmoral/Hillview/Welcome	Not previously analysed					Roundabout	0.41	9.1	1,355	A	N/A	All approaches are forecast to operate well within capacity. This model assumes 8.1% heavy vehicles, which is consistent with surrounding intersections. This intersection is modelled as a single lane roundabout

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Table 5 – Comparative results (original and modified network): medium term

Medium Term	Scenario 1 - Intersection Metrics					Scenario 2 - Intersection Metrics						
Intersection	Intersection Type	DoS	Average Delay (sec)	Total No. Vehicles - All Approaches (Peak Factored)	LoS	Intersection Type	DoS	Average Delay (sec)	Total No. Vehicles - All Approaches (Peak Factored)	LoS	Adjustments	Comments
Welcome/Sharpe	Priority	0.52	7.6	1,641	N/A	Priority	0.35	6.3	1,468	N/A	N/A	All approaches forecast to operatewell within capacity. The improvement in intersection performance and reduction in total number of vehicles (all approaches) is related to the anticipated construction of City North Boulevard and realignment of Balmoral Road and Searipple Road to form T intersections with the new road
Dampier/Sharpe	Signalised	0.83	24.9	4,047	C	Signalised	0.77	23.8	3,969	C	50% of right turning vehicles reassigned from Hillview to Sharpe at Dampier Road . This balances demand flows with excess capacity	All approaches are forecast to operate within capacity. The intersection performance under Scenario 2 is relatively comparable to Scenario 1 although queues are forecast to be shorter and there should be marginally shorter delays
Dampier/Hillview	Priority	0.96	3.6	4,020	N/A	Signalised	0.82	16.2	4,066	B	50% of right turning vehicles reassigned from Hillview to Sharpe at Dampier Road . This balances demand flows with excess capacity. To preserve access to Lot 7041 along its northern boundary, the right turn pocket on Hillview Road is limited to 50m. A 50m slip lane on the Dampier (West) has been adopted into the geometry	In Scenario 2, all approaches are forecast to operate within capacity. Right turn queues on Hillview Road are forecast to occasionally spill out of the turn pocket with 95% back of queues of approx 75m. The DoS for this approach is below 0.85
Balmoral/Hillview/Welcome	-	-	-	-	-	Roundabout	0.49	9.5	1,715	A	N/A	All approaches are forecast to operate well within capacity

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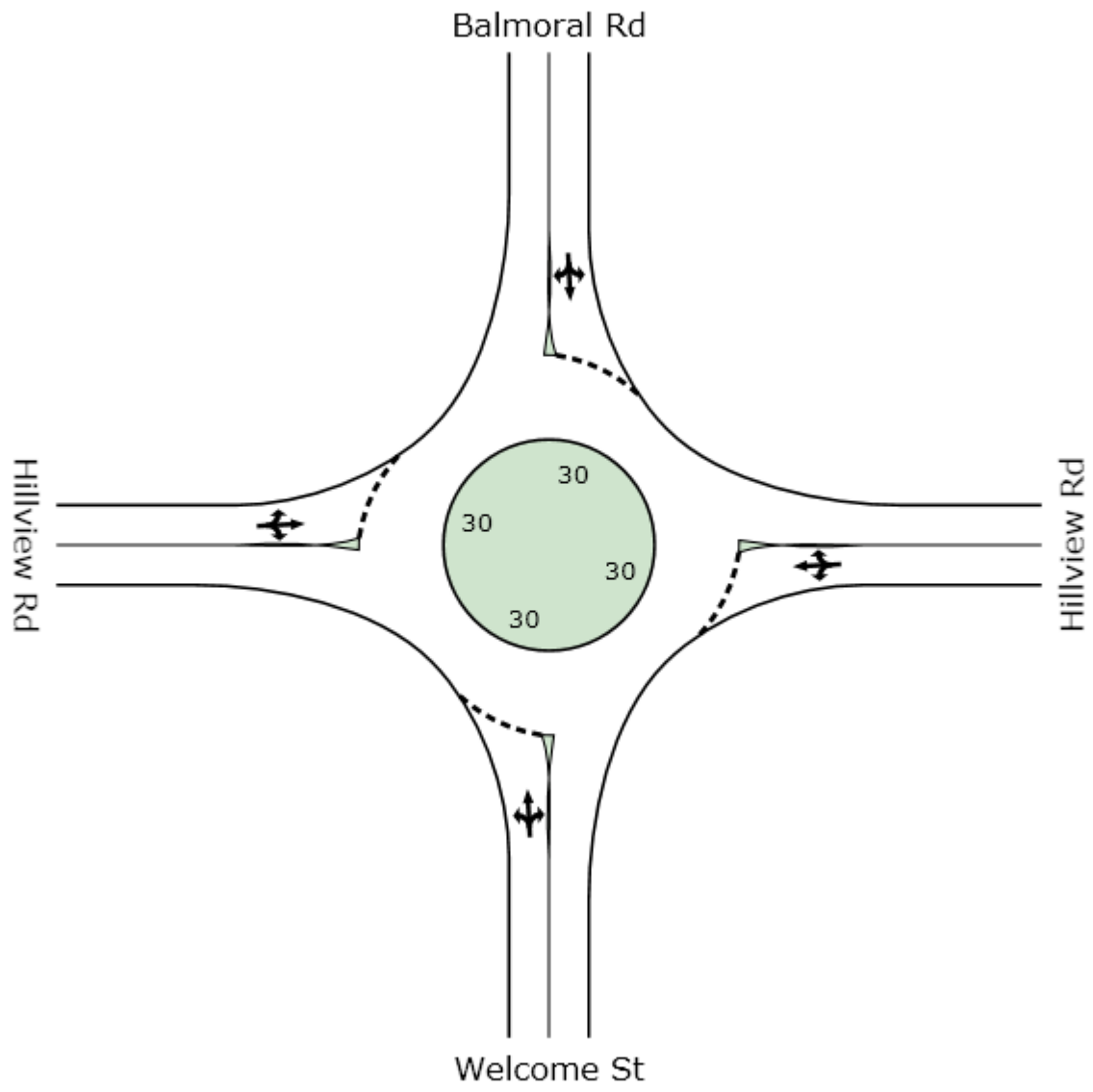
Table 6 – Comparative results (original and modified network): long term

