



TRANSPORTATION IMPACT STUDY

**37719 LAKE LINE
PORT STANLEY, ONTARIO**

KETTLE CREEK SUBDIVISION

STRATHROY TURF FARMS LIMITED

OCTOBER 2021

SBM-18-0530

LONDON LOCATION

1599 Adelaide Street N. Units 301 & 203
London, Ont, N5X 4E8
P: 519.471.6667

KITCHENER LOCATION

1415 Huron Rd., Unit 225
Kitchener, Ont, N2R 0L3
P: 519.725.8093



PLANNING • CIVIL • STRUCTURAL • MECHANICAL • ELECTRICAL

LONDON LOCATION
1599 Adelaide St. N., Units 301 & 203
London, ON N5X 4E8
P: 519-471-6667

www.sbmtd.ca

KITCHENER LOCATION
1415 Huron Rd., Unit 225
Kitchener, ON N2R 0L3
P: 519-725-8093

sbm@sbmtd.ca

Strathroy Turf Farms Limited
6297 Olde Drive
Appin, Ontario N0L 1A0

October 4, 2021
SBM-18-0530

Attn: James Glover

**Re: Transportation Impact Study
37719 Lake Line – Kettle Creek Subdivision
Port Stanley, Ontario**

Mr. Glover

Strik, Baldinelli, Moniz Ltd. is pleased to provide you with the enclosed Transportation Impact Study report for the proposed residential development at 37719 Lake Line in Port Stanley, Ontario. The report concludes that the development proposal can be accommodated by the existing transportation network with no significant impact to traffic operations.

We trust this submission meets your satisfaction and will assist with the approval of your development. Should you have any questions or require additional information, please do not hesitate to contact the undersigned.

Respectfully submitted,

Strik, Baldinelli, Moniz Ltd.

Civil • Structural • Mechanical • Electrical

Jonah Lester, P.Eng.
Transportation Engineer



EXECUTIVE SUMMARY

This Transportation Impact Study (TIS) has been prepared by Strik, Baldinelli, Moniz Ltd. (SBM) for Strathroy Turf Farms Limited to identify transportation impacts, or a lack thereof, associated with the proposed Kettle Creek Subdivision residential development located at 37719 Lake Line in Port Stanley (Municipality of Central Elgin), Ontario. The development is proposed to include 97 dwelling units (79 single-family detached homes and 18 semi-detached homes) with access from Lake Line.

This study has forecasted traffic volumes for 2028 and 2040 horizon years and assessed traffic operations within the vicinity of the subject site for existing, future background and future total traffic conditions. Site access and active transportation considerations have also been assessed. Based on the analysis completed, the following key conclusions and recommendations are made in this TIS:

- The proposed subdivision includes 79 single family detached units and 18 semi-detached units, and it is forecast that the development will generate up to a total of 70 new trips in the AM peak hour (17 in and 53 out), 94 trips in the PM peak hour (59 in and 35 out), and 97 trips during the holiday peak hour (52 in and 45 out).
- Under existing traffic conditions, all movements at the Carlow Road and Warren Street and Colborne Street and Warren Street intersections operate well at LOS A, except for the eastbound movement on Warren Street at Colborne Street which ranges from LOS B for the AM peak hour to LOS D for the holiday peak hour. Since these intersections were temporarily signalized during the preparation of this study to accommodate the detour route for the King George VI Lift Bridge Rehabilitation Project, the County requested that the intersections also be analyzed under signalized control. Both intersections would also operate well under existing traffic conditions if permanently signalized, however, it is noted that, the intersections would have higher average delay with signals than without since the current traffic volumes are so low.
- Significant background traffic growth is expected as a result of the following developments/plans:
 - ‘Seaglass’ residential development (510 dwelling units)
 - ‘Lakeview’ mixed use development (60 dwelling units and 1,800 ft² commercial)
 - Harbour Secondary Plan (Phase 1 in 2028 - 178 dwelling units and 20,274 ft² commercial, and Phase 2 in 2040 - 795 dwelling units and 29,276 ft² commercial)
 - An unnamed residential development (96 dwelling units)
 - ‘Little Creek West Lands’ development (302 dwelling units)

In total, the above background developments are expected to generate 1272 trips during the AM peak hour, 1933 trips during the PM peak hour, and 2170 trips during the holiday peak hour.

- Traffic signal warrants from the Ontario Traffic Manual (Book 12) were analyzed for the Carlow Road and Warren Street, and Colborne Street and Warren Street intersections and the traffic volumes will not meet the justification for traffic signals under existing traffic conditions or any of the future traffic scenarios considered in this study.
- Based on MTO warrant analysis, a northbound left turn lane on Colborne Street is warranted with 25 m of storage at Warren Street during the existing holiday peak hour. Since the peak holiday condition only occurs for a short period of time, we suggest that the County consider adding the lane once the warrant is met for the PM peak hour, which is expected to occur prior to 2028 due

to background traffic growth. A storage length of 30 m is recommended which should accommodate the 2040 total traffic PM peak hour condition.

- Analysis of the future background and total traffic conditions confirmed that the Carlow Road and Warren Street intersection should continue to operate well as an all-way stop control intersection through 2040 with all movements maintaining a Level of Service C or better.
- Analysis of the future background and total traffic conditions for the Colborne Street and Warren Street intersection showed that the intersection will operate acceptably with stop control through 2040 for the AM and PM peak hours, although with higher average delay (LOS F) on the eastbound movement during the PM peak hour, which is not uncommon for unsignalized connections to busy arterial roads. However, the critical eastbound movement may reach capacity during the holiday peak hour in 2028, which may be tolerable for a short-lived peak season condition, but would require mitigation once Phase 2 of the Harbour Secondary Plan begins to develop beyond 2028. Therefore, we recommend that the County plan for the installation of traffic signals at Colborne Street and Warrant Street around the year 2028, but monitor the intersection operations via future transportation impact studies related to the Harbour Secondary Plan area developments and update the timeline as necessary. If not already implemented by the time signals are to be installed, the northbound left turn lane on Colborne Street should also be installed at the same time, and consideration should be given to installing an eastbound left turn lane, which may be necessary to accommodate the full build-out of the Harbour Secondary Plan (2040 holiday peak hour traffic).
- The proposed Lake Line and Street 'A' intersection will operate well beyond the horizon period. Sightlines at the intersection location are sufficient for safe operation and the anticipated traffic volumes do not warrant the installation of any auxiliary lanes.
- The sidewalks within the proposed subdivision will provide good service for pedestrians, but there is no existing sidewalk on Lake Line, therefore it is recommended that consideration be given to the construction of a sidewalk on Lake Line between Street 'A' and Carlow Road to provide a connection to the existing sidewalk network.
- Overall, the forecasted site traffic is not expected to introduce any operational problems on the surrounding road network and no road improvements are specifically required to accommodate the proposed development.

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1 INTRODUCTION

This Transportation Impact Study (TIS) has been prepared by Strik, Baldinelli, Moniz Ltd. (SBM) for Strathroy Turf Farms Limited to identify transportation impacts, or a lack thereof, associated with the proposed residential development located at 37719 Lake Line in Port Stanley (Municipality of Central Elgin), Ontario. The development is proposed to include 97 dwelling units (79 single-family detached homes and 18 semi-detached homes) with access from Lake Line.

The location of the proposed development is illustrated in Figure 1.

Figure 1: Site Location



Aerial Image Source: Google Earth (July 2018 imagery)

1.1 SCOPE AND METHODOLOGY

The TIS scope was discussed with Municipality of Central Elgin (Municipality) and County of Elgin (County) staff prior to commencing the study. It was noted that several transportation studies have been

completed related to other developments in Port Stanley in the past few years and that this study should account for the other developments as background traffic and follow a consistent approach. The County also noted that a 2040 horizon period has been used for some studies to account for the long-term impact of the Harbour Secondary Plan and that this study should do the same. With respect to the study area, the County requested that it include the same intersections from the previous studies unless it could be shown that the proposed site traffic would have a negligible impact on them. The limitations of the site traffic impact is discussed further in Section 4.2, but with the relatively a minor amount of traffic generated by the subject site, the resultant study area has been limited to the intersections shown in Table 1.

Table 1: Study Scope and Parameters

Study Scope and Parameters	
Analysis Intersections (Study Area)	<ul style="list-style-type: none">• Carlow Road / Union Road and Warren Street / Lake Line• Colborne Street / Sunset Road and Warren Street• Proposed Street 'A' (site access) on Lake Line
Analysis Time Periods	<ul style="list-style-type: none">• Weekday AM peak hour• Weekday PM peak hour• Weekend (holiday) peak hour
Analysis Scenarios (Years)	<ul style="list-style-type: none">• Existing Traffic• 2028 Background Traffic• 2028 Total Traffic• 2040 Background Traffic• 2040 Total Traffic

The intersection operational analysis has been performed using Synchro 11 software based on the Highway Capacity Manual 2000 (HCM 2000) methodology published by the Transportation Research Board National Research Council. Since HCM 2000 does not calculate queuing at all-way stop controlled (AWSC) intersections, the HCM 6th Edition methodology has also been used where necessary to determine 95th percentile queues under AWSC conditions.

The results of the operational analysis are included in tables in this report that show the volume to capacity ratio (v/c ratio), Level of Service (LOS), and average delay for all movements. Critical movements are identified based on the following definitions:

- Any movements where the 95th percentile queue exceeds available storage.
- Any movements with a v/c ratio of 0.90 or higher at signalized intersections.
- Any movements with a Level of Service (LOS) F or worse.

Level of Service (LOS) is a function of the average control delay for an entire intersection or an individual movement. The relationships between the LOS letters and average delay ranges are defined in Table 2 for signalized and unsignalized intersections.

Table 2: Vehicular Level of Service Designations

LEVEL OF SERVICE (LOS)	CONTROL DELAY PER VEHICLE (s)	
	SIGNALIZED INTERSECTION	UN SIGNALIZED INTERSECTION
A	≤ 10	≤ 10
B	10 to 20	10 to 15
C	20 to 35	15 to 25
D	35 to 55	25 to 35
E	55 to 80	35 to 50
F	> 80	> 50

1.2 BACKGROUND (PREVIOUS TRAFFIC STUDIES)

Recent traffic studies associated with other development in Port Stanley were provided by the Municipality. These studies have been reviewed and key traffic data and background development traffic estimates from these studies have been used in this study. The following sub-sections provide brief summaries of the previous traffic studies. Where necessary, additional details and/or discussion related to these studies is provided in later sections of this report.

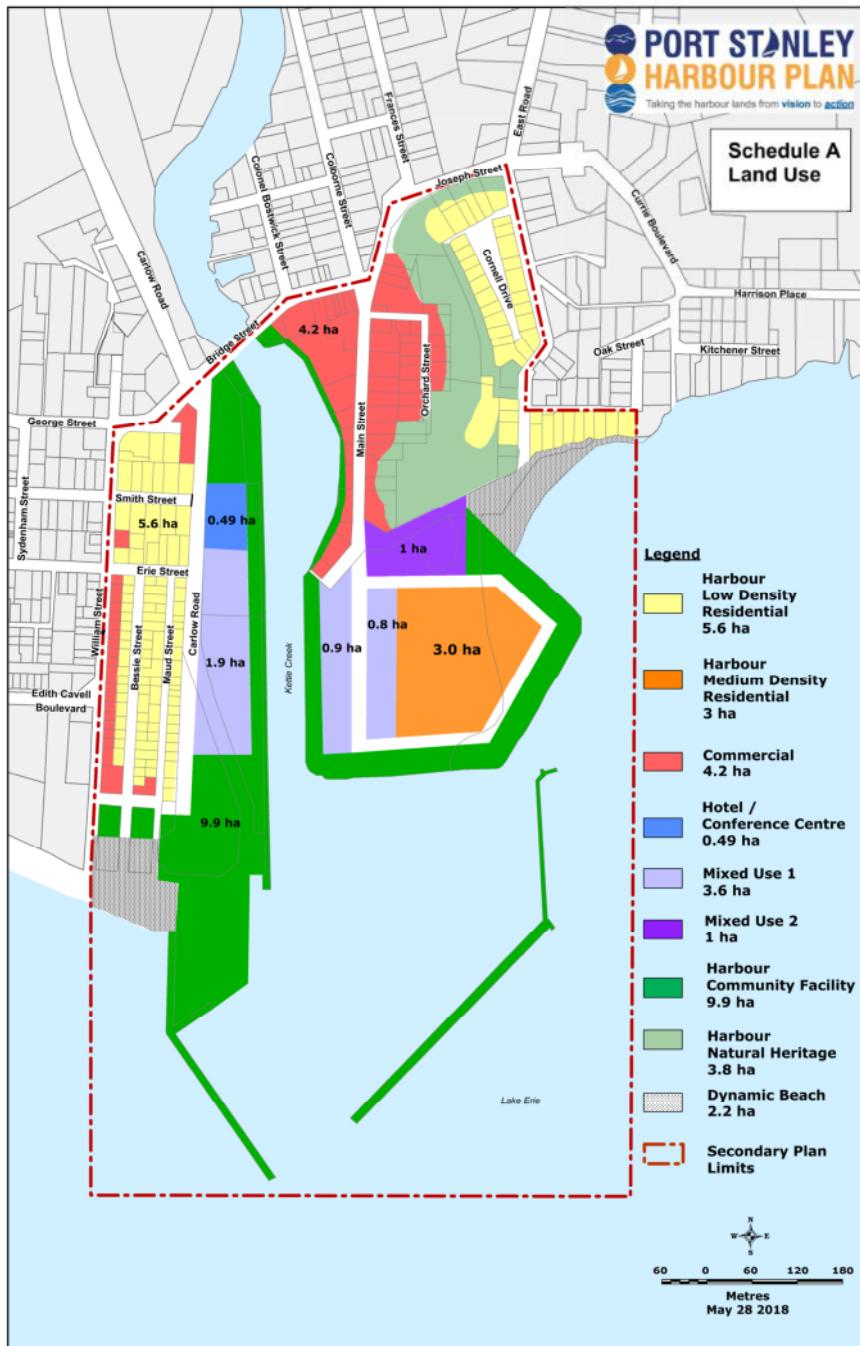
1.2.1 LAKE LINE RESIDENTIAL DEVELOPMENT TRANSPORTATION IMPACT MEMO (PARSONS, JANUARY 2018)

The *Lake Line Residential Development Transportation Impact Memo* (referred to in this report as the ‘Parsons traffic memo’) was the original traffic impact analysis for the Kettle Creek Subdivision that was prepared by Parsons in January 2018. At the time, the development was proposing 130 residential units and the focus of the analysis was on the Carlow Road / Union Road and Warren Street / Lake Line intersection. A traffic count at the intersection was taken in November 2017 during the AM and PM peak hours and the operational analysis was conducted accounting for the estimated site traffic and minor background traffic growth (5% overall growth). The analysis concluded that the intersection would continue to operate well as an all-way stop controlled intersection and the site traffic would not have any significant impact on the external road network.

1.2.2 PORT STANLEY SECONDARY PLAN – TRANSPORTATION ASSESSMENT STUDY (DILLON, MAY 2018)

The *Port Stanley Secondary Plan Transportation Assessment Study* (referred to in this report as the ‘Secondary Plan TAS’) was prepared by Dillon Consulting Limited (Dillon) in May 2018 to assess the transportation impacts of the Harbour Secondary Plan in Port Stanley. The Harbour Secondary Plan involves the long-term redevelopment of the west and east harbour areas with the land uses shown in Figure 2.

