AMENDMENT NO. 1

TO THE

CENTRAL ALKIMOS

AGREED STRUCTURE PLAN NO. 95

This Amendment to the Agreed Structure Plan has been prepared under the provisions of the City of Wanneroo District Planning Scheme No. 2

RECORD OF AMENDMENTS MADE TO THE CENTRAL ALKIMOS

AGREED STRUCTURE PLAN NO. 1

Amendment No.	Summary of the Amendment	Date approved by WAPC
01	Amend Part 1 by: 1. Replacing Table 1 Strategic Local Public Open Space 2. Replacing Plan 1 Local Structure Plan to show amendments to Strategic POS and Neighbourhood Connectors	

AMENDMENT NO. 1 TO THE
CENTRAL ALKIMOS AGREED STRUCTURE PLAN NO. 95

The City of Wanneroo, pursuant to its District Planning Scheme No. 2, hereby amends the above Agreed Structure Plan by:

1. Amending Part 1 Table 1 – Strategic Local Public Open Space in accordance with the following:

STRATEGIC LOCAL POS SITES	SIZE (HA)	FUNCTION	MANAGEMENT RESPONSIBILITY
(A) Conservation	1.49	Conversation	City of Wanneroo
(B) Passive Recreation	5.3	Passive Recreation	City of Wanneroo

2. Replacing Part 1 Plan 1 – Central Alkimos Structure Plan with the plan appended to this report (Appendix A)

This Structure Plan Amendment is prepared under the provisions of the City of Wanneroo District Planning Scheme No. 2

IT IS CERTIFIED THAT THIS STRUCTURE PLAN AMENDMENT NO. 1 TO THE CENTRAL ALKIMOS AGREED STRUCTURE PLAN NO. 95

WAS APPROVED BY

RESOLUTION OF THE WESTERN AUSTRALIAN PLANNING COMMISSION ON

……

Signed for and on behalf of the Western Australian Planning Commission

……..

an officer of the Commission duly authorised by the Commission pursuant to section 24 of the *Planning and Development Act 2005* for that purpose, in the presence of:

…… Witness

…….. Date

…….. Date of Expiry

PART 2 - EXPLANATORY REPORT

AMENDMENT NO. 1 TO THE

CENTRAL ALKIMOS AGREED STRUCTURE PLAN NO. 95

1.0 BACKGROUND

The Central Alkimos Agreed Structure Plan No. 95 comprises approximately 255 hectares of land and at ultimate development will cater for approximately 1,600 residential dwellings. The design of the Structure Plan also provides 110 hectares of a combination of conservation public open space and district playing fields, 9.1 hectares of Business, Mixed Use and Commercial zoned land and allocation for a primary school and high school.

The Central Alkimos Agree Structure Plan No .95 was approved by the Western Australian Planning Commission on 6 February 2017. The proposed amendment is the first revision to the Structure Plan since its approval.

As part of the detailed design process associated with the preparation of the Stage 1 subdivision application, issues have been identified associated with the approved Strategic Local Public Open Space network and the movement / access network.

The purpose of Amendment No. 1 is to amend the Structure Plan to address the aforementioned issues.

2.0 PROPOSED AMENDMENT

2.1 Consolidate and relocate portions of Strategic Local Public Open Space

Amendment No. 1 proposes to consolidate and relocate the approved Strategic Local Public Open Space (POS) locations A and B. This is due to the finished level of Strategic POS B, which is located on the southern side of Alkimos Drive, being 2 to 4 metres below the level of the finished levels of the surrounding roads, including Alkimos Drive. The level difference is due to the vertical alignment of Alkimos Drive being fixed as a result of it having to go over the proposed northern rail line extension to the east and to have an acceptable intersection gradient with Marmion Avenue to the west.

The level difference between the surrounding road network and Strategic POS B will result in the retained bushland being in a depression, surrounded by retaining walls. This will result in an inaccessible portion of open space with poor surveillance and usability.

In order to address this issue and provide an improved outcome for the Strategic POS, the proposed amendment consolidates Strategic POS A and Strategic POS B into one area of open space at the corner of Marmion Avenue and Alkimos Drive.

The previous portions of Strategic POS A and B will be rezoned to ‘Mixed Use’ and ‘Residential RMD25-R60’ in accordance with the surrounding area. The previous Strategic POS C will be renamed as Strategic POS B.

In order to identify areas of possible conservation, a survey of native trees which may provide potential breeding habitat for black cockatoos was undertaken in late 2014. The trees being retained in the new proposed Strategic POS A, totalling 9, were in 'Excellent' to 'Good' health and rigour and suitable for retention in open space.

The following Viability Assessment Table has been prepared in accordance with Schedule 5 of the City's *Local Planning Policy 4.3: Public Open Space* to demonstrate that proposed Strategic POS A meets the conservation requirements of the Policy. A minimum score of 14 is required for a conservation POS area to be considered viable.

VIABILITY FACTOR	**CATEGORY**	**SCORE**
Size	Less than 4ha	2
Shape	Circle, square or squat rectangle	3.5
Perimeter to Area Ratio	Greater than 0.02 less than 0.04	2
Vegetation Condition	82% Excellent 12% Completely Degraded	6.5
Connectivity	-	0
TOTAL		**14**

The proposed Strategic POS A meets the minimum score requirement of the Policy. The new proposed Strategic POS A has an overall area of 1.5 hectares. The previous Strategic POS A and B had a combined overall area of 1.05ha. As a result of the proposed amendment, the City will be receiving an additional 4,500m^2 of conservation open space compared to the design of approved ASP No. 95.

The below tables are extracts of the Strategic Local Public Open Space summary from the approved ASP No. 95 and the proposed amendment to ASP No. 95.

Table 1 – Strategic Local Public Open Space (Approved ASP No. 95)

STRATEGIC LOCAL POS SITES	**SIZE (HA)**	**FUNCTION**	**MANAGEMENT RESPONSIBILITY**
(A) Conservation	0.70	Conservation / Passive Recreation	City of Wanneroo
(B) Conservation	0.35	Conservation / Passive Recreation	City of Wanneroo
(C) Passive Recreation	5.3	Passive Recreation	City of Wanneroo

Table 1 – Strategic Local Public Open Space (Amendment 01 to ASP No. 95)

STRATEGIC LOCAL POS SITES	**SIZE (HA)**	**FUNCTION**	**MANAGEMENT RESPONSIBILITY**
(A) Conservation	1.49	Conversation	City of Wanneroo
(B) Passive Recreation	5.3	Passive Recreation	City of Wanneroo

Figures 1 and 2 are extracts from the approved Structure Plan No. 95 and the proposed amended Structure Plan detailing the proposed consolidation, relocation and rezoning.

Figure 1 – Approved Structure Plan No. 95

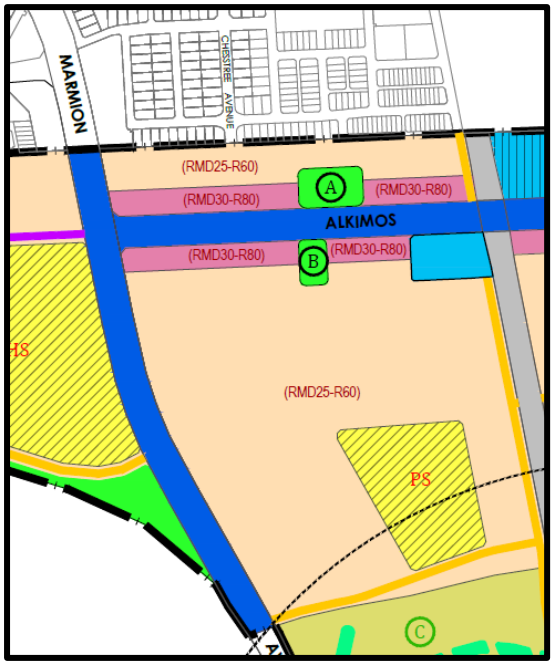
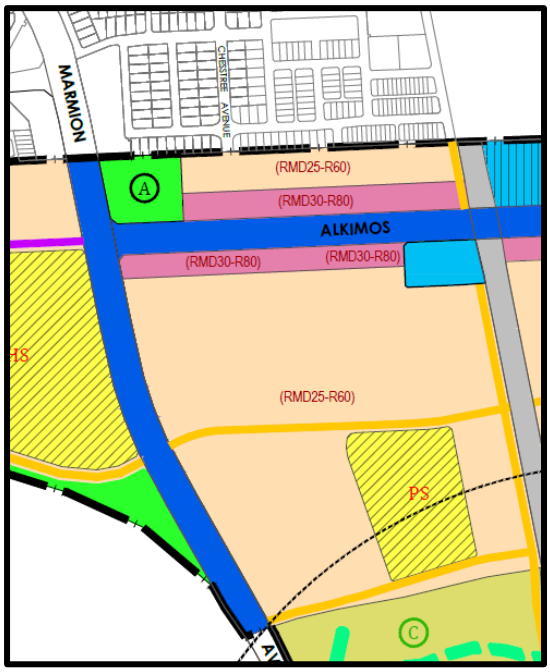


Figure 2 – Amendment No. 1 to ASP No. 95



2.2 Modify road network to include an additional Neighbourhood Connector Road

During the original LSP preparation and development, a *"Traffic and Movement Network"* report was prepared by Bruce Aulabaugh Traffic Engineering and Transport Planning. This report provided an analysis of the road network relevant to the LSP area for the ultimate traffic demand scenario in 2031, for which it remains relevant. This report defined an ultimate proposed road network for the LSP area. However, the report did not consider the staging of development or analyse the performance of ultimate intersection layouts under interim demands.

The Central Alkimos project team liaised with the City of Wanneroo in late 2016 requesting consideration of a temporary access arrangement from Marmion Avenue in lieu of the ultimate access arrangements to aid and facilitate access to the first stages of development from Marmion Avenue. This temporary access request was given in-principle support by the City, subject to a number of conditions, including the preparation of a "Traffic Assessment" in accordance with the *Marmion Avenue Arterial Road Access Policy (LPP 3.8)* and analysis to inform the design parameters for the intersection, to ensure no blocking of traffic on Marmion Avenue occurs.

In response to the conditions, the project traffic engineers, GTA, undertook an analysis of this temporary access arrangement and prepare a supporting Technical Note. This analysis has determined that the currently very high volumes of traffic on Marmion Avenue dictates that simple full movement t-intersections will not provide sufficient capacity to accommodate the estimated demands on Marmion Avenue and from the Stage 1 development area. As a result, sensitivity tests were undertaken to determine if alternative intersection forms may be appropriate and it was determined that of the four (4) options tested, a roundabout would be the most likely intersection form at this location which would provide sufficient capacity for development staging.

Following the preparation of the Technical Note, the project team met with City of Wanneroo on 20 February 2017 to discuss the content. There was a general agreement that the approach proposed in the Technical Note was appropriate. After the meeting, Russell Jackson (Traffic Engineer) of City of Wanneroo provided advice as to what information City of Wanneroo would like to see as part of any subsequent analysis.

Further, the project team met with Department of Planning on 11 May 2017 to discuss the Technical Note. During this meeting, there was also a general agreement on the proposed approach. In this context, GTA has undertaken a further detailed Traffic Impact Analysis (refer to Appendix B) to assess the suitability of a roundabout control at this location both under interim and ultimate traffic demand scenarios. This report details the context, methodology and findings of the analysis, which considers the suitability of the proposed development and the associated road infrastructure proposed for access.

The report concluded that the provision of a roundabout and left-in, left out intersection in lieu of the currently approved two full movement t-intersection was appropriate for the following reasons:

- GTA has undertaken a detailed assessment to determine if the proposed arrangements are suitable in the interim and ultimate year scenarios.
- Infrastructure and vehicle demand scenarios have been developed to test the proposal at key development stages.
- Intersection capacity test have been undertaken in SIDRA for each scenario. Results illustrate, that in each Scenario tested, the proposed intersection layouts provide sufficient capacity to accommodate estimated vehicular demands.

- The provision of the roundabout will improve connectivity for the eastern and western portions of the Alkimos Central LSP area, and is likely to reduce traffic travelling through the Alkimos Drive/Marmion Avenue signalised intersection in the ultimate scenario.
- The roundabout, in comparison to the approved layout, also reduces the overall number of vehicle conflict points at the intersections.

Figures 3 and 4 are extracts from the approved Structure Plan No. 95 and the proposed amended Structure Plan detailing the proposed addition of a Neighbourhood Connector road.

Refer to Appendix C for the amended road hierarchy plan (Figure 18 in LSP95).

Figure 3 – Approved Structure Plan No. 95

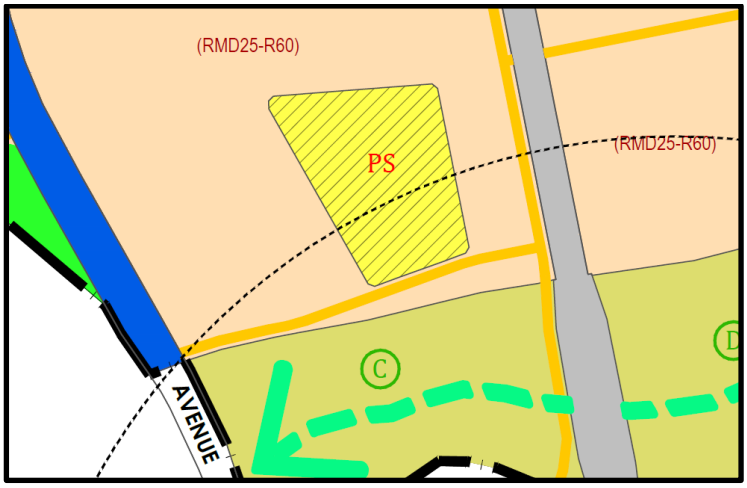
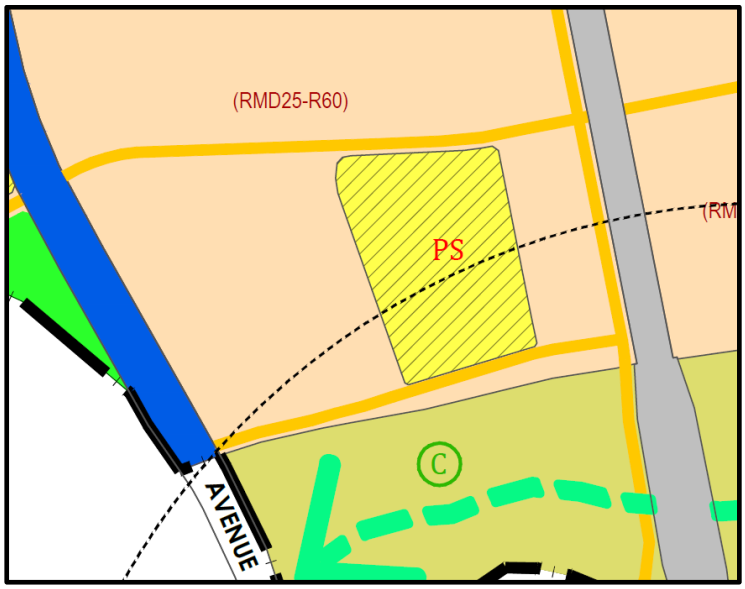


Figure 4 – Amendment No. 1 to ASP No. 95



APPENDIX A – AMENDED STRUCTURE PLAN

N

MARMION AVENUE

SOUNDING AVENUE

BROADSIDE AVENUE

CHESSTREE AVENUE

ALKIMOS DRIVE

MITCHELL FREEWAY

(RMD25-R60)

(RMD30-R80)

HS

PS

A

B

C

D

E

GWTP

WWTP

BUS/ RAIL INTERCHANGE

RAIL STATION

LEGEND

Structure Plan Boundary

Zones
- Mixed Use
- Residential
- Business
- Commercial

Reserves
- Regional Open Space
- Education & Recreation
  - HS High School
  - PS Primary School
- Railway Reserve
- Strategic POS

Other
- Primary Distributor Road
- District Distributor Integrator A (No Direct Frontage Access Permitted
- District Distributor Integrator B
- Neighbourhood Connector
- Social/ Pedestrian/ Cycle Linkage
- District Open Space (DCP Item)
- No Subdivision or Development within this area until such time as the Metropolitan Region Scheme is amended to transfer the land to the Urban Zone

- Strategic Local Open Space Refer to Table 1 of Part 1
- Strategic Regional Open Space Refer to Table 2 of Part 1

LANDCORP lendlease

robertsday.com.au planning·design·place

CADASTRAL INFORMATION
SOURCE: LANDGATE
YYMMDD: 101101
DWG REF: 0845cad
PROJECTION: PCG94

AERIAL PHOTOGRAPHY
SOURCE: NA
YYMMDD: NA

SIZE A3

1:10,000

0 metres 100 200 300 400 500

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S	VARIOUS MODS	161116	HH	RD
R	VARIOUS MODS REV P BASE	160822	HH	RD
Q	VARIOUS MODS	160531	HH	RD
P	COMMERCIAL ZONE	160414	RF	RD
O	VARIOUS UPDATES	160329	HH	RD

LOCAL STRUCTURE PLAN
Central Alkimos
City of Wanneroo

REF NO. **DLL CEN**
DRAW NO. **RD1 001**
REV. **U**

APPENDIX B – TRAFFIC IMPACT ANALYSIS (GTA, 2017)

GTAconsultants

Alkimos Central Traffic Impact Analysis

Client //	Lendlease Communities (Alkimos Central) Pty Ltd
Office //	WA
Reference //	W122760
Date //	04/04/17

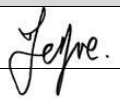
Alkimos Central

Traffic Impact Analysis

Issue: C 04/04/17

Client: Lendlease Communities (Alkimos Central) Pty Ltd
Reference: W122760
GTA Consultants Office: WA

Quality Record

Issue	Date	Description	Prepared By	Checked By	Approved By	Signed
C	4/7/17	Final	M Fowler	M Fowler	T Moran	

GTAconsultants
Melbourne | Sydney | Brisbane
Canberra | Adelaide | Perth
Gold Coast | Townsville

FINAL

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Tables

1. Introduction

1.1 Background

GTA Consultants (GTA) has been engaged by Lendlease Communities (Alkimos Central) Pty Ltd (the Applicant) to undertake a Traffic Impact Analysis to support a Subdivision Application for Stage 1 of development within the Alkimos Central approved LSP area, ASP 95.

Alkimos Central lies within the Alkimos Eglinton District Structure Plan (DSP) area, as highlighted in Figure 1.1.

Figure 1.1: Alkimos Central in DSP context

1.2 Previous Traffic Analysis and Context

During the original LSP preparation and development, a *"Traffic and Movement Network"* report was prepared by Bruce Aulabaugh Traffic Engineering and Transport Planning[1]. This report provided an analysis of the road network relevant to the LSP area for the ultimate traffic demand scenario in 2031, for which it remains relevant. This report defined an ultimate proposed road network for the LSP area, as provided at Appendix A.

The report did not consider the staging of development or analyse the performance of ultimate intersection layouts under interim demands.

RobertsDay recently wrote to the City of Wanneroo (refer Appendix B) requesting consideration of a temporary access arrangement from Marmion Avenue in lieu of the ultimate access arrangements presented at Appendix A, to aid and facilitate access to the first stages of development from Marmion Avenue.