Long Term	Scenario 1 - Intersection Metrics					Scenario 2 - Intersection Metrics						
Intersection	Intersection Type	DoS	Average Delay (sec)	Total No. Vehicles - All Approaches (Peak Factored)	LoS	Intersection Type	DoS	Average Delay (sec)	Total No. Vehicles - All Approaches (Peak Factored)	LoS	Adjustments	Comments
Welcome/Sharpe	Priority	0.97	10.3	1,725	N/A	Priority	0.97	14.6	1,735	N/A	N/A	Right turn movement from Basset Road is nearing DoS 1. Average delays of 90 sec (LoS F) are forecast and 95% back of queues are likely to spill out of the turn pocket (approx 50m). This right turn movement has increased by 100% from the medium term demand. All other approaches are forecast to operate well under saturation. IN practice, by this time, MRWA and the Shire may need to consider upgrade of this intersection to traffic signals, or the delays forecast may have to be left to be tolerated by traffic in peak hours
Dampier/Sharpe	Signalised	0.95	37.2	4,379	D	Signalised	0.96	36.1	4,223	D	50% of right turning vehicles reassigned from Hillview to Sharpe at Dampier Road . This balances demand flows with excess capacity	The through movement from Dampier Road West is forecast to operate at a DoS of 0.96 with a 310m long 95% back of queue. The right turn movement from Dampier Road East is forecast to operate at DoS 0.9 with the 95% back of queue extending past the turn pocket (approx 150m). The left turn movement from Sharpe Avenue is forecast at DoS 0.96 with a 95% back of queue length (57m) extending out of the left turn pocket. The intersection performance in Scenario 2 is comparable to Scenario 1. It will be deisrable for alternative strategic east-west links to have been indentified and constructed by this time to reduce demands on Dampier Road
Dampier/Hillview	Priority	1.39	9.8	4,316	N/A	Signalised	0.98	31	4,275	C	50% of right turning vehicles reassigned from Hillview to Sharpe at Dampier Road . This balances demand flows with excess capacity. To preserve access to Lot 7041 along its northern boundary, the right turn pocket on Hillview Road is limited to 50m. A 50m slip lane on the Dampier (West) has been adopted into the geometry	The right turn queues forecast on Hillview Road are spilling out of the turn pocket with a DoS of 0.91 and an unconstrained 95% back of queue of approx 110m. The through movement from Dampier Road West has a forecast DoS of 0.98 with 95% back of queues extending approx 260m. Overall, intersection performance is forecasted to be better in Scenario 2 than Scenario 1
Balmoral/Hillview/Welcome	-	-	-	-	-	Roundabout	0.51	10.5	1842	B	N/A	All approaches are forecast to operate well within capacity

Appendix – SIDRA Outputs

A.1 Revised SIDRA Intersection Geometries

Balmoral Road/ Hill View Road/ Welcome Road



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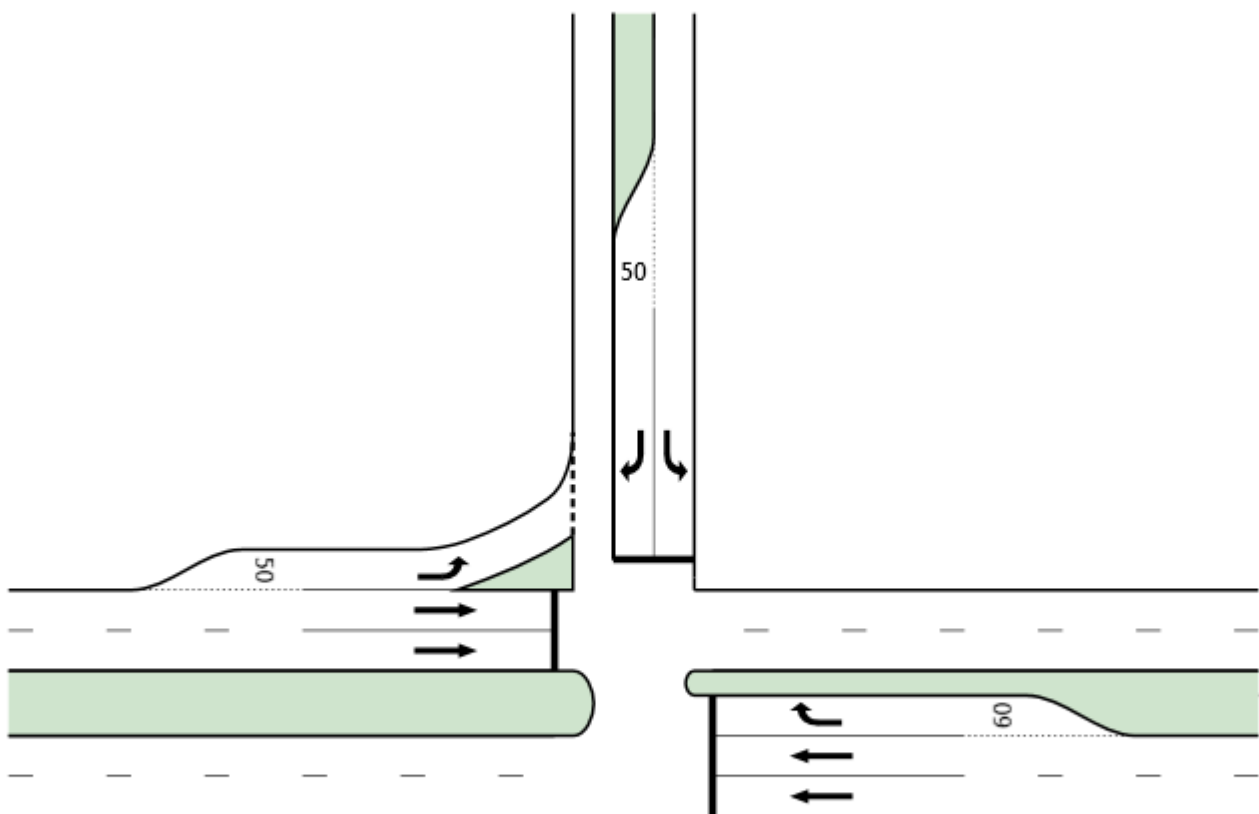
Dampier Road/ Hill View Road



Hillview Tce

Dampier Road

Dampier Road

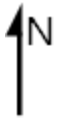


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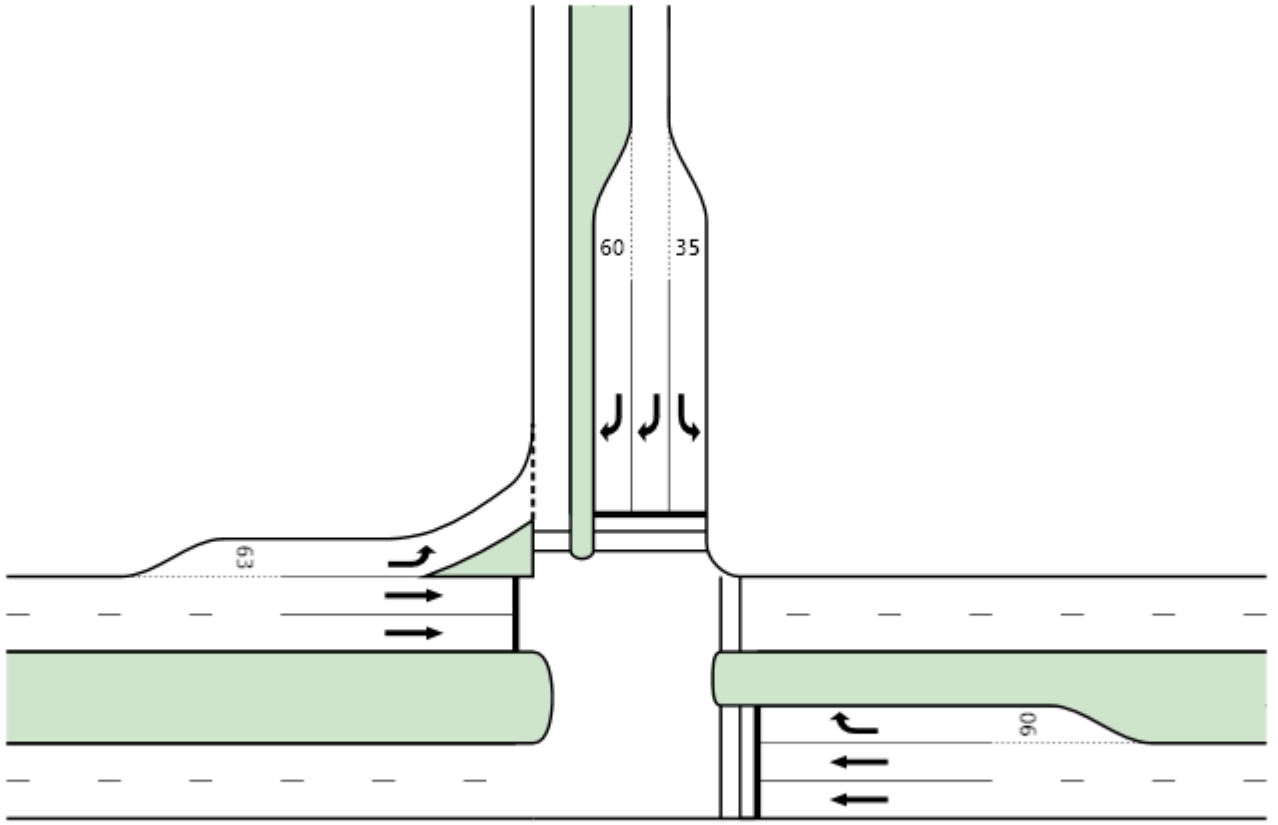
Dampier Road/ Sharpe Avenue