Figure 2: Harbour Secondary Plan Land Use Schedule



Source: Schedule A from the Port Stanley Harbour Plan (Dillon, May 2018)

The 'Secondary Plan TAS' assumed the redevelopment would include a total of 49,550 ft² of retail/commercial space, 873 residential dwelling units and a 100-room hotel which would be phased with the West harbour area being completed by 2028 (Phase 1) and the East harbour area being completed by 2040 (Phase 2).

The study area was limited to the Bridge Street intersections immediately adjacent to the Secondary Plan area (i.e. between William Street and Colborne Street) and traffic counts at the intersections were undertaken on May 22, 2017 (Victoria Day) and June 1, 2017.

The ‘Secondary Plan TAS’ produced traffic forecasts for the 2028 and 2040 horizon years accounting for other planned developments in Port Stanley, such as the ‘Seaglass’ development (approximately 510 residential units) and Lakeview mixed-use development (approximately 60 residential units and 1,800 ft² or retail). The study concluded that some modifications to the existing traffic controls and additional turn lanes would be required at the Bridge Street intersections to accommodate the ultimate traffic volumes.

1.2.3 PORT STANLEY OPERATIONS ASSESSMENT – BRIDGE STREET/GEOERGE STREET MICROSIMULATION ANALYSIS (DILLON, SEPTEMBER 2018)

The *Port Stanley Operations Assessment – Bridge Street / George Street Microsimulation Analysis*, was undertaken by Dillon in September 2018. This analysis updated the 2040 traffic forecast from the ‘Secondary Plan TAS’ based on new traffic counts collected on July 1, 2018 to better reflect peak summer conditions. A microsimulation analysis was also used, which would account for the interaction between adjacent intersections (e.g. queues from one intersection blocking an upstream intersection).

The analysis concluded that some additional mitigation would be required, beyond the previous recommendations in the ‘Secondary Plan TAS’, with the key change being the recommendation for the installation of traffic signals at the Bridge Street and Carlow Road intersection along with additional turn lanes.

1.2.4 PORT STANLEY SENSITIVITY TEST – WASTELL “SEAGLASS” CONNECTION TO CARLOW ROAD (DILLON, SEPTEMBER 2018)

The *Port Stanley Sensitivity Test – Wastell “Seaglass” Connection to Carlow Road* memo was prepared by Dillon in September 2018. It analyzed the potential option of introducing a new east-west road connection between Carlow Road and the ‘Seaglass’ development (proposed on the north side of George Street approximately 550 m west of Carlow Road) in order to reduce volumes on George Street and improve access to the development. It is our understanding that this development is now called Kokomo Beach Club, however, for consistency with previous reporting, we have continued to refer to it as the ‘Seaglass’ development in this report.

The memo built on the analysis from the ‘Port Stanley Operations Assessment’ and compared operations at the George Street and William Street and George Street/Bridge Street and Carlow Road intersections for 2040 holiday peak hour traffic volumes both with and without a theoretical new east-west connection to Carlow Road. It was concluded that a new connection to Carlow Road would reduce traffic on George Street by approximately 100 vehicles in each direction, however that would not be enough of an impact to remove the need for the mitigation previously recommended in the ‘Port Stanley Operations Assessment’.

1.2.5 ‘LITTLE CREEK WEST LANDS’ RESIDENTIAL DEVELOPMENT – TRANSPORTATION IMPACT STUDY (DILLON, FEBRUARY 2019)

The *‘Little Creek West Lands’ Residential Development – Transportation Impact Study* was completed by Dillon in February 2019 and is referred to as the ‘Little Creek West Lands’ TIS in this report. The ‘Little Creek West Lands’ TIS assessed the impact of a planned residential development that is located on the west side of East Road and is proposed to include 46 single-family units, 52 semi-detached units, 124 townhomes, and 80 apartments. The TIS covered a broad study area which included the Colborne Street / Sunset Road and Warren Street intersection and traffic counts for the intersection were taken right before and during the August 2018 Civic Holiday weekend to represent peak summer conditions.

The ‘Little Creek West Lands’ TIS assessed a 2028 horizon year and accounted for the ‘Seaglass’ development, Harbour Secondary Plan (Phase 1 – West Harbour), Lakeview development, and an

unnamed residential development near the north end of East Road (assumed 96 single family units) as background developments in the 2028 traffic forecast.

The key recommendations from the ‘Little Creek West Lands’ TIS that relate to the current study area in this report were as follows:

- The County should consider providing a 25 m northbound left turn lane from Colborne Street to Warren Street;
- The County should consider providing a 40 m eastbound left turn lane from Warren Street to Sunset Road

It is noted that it appears there were some minor errors in Dillon’s auxiliary lane warrant analysis and the northbound left turn lane from Colborne Street to Warren Street was actually warranted with 15 m of storage for the 2028 PM peak hour and 40 m of storage for the 2028 holiday peak hour.

2 EXISTING CONDITIONS

2.1 SITE CONTEXT

The proposed development land has an area of approximately 12.8 hectares and is located on the south side of Lake Line approximately 50 m west of Union Road/Carlow Road. It is bounded by the Port Stanley Public School and Kettle Creek Golf and Country Club to the south, the Lake Line right-of-way (ROW) to the east and north (which has residential properties fronting the north side of the road), and wooded area to the west.

2.2 EXISTING ROAD NETWORK

A site visit was conducted on May 5th, 2021 to review the existing study area road network conditions.

Lake Line is a local road generally running east-west to the west of Union Road and Carlow Road. It has a two-lane rural cross-section (no curb and gutter or sidewalks) with a posted speed of 50 km/h. Lake Line is under the jurisdiction of the Municipality.

Carlow Road and Union Road are under the jurisdiction of the County (County Road 20) and are classified as County Minor Arterial roads. Carlow Road runs south of the Lake Line and Warren Street intersection and has an urban/semi-urban cross-section with a posted speed of 40 km/h in the study area. There is an existing sidewalk on the east side of Carlow Road for approximately 100 m south of Warren Street, which then switches to the west side at a pedestrian crossover. Union Road runs north of the Lake Line and Warren Street intersection and generally has a rural cross-section with no sidewalk. It has a posted speed limit of 50 km/h within 45 m of the intersection which transitions to 80 km/h to the north.

It is noted that although there are no designated cycling facilities, Lake Line and Carlow Road are part of the Great Lakes Waterfront Trail (also referred to as the Lake Erie Cycling Trail), which is a signed route along the shores of the Great Lakes.

Warren Street is under the jurisdiction of the County (County Road 21) and is classified as a County Minor Arterial road. Warren Street runs east-west between Carlow Road / Union Road and Colborne Street / Sunset Road. It has an urban cross-section with sidewalk on one side of the road and a posted speed limit of 50 km/h.

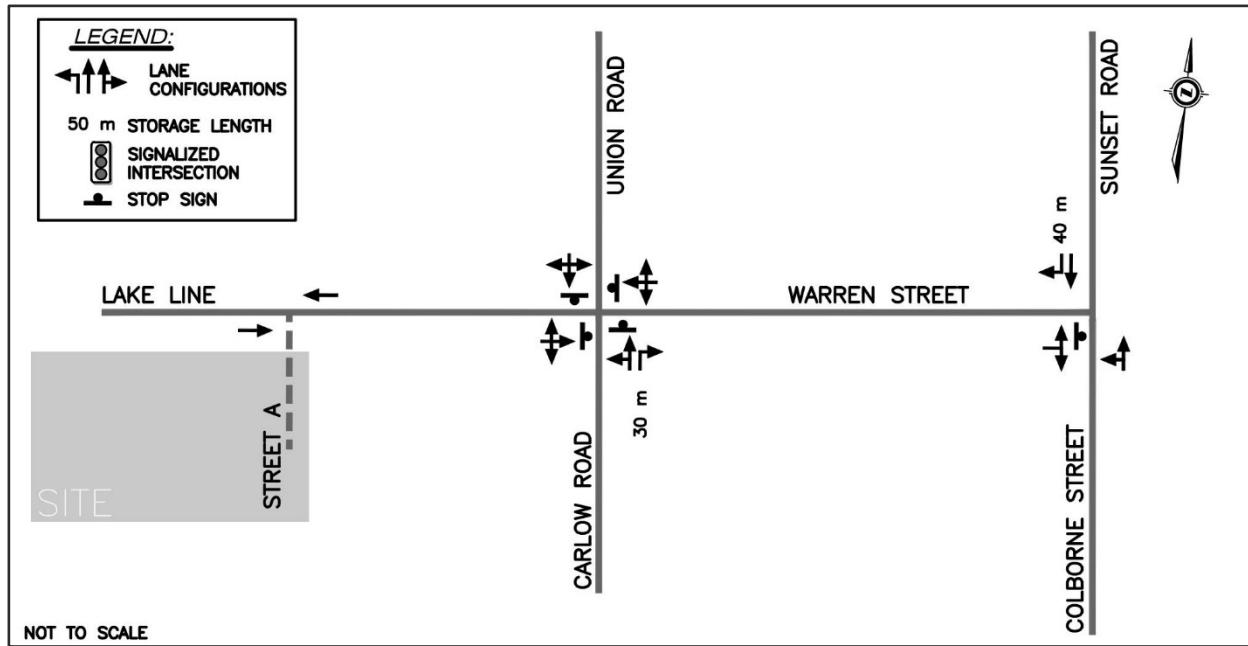
Colborne Street and Sunset Road are also County roads (County Road 4) classified as County Minor Arterials. They both have a posted speed limit of 50 km/h within the study area. Colborne Street runs south of Warren Street and has a two-lane urban cross-section with sidewalk on the west side. Sunset Road runs north of Warren Street and has a semi-urban cross-section within the study area.

In the spring of 2020, the King George VI Lift Bridge Rehabilitation Project got underway, which required a full closure of the lift bridge (the main connection between the east and west sides of Port Stanley) and required traffic to detour to Warren Street to cross Kettle Creek. To accommodate this detour, intersection improvements were undertaken at the Colborne Street / Sunset Road and Warren Street, and Carlow Road / Union Road and Warren Street / Lake Line intersections.

At the Colborne Street / Sunset Road and Warren Street intersection (hereon referred to as the Colborne Street and Warren Street intersection), which previously had single lane approaches and stop control on Warren Street, the intersection was widened on Colborne Street / Sunset Road to provide a southbound right turn lane and temporary traffic signals were installed. At the Carlow Road / Union Road and Warren Street / Lake Line intersection (hereon referred to as the Carlow Road and Warren Street intersection), which was previously an all-way stop controlled intersection with single lane approaches in all directions, a northbound right turn lane was added on Carlow Road and temporary traffic signals were installed.

When this study was initiated, the King George VI Lift Bridge was scheduled to be re-opened in the late Spring 2021 and it was expected that the temporary traffic signals at the Warren Street intersections would be removed soon after, however, the County requested that this study assess both the signalized and unsignalized condition for these intersections. Therefore, we have considered the existing intersection configuration to be unsignalized with the lane configurations, traffic control and storage lengths illustrated in Figure 3, but we have also analyzed the intersections under a signalized condition (as per the temporary traffic signals). It was assumed that traffic would revert to previous routing patterns once the bridge re-opened.

Figure 3: Existing Study Area Traffic Control and Lane Configuration



2.3 EXISTING TRAFFIC VOLUMES

With traffic being detoured to Warren Street because of the King George VI Lift Bridge Rehabilitation Project, plus ongoing COVID-19 pandemic-related restrictions that continue to affect traffic volumes and patterns, new traffic counts at the study area intersections could not be completed at the time of this

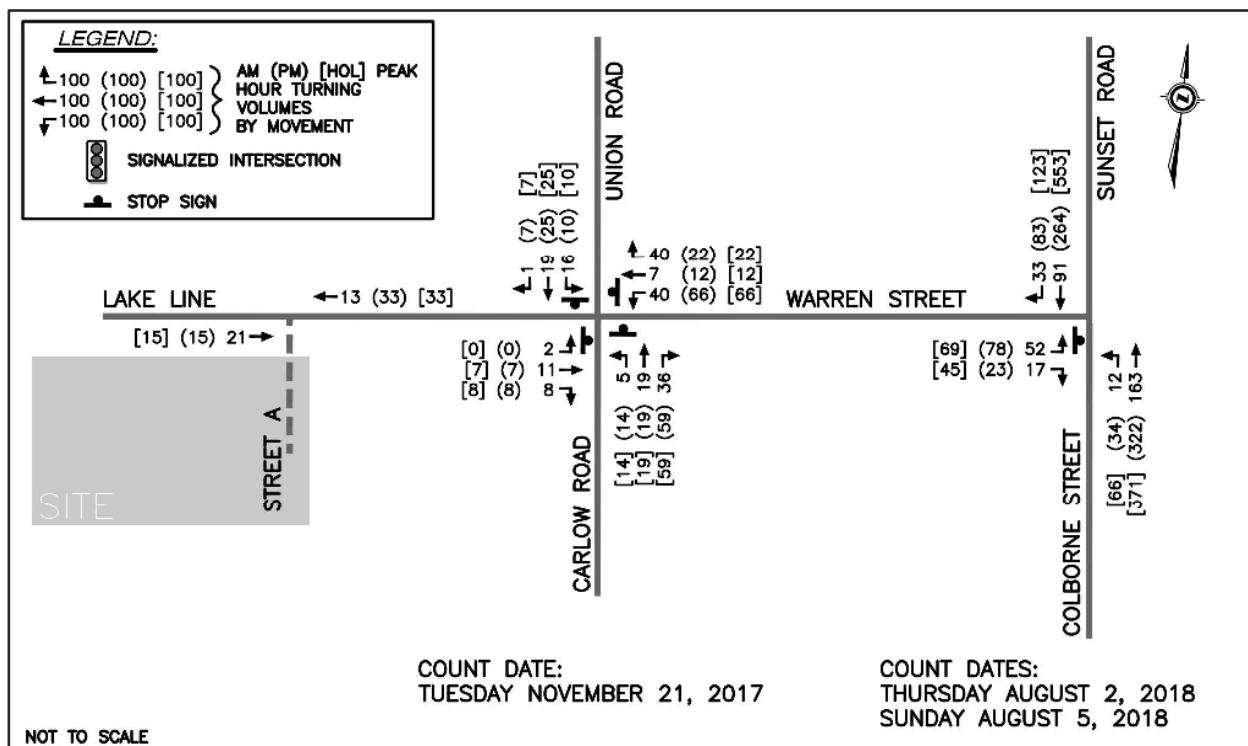
study, therefore the traffic count data from previous studies has been used. This approach also provides greater consistency and easier comparison with the previous studies.

The following summarizes the base turning movement counts collection dates used in this study.

- Carlow Road and Warren Street intersection
 - Tuesday November 21, 2017 (from the 'Parsons traffic memo')
- Colborne Street and Warren Street
 - Thursday August 2, 2018 and Sunday August 5, 2018 (from the 'Little Creek West Lands' TIS)

The base traffic volumes from the above traffic counts are shown in Figure 4 and the raw traffic count data is provided in Appendix A: It is noted that the base count at Carlow Road and Warren Street did not include a weekend (i.e. holiday) peak hour, so the PM peak hour is shown as the base volume.