This temporary access request was given in-principle support by the City in 2016, subject to a number of conditions, including the preparation of a "Traffic Assessment" in accordance with the

[1] Central Alkimos, Traffic and Movement Network, Final Report, Bruce Aulabaugh, Rev 1 – May 9, 2013

Marmion Avenue Arterial Road Access Policy (LPP 3.8) and analysis to inform the design parameters for the intersection, to ensure no blocking of traffic on Marmion Avenue occurs.

In response to the conditions, Lendlease requested GTA to undertake an analysis of this temporary access arrangement and prepare a supporting Technical Note. This analysis has determined that the currently very high volumes of traffic on Marmion Avenue dictates that simple full movement t-intersections will not provide sufficient capacity to accommodate the estimated demands on Marmion Avenue and from the Stage 1 development area. As a result, sensitivity tests were undertaken to determine if alternative intersection forms may be appropriate and it was determined that of the four (4) options tested, a roundabout would be the most likely intersection form at this location which would provide sufficient capacity for development staging. This Technical Note is Provided at Appendix C.

1.3 Consultation

Following the preparation of the Technical Note, the project team met with City of Wanneroo on Monday 20 February 2017 to discuss the content. There was a general agreement that the approach proposed in the Technical Note was appropriate. Subsequent to the meeting, Russell Jackson (Traffic Engineer) of City of Wanneroo provided advice as to what information City of Wanneroo would like to see as part of any subsequent analysis. This advice is provided at Appendix D.

Further, the project team met with Department of Planning (DoP) to discuss the Technical Note. During this meeting, there was also a general agreement on the proposed approach. In this context, GTA has undertaken a further detailed Traffic Impact Analysis (this document) to assess the suitability of a roundabout control at this location both under interim and ultimate traffic demand scenarios. This report details the context, methodology and findings of the analysis, which considers the suitability of the proposed development and the associated road infrastructure proposed for access.

2. Traffic Impact Analysis

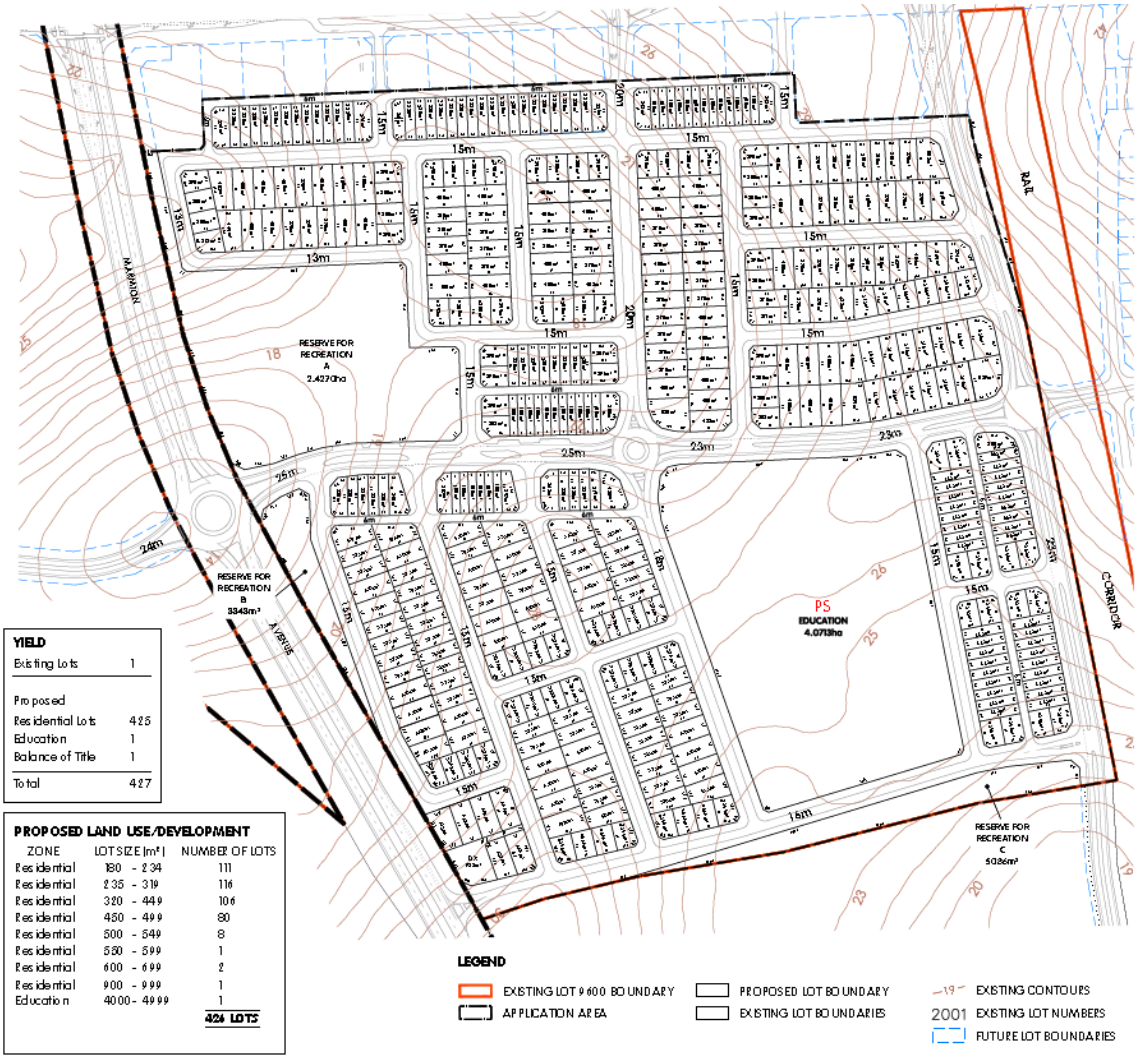
2.1 Overview

GTA has undertaken a traffic modelling exercise to assess two (2) scenarios which consider access arrangements at key points in the future, from Marmion Avenue to the Alkimos Central LSP area. Commentary has also been provided on the previous Ultimate Scenario tested and approved during the LSP stage.

Whilst this considers development of the geographic area beyond this Subdivision Application, it has been necessary to also test the measures as being suitable for the interim and ultimate scenario (2031), not only the current need.

The analysis undertaken has been informed by the proposed subdivision layout for the Stage 1 development, and a draft layout for the entire Alkimos Central LSP area. The proposed layout for Stage 1 is provided in Figure 2.1.

Figure 2.1: Stage 1 Subdivision layout



2.2 Assessment Scenarios

Table 2.1 provides a summary of the assessment scenarios considered. No particular assessment was undertaken for the Ultimate Scenario since this has already been analysed and approved as part of the LSP process. Notwithstanding, commentary has been provided in order to qualify the inclusion of a roundabout in this Scenario.

Table 2.1: Assessment Scenarios

Scenario	Year of Assessment	Road Infrastructure for Access to Alkimos Central	
		Eastern Portion	Western Portion
1	2020	3-arm roundabout	No development exists
2	2027	4-arm roundabout Left-in, left-out priority	3-arm signalised intersection (at Alkimos Drive)
Ultimate	2031	As per LSP proposal with 4-arm roundabout (includes 4-arm signalised intersection at Alkimos Drive)	

A bespoke spreadsheet model was developed for each of the tested scenarios considering the different stages of LSP development and the point in time which the proposed road infrastructure would be under the maximum demand i.e before additional infrastructure is provided to redistribute traffic or alleviate demands. Inputs to the model include the forecast background traffic on Marmion Avenue and the trip generation associated with the full development of each stage. Further information is provided in the subsequent sections related to the level of development and estimated traffic volumes under each scenario.

2.3 Marmion Avenue

To forecast the future year traffic flows, a 2.7% per annum (compound) growth rate has been applied to the existing background traffic along Marmion Avenue. This growth rate was determined by comparing 2016 daily traffic volumes which were extracted from MRWA online traffic database north of Romeo Road, and the 2031 traffic volume predicted on Marmion Avenue within the approved 2013 LSP *Traffic and Movement Network*[2] report for the site outputs. GTA discussed the applicability of these volumes for use in the analysis with Russell Jackson (Traffic Engineer, City of Wanneroo) who agreed verbally the data is applicable for use. The growth rate determined is set out in Table 2.2.

Table 2.2: Growth Rate Calculation

Year	Daily vehicles (two-way)	Location
2031	29,500	North/South of Alkimos Drive (Source: LSP)
2016	19,686	North of Romeo Road (Source: MRWA)
Average Annual Compound Growth Rate (Over 15 years from 2016 to 2031)		2.7%

The forecast Marmion Avenue peak hour traffic volumes have then been added to maximum trip generation estimates for each assessment scenario.

It is noted that the existing daily traffic volumes on Marmion Avenue are high. As a rule of thumb, the warrant for upgrading a two-way single carriageway road to a dual carriageway should

[2] Central Alkimos, Traffic and Movement Network, Final Report, Bruce Aulabaugh, Rev 1 – May 9, 2013

occur at around 15,000 vehicles per day. Presently (2016), Marmion Avenue is carrying in excess of 19,000 vehicles per day adjacent the LSP area under a two-way single carriageway cross-section. This excessive volume is the primary reason the Technical Note illustrated that priority controlled intersections will not work on Marmion Avenue, prior to the ultimate scenario in 2031. In summary, there are insufficient gaps in the Marmion Avenue's traffic during the peak hours for any minor road traffic to enter / exit the Marmion Avenue flow.

2.4 Trip Rates

The Alkimos Central LSP area will include a mix of residential and education land uses (primary and high school). The trip generation rates and arrival/departure proportions adopted for these land uses for the analysis are set out in Table 2.3 and have been extracted from *Western Australian Planning Commission Transport Impact Assessment Guidelines (2016)* (WAPC Guidelines).

Table 2.3: Adopted Trip Generation Rates

Land Use	Trip Rate (Veh/hr)	Morning Peak		Evening Peak	
		IN	OUT	IN	OUT
Residential	0.8 per dwelling	25%	75%	67%	33%
School	1.0 per child	50%	50%	50%	50%

2.5 Trip Distribution

At present, Marmion Avenue acts as the sole access for vehicles to travel to and through the northern corridor of Wanneroo. As a result, all traffic associated with the Alkimos Central LSP will travel on Marmion Avenue, prior to the Ultimate Scenario when Alkimos Drive and the Freeway extension are planned to be constructed. Therefore, the distribution of traffic associated with the LSP, prior to the Ultimate Scenario, has been based upon the observed northbound / southbound demand on Marmion Avenue. This distribution is presented in Table 2.4.

Table 2.4: Assumed Traffic Distribution on Marmion Avenue

Direction	%	
	Morning Peak	Evening Peak
Marmion Ave - Southbound	61%	44%
Marmion Ave - Northbound	39%	56%

2.6 Model Inputs and Assumptions

In order to develop the bespoke spreadsheet model, a series of assumptions have been made for each scenario. These assumptions then assist to develop the vehicular demands for each assessment scenario, adopting the previously set out trip rates and distributions. A list of assumptions made and resultant model inputs/outputs together with a schematic representation of the intersection layouts adopted are provided in Table 2.5 and Table 2.6.

Table 2.5: Scenario 1 Inputs

Scenario (Year)	Location	Land Use	External LSP Traffic Generation				Assumptions informing Assessment
			Morning Peak		Evening Peak		
			In	Out	In	Out	
1 - 2020	East of Marmion Avenue	220 Dwellings 1 Group Housing	54	162	145	71	• Access to east portion of the LSP is via 3 arm roundabout on Marmion Avenue • Marmion Avenue is configured as a dual carriageway with two lanes in each direction • Marmion Avenue background traffic as follows: - AM Peak: 1,178 vph (Southbound) and 752 vph (Northbound) - PM Peak: 804 vph (Southbound) and 1,003 vph (Northbound)
	Total		**54**	**162**	**145**	**71**	

Assessed 3-arm roundabout layout for access to eastern portion of LSP

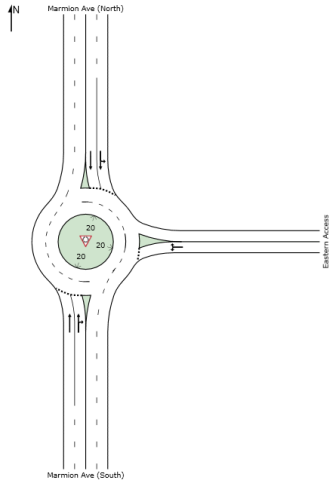
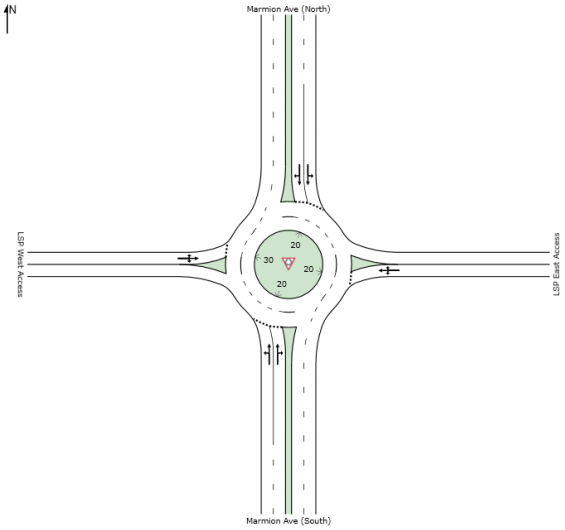
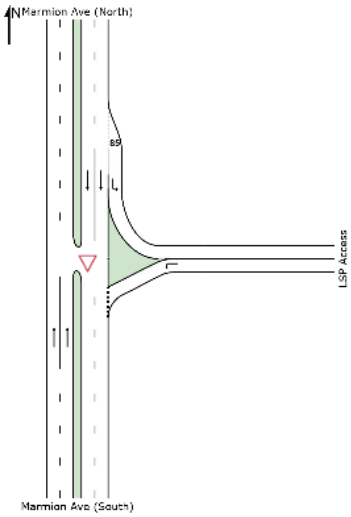
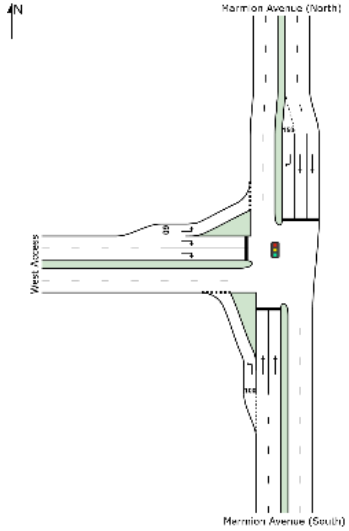


Table 2.6: Scenario 2 Inputs

Scenario (Year)	Location	Land Use	External LSP Traffic Generation				Assumptions informing Assessment
			Morning Peak		Evening Peak		
			In	Out	In	Out	
2 - 2027	East of Marmion Avenue	628 Houses 4 Group Housing 3 Duplex	123	369	330	163	• Access to east portion of the LSP is via a 4-arm roundabout and Left-in, left-out intersection on Marmion Avenue • Access to the west portion of the LSP gained via a 4-arm roundabout and 3-arm signalised intersection (at Alkimos Drive) • Marmion Avenue is configured as a dual carriageway with two lanes in each direction • Marmion Avenue background traffic as follows: - AM Peak: 1,420 vph (Southbound) and 906 vph (Northbound) - PM Peak: 969 vph (Southbound) and 1,209 vph (Northbound) • Roundabout has single lane entries on minor arms • Left-in, left out has deceleration lane for vehicles entering the LSP area and operates as a standard give-way for vehicles exiting the LSP area • Road links to Alkimos City Centre (south of the LSP) will be constructed from eastern portion of LSP area. 10% discount applied in external trip generation to account for this. • Primary school has capacity for 650 students and is assumed full. Catchment extends north to Shorehaven and south to Alkimos City Centre on eastern side of Marmion Avenue only. It therefore has limited external trip generation to Marmion Avenue, and external trips are assumed conservatively to be 25% of all school activity • All eastern precinct development traffic to/from north routed via roundabout. Southbound eastern precinct development traffic split on the basis of permitted movements, attractiveness and location of land uses in relation to intersections • Assessment assumes residential and school peaks are concurrent, resulting in a conservative assessment • High School has a capacity of 1700 students. Considering the catchment, assumed 50% of trips will travel to/from Marmion Avenue • No reduction for internal trips for western portion of LSP
		Primary School 650 students	81	81	81	81	
		Total	**204**	**450**	**411**	**243**	
	West of Marmion Avenue	450 Houses	90	270	241	119	
		High School 1700 students	425	425	425	544	
		Total	**515**	**695**	**666**	**633**	

Assessed 4-arm roundabout layout for access to eastern and western portion of LSP	Assessed left-in, left-out layout for access to eastern portion of LSP	Assessed 3-arm signalised intersection for access to western portions of LSP
		

Traffic flow movement diagrams for each assessment scenario, in each peak period are provided at Appendix E.

2.7 Assessment of Intersection Operations

The operation of the key intersections along Marmion Avenue for access to the LSP area in each scenario has been assessed using SIDRA Intersection[3] (SIDRA), utilising the "network" function. SIDRA is a computer based modelling package which calculates intersection performance. As detailed in the WAPC Guidelines, the critical measure of intersection performance is average delay per vehicle. Table 2.7 sets out the thresholds for intersection delays considered to provide an adequate Level of Service (LoS) within the WAPC Guidelines for priority-controlled intersections.

Table 2.7: WAPC Guideline Thresholds for Intersection Adequate Operations

Delay Component	Priority-Controlled Intersection Threshold	Signalised Intersection Threshold
Average delay for all vehicles passing through the intersection	<35 seconds	<55 seconds
Average delay for any individual vehicle, pedestrian or cyclist movement	<45 seconds	<65 seconds

SIDRA outputs are presented in the form of Degree of Saturation, Level of Service, Average Delay and 95% Queue. These characteristics are defined as follows:

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

2.8 Intersection Operation Results

The following section of this report sets out the SIDRA intersection assessment results for each scenario, and also provides commentary on the ultimate 2031 scenario considered in the LSP.

2.8.1 Scenario 1

The summary results of the Scenario 1 assessment are presented in Table 2.8. Full SIDRA outputs can be found at Appendix F.

[3] Program used under licence from Akcelik & Associates Pty Ltd

Table 2.8: Scenario 1 Traffic Assessment Results

Scenario (Year)	Intersection	Approach	AM Peak				PM Peak			
			DoS	Avg. Delay (s)	LOS	95% Queue Length (m)	DoS	Avg. Delay (s)	LOS	95% Queue Length (m)
1 (2020)	Marmion Ave/LSP Access - 3 Arm Roundabout'	Marmion Ave (South)	0.304	6.8	A	13.9	0.402	6.9	A	20.6
		LSP Access (1) (East)	0.263	9.1	A	7.4	0.104	8.2	A	2.8
		Marmion Ave (North)	0.430	6.4	A	20.6	0.344	6.7	A	14.1
		Total	**0.430**	**6.8**	**A**	**20.6**	**0.402**	**6.9**	**A**	**20.6**

The above results illustrate that a 3-arm roundabout with flares on entry on Marmion Avenue (to accommodate turning traffic), can adequately accommodate the Scenario 1 traffic demands.

2.8.2 Scenario 2

In Scenario 2, LSP development also occurs on the western side of Marmion Avenue. Summary results are provided in Table 2.9, with full SIDRA outputs at Appendix F.