Sharpe Road

Dampier Road

Dampier Road



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Welcome Road/ Sharpe Avenue



Sharpe Road

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20

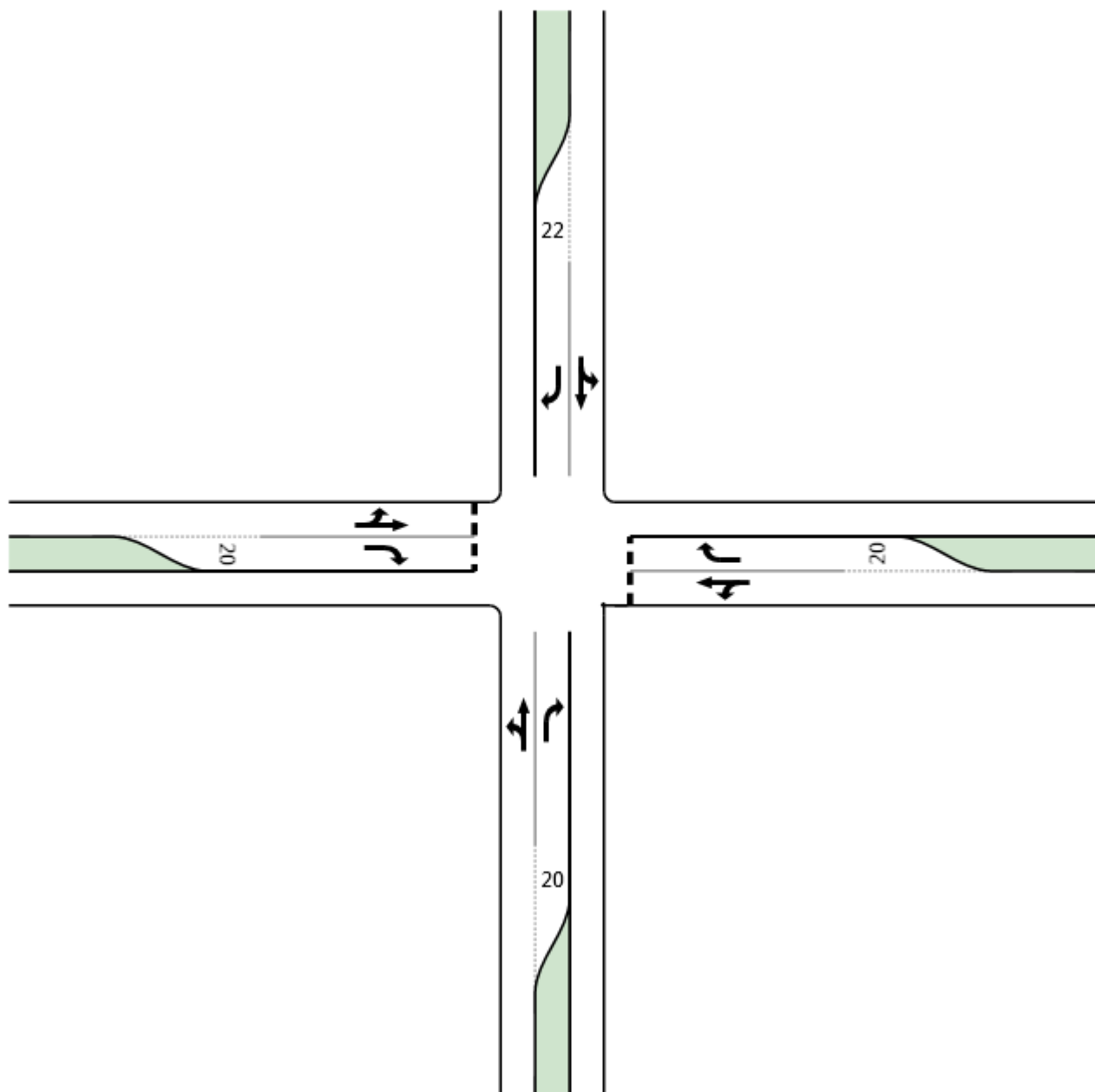
Welcome Road

20

20

Welcome Road

Sharpe Road



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A.2 Short Term

Balmoral Road/ Hill View Road/ Welcome Road

MOVEMENT SUMMARY

Site: Balmoral_Hillview_Welcome
(4 to 5pm)

New Site
Roundabout

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. 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: Welcome St											
1	L	45	8.1	0.156	8.9	LOS A	0.9	7.0	0.66	0.70	48.2
2	T	92	8.1	0.156	7.9	LOS A	0.9	7.0	0.66	0.67	48.2
3	R	3	8.1	0.156	14.7	LOS B	0.9	7.0	0.66	0.85	44.9
Approach		140	8.1	0.156	8.3	LOS A	0.9	7.0	0.66	0.68	48.1
East: Hillview Rd											
4	L	3	8.1	0.269	7.6	LOS A	1.7	12.7	0.59	0.64	48.1
5	T	139	8.1	0.269	6.6	LOS A	1.7	12.7	0.59	0.59	48.2
6	R	140	8.1	0.269	13.5	LOS B	1.7	12.7	0.59	0.79	45.4
Approach		282	8.1	0.269	10.1	LOS B	1.7	12.7	0.59	0.69	46.7
North: Balmoral Rd											
7	L	82	8.1	0.356	6.7	LOS A	2.4	18.2	0.49	0.54	48.4
8	T	20	8.1	0.356	5.7	LOS A	2.4	18.2	0.49	0.49	48.6
9	R	336	8.1	0.356	12.6	LOS B	2.4	18.2	0.49	0.70	45.0
Approach		438	8.1	0.356	11.2	LOS B	2.4	18.2	0.49	0.66	45.7
West: Hillview Rd											
10	L	283	8.1	0.405	6.9	LOS A	2.8	21.0	0.52	0.59	48.9
11	T	175	8.1	0.405	5.9	LOS A	2.8	21.0	0.52	0.52	49.1
12	R	37	8.1	0.405	12.8	LOS B	2.8	21.0	0.52	0.79	46.2
Approach		495	8.1	0.405	7.0	LOS A	2.8	21.0	0.52	0.58	48.7
All Vehicles		1355	8.1	0.405	9.1	LOS A	2.8	21.0	0.54	0.64	47.2

Level of Service (LOS) Method: Delay (HCM 2000).

Roundabout LOS Method: Same as Signalised Intersections.

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model used.