Figure 4: Base Year Traffic Count Volumes



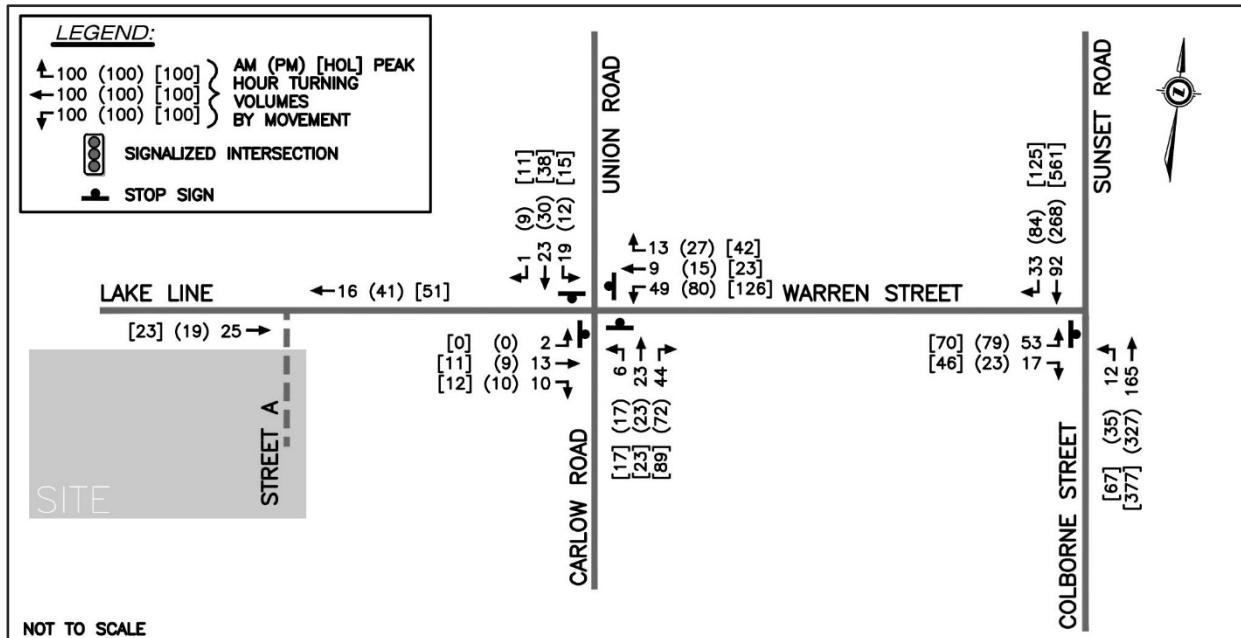
The base year traffic count data was adjusted as follows to establish "existing" 2021 peak hour traffic volumes:

- The Colborne Street and Warren Street intersection volumes were increased by 0.5% per year (for 3 years) based on historical growth rate on Sunset Road (consistent with previous studies).
- The Carlow Road and Warren Street intersection volumes were increased by 5% per year (for 4 years), recognizing that the initial volumes are lower (i.e. small growth rate has less effect) and also to better balance the volumes along Warren Street with the Colborne intersection.

- For the holiday volumes at Carlow Road and Warren Street, the traffic volumes on Warren Street were increased to balance with the holiday volumes on Warren Street at Colborne Street (factors of 1.25 and 1.57 for eastbound and westbound, respectively).

The resulting “existing” 2021 peak hour traffic volumes are illustrated in Figure 5. It is noted that this traffic volume figure (and others like it presented later on in this report) is a basic diagram of the road network, is not to scale, and we have chosen to show Lake Line running east-west as a straight line with Street ‘A’ connecting from the south to simplify the drawing and be consistent with the assigned directions for the intersection movements in the operational analysis presented later in the report.

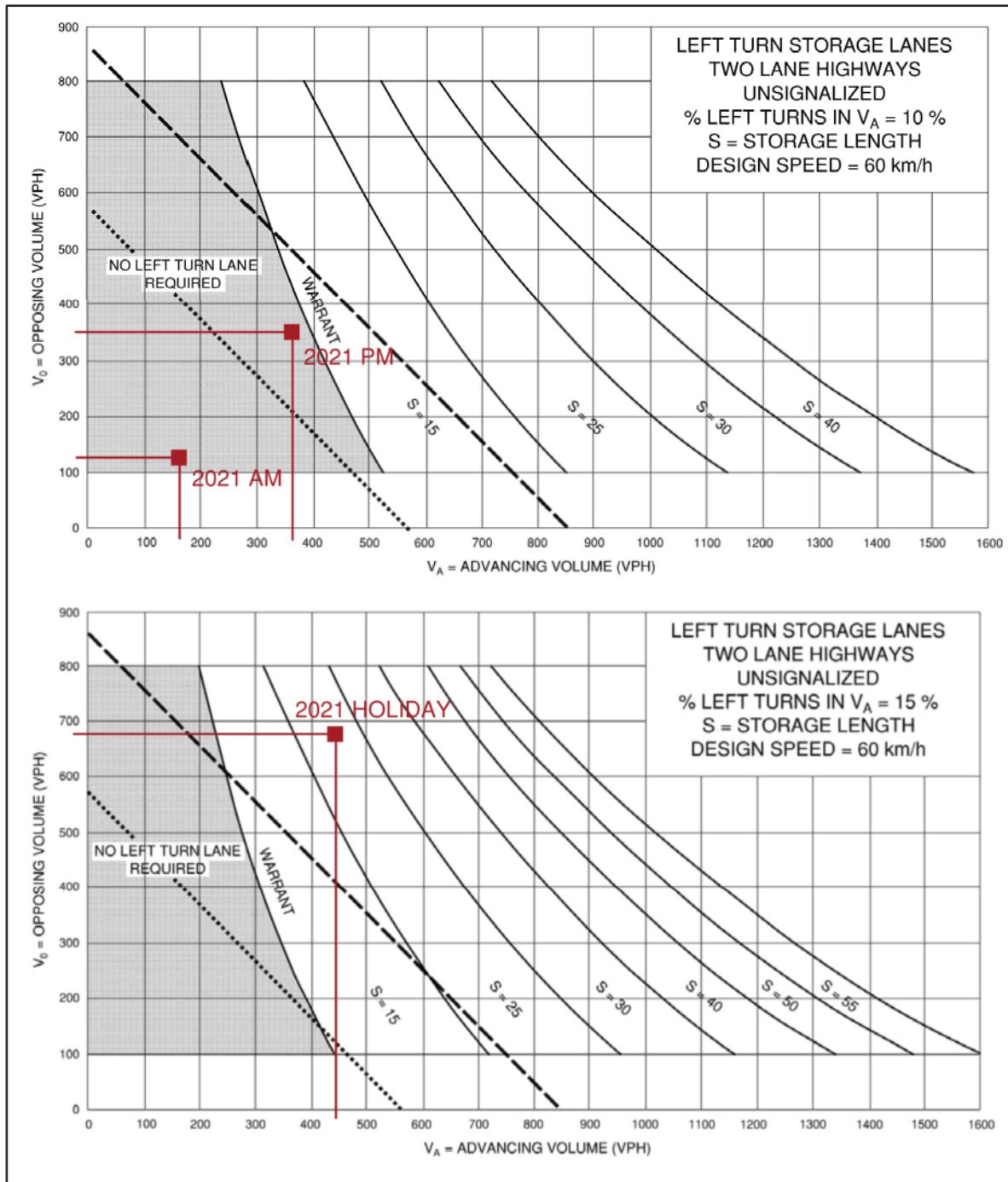
Figure 5: 2021 Peak Hour Traffic Volumes



2.4 TURNING LANE AND TRAFFIC SIGNAL WARRANTS – EXISTING TRAFFIC

Left turn lane warrants for the northbound approach of Colborne Street at Warren Street were reviewed based on the left turn lane warrant graphs from the Ministry of Transportation Design Supplement for the TAC Geometric Design Guide for Canadian Roads, June 2017 (MTO Design Supplement). The warrant is based on the hourly percentage of left turning vehicles, the advancing traffic volume and the volume of opposing traffic. Warrant graphs for 2021 AM, PM and holiday peak hours are shown in Figure 6. It is shown that a left turn lane is not warranted for the 2021 AM and PM peak hours (although the PM is getting close), but the holiday peak hour volumes meet the warrant for a left turn lane with 25 m of storage. Since the peak holiday condition only occurs for a short period of time, we would suggest that the County continue to monitor the intersection for safety concerns and consider the addition of a northbound left turn lane once the warrant is met on a more regular basis, such as for the PM peak hour.

Figure 6: Colborne Street and Warren Street Northbound Left Turn Lane Warrants for 2021 Traffic



Source: MTO Design Supplement

Traffic signal warrant analysis was performed for the Colborne Street and Warren Street, and Carlow Road and Warren Street intersections to check if the existing conditions warrant the installation of traffic signals. The analysis was based on the Ontario Traffic Manual Book 12, Justification 7, which is typically based on the AM and PM peak hour traffic volumes, however, we have also checked the holiday peak hour condition. The results conclude that traffic signals are not warranted for either of the study area

intersections under existing conditions (the highest warrant percentage is at 47% for the Colborne Street and Warren Street intersection). The signal warrant analysis sheets are contained in Appendix B.

Left turn lane and traffic signal warrants for future traffic conditions are discussed in Sections 3.4 and 5.1 of this report.

2.5 EXISTING TRAFFIC OPERATIONS AND QUEUING

Existing traffic operations were assessed for the study area intersections based on the existing lane configurations and traffic volumes presented in Sections 2.2 and 2.3, under both unsignalized and signalized conditions. Traffic signal timing for the analysis was based on field observations of the temporary signals installed for the King George VI Lift Bridge Rehabilitation Project detour, with some optimization for the various time periods considered.

For consistency with the ‘Little Creek West Lands’ TIS analysis, and since the raw traffic count data was unavailable for peak hour factor calculations, a peak hour factor of 0.92 has been used in the analysis, which is likely more conservative than the actual peak hour factors, particularly for the future holiday traffic conditions (reviewed later in this report), when volumes reach higher v/c ratios.

Table 3 and Table 4 provide summaries of the existing intersection operations under unsignalized and signalized conditions, and complete Synchro output reports are provided in Appendix C. It is noted that the Synchro reports for the holiday peak hour show “Saturday” in the scenario headings.

Table 3: 2021 Intersection Operations – Unsignalized

INTERSECTIONS / MOVEMENTS	2021 TRAFFIC									
	AM PEAK HOUR			PM PEAK HOUR			HOLIDAY PEAK HOUR			
	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	
Carlow Road / Union Road and Warren Street / Lake Line	EB LTR	0.03	A	7	0.02	A	7	0.03	A	8
	WB LTR	0.09	A	8	0.16	A	8	0.26	A	9
	NB LT	0.04	A	7	0.06	A	7	0.06	A	8
	NB R	0.05	A	6	0.09	A	7	0.12	A	7
	SB LTR	0.06	A	8	0.07	A	8	0.09	A	8
	EB LR	0.10	B	11	0.26	C	16	0.49	D	32
Colborne Street / Sunset Road and Warren Street	NB LT	0.01	A	1	0.03	A	1	0.08	A	2
	SB T	0.06	A	0	0.17	A	0	0.36	A	0
	SB R	0.02	A	0	0.05	A	0	0.08	A	0
	Notes: V/C - Volume to Capacity Ratio, LOS – Level of Service, Delay = Average Delay in Seconds EB – Eastbound, WB – Westbound, NB – Northbound, SB - Southbound L – Left, T – Through, R – Right									

Table 4: 2021 Intersection Operations – Signalized

INTERSECTIONS / MOVEMENTS	2021 TRAFFIC									
	AM PEAK HOUR			PM PEAK HOUR			HOLIDAY PEAK HOUR			
	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	
Carlow Road / Union Road and Warren Street / Lake Line	Overall	0.13	A	9	0.21	A	8	0.35	A	8
	EB LTR	0.06	B	12	0.04	B	12	0.05	B	12
	WB LTR	0.09	A	5	0.19	A	6	0.35	A	6
	NB LT	0.10	B	12	0.14	B	12	0.14	B	12
	NB R	0.03	A	7	0.05	A	7	0.06	A	7
	SB LTR	0.15	B	12	0.15	B	12	0.18	B	12
Colborne Street / Sunset Road and Warren Street	Overall	0.19	A	7	0.48	A	9	0.68	B	11
	EB LR	0.38	C	25	0.46	B	17	0.48	C	22
	NB LT	0.15	A	3	0.38	A	5	0.52	A	5
	SB T	0.08	A	3	0.48	B	11	0.75	B	15
	SB R	0.02	A	3	0.06	A	9	0.08	A	8

Notes: V/C - Volume to Capacity Ratio, LOS – Level of Service, Delay = Average Delay in Seconds
 EB – Eastbound, WB – Westbound, NB – Northbound, SB - Southbound
 L – Left, T – Through, R – Right

As unsignalized intersections, the results in Table 3 show that all movements operate well at a v/c ratio of 0.49 or less and mostly LOS A, except for the eastbound movement on Warren Street at Colborne Street which ranges from LOS B for the AM peak hour to LOS D for holiday peak hour.

With traffic signal control, the results in Table 4 show that all movements operate well, with v/c ratios under 0.75 and LOS at C or better, but it is noted that most movements have higher average delay than in the unsignalized scenario, which can occur if an intersection is signalized before the volumes justify it (either based on volume warrants or operational deficiencies).

Queuing results were also reviewed by comparing the 95th percentile queue length from the Synchro analysis with the available storage length for the turn lanes within the study area in order to determine whether any queues may block adjacent lanes. The results are summarized in Table 5 and Table 6 for unsignalized and signalized conditions, respectively.

Table 5: 2021 Intersection Queuing - Unsignalized

INTERSECTIONS / MOVEMENTS	AVAILABLE STORAGE (m)	95 th PERCENTILE QUEUE (m)		
		2021 TRAFFIC		
		AM PEAK HOUR	PM PEAK HOUR	HOLIDAY PEAK HOUR
Carlow Road / Union Road and Warren Street / Lake Line	EB LTR	N/A	<5	<5
	WB LTR	N/A	<5	<5
	NB LT	N/A	<5	<5
	NB R	30	<5	<5
	SB LTR	N/A	<5	<5
Colborne Street / Sunset Road and Warren Street	EB LR	N/A	<5	8
	NB LT	N/A	<5	<5
	SB T	N/A	<5	<5
	SB R	40	<5	<5

Notes: EB – Eastbound, WB – Westbound, NB – Northbound, SB - Southbound
 L – Left, T – Through, R – Right

Table 6: 2021 Intersection Queuing – Signalized

INTERSECTIONS / MOVEMENTS	AVAILABLE STORAGE (m)	95 th PERCENTILE QUEUE (m)		
		2021 TRAFFIC		
		AM PEAK HOUR	PM PEAK HOUR	HOLIDAY PEAK HOUR
Carlow Road / Union Road and Warren Street / Lake Line	EB LTR	N/A	<5	<5
	WB LTR	N/A	6	9
	NB LT	N/A	6	7
	NB R	30	<5	<5
	SB LTR	N/A	7	8
Colborne Street / Sunset Road and Warren Street	EB LR	N/A	14	16
	NB LT	N/A	14	31
	SB T	N/A	8	35
	SB R	40	<5	7

Notes: EB – Eastbound, WB – Westbound, NB – Northbound, SB - Southbound
L – Left, T – Through, R – Right

The existing queuing results show that the turn lane storage lengths sufficiently accommodate the 95th percentile queues for the existing traffic volumes under both intersection control scenarios.