Table 2.9: Scenario 2 Traffic Assessment Results

Scenario (Year)	Intersection	Approach	AM Peak				PM Peak			
			DoS	Avg. Delay (s)	LOS	95% Queue Length (m)	DoS	Avg. Delay (s)	LOS	95% Queue Length (m)
2 (2027)	Marmion Ave/Alkimos Dr - 4 Arm Signalised Int.'	Marmion Ave (South)	0.685	31.9	B	192.0	0.696	15.3	B	200.3
		Marmion Ave (North)	0.787	10.6	B	74.6	0.853	12.2	B	97.4
		Alkimos Dr (West)	0.636	30.7	C	85.9	0.469	28.2	C	51.5
		Total	**0.787**	**15.1**	**B**	**192.0**	**0.853**	**15.5**	**B**	**200.3**
	Marmion Ave/LSP Access (1) - 4 Arm Roundabout'	Marmion Ave (South)	0.831	11.5	B	86.5	0.866	11.5	B	111.4
		LSP Access (1) (East)	0.832	24.4	C	54.5	0.549	14.9	B	20.8
		Marmion Ave (North)	0.595	7.7	A	33.1	0.680	9.6	A	45.8
		LSP Access (West)	0.506	16.3	B	20.7	0.399	15.3	B	15.4
		Total	**0.832**	**11.7**	**B**	**86.5**	**0.866**	**11.1**	**B**	**111.4**
	Marmion Ave/LSP Access (2) - LILO'	Marmion Ave (South)	0.441	0.1	NA	0.0	0.503	0.1	NA	0.0
		LSP Access (2) (East)	0.184	10.7	B	4.5	0.061	9.1	A	1.5
		Marmion Ave (North)	0.414	0.2	NA	0.0	0.367	0.3	NA	0.0
		Total	**0.441**	**0.4**	**NA**	**4.5**	**0.503**	**0.3**	**NA**	**1.5**

The results above illustrate that in Scenario 2, the levels of delay are within the thresholds prescribed in WAPC Guidelines. It is noted that queuing occurs but this will be representative of any signalised intersection on this corridor prior to the construction of the Mitchell Freeway and the addition of an alternate route for travel north/south. This queuing does not extend back to the proposed roundabout.

The proposed intersection layouts can be found at Appendix F in the SIDRA outputs, and are summarised below.

4-arm roundabout

- Dual lane entry on Marmion Avenue accommodating 2 lanes in each direction
- Single lane entries on minor arms.

Left-in, Left-out

- Left turn deceleration lane
- Give-way for vehicles entering Marmion Avenue.

Signalised intersection

- Dual lane through routes on Marmion Avenue
- Left turn slip lane for Marmion Avenue northbound traffic into LSP (give-way)
- Left turn slip lane for Marmion Avenue northbound traffic out of LSP (give-way)
- Dual right turn lanes into Marmion Avenue for southbound traffic out of LSP.

The above intersection forms would be constructed taking cognisance of the ultimate intersection layouts noted in the approved LSP, so that limited abortive construction works would occur.

2.8.3 Ultimate Scenario (LSP, 2031)

No specific capacity analysis has been undertaken for the assessment of the Ultimate Scenario (2031) since this has already been completed as part of the previous LSP assessment. This scenario includes the introduction of major new infrastructure including extension of the northern Yanchep to Perth railway, construction of the Mitchell Freeway and Alkimos Drive and many other north/south and east/west connections to and through adjacent LSP areas. On this basis, the original LSP report remains the most relevant assessment for this Scenario, as an all-encompassing assessment of the ultimate year, some 14 years in the future.

Notwithstanding, it is important that operational efficiency is maintained on the wider road network and not only at the proposed access to the LSP. In this context, GTA has considered the proximity of the future 4-way Alkimos Drive signals to the north, and how the operation of this may impact the proposed roundabout and vice-versa.

In a vehicle movement context, the roundabout is likely to remove some right turn demand (Marmion Avenue to Alkimos Drive) from the traffic signals for local traffic entering the eastern portion of the Alkimos Central LSP. Likewise, a small proportion of vehicles exiting both the eastern and western portions of the LSP are likely to utilise the roundabout to travel south on Marmion Avenue, as opposed to utilising the traffic signals, since in the LSP proposal this opportunity does not exist. In this context, the introduction of the roundabout is likely to reduce vehicular demand travelling through the signalised intersection.

The introduction of the roundabout will not generally impact the vehicle arrival profile to the signalised intersection for northbound traffic on Marmion Avenue. Therefore there is negligible impact to the operation of the signals in this regard. Likewise, since the roundabout is downstream for southbound Marmion Avenue traffic, traffic gaps will be created by the signals to allow for improved egress from the LSP area.

Intersection spacing should also be considered, with the proposed roundabout approximately 375m south of the signals (from the stop line of the southern leg).

GTA has reviewed the intersection SIDRA model for the future Alkimos Drive intersection from the LSP report. This demonstrates a queue on the southern approach of around 350m (in the peak period). It is acknowledged this is some 25m from the roundabout, but it is considered that reduction in traffic volumes described above and the general redistribution of traffic in this context means that queuing back to the roundabout will not occur.

3. Other Considerations

3.1 Traffic routing

Marmion Avenue runs north/south through the overall LSP area and as such acts as a barrier for east/west access and connectivity for all modes of travel. As currently proposed in the LSP, the ability to travel between the east and west sides of Marmion Avenue is limited only to Alkimos Drive or via a set of staggered t-intersections on Marmion Avenue, as illustrated in Figure 3.1.

Figure 3.1: Existing LSP Movement Network

The inclusion of a 4-arm roundabout would provide a direct link between the LSP area on both sides of Marmion Avenue for a more legible local road network. A road link of the same hierarchy from east to west would provide opportunity for ease of vehicular travel between the future high schools, primary schools and residencies without the need to travel along Marmion Avenue or Alkimos Drive. It is anticipated that the roundabout would be used for local trip purposes to cross Marmion Avenue or enter the LSP area. Given it's proximity to Alkimos Drive, and the strategic purpose which Alkimos Drive serves, it is highly unlikely that any trips would use the route as a rat-run since they would be required to travel at lower speeds and also over a longer distance to gain access to the Freeway, for example. Drivers utilising the roundabout for this purpose would also need to still gain access to Alkimos Drive from the LSP area and so would be again penalised for travel time.

A greater legibility of road hierarchy ensues through the provision of a local distributor link between NS1, NS2 and the LSP on the western side of Marmion Avenue, which are all currently disconnected. The proposed road network change is highlighted in Figure 3.2.

Figure 3.2: Proposed LSP Movement Network

The proposed High School in the western portion of the LSP, due to its site topography, will have primary access on its northern edge. A key component in the overall design of the LSP was the proximity of the Alkimos Drive traffic signals to the school access points, and the resultant opportunity for pedestrian crossing of Marmion Avenue at this location to provide a direct link to the High School pedestrian entry points. This arrangement will be maintained with the revised layout.

3.2 Road Safety

Two key considerations in the choice of an appropriate intersection control are capacity performance, and road safety. The content of this report so far, has illustrated that the provision of a roundabout is suitable from the perspective of intersection capacity.

In terms of road safety, the roundabout is proposed in lieu of a set of staggered full movement t-intersections. In this respect there is a significant reduction in the number of potential conflict points with the provision of a roundabout (4 conflict points) in comparison to a full movement intersection (6 conflict points, at 2 locations). Further, the roundabout allows drivers existing the minor road to join the major road in one movement for travel north or south, as opposed to the priority controlled layout which required vehicles to perform a staggered crossing manoeuvre and give-way to oncoming vehicles from the minor road and in the median.

The roundabout (as discussed previously) also presents a more legible road network which is easier for drivers to understand, and also consolidates vehicular activity crossing Marmion Avenue. This may result in less confusion and less likelihood of vehicular conflict.

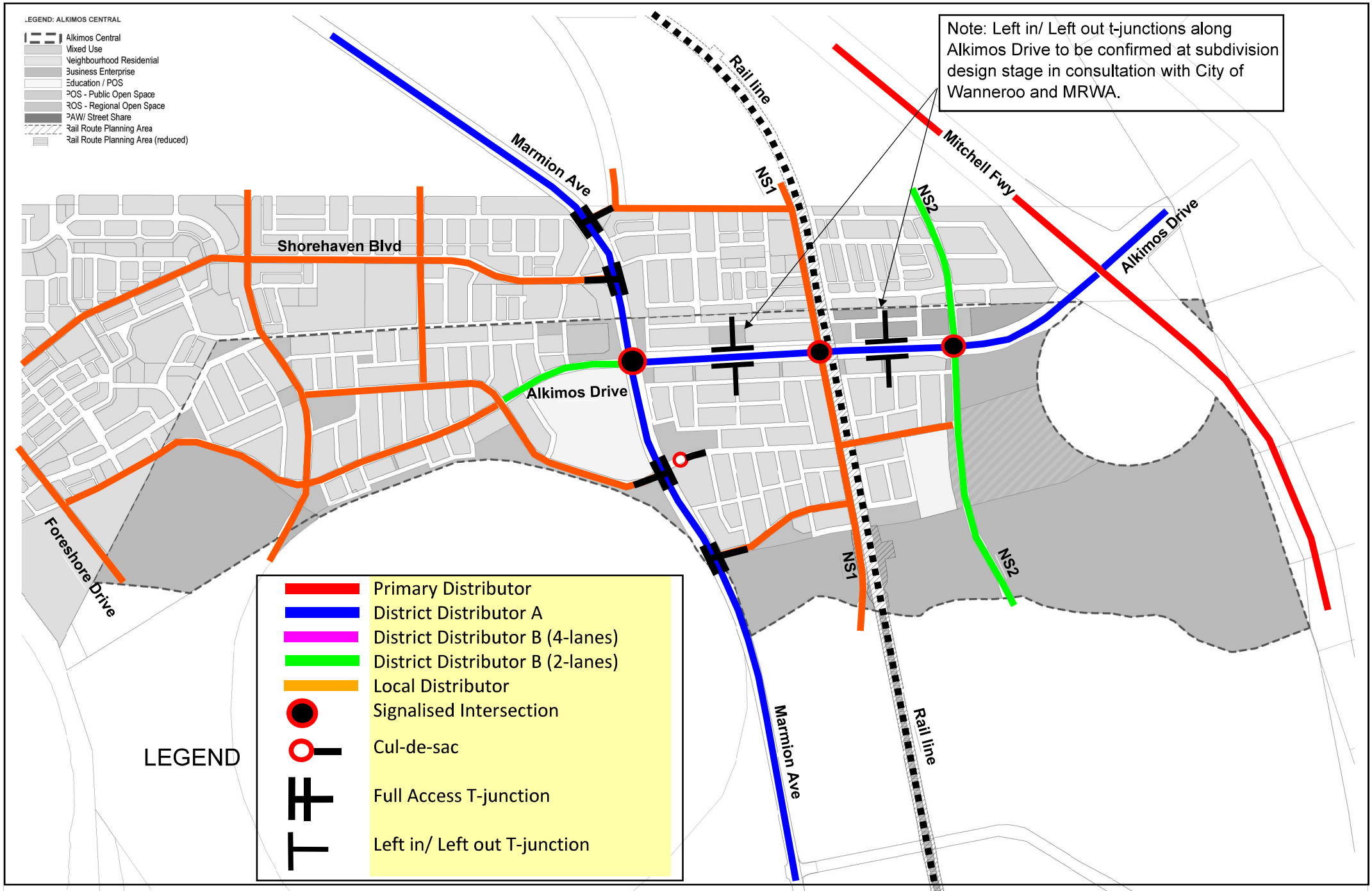
4. Conclusion

Based on the analysis and discussions presented within this report, the following conclusions are made:

- Lendlease are proposing to amend the approved Alkimos Central Structure Plan layout, to provide a roundabout and left-in, left out intersection in lieu of the currently approved two full movement t-intersections.
- The proposal has the in-principle support of City of Wanneroo and Department of Planning.
- GTA has undertaken a detailed assessment to determine if the proposed arrangements are suitable in the interim and ultimate year scenarios.
- Infrastructure and vehicle demand scenarios have been developed to test the proposal at key development stages.
- Intersection capacity tests have been undertaken in SIDRA for each scenario. Results illustrate that, in each Scenario tested, the proposed intersection layouts provide sufficient capacity to accommodate estimated vehicular demands.
- The provision of the roundabout will improve connectivity for the eastern and western portions of the Alkimos Central LSP area, and is likely to reduce traffic travelling through the Alkimos Drive/Marmion Avenue signalised intersection in the ultimate scenario.
- The roundabout, in comparison to the approved layout, also reduces the overall number of vehicle conflict points at the intersections.

Appendix A

Approved LSP Road Layout



Central Alkimos Local Structure Plan

Bruce Aulabaugh Traffic Engineering & Transport Planning

Figure 3 Road Hierarchy & Arterial Access

Base Plan: Roberts Day

Appendix B

Letter to City of Wanneroo from Roberts Day

OUR REF: DLL CEN

23 November 2016

Chief Executive Officer
City of Wanneroo
Locked Bag 1
WANNEROO WA 6946

RobertsDay
planning·design·place

Attention: Jeremy Thompson

Dear Jeremy

RE: CENTRAL ALKIMOS LOCAL STRUCTURE PLAN – ACCESS FROM MARMION AVENUE

Background

The Central Alkimos Local Structure Plan No. 95 (LSP) was supported by the City at their Ordinary Meeting of 24 May 2016. The WAPC approved the LSP subject to modifications on 15 November 2016. We are now commencing the preparation of the detailed subdivision design for the first stages if the development. These first stages will be located between Marmion Avenue and the rail reserve. The primary reasons for commencing in this location is access to services and access to Marmion Avenue.

The LSP has two proposed access points from Marmion Avenue to the eastern side; one with Alkimos Drive and one on the southern boundary of the site adjacent to the Regional Open Space reserve. There are also two access points on the western side; one with Alkimos Drive and one on the southern boundary of the proposed high school site.

The construction of the intersection with Alkimos Drive is not considered suitable at this stage due to the investment required. The proposed intersection with Marmion Avenue on the southern boundary of the site adjacent to the Regional Open Space reserve is not considered suitable, at this stage, for the following reasons:

- Only one side of the entry road can be developed which limits the scope of developing the first few stages and is a large investment that can only be utilised on one side;
- There aren't any public open space reserves proposed for this location to service new residents;
- Impact of residents on the Regional Open Space prior to rehabilitation works being undertaken; and
- The proposed sewer pump station is located approximately 500 metres to the north of the southern entry road resulting in significant costs to service this location if it to be the first stage of development.

In light of the above it is proposed to construct a temporary full access T-intersection at the location identified on the attached master plan.

robertsday
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cloisters square wa 6850
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robertsday.com.au

Proposal

It is proposed to construct a temporary full access T-intersection to provide access to the first stages of the project. The intersection will be in place until the southern intersection providing access to the western side of the project (adjacent to the high school) is required. The intersection will be constructed to City of Wanneroo and Main Roads standards.

Justification

Marmion Avenue Access Policy

The vehicular access from Marmion Avenue is guided by the City of Wanneroo Local Planning Policy 3.8: Marmion Avenue Arterial Road Access (LPP3.8). This Policy includes a figure showing the proposed access points and types from Marmion Avenue into the Central Alkimos site (refer to attached).

In respect to the proposed access points from Marmion Avenue into the site, the Policy proposed a signalised intersection on the southern boundary and one left-in/left-out intersection to access the eastern portion of the site. During the preparation of the structure plan it was determined that the signalised intersection on the southern boundary was not suitable as it did not provide access to the western portion of the site as the road would have to go through the WWTP buffer and associated conservation area. It was therefore decided to provide a full access T-intersection on the southern boundary of site to provide access to the eastern portion of the site and an additional full access T-intersection to provide access to the western portion, in particular the proposed high school.

The proposed temporary intersection on the eastern side is in accordance with the Policy. In accordance with the Policy, if the City is amenable to considering the proposed intersection we will engage a suitably qualified and experienced traffic engineer to prepare a transport and traffic assessment on the proposal.

Design

The long-term intersection to Marmion Avenue is based on maximising the operational characteristics of the Arterial by minimising intersections, and maximising their spacing.

Liveable Neighbourhoods advocates the balancing of operational arterial requirements with the need for improved local movement, and consequently applies minimum spacing requirements in the order of 190m (Integrator A, 70kmh). This spacing requirement is intended to maximise intersections, thereby maximising traffic distribution and reducing overloading on major intersections.

The nominated location of the temporary intersection achieves an optimal internal distribution of local traffic due to its central location in the residential cell. By contrast, the long-term intersection requires all local traffic to trickle to the southern boundary of the cell.

In addition, the location provides better legibility, and is also ‘announced’ by the presence of residential street-blocks both north and south of it, compared with the long term location which presents itself more abruptly to northbound traffic along Marmion Avenue.

Summary

In order to provide suitable access to the first stages of the Central Alkimos project it is proposed to construct a temporary full access T-intersection on the eastern side of Marmion Avenue. In light of the

information provided above we are seeking advice from the City if they are amenable to this proposal subject to the preparation of a traffic and transport assessment.

Should you require and clarification of the above or further information, please do not hesitate to contact the undersigned on 9213 7300.

Yours Sincerely
ROBERTS DAY

RYAN DARBY
PRINCIPAL

CC: LENDLEASE L SWINTON

Appendix C

GTA Technical Note

MEMORANDUM

TO: Jeremy Thompson (Senior Planner), City of Wanneroo

CC: Lend Lease, Roberts Day, Cossill and Webley

FROM: GTA Consultants

DATE: 17/2/2017

OUR REF: W116700

RE: **Central Alkimos Local Structure Plan – Access from Marmion Avenue**

Dear Jeremy

The Central Alkimos Local Structure Plan No. 95 (LSP) (which is located between Marmion Avenue and the rail reserve), is currently being progressed through detailed subdivision design for the first stages of the development.

Roberts Day recently wrote to the City requesting consideration of a temporary access arrangement from Marmion Avenue in lieu of ultimate access arrangements documented in the 2012 LSP documents, to aid and facilitate the access to the first stages of development from Marmion Avenue.

This temporary access request was given in-principle support by the City in 2016, subject to a number of conditions, including the preparation of a "Traffic Assessment" in accordance with the Marmion Avenue Arterial Road Access Policy (LPP 3.8) and analysis to inform the design parameters for the intersection to ensure no blocking of traffic on Marmion Avenue occurs.

GTA Consultants (GTA) have been working with the project team to prepare a Traffic Assessment for the temporary access arrangement. This note sets out at a high level the approach adopted, the findings and recommendations for further assessment requirements.

Temporary Access Capacity Testing

To inform the intersection design process (as requested by City) and define required turning pocket lengths, GTA have undertaken an intersection capacity analysis. This considers the maximum demand expected for the first stages of development, which could be up to 5 years in the future.

Inputs to this exercise include existing and forecast traffic data on Marmion Avenue and trip generation associated with the full first 5 years of development. Base peak hour traffic volumes were extracted from a MRWA count carried out in 2016 on Marmion Avenue, north of Romeo Road. Mark Fowler from GTA discussed the applicability of these volumes for use in the analysis with Russell Jackson (Traffic Engineer, City of Wanneroo) who agreed verbally the data is applicable for use. We have then compared this data to the ultimate traffic volume predicted on Marmion Avenue within the approved 2013 LSP Traffic and Movement Network[1] report for the site, to determine an

[1] Central Alkimos, Traffic and Movement Network, Final Report, Bruce Aulabaugh, Rev 1 – May 9, 2013

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annual average traffic growth rate for Marmion Avenue and estimate future traffic flows on Marmion Avenue. The growth rate determined is set out in the table below.

