

# Fifth Wheel Redevelopment 398 North Service Road Town of Grimsby Transportation Impact Study Update



October 2019



# **Project Summary**



# **Project Number**

190563

### October 2019

### Client

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Signatures and Seals



Signature

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# **Executive Summary**

# Content

Losani Homes retained Paradigm Transportation Solutions Limited (Paradigm) to conduct this Transportation Impact Study for a proposed mixed-use development located at 398 North Service Road in the Town of Grimsby.

This Transportation Impact Study (TIS) includes an analysis of existing traffic conditions, a description of the proposed development, traffic forecasts for a five-year horizon from full build-out (Year 2034), Transportation Demand Management (TDM) measures and any recommendations required to improve future traffic conditions.

# **Development Concept**

The subject site is located on the former Fifth Wheel lands located in the northeast quadrant of the Casablanca Boulevard and Queen Elizabeth Way interchange in the Town of Grimsby. The subject site is proposed to consist of the following land uses:

- 36 townhouse units;
- 1,240 condominium apartment units (high-rise);
- ▶ 50,510 square feet of employment land uses; and
- 30,636 square feet of commercial land uses.

Vehicular access is proposed by four driveway connections to the North Service Road. The build-out of the subject site is anticipated to occur by Year 2029. However, timing may change to reflect market conditions.

# Conclusions

Based on the investigations carried out, it is concluded that:

- Existing Traffic Conditions: All study area intersections are operating at acceptable levels of service;
- Background Traffic Conditions: All study area intersections are forecast to operate with acceptable levels of service;
- Development Generated Traffic: The subject site is forecast to generate approximately 600 new vehicle trips during the AM peak hour and approximately 644 new vehicle trips during the PM peak hour;



Total Traffic Conditions: All study area intersections are forecast to operate with acceptable levels of service.

From a capacity perspective, four full move driveways to the North Service Road are not viewed as necessary to support the site generated traffic. Two of the driveway connections should be designed to function as right-in/right-out driveways.

- Remedial Measures: Auxiliary left-turn lanes with 25-metres of storage are warranted at the North Service Road intersection with the Winston Road driveway and at the proposed Driveway B intersection.
- Transportation Demand Management: to encourage sustainable travel choices TDM measures be reviewed at the Site Plan Approval stage.

### Recommendations

Based on the findings of this study, it is recommended that:

- Auxiliary left-turn lanes with 25-metres of storage be developed at the North Service Road intersection with the Winston Road driveway and at the proposed Driveway B intersection.
- Site Driveway A and Driveway C be restricted to right-in/rightout connections. Left-turn restrictions should be enforced by raised centre medians on the North Service Road.
- All site driveways operate under stop control for the driveway approach to the North Service Road.
- To encourage sustainable travel choices TDM measures should be incorporated into the overall development design and program.
- The final site design and layout be addressed at the Site Plan Approval stage.
- The Town of Grimsby should consider developing on-street bicycle lanes across the site's North Service Road frontage to connect to the existing cycling infrastructure west of Casablanca Boulevard and to the cycling infrastructure proposed as part of the Casablanca Boulevard and GO Station EA.
- Due to the increasing urbanization of the North Service Road corridor, the Town of Grimsby consider lowering the posted speed limit on the North Service Road across the site's frontage to 50 km/h.



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# 1 Introduction

# 1.1 Overview

Losani Homes retained Paradigm Transportation Solutions Limited (Paradigm) to conduct this Transportation Impact Study for a proposed mixed-use development located at 398 North Service Road in the Town of Grimsby. **Figure 1.1** illustrates the location of the subject site.

The original study was submitted to the Town of Grimsby in May 2018<sup>1</sup>. Town of Grimsby Staff provided comment on the study in April 2019. **Appendix A** contains the Town Comments. In September 2019, the site plan was updated to reflect design changes to the development program. This updated report is intended to address the Town's comments.

# 1.2 Purpose and Scope

This study determines the traffic impacts of the proposed development on the surrounding road network and identifies the recommended improvements to accommodate the site-generated traffic. The scope of the study includes:

- Assessment of the current traffic and site conditions within the study area;
- Estimates of background traffic growth for a five-year horizon following the anticipated build-out of the site (Year 2034);
- Estimates of additional traffic generated by the subject site;
- Analysis of the impact of the future traffic on the surrounding road network;
- Recommendations necessary to mitigate the site generated traffic in a satisfactory manner; and
- Transportation Demand Management (TDM) strategies to promote the use of alternative modes of transportation.

The study area intersections assessed in this study include:

 North Service Road and Casablanca Boulevard (signalized); and

<sup>&</sup>lt;sup>1</sup> Winston Road And North Service Road, Town Of Grimsby – Fifth Wheel Site – Transportation Impact Study Brief. Paradigm Transportation Solutions Limited. May 2018. Project 170205



 Four proposed site driveways to North Service Road (unsignalized).

This study has been prepared in accordance with the Niagara Region Guidelines for Transportation Impact Studies<sup>2</sup>.

<sup>&</sup>lt;sup>2</sup> Guidelines for Transportation Impact Studies, Niagara Region, May 2012.







# **Location of Subject Site**

398 North Service Road Fifth Wheel Site, Grimsby TIS 190563

Figure 1.1

# 2 Existing Conditions

# 2.1 Existing Roadways

The main roadways near the subject site considered in assessing the traffic impacts of the development include:

- Casablanca Boulevard is a north-south minor arterial<sup>3</sup> roadway with a two-lane cross-section and a posted speed limit of 60 km/h. The roadway has an interchange with the Queen Elizabeth Way (QEW) to the south of the study area. Within the study area there are no sidewalks present or any visible cycling infrastructure along this roadway. The intersection with the North Service Road is signalized and operates with an eastbound right-turn lane and westbound left-turn lane.
- North Service Road is an east-west minor arterial roadway with a two-lane cross section. The speed limit west of Casablanca Boulevard is 60 km/h. East of Casablanca Boulevard the speed limit is 50 km/h. Sidewalks are provided on both sides of this roadway west of Casablanca Boulevard. East of Casablanca Boulevard, discontinuous sidewalks are provided along the north side of this roadway to Winston Road. Sidewalks connect to the Waterfront Trail. Dedicated on-street bicycle lanes are provided on both sides of this roadway west of Casablanca Boulevard. No visible cycling infrastructure is present east of Casablanca Boulevard.

**Figure 2.1** illustrates the existing lane configuration and traffic control at the study area intersection. The surrounding land uses include midrise residential to the west, low rise residential to the east and Lake Ontario to the north.

# 2.2 Existing Transit Service

There is currently no local transit service available within the Town of Grimsby. However, GO Transit operates one route within proximity to the subject site.

GO Bus Route 12 travels from Niagara Falls to Burlington with a stop in Grimsby within the park and ride at the northwest corner of Casablanca Boulevard and South Service Road. The route operates from Monday to Friday with headways of approximately 30-45 minutes.

<sup>&</sup>lt;sup>3</sup> Town of Grimsby Official Plan, Schedule C – Transportation and Trails, August 2018.







# Existing Lane Configuration and Traffic Control

398 North Service Road Fifth Wheel Site, Grimsby TIS 190563

Figure 2.1





# Existing Go Transit Network – Route 12

398 North Service Road Fifth Wheel Site, Grimsby TIS 190563

Figure 2.2

### 2.3 Existing Traffic Data

Turning Movement Count (TMC) data contained in the Environmental Assessment (Class EA) for Casablanca Boulevard<sup>4</sup> is used in this updated report. TMC data was provided by the Niagara Region with 8-hour TMC collected during May 2018. **Figure 2.3** illustrates the existing AM and PM weekday peak hour traffic volumes.

A data request for existing signal timings was made to the Niagara Region (September 2019). However, the data was not provided in time for this study update. Existing signal timings used in the analysis have been optimized.

<sup>&</sup>lt;sup>4</sup> Niagara Region Detailed Transportation Assessment – Draft Report Detailed Transportation Assessment and Municipal Class Environmental Assessment for Casablanca Boulevard, in the Town of Grimsby. October 2018.





# 2.4 Traffic Operations

Intersection level of service (LOS) is a recognized method of quantifying the average delay experienced by drivers at intersections. It is based on the delay experienced by individual vehicles executing the various movements. The delay is related to the number of vehicles intending to make a particular movement, compared to the estimated capacity for that movement. The capacity is based on a number of criteria related to the opposing traffic flows and intersection geometry.

The highest possible rating is LOS A, under which the average total delay is equal or less than 10.0 seconds per vehicle. When the average delay exceeds 80 seconds for signalized intersections, 50 seconds for unsignalized intersections or when the volume to capacity ratio is greater than 1.0, the movement is classed as LOS F and remedial measures are usually implemented, if they are feasible. LOS E is usually used as a guideline for the determination of road improvement needs on through lanes, while LOS F may be acceptable for left-turn movements at peak times, depending on delays.

The operations of the study area intersections were evaluated using the existing lane configurations, traffic controls and the existing traffic peak volumes.

The level of service conditions on the existing road network have been assessed using Synchro 9. Movements are considered critical under the following conditions at signalized intersections:

- Overall intersection, through and/or through-right an/or right-turn movements with a v/c ratio greater than 0.85; and
- V/C ratios for dedicated left-turn movements greater than 0.90;

Movements are considered critical under the following conditions at unsignalized intersections:

- Movements expected to operate at LOS D or worse; and
- Estimated 95<sup>th</sup> percentile queue length for an individual movement exceeds the available queueing space.

**Table 2.1** summarizes the existing intersection operations. The entries in the table indicate the AM and PM peak hour level of service (LOS), volume to capacity ratios (v/c), and 95th percentile queue lengths.

All intersections are forecast to operate within acceptable levels, with no specific movements considered critical under existing traffic conditions. **Appendix B** contains the detailed Synchro 9 reports.



od				Direction / Movement / Approach																
Peri		Control Type			Eastb	ound		Westbound				Northbound				<i>u,</i>	South	bound	k	
Analysis F	Intersection		MOE	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	OVERALL
<b>_</b>			LOS		В	В	В	В	В		В	А		٧	Α					В
Inol	Casablanca Boulevard & North Service Road	TCS	Delay		15	15	15	17	15		16	5		>	5					12
Peak H			V/C		0.12	0.18		0.38	0.17			0.24		>						0.28
			95th		9	13		19	12			19		>						
AM			Storage		-	60		160	-			-		>						
			Avail.		-	47		141	-			-		>						
<u> </u>			LOS		В	В	В	В	В		В	А		>	Α					В
hou	Casablanas		Delay		16	16	16	16	15		16	6		>	6					11
ak F	Casabianca Boulevard & North	TCS	V/C		0.20	0.19		0.27	0.11			0.42		>						0.39
Pei	Service Road	100	95th		13	14		13	9			37		>						
We			Storage		-	60		160	-			-		>						
			Avail.		-	46		147	-			-		>						

### TABLE 2.1: EXISTING TRAFFIC OPERATIONS

MOE - Measure of Effectiveness

V/C - Volume to Capacity Ratio

Avail. - Available Storage (m)

TWSC - Two-Way Stop Control

LOS - Level of Service

TCS - Traffic Control Signal

95th - 95th Percentile Queue Length Storage - Existing Storage (m) > - Shared Right-Turn Lane

< - Shared Left-Turn Lane



# **3 Development Concept**

# 3.1 **Development Description**

The subject site is located on the former Fifth Wheel lands located in the northeast quadrant of the Casablanca Boulevard and Queen Elizabeth Way interchange in the Town of Grimsby. The subject site is proposed to consist of the following land uses:

- 36 townhouse units;
- ▶ 1,240 condominium apartment units (high-rise);
- ▶ 50,510 square feet of employment land uses; and
- ▶ 30,636 square feet of commercial land uses.

Vehicular access is proposed by four driveway connections to North Service Road. The driveways are positioned as follows:

- Winston Road 225 metres (centre line (CL) to CL) east of Casablanca Boulevard;
- Driveway A 380 metres (CL to CL) east of Casablanca Boulevard;
- Driveway B 535 metres (CL to CL) east of Casablanca Boulevard; and
- Driveway C 695 metres (CL to CL) east of Casablanca Boulevard.

All driveways are proposed to operate as a single lane stop controlled approach to the North Service Road.

Build-out of the subject site is anticipated to occur by Year 2029. However, timing may change to reflect market conditions.

Figure 3.1 illustrates the site concept plan.





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398 North Service Road Fifth Wheel Site, Grimsby TIS 190563

**Proposed Site Plan** 

Figure 3.1

### 3.2 Development Trip Generation

The Institute of Transportation Engineers (ITE) Trip Generation<sup>5</sup> methods predict the site trip generation. The following Land Use Codes (LUC) were used to estimate the site trip generation:

- Townhouse units LUC 220 (Multifamily Housing, Low-Rise);
- Condominium apartment units LUC 222 (Multifamily Housing, High-Rise);
- Employment land uses LUC 710 (General Office Building); and
- ▶ Commercial land uses LUC 820 (Shopping Centre).

Regression equation rates were used to calculate the trips generated by the subject site for all land uses. **Table 3.1** summarizes the estimated trip generation. The site's total trip generation is estimated to be approximately 619 AM peak hour trips and 740 PM peak hour trips.

The Transportation Tomorrow Survey<sup>6</sup> (TTS) data was used to estimate the modal split for the site. A 3% modal split reduction for active transportation modes such as cycling and walking is identified for the Town of Grimsby.

The commercial land uses are estimated to generate pass-by trips during the PM peak hour. An average pass-by trip rate of 34% is noted for LUC 820<sup>7</sup>. Pass-by trips were distributed based on the existing traffic volumes on North Service Road east of Casablanca Boulevard and the general location of the commercial land uses within the site.

After modal split and pass-by trip reductions, the site's net trip generation is estimated to be approximately 600 AM peak hour trips and 644 PM peak hour trips.

<sup>&</sup>lt;sup>7</sup> ITE Trip Generation Handbook 3rd Edition Table E.9 Average Pass-by trip percentage



<sup>&</sup>lt;sup>5</sup> Trip Generation Manual 10th Edition Institute of Transportation Engineers Washington DC

<sup>&</sup>lt;sup>6</sup> TTS 2016. Frequency Distribution Query Form - Trip - 2016 v1.1 Field: Primary travel mode of trip - mode\_prime Planning district of household - pd\_hhld In 51 (Grimsby)

Land Us	e/	AM	Peak	Hour	PM Peak Hour						
Number of Uni	its/GFA	In	Out	Sum	In	Out	Sum				
LUC 220 <sup>1</sup>	36	4	14	18	15	9	24				
LUC 222 <sup>2</sup>	1,240	86	274	360	262	168	430				
LUC 710 <sup>3</sup>	LUC 710 <sup>3</sup> 50.51				10	50	60				
LUC 820 <sup>4</sup>	LUC 820 <sup>4</sup> 30.64				108	118	226				
<b>Total Generation</b>		258	361	619	395	345	740				
Modal Split (3%) <sup>5</sup>		8	11	19	12	10	22				
Pass-by Trips (PM	-34%) <sup>6</sup>	0	0	0	37	37	74				
Net Generation		250	350	600	346	298	644				

### TABLE 3.1: ESTIMATED TRIP GENERATION

1 - LUC 220. AM Ln(T) = 0.95 Ln(X) - 0.51 | PM Ln(T) = 0.89 Ln(X) - 0.02

2 - LUC 222. AM T = 0.28(X) + 12.86 | PM T = 0.34(X) + 8.56

3 - LUC 710. AM T =  $0.94(X) + 26.49 \mid PM Ln(T) = 0.95 Ln(X) + 0.36$ 

4 - LUC 820. AM T =  $0.50(\hat{X}) + 151.78$  | PM Ln(T) = 0.74 Ln(X) + 2.89

5 – TTS Modal Split – Town of Grimsby

6 - ITE Trip Generation Handbook 3rd Edition Table E.9 Average Pass-by trip percentage

**Table 3.2** summarizes the estimated trip distribution. The distribution was developed using TTS 2016 data for the zone containing the subject site<sup>8</sup>. Site traffic is assigned to the site driveways using the proposed distribution of land uses. **Figure 3.2** illustrates the net trip generation. **Figure 3.3** illustrates the pass-by trip generation. **Figure 3.4** illustrates the total vehicle trip generation (sum of net generation and pass-by trips).

### TABLE 3.2: ESTIMATED TRIP DISTRIBUTION

Origin/Destination	In	Out
South via Casablanca Boulevard	75%	65%
East via North Service Road	20%	20%
West via North Service Road	5%	15%
Total	100%	100%

Site generated traffic originating or destined to areas east of the subject site via the North Service Road is expected to use Olive Street to filter through the existing network towards the QEW or downtown Grimsby.





# Site Generated Traffic Volumes – Net Generation





# Site Generated Traffic Volumes – Pass-by Trips



AM Peak Hour

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# **4** Future Conditions

The assessment of the future traffic conditions contained in this section includes the traffic forecasts as well as the level of service analysis.

### 4.1 Network Improvements

The preferred design resulting from Class EA includes a four-lane cross-section for Casablanca Boulevard between the North Service Road and the South Service Road. At the North Service Road intersection, a northbound right-turn lane is planned.

The preferred design includes an Parclo A4 concept for the QEW interchange with both the north and south ramps operating as signalized intersections.

To support cycling and pedestrian traffic crossing the interchange, a multi-use path is proposed along the west side of Casablanca Boulevard between the North Service Road and the South Service Road. This path is proposed to be separated from vehicle traffic and will help provide cycling and pedestrian connectivity across the interchange with connectively to the Waterfront Trail.

# 4.2 Traffic Forecasts

A five-year horizon (Year 2034) following the anticipated build-out of the subject site has been assessed. The likely future traffic volumes near the subject site are estimated to consist of:

- Increased non-site traffic (generalized background traffic growth);
- Traffic generated by adjacent development applications in the West End development area; and
- Traffic generated by the subject site.

The generalized background traffic growth assumes an annual growth rate of 2% per annum. This growth rate is consistent with the Region's TIS guidelines.

A total of eight developments are identified within the West End development area<sup>9</sup>, including the subject site (Site 6).

<sup>&</sup>lt;sup>9</sup> CIMA+ Town of Grimsby Traffic Operations Study for the Future Development on Casablanca Boulevard between Winston Road and South Service Road, November 2016.



The majority of the West End lands appear to be built-out and occupied and would be captured in the existing turning movement data. Construction is underway for the Aqua Zul (Site 7B) mixed-use development. Site 8 appears to be vacant and is planned as a mixed-use development. **Figure 4.1** illustrates the location for the background developments. These developments are described generally as follows:

- The Aqua Zul (Site 7B) mixed-use development located on the southwest corner of Casablanca Boulevard and North Service Road is proposed to consist of 342 high-rise condominium units and 59,200 square feet of office land uses. The site is estimated to generate approximately 244 AM peak hour trips and 262 PM peak hour trips.
- A mixed-use development (Site 8) on the south side of North Service Road between Casablanca Boulevard and Hunter Road is proposed to consist of 179 apartment units and 7,200 square feet of office land uses. The site is estimated to generate approximately 67 AM peak hour trips and 93 PM peak hour trips.