3 FUTURE BACKGROUND TRAFFIC

Future background traffic forecasts typically include existing traffic with a general growth rate applied, plus traffic anticipated to be generated from specific developments surrounding the study area. For the purposes of this study, horizon years of 2028 and 2040 have been selected for future traffic projections and analysis to be consistent with the horizon years analyzed in the previous traffic studies identified in Section 1.2.

3.1 BACKGROUND GROWTH RATE

For the 2028 and 2040 horizon years, a background growth rate of 0.5% per year has been used, which is based on historic trend of traffic growth on County Road 4 and is consistent with the background growth rate used in the ‘Little Creek West Lands’ TIS.

3.2 BACKGROUND DEVELOPMENT TRAFFIC

The background developments accounted for in the future background traffic in this study are the same background developments that were considered in the ‘Little Creek West Lands’ TIS with the addition of the ‘Little Creek West Lands’ development traffic and traffic from Phase 2 (East Harbour) of the Harbour Secondary Plan, as listed below:

- ‘Seaglass’ residential development
- ‘Lakeview’ mixed use development
- Harbour Secondary Plan (Phase 1 in 2028 and Phase 2 in 2040)
- An unnamed residential development
- ‘Little Creek West Lands’ development

The locations of the background developments are shown in Figure 7.

Figure 7: Background Developments



Aerial Image Source: Google Earth (July 2018 imagery)

The trip generation for the background developments was taken from the 'Little Creek West Lands' TIS, which was based on published rates from the Institute of Transportation Engineers (ITE) *Trip Generation Manual, 9th Edition*. The overall unit counts and trip generation estimates for the background developments are summarized in Table 7.

Table 7: Background Development Trip Generation Summary

Development	Total Units / GFA	AM PEAK HOUR TRIPS			PM PEAK HOUR TRIPS			HOL PEAK HOUR TRIPS		
		IN	OUT	TOTAL	IN	OUT	TOTAL	IN	OUT	TOTAL
'Seaglass'	510	53	205	258	210	113	323	156	133	289
'Lakeview'	60 1,800 ft ²	14	33	47	45	34	81	48	44	92
Harbour Plan – Phase 1 (West Harbour Area 2028)	178 20,274 ft ²	65	120	185	202	164	366	252	230	482
'Unnamed Residential'	96	18	53	71	60	35	95	48	41	89
'Little Creek West Lands'	302	39	120	158	126	75	202	113	100	213
2028 Total	1146 22,074 ft²	189	531	719	643	421	1067	617	548	1165
Harbour Plan – Phase 2 (East Harbour Area 2040)	795 29,276 ft ²	173	380	553	504	362	866	532	474	1,005
2040 Total	1941 51,350 ft²	362	911	1272	1147	783	1933	1149	1022	2170

For the 2028 horizon year, the background development traffic was assigned to the Colborne Street and Warren Street intersection with the same distribution as Dillon used in the 'Little Creek West Lands' TIS. At the Carlow Road and Warren Street intersection, it was assumed that 70% of the 'Seaglass' development and Harbour Secondary Plan traffic that was assigned to Carlow Road in the 'Secondary Plan TAS' would be passing through the intersection, with the majority of the trips being to/from Union Road (only 5-10 trips to/from Lake Line and Warren Street).

Similarly, for the 2040 horizon year, it was assumed that 70% of the Harbour Secondary Plan – Phase 2 traffic that was assigned to Carlow Road and Colborne Street in the 'Secondary Plan TAS' would be passing through the Warren Street intersections, with the majority of the trips being to/from Sunset Road and Union Road (only 5 trips to/from Lake Line and Warren Street).

The 2028 and 2040 combined background developments traffic volumes in the study area are illustrated in Figure 8 and Figure 9, respectively.

Figure 8: 2028 Background Development Traffic

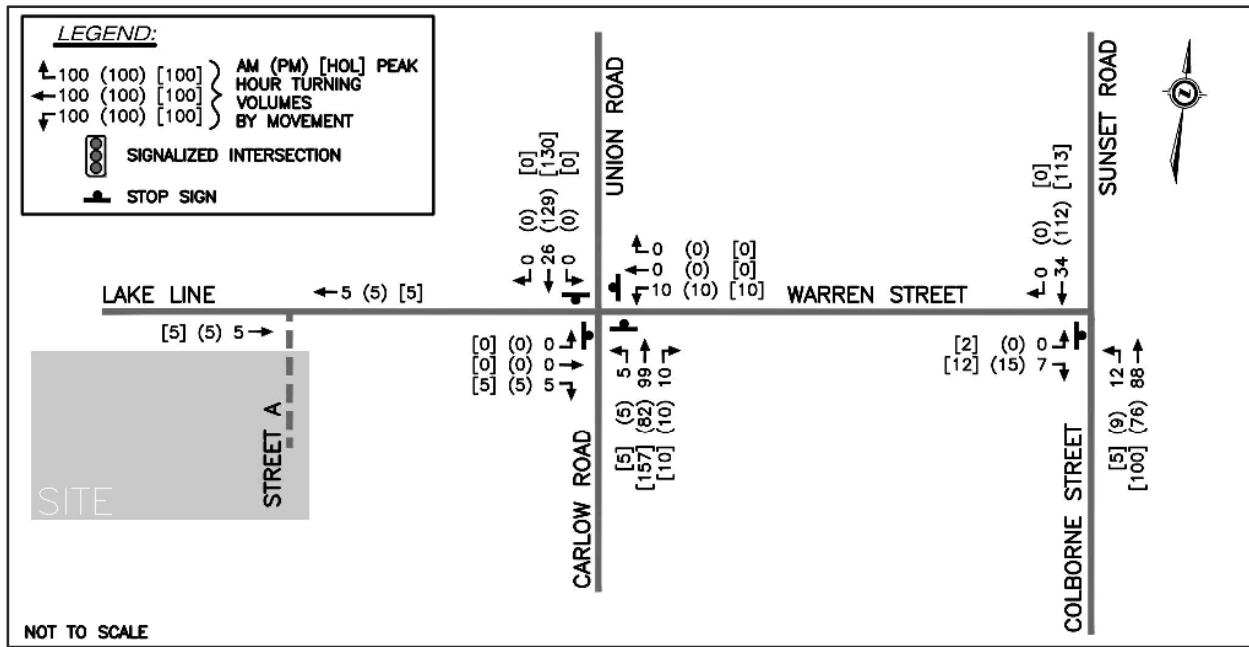
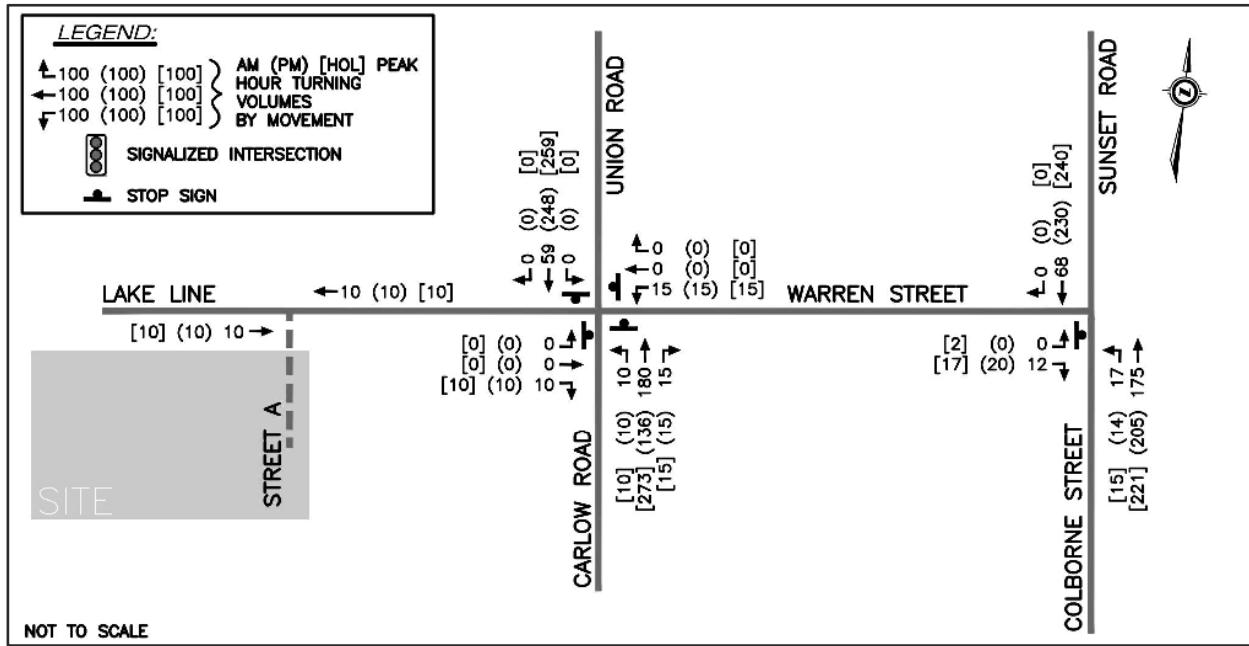


Figure 9: 2040 Background Development Traffic



3.3 FUTURE BACKGROUND TRAFFIC VOLUMES

Combining the background growth rate applied to the existing traffic and the traffic from the five background developments discussed in Section 3.2, the resulting 2028 and 2040 background traffic volumes for the AM, PM and holiday peak hours are presented in Figure 10 and Figure 11, respectively.

Figure 10: 2028 Background Traffic

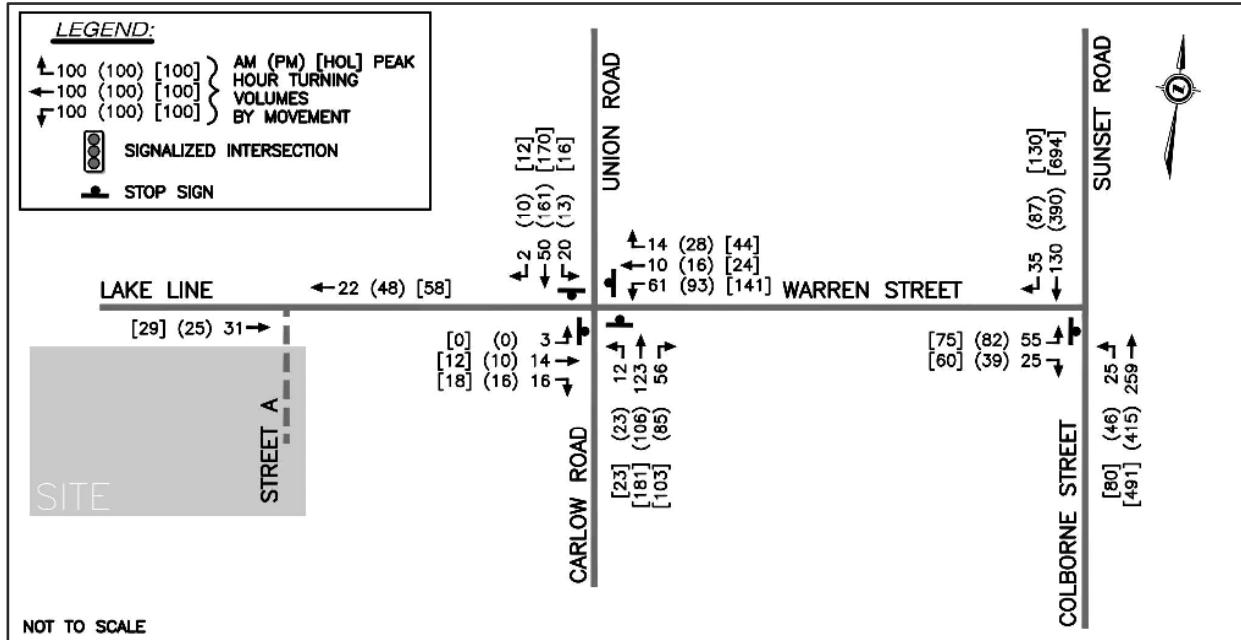
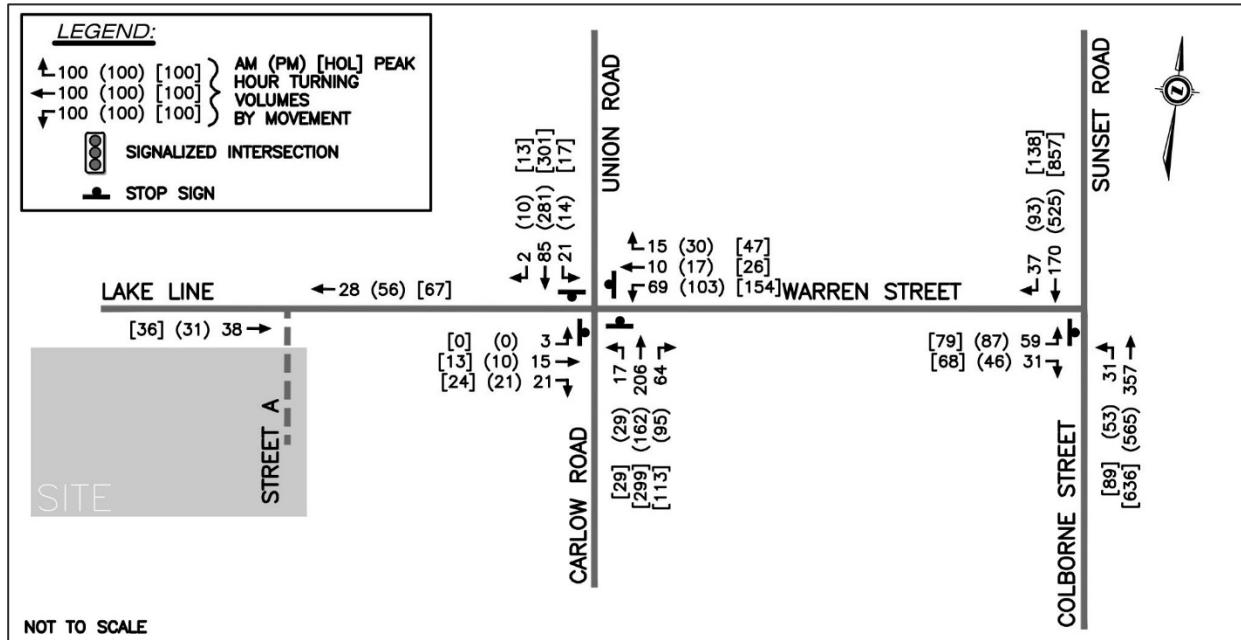