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Dampier Road/ Hill View Road

MOVEMENT SUMMARY

Site: 6. Dampier_Hillview (4 to 5pm) - Adjusted

Staged crossing at three-way intersection with 4-lane major road (Stop control)
Signals - Fixed Time Cycle Time = 70 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. 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
East: Dampier Road											
11	T	1755	8.1	0.737	9.1	LOS A	20.3	152.3	0.73	0.67	45.4
12	R	48	8.1	0.133	16.0	LOS B	0.7	4.9	0.64	0.72	41.9
Approach		1803	8.1	0.737	9.3	LOS A	20.3	152.3	0.73	0.67	45.3
North: Hillview Tce											
1	L	24	8.1	0.039	24.2	LOS C	0.5	4.0	0.68	0.71	36.1
3	R	242	8.1	0.743	43.6	LOS D	8.6	64.5	1.00	0.89	27.0
Approach		266	8.1	0.743	41.8	LOS D	8.6	64.5	0.97	0.88	27.7
West: Dampier Road											
4	L	523	8.1	0.480	8.5	LOS A	2.3	17.2	0.26	0.66	48.4
5	T	840	8.1	0.481	13.7	LOS B	9.9	73.9	0.73	0.64	41.4
Approach		1363	8.1	0.481	11.7	LOS B	9.9	73.9	0.55	0.65	43.9
All Vehicles		3433	8.1	0.743	12.8	LOS B	20.3	152.3	0.68	0.68	42.9

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

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PHASING SUMMARY

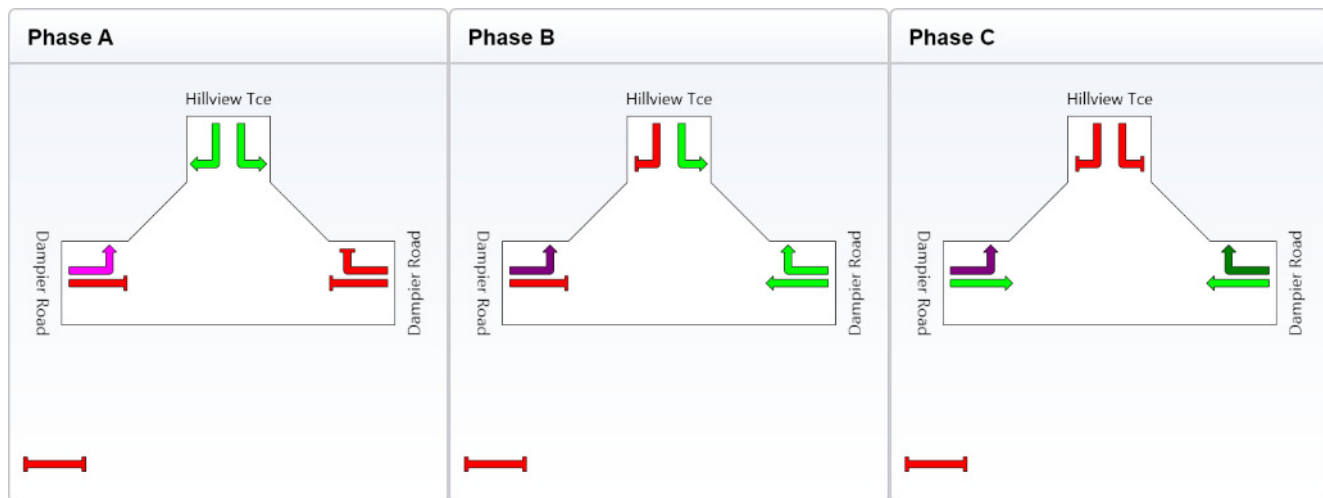
Site: 6. Dampier_Hillview (4 to 5pm) - Adjusted

Staged crossing at three-way intersection with 4-lane major road (Stop control)
Signals - Fixed Time Cycle Time = 70 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program
Sequence: Leading Right
Input Sequence: A, B, C
Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Green Time (sec)	13	6	33
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	19	12	39
Phase Split	27 %	17 %	56 %



	Normal Movement		Permitted/Opposed
	Slip-Lane Movement		Opposed Slip-Lane
	Stopped Movement		Continuous Movement
	Turn On Red		Undetected Movement
			Phase Transition Applied

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221566

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Dampier Road/ Sharpe Avenue

MOVEMENT SUMMARY

Site: 5. Dampier_Sharpe (4 to 5pm) - Adjusted

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. 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
East: Dampier Road											
11	T	937	8.1	0.588	23.4	LOS C	17.4	130.3	0.82	0.72	34.8
12	R	81	0.0	0.273	47.4	LOS D	3.6	24.9	0.92	0.76	24.6
Approach		1018	7.5	0.588	25.3	LOS C	17.4	130.3	0.83	0.72	33.8
North: Sharpe Road											
1	L	61	0.0	0.053	6.8	LOS A	0.2	1.1	0.06	0.60	37.0
3	R	866	0.0	0.590	15.8	LOS B	10.7	75.2	0.48	0.70	32.2
Approach		927	0.0	0.590	15.2	LOS B	10.7	75.2	0.46	0.69	32.5
West: Dampier Road											
4	L	459	0.0	0.389	7.1	LOS A	2.9	20.6	0.22	0.62	48.3
5	T	408	8.1	0.525	38.5	LOS D	9.0	67.5	0.94	0.78	27.9
Approach		867	3.8	0.525	21.9	LOS C	9.0	67.5	0.56	0.69	35.6
All Vehicles		2813	3.9	0.590	20.9	LOS C	17.4	130.3	0.62	0.70	33.9

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P7	Across E approach	53	25.9	LOS C	0.1	0.1	0.72	0.72
P1	Across N approach	53	41.4	LOS E	0.1	0.1	0.91	0.91
All Pedestrians		106	33.7	LOS D			0.82	0.82

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

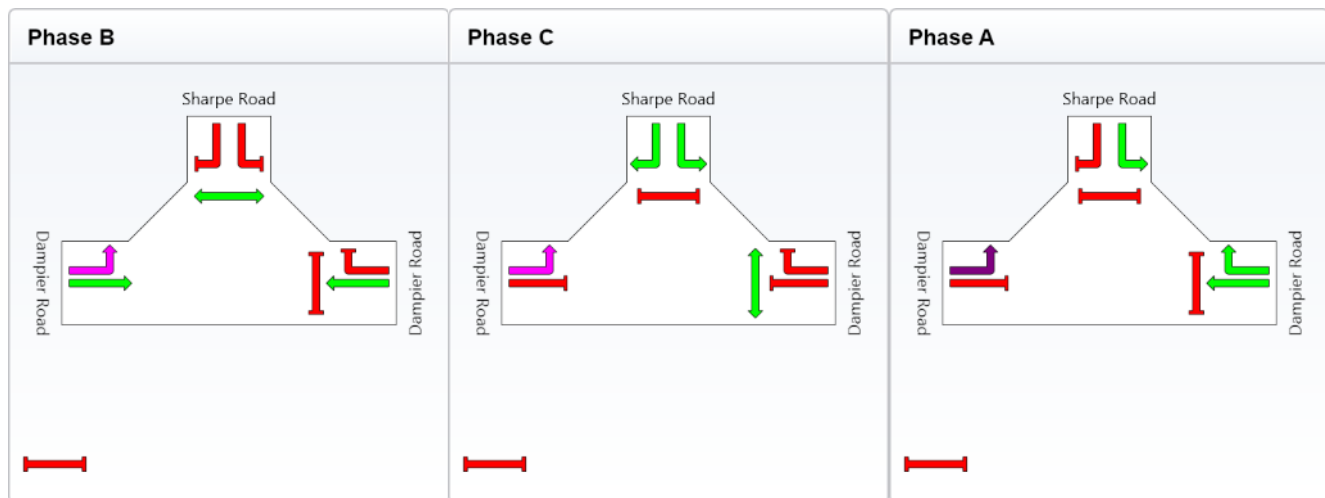
Site: 5. Dampier_Sharpe (4 to 5pm) - Adjusted