Appendix C contains the forecast traffic volumes.

**Figure 4.2** illustrates the forecast Five-Year Background Traffic volumes which is the combination of the generalized growth and the background developments. **Figure 4.3** illustrates the forecast Five-Year Total Traffic volumes which includes the subject site generated traffic.







# Location of Background Developments

398 North Service Road Fifth Wheel Site, Grimsby TIS 190563

Figure 4.1



Figure 4.2



# 4.2 Traffic Operations

The background and total traffic volumes at the 2034 horizon year were analyzed using the same methodology and parameters used for the existing traffic conditions. Signal optimization was applied to assist in maintaining a reasonable level of service.

### 4.2.1 Background Traffic Operations

**Table 4.1** summarizes the results of the background traffic operations. The study area intersections are forecast to operate with acceptable levels of service during the AM and PM peak hours. No movements are considered critical.

Overall, the Casablanca Boulevard intersection with the North Service Road is estimated to operate with delays in the LOS B range with a v/c ratio of less than 0.55.

The 95<sup>th</sup> percentile queue lengths are not expected to exceed the available storage lengths.

Appendix D contains the supporting detailed Synchro 9 reports.

### 4.2.2 Total Traffic Operations

**Table 4.2** summarizes the results of the total traffic operations. The study area intersections are forecast to operate with acceptable levels of service during the AM and PM peak hours. No movements are considered critical.

Overall, the Casablanca Boulevard intersection with the North Service Road is estimated to operate with delays in the LOS B range with a v/c ratio of less than 0.75.

The site driveway connections to the North Service Road are forecast to operate with delays in the LOS B to C range with low v/c ratios.

The 95<sup>th</sup> percentile queue lengths are not expected to exceed the available storage lengths. Queue lengths on the site driveway approaches range from 10-20 metres.

Appendix E contains the supporting detailed Synchro 9 reports.



od				Direction / Movement / Approach																
Peri		Control Type	MOE		Eastb	ound		Westbound				١	lorth	boune	k	<b>v</b> ,	South	bound	k	
Analysis F	Intersection			Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	OVERALL
-			LOS		В	В	В	В	В		В	А		А	Α					В
Peak Hou	Casablanca Boulevard & North Service Road	TCS	Delay		14	15	14	16	14		15	7		6	7					12
			V/C		0.22	0.32		0.45	0.27			0.40		0.06						0.42
			95th		15	16		24	18			40		6						
AM			Storage		-	60		160	-			-		-						
			Avail.		-	44		136	-			-		-						
<u> </u>			LOS		В	В	В	В	В		В	А		А	Α					В
noț	Ossahlaria		Delay		15	15	15	15	14		15	9		6	8					12
ak F	Casabianca Boulevard & North	TCS	V/C		0.32	0.36		0.33	0.20			0.58		0.11						0.51
Pea	Service Road	165	95th		21	17		16	15			78		9						
M			Storage		-	60		160	-			-		-						
			Avail.		-	43		144	-			-		-						

### TABLE 4.1: BACKGROUND TRAFFIC OPERATIONS

MOE - Measure of Effectiveness

V/C - Volume to Capacity Ratio

Avail. - Available Storage (m)

TWSC - Two-Way Stop Control

LOS - Level of Service

TCS - Traffic Control Signal

95th - 95th Percentile Queue Length Storage - Existing Storage (m) > - Shared Right-Turn Lane< - Shared Left-Turn Lane</li>

bo				Direction / Movement / Approach																
erio					Eastb	ound		1	Westk	ounc	ł	1	North	boun	d	5	South	boun	d	
Analysis P	Intersection	Control Type	MOE	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	OVERALL
	Casablanca Boulevard & North Service Road	TCS	LOS Delay V/C 95th Storage Avail.		B 10 0.17 15 - -	B 11 0.32 14 60 46	B 11	C 22 0.79 76 160 84	B 11 0.26 22 - -		B 18	B 14 0.52 54 - -		B 12 0.21 14 - -	В 13					B 14 0.65
łour	North Service Road & Winston Road	TWSC	LOS Delay V/C 95th	v v v v	A 2 0.07 2		A 2		A 0 0.29 0	~ ^ ^ ^	A 0					C 16 0.28 9		^ ^ ^ ^	C 16	
AM Peak H	North Service Road & Driveway A	TWSC	LOS Delay V/C 95th	v v v v	A 0 0.00 0		A 0		A 0 0.28 0	~ ~ ~ ~	A 0					B 12 0.01 0		~ ^ ^ ^	B 12	
	North Service Road & Driveway B	TWSC	LOS Delay V/C 95th	v v v v	A 4 0.10 3		A 4		A 0 0.20 0	~ ^ ^ ^	A 0					C 15 0.39 15		~ ^ ^ ^	C 15	
	North Service Road & Driveway C	TWSC	LOS Delay V/C 95th	~ ~ ~ ~	A 0 0.01 0		A 0		A 0 0.19 0	v v v v	A 0					B 11 0.02 0		~ ~ ~ ~	B 11	
	Casablanca Boulevard & North Service Road	TCS	LOS Delay V/C 95th Storage Avail.		B 13 0.26 23 - -	B 14 0.36 16 60 44	B 14	C 23 0.75 62 160 98	B 13 0.23 21 - -		B 20	B 15 0.67 83 - -		B 11 0.30 14 -	B 13					B 15 0.70
our	North Service Road & Winston Road	TWSC	LOS Delay V/C 95th	~ ~ ~ ~	A 3 0.10 3		A 3		A 0 0.23 0	~ ~ ~ ~	A 0					C 16 0.28 9		~ ~ ~ ~	C 16	
PM Peak H	North Service Road & Driveway A	TWSC	LOS Delay V/C 95th	v v v v	A 0 0.01 0		A 0		A 0 0.22 0	~ ^ ^ ^	A 0					B 12 0.02 1		^ ^ ^ ^	B 12	
	North Service Road & Driveway B	TWSC	LOS Delay V/C 95th	~ ~ ~ ~	A 4 0.15 4		A 4		A 0 0.16 0	~ ~ ~ ~	A 0					C 17 0.43 17		~ ^ ^ ^	C 17	
	North Service Road & Driveway C	TWSC	LOS Delay V/C 95th	~ ~ ~ ~	A 0 0.01 0		A 0		A 0 0.16 0	~ ~ ~ ~	A 0					B 10 0.01 0		~ ~ ~ ~	B 10	
MOE TWS	E - Measure of Effecti SC - Two-Way Stop C	iveness Control		V/C - 95th	- Volu - 95th	me to Perc	Capa entile	Que	Ratio Ie Len (m)	gth		Avail > - S	Av hared	ailable Right	e Stor t-Turn	age (I Lane	n)			

# **TABLE 4.2: TOTAL TRAFFIC OPERATIONS**

LOS - Level of Service TCS - Traffic Control Signal Storage - Existing Storage (m)

< - Shared Left-Turn Lane



# 5 Sensitivity Analysis

# 5.1 Driveway Turning Restrictions

The site concept plan includes four all move driveway connections to the North Service Road.

**Table 4.2** indicates that the site driveway connections are forecast to operate with delays in the LOS B to C range during the AM and PM peak hours. From a capacity perspective, the four connections are not viewed as necessary to support the site generated traffic.

To limit conflict points and to establish a cross-section similar to what the Town has developed west of Casablanca Boulevard (raised centre medians with on-street bicycle lanes), it is recommended that the Driveway A and Driveway C connections be restricted to right-in/rightout operation. Left-turn restrictions should ideally be enforced through use of raised centre medians along the North Service Road.

**Figure 5.1** illustrates the forecast total traffic volumes with left-turn movements restricted at the Driveway A and C intersections. **Table 5.1** summarizes the results of the total traffic operations with turning restrictions applied to the Driveway A and Driveway C intersections.

The analysis indicates that with only two full movement driveways, the driveway approaches are forecast to operate with delays in the A to C range.

Appendix F contains the detailed Synchro 9 reports.




#### TABLE 5.1: TOTAL TRAFFIC OPERATIONS - SENSITIVITY ANALYSIS

g									Dire	ctior	n / Mo	veme	ent / /	Appro	ach					
erio					Eastb	ound		, I	Westk	ounc	k	1	orth	boun	d	S	South	bound	k	
Analysis P	Intersection	Control Type	MOE	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	OVERALL
	Casablanca Boulevard & North Service Road	TCS	LOS Delay V/C 95th Storage Avail.		B 10 0.17 15 - -	B 11 0.32 14 60 46	B 11	C 22 0.79 76 160 84	B 11 0.26 22 - -		B 18	B 14 0.52 54 - -		B 12 0.21 14 - -	B 13					B 14 0.65
lour	North Service Road & Winston Road	TWSC	LOS Delay V/C 95th	<pre></pre>	A 2 0.08 2		A 2		A 0 0.29 0	~ ~ ~ ~	A 0					C 16 0.29 9		v v v v	C 16	
AM Peak H	North Service Road & Driveway A	TWSC	LOS Delay V/C 95th		A 0 0.21 0		A 0		A 0 0.28 0	~ ~ ~ ~	A 0							B 11 0.01 0	B 11	
	North Service Road & Driveway B	TWSC	LOS Delay V/C 95th	~ ~ ~ ~	A 4 0.11 3		A 4		A 0 0.20 0	~ ~ ~ ~	A 0					C 15 0.40 15		v v v v	C 15	
	North Service Road & Driveway C	TWSC	LOS Delay V/C 95th		A 0 0.15 0		A 0		A 0 0.19 0	~ ^ ^ ^	A 0							B 10 0.01 0	B 10	
	Casablanca Boulevard & North Service Road	TCS	LOS Delay V/C 95th Storage Avail.		B 13 0.26 23 - -	B 14 0.36 16 60 44	B 14	C 23 0.75 62 160 98	B 13 0.23 21 - -		B 20	B 15 0.67 83 - -		B 11 0.30 14 - -	B 13					B 15 0.70
our	North Service Road & Winston Road	TWSC	LOS Delay V/C 95th	~ ~ ~ ~	A 3 0.10 3		A 3		A 0 0.23 0	~ ^ ^ ^	A 0					C 17 0.30 10		v v v v	C 17	
PM Peak H	North Service Road & Driveway A	TWSC	LOS Delay V/C 95th		A 0 0.30 0		A 0		A 0 0.22 0	~ ~ ~ ~	A 0							B 10 0.01 0	B 10	
	North Service Road & Driveway B	TWSC	LOS Delay V/C 95th	<pre></pre>	A 4 0.16 5		A 4		A 0 0.16 0	> > > >	A 0					C 18 0.45 18		~ ~ ~ ~	C 18	
	North Service Road & Driveway C	TWSC	LOS Delay V/C 95th		A 0 0.22 0		A 0		A 0 0.16 0	~ ~ ~ ~	A 0							A 10 0.01 0	A 10	
MOF	- Measure of Effecti	iveness		V/C	- Volu	me to	Cape	acity F	Ratio			Avail	- Av	ailable	- Stor	ade (r	n)			

MOE - Measure of Effectiveness TWSC - Two-Way Stop Control LOS - Level of Service TCS - Traffic Control Signal V/C - Volume to Capacity Ratio 95th - 95th Percentile Queue Length Storage - Existing Storage (m) Avail. - Available Storage (n > - Shared Right-Turn Lane

< - Shared Left-Turn Lane



## 6 Remedial Measures

### 6.1 Left-Turn Lanes

The Ministry of Transportation's Design Supplement for the Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads<sup>10</sup> provides guidance on the assessment and/or need for auxiliary left-turn lanes at intersections.

Warrants have been calculated for the four proposed site driveways to the North Service Road. The warrants have been completed using the nomographs for left-turn lanes on a two-lane undivided highway at an unsignalized intersection. A design speed of 70 km/h (10 km/h over the posted speed limit) has been used for analysis purposes.

The following auxiliary left-turn lanes are warranted:

- Winston Road eastbound left-turn lane with 25 metres of storage;
- Driveway B eastbound left-turn lane with 25 metres of storage;

The forecast traffic volumes at the Driveway A and Driveway C intersections do not meet the minimum vehicular warrants. However it is recommended that left-turn movements at these driveways be restricted.

With Driveway A and Driveway C restricted to right-in-right-out operations, the amount of storage warranted for the eastbound left-turn lanes on North Service Road at Winston Road and at Driveway B are the same as under the unrestricted conditions. Two eastbound left-turn lanes with 25 metres of storage remains warranted.

**Appendix G** contains the left-turn warrant lane nomographs.

## 6.2 Traffic Control Improvements

No improvements to the existing form of traffic control at the Casablanca Boulevard intersection with the North Service Road are recommended. The Niagara Region should continue to monitor signal timings in the future as the West End Developments build-out and following the implementation of the Casablanca Boulevard EA improvements.

<sup>&</sup>lt;sup>10</sup> MTO Design Supplement for TAC Geometric Design Guide for Canadian Roads, June 2017 Appendix 9 for Chapter 9 Intersections



The capacity analysis for the site driveways suggests that stop control is the appropriate form of traffic control for the site driveway approaches to the North Service Road.

**Figure 6.1** illustrates the future lane configuration and traffic control for the study area intersections.







## Future Lane Configuration and Traffic Control

398 North Service Road Fifth Wheel Site, Grimsby TIS 190563

Figure 6.1

### 6.3 North Service Road Sight Lines

The existing design of the North Service Road should allow for minimum stopping sight distance (105 metres) in both travel directions<sup>11</sup>. However, sight distance requirements on the North Service Road will need to be reviewed considering the recommended modifications, including the addition of eastbound left-turn lanes at the Winston Road and Driveway B connections, and the provision of raised centre medians at the Driveway A and Driveway C connections to restrict left-turns.

It may also be appropriate for the Town of Grimsby to lower the posted speed limit on the North Service Road across the site's frontage to 50 km/h. This would be supportive to the increasing urbanization of the corridor and will lower the design requirements for designing auxiliary turn lanes and sight distances.

### 6.4 Site Plan Design

In order for major driveways to operate efficiently, both from the roadside and internally, it is desirable to provide a no conflict and storage zone within the driveway. This zone is commonly referred to as the clear throat length or set-back distance and is measured from the ends of the driveway curb return radii at the roadway and the point of first conflict on-site. Failure to provide sufficient throat distance results in frequent blocking of on-site circulation roads which can in turn create queues of entering vehicles.

The recommended clear throat length for each site driveway is 25 metres<sup>12</sup>. The site plan indicates a clear throat distance of approximately 10-15 metres for all four (4) driveway connections. It is recommended that the driveway connections be designed to include 25 metres of clear throat length.

The underground parking Ramp #3 to Building A-B is located on the inside of the Winston Road curve. To maintain clear sightlines, the area between the ramp and the parking spaces to the west should be kept clear of all obstructions or relocated on site.

 <sup>&</sup>lt;sup>12</sup> Transportation Association of Canada, Geometric Design Guide for Canadian Roads (2017), chapters 8.9.10 Clear Throat Lengths
 8 Transportation Association



<sup>&</sup>lt;sup>11</sup> Transportation Association of Canada, Geometric Design Guide for Canadian Roads (2017) Table 2.5.2:

Stopping Sight Distance on level roadways for Automobiles

It is expected that the site's design and layout will be further defined during the Site Plan Approval stage.

### 6.5 Queue Length Assessment

#### 6.5.1 North Service Road Queueing

The Winston Road driveway is located approximately 225 metres (CL to CL) east of the signalized Casablanca Boulevard intersection. The operational conditions outlined in **Section 4** and **Section 5** indicates that the queuing of vehicles generated by the signalized intersection will extend approximately 15-25 metres. Queue lengths of this extent are not expected to impact the normal operation of the Winston Road driveway connection. Moreover, no additional storage is recommended for the eastbound left-turn movement from the North Service Road to Casablanca Boulevard.

#### 6.5.2 Site Driveway Queueing

The operational conditions outline in **Section 4** and **Section 5** indicate queuing conditions on the site driveway approaches to the North Service Road are forecast to range between 10-20 metres. As outlined in **Section 6.4** each driveway should be designed with a clear throat length of at least 25 metres to allow for a no conflict and storage zone on the driveway approaches. Failure to provide sufficient throat length results in frequent blocking of on-site circulation roads which can in turn create queues of entering vehicles.



## 7 Transportation Demand Management

Transportation Demand Management (TDM) refers to ways of making the capacity of our roads more efficient by reducing the demand for single occupancy vehicles. TDM approaches consider how people's choices of travel mode are affected by factors such as land use patterns, development design, parking availability, parking cost, and the relative cost, convenience and availability of alternative modes of travel. TDM is one of the tools that municipalities are using to create more vibrant and sustainable communities. Using policies and programs to make active and sustainable transportation more convenient, a TDM approach to transportation can deliver long-term environmental sustainability, improve public health, create stronger communities, and build more prosperous and livable cities. Various TDM strategies are used to influence these factors so that the alternatives are more competitive with driving alone, thus reducing reliance on motor vehicles.

TDM strategies can be divided into two basic categories:

- Pre-occupancy: actions that can be done while a development is being designed and built, and
- Post-occupancy: actions that can be done once people are using the development.

The pre-occupancy actions are critical because they are most likely to determine how attractive, convenient and safe alternative travel will be once the site is occupied. Actions such as modifying the site plan to improve pedestrian safety and convenience or reducing the number of provided parking stalls can encourage a reduction in vehicle trips to the site. After the development is built, further strategies include transit or rideshare subsidies and providing convenient information about where and how to use these alternatives. It should be noted that the actions taken after development will not be as effective if TDM strategies are not initially implemented in the site planning stages.

## 7.1 Potential TDM Measures

#### 7.1.1 Walking

The accessibility of a development is essential in helping to ensure that those that can walk, do. Proper pedestrian connections from the community to the site should be available to ensure safety and to increase the experience of those that choose to walk.



The site plan includes provisions for sidewalks on at least one side of all internal roadways. Multi-use paths and sidewalk connections are proposed to the waterfront trail across the site's northern frontage.

To support cycling and pedestrian traffic crossing the QEW interchange, a multi-use path is proposed along the west side of Casablanca Boulevard between the North Service Road and the South Service Road. This path is proposed to be separated from vehicle traffic and will help provide cycling and pedestrian connectivity across the interchange.

To enhance the attractiveness of walking, proper lighting and weather protection should be provided at the main building entrances. The landscaping plan should consider enhancing the common amenity areas to include pedestrian amenities such as benches or seating areas.

#### 7.1.2 Cycling

To create an environment that supports pedestrian and cycling activity, the public space must be accessible, safe and comfortable to encourage movement on the street and in the surrounding areas.

Casablanca Boulevard and North Service Road are currently noted as bike routes in the Town of Grimsby's Official Plan<sup>13</sup>. In addition, the Class EA indicates that a multi-use trail will be developed on the west side of Casablanca Boulevard across the QEW interchange.

Town of Grimsby should consider developing on-street bicycle lanes across the site's North Service Road frontage to connect to the existing cycling infrastructure west of Casablanca Boulevard and to the cycling infrastructure proposed as part of the Casablanca Boulevard and GO Station EA.

Providing safe and secure bicycle storage in the first underground parking level or within the buildings on the main floor should be considered in the site design.