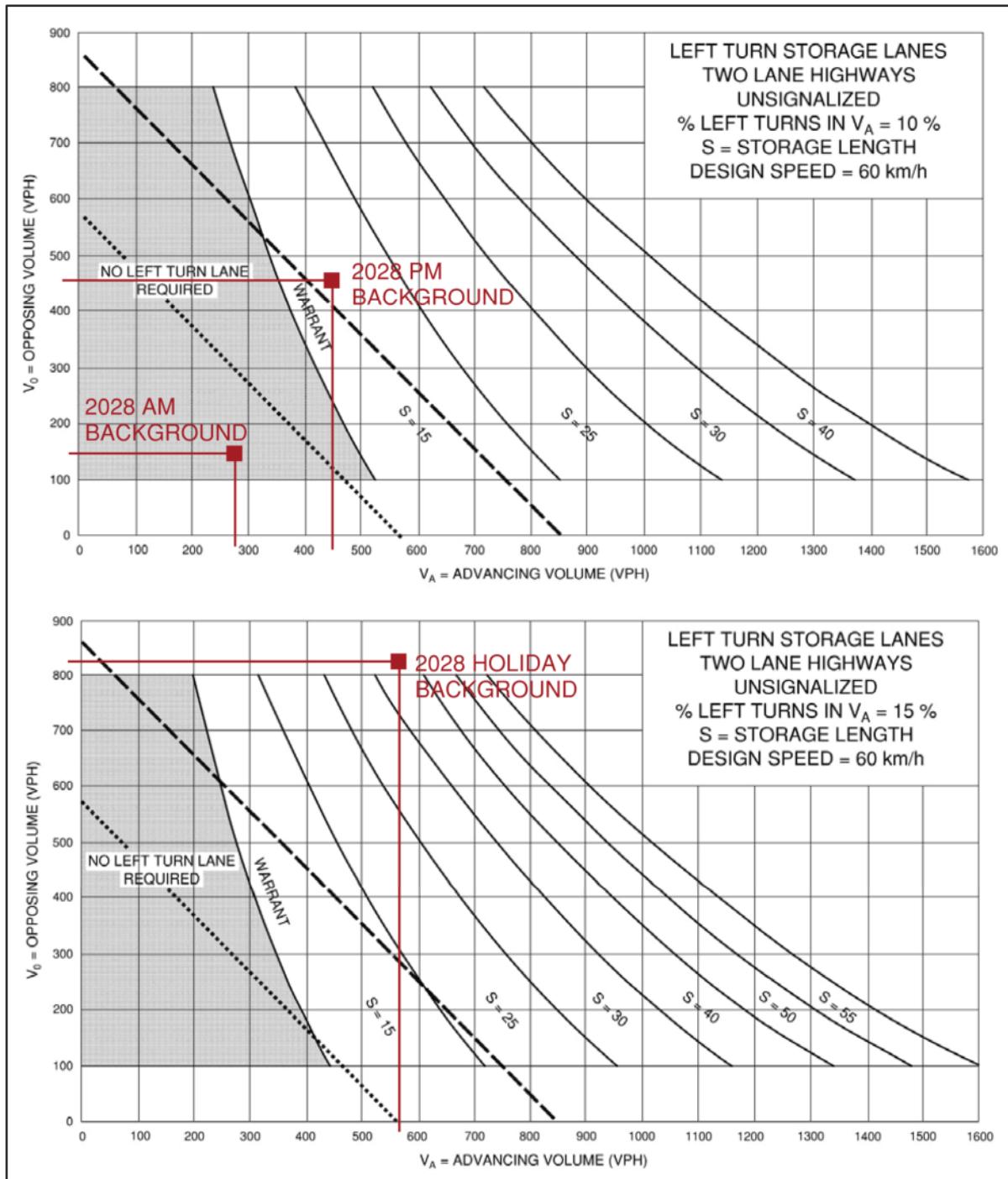
Figure 11: 2040 Background Traffic



3.4 TURNING LANE AND TRAFFIC SIGNAL WARRANTS – FUTURE BACKGROUND TRAFFIC

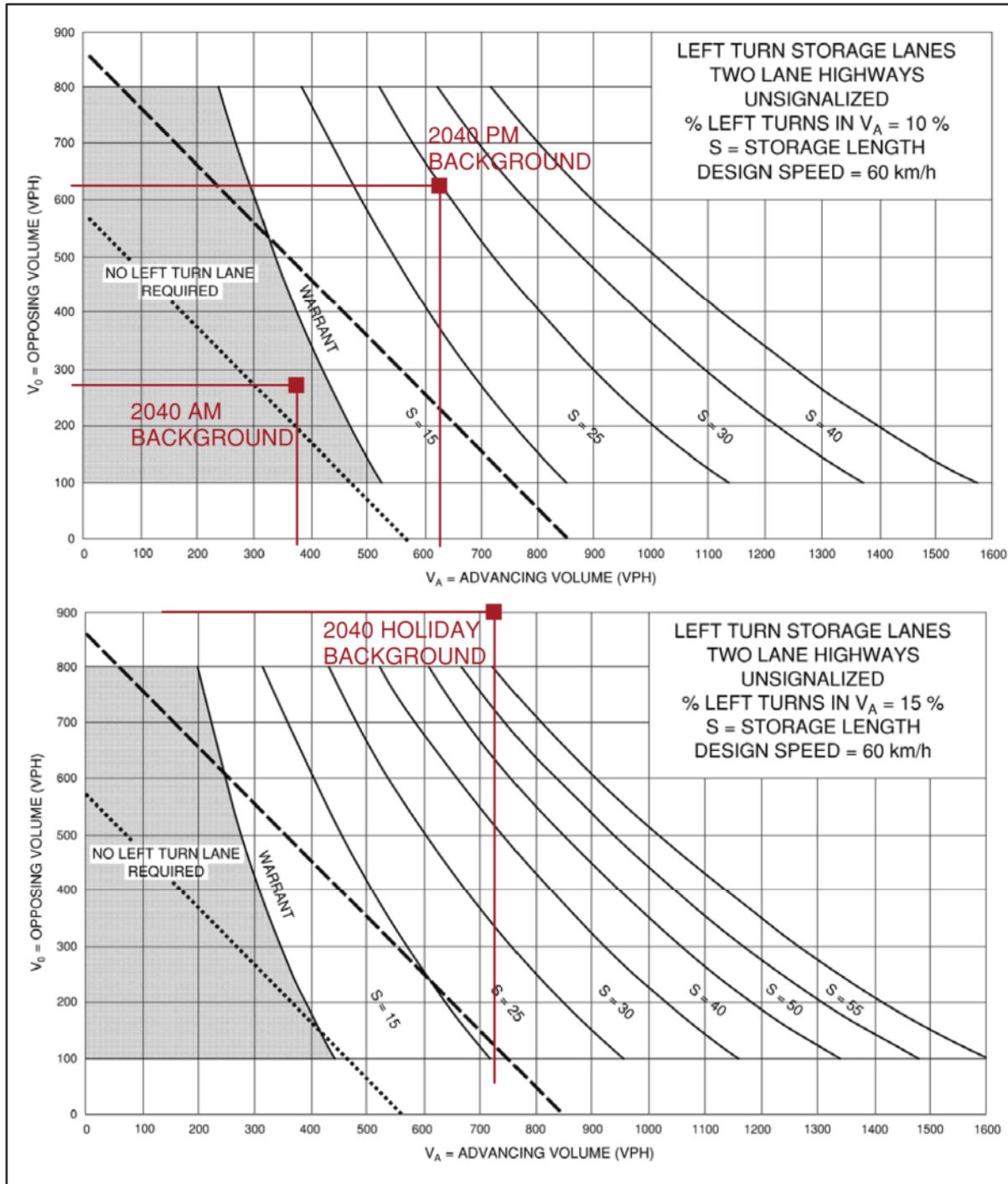
Left turn lane warrants for the northbound approach of Colborne Street at Warren Street were reviewed again based on the future background traffic volumes and the warrant graphs are shown in Figure 12 and Figure 13.

Figure 12: Colborne Street and Warren Street Northbound Left Turn Lane Warrants for 2028 Background Traffic



Source: MTO Design Supplement

Figure 13: Colborne Street and Warren Street Northbound Left Turn Lane Warrants for 2040 Background Traffic



Source: MTO Design Supplement

It is shown that a left turn lane is warranted with 15 m of storage based on the 2028 PM background traffic and the storage requirement increases to 25 m for the 2040 PM background traffic, although it is right at the edge of crossing into the 30 m storage requirement. The future holiday traffic conditions would

warrant 40 m of storage in 2028 and 60 m of storage in 2040. Given the limited occurrence of the holiday peak hour we suggest that the PM peak hour may be a more appropriate design condition, therefore we recommend that the County consider the installation of a northbound left turn lane by 2028 with 30 m of storage, which would fully accommodate the long term PM peak hour storage requirement.

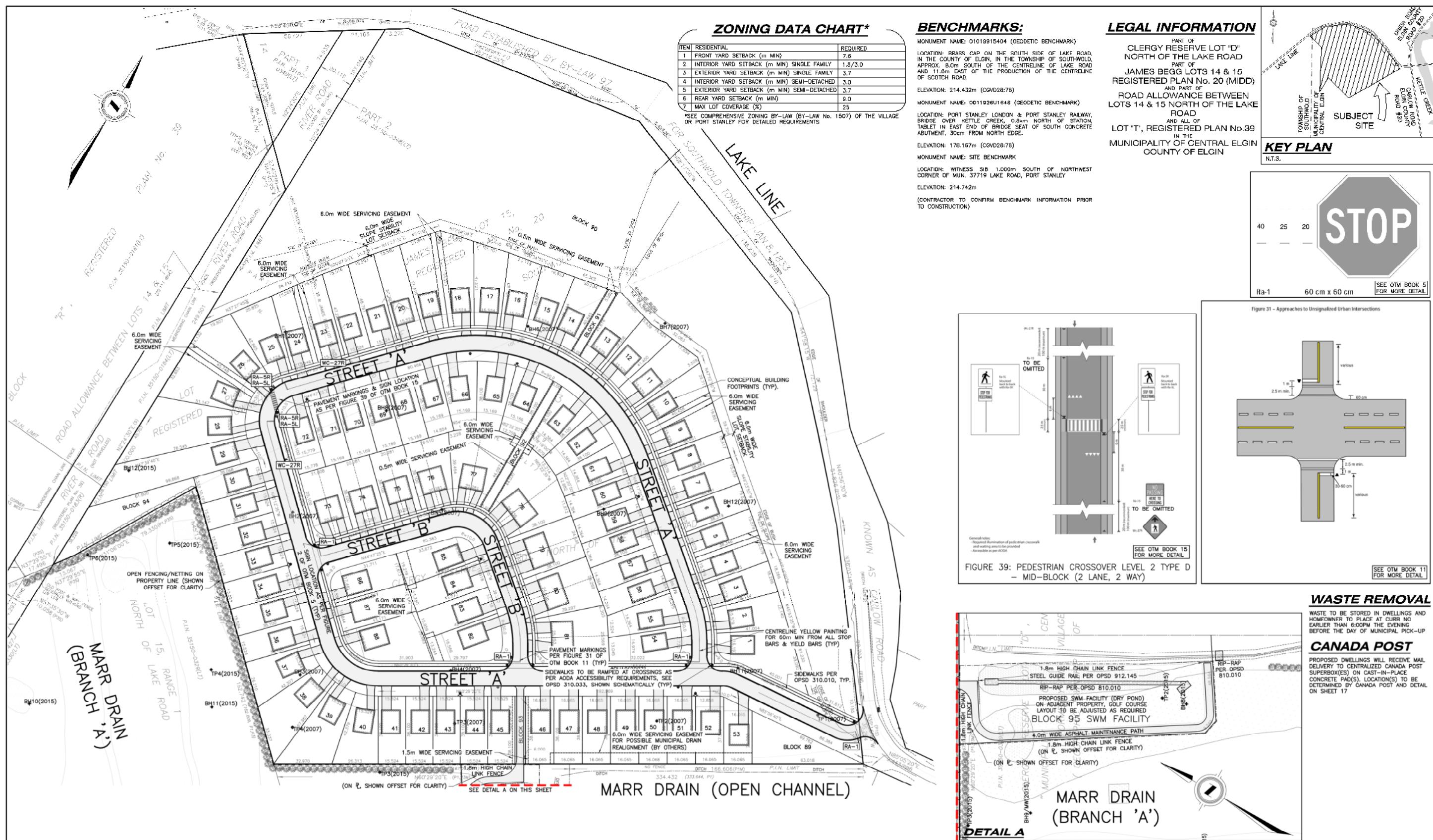
Traffic signal warrant analysis was also revisited for the future background traffic conditions. The analysis (provided in Appendix C) concludes that 2028 and 2040 background traffic volumes do not meet warrants for traffic signals (the highest warrant percentage, for 2040 holiday traffic, reaches only 72% out of the 120% required to meet the warrant).

4 PROPOSED DEVELOPMENT

4.1 SUBDIVISION PLAN

The proposed development will consist of 79 single family detached homes and 18 semi-detached homes. A cropped version of the Subdivision Plan is provided in Figure 14 and a full version of the drawing is provided in Appendix D. As shown on the plan, the subdivision will include two public roads with one road (Street 'A') connecting to Lake Line. The intersection at Lake Line will be stop controlled and allow for movements in all directions.

Figure 14: Subdivision Plan



4.2 SITE TRAFFIC GENERATION AND DISTRIBUTION

Site generated traffic volumes from the proposed development have been estimated based on trip rate information contained in the ITE *Trip Generation Manual, 10th Edition* (September 2017). “Single Family Detached” (Land Use Code 210) and “Multifamily Housing (Low-Rise)” (Land Use Code 220) were used for trip generation estimates, which are summarized in Table 8. The holiday peak hour trips were based on trip generation data for a Saturday peak hour.

Table 8: Trip Generation Summary

ITE LAND USE DESCRIPTION	# UNITS	AM PEAK HOUR TRIPS			PM PEAK HOUR TRIPS			HOL PEAK HOUR TRIPS		
		IN	OUT	TOTAL	IN	OUT	TOTAL	IN	OUT	TOTAL
Single Family Detached Housing LUC 210	79	15	46	61	51	30	81	45	39	84
Multifamily Housing (Low-Rise) LUC 220	18	2	7	9	8	5	13	7	6	13
Total Trips		17	53	70	59	35	94	52	45	97

As shown in Table 8, the new trip generation (two-way) for the proposed development is forecast to be 70, 94, and 97 trips in the AM, PM and holiday peak hours, respectively. This is a relatively minor amount of new traffic and in many municipalities would not even be enough to warrant the undertaking of a Transportation Impact Study. It is also worth noting that the trip generation for this development will represent less than 6% of the total new traffic forecasted from all of the other planned developments in Port Stanley (i.e. background developments discussed in Section 3.2).

The forecast development traffic has been distributed over the road network based on a combination of the existing traffic patterns in the study area and expected origin/destinations. Table 9 summarizes the trip distribution applied in this study.

Table 9: New Trip Distribution Summary

DIRECTION TO / FROM	VIA	AM	PM	HOLIDAY
North	Union Road	5%	5%	10%
	Sunset Road	45%	35%	30%
South	Carlow Road	35%	45%	40%
	Colborne Street	15%	15%	20%
West	Lake Line	0%	0%	0%
Total		100%		100%

The resulting site traffic from the proposed development is illustrated in Figure 15.