Year	Daily vehicles (two-way)	Location
2031	29,500	North/South of Alkimos Drive (Source: LSP)
2016	19,686	North of Romeo Road (Source: MRWA)
Average Annual Compound Growth Rate (Over 15 years from 2016 to 2031)		2.7%

It is noted that the existing daily traffic volumes on Marmion Avenue are high. As a rule of thumb, the warrant for upgrading a two-way single carriageway road to a dual carriageway should occur at around 15,000 vehicles per day. Presently (2016), Marmion Avenue is carrying in excess of 19,000 vehicles per day at the LSP on a two-way single carriageway cross-section.

The trip generation estimates are set out below and have been derived using WAPC trip rates and peak hour arrival / departure distributions. The directional distribution has been based upon the weighting of north/south demand currently observed on Marmion Avenue.

Year	Total Lot Yield (Residential)	Trip Rate (veh/hr)	AM TRAFFIC		PM TRAFFIC	
			IN	OUT	IN	OUT
			25%	75%	67%	33%
Yr 5 (2022)	525	0.8	105	315	281	139

The forecast Marmion Avenue peak hour traffic volumes have then been added to maximum trip generation estimates for the first stages of LSP development, for a 5 year period from 2018, to estimate turning movements for the capacity testing of a temporary access. Our analysis assumes Marmion Avenue remains single carriageway for this 5 year period, and turning pockets are provided on Marmion Avenue to access the subdivision. During the preparation of this analysis, the City advised that at present they have submitted a grant application for upgrading of Marmion Avenue from two-lane single carriageway up to Graceful Boulevard, but north of this and adjacent to the subject site there is no funding or commitment.

On the basis of the above, the results of GTA's intersection capacity analysis indicate that it is not possible to provide an T-intersection at this location on Marmion Avenue that will provide sufficient capacity to service the total demand associated with the full first 5 years of development. The development flows are not particularly large but the peak hour volumes expected along Marmion Avenue are, which is causing the intersection to fail (i.e insufficient gaps in traffic on Marmion Avenue for traffic to enter/exit the LSP). It should be noted, that these results are representative of not only the temporary access T-intersection but also any T-intersection to be located along this section of Marmion Avenue under the demands expected after 5 years of development. This is

exemplified by the congestion currently observed at the Shorehaven access on the western side of Marmion Avenue. Until the parallel Freeway is extended to a future Alkimos Drive, the demand on Marmion Avenue will only increase.

Temporary Access Sensitivity Testing

In the context of the above, GTA has undertaken a series of sensitivity tests to investigate different or alternative intersection forms to accommodate the full first 5 years of development. This considered:

- T-intersection with two-through lanes in each direction on Marmion Avenue.
- Single lane, 3-arm roundabout.
- Dual lane on Marmion Avenue, single lane on LSP, 3-arm roundabout.

The results of the analysis illustrate that the alternative T-intersection layout or single lane roundabout will not provide sufficient capacity for the full first 5 years of development.

The dual lane roundabout does provide capacity to accommodate the full first 5 years of development. In this form, under the full 5 year development scenario, including 5 years of growth on through traffic for Marmion Avenue, the following results from SIDRA are determined.

Peak Period	Intersection Approach	Year 5 results			
		DoS	Avg Delay (sec)	95th %ile Queue (m)	LoS
AM	LSP	0.66	18.3	35.2	B
	Marmion Avenue (N)	0.69	6.9	54.3	A
	Marmion Avenue (S)	0.52	7.5	32.0	A
PM	LSP	0.23	9.8	8.0	A
	Marmion Avenue (N)	0.59	7.2	36.1	A
	Marmion Avenue (S)	0.65	7.4	50.1	A

As is evident, the provision of a dual lane roundabout at this location provides a satisfactory capacity outcome, and allows the full first 5 years of development to commence with access from Marmion Avenue. As presented in the table above, there is limited impact on the operation of Marmion Avenue, with only limited delays occurring in the peak hours.

Roundabout Access

As a result of the above, GTA has considered the appropriateness of a roundabout at this location for the ultimate scenario, in lieu of the currently approved staggered full movement T-intersections. This will involve constructing a 3-arm roundabout now to provide access to the first stages of the LSP development, then upgrading the roundabout to a 4-arm, to connect the LSP to the west at an appropriate time in the future. There are a number of considerations in this regard, which are discussed below.

2031 Intersection Capacity

GTA has undertaken a high-level assessment of the capacity of a 4-arm roundabout under 2031 traffic conditions. To inform this exercise, GTA referred to the 2013 LSP Traffic and Movement report to extract future forecast flows on Marmion Avenue and the eastern and western links for the LSP in this area. This information was translated into turning movements for the purpose of a SIDRA modelling exercise under 2031 demands. It is important to note in this context that in 2031, the traffic volumes travelling north and south on Marmion Avenue have reduced as a result of the opening of Alkimos Drive and Freeway.

This analysis shows satisfactory operation of a 4-arm roundabout, with an intersection LoS A recorded. 95th percentile queuing on the northern arm of the roundabout reaches around 50m, and so does not extend back to the signals which is located around 375m away.

LSP Connectivity and Permeability

Marmion Avenue runs north/south through the overall LSP area and as such acts as a barrier for east/west access and connectivity for all modes of travel. As currently proposed in the LSP, the ability to travel between the east and west sides of Marmion Avenue is limited only to Alkimos Drive or via a set of staggered t-intersections on Marmion Avenue, as illustrated in Figure 1.1.

Figure 1: Existing LSP Movement Network

The inclusion of a 4-arm roundabout would provide a direct link between the LSP area on both sides of Marmion Avenue for a more legible road network. A road link of the same hierarchy from east to west would provide opportunity for ease of travel between the future high schools, primary schools and residencies. This applies to all modes of travel, and in particular allow continuity of a proposed shared path / footpath link between both sides of the LSP. A greater legibility of road hierarchy ensues through the provision of a local distributor link between NS1, NS2 and the LSP on the western side of Marmion Avenue, which are all currently disconnected. The proposed road network change is highlighted in Figure 1.2.

Figure 2: Proposed Movement Network

Proximity to Alkimos Drive Signals

It is important that operational efficiency is maintained on the wider road network and not only at the proposed access to the LSP. In this context, we have considered the proximity of a future Alkimos Drive signals to the north, and how the operation of this may impact the proposed roundabout and vice-versa.

In a vehicle movement context, the introduction of the roundabout will not generally impact the vehicle arrival profile to the signalised intersection for northbound traffic on Marmion Avenue. Therefore there is negligible impact to the operation of the signals in this regard. Likewise, since the roundabout is downstream for southbound Marmion Avenue traffic, traffic gaps will be created by the signals to allow for improved egress from the LSP area.

Intersection spacing should also be considered. Generally, MRWA adopt a 5s of travel time approach to determine spacing requirements. For a 70km/h road this results in approximately 100m, the roundabout is proposed approximately 375m south of the signals.

GTA has reviewed the intersection SIDRA model for the future Alkimos Drive intersection from the 2013 LSP report. This demonstrates a queue on the southern approach of around 350m. It is acknowledged this is some 25m from the roundabout, but it is considered that traffic volumes and patterns may have changed since the preparation of the LSP report and so the vehicle distribution and volume assumptions should be revisited. This is particularly relevant when considering the additional connectivity the roundabout may provide for local traffic and the resultant impacts on local vehicle distribution.

Summary and Proposed Route Forward

In summary:

- GTA has undertaken a traffic assessment to support the provision of a temporary access from Marmion Avenue for the early stages of subdivision.
- GTA has determined future year traffic flows on Marmion Avenue and carried out a trip generation exercise for the first stages of development to determine peak hour traffic movements at the intersection.
- A priority controlled T-intersection does not provide sufficient capacity to provide access to the first stages of development, primarily due to the high current vehicle demands on Marmion Avenue. This outcome is representative of the temporary intersection location and any other on this section of Marmion Avenue.
- Sensitivity tests were undertaken to determine alternative intersection forms. It was determined that of the options tested, a roundabout with dual lane approaches on Marmion Avenue and single lane approaches on the LSP arm of the development would provide sufficient capacity for the intersection.
- In this context, GTA has considered the provision of a 4-arm roundabout at this location as a permanent solution to provide access for the LSP.
- A 4-arm roundabout has many benefits from a connectivity, permeability and legibility perspective, and on the basis of a high-level analysis using 2031 demands it is suggested will operate well from a capacity perspective.

As a result of the above, we are confident that a roundabout would operate well in the long term. We are seeking in-principle agreement from City of Wanneroo to consider a roundabout at this location further, should the potential benefits and capacity results identified at a high-level in this note be proven.

If this in-principle agreement is provided, GTA and the wider project team will work with City of Wanneroo to develop a scope of assessment to test the above.

Yours sincerely

GTA CONSULTANTS

Mark Fowler

Associate

Appendix D

City of Wanneroo Scoping Correspondence

Mark Fowler

From: Jackson, Russell <Russell.Jackson@wanneroo.wa.gov.au>
Sent: Wednesday, 22 February 2017 11:41 AM
To: Ryan Darby; Thompson, Jeremy; Mark Fowler
Cc: laura.swinton@lendlease.com; Wansbrough, Craig; Shrestha, Sujit; Timms, Chelsea; Bracone, Pas; Dale Slieker; Craig Hansen; Chris Newton; Tanya Moran
Subject: RE: Central Alkimos

Following from our meeting last week, these are the impacts which require further investigation regarding the proposed roundabout on Marmion Avenue. Any concerns which would cause Main Roads WA to raise objections should also be considered.

Impacts on road network:

- Please justify from a network perspective, why a four way Local Distributor/Local Distributor connection is required just 375m south of a four way controlled District Distributor/District Distributor intersection. Why the traffic would not be distributed through the higher hierarchy road and intersection?

- Impact on Marmion Avenue travel times. What are the average delays to Marmion Avenue traffic at the roundabout?

- What impact would the roundabout have on the Alkimos Drive traffic signals? Would this reduce overall delays by reducing traffic demand? Would there be any issues with queuing during peak times which would impact on the roundabout or signals?

- Will it be easier for traffic to the west of Marmion to access the Freeway by using the roundabout and rat running through the development, rather than using the signals at Marmion Avenue/ Alkimos Drive?

Impacts on road safety:

- How would the proposed roundabout & t-intersection (the City would support a left-in/ left out intersection) compare to the two full movement t-intersections in terms of road safety?

City of Wanneroo

Russell Jackson
Traffic Engineer
Traffic Services

08 9405 5894
Russell.Jackson@wanneroo.wa.gov.au

Wanneroo Community Centre
23 Civic Drive, Wanneroo, WA 6065
Locked Bag 1, Wanneroo WA 6946

wanneroo.wa.gov.au

From: Ryan Darby [mailto:Ryan.Darby@robertsday.com.au]
Sent: Friday, 17 February 2017 5:09 PM
To: Thompson, Jeremy; laura.swinton@lendlease.com; Wansbrough, Craig; Shrestha, Sujit; Timms, Chelsea; Bracone, Pas; Jackson, Russell; Dale Slieker; Mark Fowler; Craig Hansen; Chris Newton; Tanya Moran
Subject: Re: Central Alkimos

Good afternoon

Please find attached the agenda and traffic note (Marmion Avenue access) for Monday's meeting.

Please contact me if you have any queries.

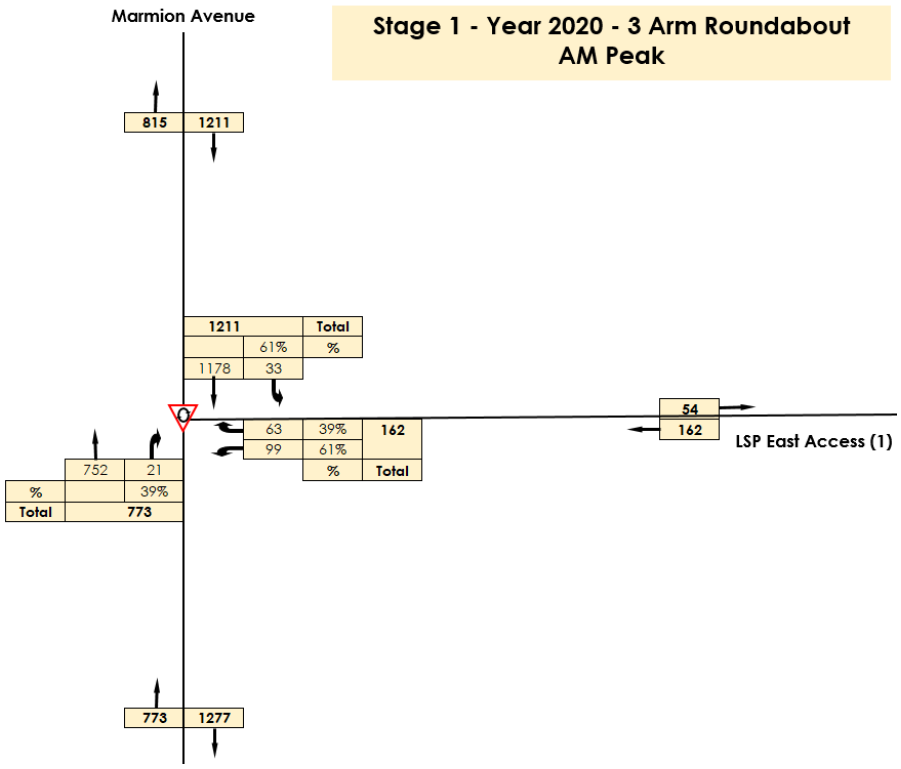
Cheers
Ryan

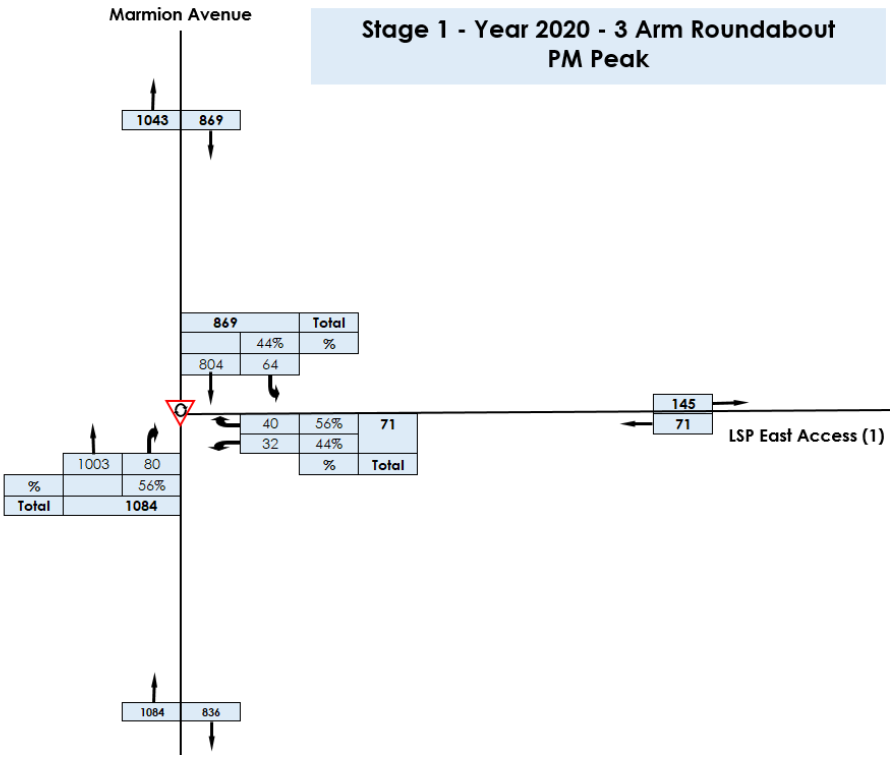
From: Jeremy.Thompson@wanneroo.wa.gov.au
When: 1:00 PM - 2:00 PM 20 February 2017
Subject: Central Alkimos
Location: Room - Dryandra

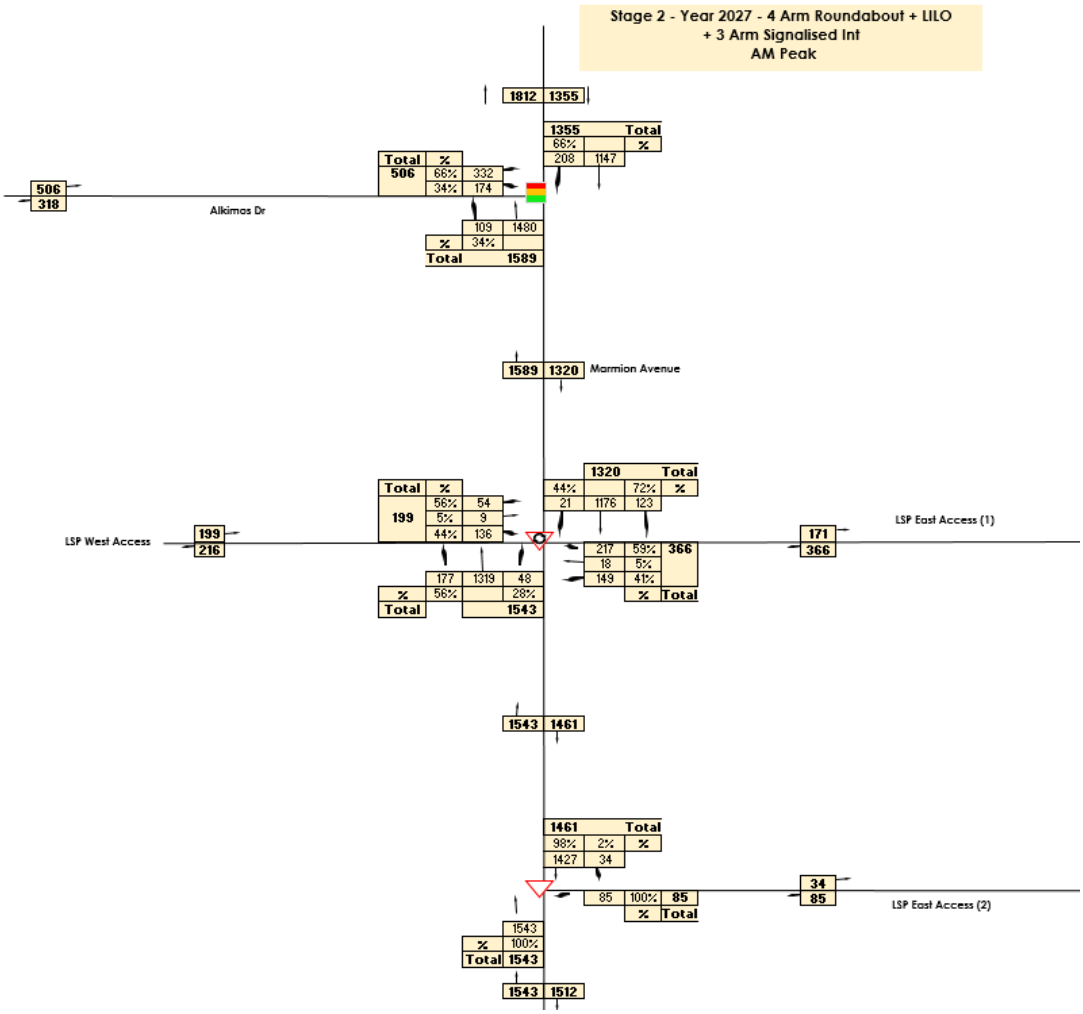
Hi Jeremy
Further to the emails below and the attached fil approval from the WAPC for the Central Alkimos Local Structure Plan, the following is advised.
We are currently preparing the Stage 1 subdivision design (the area bound by Alkimos Drive, rail reserve, ROS and Marmion Avenue) and we would like to meet with the City to present the options and discuss two important strategic matters: Marmion Avenue access and the treatment of drainage in public open space.
As the matters are strategic in nature, it is requested that the following City Officers attend so we can get prompt and clear direction: Mark Dickson, Pas Bracone, Craig Wansbrough and Russell Jackson. We will prepare and send a background email detailing the matters prior to the meeting.
Can you please advise on the City officers availability for a meeting next week.
Please contact me if you have any queries.
Regards