Short-term bicycle parking near the building entrance(s) should be provided for visitors to the site. In addition, shower and change facilities should be considered for the non-residential land uses consistent with LEED requirements. The Town of Grimsby zoning by-law<sup>14</sup> recommends the following bicycle parking rates:



<sup>&</sup>lt;sup>13</sup> Town of Grimsby Official Plan, Schedule C – Transportation and Trails, August 2018.

<sup>&</sup>lt;sup>14</sup> Town of Grimsby Zoning By-Law 14-45, May 2012.

- Apartments: 0.30 bicycle parking spaces per unit; and
- Office and Commercial: 7% of the vehicle parking spaces required.

Based on this, approximately 383 bicycle parking spaces are required for the residential land uses and 18 bicycle parking spaces for the office and commercial components of the development.

#### 7.1.3 Transit

The availability of convenient and desirable transit options can reduce the number of personal automobile trips. As previously noted, there is no local transit service provided in the Town of Grimsby. A GO Transit bus station is located at near the Casablanca Boulevard intersection with the South Service Road. Information about GO transit services could be provided within the main lobbies for all buildings on-site.

A Shuttle service between the future GO Transit Station and/or other high demand centres in the Town of Grimsby could be considered by the site operator.

#### 7.1.4 Parking Management

Managing parking supply helps to reduce the undesirable impacts of parking demand on local and regional traffic levels and can result in positive impacts on community livability and design.

To encourage residents to use sustainable travel modes, the development could consider selling parking spaces separately from the cost of a unit. This is more equitable and efficient since occupants are not forced to pay for parking they do not need and allows consumers to adjust their parking supply to reflect their needs. This is an important factor that supports reducing the parking supply as residents are notified at the onset of the project that parking will be provided on a limited basis as an additional cost in lieu of the price to purchase a unit. If residents are unwilling to change their travel behaviour, they will not purchase a unit.

If the number of parking spaces is reduced, caution should be given to providing adequate accessibility to other transportation modes. Additional provisions should be made, such as providing suitable bike parking, providing suitable access to transit service, and enhancing pedestrian and bike connections to ensure that other modes of transportation are readily accessible.

The development should consider the use of shared parking for residential visitors, office and commercial user groups. Shared parking



allows parking spaces to be used more efficiently as different user groups have different utilization patterns.

#### 7.1.5 Carpooling and Carshare

Ride-share involves two or more people sharing a vehicle for a trip. The cost of the journey (fuel, tolls, parking, etc.) can be split between the driver and passengers, resulting in savings for all concerned. This also reduces the number of vehicle trips and parking demands.

There are several tools available such as Carpool World, which set up online ride sharing databases. These databases enable people to enter their daily journey so that the database can automatically search out coworkers whose journeys match. A less formal option would be installing notice boards in the lobby of the buildings for residents who may organize informal carpools.

Car sharing is used as a means of reducing automobile dependence by providing access to a car on an as-need basis and reducing the need to own a vehicle. The provision of secured car-share spaces in private lots can result in a reduction in residential parking requirements. Car-share appeals to a broad range of households from young urban professionals to families who want a lifestyle that is not tied to owning and maintaining a private vehicle. It also attracts those that want to retain the option to drive for non-work trip purposes.

#### 7.1.6 Travel Planning

The following measures could be implemented to inform residents of existing transit and active transportation opportunities and encourage their usage:

- Ensuring up-to-date bus routes and maps are available within the lobbies of the buildings and providing information on next available bus, cost of trip and where to purchase passes;
- Helping residents in signing up for and arranging carpool services; and
- Highlight TDM elements in marketing materials: proximity to Go transit, cycling facilities, carshare/bikeshare facilities, etc.

The above TDM measures can assist in further mitigating the site's impact on the adjacent road network, promote a strong and vibrant economy, and create a livable community that has a balanced transportation network that accommodates all modes of transportation.



#### 7.2 TDM Summary

In summary, the following TDM measures are appropriate for the proposed development:

- Provision of safe and attractive pedestrian connections to existing and new pedestrian facilities (sidewalks/multi-use trail);
- Consideration be given to the installation of additional lighting, benching and weather protection at entrances on the subject site to promote walking;
- Bicycle parking be provided on site per the Town of Grimsby zoning by-law requirements;
- End of trip change facilities (locker room/changeroom and showers) be considered for the non-residential land uses consistent with LEED requirements;
- Rent/sell parking spaces separate to the cost of the unit to reduce the number of parking spaces that are not needed;
- Shuttles service between the future GO Station and/or other high demand centres may be considered by the site operator.
- Consideration be given to provide on-site car-share spaces or nearby car-share vehicles; and
- Providing travel planning resources including signage and assistance.



## 8 **Conclusions and Recommendations**

### 8.1 Conclusions

Based on the investigations carried out, it is concluded that:

- Existing Traffic Conditions: All study area intersections are operating at acceptable levels of service;
- Background Traffic Conditions: All study area intersections are forecast to operate with acceptable levels of service;
- Development Generated Traffic: The subject site is forecast to generate approximately 600 new vehicle trips during the AM peak hour and approximately 644 new vehicle trips during the PM peak hour;
- Total Traffic Conditions: All study area intersections are forecast to operate with acceptable levels of service.

From a capacity perspective, four full move driveways to the North Service Road are not viewed as necessary to support the site generated traffic. Two of the driveway connections should be designed to function as right-in/right-out driveways.

- Remedial Measures: Auxiliary left-turn lanes with 25-metres of storage are warranted at the North Service Road intersection with the Winston Road driveway and at the proposed Driveway B intersection.
- Transportation Demand Management: to encourage sustainable travel choices TDM measures be reviewed at the Site Plan Approval stage.

### 8.2 **Recommendations**

Based on the findings of this study, it is recommended that:

- Auxiliary left-turn lanes with 25-metres of storage be developed at the North Service Road intersection with the Winston Road driveway and at the proposed Driveway B intersection.
- Site Driveway A and Driveway C be restricted to right-in/rightout connections. Left-turn restrictions should be enforced by raised centre medians on the North Service Road.
- All site driveways operate under stop control for the driveway approach to the North Service Road.



- To encourage sustainable travel choices TDM measures should be incorporated into the overall development design and program.
- The final site design and layout be addressed at the Site Plan Approval stage.
- The Town of Grimsby should consider developing on-street bicycle lanes across the site's North Service Road frontage to connect to the existing cycling infrastructure west of Casablanca Boulevard and to the cycling infrastructure proposed as part of the Casablanca Boulevard and GO Station EA.
- Due to the increasing urbanization of the North Service Road corridor, the Town of Grimsby consider lowering the posted speed limit on the North Service Road across the site's frontage to 50 km/h.



## **Appendix A**

**Town Comments** 





# Memorandum

Date:	April 11, 2019
То:	Losani Homes
From:	Bob LeRoux P.Eng. Michael Palomba C.E.T.
CC:	Paradigm Ltd MHBC Planning Ltd
Subject:	Fifth Wheel Redevelopment Site Traffic and Parking Study Comments

### Introduction

The Town of Grimsby's Public Works staff have completed a review of the submitted Traffic Impact Study Brief and Parking Study for the Fifth Wheel Development site. In addition to the staff review, the Town retained CIMA+ to conduct a peer review of both reports to provide further insight. Based on the review of the submitted documents, Town staff have compiled their comments and recommendations for your information.

## Traffic Impact Study Brief Review:

After review of the *Traffic Impact Study Brief* completed by Paradigm Ltd, Town staff have determined that the brief cannot be approved at this time. Due to the size of the proposed development, a comprehensive transportation impact study (TIS) is required in order to assess the future impacts of the site on the Town of Grimsby's transportation network. Based on the submission type, there are a number of outstanding items that have not been provided but are required in order to move forward with the development application. A complete transportation impact study (TIS) will need to be completed in order to provide the required outstanding information. Below is a list of comments and recommendations from the initial review:

- Town staff are in agreement with a number of the findings are recommendations that are outlined in the traffic brief such as;
  - Requirement of a secondary access for emergency services at the east end of the development site;
  - Redesign of site accesses in order to provide proper clear throat distances to improve site operations;
  - Location of underground parking ramps will need to be reconsidered in order to provide proper sight distances and prevent operational issues;



- Consideration of Driveway A and C turning restrictions (right-in, right-out operation) in order to provide appropriate left turning lanes along North Service Road;
- Additional justification will be required in order to consider the reduction of the proposed parking supply.
- In order to complete the traffic submission requirements, revise the report in accordance with the format recommended within the Niagara Region TIS Guidelines;
- Revise the footnote provided on Page 1 of the report to reference the correct version of the ITE Trip Generation Manual;
- Provide further clarification or justification as to why the average rate was selected for the Shopping Center (820 Land Use Code) land use type compared to the regression equation;
- Provide clarification as to how the internal trip capture was determined using NCHRP Report 684 and TTS modal split data for the Town of Grimsby. Include calculations within the appendices of the report;
- Results of the transportation analysis and the parameters utilized must comply with the Niagara Region TIS guidelines. Clarify details regarding signal timing and optimizations considered at the intersection of Casablanca Boulevard & North Service Road/Winston Road;
- Additional information should be provided regarding existing traffic volumes and operations;
- Provide clarification of future traffic volume details considered from the CIMA+ report within the future traffic volume assumptions;
- The traffic impact brief should utilize the latest report completed by CIMA+, which estimates traffic volume generated for the surrounding area. It would be beneficial to conduct current turning movement counts at the intersection of Casablanca Boulevard & North Service Road/Winston Road in order to establish a comparison to assumptions developed by CIMA+; and
- Provide clarification as to how the pass-by trip volumes were applied to specific turning movements within the study area during the PM peak hour;
- Considerations will need to be made as to the possibility of site-generated traffic being attracted eastbound along the North Service Road towards Olive St and Christie St.



### **Parking Study Review:**

Town of Grimsby Public works staff reviewed the *Fifth Wheel Development Site Parking Study* submitted by MHBC Planning Ltd. and have provided the following comments for your review:

- The parking study provides a consistent approach for the potential reduction of parking requirements, however, it is not clear how the proposed 20% reduction on parking requirements for apartment dwelling units was estimated;
- The different elements considered for potential parking reduction suggest a range between 1% to 11% could be considered by Town staff, however based on existing timelines for construction it should be noted that the completed compounded effect of transit and active transportation improvements will not take place until the 2041 horizon year;
- The proposed 190 parking spaces provided in the MTO lands cannot be considered in the parking supply requirements by Town staff;
- Confirm and state any discussions with Town Staff regarding the proposed change of land use and acceptance of any development incentives;
- Confirm how the 20% reduction on parking requirements for apartment dwelling units was estimated;
- Further justification of the proposed parking reduction is required. Additional information should be provided as to the expected future parking demand, in order to evaluate the proposed parking supply.

Please review the comments and recommendations provided and contact us if there are any comments or concerns. If you would like to set up a meeting to discuss, Town staff are more than willing to get together to provide further clarification.