Figure 15: Site Traffic

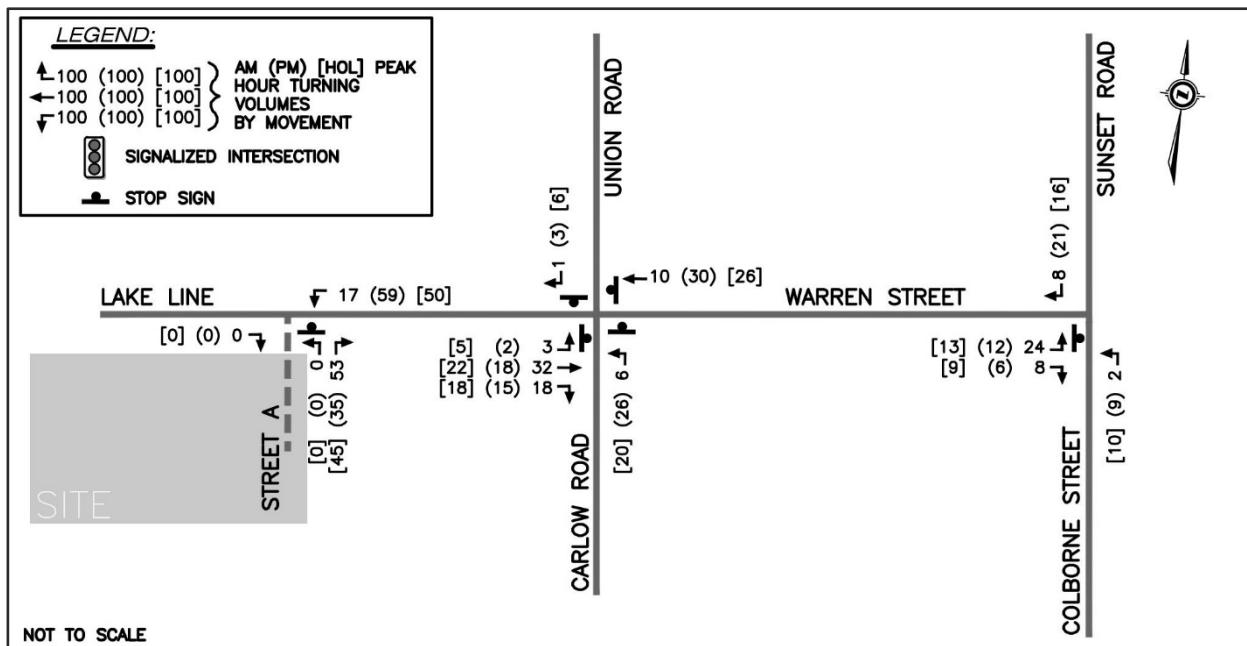


Figure 15 shows that the site traffic has directional volumes of less than 60 vehicles per hour (i.e. average of 1 vehicle per minute) during the various peak hours, and these volumes are further dispersed at the Carlow Road and Warren Street intersection.

The highest volumes to/from outside of the study area are on Carlow Road, but they are at most 18 trips southbound and 26 trips northbound during any peak hour. It can be assumed that many of these trips will be to/from the various attractions on Carlow Road (e.g. Kettle Creek Public School, Kettle Creek Golf & Country Club, Port Stanley Arena & Community Centre, multiple marinas, LCBO, etc.), so the volume of site traffic reaching Bridge Street will be further reduced and will not have any noticeable impact on the traffic operations on Bridge Street, particularly in relation to the significant traffic anticipated from the background developments. Therefore, we are confident that the extents of the study area are appropriate for identifying the relevant traffic impact of this development.

4.3 ACCESS CONSIDERATIONS

Access to the subdivision is proposed via a new local road (Street 'A') that will connect to Lake Line approximately 60 m west of Carlow Road (measured centerline to centerline). The intersection of Lake Line and Street 'A' will allow for movements in all directions (i.e. no prohibited turn movements) with one lane in each direction on Street 'A'. Additional analysis and considerations related to the Street 'A' intersection are presented in the following subsections.

4.3.1 SIGHT DISTANCES

As part of the site visit conducted for this study, sightlines at the proposed intersection location of Street 'A' at Lake Line were reviewed with respect to Transportation Association of Canada (TAC) guidelines for sight distances. Sightlines are unrestricted along Lake Line to the east of the intersection location. To the northwest, the combination of horizontal and vertical curves on Lake Line limits the visibility to a distance of 155 m, however, this is greater than the minimum intersection sight distance of

130 m recommended by TAC for turning movements from a stop condition on the minor road at a design speed of 60 km/h.

For the westbound vehicles on Lake Line that will turn left onto Street 'A', a sight distance of at least 145 m to the west (northwest) is available to see oncoming vehicles, which meets the TAC requirements for a 60 km/h design speed (minimum 95 m sight distance).

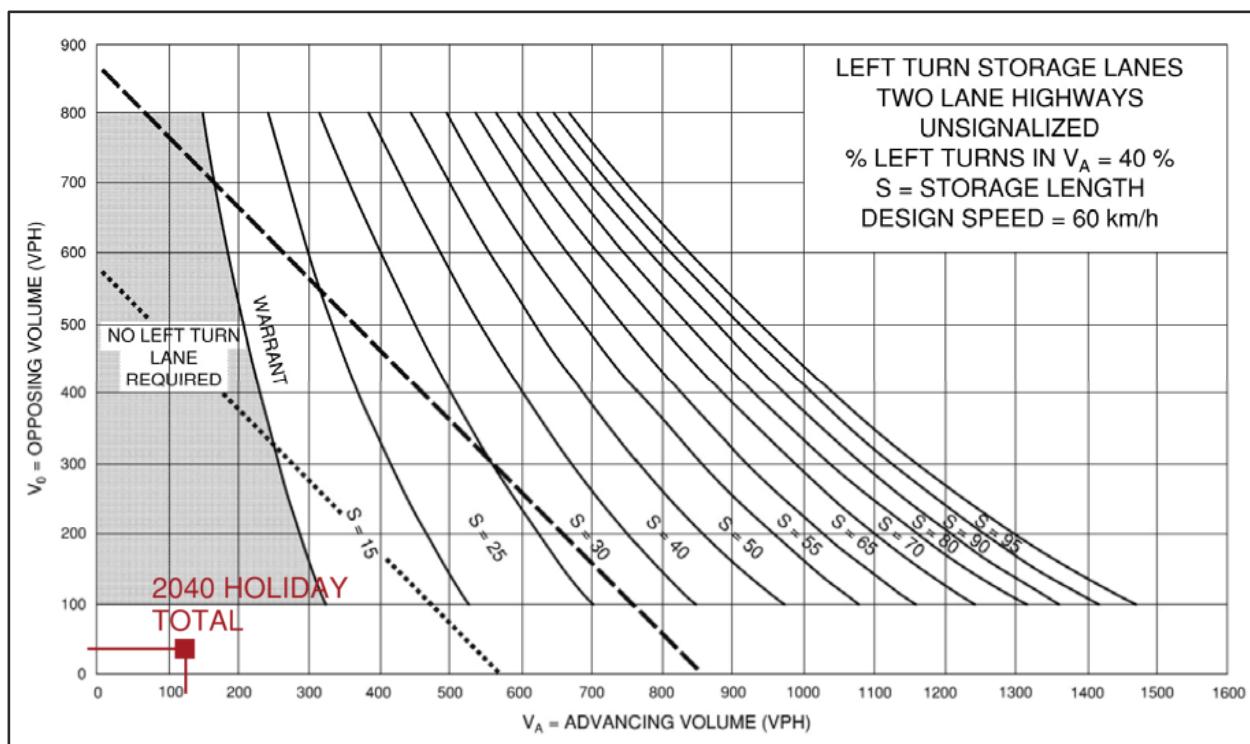
Based on the above there are no visibility concerns for the proposed Street 'A' intersection with Lake Line.

Sightline analysis sheets are provided in Appendix E.

4.3.2 LEFT TURN LANE WARRANTS – LAKE LINE AT STREET 'A'

Left turn lane requirements for Street 'A' were reviewed based on warrant graphs from the MTO Design Supplement. The warrant graph for the worst case scenario (2040 holiday total traffic) is shown in Figure 16, which shows that a left turn lane is not warranted throughout the horizon period.

Figure 16: Lake Line and Proposed Street 'A' Left Turn Lane Warrant



Source: MTO Design Supplement

4.3.3 PEDESTRIAN AND CYCLIST ACCESS

Sidewalks are proposed on one side of all streets within the Kettle Creek Subdivision, which will provide good pedestrian access within the development.

Since Lake Line does not currently have a sidewalk, we suggest that consideration be given to the construction of a sidewalk on Lake Line between Carlow Road and Street 'A' to provide a connection to the existing sidewalk network.

Since there are no existing or planned designated cycling facilities in the study area, cyclists will need to share lanes with vehicular traffic.

5 FUTURE TOTAL TRAFFIC

The total future traffic is determined by combining the development traffic (site traffic) from Section 4.2 with the future background traffic from Section 3.3. The resulting 2028 and 2040 total traffic volumes for the AM, PM and holiday peak hours are shown in Figure 17 and Figure 18, respectively.

Figure 17: 2028 Total Traffic

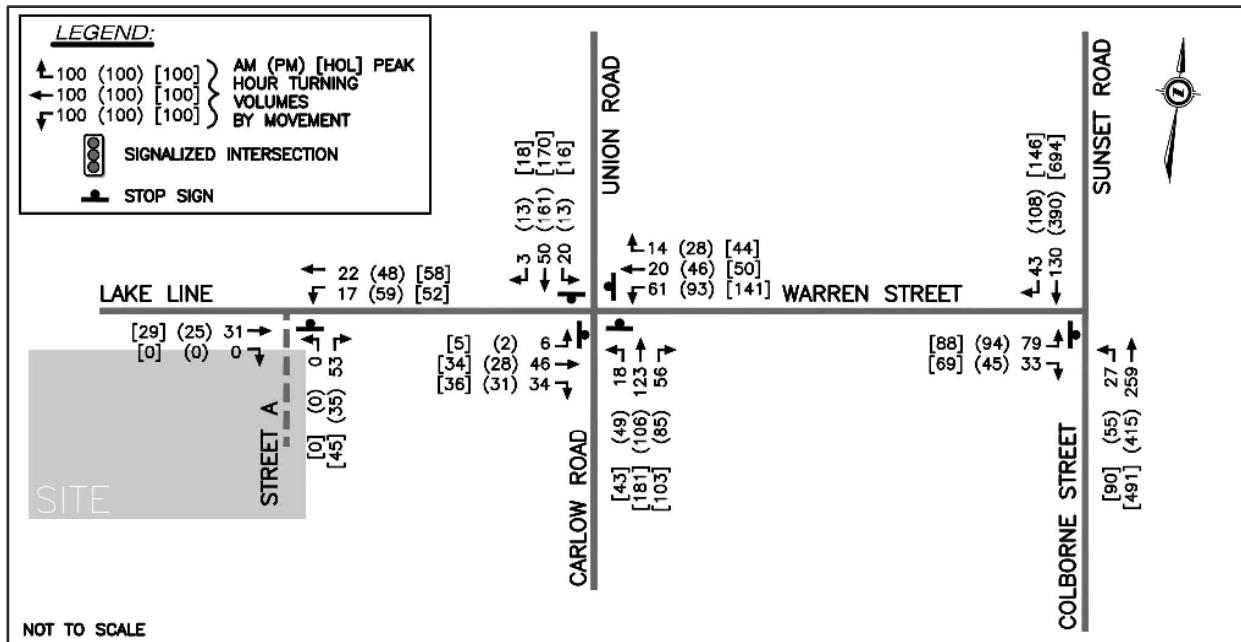
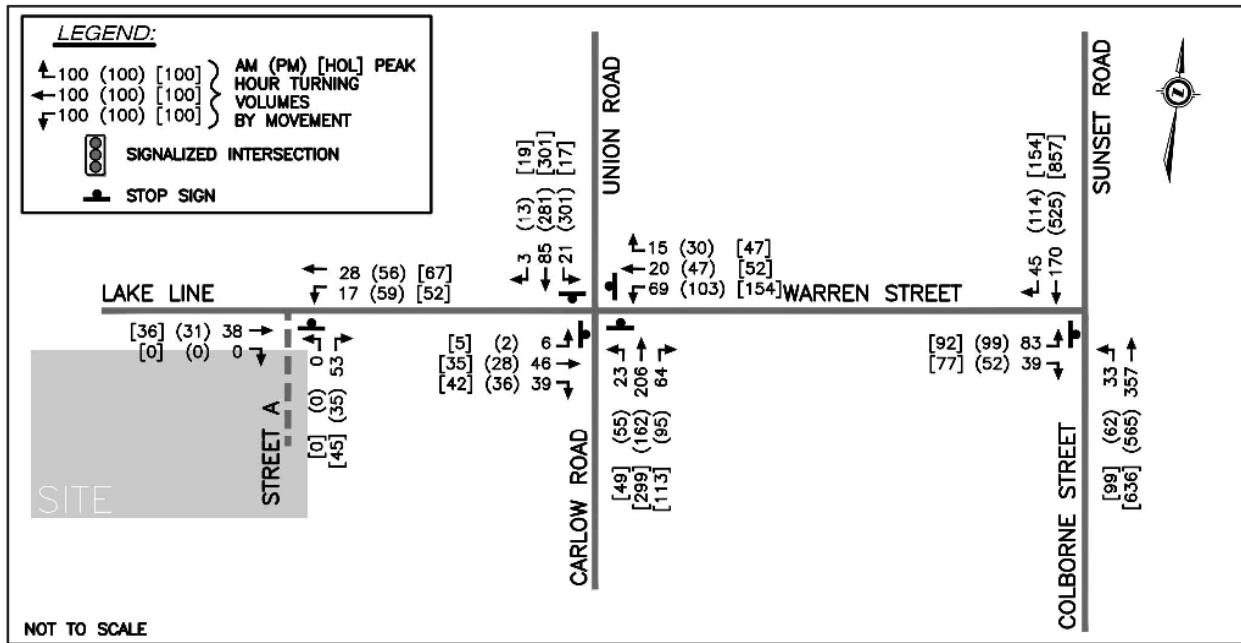