Three-way intersection with 2 & 3-lane approaches (Signals)
 Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program
 Sequence: Leading Right Turn
 Input Sequence: B, C, A
 Output Sequence: B, C, A

Phase Timing Results

Phase	B	C	A
Green Time (sec)	21	45	16
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	27	51	22
Phase Split	27 %	51 %	22 %



	Normal Movement		Permitted/Opposed
	Slip-Lane Movement		Opposed Slip-Lane
	Stopped Movement		Continuous Movement
	Turn On Red		Undetected Movement
			Phase Transition Applied

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SIDRA
 INTERSECTION

Technical Note

221566

2 July 2013

Welcome Road/ Sharpe Avenue

MOVEMENT SUMMARY

Site: 4. Welcome_Sharpe (4 to 5pm)

New Site
Giveaway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. 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: Sharpe Road											
1	L	47	0.0	0.179	4.5	LOS A	0.0	0.0	0.00	0.67	36.7
2	T	299	0.0	0.179	0.0	LOS A	0.0	0.0	0.00	0.00	40.0
3	R	194	0.0	0.277	9.2	LOS A	1.0	7.3	0.59	0.84	33.8
Approach		540	0.0	0.277	3.7	NA	1.0	7.3	0.21	0.36	37.2
East: Welcome Road											
4	L	107	0.0	0.372	15.6	LOS C	1.7	12.1	0.72	0.98	30.5
5	T	35	8.1	0.372	14.3	LOS B	1.7	12.1	0.72	0.91	30.8
6	R	65	0.0	0.438	37.4	LOS E	1.7	12.1	0.90	1.05	22.8
Approach		207	1.4	0.438	22.2	LOS C	1.7	12.1	0.78	0.99	27.6
North: Sharpe Road											
7	L	77	0.0	0.330	4.5	LOS A	0.0	0.0	0.00	0.67	36.7
8	T	562	0.0	0.330	0.0	LOS A	0.0	0.0	0.00	0.00	40.0
9	R	18	0.0	0.022	6.1	LOS A	0.1	0.5	0.36	0.56	35.6
Approach		657	0.0	0.330	0.7	NA	0.1	0.5	0.01	0.09	39.4
West: Welcome Road											
10	L	16	0.0	0.316	24.5	LOS C	1.3	9.4	0.78	0.85	27.0
11	T	54	8.1	0.316	23.3	LOS C	1.3	9.4	0.78	0.92	27.2
12	R	22	0.0	0.167	32.3	LOS D	0.5	3.8	0.87	0.95	24.2
Approach		92	4.7	0.316	25.7	LOS D	1.3	9.4	0.80	0.92	26.4
All Vehicles		1496	0.5	0.438	6.3	NA	1.7	12.1	0.24	0.36	35.5

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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INTERSECTION

Technical Note

221566

2 July 2013

A.3 Medium Term

Balmoral Road/ Hill View Road/ Welcome Road

MOVEMENT SUMMARY

Site: Balmoral_Hillview_Welcome
(4 to 5pm)

New Site
Roundabout

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. 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: Welcome St											
1	L	71	8.1	0.268	10.1	LOS B	1.8	13.3	0.77	0.79	47.6
2	T	132	8.1	0.268	9.1	LOS A	1.8	13.3	0.77	0.77	47.3
3	R	13	8.1	0.268	15.9	LOS B	1.8	13.3	0.77	0.89	44.0
Approach		215	8.1	0.268	9.8	LOS A	1.8	13.3	0.77	0.78	47.2
East: Hillview Rd											
4	L	7	8.1	0.377	8.2	LOS A	2.6	19.6	0.69	0.71	47.5
5	T	182	8.1	0.377	7.2	LOS A	2.6	19.6	0.69	0.64	47.4
6	R	184	8.1	0.377	14.0	LOS B	2.6	19.6	0.69	0.82	45.0
Approach		374	8.1	0.377	10.6	LOS B	2.6	19.6	0.69	0.73	46.2
North: Balmoral Rd											
7	L	169	8.1	0.482	7.1	LOS A	3.8	28.4	0.59	0.59	47.8
8	T	60	8.1	0.482	6.1	LOS A	3.8	28.4	0.59	0.54	47.9
9	R	351	8.1	0.482	13.0	LOS B	3.8	28.4	0.59	0.73	45.0
Approach		580	8.1	0.482	10.5	LOS B	3.8	28.4	0.59	0.67	46.0
West: Hillview Rd											
10	L	318	8.1	0.487	7.7	LOS A	3.6	27.2	0.65	0.67	48.1
11	T	197	8.1	0.487	6.7	LOS A	3.6	27.2	0.65	0.60	48.1
12	R	32	8.1	0.487	13.6	LOS B	3.6	27.2	0.65	0.82	45.7
Approach		546	8.1	0.487	7.7	LOS A	3.6	27.2	0.65	0.65	47.9
All Vehicles		1715	8.1	0.487	9.5	LOS A	3.8	28.4	0.65	0.69	46.8

Level of Service (LOS) Method: Delay (HCM 2000).

Roundabout LOS Method: Same as Signalised Intersections.

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model used.

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Technical Note

221566

2 July 2013

Dampier Road/ Hill View Road

MOVEMENT SUMMARY

Site: 6. Dampier_Hillview (4 to 5pm) - Adjusted

Staged crossing at three-way intersection with 4-lane major road (Stop control)
Signals - Fixed Time Cycle Time = 70 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. 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
East: Dampier Road											
11	T	1940	8.1	0.815	13.2	LOS B	27.6	206.4	0.81	0.80	41.6
12	R	111	8.1	0.383	19.9	LOS B	1.7	13.1	0.83	0.78	38.9
Approach		2051	8.1	0.815	13.6	LOS B	27.6	206.4	0.81	0.80	41.4
North: Hillview Tce											
1	L	72	8.1	0.114	24.8	LOS C	1.6	12.3	0.70	0.75	35.8
3	R	265	8.1	0.814	46.5	LOS D	10.0	74.9	1.00	0.95	25.9
Approach		337	8.1	0.814	41.9	LOS D	10.0	74.9	0.94	0.90	27.7
West: Dampier Road											
4	L	429	8.1	0.409	8.6	LOS A	2.1	15.4	0.26	0.66	48.4
5	T	1249	8.1	0.715	16.3	LOS B	17.3	129.7	0.86	0.77	39.2
Approach		1679	8.1	0.715	14.3	LOS B	17.3	129.7	0.70	0.74	41.2
All Vehicles		4066	8.1	0.815	16.2	LOS B	27.6	206.4	0.78	0.78	39.9