Sincerely,

R. LeRoux, P. Eng. Director of Public Works Michael Palomba, C.E.T. Transportation Engineering Technologist

## **Appendix B**

**Existing Traffic Operations Reports** 



Lane Group         EBT         EW         WBL         WBL         WBL           Lane Configurations         1		-	>	4	+	•	
Link Status       Link Status         Tradific Volume (vph)       39       243       103       59       162         Turn Type       NA       Perm       Perm       NA       Prot         Protected Phases       4       8       2         Permitted Phases       4       8       2         Winhum Initial (s)       5.0       5.0       5.0       5.0         Total Split (s)       28.0       28.0       28.0       28.0         Total Split (s)       4.0       4.0       4.0       4.0         AlRed Time (s)       2.0       2.0       2.0       2.0         Total Split (s)       2.0       2.0       2.0       2.0       2.0         Lead-Lag Optimize?       Recall Mode       None       None       Max         Act Effet Green (s)       11.5       11.5       11.5       2.9       8         Actad Q Ditimize?       Recall Mode       None       None       None       None       None       None       None <t< th=""><th>ane Group</th><th>FBT</th><th>FBR</th><th>WBI</th><th>WBT</th><th>NBI</th><th></th></t<>	ane Group	FBT	FBR	WBI	WBT	NBI	
abs       1	ane Configurations	*	1	*	*	M	
turne volume (vph)       39       243       103       59       162         turn Type       NA       Perm       NA       Prot         'rolected Phases       4       8       2         Permilted Phases       4       8       2         Permilted Phases       4       8       2         Permilted Phases       4       8       2         Vermilted Phases       4       8       2         Minimum Split (s)       5.0       5.0       5.0       5.0         Vial Split (s)       28.0       28.0       28.0       28.0       28.0         Vial Split (s)       2.0       2.0       2.0       2.0       2.0       2.0         Vial Los Time Adjus (s)       -2.0       -2.0       -2.0       -2.0       -2.0       -2.0         Coal Los Time Adjus (s)       -2.0       -2.0       -2.0       -2.0       -2.0       -2.0         Coal Los Time Adjus (s)       -2.0       -2.0       -2.0       -2.0       -2.0       -2.0         Coal Los Time Adjus (s)       -2.0       -2.0       -2.0       -2.0       -2.0       -2.0         Coal Los Time Adjus (s)       0.0       0.0       0.0	Fraffic Volume (vph)	39	243	103	59	162	
Turn Type       NA       Perm       Perm       Perm       NA       Perd         Vidected Phases       4       8       2         Vidected Phases       4       8       2         Vidected Phases       4       4       8       2         Vidected Phases       4       4       8       8       2         Vinimum Itilal (s)       5.0       5.0       5.0       5.0       5.0         Vinimum Spit (s)       28.0       28.0       28.0       28.0       28.0         Vial Spit (s)       46.0       4.0       4.0       4.0       4.0         Viered Time (s)       4.0       4.0       4.0       4.0       4.0         Viered Time (s)       4.0       4.0       4.0       4.0       4.0         Viered Time (s)       4.0       4.0       4.0       4.0       4.0         vead/Lag       ead-Lag Optimize?       ead-Lag Optimize?       ead-Lag Optimize?       ead-Lag Optimize?         Vecal Mode       None       None       None       Max       kte Effci Green (s)       1.1.5       11.5       11.5       2.2       2.2       2.2       2.2       2.2       2.2       2.2       2.2	Future Volume (vph)	39	243	103	59	162	
Norm       Form       Form       Form       Form         Permitted Phases       4       8       2         Permitted Phases       4       8       2         Switch Phase       4       4       8       2         Switch Phase       50       5.0       5.0       5.0       5.0         folal Split (s)       28.0       28.0       28.0       28.0       28.0         folal Split (s)       28.0       28.0       28.0       32.0       5.0       5.0         folal Split (s)       28.0       28.0       28.0       28.0       28.0       28.0         folal Split (s)       2.0       2.0       2.0       2.0       2.0       2.0       2.0         cost Time Adjust (s)       2.0       2.0       2.0       2.0       2.0       2.0       2.0         cost Time Adjust (s)       2.0	Furn Tyne	NΔ	Perm	Perm	NΔ	Prot	
Normality     Image     Image       Velector Phase     4     8     8       Velector Phase     28.0     28.0     28.0       Velector Phase     46.7%     46.7%     45.7%       Velector Phase     4.0     4.0     4.0       Velector Phase     2.0     2.0     2.0       Velector Phase     4.0     4.0     4.0       Velector Phase     4.15.1     11.5     11.5       Vetated g/C Ratio     0.23 </td <td>Protected Phases</td> <td>4</td> <td>1 Citili</td> <td>1 Cilli</td> <td>8</td> <td>2</td> <td></td>	Protected Phases	4	1 Citili	1 Cilli	8	2	
Defector Phase       4       8       8       2         Witch Phase       4       8       8       2         Witch Phase       4       8       8       2         Witch Phase       50       5.0       5.0       5.0         Vinimum Spit (s)       28.0       28.0       28.0       28.0         Total Spit (s)       46.7%       46.7%       46.7%       53.3%         Fellow Time (s)       4.0       4.0       4.0       4.0         Valk Red Time (s)       2.0       2.0       2.0       2.0         Lost Time Adjust (s)       -2.0       -2.0       -2.0       -2.0         Colal Lost Time (s)       4.0       4.0       4.0       4.0         Lead-Lag Optimize?       Recall Mode       None       None       Max         Vact Effed Green (s)       11.5       11.5       11.5       2.8         Control Delay       14.4       5.8       18.7       15.0       5.2         Dueue Delay       0.0       0.0       0.0       0.0       0.0         Otal Delay       14.4       5.8       15.0       5.2       0.0         OS       B       A       B	Pormitted Phases		4	8	0	2	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	otoctor Dhaso	4	4	0	0	2	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Switch Phase	4	4	0	0	2	
Annument numer (a)     3.0     3.0     3.0     3.0     3.0       Total Split (s)     28.0     28.0     28.0     28.0       Total Split (s)     28.0     28.0     28.0     28.0       Total Split (s)     46.7%     46.7%     46.7%     46.7%       Vil-Red Time (s)     4.0     4.0     4.0     4.0       Vil-Red Time (s)     2.0     2.0     2.0     2.0       cost Time Adjust (s)     -2.0     -2.0     -2.0     -2.0       cad/Lag	linimum Initial (c)	5.0	5.0	5.0	5.0	5.0	
minimum spin (s)       28.0       28.0       28.0       28.0       28.0         fotal Split (%)       46.7%       46.7%       46.7%       46.7%       53.3%         folal Split (%)       40       4.0       4.0       4.0         soft Time (s)       2.0       2.0       2.0       2.0         cost Time Adjust (s)       2.0       4.0       4.0       4.0         ead-Lag Optimize?       Recall Mode       None       None       Max         vkt Effct Green (s)       11.5       11.5       11.5       29.8         vctuated g/C Ratio       0.23       0.23       0.23       0.60         v(c Ratio       0.12       0.49       0.38       0.17       0.26         Control Delay       14.4       5.8       18.7       15.0       5.2         Jueue Delay       0.0       0.0       0.0       0.0       0.0         Jorda Delay       7.0       17.3       5.2       0.2 <td>Jinimum Split (s)</td> <td>20.0</td> <td>20 0</td> <td>20 0</td> <td>28.0</td> <td>20.0</td> <td></td>	Jinimum Split (s)	20.0	20 0	20 0	28.0	20.0	
Unit Synt (s)       20.0       20.0       20.0       52.0         Unit Split (s)       46.7%       46.7%       53.3%         fellow Time (s)       2.0       2.0       2.0       2.0         usin Edition (s)       2.0       2.0       2.0       2.0         otal Split (s)       -2.0       -2.0       -2.0       -2.0         otal Lost Time (s)       4.0       4.0       4.0       4.0         ead-Lag Optimize?       -2.0       -2.0       -2.0       -2.0         ecal Mode       None       None       Max       -2.3       0.23       0.23       0.23       0.60         /cc Ratio       0.12       0.49       0.38       0.17       0.26	Total Split (s)	20.0	20.0	20.0	20.0	20.0	
Udd Jplin (v)       40,7%       40,7%       40,7%       53.3%         Vilk Red Time (s)       4.0       4.0       4.0       4.0         Vilk Red Time (s)       2.0       2.0       2.0       2.0         Jolal Lost Time (s)       4.0       4.0       4.0       4.0         Vilk Red Time (s)       4.0       4.0       4.0       4.0         Vilk Red Time (s)       4.0       4.0       4.0       4.0         ead/Lag       ead/Lag       ead/Lag       ead/Lag       ead/Lag         eead/Lag       0       1.5       11.5       11.5       11.5         Ketuated g/C Ratio       0.23       0.23       0.23       0.60	otal Split (S)	20.0	20.0	20.0	20.0	32.U	
removinitie (s)       4.0       4.0       4.0       4.0         WRed Time (s)       2.0       2.0       2.0       2.0         .ost Time Adjust (s)       -2.0       -2.0       -2.0       -2.0         .ead/Lag       .ead/Lag       .ead/Lag       .ead/Lag       .ead/Lag         .ead/Lag       .ead/Lag       .ead/Lag       .ead/Lag       .ead/Lag         Recall Mode       None       None       None       Max         Valueted g/C Ratio       0.23       0.23       0.23       0.60         /c Ratio       0.12       0.49       0.38       0.17       0.26         Control Delay       14.4       5.8       18.7       15.0       5.2         Dueue Delay       0.0       0.0       0.0       0.0       0.0         OS       B       A       B       A       Network       Network         Approach LOS       A       B       A       B       A       Network       Network         Cycle Length: 60       .ctuated Cycle Length: 49.4       .daximum v/C Ratio: 0.49       .daximum v/C Ratio:	(ollow Time (o)	40.7%	40.7%	40.7%	40.7%	JJ.370	
varies       2.0       2.0       2.0       2.0       2.0         cost Time Adjust (s)       2.0       2.0       2.0       2.0       2.0         folal Lost Time (s)       4.0       4.0       4.0       4.0       4.0         ead-Lag Optimize?       execall Mode       None       None       Max         Act Effet Green (s)       11.5       11.5       11.5       2.8         Act Effet Green (s)       0.12       0.49       0.38       0.17       0.26         Control Delay       14.4       5.8       18.7       15.0       5.2         Dueue Delay       0.0       0.0       0.0       0.0       0.0         folal Delay       14.4       5.8       18.7       15.0       5.2         Dueue Delay       0.0       0.0       0.0       0.0       0.0         fola Delay       7.0       17.3       5.2       0.23       0.24 <t< td=""><td>reliuw Time (S)</td><td>4.0</td><td>4.0</td><td>4.0</td><td>4.0</td><td>4.0</td><td></td></t<>	reliuw Time (S)	4.0	4.0	4.0	4.0	4.0	
Ost Imme Adjust (s)       -2.0       -2.0       -2.0       -2.0         Iotal Lost Time (s)       4.0       4.0       4.0       4.0         e.ead/Lag	All-Reu Time (S)	2.0	2.0	2.0	2.0	2.0	
Otal LOS 1 Ime (S)       4.0       4.0       4.0       4.0         ead/Lag       cead/Lag       cead/Lag       cead/Lag         ead/Lag       Qptimize?       Secal Mode       None       None       None         Vact Effic Green (S)       11.5       11.5       11.5       29.8         Actuated g/C Ratio       0.23       0.23       0.23       0.60         //c Ratio       0.12       0.49       0.38       0.17       0.26         Control Delay       14.4       5.8       18.7       15.0       5.2         Dueue Delay       14.4       5.8       18.7       15.0       5.2         .OS       B       A       B       A       A       A         .OS       B       A       B       A       A       A         .OS       A       B       A       A       A       A         .OS       A       B       A       A       A       A       A         .OS       A       B       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A       A <t< td=""><td>Lost Time Adjust (s)</td><td>-2.0</td><td>-2.0</td><td>-2.0</td><td>-2.0</td><td>-2.0</td><td></td></t<>	Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	
ead-Lag Optimize? ead-Lag Optim	otal Lost Time (s)	4.0	4.0	4.0	4.0	4.0	
Lead-Is Optimizer     None     None     None     Max       Vact Effct Green (s)     11.5     11.5     11.5     29.8       Act Effct Green (s)     0.12     0.23     0.23     0.23     0.60       //c Ratio     0.12     0.49     0.38     0.17     0.26       Control Delay     14.4     5.8     18.7     15.0     5.2       Dueue Delay     0.0     0.0     0.0     0.0       OS     B     A     B     B       Approach Delay     7.0     17.3     5.2       OS     A     B     A       Netresction Summary     2/202     2/202     2/202       Cycle Length: 40.4     4.4     5.8     18.7       Variantian Cycle: 60     5/2     5/2       Control Type: Semi Act-Uncoord     4/202     4/202       Aaximum v/c Ratio: 0.49     Intersection LOS: A     1       Intersection Signal Delay: 8.9     Intersection LOS: A     1       Intersection Capacity Utilization 33.5%     ICU Level of Service A       Analysis Period (min) 15     5/2     2/2	_ead/Lag						
Vecal Mode         None         None         None         Max           Act Effect Green (s)         11.5         11.5         11.5         11.5         29.8           Act Lated g/C Ratio         0.23         0.23         0.23         0.60           v/c Ratio         0.12         0.49         0.38         0.17         0.26           Control Delay         14.4         5.8         18.7         15.0         5.2           Dueue Delay         0.0         0.0         0.0         0.0         0.0           Total Delay         14.4         5.8         18.7         15.0         5.2           .OS         B         A         B         A         A         A           Approach LOS         A         B         A         A         B         A           Vole Length: 60         Actuated Cycle Length: 49.4         Valural Cycle: 60         Vole Length: 49.4	_ead-Lag Optimize?						
VCL EffC Green (S)       11.5       11.5       11.5       29.8         Actuated g/C Ratio       0.23       0.23       0.23       0.60         //c Ratio       0.12       0.49       0.38       0.17       0.26         Control Delay       14.4       5.8       18.7       15.0       5.2         Dueue Delay       0.0       0.0       0.0       0.0       0.0         Colal Delay       14.4       5.8       18.7       15.0       5.2         LOS       B       A       B       B       A         Approach Delay       7.0       17.3       5.2         LoS       A       B       A       A         Approach LOS       A       B       A       A         Vegle Length: 60       Cottuated Cycle Length: 49.4       Vatural Cycle: 60       Cottuated Cycle: 60         Control Type: Semi Act-Uncoord       Vaximum v/c Ratio: 0.49       Intersection LOS: A       Intersection LOS: A         Intersection Signal Delay: 8.9       Intersection LOS: A       Intersection LOS: A       Analysis Period (min) 15         Splits and Phases:       1: Casablanca Boulevard & North Service Road       Image: Page 4       28 s	Recall Mode	None	None	None	None	Max	
Actuated g/C Katio 0.23 0.23 0.23 0.23 0.60 // C Ratio 0.12 0.49 0.38 0.17 0.26 Control Delay 14.4 5.8 18.7 15.0 5.2 Dueue Delay 0.0 0.0 0.0 0.0 0.0 Total Delay 14.4 5.8 18.7 15.0 5.2 OS B A B B A Approach Delay 7.0 17.3 5.2 Approach LOS A B A htersection Summary Cycle Length: 49.4 Vatural Cycle : 60 Control Type: Semi Act-Uncoord Waximum v/c Ratio: 0.49 Intersection Signal Delay: 8.9 Intersection LOS: A ntersection Signal Delay: 8.9 Intersection LOS: A ntersection Capacity Utilization 33.5% ICU Level of Service A Analysis Period (min) 15 Splits and Phases: 1: Casablanca Boulevard & North Service Road 28 2 28	Act Effet Green (s)	11.5	11.5	11.5	11.5	29.8	
vic Ratio       0.12       0.49       0.38       0.17       0.26         Control Delay       14.4       5.8       18.7       15.0       5.2         Jueue Delay       0.0       0.0       0.0       0.0       0.0         Total Delay       14.4       5.8       18.7       15.0       5.2         Jueue Delay       0.0       0.0       0.0       0.0       0.0         Total Delay       14.4       5.8       18.7       15.0       5.2         JOS       B       A       B       B       A         Approach Delay       7.0       17.3       5.2         Approach LOS       A       B       A         Intersection Summary       Intersection Summary       Intersection Summary         Cycle Length: 60       Actuated Cycle: 60       Intersection LOS: A         Control Type: Semi Act-Uncoord       Maximum vic Ratio: 0.49       Intersection LOS: A         Intersection Signal Delay: 8.9       Intersection LOS: A         Intersection Capacity Utilization 33.5%       ICU Level of Service A         Analysis Period (min) 15       Splits and Phases:       1: Casablanca Boulevard & North Service Road         Age       Image       Image       Image	Actuated g/C Ratio	0.23	0.23	0.23	0.23	0.60	
Control Delay       14.4       5.8       18.7       15.0       5.2         Dueue Delay       0.0       0.0       0.0       0.0       0.0         Ofal Delay       14.4       5.8       18.7       15.0       5.2         .OS       B       A       B       B       A         Approach Delay       7.0       17.3       5.2         Approach LOS       A       B       A         Intersection Summary	//c Ratio	0.12	0.49	0.38	0.17	0.26	
Jueue Delay       0.0       0.0       0.0       0.0         Total Delay       14.4       5.8       18.7       15.0       5.2         OS       B       A       B       B       A         Approach Delay       7.0       17.3       5.2         Approach LOS       A       B       A         Intersection Summary       Executive of Cycle Length: 49.4         Vatural Cycle: 60       Control Type: Semi Act-Uncoord         Aximum v/c Ratio: 0.49       Intersection LOS: A         Intersection Signal Delay: 8.9       Intersection LOS: A         Analysis Period (min) 15       Splits and Phases: 1: Casablanca Boulevard & North Service Road         Image: 2       28 s	Control Delay	14.4	5.8	18.7	15.0	5.2	
total Delay       14.4       5.8       18.7       15.0       5.2         .OS       B       A       B       A       Image: Second	Queue Delay	0.0	0.0	0.0	0.0	0.0	
LOS     B     A     B     B     A       Approach Delay     7.0     17.3     5.2       Approach Delay     8     A     B     A       Intersection Summary     Delay     Example     Example       Control Type: Semi Act-Uncoord     Jaximum Vic Ratio: 0.49     Intersection LOS: A       Intersection Signal Delay: 8.9     Intersection LOS: A       Intersection Capacity Utilization 33.5%     ICU Level of Service A       Analysis Period (min) 15     Splits and Phases:     1: Casablanca Boulevard & North Service Road       Apple     Pol4       Star     28 s	fotal Delay	14.4	5.8	18.7	15.0	5.2	
Approach Delay       7.0       17.3       5.2         Approach LOS       A       B       A         Intersection Summary	_OS	В	A	В	В	A	
A     B     A       httpspection     Summary       Cycle Length: 60     Summary       Cycle Length: 49.4     Summary       Vatural Cycle: 60     Summary       Control Type: Semi Act-Uncoord     Summary (c Ratio: 0.49)       Intersection Signal Delay: 8.9     Intersection LOS: A       Intersection Capacity Utilization 33.5%     ICU Level of Service A       Analysis Period (min) 15     Splits and Phases: 1: Casablanca Boulevard & North Service Road       Image: 2012 Service Service     Service Road	Approach Delay	7.0			17.3	5.2	
Intersection Summary         Sycle Length: 60         Sycle Length: 49.4         Latural Cycle: 60         Control Type: Semi Act-Uncoord         Maximum v/c Ratio: 0.49         Intersection Capacity Utilization 33.5%         ICU Level of Service A         Inalysis Period (min) 15         Splits and Phases:         1: Casablanca Boulevard & North Service Road         Image: 201         Image: 20	pproach LOS	A			В	A	
Cycle Length: 60         Cycluated Cycle: 60         Sontrol Type: Semi Act-Uncoord         Maximum v/c Ratio: 0.49         Intersection Signal Delay: 8.9         Intersection Capacity Utilization 33.5%         ICU Level of Service A         Inalysis Period (min) 15         jplits and Phases:         1: Casablanca Boulevard & North Service Road         1/2         1/2         1/2         1/2	ntersection Summary						
Analysis Period (min) 15 Splits and Phases: 1: Casablanca Boulevard & North Service Road Splits and Phases: 1: Casablanca Boulevard & North Service Road 28 Splits and Phases: 2	Cycle Length: 60 Actuated Cycle Length: 4 Natural Cycle: 60	9.4					
ntersection Signal Delay: 8.9 Intersection LOS: A ntersection Capacity Utilization 33.5% ICU Level of Service A Analysis Period (min) 15 Splits and Phases: 1: Casablanca Boulevard & North Service Road	Control Type: Semi Act-U Maximum v/c Ratio: 0.49	ncoord					
ICU Level of Service A       Analysis Period (min) 15       Splits and Phases:       1: Casablanca Boulevard & North Service Road       Image: splits and Phases:       1: Casablanca Boulevard & North Service Road       Image: splits and Phases:       1: Casablanca Boulevard & North Service Road       Image: splits and Phases:       1: Casablanca Boulevard & North Service Road       Image: splits and Phases:       1: Casablanca Boulevard & North Service Road       Image: splits and Phases:       1: Casablanca Boulevard & North Service Road       Image: splits and Phases:       1: Casablanca Boulevard & North Service Road       Image: splits and Phases:       1: Casablanca Boulevard & North Service Road	ntersection Signal Delay:	8.9			Ir	ntersectior	LOS: A
Analysis Period (min) 15 Splits and Phases: 1: Casablanca Boulevard & North Service Road \$\vee \vee 2 \$2 \$\vee 4 \$2	ntersection Capacity Utili	zation 33.5%			10	CU Level o	of Service A
Splits and Phases: 1: Casablanca Boulevard & North Service Road	Analysis Period (min) 15						
02 32 s 28 s 28 s	Splits and Phases: 1: C	asablanca B	oulevard	& North S	Service R	oad	
22s 28s	<b>1</b> @2						724
	102 32 s					5	דשיי פ
						-	

Synchro 9 Report

Queues 1: Casablanca Bou	levard &	k North	ו Servi	ice Ro	ad	Existing Al 1905
	-	$\mathbf{r}$	4	+	•	
Lane Group	EBT	EBR	WBL	WBT	NBL	
Lane Group Flow (vph)	42	264	112	64	246	
v/c Ratio	0.12	0.49	0.38	0.17	0.26	
Control Delay	14.4	5.8	18.7	15.0	5.2	
Queue Delay	0.0	0.0	0.0	0.0	0.0	
Total Delay	14.4	5.8	18.7	15.0	5.2	
Queue Length 50th (m)	2.9	0.0	8.2	4.5	6.8	
Queue Length 95th (m)	8.5	13.2	18.8	11.7	19.1	
Internal Link Dist (m)	120.4			206.5	218.5	
Turn Bay Length (m)		60.0	160.0			
Base Capacity (vph)	741	845	622	775	957	
Starvation Cap Reductn	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	
Reduced v/c Ratio	0.06	0.31	0.18	0.08	0.26	
Intersection Summary						

Paradigm Transportation Solutions Limited

Synchro 9 Report

Novement .ane Configurations Irraffic Volume (vph) uture Volume (vph) deal Flow (vphpl) folal Lost time (s) .ane Util. Factor Fit It Protected Satd. Flow (prot) Til Permitted Satd. Flow (perm) Peak-hour factor, PHF Adj. Flow (vph) TOR Reduction (vph) .ane Group Flow (vph) Heavy Vehicles (%) Furm Type Torlected Phases	► EBT ↑ 39 39 1750 4.0 1.00 1.00 1.00 1522 1.00 1522	EBR 243 243 1750 4.0 1.00 0.85 1.00	WBL 103 103 1750 4.0	← WBT ↑ 59 59 1750	NBL ¥ 162	NBR		
Movement ane Configurations Traffic Volume (vph) Uture Volume (vph) deal Flow (vph) Total Lost time (s) ane Util. Factor Trt Tit Protected Satd. Flow (prot) "It Permitted Satd. Flow (perm) Peak-hour factor, PHF Adj. Flow (vph) ane Group Flow (vph) teavy Vehicles (%) Furm Type Trotected Phases	EBT 39 39 1750 4.0 1.00 1.00 1.00 1522 1.00 1522	EBR 243 243 1750 4.0 1.00 0.85 1.00	WBL 103 103 1750 4.0 1.00	WBT 59 59 1750	NBL 162	NBR		
ane Configurations Traffic Volume (vph) Uture Volume (vph) deal Flow (vphpt) Total Lost time (s) ane Util. Factor Trt It Protected Satd. Flow (prot) Tit Permitted Satd. Flow (perm) Peak-hour factor, PHF Adj. Flow (vph) Lane Group Flow (vph) How (vph) Utor Type Trotected Phases	↑ 39 39 1750 4.0 1.00 1.00 1.00 1522 1.00 1522	243 243 1750 4.0 1.00 0.85 1.00	103 103 1750 4.0 1.00	∲ 59 59 1750	¥ 162			
Iraffic Volume (vph) 'uture Volume (vph) deal Flow (vphpl) fotal Lost time (s) .ane Util. Factor 'ft Protected Sald. Flow (port) 'it Permitted Sald. Flow (perm) 'Peak-hour factor, PHF Adj. Flow (vph) RTOR Reduction (vph) .ane Group Flow (vph) Heavy Vehicles (%) Furm Type Tordected Phases	39 39 1750 4.0 1.00 1.00 1.00 1522 1.00 1522	243 243 1750 4.0 1.00 0.85 1.00	103 103 1750 4.0	59 59 1750	162			
Juture Volume (vph) deal Flow (vphpl) Total Lost time (s) a.ane Util. Factor rit It Protected satd. Flow (prot) satd. Flow (prot) Peak-hour factor, PHF vdj. Flow (vph) TOR Reduction (vph) a.ane Group Flow (vph) teavy Vehicles (%) Turn Type Totected Phases	39 1750 4.0 1.00 1.00 1.00 1522 1.00 1522	243 1750 4.0 1.00 0.85 1.00	103 1750 4.0	59 1750		64		
deal Flow (vphpt) total Lost time (s) ane Util. Factor rt It Protected Sadd. Flow (prot) til Pernitted Sadd. Flow (perm) Peak-hour factor, PHF ddj. Flow (vph) TOR Reduction (vph) ane Group Flow (vph) leavy Vehicles (%) um Type Totolected Phases	1750 4.0 1.00 1.00 1.00 1522 1.00 1522	1750 4.0 1.00 0.85 1.00	1750 4.0	1750	162	64		
total Lost time (s) ane Util. Factor it it Protected add. Flow (prot) 'eak-hour factor, PHF 'eak-hour factor, PHF 'eak-hour factor, PHF 'tOR Reduction (vph) ane Group Flow (vph) leavy Vehicles (%) 'um Type Totected Phases	4.0 1.00 1.00 1.00 1522 1.00 1522	4.0 1.00 0.85 1.00	4.0		1750	1750		
ane Util. Factor if I it Protected Satd. Flow (prot) it Permitted Satd. Flow (perm) Peak-hour factor, PHF Peak-hour factor, PHF Peak-hour factor, PHF Add, Flow (vph) ATOR Reduction (vph) Ator Reduction (vph) Heavy Vehicles (%) Turn Type Totected Phases	1.00 1.00 1.00 1522 1.00 1522	1.00 0.85 1.00	1.00	4.0	4.0			
rt it Protected stad. Flow (prot) it Permitted stad. Flow (perm) Peak-hour factor, PHF ddj. Flow (vph) (J. Flow (vph) ane Group Flow (vph) teavy Vehicles (%) 'um Type Totected Phases	1.00 1.00 1522 1.00 1522	0.85 1.00	1.00	1.00	1.00			
It Protected said. Flow (prot) at Permitted said. Flow (perm) Peak-hour factor, PHF dij. Flow (vph) TIOR Reduction (vph) ane Group Flow (vph) leavy Vehicles (%) um Type rotected Phases	1.00 1522 1.00 1522	1.00	1.00	1.00	0.96			
sald. Flow (prot) ilt Permitted Sald. Flow (perm) 'eak-hour factor, PHF 'eak-hour factor, PHF 'eak-hour factor, PHF 'eak-hour factor, PHF tack, Flow (vph) ane Group Flow (vph) tack (	1522 1.00 1522		0.95	1.00	0.97			
It Permitted Satd. Flow (perm) Peak-hour factor, PHF Peak-hour factor, PHF NOR Reduction (vph) ATOR Reduction (vph) eavy Vehicles (%) um Type Totected Phases	1.00	1458	1662	1591	1556			
Sald. Flow (perm) Peak-hour factor, PHF vdj. Flow (vph) TIOR Reduction (vph) ane Group Flow (vph) teavy Vehicles (%) um Type rotected Phases	1522	1.00	0.73	1.00	0.97			
Peak-hour factor, PHF kdj. Flow (vph) RTOR Reduction (vph) .ane Group Flow (vph) leavy Vehicles (%) furn Type Protected Phases		1458	1277	1591	1556			
Adj. Flow (vph) TTOR Reduction (vph) .ane Group Flow (vph) leavy Vehicles (%) Tym Type Protected Phases	0.92	0.92	0.92	0.92	0.92	0.92		
RTOR Reduction (vph) ane Group Flow (vph) Heavy Vehicles (%) Furn Type Protected Phases	42	264	112	64	176	70		
ane Group Flow (vph) leavy Vehicles (%) Turn Type Protected Phases	0	202	0	0	18	0		
leavy Vehicles (%) Furn Type Protected Phases	42	62	112	64	228	0		
urn Type Protected Phases	15%	2%	0%	10%	5%	3%		
Protected Phases	NA	Perm	Perm	NA	Prot			
	4			8	2			
Permitted Phases		4	8					
ctuated Green, G (s)	9.5	9.5	9.5	9.5	27.8			
Effective Green, g (s)	11.5	11.5	11.5	11.5	29.8			
Actuated g/C Ratio	0.23	0.23	0.23	0.23	0.60			
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0			
/ehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			
ane Grp Cap (vph)	355	340	297	371	940			
/s Ratio Prot	0.03			0.04	c0.15			
/s Ratio Perm		0.04	c0.09					
/c Ratio	0.12	0.18	0.38	0.17	0.24			
Jniform Delay, d1	14.9	15.1	15.9	15.1	4.5			
Progression Factor	1.00	1.00	1.00	1.00	1.00			
ncremental Delay, d2	0.1	0.3	0.8	0.2	0.6			
Delay (s)	15.1	15.4	16.7	15.3	5.1			
evel of Service	В	В	В	В	A			
pproach Delay (s)	15.3			16.2	5.1			
Approach LOS	В			В	A			
ntersection Summary								
ICM 2000 Control Delay			12.1	Н	CM 2000	Level of Service	В	
ICM 2000 Volume to Capacity r	00 Volume to Capacity ratio 0.2							
ctuated Cycle Length (s)	ed Cycle Length (s) 49			S	um of lost	time (s)	8.0	
ersection Capacity Utilization			33.5%	IC	U Level o	of Service	٨	