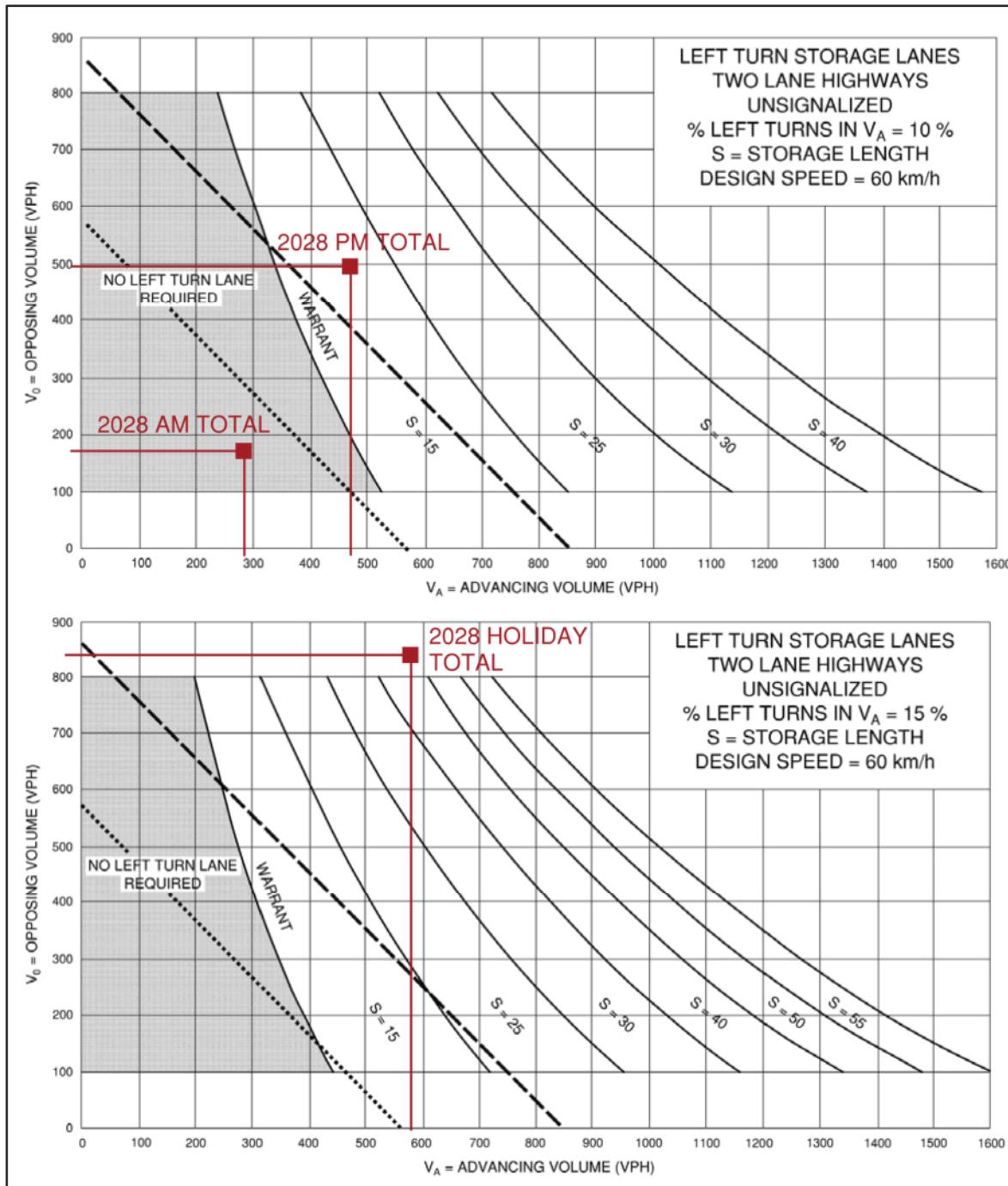
Figure 18: 2040 Total Traffic



5.1 TURNING LANE AND TRAFFIC SIGNAL WARRANTS – FUTURE TOTAL TRAFFIC

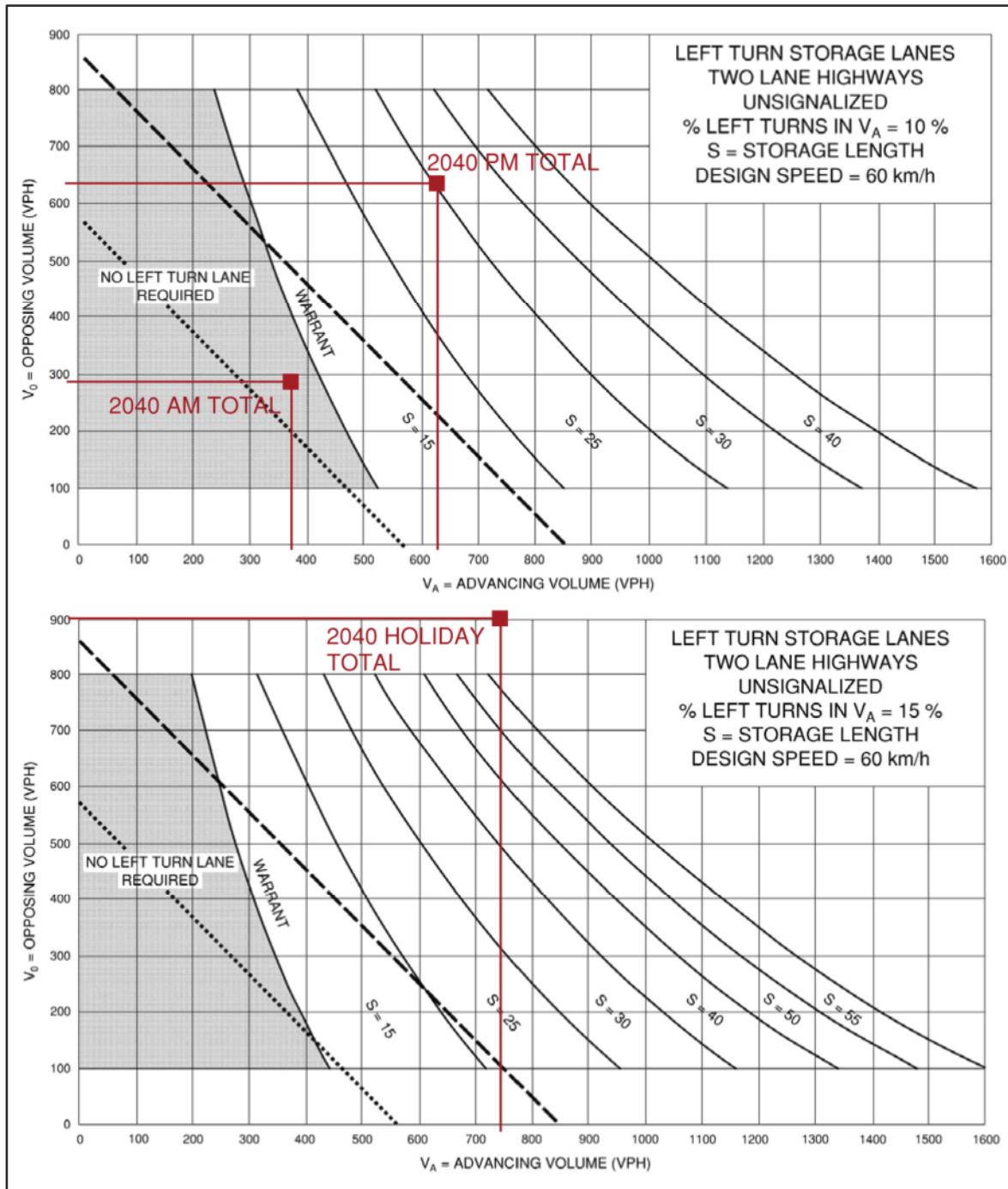
Left turn lane warrants for the northbound approach of Colborne Street at Warren Street were reviewed again based on the future total traffic volumes and the warrant graphs are shown in Figure 19 and Figure 20.

Figure 19: Colborne Street and Warren Street Northbound Left Turn Lane Warrants for 2028 Total Traffic



Source: MTO Design Supplement

Figure 20: Colborne Street and Warren Street Northbound Left Turn Lane Warrants for 2040 Total Traffic



Source: MTO Design Supplement

From the above figures, we can see that a left turn lane is warranted with 15 m of storage for the 2028 PM total traffic and the storage requirement increases to 30 m for the 2040 PM total traffic. The future holiday traffic conditions would warrant 40 m of storage in 2028 and 60 m of storage in 2040. As previously stated, we recommend that the County consider the installation of a northbound left turn lane by 2028 with 30 m of storage to accommodate the 2040 PM peak hour storage requirement.

Traffic signal warrant analysis was also conducted again for the future total traffic conditions. The analysis (provided in Appendix C) concludes that 2028 and 2040 total traffic volumes do not meet warrants for traffic signals (the highest warrant percentage, for 2040 holiday traffic, reaches only 79% out of the 120% required to meet the warrant for a future condition).

6 FUTURE TRAFFIC OPERATIONAL ANALYSIS

Intersection operations were re-assessed for future background and total traffic conditions. The results for the 2028 and 2040 horizon years are presented and discussed in the following subsections.

6.1 2028 INTERSECTION OPERATIONS

The results of the operational analysis for the 2028 background and total traffic conditions are summarized in Table 10 and Table 11 for unsignalized and signalized control, respectively. Detailed Synchro reports for the 2028 background and total traffic conditions are available in Appendix F and Appendix G, respectively.

From the results in Table 10, we can see that the Carlow Road and Warren Street intersection will continue to function well with AWSC through 2028 and there are no operational concerns with the proposed Lake Line and Street 'A' intersection.

The Colborne Street and Warren Street intersection will operate well during the 2028 AM and PM peak hours, but the eastbound movement exhibits longer delay at LOS F during the holiday peak hour and reaches a v/c ratio of 0.99 under the 2028 total traffic volumes. Since this would only occur for a short period of time during the peak summer weekends, we suggest that this condition could be considered tolerable, but beyond 2028, as Phase 2 of the Harbour Secondary Plan begins to develop, additional capacity will be required. The addition of an eastbound left turn lane is an option that would provide some additional capacity and significantly reduce the delay for the right turn movement (as was recommended in the 'Little Creek West Lands' TIS), which is evaluated and discussed in more detail in Section 6.3.

Signalization of the Colborne Street and Warren Street intersection would also provide additional capacity for the eastbound movement, as shown by the results in Table 11 which indicate that both Warren Street intersections would operate acceptably through 2028 as signalized intersections. All movements at Carlow Road and Warren Street would be at LOS B or better with the maximum v/c ratio reaching only 0.52. At Colborne Street and Warren Street, all movements would be at LOS C or better with the maximum v/c ratio reaching 0.86.

Queuing results for the 2028 background and total traffic conditions were reviewed from the Synchro analysis to compare 95th percentile queue with the available storage lengths and the results are presented in Table 12 and Table 13 for unsignalized and signalized control, respectively.

Table 10: 2028 Intersection Operations Summary – Unsignalized

INTERSECTIONS / MOVEMENTS	2028 BACKGROUND									2028 TOTAL									
	AM PEAK HOUR			PM PEAK HOUR			HOLIDAY PEAK HOUR			AM PEAK HOUR			PM PEAK HOUR			HOLIDAY PEAK HOUR			
	V/C	LOS	DELAY	V/C	LOS	DELAY	V/C	LOS	DELAY	V/C	LOS	DELAY	V/C	LOS	DELAY	V/C	LOS	DELAY	
Carlow Road / Union Road and Warren Street / Lake Line	EB LTR	0.04	A	8	0.04	A	8	0.05	A	9	0.12	A	8	0.09	A	9	0.13	A	9
	WB LTR	0.12	A	8	0.21	A	9	0.34	B	11	0.14	A	9	0.26	A	10	0.40	B	12
	NB LT	0.20	A	8	0.21	A	8	0.34	A	10	0.22	A	8	0.26	A	9	0.40	B	12
	NB R	0.07	A	6	0.11	A	7	0.15	A	8	0.07	A	7	0.12	A	7	0.16	A	8
	SB LTR	0.10	A	8	0.26	A	9	0.31	B	11	0.11	A	8	0.28	A	10	0.34	B	11
Colborne Street / Sunset Road and Warren Street	EB LR	0.14	B	12	0.40	C	23	0.81	F	78	0.20	B	12	0.48	D	26	0.99	F	119
	NB LT	0.02	A	1	0.05	A	1	0.11	A	3	0.02	A	1	0.06	A	2	0.13	A	3
	SB T	0.08	A	0	0.25	A	0	0.44	A	0	0.08	A	0	0.25	A	0	0.44	A	0
	SB R	0.02	A	0	0.06	A	0	0.08	A	0	0.03	A	0	0.07	A	0	0.09	A	0
Lake Line and Street 'A'	EB TR									0.02	A	0	0.02	A	0	0.02	A	0	
	WB LT		N/A							0.01	A	3	0.04	A	4	0.04	A	4	
	NB LR									0.06	A	9	0.04	A	9	0.05	A	9	

Notes: V/C - Volume to Capacity Ratio, LOS – Level of Service, Delay = Average Delay in Seconds
EB – Eastbound, WB – Westbound, NB – Northbound, SB - Southbound
L – Left, T – Through, R – Right

Table 11: 2028 Intersection Operations Summary – Signalized

INTERSECTIONS / MOVEMENTS	2028 BACKGROUND									2028 TOTAL									
	AM PEAK HOUR			PM PEAK HOUR			HOLIDAY PEAK HOUR			AM PEAK HOUR			PM PEAK HOUR			HOLIDAY PEAK HOUR			
	V/C	LOS	DELAY	V/C	LOS	DELAY	V/C	LOS	DELAY	V/C	LOS	DELAY	V/C	LOS	DELAY	V/C	LOS	DELAY	
Carlow Road / Union Road and Warren Street / Lake Line	Overall	0.24	A	10	0.38	A	9	0.51	B	11	0.26	B	11	0.38	B	11	0.52	B	11
	EB LTR	0.07	B	13	0.05	B	13	0.06	B	13	0.20	B	13	0.13	B	13	0.17	B	14
	WB LTR	0.12	A	6	0.25	A	7	0.42	A	8	0.13	A	6	0.25	A	7	0.40	A	9
	NB LT	0.36	B	12	0.33	B	12	0.48	B	13	0.38	B	13	0.43	B	13	0.52	B	13
	NB R	0.04	A	7	0.06	A	7	0.07	A	7	0.04	A	7	0.06	A	7	0.07	A	7
	SB LTR	0.21	B	12	0.44	B	12	0.45	B	12	0.21	B	12	0.44	B	13	0.43	B	12
Colborne Street / Sunset Road and Warren Street	Overall	0.29	A	7	0.58	B	10	0.81	B	15	0.32	B	15	0.59	B	11	0.90	B	18
	EB LR	0.40	C	26	0.42	B	18	0.69	D	36	0.40	C	23	0.47	B	18	0.64	C	30
	NB LT	0.24	A	3	0.48	A	6	0.75	A	9	0.26	A	4	0.51	A	6	0.86	B	17
	SB T	0.11	A	3	0.63	B	13	0.82	B	17	0.12	A	4	0.63	B	14	0.82	B	18
	SB R	0.02	A	3	0.06	A	9	0.09	A	7	0.03	A	4	0.07	A	9	0.10	A	8

Notes: V/C - Volume to Capacity Ratio, LOS – Level of Service, Delay = Average Delay in Seconds
EB – Eastbound, WB – Westbound, NB – Northbound, SB - Southbound
L – Left, T – Through, R – Right

Table 12: 2028 Intersection Queuing Summary – Unsignalized

INTERSECTIONS / MOVEMENTS	AVAILABLE STORAGE (m)	95 th PERCENTILE QUEUE (m)					
		2028 BACKGROUND			2028 TOTAL		
		AM PEAK HOUR	PM PEAK HOUR	HOL PEAK HOUR	AM PEAK HOUR	PM PEAK HOUR	HOL PEAK HOUR
Carlow Road / Union Road and Warren Street / Lake Line	EB LTR	N/A	<5	<5	<5	<5	<5
	WB LTR	N/A	<5	6	11	<5	7
	NB LT	N/A	6	6	11	6	7
	NB R	30	<5	<5	<5	<5	<5
	SB LTR	N/A	<5	<5	10	<5	8
Colborne Street / Sunset Road and Warren Street	EB LR	N/A	<5	14	43	6	19
	NB LT	N/A	<5	<5	<5	<5	<5
	SB T	N/A	<5	<5	<5	<5	<5
	SB R	40	<5	<5	<5	<5	<5
Lake Line and Street 'A'	NB LR	N/A	N/A			<5	<5
Notes: EB – Eastbound, WB – Westbound, NB – Northbound, SB - Southbound L – Left, T – Through, R – Right							

Table 13: 2028 Intersection Queuing Summary – Signalized

INTERSECTIONS / MOVEMENTS	AVAILABLE STORAGE (m)	95 th PERCENTILE QUEUE (m)					
		2028 BACKGROUND			2028 TOTAL		
		AM PEAK HOUR	PM PEAK HOUR	HOL PEAK HOUR	AM PEAK HOUR	PM PEAK HOUR	HOL PEAK HOUR
Carlow Road / Union Road and Warren Street / Lake Line	EB LTR	N/A	6	5	6	12	9
	WB LTR	N/A	8	13	21	9	16
	NB LT	N/A	18	17	28	20	21
	NB R	30	<5	<5	<5	<5	<5
	SB LTR	N/A	11	22	26	11	23
Colborne Street / Sunset Road and Warren Street	EB LR	N/A	15	21	33	19	24
	NB LT	N/A	23	40	46	25	43
	SB T	N/A	11	50	96	12	52
	SB R	40	<5	6	6	3	7
Notes: EB – Eastbound, WB – Westbound, NB – Northbound, SB - Southbound L – Left, T – Through, R – Right							

The 2028 queuing results show that the turn lane storage lengths will continue to sufficiently accommodate the 95th percentile queues for the 2028 traffic volumes under both intersection control scenarios, therefore there are no queueing concerns.