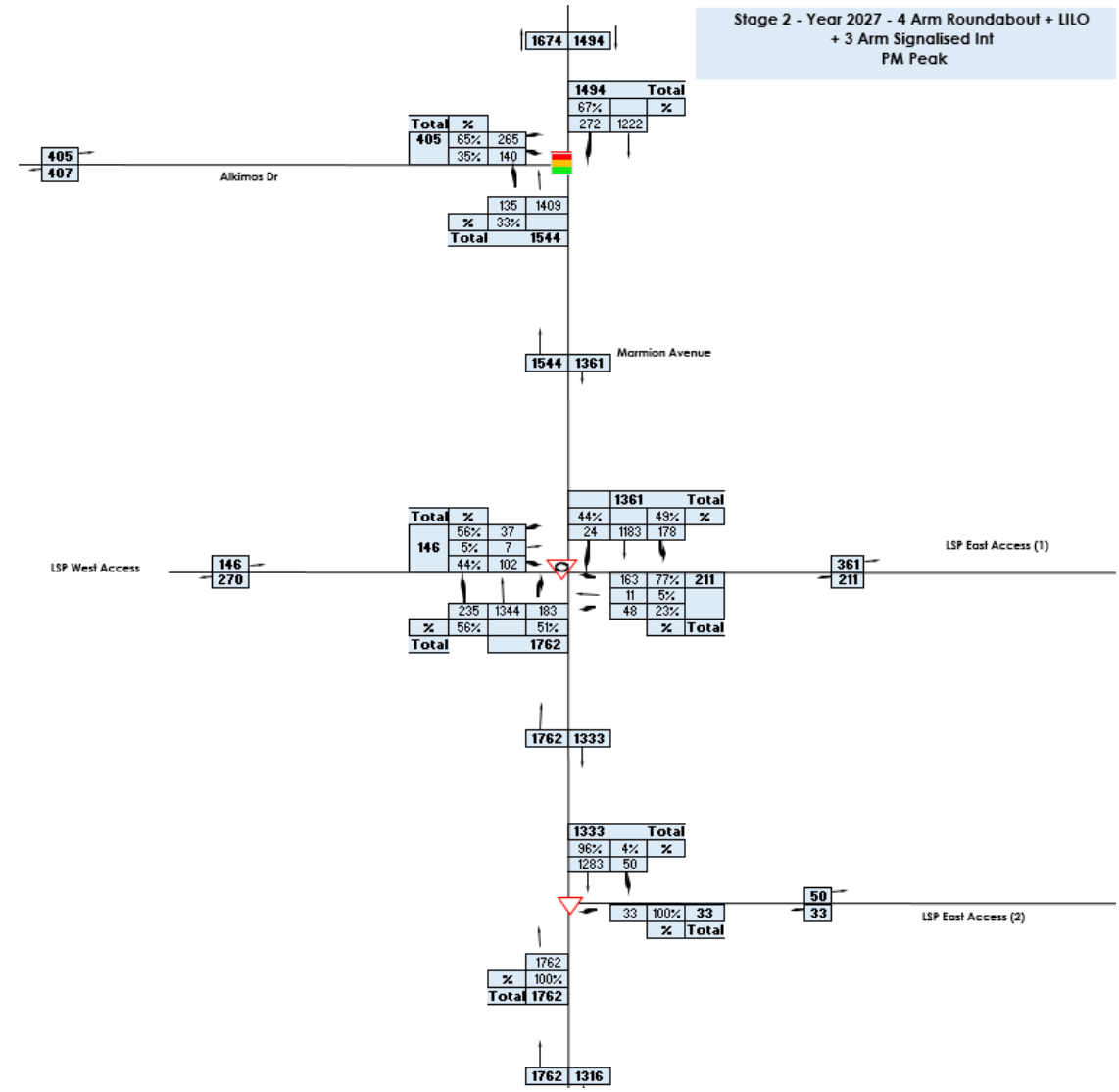
Appendix E

Traffic Flow Diagrams


Marmion Avenue
Stage 1 - Year 2020 - 3 Arm Roundabout
AM Peak
815
1211
1211
Total
61%
%
1178
33
54
162
63
39%
162
99
61%
%
Total
LSP East Access (1)
752
21
%
39%
Total
773
773
1277


Marmion Avenue
Stage 1 - Year 2020 - 3 Arm Roundabout
PM Peak
1043
869
869
Total
44%
%
804
64
145
71
40
56%
71
32
44%
%
Total
LSP East Access (1)
1003
80
%
56%
Total
1084
1084
836


Stage 2 - Year 2027 - 4 Arm Roundabout + LILO
+ 3 Arm Signalised Int
AM Peak
Alkimos Dr
Marmion Avenue
LSP West Access
LSP East Access (1)
LSP East Access (2)


Stage 2 - Year 2027 - 4 Arm Roundabout + LILO
+ 3 Arm Signalised Int
PM Peak
Alkimos Dr
Marmion Avenue
LSP West Access
LSP East Access (1)
LSP East Access (2)

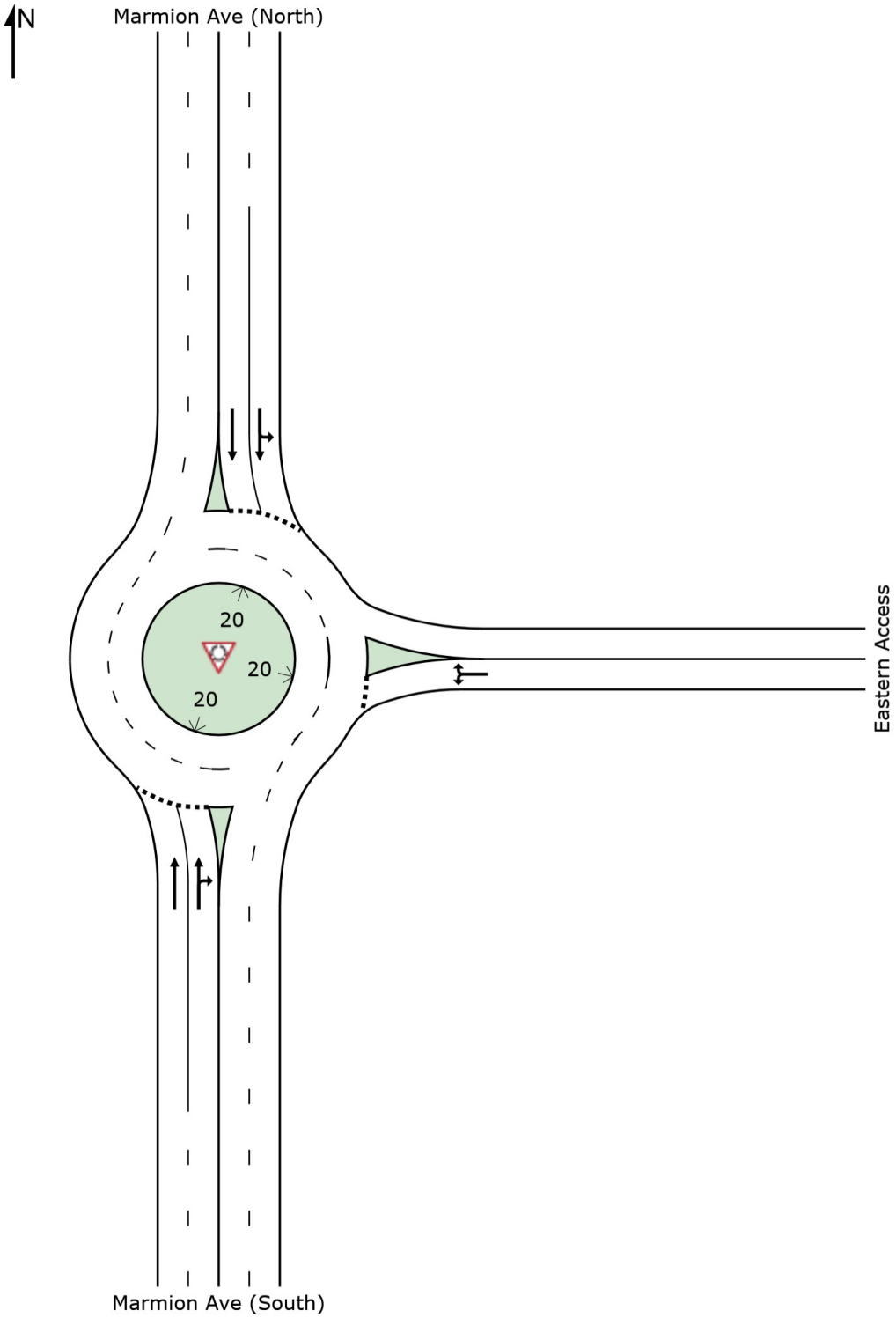
Appendix F

SIDRA Model Outputs

SITE LAYOUT

Site: [Stage 1 - Yr 2020 - 3 Arm Roundabout - AM]

Roundabout



MOVEMENT SUMMARY

Site: [Stage 1 - Yr 2020 - 3 Arm Roundabout - AM]

Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Marmion Ave (South)											
2	T1	792	9.0	0.304	6.6	LOS A	1.8	13.9	0.24	0.50	64.5
3	R2	22	2.0	0.304	11.1	LOS B	1.8	13.7	0.24	0.51	60.7
Approach		814	8.8	0.304	6.8	LOS A	1.8	13.9	0.24	0.50	64.4
East: Eastern Access											
4	L2	104	2.0	0.263	7.3	LOS A	1.0	7.4	0.65	0.83	40.6
6	R2	66	2.0	0.263	11.8	LOS B	1.0	7.4	0.65	0.83	41.9
Approach		171	2.0	0.263	9.1	LOS A	1.0	7.4	0.65	0.83	41.1
North: Marmion Ave (North)											
7	L2	35	2.0	0.430	6.0	LOS A	2.7	20.5	0.12	0.49	59.9
8	T1	1240	9.0	0.430	6.5	LOS A	2.7	20.5	0.13	0.48	65.4
Approach		1275	8.8	0.430	6.4	LOS A	2.7	20.6	0.13	0.48	65.2
All Vehicles		2259	8.3	0.430	6.8	LOS A	2.7	20.6	0.21	0.52	62.2

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

LANE LEVEL OF SERVICE

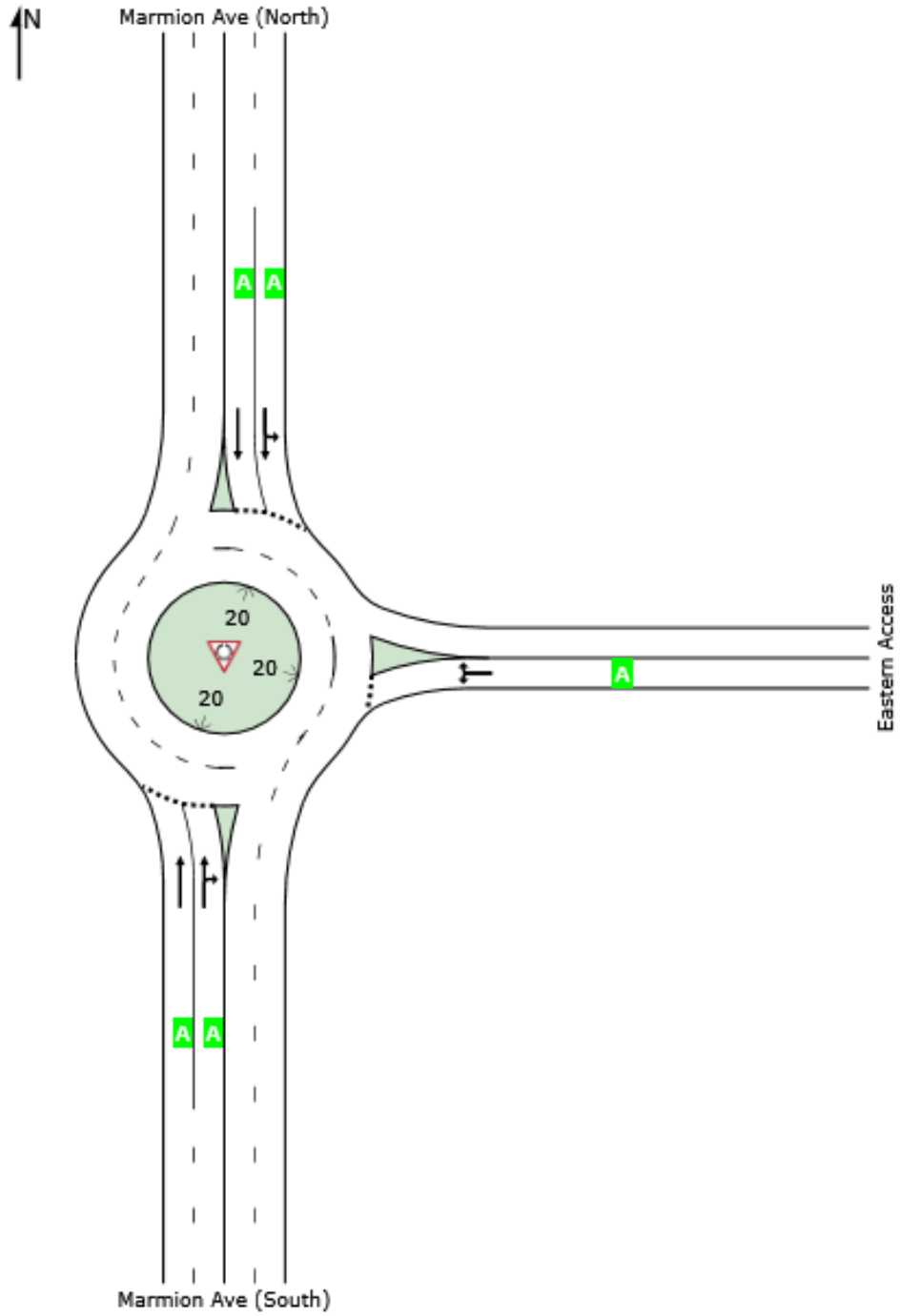
Lane Level of Service

Site: [Stage 1 - Yr 2020 - 3 Arm Roundabout - AM]

Roundabout

All Movement Classes

	South	East	North	Intersection
LOS	A	A	A	A



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Roundabout LOS Method: SIDRA Roundabout LOS.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

MOVEMENT SUMMARY

Site: [Stage 1 - Yr 2020 - 3 Arm Roundabout - PM]

Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Marmion Ave (South)											
2	T1	1056	9.0	0.402	6.6	LOS A	2.7	20.6	0.20	0.50	64.6
3	R2	84	2.0	0.402	11.0	LOS B	2.7	20.2	0.21	0.52	60.6
Approach		1140	8.5	0.402	6.9	LOS A	2.7	20.6	0.20	0.50	64.3
East: Esatern Access											
4	L2	34	2.0	0.104	5.7	LOS A	0.4	2.8	0.56	0.77	41.0
6	R2	42	2.0	0.104	10.2	LOS B	0.4	2.8	0.56	0.77	42.4
Approach		76	2.0	0.104	8.2	LOS A	0.4	2.8	0.56	0.77	41.8
North: Marmion Ave (North)											
7	L2	67	2.0	0.344	6.3	LOS A	1.9	14.1	0.24	0.51	59.3
8	T1	846	9.0	0.344	6.8	LOS A	1.9	14.1	0.25	0.51	64.6
Approach		914	8.5	0.344	6.7	LOS A	1.9	14.1	0.25	0.51	64.2
All Vehicles		2129	8.3	0.402	6.9	LOS A	2.7	20.6	0.23	0.51	63.0

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

LANE LEVEL OF SERVICE

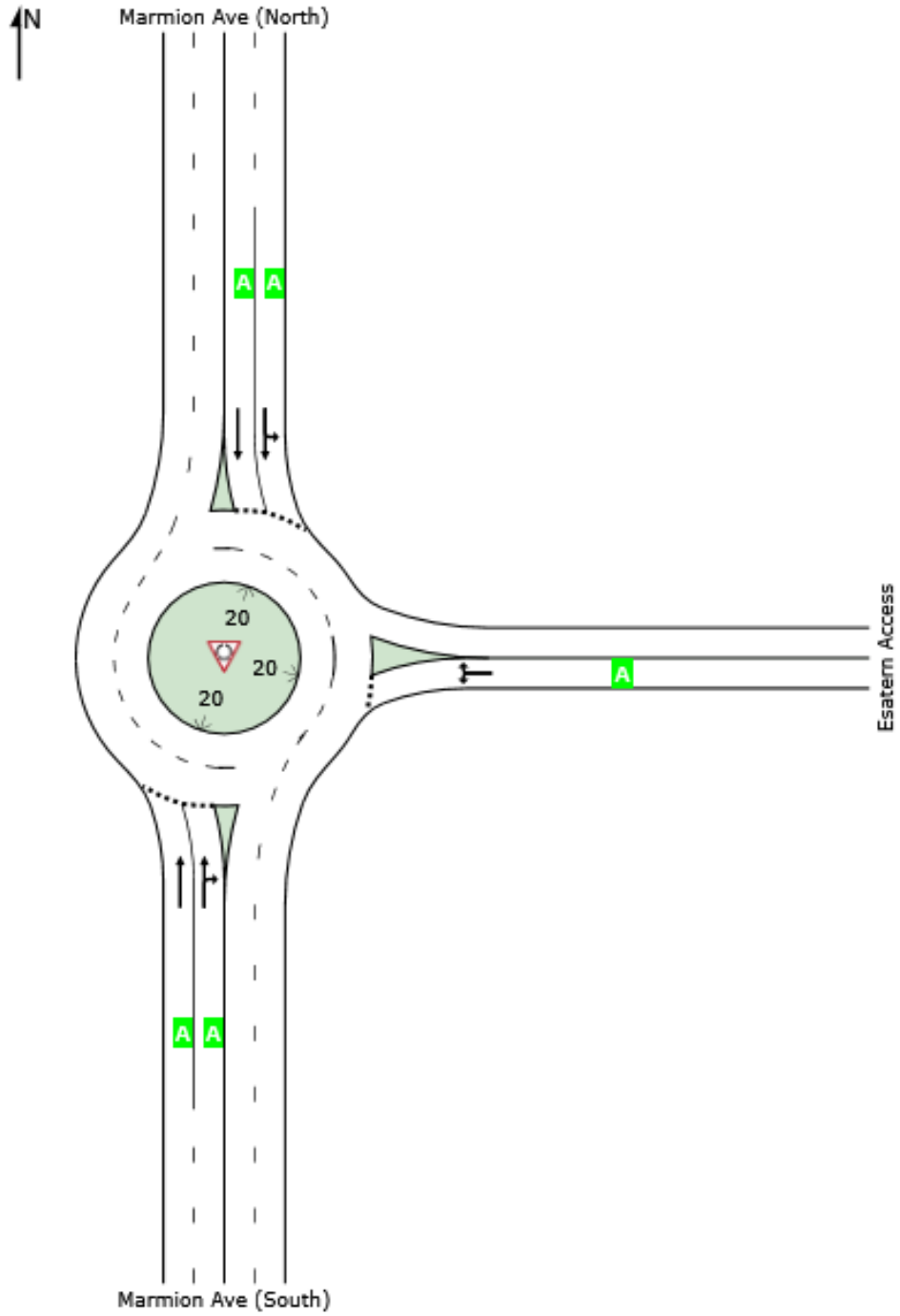
Lane Level of Service

Site: [Stage 1 - Yr 2020 - 3 Arm Roundabout - PM]