Synchro 9 Report

1. Oucubiariou Bo	ulevalu		10010		au	
	-	$\mathbf{r}$	4	+	1	
Lane Group	EBT	EBR	WBL	WBT	NBL	
Lane Configurations	1	1	<u>۲</u>	•	- M	
Traffic Volume (vph)	66	254	67	40	294	
Future Volume (vph)	66	254	67	40	294	
Turn Type	NA	Perm	Perm	NA	Prot	
Protected Phases	4			8	2	
Permitted Phases		4	8			
Detector Phase	4	4	8	8	2	
Switch Phase						
Vinimum Initial (s)	5.0	5.0	5.0	5.0	5.0	
Vinimum Split (s)	28.0	28.0	28.0	28.0	28.0	
Total Split (s)	28.0	28.0	28.0	28.0	32.0	
Total Split (%)	46.7%	46.7%	46.7%	46.7%	53.3%	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None	None	None	Max	
Act Effct Green (s)	10.4	10.4	10.4	10.4	29.8	
Actuated g/C Ratio	0.22	0.22	0.22	0.22	0.62	
//c Ratio	0.20	0.52	0.27	0.11	0.43	
Control Delay	15.7	6.5	17.5	14.7	6.5	
Queue Delay	0.0	0.0	0.0	0.0	0.0	
Total Delay	15.7	6.5	17.5	14.7	6.5	
LOS	В	А	В	В	А	
Approach Delay	8.4			16.5	6.5	
Approach LOS	А			В	А	
ntersection Summary						
Cycle Length: 60						
Actuated Cycle Length: 48	8.2					
Vatural Cycle: 60						
Control Type: Semi Act-U	ncoord					
Vaximum v/c Ratio: 0.52						
ntersection Signal Delay:	8.5			Ir	ntersection	n LOS: A
ntersection Canacity Litili	zation 12.5%			10		of Sonvico A

Splits and Phases: 1: Casablanca Boulevard & North Service Road

<b>↑</b> ø2	<u></u> ■ Ø4	
32 s	28 s	
	₩ Ø8	
	28 s	

Paradigm Transportation Solutions Limited

Synchro 9 Report

Queues 1: Casablanca Bou	ueues Casablanca Boulevard & North Service Road													
	-	$\mathbf{F}$	4	+	1									
Lane Group	EBT	EBR	WBL	WBT	NBL									
Lane Group Flow (vph)	72	276	73	43	443									
v/c Ratio	0.20	0.52	0.27	0.11	0.43									
Control Delay	15.7	6.5	17.5	14.7	6.5									
Queue Delay	0.0	0.0	0.0	0.0	0.0									
Total Delay	15.7	6.5	17.5	14.7	6.5									
Queue Length 50th (m)	5.0	0.0	5.2	2.9	14.2									
Queue Length 95th (m)	12.7	13.8	13.4	8.7	36.5									
Internal Link Dist (m)	120.4			206.5	218.5									
Turn Bay Length (m)		60.0	160.0											
Base Capacity (vph)	858	860	621	875	1019									
Starvation Cap Reductn	0	0	0	0	0									
Spillback Cap Reductn	0	0	0	0	0									
Storage Cap Reductn	0	0	0	0	0									
Reduced v/c Ratio	0.08	0.32	0.12	0.05	0.43									
Intersection Summary														

HCM Signalized In 1. Casablanca Bou	tersection tersection tersection tersection tersection termination termination termination tersection tersecti	Existing PN 19056					
	-		<b>1</b> 00111	<b>+</b>	<u></u>	~	
Movement	EBT	EBR	WBL	WBT	NBL	NBR	
Lane Configurations	4	1	<b>N</b>	•	M		
Traffic Volume (vph)	66	254	67	40	294	113	
Future Volume (vph)	66	254	67	40	294	113	
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		
Frt	1.00	0.85	1.00	1.00	0.96		
Flt Protected	1.00	1.00	0.95	1.00	0.97		
Satd. Flow (prot)	1716	1444	1662	1750	1621		
Flt Permitted	1.00	1.00	0.71	1.00	0.97		
Satd. Flow (perm)	1716	1444	1243	1750	1621		
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	
Adi, Flow (vph)	72	276	73	43	320	123	
RTOR Reduction (vph)	0	217	0	0	16	0	
I ane Group Flow (vph)	72	59	73	43	427	0	
Heavy Vehicles (%)	2%	3%	0%	0%	0%	1%	
Turn Type	NA	Perm	Perm	NA	Prot		
Protected Phases	4	1 onn	1 01111	8	2		
Permitted Phases		4	8	0	2		
Actuated Green G (s)	83	83	83	83	27.8		
Effective Green a (s)	10.3	10.3	10.3	10.3	29.8		
Actuated g/C Ratio	0.21	0.21	0.21	0.21	0.62		
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		
Lane Grn Can (vnh)	367	309	266	374	1004		
v/s Ratio Prot	0.04	507	200	0.02	c0.26		
v/s Patio Porm	0.04	0.04	c0.06	0.02	00.20		
v/c Ratio	0.20	0.04	0.27	0.11	0.42		
Uniform Delay, d1	15.5	15.5	15.8	15.2	4.7		
Progression Factor	1.00	1 00	1 00	1.00	1.00		
Incremental Delay, d2	0.3	0.3	0.6	0.1	1.00		
Delay (s)	15.8	15.8	16.3	15.4	6.0		
Level of Service	R	10.0 R	10.3 B	B	Δ		
Approach Delay (s)	15.8	5	5	16.0	6.0		
Approach LOS	B			B	A		
Intersection Summary							
HCM 2000 Control Delay			11.1	H	CM 2000	Level of Service	В
HCM 2000 Volume to Capa	acity ratio		0.39				
Actuated Cycle Length (s)	,		48.1	S	um of lost	time (s)	8.0
Intersection Capacity Utiliza	ation		42.5%	IC	U Level o	of Service	А
Analysis Period (min)			15				
c Critical Lane Group							

Synchro 9 Report

Paradigm Transportation Solutions Limited

Synchro 9 Report

## **Appendix C**

**Background Development Traffic Volumes** 





398 North Service Road Fifth Wheel Site, Grimsby TIS 190563

Appendix B



398 North Service Road Fifth Wheel Site, Grimsby TIS 190563

Appendix **B** 



398 North Service Road Fifth Wheel Site, Grimsby TIS 190563

Appendix **B** 

## **Appendix D**

**Background Traffic Operations Reports** 



	-	$\mathbf{r}$	1	+	•	1	
ane Group	FBT	FBR	WBI	WBT	NBI	NBR	
ane Configurations	*	1		*	8	1	
Fraffic Volume (vph)	39	243	103	59	162	64	
Future Volume (vph)	30	243	103	59	162	64	
	NΔ	Porm	Porm	NΔ	Prot	Porm	
Protoctod Phasos	1	1 CIIII	1 CIIII	8	2	1 GHH	
Pormittod Phasos	٦	4	0	0	2	2	
Petrililleu Pridses	4	4	0	0	2	2	
Switch Dhaco	4	4	8	8	2	2	
Vinimum Initial (a)	E O	E C	E C	E A	EA	E O	
viinimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	
viinimum Split (s)	28.0	28.0	28.0	28.0	28.0	28.0	
fotal Split (s)	28.0	28.0	28.0	28.0	32.0	32.0	
Fotal Split (%)	46.7%	46.7%	46.7%	46.7%	53.3%	53.3%	
rellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	
ost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	0.0	
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	6.0	
.ead/Lag							
_ead-Lag Optimize?							
Recall Mode	None	None	None	None	Мах	Max	
Act Effct Green (s)	11.5	11.5	11.5	11.5	29.8	27.8	
Actuated g/C Ratio	0.23	0.23	0.23	0.23	0.60	0.56	
Ic Ratio	0.12	0.49	0.38	0.17	0.18	0.08	
Control Delay	14.4	5.8	18.7	15.0	5.8	2.4	
	0.0	0.0	0.0	0.0	0.0	0.0	
Zueue Delay	14.4	0.0 E 0	10.0	15.0	0.0 E 0	2.4	
	14.4 D	J.0	10.7 D	13.0 D	J.0	Ζ.4	
Inproach Dolay	7.0	A	D	17.2	10	A	
ipproach LOS	7.0			17.5	4.0		
upproach LOS	A			Б	A		
ntersection Summary							
Cycle Length: 60							
Actuated Cycle Length: 49	9.4						
Vatural Cycle: 60							
Control Type: Semi Act-U	ncoord						
Aximum v/c Ratio: 0.49							
ntersection Signal Delay:	8.8			Ir	ntersectio	n LOS <sup>,</sup> A	
tersection Canacity Utiliz	zation 29.3%			10	CULevel	of Service A	4
nalysis Period (min) 15	201011 2 7.0 /0			I.	00 2000	0. 001 MCC /	•
Solits and Phases: 1.C	asahlanca R	oulevard	& North	Service P	nad		
		Gaicvalu	a north .	JOINICE IN	l		
Vø2						<b>₩</b> Ø4	
32 s					2	18 s	
					_		

Synchro 9 Report

Queues 1: Casablanca Bou	levard 8	k North	n Servi	ice Ro	ad		Background AN 19056
	-	$\mathbf{r}$	4	+	•	1	
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	
Lane Group Flow (vph)	42	264	112	64	176	70	
v/c Ratio	0.12	0.49	0.38	0.17	0.18	0.08	
Control Delay	14.4	5.8	18.7	15.0	5.8	2.4	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	14.4	5.8	18.7	15.0	5.8	2.4	
Queue Length 50th (m)	2.9	0.0	8.2	4.5	5.9	0.0	
Queue Length 95th (m)	8.5	13.2	18.8	11.7	15.9	4.6	
Internal Link Dist (m)	120.4			206.5	218.5		
Turn Bay Length (m)		60.0	160.0				
Base Capacity (vph)	741	845	622	775	956	844	
Starvation Cap Reductn	0	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	0	
Reduced v/c Ratio	0.06	0.31	0.18	0.08	0.18	0.08	
Intersection Summary							

Paradigm Transportation Solutions Limited

Synchro 9 Report

1: Casablanca Bou	levard 8	& North	n Servi	ce Ro	ad				190563
	-	$\mathbf{\hat{v}}$	4	←	1	1			
Vovement	EBT	EBR	WBL	WBT	NBL	NBR			
ane Configurations	<b>^</b>	1	٦	•	٦	1			
Fraffic Volume (vph)	39	243	103	59	162	64			
Future Volume (vph)	39	243	103	59	162	64			
deal Flow (vphpl)	1750	1750	1750	1750	1750	1750			
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	6.0			
ane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00			
rt	1.00	0.85	1.00	1.00	1.00	0.85			
It Protected	1.00	1.00	0.95	1.00	0.95	1.00			
Satd. Flow (prot)	1522	1458	1662	1591	1583	1444			
It Permitted	1.00	1.00	0.73	1.00	0.95	1.00			
Satd. Flow (perm)	1522	1458	1277	1591	1583	1444			
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92			
Adj. Flow (vph)	42	264	112	64	176	70			
RTOR Reduction (vph)	0	202	0	0	0	31			
ane Group Flow (vph)	42	62	112	64	176	39			
leavy Vehicles (%)	15%	2%	0%	10%	5%	3%			
Turn Type	NA	Perm	Perm	NA	Prot	Perm			
Protected Phases	4			8	2				
Permitted Phases		4	8			2			
Actuated Green, G (s)	9.5	9.5	9.5	9.5	27.8	27.8			
Effective Green, g (s)	11.5	11.5	11.5	11.5	29.8	27.8			
Actuated g/C Ratio	0.23	0.23	0.23	0.23	0.60	0.56			
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0			
/ehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0			
ane Grp Cap (vph)	355	340	297	371	956	814			
/s Ratio Prot	0.03			0.04	c0.11				
//s Ratio Perm		0.04	c0.09			0.03			
//c Ratio	0.12	0.18	0.38	0.17	0.18	0.05			
Jniform Delay, d1	14.9	15.1	15.9	15.1	4.3	4.8			
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00			
ncremental Delay, d2	0.1	0.3	0.8	0.2	0.4	0.1			
Delay (s)	15.1	15.4	16.7	15.3	4.8	4.9			
evel of Service	В	В	В	В	А	A			
Approach Delay (s)	15.3			16.2	4.8				
Approach LOS	В			В	A				
ntersection Summary									
ICM 2000 Control Delay			12.0	Н	CM 2000	Level of Service		В	
ICM 2000 Volume to Capa	icity ratio		0.24						
Actuated Cycle Length (s)	Jated Cycle Length (s)		49.3	S	um of los	t time (s)	8	.0	
tersection Capacity Utilization			29.3%	10	CU Level	of Service		A	
nalysis Period (min)			15						
Critical Lane Group									

Synchro 9 Report

	<b>→</b>	$\mathbf{r}$	4	-	•	*	
l ane Group	FBT	FBR	WBI	WBT	NBI	NBR	
Lane Configurations		1	*	*	5	1	
Traffic Volume (vph)	129	473	90	85	511	152	
Future Volume (vph)	129	473	90	85	511	152	
Turn Type	NA	Perm	Perm	NA	Prot	Perm	
Protected Phases	4	1 01111	1 0.111	8	2	1 0111	
Permitted Phases		4	8			2	
Detector Phase	4	4	8	8	2	2	
Switch Phase							
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	
Minimum Split (s)	28.0	28.0	28.0	28.0	28.0	28.0	
Total Split (s)	28.0	28.0	28.0	28.0	32.0	32.0	
Total Split (%)	46.7%	46.7%	46.7%	46.7%	53.3%	53.3%	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	0.0	
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	6.0	
Lead/Lag							
Lead-Lag Optimize?							
Recall Mode	None	None	None	None	Max	Max	
Act Effct Green (s)	12.6	12.6	12.6	12.6	28.2	26.2	
Actuated g/C Ratio	0.26	0.26	0.26	0.26	0.58	0.54	
v/c Ratio	0.32	0.68	0.33	0.20	0.58	0.19	
Control Delay	16.0	6.9	17.1	14.6	11.1	2.5	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	16.0	6.9	17.1	14.6	11.1	2.5	
LOS	В	А	В	В	В	А	
Approach Delay	8.8			15.9	9.1		
Approach LOS	A			В	А		
Intersection Summary							
Cycle Length: 60							
Actuated Cycle Length: 4	8.9						
Natural Cycle: 60							
Control Type: Semi Act-U	ncoord						
Maximum v/c Ratio: 0.68							
Intersection Signal Delay	9.8			Ir	ntersectio	n LOS: A	
Intersection Capacity Utilization 53.5%						Δ	

Splits and Phases: 1: Casablanca Boulevard & North Service Road

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32 s	28 s	
	₩ Ø8	
	28 s	

Paradigm Transportation Solutions Limited

Synchro 9 Report
Queues 1: Casablanca Bou	levard 8	k North	n Serv	ice Ro	ad		Background PM 190563
	-	$\mathbf{r}$	4	+	•	1	
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	
Lane Group Flow (vph)	140	514	98	92	555	165	
v/c Ratio	0.32	0.68	0.33	0.20	0.58	0.19	
Control Delay	16.0	6.9	17.1	14.6	11.1	2.5	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	16.0	6.9	17.1	14.6	11.1	2.5	
Queue Length 50th (m)	10.2	0.0	7.1	6.5	24.5	0.0	
Queue Length 95th (m)	20.8	16.6	16.4	14.5	78.4	8.6	
Internal Link Dist (m)	120.4			206.5	218.5		
Turn Bay Length (m)		60.0	160.0				
Base Capacity (vph)	849	974	578	866	960	866	
Starvation Cap Reductn	0	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	0	
Reduced v/c Ratio	0.16	0.53	0.17	0.11	0.58	0.19	