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

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PHASING SUMMARY

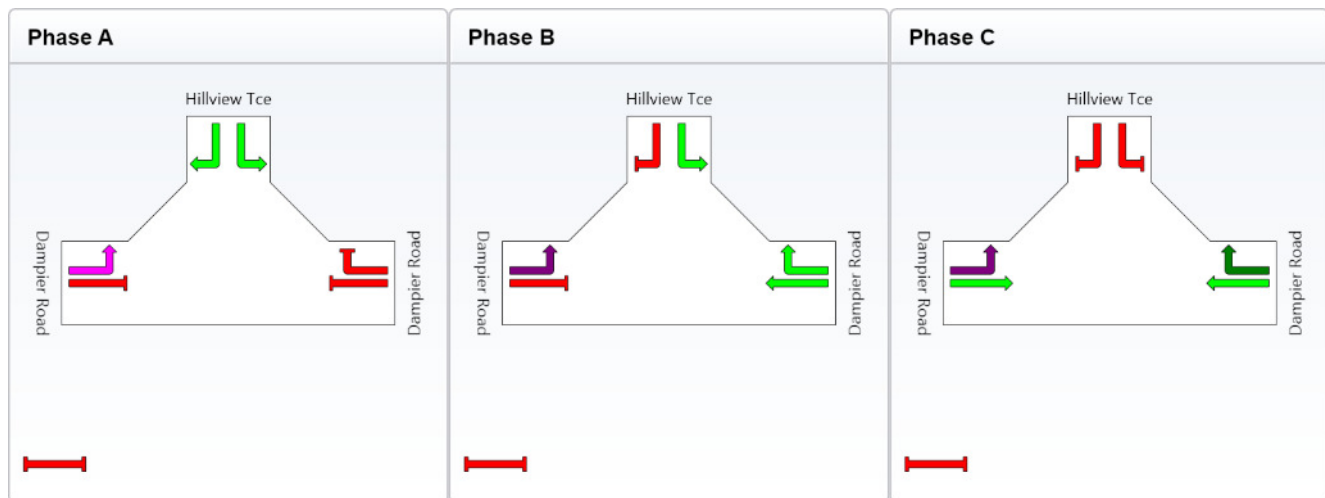
Site: 6. Dampier_Hillview (4 to 5pm) - Adjusted

Staged crossing at three-way intersection with 4-lane major road (Stop control)
Signals - Fixed Time Cycle Time = 70 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program
Sequence: Leading Right
Input Sequence: A, B, C
Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Green Time (sec)	13	6	33
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	19	12	39
Phase Split	27 %	17 %	56 %



	Normal Movement		Permitted/Opposed
	Slip-Lane Movement		Opposed Slip-Lane
	Stopped Movement		Continuous Movement
	Turn On Red		Undetected Movement
			Phase Transition Applied

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INTERSECTION

Technical Note

221566

2 July 2013

Dampier Road/ Sharpe Avenue

MOVEMENT SUMMARY

Site: 5. Dampier_Sharpe (4 to 5pm) - Adjusted

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. 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
East: Dampier Road											
11	T	1502	8.1	0.624	11.0	LOS B	21.3	159.5	0.64	0.58	44.0
12	R	275	0.0	0.740	49.9	LOS D	13.3	93.2	1.00	0.88	23.9
Approach		1777	6.8	0.740	17.0	LOS B	21.3	159.5	0.69	0.63	39.3
North: Sharpe Road											
1	L	323	0.0	0.770	25.6	LOS C	6.6	46.0	0.72	0.81	28.0
3	R	552	0.0	0.722	36.7	LOS D	13.2	92.7	0.88	0.82	24.7
Approach		875	0.0	0.770	32.6	LOS C	13.2	92.7	0.82	0.82	25.8
West: Dampier Road											
4	L	199	0.0	0.222	8.8	LOS A	2.3	15.8	0.30	0.63	46.5
5	T	1118	8.1	0.774	30.3	LOS C	24.7	184.7	0.94	0.86	31.2
Approach		1317	6.9	0.774	27.1	LOS C	24.7	184.7	0.84	0.83	32.7
All Vehicles		3968	5.3	0.774	23.8	LOS C	24.7	184.7	0.77	0.74	33.2

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P7	Across E approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
P1	Across N approach	53	26.6	LOS C	0.1	0.1	0.73	0.73
All Pedestrians		106	35.4	LOS D			0.84	0.84

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY

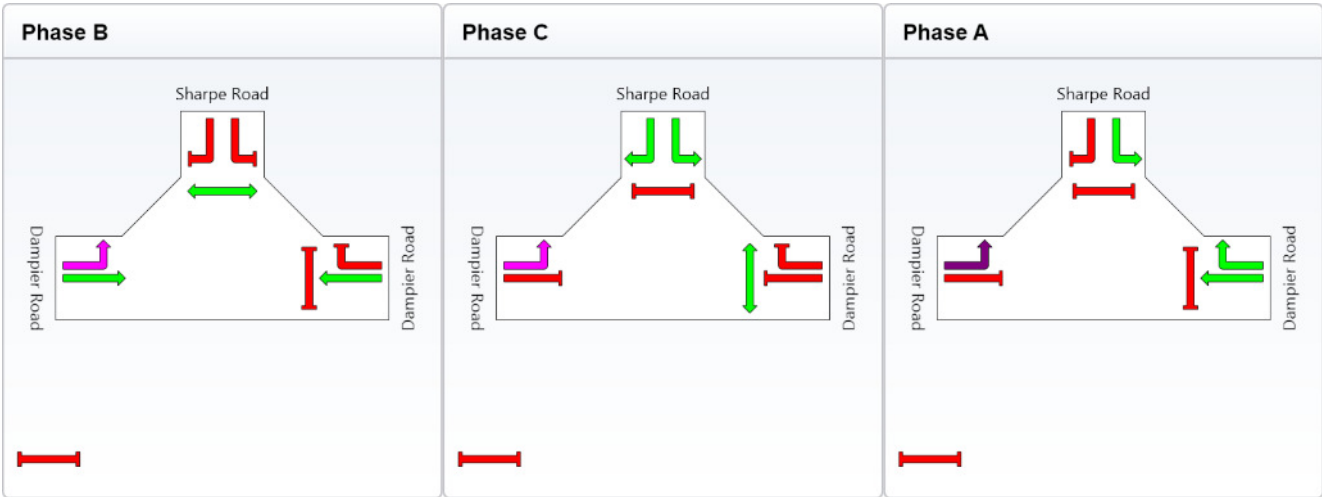
Site: 5. Dampier_Sharpe (4 to 5pm) - Adjusted

Three-way intersection with 2 & 3-lane approaches (Signals)
Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program
Sequence: Leading Right Turn
Input Sequence: B, C, A
Output Sequence: B, C, A

Phase Timing Results

Phase	B	C	A
Green Time (sec)	39	23	20
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	45	29	26
Phase Split	45 %	29 %	26 %



Normal Movement	Permitted/Opposed
Slip-Lane Movement	Opposed Slip-Lane
Stopped Movement	Continuous Movement
Turn On Red	Undetected Movement
	Phase Transition Applied

Technical Note

221566

2 July 2013

Welcome Road/ Sharpe Avenue

MOVEMENT SUMMARY

Site: 4. Welcome_Sharpe (4 to 5pm)