Roundabout

All Movement Classes

	South	East	North	Intersection
LOS	A	A	A	A



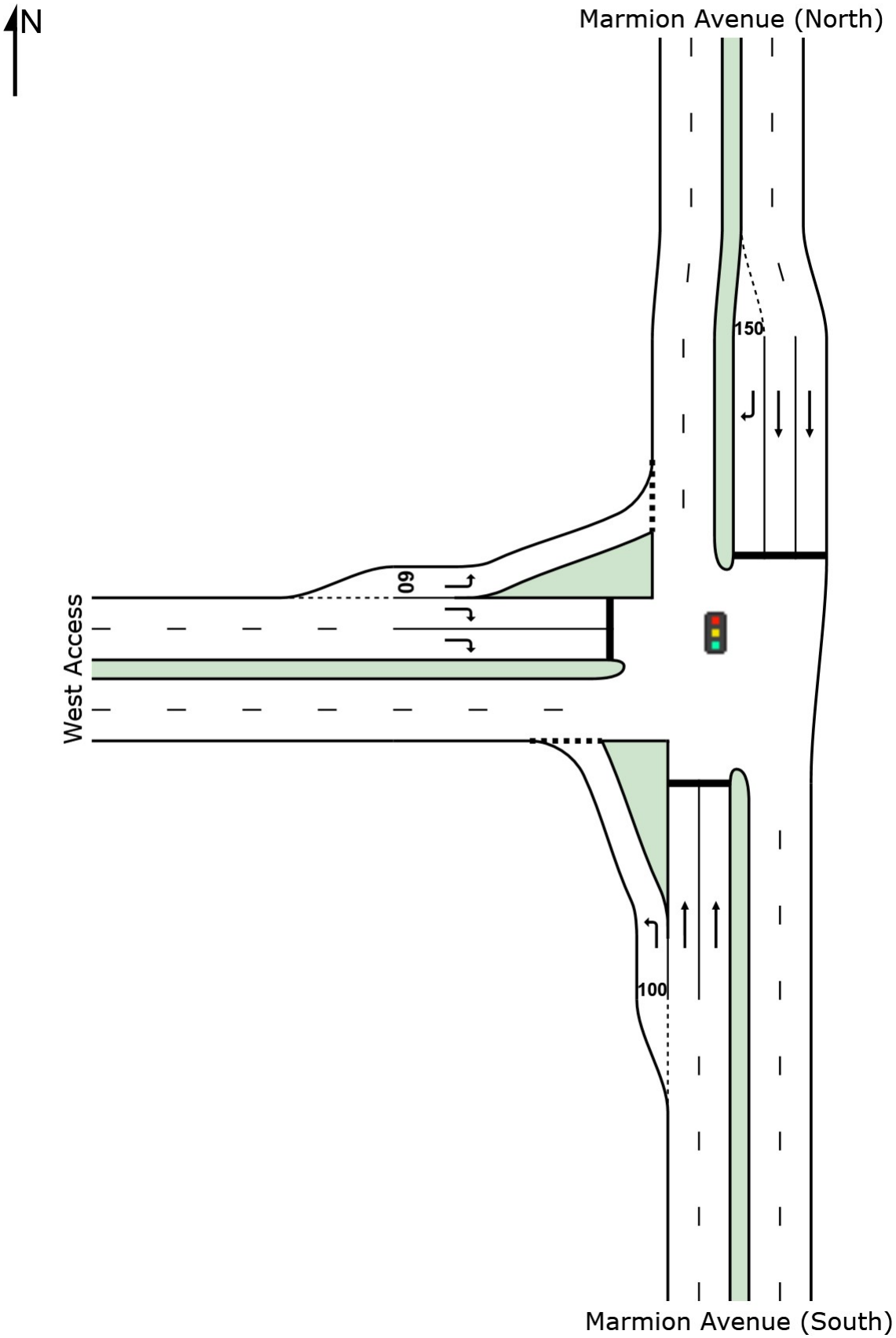
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Roundabout LOS Method: SIDRA Roundabout LOS.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

SITE LAYOUT

Site: [Stage 3 - Yr 2027 - Marmion Ave/Alkimos Dr - 3 Arm Signalised - AM]

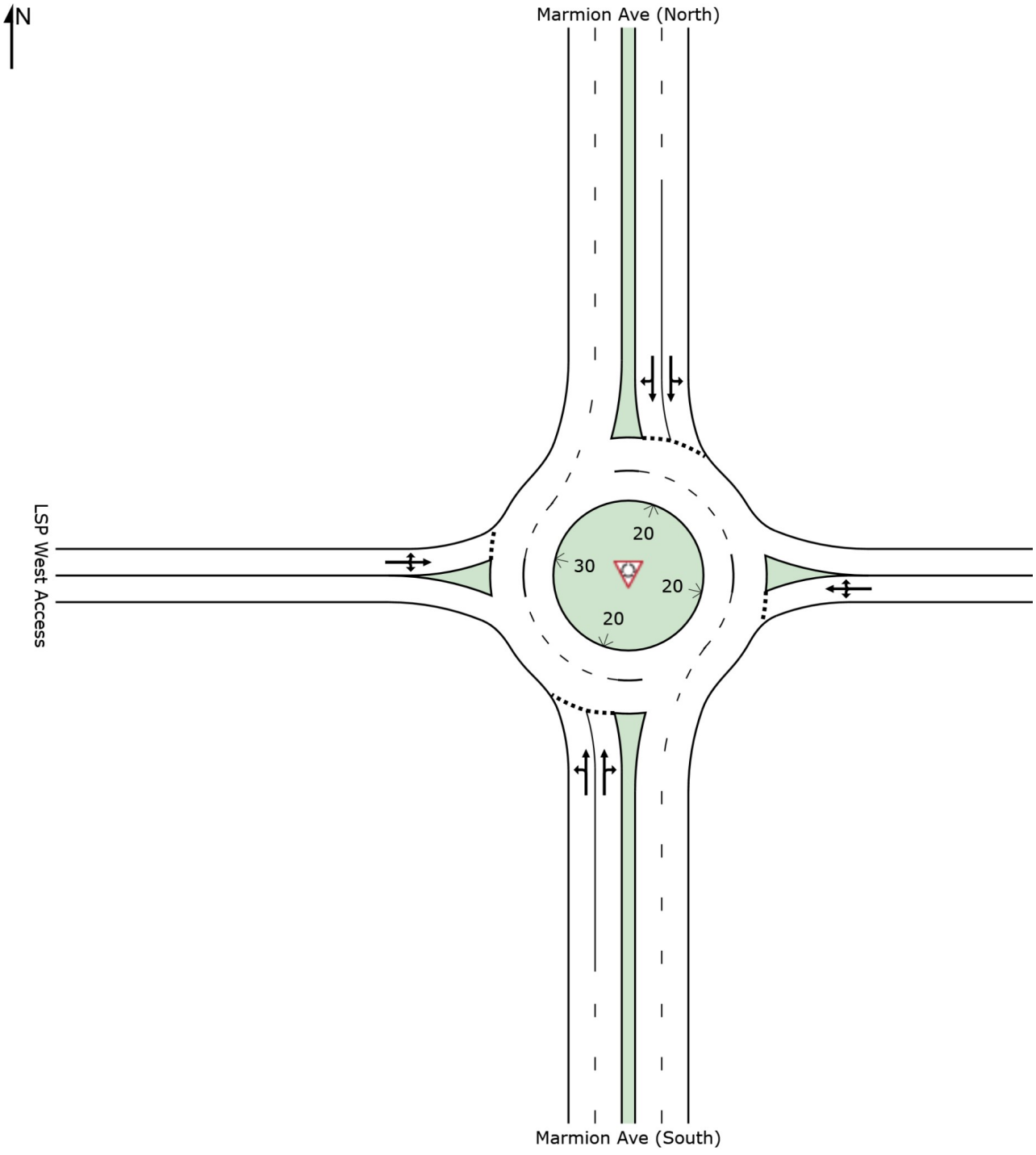
Signals - Actuated Isolated



SITE LAYOUT

Site: [Stage 3 - Yr 2027 - 4 Arm Roundabout - AM - 4 Lanes on Marmion Ave]

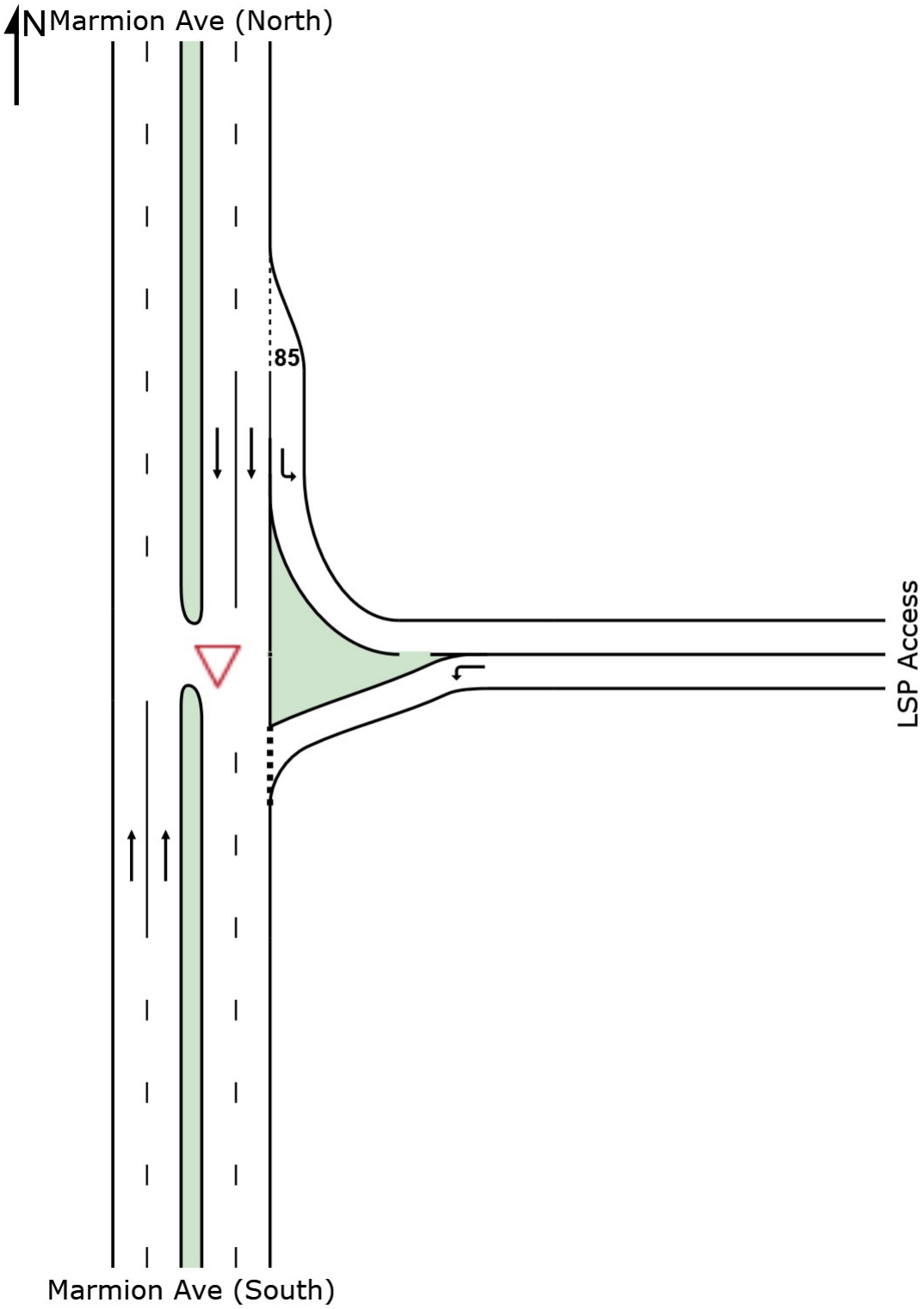
Roundabout



SITE LAYOUT

Site: [Stage 3 - Yr 2027 - LILO - AM - 4 Lanes on Marmion Ave]

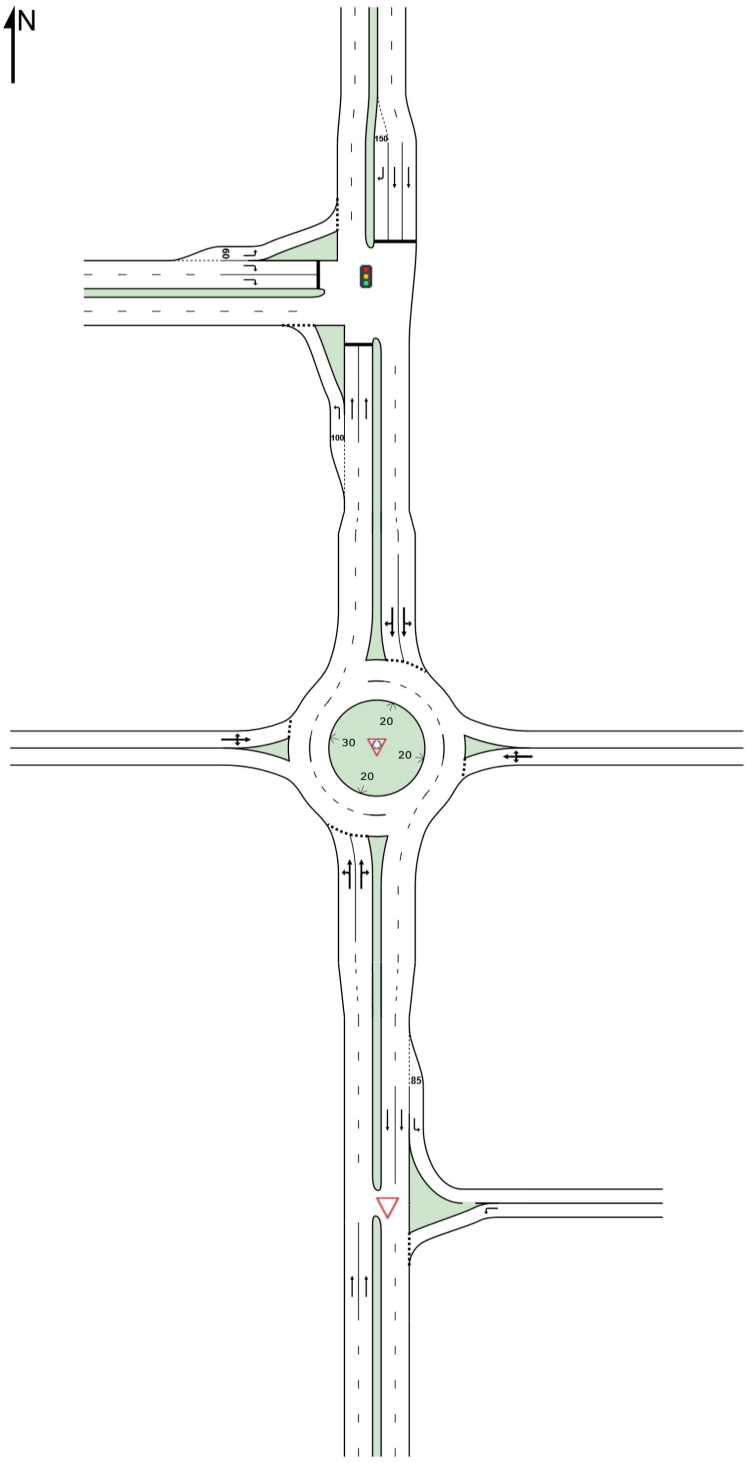
Giveway / Yield (Two-Way)



NETWORK LAYOUT

Network: N101 [Stage 2 - Yr 2027 - AM Peak]

New Network



SITES IN NETWORK

Site ID	Site Name
	Stage 3 - Yr 2027 - Marmion Ave/Alkimos Dr - 3 Arm Signalised - AM
	Stage 3 - Yr 2027 - 3 Arm Roundabout - AM - 4 Lanes on Marmion Ave
	Stage 3 - Yr 2027 - LILO - AM - 4 Lanes on Marmion Ave

MOVEMENT SUMMARY

Site: [Stage 3 - Yr 2027 - Marmion Ave/Alkimos Dr - 3 Arm Signalised - AM]

Network: N101 [Stage 2 - Yr 2027 - AM Peak]

Signals - Actuated Isolated Cycle Time = 102 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows 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: Marmion Avenue (South)													
1	L2	115	2.0	115	2.0	0.131	18.3	LOS B	2.5	17.8	0.57	0.72	43.2
2	T1	1558	9.0	1558	9.0	0.685	13.6	LOS B	25.5	192.0	0.69	0.63	55.8
Approach		1673	8.5	1673	8.5	0.685	13.9	LOS B	25.5	192.0	0.68	0.64	54.7
North: Marmion Avenue (North)													
8	T1	1207	9.0	1207	9.0	0.423	4.2	LOS A	9.9	74.6	0.35	0.32	67.7
9	R2	219	2.0	219	2.0	0.787	45.6	LOS D	10.5	74.4	1.00	0.96	36.5
Approach		1426	7.9	1426	7.9	0.787	10.6	LOS B	10.5	74.6	0.45	0.42	55.3
West: West Access													
10	L2	349	2.0	349	2.0	0.636	18.4	LOS B	12.1	85.9	0.78	0.81	36.9
12	R2	183	2.0	183	2.0	0.464	54.2	LOS D	4.5	31.9	0.96	0.77	20.4
Approach		533	2.0	533	2.0	0.636	30.7	LOS C	12.1	85.9	0.84	0.80	31.5
All Vehicles		3632	7.3	3632	7.3	0.787	15.1	LOS B	25.5	192.0	0.61	0.57	48.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Network Model Accuracy Level (largest change in degree of saturation for any lane): 0.9 %
Number of Iterations: 5 (maximum specified: 10)