HCM Signalized In 1: Casablanca Boi	tersection tersection tersection tersection tersection termination termination termination tersection tersecti	on Cap & North	acity A Servi	Analysi ce Ro:	S ad		Background Pl 1905
	→		<b>(</b>	+	<u> </u>	~	
Movement	EBT	EBR	WBL	WBT	NBL	NBR	
Lane Configurations	•	1	5	*	5	1	
Traffic Volume (vph)	129	473	90	85	511	152	
Future Volume (vph)	129	473	90	85	511	152	
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	6.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	1.00	0.85	
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00	
Satd. Flow (prot)	1716	1444	1662	1750	1662	1473	
Flt Permitted	1.00	1.00	0.67	1.00	0.95	1.00	
Satd. Flow (perm)	1716	1444	1168	1750	1662	1473	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	
Adi, Flow (vph)	140	514	98	92	555	165	
RTOR Reduction (vph)	0	382	0	0	0	76	
ane Group Flow (vph)	140	132	- 98	92	555	89	
Heavy Vehicles (%)	2%	3%	0%	0%	0%	1%	
Turn Type	NA	Perm	Perm	NA	Prot	Perm	
Protected Phases	4	1 onn	1 01111	8	2	1 0.111	
Permitted Phases		4	8	0	2	2	
Actuated Green G (s)	10.6	10.6	10.6	10.6	26.3	26.3	
Effective Green a (s)	12.6	12.6	12.6	12.6	28.3	26.3	
Actuated g/C Ratio	0.26	0.26	0.26	0.26	0.58	0.54	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grn Can (vnh)	442	372	300	450	961	792	
v/s Ratio Prot	0.08	572	500	0.05	c0 33	172	
v/s Ratio Perm	0.00	0.00	0.08	0.00	00.00	0.06	
v/c Ratio	0.32	0.36	0.33	0.20	0.58	0.11	
Uniform Delay, d1	14 7	14.8	14 7	14.2	6.5	5.6	
Progression Factor	1.00	1 00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.4	0.6	0.6	0.2	2.5	0.3	
Delay (s)	15.1	15.4	15.4	14.4	9.0	5.8	
Level of Service	R	R	B	B	Δ	A	
Approach Delay (s)	15.3	5	5	14.9	8.3	~	
Approach LOS	B			В	A		
Intersection Summary							
HCM 2000 Control Delay			12.1	H	CM 2000	Level of Servic	e B
HCM 2000 Volume to Capa	acity ratio		0.51				
Actuated Cycle Length (s)	,		48.9	S	um of lost	time (s)	8.0
Intersection Capacity Utiliza	ation		53.5%	IC	U Level o	of Service	A
Analysis Period (min)			15				
Critical Lane Group							

Synchro 9 Report

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## Appendix E

**Total Traffic Operations Reports** 



	-	~	4	+	•	*	
ane Group	FBT	FBR	WBI	WBT	NBI	NBR	
ane Configurations	*	1	5	*	5	1	
Traffic Volume (vph)	98	433	366	162	328	273	
Future Volume (vph)	98	433	366	162	328	273	
Turn Type	NA	Perm	Perm	NA	Prot	Perm	
Protected Phases	4	1 0.111	1 0.111	8	2	1 01111	
Permitted Phases		4	8		_	2	
Detector Phase	4	4	8	8	2	2	
Switch Phase	т	-	0	0	2	2	
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	
Minimum Snlit (s)	28.0	28.0	28.0	28.0	28.0	28.0	
Total Split (s)	32.0	32.0	32.0	32.0	28.0	28.0	
Total Split (%)	53 3%	53.3%	52.0	53.3%	46.7%	46.7%	
Vollow Time (s)	10	10	10	10	10.770	10.770	
All-Red Time (s)	4.0	4.0	4.0	4.0	4.0	2.0	
Lost Timo Adjust (s)	2.0	2.0	2.0	2.0	2.0	2.0	
Total Lost Timo (s)	-2.0	-2.0	-2.0	-2.0	-2.0	6.0	
	4.0	4.0	4.0	4.0	4.0	0.0	
Load Lag Optimizo?							
	Nono	Nono	Nono	Nono	Max	Max	
Act Effet Groop (c)	22.4	22.4	22.4	22.4	24.2	22.2	
Actuated a/C Datio	0.42	0.42	23.4	0.42	0.42	0.40	
de Datio	0.42	0.42	0.42	0.42	0.43	0.40	
Control Dolay	10.2	2.7	26.7	0.20	16.2	2.0	
	10.5	0.0	20.7	0.0	0.0	0.0	
Total Dolay	10.2	2.7	24.7	11.2	14.0	2.0	
	10.5 R	3.7 A	20.7	11.Z	10.2 R	J.0 A	
Approach Dolay	10	A	C	22.0	10.4	A	
	4.9			22.0	10.0 D		
Approach LOS	A			U	Б		
ntersection Summary							
Cycle Length: 60							
Actuated Cycle Length: 5	5.7						
Vatural Cycle: 60							
Control Type: Semi Act-U	ncoord						
Vaximum v/c Ratio: 0.79							
ntersection Signal Delay:	12.4			li	ntersectio	n LOS: B	
Intersection Capacity Utili	zation 57.8%	, D		10	CU Level	of Service	В
Analysis Period (min) 15							
Splits and Phases: 1: 0	Casablanca E	Boulevard	& North S	Service R	oad		
<b>√</b> ø2					<b>*</b> Ø4		
28 s					32 s		
					+		
				L L	♥ Ø8		

Synchro 9 Report

Queues 1: Casablanca Bou	levard &	k North	n Servi	ice Ro	ad		Total A 1905
	-	$\mathbf{r}$	4	+	•	1	
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	
Lane Group Flow (vph)	107	471	398	176	357	297	
v/c Ratio	0.17	0.53	0.79	0.26	0.52	0.39	
Control Delay	10.3	3.7	26.7	11.2	16.2	3.8	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	10.3	3.7	26.7	11.2	16.2	3.8	
Queue Length 50th (m)	6.7	0.0	34.5	11.4	28.8	0.0	
Queue Length 95th (m)	14.5	13.6	#76.3	22.4	54.4	13.5	
Internal Link Dist (m)	120.4			206.5	218.5		
Turn Bay Length (m)		60.0	160.0				
Base Capacity (vph)	771	971	610	806	688	754	
Starvation Cap Reductn	0	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	0	
Reduced v/c Ratio	0.14	0.49	0.65	0.22	0.52	0.39	
Intersection Summary # 95th percentile volume	exceeds car	pacity di	ielie mav	he longe	r		

Queue shown is maximum after two cycles.

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HCM Signalized In 1: Casablanca Bou	tersection levard &	on Cap & Nortl	bacity A h Servi	Analys ce Ro	is ad			Total AM 190563
	-	$\mathbf{r}$	•	+	•	1		
Movement	EBT	EBR	WBL	WBT	NBL	NBR		
Lane Configurations	<b>^</b>	1	٢	•	٦	1		
Traffic Volume (vph)	98	433	366	162	328	273		
Future Volume (vph)	98	433	366	162	328	273		
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750		
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	6.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00		
Frt	1.00	0.85	1.00	1.00	1.00	0.85		
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00		
Satd. Flow (prot)	1522	1458	1662	1591	1583	1444		
Flt Permitted	1.00	1.00	0.69	1.00	0.95	1.00		
Satd. Flow (perm)	1522	1458	1204	1591	1583	1444		
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92		
Adj. Flow (vph)	107	471	398	176	357	297		
RTOR Reduction (vph)	0	273	0	0	0	178		
Lane Group Flow (vph)	107	198	398	176	357	119		
Heavy Vehicles (%)	15%	2%	0%	10%	5%	3%		
Turn Type	NA	Perm	Perm	NA	Prot	Perm		
Protected Phases	4			8	2			
Permitted Phases		4	8			2		
Actuated Green, G (s)	21.4	21.4	21.4	21.4	22.2	22.2		
Effective Green, g (s)	23.4	23.4	23.4	23.4	24.2	22.2		
Actuated g/C Ratio	0.42	0.42	0.42	0.42	0.44	0.40		
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0		
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0		
Lane Grp Cap (vph)	640	613	506	669	689	576		
v/s Ratio Prot	0.07			0.11	c0.23			
v/s Ratio Perm		0.14	c0.33			0.08		
v/c Ratio	0.17	0.32	0.79	0.26	0.52	0.21		
Uniform Delay, d1	10.0	10.8	13.9	10.5	11.4	10.9		
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00		
Incremental Delay, d2	0.1	0.3	7.9	0.2	2.8	0.8		
Delay (s)	10.2	11.1	21.8	10.7	14.2	11.7		
Level of Service	В	В	С	В	В	В		
Approach Delay (s)	10.9			18.4	13.1			
Approach LOS	В			В	В			
Intersection Summary								
HCM 2000 Control Delay			14.1	Н	CM 2000	Level of Service	В	
HCM 2000 Volume to Capa	icity ratio		0.65					
Actuated Cycle Length (s)			55.6	S	um of los	t time (s)	8.0	
Intersection Capacity Utiliza	ation		57.8%	IC	CU Level	of Service	В	
Analysis Period (min)			15					
c Critical Lane Group								

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Synchro 9 Report

2: North Service R	ad & W	/instor	apacit Road	y Anai	ysis		190563 190563
	۶	-	-	×.	1	4	
Movement	EBL	EBT	WBT	WBR	SBL	SBR	
Lane Configurations		et.	ĥ		W.		
Traffic Volume (veh/h)	71	301	429	18	25	99	
Future Volume (Veh/h)	71	301	429	18	25	99	
Sian Control		Free	Free		Stop		
Grade		0%	0%		0%		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	
Hourly flow rate (vph)	77	327	466	20	27	108	
Pedestrians							
Lane Width (m)							
Walking Speed (m/s)							
Percent Blockage							
Right turn flare (veh)							
Median type		None	None				
Median storage veh)							
Upstream signal (m)		230					
pX, platoon unblocked							
vC, conflicting volume	486				957	476	
vC1. stage 1 conf vol							
vC2. stage 2 conf vol							
vCu, unblocked vol	486				957	476	
tC. single (s)	4.1				6.4	6.2	
tC. 2 stage (s)							
tE (s)	2.2				3.5	3.3	
p0 queue free %	93				90	82	
cM capacity (veh/h)	1087				268	593	
Direction, Lane #	EB 1	WB 1	SB 1				
Volume Total	404	486	135				
Volume Left	77	0	27				
Volume Right	0	20	108				
cSH	1087	1700	477				
Volume to Capacity	0.07	0.29	0.28				
Queue Length 95th (m)	1.8	0.0	9.2				
Control Delay (s)	2.2	0.0	15.5				
Lane LOS	А		С				
Approach Delay (s)	2.2	0.0	15.5				
Approach LOS			С				
Intersection Summary							
Average Delay			2.9				
Intersection Capacity Utiliza	tion		65.3%	IC	U Level o	of Service	С
Analysis Period (min)			15				

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			.,	•	,	,			
	•	→	-	×.	>	*	ور	-	1
Movement	EBL	EBT	WBT	WBR	SBL	SBR	Movement EBL	EBT	V
Lane Configurations		<del>ન</del> ી	eî 👘		- Y		Lane Configurations	ર્ન	
fraffic Volume (veh/h)	4	322	442	1	1	5	Traffic Volume (veh/h) 119	204	
Future Volume (Veh/h)	4	322	442	1	1	5	Future Volume (Veh/h) 119	204	
Sign Control		Free	Free		Stop		Sign Control	Free	
Grade		0%	0%		0%		Grade	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	Peak Hour Factor 0.92	0.92	
Hourly flow rate (vph)	4	350	480	1	1	5	Hourly flow rate (vph) 129	222	
Pedestrians							Pedestrians		
ane Width (m)							Lane Width (m)		
Walking Speed (m/s)							Walking Speed (m/s)		
Percent Blockage							Percent Blockage		
Right turn flare (veh)							Right turn flare (veh)		
/edian type		None	None				Median type	None	1
Aedian storage veh)							Median storage veh)		
Instream signal (m)		381					Linstream signal (m)		
X platoon unblocked		001					nX platoon unblocked		
C. conflicting volume	481				838	480	vC conflicting volume 332		
C1_stage 1 conf vol	101				000	100			
C2_stage 2 conf vol							vC2 state 2 cont vol		
Cu. unblocked vol	481				838	480	vCL unblocked vol 332		
cinalo (c)	/ 1				6.4	6.2	tC sindle (s) 41		
2, single (3)	7.1				0.4	0.2	to, single (s) +.1		
5, 2 staye (s) F (s)	2.2				3.5	3.3	F(c) = 22		
0 quouo froo %	100				100	00	n (1 (3) 2.2 p0 mous free % 00		
M canacity (yoh/h)	100				220	500			
ivi capacity (ven/n)	1092				338	290			
irection, Lane #	EB 1	WB 1	SB 1				Direction, Lane # EB 1	WB 1	
olume Total	354	481	6				Volume Total 351	332	
olume Left	4	0	1				Volume Left 129	0	
olume Right	0	1	5				Volume Right 0	32	
:SH	1092	1700	524				cSH 1239	1700	
olume to Capacity	0.00	0.28	0.01				Volume to Capacity 0.10	0.20	
Queue Length 95th (m)	0.1	0.0	0.3				Queue Length 95th (m) 2.8	0.0	
Control Delay (s)	0.1	0.0	11.9				Control Delay (s) 3.7	0.0	
ane LOS	A		В				Lane LOS A		
Approach Delay (s)	0.1	0.0	11.9				Approach Delay (s) 3.7	0.0	
Approach LOS			В				Approach LOS		
ntersection Summary							Intersection Summary		
verage Delav			0.1				Average Delay		
ntersection Capacity Utiliza	tion		35.3%	IC	U Level o	of Service	A Intersection Capacity Utilization		6
			10	10					-

Synchro 9 Report

acity Analysis Total AM 190563 - 🔨 🍾 🆌 
 WBR
 SBL
 SBR

 WBR
 SBL
 SBR

 S
 29
 42
 167
 29 42 167 Stop 
 6
 0%

 2
 0.92
 0.92
 0.92

 32
 46
 182
 796 316 7963166.46.2 3.5 3.3 86 321 75 729 ICU Level of Service В

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	Jau & D	nvewa	iy C					19030
	٦	-	-	•	1	∢		
Movement	EBL	EBT	WBT	WBR	SBL	SBR		
Lane Configurations		۴	¢Î		Y			
Traffic Volume (veh/h)	6	240	296	2	2	9		
Future Volume (Veh/h)	6	240	296	2	2	9		
Sign Control		Free	Free		Stop			
Grade		0%	0%		0%			
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92		
-lourly flow rate (vph)	7	261	322	2	2	10		
Pedestrians								
_ane Width (m)								
Valking Speed (m/s)								
Percent Blockage								
Right turn flare (veh)								
Vedian type		None	None					
Median storage veh)								
Jpstream signal (m)								
X, platoon unblocked								
C, conflicting volume	324				598	323		
/C1, stage 1 conf vol								
/C2, stage 2 conf vol								
/Cu, unblocked vol	324				598	323		
C, single (s)	4.1				6.4	6.2		
C, 2 stage (s)								
F (s)	2.2				3.5	3.3		
00 queue free %	99				100	99		
:M capacity (veh/h)	1247				466	723		
Direction, Lane #	EB 1	WB 1	SB 1					
/olume Total	268	324	12				 	
/olume Left	7	0	2					
/olume Right	0	2	10					
:SH	1247	1700	662					
/olume to Capacity	0.01	0.19	0.02					
Queue Length 95th (m)	0.1	0.0	0.4					
Control Delay (s)	0.3	0.0	10.5					
ane LOS	А		В					
Approach Delay (s)	0.3	0.0	10.5					
Approach LOS			В					
ntersection Summary							 	
Verage Delay			0.3					
ntersection Capacity Utiliza	ition		29.0%	IC	U Level o	of Service	A	
Inclusic Dariad (min)			15					

Synchro 9 Report

		$\mathbf{x}$	1	-	•	-
Lana Croun	FDT		▼ WDI	WDT	NDI	NDD
Lane Group	EBI	EBR	WBL	WBI	NBL	NBR
Lane Configurations	<b>T</b>	470	<b>1</b>	120	<b>1</b>	<b>f</b>
Traffic Volume (vpn)	146	4/3	283	130	511	412
Future volume (vpn)	146	4/3	283	130	511	412
Turn Type	NA	Perm	Perm	NA	Prot	Perm
Protected Phases	4			8	2	
Permitted Phases		4	8			2
Detector Phase	4	4	8	8	2	2
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	28.0	28.0	28.0	28.0	28.0	28.0
Total Split (s)	28.0	28.0	28.0	28.0	32.0	32.0
Total Split (%)	46.7%	46.7%	46.7%	46.7%	53.3%	53.3%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None	None	None	Max	Max
Act Effct Green (s)	20.2	20.2	20.2	20.2	28.1	26.1
Actuated g/C Ratio	0.36	0.36	0.36	0.36	0.50	0.46
v/c Ratio	0.26	0.61	0.75	0.22	0.67	0.49
Control Delay	13.6	4.9	28.7	13.2	16.9	3.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	13.6	4.9	28.7	13.2	16.9	3.4
LOS	В	А	С	В	В	А
Approach Delay	7.0			23.8	10.9	
Approach LOS	А			С	В	
Intersection Summary						
Cycle Length: 60						
Actuated Cycle Length: 56	5.4					
Natural Cycle: 60	J.T					
Control Type: Somi Act Li	ncoord					
Control Type: Seria ACI-UI	IICUUIU					
Intersection Signal Delays	12.4				atorcoctic	
Intersection Signal Delay:	12.4			1	nersectio	of Convict
intersection capacity Utiliz	2211011 00.1%			10	20 Level	or Service

<b>√</b> /ø2	<b>₩</b> Ø4	
32 s	28 s	
	₩ Ø8	
	28 s	

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Queues 1: Casablanca Bou	levard &	<b>Total PM</b> 190563					
	-	$\mathbf{i}$	4	+	1	1	
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	
Lane Group Flow (vph)	159	514	308	141	555	448	
v/c Ratio	0.26	0.61	0.75	0.22	0.67	0.49	
Control Delay	13.6	4.9	28.7	13.2	16.9	3.4	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	13.6	4.9	28.7	13.2	16.9	3.4	
Queue Length 50th (m)	11.7	0.0	28.1	10.3	45.7	0.0	
Queue Length 95th (m)	23.1	16.3	#62.1	20.7	83.1	14.3	
Internal Link Dist (m)	120.4			206.5	218.5		
Turn Bay Length (m)		60.0	160.0				
Base Capacity (vph)	734	912	491	748	829	923	
Starvation Cap Reductn	0	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	0	
Reduced v/c Ratio	0.22	0.56	0.63	0.19	0.67	0.49	

95th percentile volume exceeds capacity, queue may be longer.Queue shown is maximum after two cycles.