New Site
Giveaway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. 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: Sharpe Road											
1	L	63	0.0	0.164	4.5	LOS A	0.0	0.0	0.00	0.66	36.7
2	T	254	0.0	0.164	0.0	LOS A	0.0	0.0	0.00	0.00	40.0
3	R	156	0.0	0.208	8.3	LOS A	0.7	5.0	0.54	0.77	34.3
Approach		473	0.0	0.208	3.3	NA	0.7	5.0	0.18	0.34	37.5
East: Welcome Road											
4	L	88	0.0	0.308	13.5	LOS B	1.3	9.6	0.67	0.91	31.5
5	T	40	8.1	0.308	12.3	LOS B	1.3	9.6	0.67	0.84	31.8
6	R	47	0.0	0.278	28.7	LOS D	1.0	7.1	0.86	0.98	25.3
Approach		176	1.8	0.308	17.3	LOS C	1.3	9.6	0.72	0.91	29.6
North: Sharpe Road											
7	L	137	0.0	0.307	4.5	LOS A	0.0	0.0	0.00	0.65	36.7
8	T	455	0.0	0.307	0.0	LOS A	0.0	0.0	0.00	0.00	40.0
9	R	33	0.0	0.039	6.0	LOS A	0.1	0.8	0.35	0.56	35.7
Approach		624	0.0	0.307	1.3	NA	0.1	0.8	0.02	0.17	39.0
West: Welcome Road											
10	L	73	0.0	0.348	15.7	LOS C	1.7	11.9	0.61	0.78	30.5
11	T	58	8.1	0.348	14.4	LOS B	1.7	11.9	0.61	0.81	30.9
12	R	65	0.0	0.354	28.7	LOS D	1.4	9.7	0.86	1.01	25.3
Approach		196	2.4	0.354	19.6	LOS C	1.7	11.9	0.69	0.87	28.7
All Vehicles		1468	0.5	0.354	6.3	NA	1.7	11.9	0.24	0.41	35.5

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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Technical Note

221566

2 July 2013

A.4 Long Term

Balmoral Road/ Hill View Road/ Welcome Road

MOVEMENT SUMMARY

Site: Balmoral_Hillview_Welcome
(4 to 5pm)

New Site
Roundabout

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. 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: Welcome St											
1	L	80	8.1	0.330	12.1	LOS B	2.4	17.8	0.88	0.88	45.7
2	T	133	8.1	0.330	11.1	LOS B	2.4	17.8	0.88	0.87	45.9
3	R	5	8.1	0.330	17.9	LOS B	2.4	17.8	0.88	0.93	42.6
Approach		218	8.1	0.330	11.6	LOS B	2.4	17.8	0.88	0.87	45.7
East: Hillview Rd											
4	L	13	8.1	0.514	10.3	LOS B	4.4	32.6	0.82	0.86	46.7
5	T	240	8.1	0.514	9.3	LOS A	4.4	32.6	0.82	0.84	46.4
6	R	206	8.1	0.514	16.1	LOS B	4.4	32.6	0.82	0.92	43.5
Approach		459	8.1	0.514	12.4	LOS B	4.4	32.6	0.82	0.88	45.0
North: Balmoral Rd											
7	L	117	8.1	0.501	6.9	LOS A	4.1	30.8	0.58	0.57	47.8
8	T	74	8.1	0.501	5.9	LOS A	4.1	30.8	0.58	0.53	47.9
9	R	432	8.1	0.501	12.8	LOS B	4.1	30.8	0.58	0.71	44.9
Approach		622	8.1	0.501	10.9	LOS B	4.1	30.8	0.58	0.66	45.7
West: Hillview Rd											
10	L	337	8.1	0.497	7.8	LOS A	3.8	28.3	0.68	0.68	47.8
11	T	147	8.1	0.497	6.8	LOS A	3.8	28.3	0.68	0.61	47.7
12	R	59	8.1	0.497	13.7	LOS B	3.8	28.3	0.68	0.82	45.5
Approach		543	8.1	0.497	8.2	LOS A	3.8	28.3	0.68	0.67	47.5
All Vehicles		1842	8.1	0.514	10.5	LOS B	4.4	32.6	0.70	0.74	46.1

Level of Service (LOS) Method: Delay (HCM 2000).

Roundabout LOS Method: Same as Signalised Intersections.

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model used.

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SIDRA
INTERSECTION

Technical Note

221566

2 July 2013

Dampier Road/ Hill View Road

MOVEMENT SUMMARY

Site: 6. Dampier_Hillview (4 to 5pm) - Adjusted

Staged crossing at three-way intersection with 4-lane major road (Stop control)
Signals - Fixed Time Cycle Time = 60 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. 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
East: Dampier Road											
11	T	1821	8.1	0.843	17.3	LOS B	26.7	199.6	0.89	0.93	38.4
12	R	100	8.1	0.329	21.9	LOS C	1.5	11.0	0.93	0.76	37.6
Approach		1921	8.1	0.843	17.6	LOS B	26.7	199.6	0.89	0.92	38.3
North: Hillview Tce											
1	L	178	8.1	0.243	20.8	LOS C	3.4	25.7	0.69	0.77	38.3
3	R	347	8.1	0.913	39.0	LOS D	10.9	81.6	1.00	0.88	28.9
Approach		525	8.1	0.913	32.9	LOS C	10.9	81.6	0.89	0.85	31.8
West: Dampier Road											
4	L	438	8.1	0.414	8.9	LOS A	2.1	15.7	0.32	0.68	48.1
5	T	1391	8.1	0.979	55.9	LOS E	35.0	261.7	1.00	1.44	22.8
Approach		1828	8.1	0.979	44.6	LOS D	35.0	261.7	0.84	1.26	26.1
All Vehicles		4275	8.1	0.979	31.0	LOS C	35.0	261.7	0.87	1.06	31.3

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

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SIDRA
INTERSECTION

PHASING SUMMARY

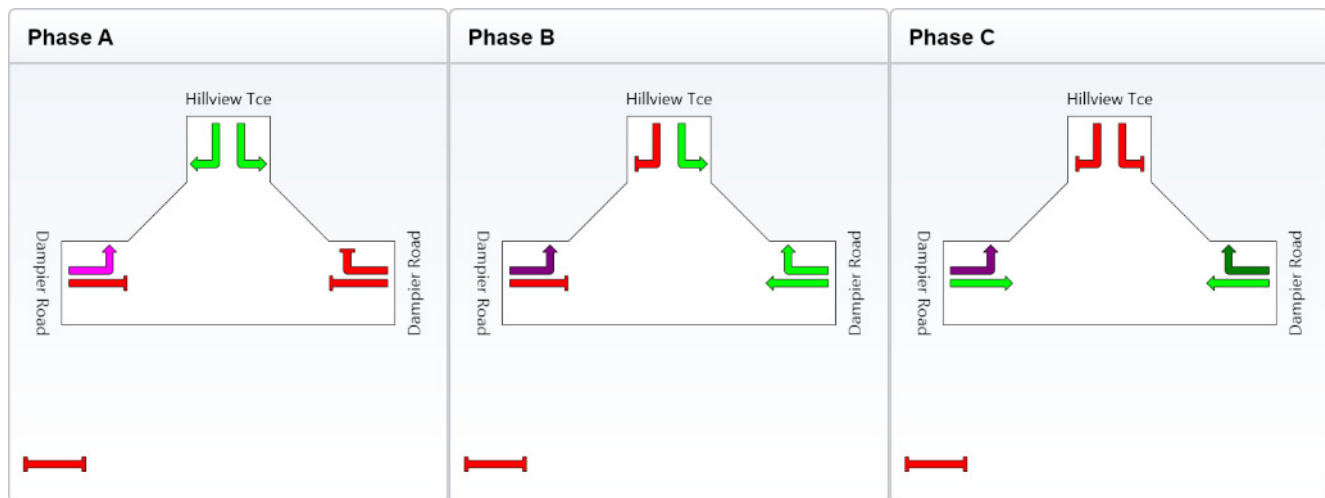
Site: 6. Dampier_Hillview (4 to 5pm) - Adjusted