LANE LEVEL OF SERVICE

Lane Level of Service

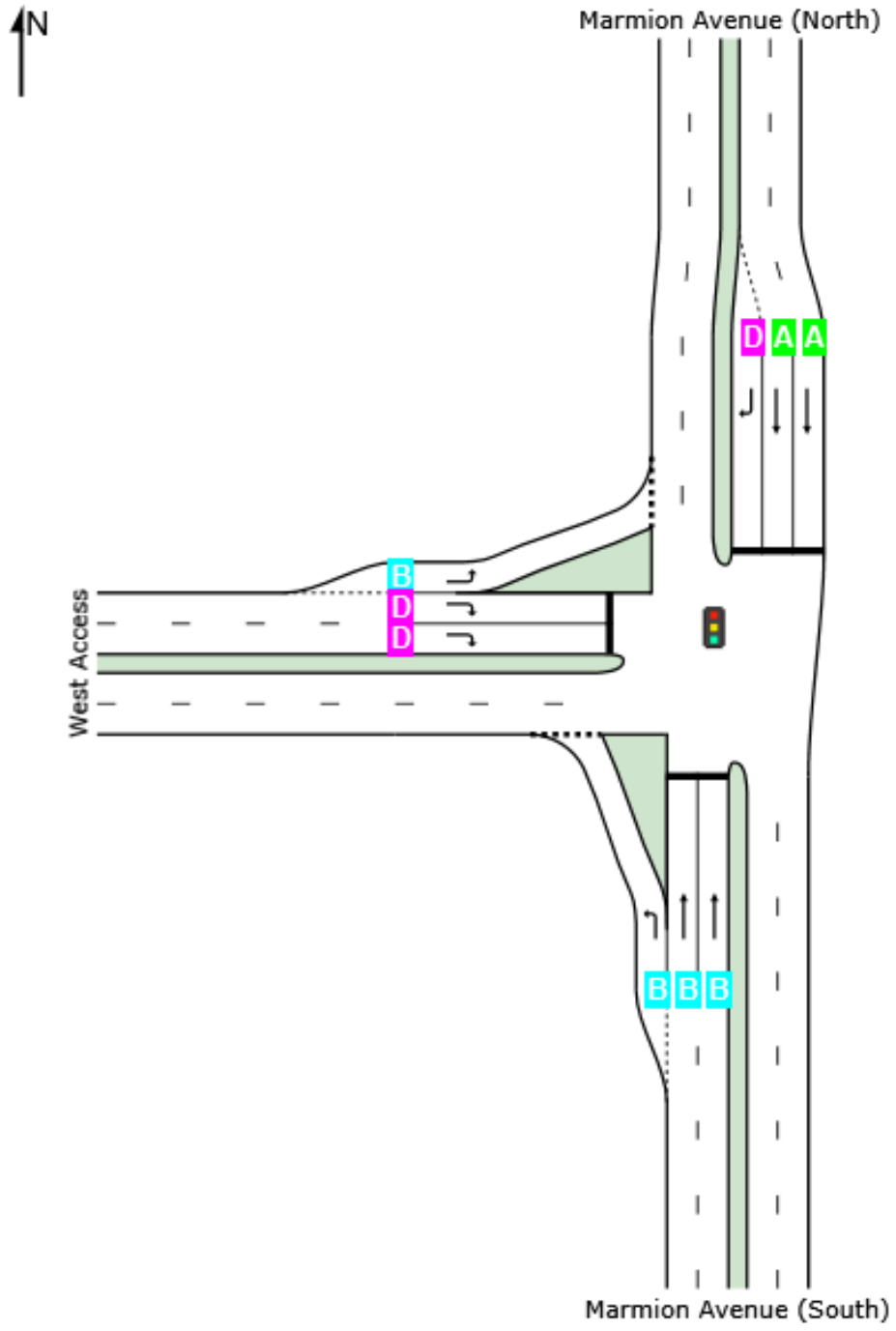
Network: N101 [Stage 2 - Yr 2027 - AM Peak]

Site: [Stage 3 - Yr 2027 - Marmion Ave/Alkimos Dr - 3 Arm Signalised - AM]

Signals - Actuated Isolated Cycle Time = 102 seconds (User-Given Phase Times)

All Movement Classes

	South	North	West	Intersection
LOS	B	B	C	B



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

MOVEMENT SUMMARY

Site: [Stage 3 - Yr 2027 - Marmion Ave/Alkimos Dr - 3 Arm Signalised - PM]

Network: N101 [Stage 2 - Yr 2027 - PM Peak]

Signals - Actuated Isolated Cycle Time = 104 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows 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: Marmion Avenue (South)													
1	L2	142	2.0	142	2.0	0.164	17.8	LOS B	3.0	21.3	0.58	0.73	43.6
2	T1	1483	9.0	1483	9.0	0.696	15.0	LOS B	26.6	200.3	0.70	0.64	54.0
Approach		1625	8.4	1625	8.4	0.696	15.3	LOS B	26.6	200.3	0.69	0.65	52.9
North: Marmion Avenue (North)													
8	T1	1286	9.0	1286	9.0	0.448	4.3	LOS A	10.9	82.0	0.36	0.33	67.6
9	R2	286	2.0	286	2.0	0.853	47.9	LOS D	13.7	97.4	1.00	1.00	35.7
Approach		1573	7.7	1573	7.7	0.853	12.2	LOS B	13.7	97.4	0.48	0.45	53.2
West: West Access													
10	L2	279	2.0	279	2.0	0.469	14.2	LOS B	7.2	51.5	0.59	0.72	38.5
12	R2	147	2.0	147	2.0	0.380	54.8	LOS D	3.6	25.9	0.95	0.75	20.3
Approach		426	2.0	426	2.0	0.469	28.2	LOS C	7.2	51.5	0.72	0.74	32.4
All Vehicles		3624	7.3	3624	7.3	0.853	15.5	LOS B	26.6	200.3	0.60	0.57	48.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Network Model Accuracy Level (largest change in degree of saturation for any lane): 1.0 %
Number of Iterations: 6 (maximum specified: 10)

LANE LEVEL OF SERVICE

Lane Level of Service

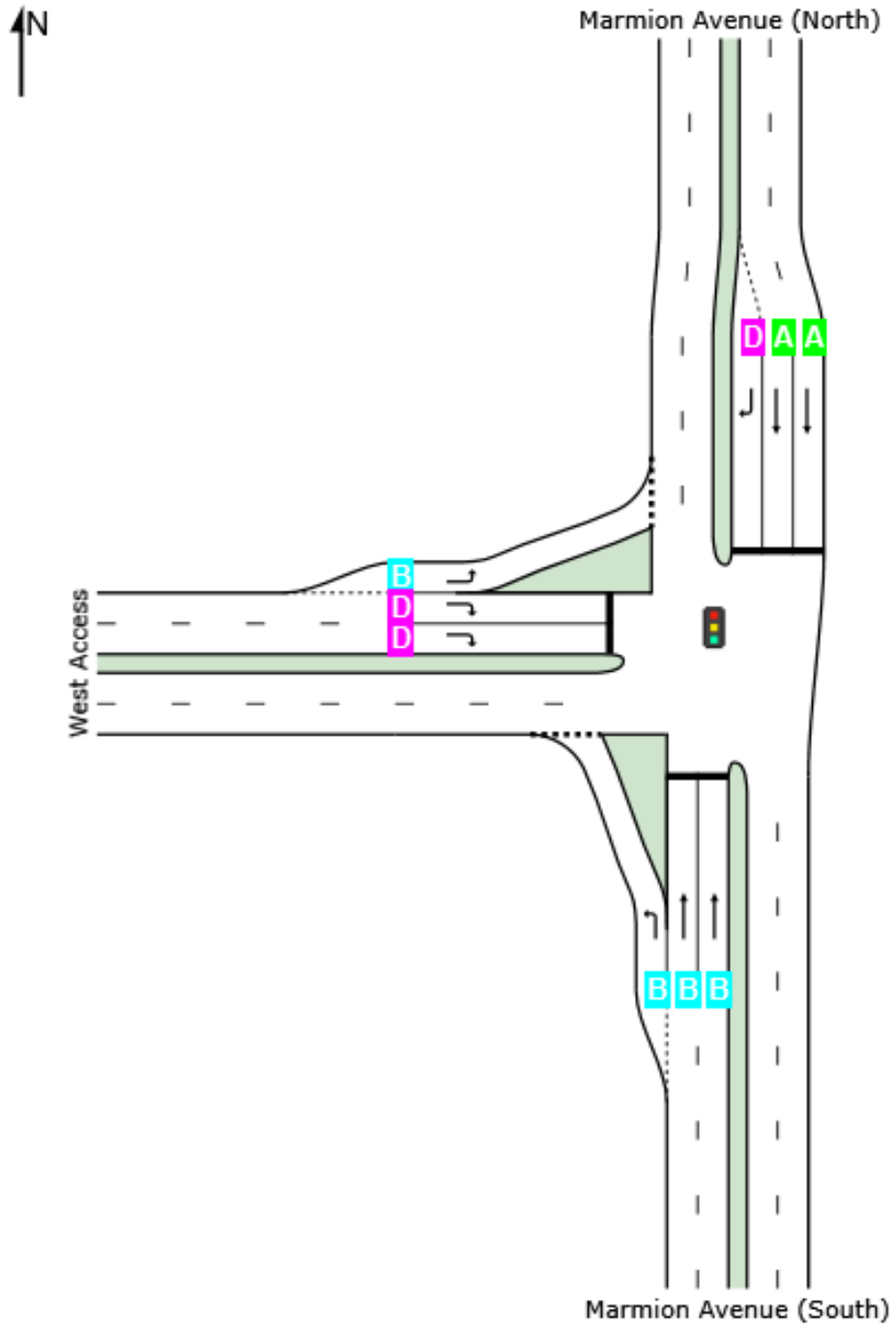
Network: N101 [Stage 2 - Yr 2027 - PM Peak]

Site: [Stage 3 - Yr 2027 - Marmion Ave/Alkimos Dr - 3 Arm Signalised - PM]

Signals - Actuated Isolated Cycle Time = 104 seconds (User-Given Phase Times)

All Movement Classes

	South	North	West	Intersection
LOS	B	B	C	B



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

MOVEMENT SUMMARY

Site: [Stage 3 - Yr 2027 - 4 Arm Roundabout - AM - 4 Lanes on Marmion Ave]

Network: N101 [Stage 2 - Yr 2027 - AM Peak]

Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Marmion Ave (South)													
1	L2	186	0.0	186	0.0	0.831	10.6	LOS B	11.6	86.5	0.85	0.82	48.7
2	T1	1388	9.0	1388	9.0	0.831	11.4	LOS B	11.6	86.5	0.82	0.83	33.8
3	R2	51	2.0	51	2.0	0.831	17.0	LOS B	10.2	76.4	0.80	0.84	50.2
Approach		1625	7.8	1625	7.8	0.831	11.5	LOS B	11.6	86.5	0.83	0.83	38.3
East: LSP East Access													
4	L2	157	2.0	157	2.0	0.832	21.8	LOS C	7.7	54.5	0.93	1.32	30.9
5	T1	19	0.0	19	0.0	0.832	21.7	LOS C	7.7	54.5	0.93	1.32	40.6
6	R2	228	2.0	228	2.0	0.832	26.4	LOS C	7.7	54.5	0.93	1.32	30.9
Approach		404	1.9	404	1.9	0.832	24.4	LOS C	7.7	54.5	0.93	1.32	31.6
North: Marmion Ave (North)													
7	L2	129	2.0	129	2.0	0.595	7.1	LOS A	4.4	33.1	0.50	0.61	51.4
8	T1	1238	9.0	1238	9.0	0.595	7.6	LOS A	4.4	33.1	0.51	0.61	40.2
9	R2	22	0.0	22	0.0	0.595	12.1	LOS B	4.3	32.5	0.52	0.61	53.1
Approach		1389	8.2	1389	8.2	0.595	7.7	LOS A	4.4	33.1	0.51	0.61	43.0
West: LSP West Access													
10	L2	57	0.0	57	0.0	0.506	12.6	LOS B	3.0	20.7	0.89	1.03	40.1
11	T1	9	0.0	9	0.0	0.506	13.0	LOS B	3.0	20.7	0.89	1.03	48.5
12	R2	143	0.0	143	0.0	0.506	18.1	LOS B	3.0	20.7	0.89	1.03	40.1
Approach		209	0.0	209	0.0	0.506	16.3	LOS B	3.0	20.7	0.89	1.03	40.7
All Vehicles		3628	6.8	3628	6.8	0.832	11.7	LOS B	11.6	86.5	0.72	0.81	38.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Network Model Accuracy Level (largest change in degree of saturation for any lane): 0.9 %
Number of Iterations: 5 (maximum specified: 10)

LANE LEVEL OF SERVICE

Lane Level of Service

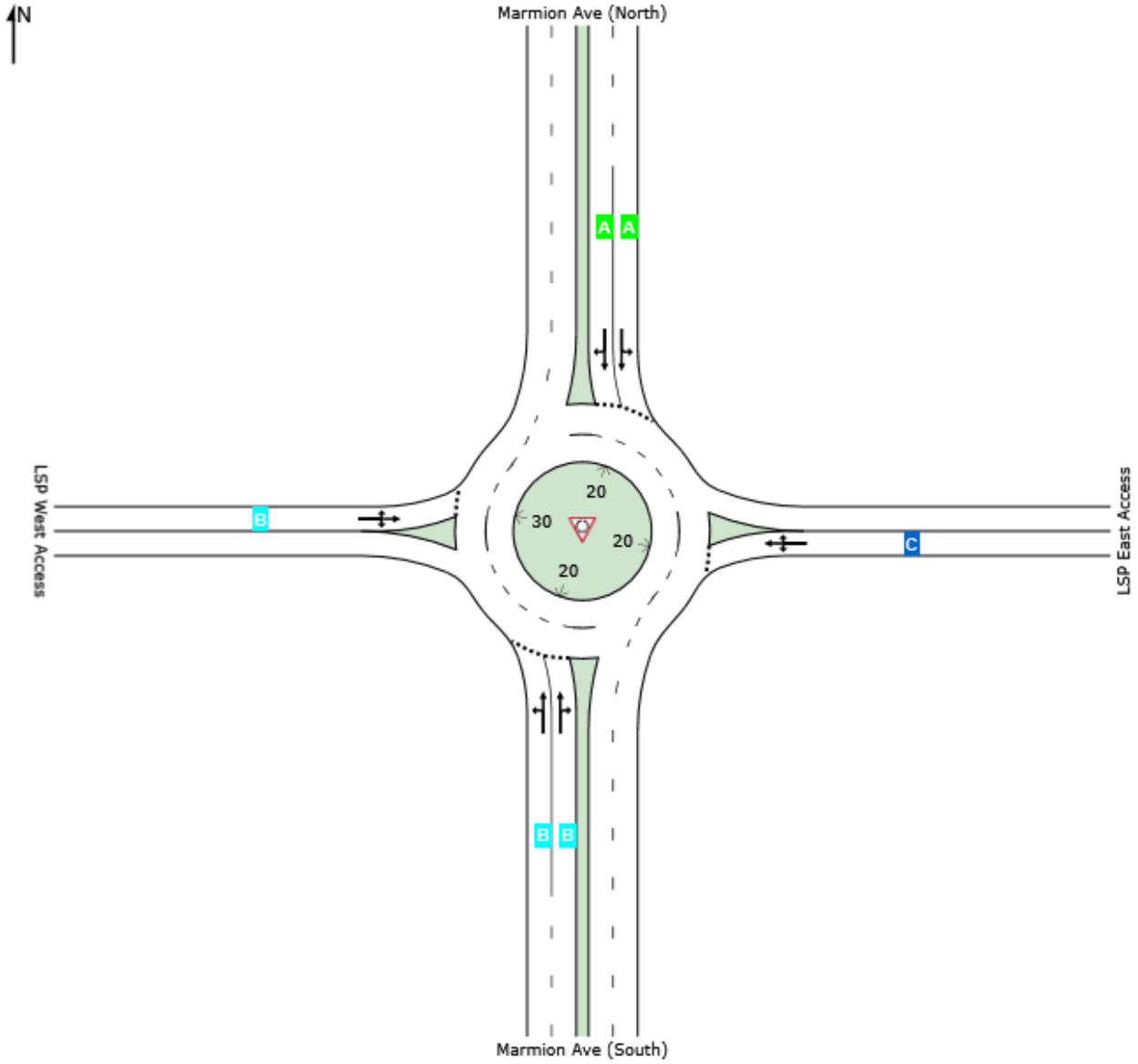
Network: N101 [Stage 2 - Yr 2027 - AM Peak]

Site: [Stage 3 - Yr 2027 - 4 Arm Roundabout - AM - 4 Lanes on Marmion Ave]

Roundabout

All Movement Classes

	South	East	North	West	Intersection
LOS	B	C	A	B	B



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

MOVEMENT SUMMARY

Site: [Stage 3 - Yr 2027 - 4 Arm Roundabout - PM - 4 Lanes on Marmion Ave]

Network: N101 [Stage 2 - Yr 2027 - PM Peak]

Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows 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: Marmion Ave (South)													
1	L2	247	2.0	247	2.0	0.866	10.2	LOS B	15.0	111.4	0.90	0.76	48.4
2	T1	1415	9.0	1415	9.0	0.866	11.0	LOS B	15.0	111.4	0.84	0.77	33.4
3	R2	193	2.0	193	2.0	0.866	16.7	LOS B	11.5	85.5	0.76	0.79	49.7
Approach		1855	7.3	1855	7.3	0.866	11.5	LOS B	15.0	111.4	0.84	0.77	40.1
East: LSP East Access													
4	L2	51	2.0	51	2.0	0.549	11.5	LOS B	2.9	20.8	0.84	1.03	36.6
5	T1	12	2.0	12	2.0	0.549	11.5	LOS B	2.9	20.8	0.84	1.03	45.3
6	R2	172	2.0	172	2.0	0.549	16.1	LOS B	2.9	20.8	0.84	1.03	36.6
Approach		234	2.0	234	2.0	0.549	14.9	LOS B	2.9	20.8	0.84	1.03	37.2
North: Marmion Ave (North)													
7	L2	187	2.0	187	2.0	0.680	8.9	LOS A	6.2	45.8	0.63	0.73	50.6
8	T1	1245	9.0	1245	9.0	0.680	9.6	LOS A	6.2	45.8	0.64	0.74	38.5
9	R2	25	2.0	25	2.0	0.680	14.2	LOS B	6.1	45.7	0.65	0.75	52.0
Approach		1458	8.0	1458	8.0	0.680	9.6	LOS A	6.2	45.8	0.64	0.74	42.3
West: LSP West Access													
10	L2	39	2.0	39	2.0	0.399	11.4	LOS B	2.2	15.4	0.87	0.99	41.0
11	T1	7	2.0	7	2.0	0.399	11.8	LOS B	2.2	15.4	0.87	0.99	49.1
12	R2	107	2.0	107	2.0	0.399	16.9	LOS B	2.2	15.4	0.87	0.99	41.0
Approach		154	2.0	154	2.0	0.399	15.3	LOS B	2.2	15.4	0.87	0.99	41.6
All Vehicles		3700	7.0	3700	7.0	0.866	11.1	LOS B	15.0	111.4	0.76	0.78	40.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Network Model Accuracy Level (largest change in degree of saturation for any lane): 1.0 %
Number of Iterations: 6 (maximum specified: 10)