1	Paradiam	Transporta	ation	Solutions	Limited	

Synchro 9 Report

HCM Signalized Intersection Capacity Analysis 1: Casablanca Boulevard & North Service Road

Total PM 190563

	-	$\rightarrow$	1	+	•	1		
Movement	FBT	FBR	WBI	WBT	NBI	NBR		
ane Configurations	•	1	<u>8</u>	*	3	1		
Traffic Volume (vph)	146	473	283	130	511	412		
Future Volume (vph)	146	473	283	130	511	412		
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750		
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	6.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00		
Frt	1.00	0.85	1.00	1.00	1.00	0.85		
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00		
Satd. Flow (prot)	1716	1444	1662	1750	1662	1473		
Flt Permitted	1.00	1.00	0.66	1.00	0.95	1.00		
Satd. Flow (perm)	1716	1444	1148	1750	1662	1473		
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92		
Adj. Flow (vph)	159	514	308	141	555	448		
RTOR Reduction (vph)	0	330	0	0	0	240		
Lane Group Flow (vph)	159	184	308	141	555	208		
Heavy Vehicles (%)	2%	3%	0%	0%	0%	1%		
Turn Type	NA	Perm	Perm	NA	Prot	Perm		
Protected Phases	4			8	2			
Permitted Phases		4	8			2		
Actuated Green, G (s)	18.2	18.2	18.2	18.2	26.2	26.2		
Effective Green, g (s)	20.2	20.2	20.2	20.2	28.2	26.2		
Actuated g/C Ratio	0.36	0.36	0.36	0.36	0.50	0.46		
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0		
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0		
Lane Grp Cap (vph)	614	517	411	626	831	684		
v/s Ratio Prot	0.09			0.08	c0.33			
v/s Ratio Perm		0.13	c0.27			0.14		
v/c Ratio	0.26	0.36	0.75	0.23	0.67	0.30		
Uniform Delay, d1	12.8	13.3	15.9	12.6	10.6	9.4		
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00		
Incremental Delay, d2	0.2	0.4	7.3	0.2	4.2	1.1		
Delay (s)	13.0	13.7	23.2	12.8	14.8	10.6		
Level of Service	В	В	С	В	В	В		
Approach Delay (s)	13.6			19.9	12.9			
Approach LOS	В			В	В			
Intersection Summary								
HCM 2000 Control Delay			14.6	Н	CM 2000	Level of Servic	e	В
HCM 2000 Volume to Capa	city ratio		0.70					
Actuated Cycle Length (s)			56.4	S	um of los	t time (s)		8.0
Intersection Capacity Utiliza	tion		66.1%	IC	CU Level (	of Service		С
Analysis Period (min)			15					
c Critical Lane Group								

Paradigm Transportation Solutions Limited

2. NOTH Service R	loau & M	Instor	Roau					19030
	≯	-	+	•	1	<		
Novement	EBL	EBT	WBT	WBR	SBL	SBR		
ane Configurations		ę	ĥ		Y			
raffic Volume (veh/h)	105	453	325	28	28	88		
uture Volume (Veh/h)	105	453	325	28	28	88		
Sign Control		Free	Free		Stop			
Grade		0%	0%		0%			
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92		
lourly flow rate (vph)	114	492	353	30	30	96		
vedestrians								
ane Width (m)								
Valking Speed (m/s)								
Percent Blockage								
Right turn flare (veh)								
ledian type		None	None					
/ledian storage veh)								
Jpstream signal (m)		230						
X, platoon unblocked	202				1000	2/0		
C, conflicting volume	383				1088	308		
CT, stage T cont vol								
CZ, Stage Z COTIL VOL	202				1000	240		
	303				4 4	4.0		
2, Siriyie (S)	4.1				0.4	0.2		
2, 2 sidye (s)	2.2				2.5	2.2		
(S) O quouo froo %	2.2				9.5	96		
M canacity (veh/h)	70				219	682		
	1107				210	002		
ection, Lane #	EB 1	WB 1	SB 1					
lume Total	606	383	126					
blume Left	114	0	30					
olume Right	0	30	96					
SH Caraality	1187	1/00	452					
oume to Capacity	0.10	0.23	0.28					
Zueue Length 95th (m)	2.5	0.0	9.0					
ontroi Delay (s)	2.5	0.0	16.0					
IIIE LUS	A 25	0.0	14.0					
pproach LOS	2.5	0.0	16.0					
proach LUS			Ċ					
rsection Summary								
erage Delay			3.2					
ersection Capacity Utiliz	ation		70.2%	IC	U Level o	f Service	С	
alysis Period (min)			15					

Synchro 9 Report

3: North Service R	oad & D	rivewa	Japacit av A	y Anai	ysis		10tal PN 19056:
	۶	-	-	×.	1	1	
Movement	EBL	EBT	WBT	WBR	SBL	SBR	
Lane Configurations		ર્શ	eî		Y		
Traffic Volume (veh/h)	7	474	347	2	3	6	
Future Volume (Veh/h)	7	474	347	2	3	6	
Sign Control		Free	Free		Stop		
Grade		0%	0%		0%		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	
Hourly flow rate (vph)	8	515	377	2	3	7	
Pedestrians							
Lane Width (m)							
Walking Speed (m/s)							
Percent Blockage							
Right turn flare (veh)							
Median type		None	None				
Median storage veh)							
Upstream signal (m)		381					
pX, platoon unblocked							
vC, conflicting volume	379				909	378	
vC1, stage 1 conf vol							
vC2, stage 2 conf vol							
vCu, unblocked vol	379				909	378	
tC, single (s)	4.1				6.4	6.2	
tC, 2 stage (s)							
tF (s)	2.2				3.5	3.3	
p0 queue free %	99				99	99	
cM capacity (veh/h)	1191				306	673	
Direction, Lane #	EB 1	WB 1	SB 1				
Volume Total	523	379	10				
Volume Left	8	0	3				
Volume Right	0	2	7				
cSH	1191	1700	495				
Volume to Capacity	0.01	0.22	0.02				
Queue Length 95th (m)	0.2	0.0	0.5				
Control Delay (s)	0.2	0.0	12.4				
Lane LOS	А		В				
Approach Delay (s)	0.2	0.0	12.4				
Approach LOS			В				
Intersection Summary							
Average Delay			0.3				
Intersection Capacity Utilization	ation		43.2%	IC	U Level o	of Service	A
Analysis Period (min)			15				

Paradigm Transportation Solutions Limited

HCM Unsignalized	Interse	ction C	Capacit	y Analy	ysis			Total PM 190563	HCM Unsignalized	I Inter
	•	→	<u>↔</u>	×	1					.ouu (
Movement	EBL	EBT	WBT	WBR	SBL	SBR			Movement	E
Lane Configurations		ર્સ	1.		Y				Lane Configurations	
Traffic Volume (veh/h)	180	297	199	50	51	150			Traffic Volume (veh/h)	
Future Volume (Veh/h)	180	297	199	50	51	150			Future Volume (Veh/h)	
Sign Control		Free	Free		Stop				Sign Control	
Grade		0%	0%		0%				Grade	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92			Peak Hour Factor	0
Hourly flow rate (vph)	196	323	216	54	55	163			Hourly flow rate (yph)	
Pedestrians			2.5						Pedestrians	
Lane Width (m)									Lane Width (m)	
Walking Speed (m/s)									Walking Speed (m/s)	
Percent Blockage									Percent Blockage	
Right turn flare (veh)									Right turn flare (veh)	
Median type		None	None						Median type	
Median storage veh)		110110	110110						Median storage veh)	
Unstream signal (m)									Upstream signal (m)	
nX platoon unblocked									pX_platoon unblocked	
VC. conflicting volume	270				958	243			vC. conflicting volume	2
vC1_stage 1 conf vol									vC1_stage 1 conf vol	_
vC2. stage 2 conf vol									vC2, stage 2 conf vol	
VCu. unblocked vol	270				958	243			vCu, unblocked vol	2
C. single (s)	4.1				6.4	6.2			tC, single (s)	-
C. 2 stage (s)									tC, 2 stage (s)	
iF (s)	2.2				3.5	3.3			tF (s)	
o0 queue free %	85				78	80			p0 queue free %	
cM capacity (veh/h)	1305				245	801			cM capacity (veh/h)	13
Direction Lane #	ED 1	W/D 1	CD 1						Direction Lone #	E
/olumo Total	510	270	210						Volumo Total	
	106	270	210						Volume Left	J
Volume Len	170	54	162						Volume Dight	
	1205	1700	500							15
Volume to Canacity	0.15	0.16	0.43						Volume to Canacity	0
Ouque Longth 05th (m)	1.2	0.10	17.0						Quoue Longth 95th (m)	0.
Control Delay (s)	4.Z	0.0	17.0						Control Delay (s)	
ane LOS	4.1 Δ	0.0	17.5 C						Lane LOS	
Approach Dolay (c)	/ 1	0.0	17.2						Approach Dolay (s)	
Approach LOS	4.1	0.0	17.3 C						Approach LOS	(
Intersection Summary			5						Intersection Summers	
Avorago Dolav			5.0						Average Delay	
Intersection Canacity Litilize	tion		5.6%	10		f Sonvico	C		Intersection Canacity Utilize	ation
nicisection capacity Utiliza			00.070	IC	O LEVELO	I JEI VILE	C C		mersection capacity Utiliza	αιίθΗ

Synchro 9 Report

section Capacity Analysis Driveway C Total PM 190563 × 🖌 ٩. --WBT WBR SBL SBR L EBT Y **4** 339 **1** 242 2 2 339 242 2 2 7 Free Free Stop 0% 0% 0% 0.92 0.92 0.92 0.92 0.92 92 368 263 2 2 8 None None 652 264 652 264 6.4 6.2 3.5 3.3 100 99 432 780 WB 1 265 SB 1 1 10 0 2 2 8 1 1700 672 0.16 0.01 0.0 0.4 10.4 0.0 В 0.0 10.4 В 0.3 37.2% ICU Level of Service А 15

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## Appendix F

**Total Traffic Operations Reports – Sensitivity Analysis** 



	-	~	4	+	•	*	
ane Group	FBT	FBR	WBI	WBT	NBI	NBR	
ane Configurations	*	1	5	*	5	1	
Traffic Volume (vph)	98	433	366	162	328	273	
Future Volume (vph)	98	433	366	162	328	273	
Turn Type	NA	Perm	Perm	NA	Prot	Perm	
Protected Phases	4	1 0/11	1 0.111	8	2	1 01111	
Permitted Phases		4	8		_	2	
Detector Phase	4	4	8	8	2	2	
Switch Phase	т	-	0	0	2	2	
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	
Minimum Snlit (s)	28.0	28.0	28.0	28.0	28.0	28.0	
Total Split (s)	32.0	32.0	32.0	32.0	28.0	28.0	
Total Split (%)	53 3%	53.3%	52.0	53.3%	46.7%	46.7%	
Vollow Time (s)	10	10	10	10	10.770	10.770	
All-Red Time (s)	4.0	4.0	4.0	4.0	4.0	2.0	
Lost Timo Adjust (s)	2.0	2.0	2.0	2.0	2.0	2.0	
Total Lost Timo (s)	-2.0	-2.0	-2.0	-2.0	-2.0	6.0	
	4.0	4.0	4.0	4.0	4.0	0.0	
Load Lag Optimizo?							
	Nono	Nono	Nono	Nono	Max	Max	
Act Effet Groop (c)	22.4	22.4	22.4	22.4	24.2	22.2	
Actuated a/C Datio	0.42	0.42	23.4	0.42	0.42	0.40	
de Datio	0.42	0.42	0.42	0.42	0.43	0.40	
Control Dolay	10.2	2.7	26.7	0.20	16.2	2.0	
	10.5	0.0	20.7	0.0	0.0	0.0	
Total Dolay	10.2	2.7	24.7	11.2	14.0	2.0	
	10.5 R	3.7 A	20.7	11.Z	10.2 R	J.0 A	
Approach Dolay	10	A	C	22.0	10.4	A	
	4.9			22.0	10.0 D		
Approach LOS	A			U	Б		
ntersection Summary							
Cycle Length: 60							
Actuated Cycle Length: 5	5.7						
Vatural Cycle: 60							
Control Type: Semi Act-U	ncoord						
Vaximum v/c Ratio: 0.79							
ntersection Signal Delay:	12.4			li	ntersectio	n LOS: B	
Intersection Capacity Utili	zation 57.8%	, D		10	CU Level	of Service	В
Analysis Period (min) 15							
Splits and Phases: 1: 0	Casablanca E	Boulevard	& North S	Service R	oad		
<b>√</b> ø2					<b>*</b> Ø4		
28 s					32 s		
					+		
				L L	♥ Ø8		

Synchro 9 Report

Queues 1: Casablanca Bou	levard &	k North	n Servi	ice Ro	ad		Total A 1905
	-	$\mathbf{r}$	4	+	•	1	
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	
Lane Group Flow (vph)	107	471	398	176	357	297	
v/c Ratio	0.17	0.53	0.79	0.26	0.52	0.39	
Control Delay	10.3	3.7	26.7	11.2	16.2	3.8	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	10.3	3.7	26.7	11.2	16.2	3.8	
Queue Length 50th (m)	6.7	0.0	34.5	11.4	28.8	0.0	
Queue Length 95th (m)	14.5	13.6	#76.3	22.4	54.4	13.5	
Internal Link Dist (m)	120.4			206.5	218.5		
Turn Bay Length (m)		60.0	160.0				
Base Capacity (vph)	771	971	610	806	688	754	
Starvation Cap Reductn	0	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	0	
Reduced v/c Ratio	0.14	0.49	0.65	0.22	0.52	0.39	
Intersection Summary # 95th percentile volume	exceeds car	pacity di	ielie mav	he longe	r		

Queue shown is maximum after two cycles.

Paradigm Transportation Solutions Limited

HCM Signalized In 1: Casablanca Bou	tersection levard &	on Cap & Nortl	bacity A h Servi	Analys ce Ro	is ad			Total AM 190563
	-	$\mathbf{r}$	4	-	•	1		
Movement	EBT	EBR	WBL	WBT	NBL	NBR		
Lane Configurations	<b>↑</b>	1	٦	<b>↑</b>	٦ آ	1		
Traffic Volume (vph)	98	433	366	162	328	273		
Future Volume (vph)	98	433	366	162	328	273		
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750		
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	6.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00		
Frt	1.00	0.85	1.00	1.00	1.00	0.85		
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00		
Satd. Flow (prot)	1522	1458	1662	1591	1583	1444		
Flt Permitted	1.00	1.00	0.69	1.00	0.95	1.00		
Satd. Flow (perm)	1522	1458	1204	1591	1583	1444		
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92		
Adj. Flow (vph)	107	471	398	176	357	297		
RTOR Reduction (vph)	0	273	0	0	0	178		
Lane Group Flow (vph)	107	198	398	176	357	119		
Heavy Vehicles (%)	15%	2%	0%	10%	5%	3%		
Turn Type	NA	Perm	Perm	NA	Prot	Perm		
Protected Phases	4			8	2			
Permitted Phases		4	8			2		
Actuated Green, G (s)	21.4	21.4	21.4	21.4	22.2	22.2		
Effective Green, g (s)	23.4	23.4	23.4	23.4	24.2	22.2		
Actuated g/C Ratio	0.42	0.42	0.42	0.42	0.44	0.40		
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0		
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0		
Lane Grp Cap (vph)	640	613	506	669	689	576		
v/s Ratio Prot	0.07			0.11	c0.23			
v/s Ratio Perm		0.14	c0.33			0.08		
v/c Ratio	0.17	0.32	0.79	0.26	0.52	0.21		
Uniform Delay, d1	10.0	10.8	13.9	10.5	11.4	10.9		
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00		
Incremental Delay, d2	0.1	0.3	7.9	0.2	2.8	0.8		
Delay (s)	10.2	11.1	21.8	10.7	14.2	11.7		
Level of Service	В	В	С	В	В	В		
Approach Delay (s)	10.9			18.4	13.1			
Approach LOS	В			В	В			
Intersection Summary								
HCM 2000 Control Delay			14.1	Н	CM 2000	Level of Service	B	
HCM 2000 Volume to Capa	icity ratio		0.65					
Actuated Cycle Length (s)			55.6	S	um of los	t time (s)	8.0	
Intersection Capacity Utilization	ation		57.8%	IC	CU Level	of Service	В	
Analysis Period (min)			15					
c Critical Lane Group								

Paradigm	Transportation	Solutions	Limited

Synchro 9 Report

2: North Service R	oad & V	/instor	apacit Road	y Anai	ysis		190563 190563
	۶	-	-	×.	1	∢	
Movement	EBL	EBT	WBT	WBR	SBL	SBR	
Lane Configurations		થ	ĥ		Y		
Traffic Volume (veh/h)	75	297	429	18	26	99	
Future Volume (Veh/h)	75	297	429	18	26	99	
Sign Control		Free	Free		Stop		
Grade		0%	0%		0%		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	
Hourly flow rate (vph)	82	323	466	20	28	108	
Pedestrians							
Lane Width (m)							
Walking Speed (m/s)							
Percent Blockage							
Right turn flare (veh)							
Median type		None	None				
Median storage veh)							
Upstream signal (m)		230					
pX, platoon unblocked							
vC, conflicting volume	486				963	476	
vC1, stage 1 conf vol							
vC2, stage 2 conf vol							
vCu, unblocked vol	486				963	476	
tC, single (s)	4.1				6.4	6.2	
tC. 2 stage (s)							
tF (s)	2.2				3.5	3.3	
p0 queue free %	92				89	82	
cM capacity (veh/h)	1087				264	593	
Direction, Lane #	EB 1	WB 1	SB 1				
Volume Total	405	486	136				
Volume Left	82	0	28				
Volume Right	0	20	108				
cSH	1087	1700	472				
Volume to Capacity	0.08	0.29	0.29				
Queue Length 95th (m)	2.0	0.0	9.4				
Control Delay (s)	2.4	0.0	15.7				
Lane LOS	А		С				
Approach Delay (s)	2.4	0.0	15.7				
Approach LOS			С				
Intersection Summary							
Average Delay			3.0				
Intersection Capacity Utiliza	ition		65.4%	IC	U Level o	of Service	С
Analysis Period (min)			15				