Staged crossing at three-way intersection with 4-lane major road (Stop control)
Signals - Fixed Time Cycle Time = 60 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program
Sequence: Leading Right
Input Sequence: A, B, C
Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Green Time (sec)	13	6	23
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	19	12	29
Phase Split	32 %	20 %	48 %



	Normal Movement		Permitted/Opposed
	Slip-Lane Movement		Opposed Slip-Lane
	Stopped Movement		Continuous Movement
	Turn On Red		Undetected Movement
			Phase Transition Applied

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SIDRA
INTERSECTION

Technical Note

221566

2 July 2013

Dampier Road/ Sharpe Avenue

MOVEMENT SUMMARY

Site: 5. Dampier_Sharpe (4 to 5pm) Adjusted

Three-way intersection with 2 & 3-lane approaches (Signals)

Signals - Fixed Time Cycle Time = 105 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. 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
East: Dampier Road											
11	T	1341	8.1	0.543	9.7	LOS A	17.7	132.3	0.57	0.51	45.4
12	R	384	0.0	0.904	55.1	LOS E	21.0	146.9	0.99	0.95	22.5
Approach		1725	6.3	0.904	19.8	LOS B	21.0	146.9	0.66	0.61	37.4
North: Sharpe Road											
1	L	489	0.0	0.962	26.3	LOS C	8.2	57.1	0.95	0.87	27.8
3	R	579	0.0	0.803	41.5	LOS D	15.9	111.0	0.92	0.87	23.4
Approach		1068	0.0	0.962	34.5	LOS C	15.9	111.0	0.93	0.87	25.2
West: Dampier Road											
4	L	216	0.0	0.271	10.7	LOS B	3.4	23.5	0.37	0.65	44.6
5	T	1214	8.1	0.955	65.0	LOS E	41.7	312.0	1.00	1.22	20.8
Approach		1429	6.9	0.955	56.8	LOS E	41.7	312.0	0.90	1.13	22.5
All Vehicles		4223	4.9	0.962	36.1	LOS D	41.7	312.0	0.81	0.85	27.8

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P7	Across E approach	53	46.7	LOS E	0.1	0.1	0.94	0.94
P1	Across N approach	53	31.2	LOS D	0.1	0.1	0.77	0.77
All Pedestrians		106	39.0	LOS D			0.86	0.86

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

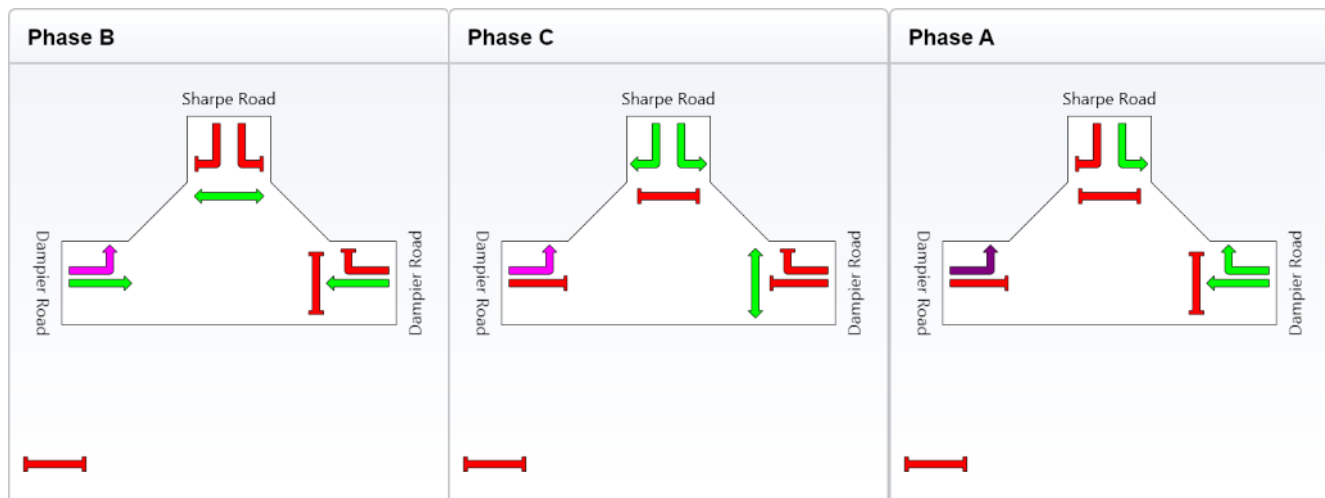
Site: 5. Dampier_Sharpe (4 to 5pm) Adjusted

Three-way intersection with 2 & 3-lane approaches (Signals)
 Signals - Fixed Time Cycle Time = 105 seconds (Optimum Cycle Time - Minimum Delay)

Phase times determined by the program
 Sequence: Leading Right Turn
 Input Sequence: B, C, A
 Output Sequence: B, C, A

Phase Timing Results

Phase	B	C	A
Green Time (sec)	36	23	28
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	42	29	34
Phase Split	40 %	28 %	32 %



	Normal Movement		Permitted/Opposed
	Slip-Lane Movement		Opposed Slip-Lane
	Stopped Movement		Continuous Movement
	Turn On Red		Undetected Movement
			Phase Transition Applied

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SIDRA
 INTERSECTION

Technical Note

221566

2 July 2013

Welcome Road/ Sharpe Avenue

MOVEMENT SUMMARY

Site: 4. Welcome_Sharpe (4 to 5pm)

New Site
Giveaway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. 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: Sharpe Road											
1	L	76	0.0	0.203	4.5	LOS A	0.0	0.0	0.00	0.66	36.7
2	T	316	0.0	0.203	0.0	LOS A	0.0	0.0	0.00	0.00	40.0
3	R	197	0.0	0.262	7.9	LOS A	0.9	6.2	0.50	0.75	34.5
Approach		588	0.0	0.262	3.2	NA	0.9	6.2	0.17	0.33	37.6
East: Welcome Road											
4	L	144	0.0	0.480	16.4	LOS C	2.7	19.1	0.70	1.05	30.2
5	T	55	8.1	0.480	15.1	LOS C	2.7	19.1	0.70	0.95	30.4
6	R	94	0.0	0.661	50.7	LOS F	3.1	21.7	0.94	1.20	19.8
Approach		293	1.5	0.661	27.1	LOS D	3.1	21.7	0.78	1.08	25.9
North: Sharpe Road											
7	L	76	0.0	0.273	4.5	LOS A	0.0	0.0	0.00	0.67	36.7
8	T	454	0.0	0.273	0.0	LOS A	0.0	0.0	0.00	0.00	40.0
9	R	32	0.0	0.039	6.4	LOS A	0.1	0.9	0.39	0.58	35.4
Approach		561	0.0	0.273	1.0	NA	0.1	0.9	0.02	0.12	39.2
West: Welcome Road											
10	L	86	0.0	0.488	20.5	LOS C	2.7	19.8	0.69	1.01	28.5
11	T	78	8.1	0.488	19.2	LOS C	2.7	19.8	0.69	0.95	28.7
12	R	128	0.0	0.968	91.2	LOS F	7.1	49.7	0.99	1.59	14.1
Approach		293	2.2	0.968	51.2	LOS F	7.1	49.7	0.82	1.25	19.7
All Vehicles		1735	0.6	0.968	14.6	NA	7.1	49.7	0.33	0.55	30.9

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

DOCUMENT CHECKING

	Prepared by	Checked by	Approved by
Name	Suan Guo/ Ryan Falconer	Darryl Patterson	Darryl Patterson
Signature	