LANE LEVEL OF SERVICE

Lane Level of Service

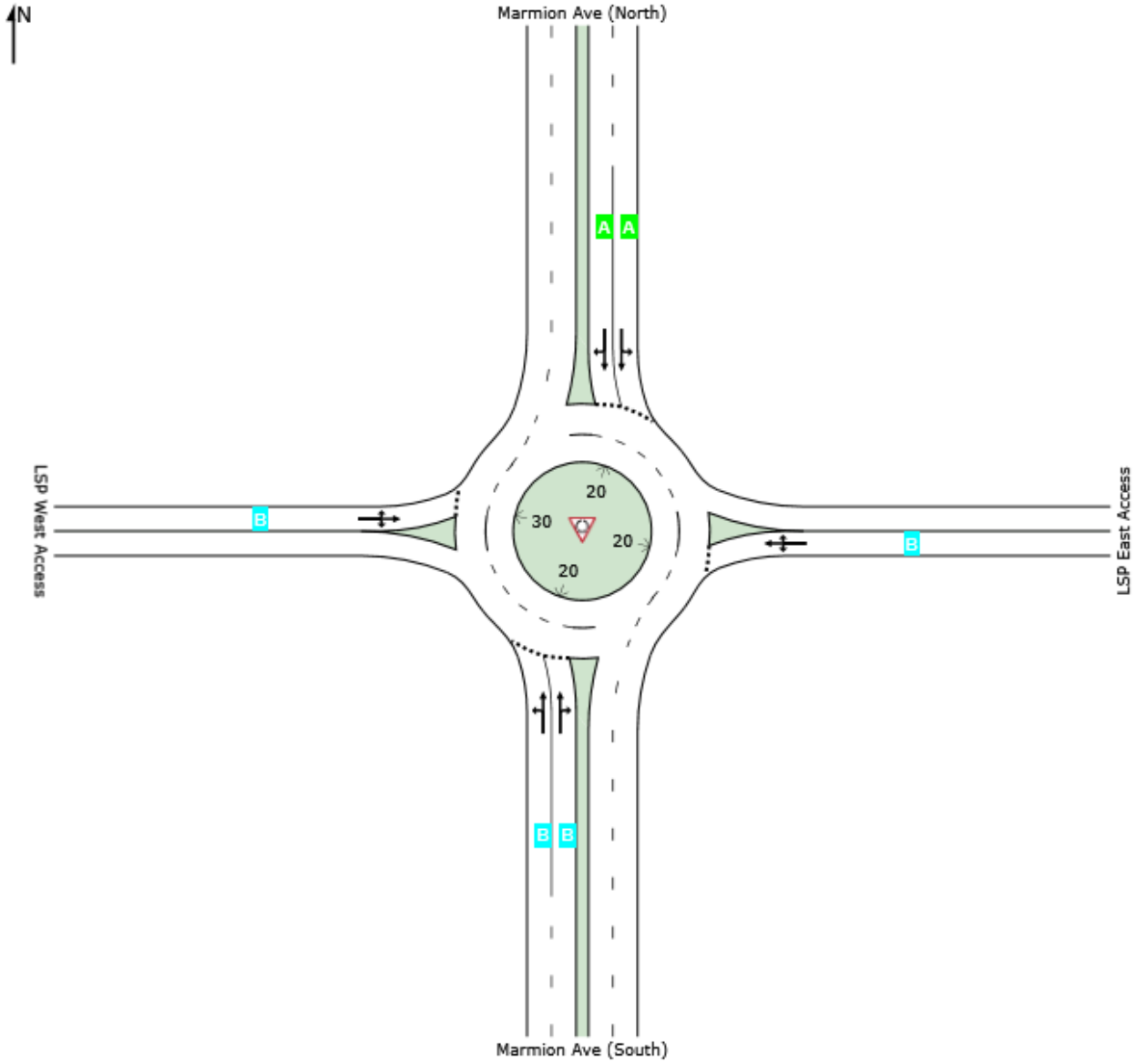
Network: N101 [Stage 2 - Yr 2027 - PM Peak]

Site: [Stage 3 - Yr 2027 - 4 Arm Roundabout - PM - 4 Lanes on Marmion Ave]

Roundabout

All Movement Classes

	South	East	North	West	Intersection
LOS	B	B	A	B	B



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

MOVEMENT SUMMARY

Site: [Stage 3 - Yr 2027 - LILO - AM - 4 Lanes on Marmion Ave]

Network: N101 [Stage 2 - Yr 2027 - AM Peak]

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows 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: Marmion Ave (South)													
2	T1	1624	9.0	1624	9.0	0.441	0.1	LOS A	0.0	0.0	0.00	0.00	79.8
Approach		1624	9.0	1624	9.0	0.441	0.1	NA	0.0	0.0	0.00	0.00	79.8
East: LSP Access													
4	L2	89	2.0	89	2.0	0.184	10.7	LOS B	0.6	4.5	0.68	0.84	40.0
Approach		89	2.0	89	2.0	0.184	10.7	LOS B	0.6	4.5	0.68	0.84	40.0
North: Marmion Ave (North)													
7	L2	35	2.0	35	2.0	0.019	7.6	LOS A	0.0	0.0	0.00	0.60	60.2
8	T1	1524	9.0	1524	9.0	0.414	0.0	LOS A	0.0	0.0	0.00	0.00	79.8
Approach		1559	8.8	1559	8.8	0.414	0.2	NA	0.0	0.0	0.00	0.01	79.2
All Vehicles		3273	8.7	3273	8.7	0.441	0.4	NA	0.6	4.5	0.02	0.03	75.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Network Model Accuracy Level (largest change in degree of saturation for any lane): 0.9 %
Number of Iterations: 5 (maximum specified: 10)

LANE LEVEL OF SERVICE

Lane Level of Service

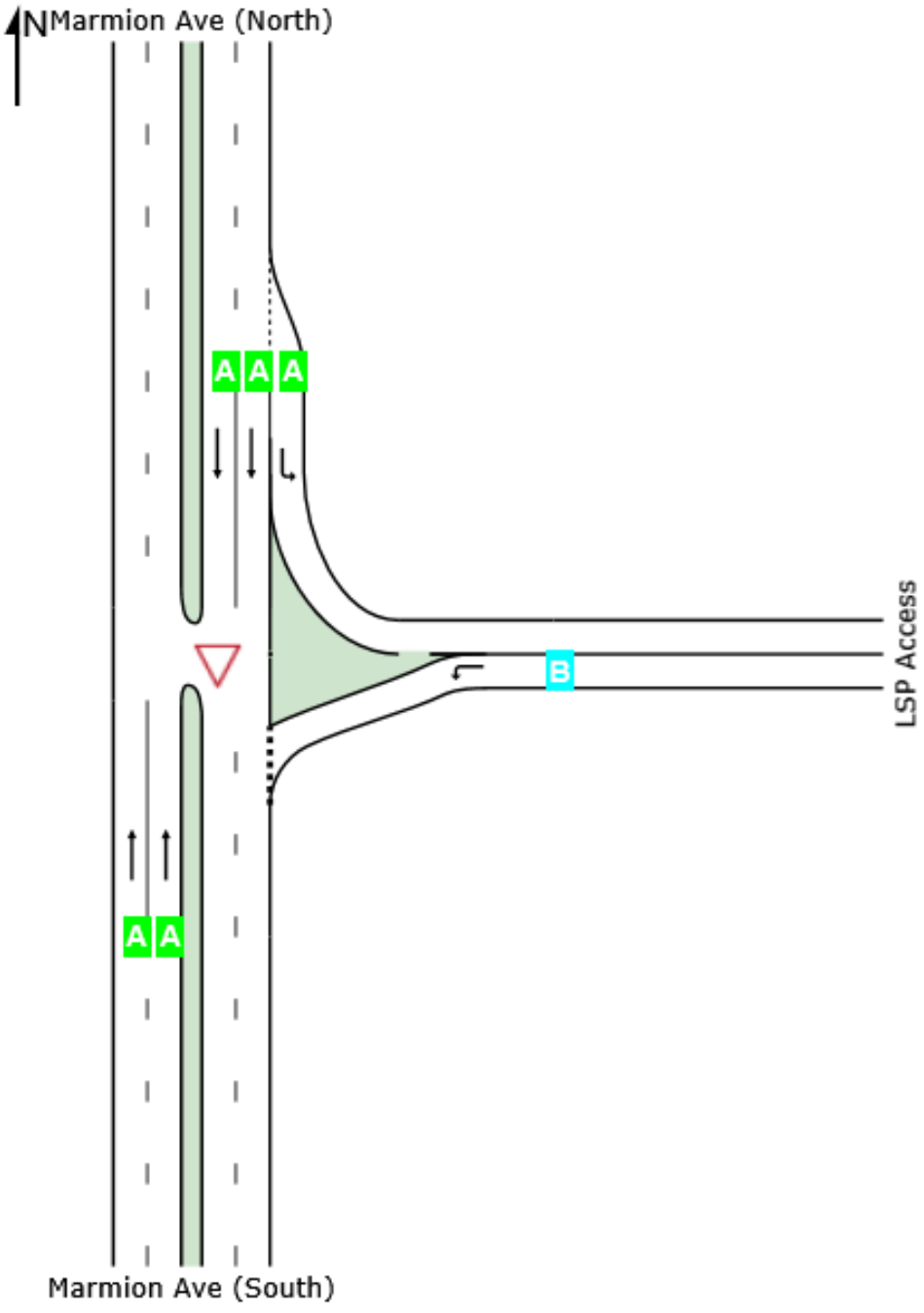
Network: N101 [Stage 2 - Yr 2027 - AM Peak]

Site: [Stage 3 - Yr 2027 - LILO - AM - 4 Lanes on Marmion Ave]

Giveway / Yield (Two-Way)

All Movement Classes

	South	East	North	Intersection
LOS	NA	B	NA	NA



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Lane LOS values are based on average delay per lane.

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

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 lanes.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

MOVEMENT SUMMARY

Site: [Stage 3 - Yr 2027 - LILO - PM - 4 Lanes on Marmion Ave]

Network: N101 [Stage 2 - Yr 2027 - PM Peak]

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows 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: Marmion Ave (South)													
2	T1	1855	9.0	1855	9.0	0.503	0.1	LOS A	0.0	0.0	0.00	0.00	79.7
Approach		1855	9.0	1855	9.0	0.503	0.1	NA	0.0	0.0	0.00	0.00	79.7
East: LSP Access													
4	L2	35	2.0	35	2.0	0.061	9.1	LOS A	0.2	1.5	0.59	0.77	40.8
Approach		35	2.0	35	2.0	0.061	9.1	LOS A	0.2	1.5	0.59	0.77	40.8
North: Marmion Ave (North)													
7	L2	53	2.0	53	2.0	0.029	7.6	LOS A	0.0	0.0	0.00	0.60	60.2
8	T1	1351	9.0	1351	9.0	0.367	0.0	LOS A	0.0	0.0	0.00	0.00	79.8
Approach		1403	8.7	1403	8.7	0.367	0.3	NA	0.0	0.0	0.00	0.02	78.8
All Vehicles		3293	8.8	3293	8.8	0.503	0.3	NA	0.2	1.5	0.01	0.02	77.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Network Model Accuracy Level (largest change in degree of saturation for any lane): 1.0 %
Number of Iterations: 6 (maximum specified: 10)

LANE LEVEL OF SERVICE

Lane Level of Service

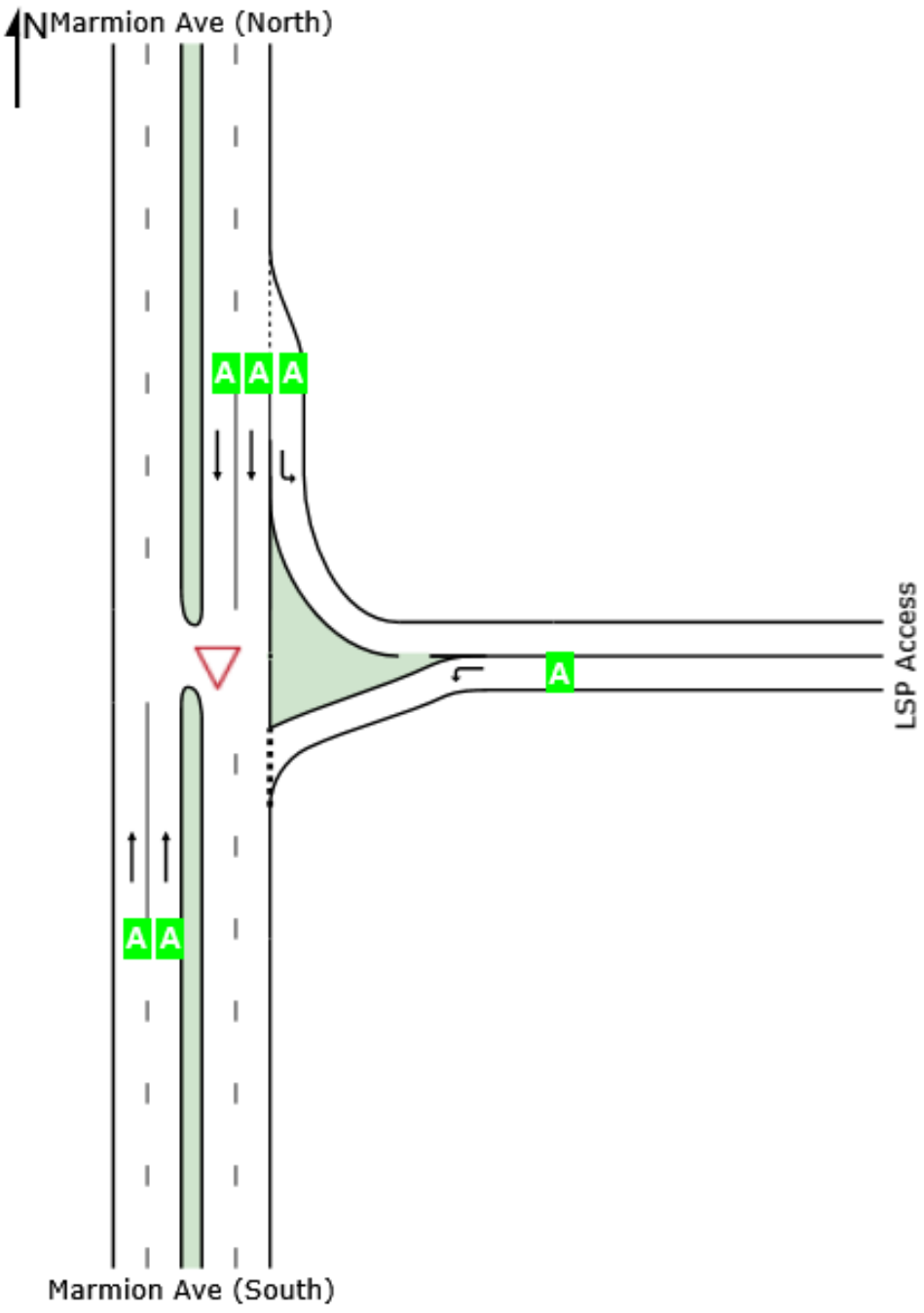
Network: N101 [Stage 2 - Yr 2027 - PM Peak]

Site: [Stage 3 - Yr 2027 - LILO - PM - 4 Lanes on Marmion Ave]

Giveway / Yield (Two-Way)

All Movement Classes

	South	East	North	Intersection
LOS	NA	A	NA	NA



Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Lane LOS values are based on average delay per lane.

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

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 lanes.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

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F +617 5510 4814
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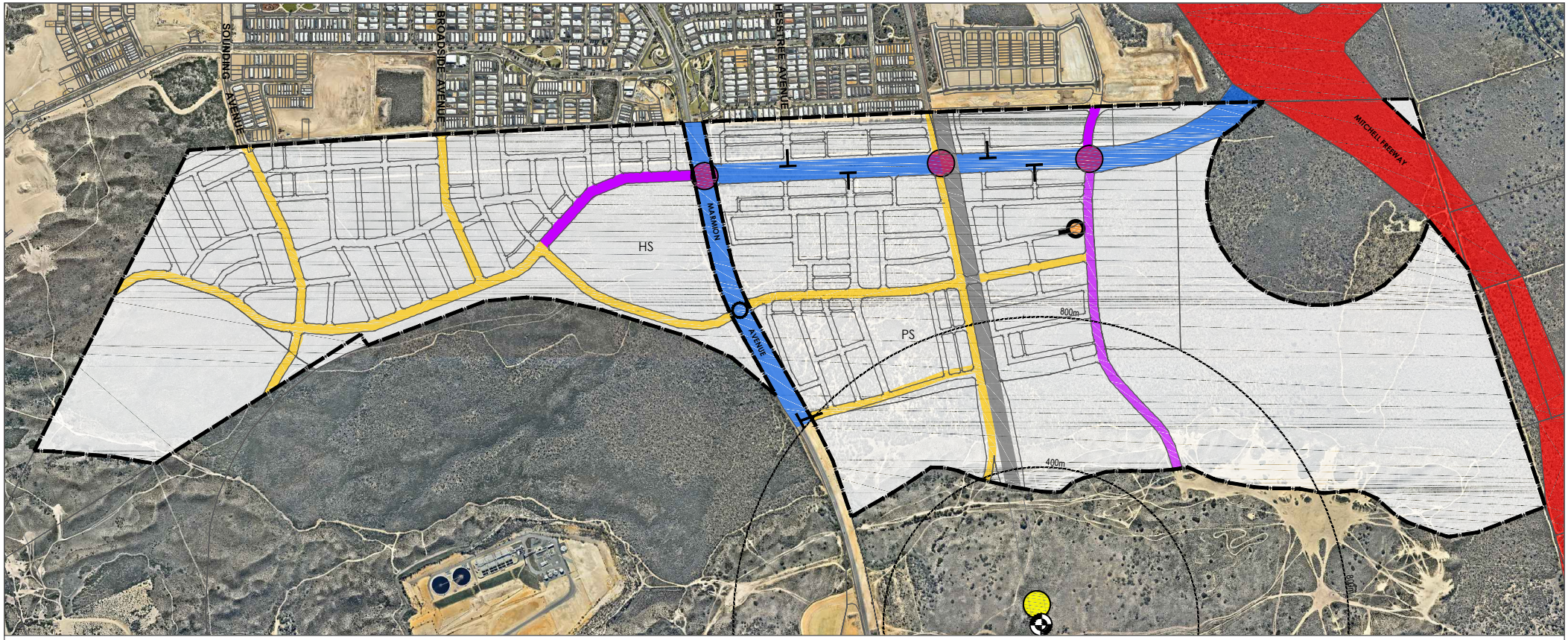
PO Box 7025, Cloisters Square
PERTH WA 6850
P +618 6169 1000
E perth@gta.com.au

APPENDIX C – AMENDED ROAD HIERARCHY PLAN



LEGEND

- STRUCTURE PLAN AREA
- PRIMARY DISTRIBUTOR
- DISTRICT DISTRIBUTOR A
- DISTRICT DISTRIBUTOR B (2-LANES)
- NEIGHBOURHOOD CONNECTOR
- RAIL STATION
- SIGNALISED INTERSECTION
- CUL-DE-SAC
- BUS/ RAIL INTERCHANGE
- RAILWAY CORRIDOR
- LEFT IN/ LEFT OUT T-JUNCTION
- ROUNDABOUT
- WALKABLE CATCHMENT 400M/800M

N

LANDCORP Partnering

lendlease

RD great places_ robertsday.com.au planning design place

CADASTRAL INFORMATION
SOURCE: MAPS
YYMMDD: VARIED
DWG REF: VARIED
PROJECTION: PCG94

AERIAL PHOTOGRAPHY
SOURCE: NEARMAPS
YYMMDD: 160423

SIZE A4

1:15,000

0 metres 150 300 450 600 750

REV	DESCRIPTION	YYMMDD	DRAWN	APPR'D
D	UPDATE STAGE 1 MASTERPLAN	170627	HH	RD
C	UPDATE MASTERPLAN	160531	SB	RD
B	POS LABELS	130429	RH	RD
A	BASE PLAN	121126	SB	RD

PROPOSED ROAD HIERACHY
Alkimos Central, Alkimos
City of Wanneroo

REF NO. **DLL CEN**
DRAW NO. **RD1 010**
REV. **D**