Paradigm Transportation Solutions Limited

3: North Service R	pad & D	rivewa	apacit y A	y Anal	ysis		1905	53	4: North Service Ro	bad & D	rivewa	арасіі іу В	y Anar	/515	
	≯	-	+	×	1			-		≯	-	+	×	1	~
Novement	EBL	EBT	WBT	WBR	SBL	SBR			Movement	EBL	EBT	WBT	WBR	SBL	SB
ane Configurations		*	٦.			1		-	Lane Configurations		et.	1.		M	
Fraffic Volume (veh/h)	0	323	442	1	0	5			Traffic Volume (veh/h)	125	198	276	29	44	16
uture Volume (Veh/h)	0	323	442	1	0	5			Future Volume (Veh/h)	125	198	276	29	44	16
Sign Control	5	Free	Free		Stop	0			Sign Control	.20	Free	Free	27	Stop	10
Grade		0%	0%		0%				Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92			Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.0
Jourly flow rate (yph)	0.72	251	10.72	0.72	0.72	5			Hourdy flow rate (yeb)	124	0.72 21E	200	22	10.72	10.7
odostrians	U	301	400	1	U	0			Podostrians	130	210	300	эz	40	10
ano Width (m)									Lano Width (m)						
Lane Wildli (III)									Malking Speed (m/s)						
Porcont Plockago									Walking Speed (III/S)						
Pickt turn flore (uch)									Dight turn flore (uph)						
Right turn hare (ven)									Right turn liare (ven)						
viedian type		None	None						Median type		None	None			
ledian storage veh)									Median storage veh)						
Jpstream signal (m)		381						_	Upstream signal (m)						
X, platoon unblocked									pX, platoon unblocked						
C, conflicting volume	481				832	480			vC, conflicting volume	332				803	31
/C1, stage 1 conf vol									vC1, stage 1 conf vol						
/C2, stage 2 conf vol									vC2, stage 2 conf vol						
Cu, unblocked vol	481				832	480			vCu, unblocked vol	332				803	31
C, single (s)	4.1				6.4	6.2			tC, single (s)	4.1				6.4	6.
C, 2 stage (s)									tC, 2 stage (s)						
F (s)	2.2				3.5	3.3			tF (s)	2.2				3.5	3.
00 queue free %	100				100	99			p0 queue free %	89				85	7
M capacity (veh/h)	1092				342	590		-	cM capacity (veh/h)	1239				316	72
Direction Lane #	FB 1	WB 1	SB 1						Direction Lane #	FB 1	WB 1	SB 1			_
/olume Total	351	/81	5					-	Volume Total	351	332	230			
/olume Left	0	401	0						Volume Left	136	0	230			
/olumo Dight	0	1	5						Volume Dight	130	22	102			
	1700	1700	500							1220	3Z	10Z			
Jolumo to Conacitu	0.21	0.20	0.01						LOR Volume to Capacity	0.11	0.20	5/3			
volume to Capacity	0.21	0.28	0.01						Queue Length OEtte ()	0.11	0.20	15.4			
2ueue Lengin 95in (M)	0.0	0.0	0.2						Queue Lengin 95iñ (m)	3.0	0.0	15.4			
Jonirol Delay (s)	0.0	0.0	11.2						Control Delay (s)	3.8	0.0	15.4			
ane LOS			B						Lane LUS	A		C			
Approach Delay (s)	0.0	0.0	11.2						Approach Delay (s)	3.8	0.0	15.4			
Approach LOS			В						Approach LOS			С			
ntersection Summary									Intersection Summary						
Average Delay			0.1						Average Delay			5.4			
ntersection Canacity Utiliza	tion		35.3%	IC	UL evel o	f Service	Α		Intersection Canacity Litiliza	tion		60.3%	IC	Llevel	of Ser
			10	10	5 201010	0011100			intersection oupdatly Othiza			50.570	10	S LOFUL	

Synchro 9 Report

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Synchro 9 Report

В

Total AM 190563

5: North Service Ro	bad & D	rivewa	iy C					190563
	≯	-	+	•	1	∢		
Movement	EBL	EBT	WBT	WBR	SBL	SBR		
Lane Configurations		•	1.			1		
Traffic Volume (veh/h)	0	242	296	2	0	9		
Future Volume (Veh/h)	0	242	296	2	0	9		
Sign Control		Free	Free		Stop			
Grade		0%	0%		0%			
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92		
Hourly flow rate (vph)	0	263	322	2	0	10		
Pedestrians								
Lane Width (m)								
Walking Speed (m/s)								
Percent Blockage								
Right turn flare (veh)								
Median type		None	None					
Median storage veh)								
Upstream signal (m)								
oX. platoon unblocked								
/C. conflicting volume	324				586	323		
/C1, stage 1 conf vol								
vC2, stage 2 conf vol								
Cu, unblocked vol	324				586	323		
C. single (s)	4.1				6.4	6.2		
C, 2 stage (s)								
iF (s)	2.2				3.5	3.3		
0 aueue free %	100				100	99		
cM capacity (veh/h)	1247				476	723		
Direction Lane #	FB 1	WB 1	SB 1					
/olume Total	263	324	10					
/olume Left	0	0	0					
/olume Right	0	2	10					
SH	1700	1700	723					
Volume to Capacity	0.15	0.19	0.01					
Queue Length 95th (m)	0.0	0.0	0.3					
Control Delay (s)	0.0	0.0	10.1					
ane LOS	0.0	0.0	B					
Approach Delay (s)	0.0	0.0	10.1					
Approach LOS	0.0	0.0	B					
Intersection Summary								
Norado Dolay			0.2					
intersection Canacity Litiliza	tion		27.0%	IC		of Service		7
Analysis Period (min)	tion		15	10	O LOVEI (	, JUNC	,	<b>`</b>
			13					

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Synchro 9 Report

	-	7	1	-	1	1							
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR							
Lane Configurations	1	1	ľ	•	1	1							
Traffic Volume (vph)	146	473	283	130	511	412							
Future Volume (vph)	146	473	283	130	511	412							
Turn Type	NA	Perm	Perm	NA	Prot	Perm							
Protected Phases	4			8	2								
Permitted Phases		4	8			2							
Detector Phase	4	4	8	8	2	2							
Switch Phase													
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0							
Minimum Split (s)	28.0	28.0	28.0	28.0	28.0	28.0							
Total Split (s)	28.0	28.0	28.0	28.0	32.0	32.0							
Total Split (%)	46.7%	46.7%	46.7%	46.7%	53.3%	53.3%							
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0							
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0							
Lost Time Adjust (s)	-2.0	-2.0	-2.0	-2.0	-2.0	0.0							
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	6.0							
Lead/Lag													
Lead-Lag Optimize?													
Recall Mode	None	None	None	None	Max	Max							
Act Effct Green (s)	20.2	20.2	20.2	20.2	28.1	26.1							
Actuated g/C Ratio	0.36	0.36	0.36	0.36	0.50	0.46							
v/c Ratio	0.26	0.61	0.75	0.22	0.67	0.49							
Control Delay	13.6	4.9	28.7	13.2	16.9	3.4							
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0							
Total Delay	13.6	4.9	28.7	13.2	16.9	3.4							
LOS	В	А	С	В	В	А							
Approach Delay	7.0			23.8	10.9								
Approach LOS	A			С	В								
Intersection Summary													
Cycle Length: 60													
Actuated Cycle Length: 56	.4												
Natural Cycle: 60													
Control Type: Semi Act-Ur	ncoord												
Maximum v/c Ratio: 0.75													
Intersection Signal Delay:	12.4			li	ntersectio	n LOS: B							
Intersection Canacity Utiliz	ation 66 1%			10	CLLLevel	of Service							

<b>1</b> √ø₂	<u>⊸</u> ∎Ø4	
32 s	28 s	
	₩Ø8	
	28 s	

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Queues 1: Casablanca Bou	<b>Total PM</b> 190563						
	-	$\mathbf{i}$	4	+	1	1	
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	
Lane Group Flow (vph)	159	514	308	141	555	448	
v/c Ratio	0.26	0.61	0.75	0.22	0.67	0.49	
Control Delay	13.6	4.9	28.7	13.2	16.9	3.4	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	13.6	4.9	28.7	13.2	16.9	3.4	
Queue Length 50th (m)	11.7	0.0	28.1	10.3	45.7	0.0	
Queue Length 95th (m)	23.1	16.3	#62.1	20.7	83.1	14.3	
Internal Link Dist (m)	120.4			206.5	218.5		
Turn Bay Length (m)		60.0	160.0				
Base Capacity (vph)	734	912	491	748	829	923	
Starvation Cap Reductn	0	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	0	
Reduced v/c Ratio	0.22	0.56	0.63	0.19	0.67	0.49	

95th percentile volume exceeds capacity, queue may be longer.Queue shown is maximum after two cycles.

1	Paradiam	Transporta	ation	Solutions	Limited	

Synchro 9 Report

HCM Signalized Intersection Capacity Analysis 1: Casablanca Boulevard & North Service Road

Total PM 190563

	-	$\rightarrow$	1	+	•	1		
Movement	FBT	FBR	WBI	WBT	NBI	NBR		
ane Configurations	•	1	<u>8</u>	*	3	1		
Traffic Volume (vph)	146	473	283	130	511	412		
Future Volume (vph)	146	473	283	130	511	412		
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750		
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	6.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00		
Frt	1.00	0.85	1.00	1.00	1.00	0.85		
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00		
Satd. Flow (prot)	1716	1444	1662	1750	1662	1473		
Flt Permitted	1.00	1.00	0.66	1.00	0.95	1.00		
Satd. Flow (perm)	1716	1444	1148	1750	1662	1473		
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92		
Adj. Flow (vph)	159	514	308	141	555	448		
RTOR Reduction (vph)	0	330	0	0	0	240		
Lane Group Flow (vph)	159	184	308	141	555	208		
Heavy Vehicles (%)	2%	3%	0%	0%	0%	1%		
Turn Type	NA	Perm	Perm	NA	Prot	Perm		
Protected Phases	4			8	2			
Permitted Phases		4	8			2		
Actuated Green, G (s)	18.2	18.2	18.2	18.2	26.2	26.2		
Effective Green, g (s)	20.2	20.2	20.2	20.2	28.2	26.2		
Actuated g/C Ratio	0.36	0.36	0.36	0.36	0.50	0.46		
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0		
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0		
Lane Grp Cap (vph)	614	517	411	626	831	684		
v/s Ratio Prot	0.09			0.08	c0.33			
v/s Ratio Perm		0.13	c0.27			0.14		
v/c Ratio	0.26	0.36	0.75	0.23	0.67	0.30		
Uniform Delay, d1	12.8	13.3	15.9	12.6	10.6	9.4		
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00		
Incremental Delay, d2	0.2	0.4	7.3	0.2	4.2	1.1		
Delay (s)	13.0	13.7	23.2	12.8	14.8	10.6		
Level of Service	В	В	С	В	В	В		
Approach Delay (s)	13.6			19.9	12.9			
Approach LOS	В			В	В			
Intersection Summary								
HCM 2000 Control Delay			14.6	Н	CM 2000	Level of Servic	e	В
HCM 2000 Volume to Capa	city ratio		0.70					
Actuated Cycle Length (s)			56.4	S	um of los	t time (s)		8.0
Intersection Capacity Utiliza	tion		66.1%	IC	CU Level	of Service		С
Analysis Period (min)			15					
c Critical Lane Group								

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HCM Unsignalized 2 <sup>.</sup> North Service R	Interse	ction C /inston	apacit Road	y Analy	ysis		Total P 1905	M 63	HCM Unsignalized I 3: North Service Ro
2. North Cervice IV	•	-	<b>+</b>	×	1	1			
Movement	FBI	FBT	WBT	WBR	SBI	SBR			Movement
Lane Configurations		4	۴.		M			-	Lane Configurations
Traffic Volume (veh/h)	112	446	325	28	31	88			Traffic Volume (veh/h)
Future Volume (Veh/h)	112	446	325	28	31	88			Future Volume (Veh/h)
Sign Control	112	Free	Free	20	Ston	00			Sign Control
Grado		0%	0%		0%				Grade
Doak Hour Eactor	0.02	0.02	0.02	0.02	0.02	0.02			Poak Hour Factor
Hourly flow rate (upb)	122	0.7Z	252	20	2/	0.72			Houdy flow rate (upb)
Podostrians	122	480	303	30	34	90			Podostrians
reuesilidiis Lano Width (m)									Peuesinans
Lane widin (m)									Lane Width (m)
Walking Speed (m/s)									Walking Speed (m/s)
Percent Blockage									Percent Blockage
Right turn flare (ven)									Right turn flare (ven)
Median type		None	None						Median type
Median storage veh)									Median storage veh)
Upstream signal (m)		230						_	Upstream signal (m)
pX, platoon unblocked									pX, platoon unblocked
vC, conflicting volume	383				1097	368			vC, conflicting volume
vC1, stage 1 conf vol									vC1, stage 1 conf vol
vC2, stage 2 conf vol									vC2, stage 2 conf vol
vCu, unblocked vol	383				1097	368			vCu, unblocked vol
tC, single (s)	4.1				6.4	6.2			tC, single (s)
tC, 2 stage (s)									tC, 2 stage (s)
iF (s)	2.2				3.5	3.3			tF (s)
p0 queue free %	90				84	86			p0 queue free %
cM capacity (veh/h)	1187				213	682			cM capacity (veh/h)
Direction, Lane #	EB 1	WB 1	SB 1						Direction, Lane #
Volume Total	607	383	130					-	Volume Total
Volume Left	122	0	34						Volume Left
Volume Right	0	30	96						Volume Right
cSH	1187	1700	433						cSH
Volume to Capacity	0.10	0.23	0.30						Volume to Capacity
Queue Length 95th (m)	2.7	0.0	10.0						Queue Length 95th (m)
Control Delay (s)	2,6	0.0	16.8						Control Delay (s)
Lane LOS	A		С						Lane LOS
Approach Delay (s)	2.6	0.0	16.8						Approach Delay (s)
Approach LOS			С						Approach LOS
Intersection Summary									Intersection Summary
Average Delay			3.4					-	Average Delay
Intersection Capacity Litiliz:	ation		70.4%	IC		f Service	C.	-	Intersection Capacity Litilizati
Analysis Poriod (min)			15	10	2 201010		÷		Analysis Doried (min)

Synchro 9 Report

ntersection Capacity Analysis ad & Driveway A Total PM 190563 → ← ۶ X X 4 EBT WBT WBR SBL SBR EBL **†** 477 **1** 347 7 0 2 0 6 0 477 347 2 0 6 Free Free Stop 0% 0% 0% 0.92 0.92 0.92 0.92 0.92 0.92 518 377 0 2 0 7 None None 381 379 896 378 379 896 378 4.1 6.4 6.2 2.2 3.5 3.3 100 100 99 1191 313 673 EB 1 518 WB1 SB1 379 7 0 0 0 0 2 7 1700 1700 673 0.30 0.22 0.01 0.0 0.3 0.0 0.0 0.0 10.4 В 0.0 0.0 10.4 В 0.1 30.6% ICU Level of Service А n 15

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4: North Service R	load & D	rivewa	iv B	<i>y</i> ,	, 0.0			19056	3	5: North Service
	۶	-	<u>, −</u>	×	1	4			-	
Movement	FBI	FBT	WRT	WRR	SRI	SRP				Movement
Lane Configurations	LDL	101	1	WDIX	M	351			-	Lane Configurations
Traffic Volume (veh/h)	180	288	100	50	53	150				Traffic Volume (veh/h)
Future Volume (Veh/h)	189	288	199	50	53	150				Future Volume (Veh/h)
Sign Control	107	Free	Free	50	Ston	150				Sign Control
Grado		0%	0%		0%					Grade
Peak Hour Factor	0.02	0.02	0.02	0.02	0.02	0.02				Peak Hour Factor
Hourly flow rate (yph)	205	313	216	5/	58	163				Hourly flow rate (yph)
Podostrians	203	515	210	JT	50	105				Podestrians
Lane Width (m)										Lane Width (m)
Walking Speed (m/s)										Walking Speed (m/s)
Porcont Blockago										Percent Blockage
Pight turn flare (veh)										Pight turn flare (yeh)
Modian typo		Nono	Nono							Modian typo
Median storade veh)		NULLE	NULLE							Median storage veh)
Linstroam signal (m)										Linstream signal (m)
nX nlatoon unblockod										nY platoon unblocked
vC conflicting volume	270				966	2/13				vC conflicting volume
vC1_stage 1 confive	210				700	243				vC1_stage 1 conf vol
vC1, stage 1 contivol										vC1, stage 1 confive
vCz, stage z com vol	270				966	2/13				vCz, stage z com vol
tC singlo (s)	11				6.4	6.2				tC single (s)
tC, single (s)	4.1				0.4	0.2				tC, single (s)
tE (c)	2.2				3.5	2.2				tE (s)
n (s)	2.2				76	90				n (s)
p0 queue iree 70	1205				240	001				cM capacity (yob/b)
civi capacity (veri/ri)	1303				240	001			_	
Direction, Lane #	EB 1	WB 1	SB 1							Direction, Lane #
Volume Total	518	270	221							Volume Total
Volume Left	205	0	58							Volume Left
Volume Right	0	54	163							Volume Right
cSH	1305	1700	496							cSH
Volume to Capacity	0.16	0.16	0.45							Volume to Capacity
Queue Length 95th (m)	4.5	0.0	18.1							Queue Length 95th (m
Control Delay (s)	4.2	0.0	17.9							Control Delay (s)
Lane LOS	A		С							Lane LOS
Approach Delay (s)	4.2	0.0	17.9							Approach Delay (s)
Approach LOS			С							Approach LOS
Intersection Summary										Intersection Summary
Average Delay			61						-	Average Delay
Intersection Capacity Utiliz	ation		65.7%	IC	Ulevelo	f Service	C.			Intersection Canacity I
Analysis Period (min)			15	10	2 201010		5			Analysis Period (min)

Synchro 9 Report

ized Intersection Capacity Analysis æ Road & Driveway C Total PM 190563 → ← ⊁ X X 4 EBL EBT WBT WBR SBL SBR **↑** 341 **1** 242 7 0 2 0 0 341 242 2 0 7 Free Free Stop 0% 0% 0% 0.92 0.92 0.92 0.92 0.92 0.92 371 263 0 2 0 8 None None 265 635 264 265 635 264 6.2 4.1 6.4 3.5 3.3 2.2 100 99 100 1311 446 780 EB1 WB1 SB1 371 265 8 0 0 0 0 2 8 1700 1700 780 0.22 0.16 0.01 0.2 0.0 0.0 0.0 0.0 9.7 А 0.0 0.0 9.7 А 0.1 Utilization 24.0% ICU Level of Service А 15

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## Appendix G

## **Left-Turn Lane Warrants**





AM Peak Hour — PM Peak Hour



Location: Direction: Horizon Year: North Service Road & Winston Road Eastbound 2034 Total Traffic



AM Peak Hour – PM Peak Hour



Location: Direction: Horizon Year: North Service Road & Driveway A Eastbound 2034 Total Traffic



AM Peak Hour — PM Peak Hour



Location: Direction: Horizon Year: North Service Road & Driveway B Eastbound 2034 Total Traffic



AM Peak Hour – PM Peak Hour



Location: Direction: Horizon Year: North Service Road & Driveway C Eastbound 2034 Total Traffic



AM Peak Hour — PM Peak Hour

Sensitivity Analysis – Driveway A & C Right-In/Right-Out

Location: Direction: Horizon Year:

North Service Road & Winston Road Eastbound 2034 Total Traffic – Reduced Access



AM Peak Hour — PM Peak Hour

Sensitivity Analysis – Driveway A & C Right-In/Right-Out



Location: Direction: Horizon Year:

North Service Road & Driveway B Eastbound 2034 Total Traffic – Reduced Access