6.2 2040 INTERSECTION OPERATIONS

The results of the operational analysis for the 2040 background and total traffic conditions are summarized in Table 14 and Table 15 for unsignalized and signalized control, respectively. Detailed Synchro reports for the 2040 background and total traffic conditions are available in Appendix H and Appendix I, respectively.

From the results in Table 14, we can see that the Carlow Road and Warren Street intersection will continue to function well as an AWSC intersection through 2040 and there are no operational concerns with the proposed Lake Line and Street 'A' intersection through 2040.

The Colborne Street and Warren Street intersection will operate acceptably during the 2040 AM and PM peak hours, but the Warren Street approach will be significantly over capacity with extreme delay during the holiday peak hour under stop control, indicating that intersection improvements will be required to accommodate the 2040 traffic.

The results in Table 15 show that the Carlow Road and Warren Street intersection would operate well in 2040 as a signalized intersection. For the Colborne Street and Warren Street intersection, signalization would provide acceptable operations during the AM and PM peaks, but the intersection would essentially reach capacity during the holiday peak hour, therefore some additional improvements (above signalization) may be required in the long term, which are discussed further in the next subsection.

Queuing results for the 2040 background and total traffic conditions were reviewed from the Synchro analysis to compare 95th percentile queue with the available storage lengths and the results are presented in Table 16 and Table 17 for unsignalized and signalized control, respectively.

Table 14: 2040 Intersection Operations Summary – Unsignalized

INTERSECTIONS / MOVEMENTS	2040 BACKGROUND									2040 TOTAL									
	AM PEAK HOUR			PM PEAK HOUR			HOLIDAY PEAK HOUR			AM PEAK HOUR			PM PEAK HOUR			HOLIDAY PEAK HOUR			
	V/C	LOS	DELAY	V/C	LOS	DELAY	V/C	LOS	DELAY	V/C	LOS	DELAY	V/C	LOS	DELAY	V/C	LOS	DELAY	
Carlow Road / Union Road and Warren Street / Lake Line	EB LTR	0.06	A	8	0.05	A	9	0.07	A	10	0.14	A	9	0.11	A	10	0.17	B	11
	WB LTR	0.14	A	9	0.25	B	10	0.42	B	14	0.16	A	9	0.32	B	11	0.50	C	16
	NB LT	0.34	A	9	0.32	A	10	0.60	B	16	0.36	A	9	0.39	B	11	0.68	C	21
	NB R	0.08	A	7	0.14	A	7	0.18	A	8	0.09	A	7	0.14	A	8	0.20	A	9
	SB LTR	0.16	A	9	0.46	B	12	0.56	C	16	0.16	A	9	0.49	B	13	0.62	C	19
Colborne Street / Sunset Road and Warren Street	EB LR	0.19	B	14	0.67	E	50	1.41	F	299	0.26	B	15	0.78	F	65	1.71	F	426
	NB LT	0.03	A	1	0.06	A	2	0.15	A	4	0.03	A	1	0.07	A	2	0.17	A	5
	SB T	0.11	A	0	0.34	A	0	0.55	A	0	0.11	A	0	0.34	A	0	0.55	A	0
	SB R	0.02	A	0	0.06	A	0	0.09	A	0	0.03	A	0	0.07	A	0	0.10	A	0
Lake Line and Street 'A'	EB TR									0.02	A	0	0.02	A	0	0.02	A	0	
	WB LT		N/A							0.01	A	3	0.04	A	4	0.04	A	3	
	NB LR									0.06	A	9	0.04	A	9	0.05	A	9	

Notes: V/C - Volume to Capacity Ratio, LOS – Level of Service, Delay = Average Delay in Seconds
EB – Eastbound, WB – Westbound, NB – Northbound, SB - Southbound
L – Left, T – Through, R – Right

Table 15: 2040 Intersection Operations Summary – Signalized

INTERSECTIONS / MOVEMENTS	2040 BACKGROUND									2040 TOTAL									
	AM PEAK HOUR			PM PEAK HOUR			HOLIDAY PEAK HOUR			AM PEAK HOUR			PM PEAK HOUR			HOLIDAY PEAK HOUR			
	V/C	LOS	DELAY	V/C	LOS	DELAY	V/C	LOS	DELAY	V/C	LOS	DELAY	V/C	LOS	DELAY	V/C	LOS	DELAY	
Carlow Road / Union Road and Warren Street / Lake Line	Overall	0.33	B	11	0.51	A	11	0.62	B	13	0.34	B	12	0.50	B	11	0.63	B	13
	EB LTR	0.08	B	14	0.05	B	14	0.06	B	15	0.21	B	14	0.14	B	15	0.17	B	16
	WB LTR	0.14	A	7	0.33	A	9	0.49	B	11	0.15	A	7	0.32	A	9	0.47	B	11
	NB LT	0.50	B	12	0.39	B	11	0.62	B	14	0.51	B	13	0.49	B	12	0.65	B	15
	NB R	0.04	A	7	0.06	A	7	0.08	A	7	0.04	A	7	0.06	A	7	0.08	A	7
	SB LTR	0.26	B	13	0.58	B	13	0.61	B	14	0.26	B	12	0.59	B	13	0.59	B	13
Colborne Street / Sunset Road and Warren Street	Overall	0.37	A	7	0.72	B	12	0.96	C	21	0.40	A	8	0.77	B	13	1.01	C	28
	EB LR	0.34	C	25	0.51	C	21	0.79	E	61	0.45	C	25	0.60	C	24	0.99	F	110
	NB LT	0.34	A	4	0.67	A	8	0.94	C	26	0.35	A	5	0.71	A	9	0.97	C	32
	SB T	0.14	A	4	0.72	B	15	0.75	B	13	0.15	A	4	0.72	B	15	0.74	B	12
	SB R	0.03	A	3	0.06	A	8	0.10	A	6	0.03	A	3	0.08	A	8	0.12	A	5

Notes: V/C - Volume to Capacity Ratio, LOS – Level of Service, Delay = Average Delay in Seconds
EB – Eastbound, WB – Westbound, NB – Northbound, SB - Southbound
L – Left, T – Through, R – Right

Table 16: 2040 Intersection Queuing Summary – Unsignalized

INTERSECTIONS / MOVEMENTS	AVAILABLE STORAGE (m)	95 th PERCENTILE QUEUE (m)					
		2040 BACKGROUND			2040 TOTAL		
		AM PEAK HOUR	PM PEAK HOUR	HOL PEAK HOUR	AM PEAK HOUR	PM PEAK HOUR	HOL PEAK HOUR
Carlow Road / Union Road and Warren Street / Lake Line	EB LTR	N/A	<5	<5	<5	<5	<5
	WB LTR	N/A	<5	6	15	<5	10
	NB LT	N/A	10	10	28	11	13
	NB R	30	<5	<5	<5	<5	<5
	SB LTR	N/A	<5	17	24	<5	20
Colborne Street / Sunset Road and Warren Street	EB LR	N/A	5	31	85	8	41
	NB LT	N/A	<5	<5	<5	<5	<5
	SB T	N/A	<5	<5	<5	<5	<5
	SB R	40	<5	<5	<5	<5	<5
Lake Line and Street 'A'	NB LR	N/A	N/A			<5	<5
Notes: EB – Eastbound, WB – Westbound, NB – Northbound, SB – Southbound L – Left, T – Through, R – Right							

Table 17: 2040 Intersection Queuing Summary – Signalized

INTERSECTIONS / MOVEMENTS	AVAILABLE STORAGE (m)	95 th PERCENTILE QUEUE (m)					
		2040 BACKGROUND			2040 TOTAL		
		AM PEAK HOUR	PM PEAK HOUR	HOL PEAK HOUR	AM PEAK HOUR	PM PEAK HOUR	HOL PEAK HOUR
Carlow Road / Union Road and Warren Street / Lake Line	EB LTR	N/A	7	6	7	13	10
	WB LTR	N/A	10	18	29	12	21
	NB LT	N/A	27	23	49	30	28
	NB R	30	<5	<5	<5	<5	<5
	SB LTR	N/A	14	36	49	15	37
Colborne Street / Sunset Road and Warren Street	EB LR	N/A	17	25	56	21	29
	NB LT	N/A	33	55	99	36	57
	SB T	N/A	14	69	139	15	69
	SB R	40	<5	6	7	<5	6
Notes: EB – Eastbound, WB – Westbound, NB – Northbound, SB – Southbound L – Left, T – Through, R – Right							

The 2040 queuing results show that the turn lane storage lengths will continue to sufficiently accommodate the 95th percentile queues for the 2040 traffic volumes under both intersection control scenarios, therefore there are no queueing concerns.

6.3 POTENTIAL FUTURE INTERSECTION IMPROVEMENTS – COLBORNE STREET AND WARREN STREET

Potential mitigation measures for the Colborne Street and Warren Street intersection were assessed to determine what intersection improvements may ultimately be required. Since the previous analysis showed that the installation of traffic signals alone would accommodate the 2028 and 2040 AM and PM peak hour traffic, the mitigation analysis has focused on the 2028 and 2040 holiday peak hour. Synchro reports for the improvement scenarios are provided in Appendix J.

The first scenario analyzed was to keep the intersection unsignalized and add an eastbound left turn lane and a northbound left turn lane, which were previously recommended for consideration in the ‘Little Creek West Lands’ TIS. The results of the Synchro analysis are summarized in Table 18.

Table 18: 2028 and 2040 Holiday Peak Hour Intersection Operations – Unsignalized With Additional Left Turn Lanes

INTERSECTIONS / MOVEMENTS	2028 TOTAL TRAFFIC			2040 TOTAL TRAFFIC		
	HOLIDAY PEAK HOUR			HOLIDAY PEAK HOUR		
	V/C	LOS	Delay	V/C	LOS	Delay
Colborne Street / Sunset Road and Warren Street (With Additional EB and NB Left Turn Lanes)	EB L	0.80	F	104	1.45	F
	EB R	0.18	C	16	0.26	C
	NB L	0.13	B	11	0.17	B
	NB T	0.31	A	0	0.41	A
	SB T	0.44	A	0	0.55	A
	SB R	0.09	A	0	0.10	A
						0

Notes: V/C - Volume to Capacity Ratio, LOS – Level of Service, Delay = Average Delay in Seconds
EB – Eastbound, WB – Westbound, NB – Northbound, SB - Southbound
L – Left, T – Through, R – Right

From the results in Table 18, we can see that the addition of the eastbound left turn lane produces more acceptable v/c ratios for the eastbound movements during the 2028 holiday peak hour, however, the eastbound left turn delay is still quite high (104 seconds, LOS F) and during 2040 holiday peak hour it will still be significantly over capacity with extreme delay (v/c ratio of 1.45 and 370 seconds delay).

Recall that the signalized intersection analysis in sections 6.1 and 6.2 showed that the installation of traffic signals alone at the Colborne Street and Warren Street intersection could provide acceptable operations through 2028, but would be over capacity during the 2040 holiday peak hour. Therefore, the second improvement scenario analyzed included the signalization of the intersection plus the addition of an eastbound left turn lane and a northbound left turn lane. The results of the Synchro analysis are summarized in Table 19.

Table 19: 2028 and 2040 Holiday Peak Hour Intersection Operations – Signalized With Additional Lanes

INTERSECTIONS / MOVEMENTS	Overall	2028 TOTAL TRAFFIC			2040 TOTAL TRAFFIC		
		HOLIDAY PEAK HOUR			HOLIDAY PEAK HOUR		
		V/C	LOS	Delay	V/C	LOS	Delay
Colborne Street / Sunset Road and Warren Street (Signalized with Additional EB and NB Left Turn Lanes)	Overall	0.74	B	14	0.80	B	14
	EB L	0.57	C	28	0.75	D	51
	EB R	0.05	C	22	0.05	C	30
	NB L	0.26	A	7	0.33	B	10
	NB T	0.42	A	4	0.49	A	4
	SB T	0.85	B	20	0.84	B	18
	SB R	0.10	A	8	0.12	A	6
	Notes: V/C - Volume to Capacity Ratio, LOS – Level of Service, Delay = Average Delay in Seconds EB – Eastbound, WB – Westbound, NB – Northbound, SB - Southbound L – Left, T – Through, R – Right						

The results in Table 19 show that signalizing the Colborne Street and Warren Street intersection with additional eastbound and northbound left turn lanes will provide sufficient capacity to accommodate the future holiday peak hour traffic through 2040, with the maximum v/c ratio reaching 0.84 and all movements at LOS D or better.

Based on the operational analysis completed, we suggest that the County may wish to plan for the installation of traffic signals at Colborne Street and Warren Street around the year 2028, but monitor the intersection operations via future transportation impact studies that will be required for developments within the Harbour Secondary Plan area and update the planned mitigation measures and timeline as necessary. If, when the time comes for signalization, a northbound left turn lane has not already been installed beforehand (i.e. from a safety perspective based on warrants), we recommend that it be included with the signals installation and the County should also give consideration to adding an eastbound left turn lane at the same time to provide the long term capacity that may ultimately be required to accommodate the full build-out of the Harbour Secondary Plan.

7 CONCLUSIONS AND RECOMMENDATIONS

Based on the analysis completed, the following key conclusions and recommendations are made in this TIS:

- The proposed subdivision includes 79 single family detached units and 18 semi-detached units, and it is forecast that the development will generate up to a total of 70 new trips in the AM peak hour (17 in and 53 out), 94 trips in the PM peak hour (59 in and 35 out), and 97 trips during the holiday peak hour (52 in and 45 out).
- Under existing traffic conditions, all movements at the Carlow Road and Warren Street and Colborne Street and Warren Street intersections operate well at LOS A, except for the eastbound movement on Warren Street at Colborne Street which ranges from LOS B for the AM peak hour to LOS D for the holiday peak hour. Since these intersections were temporarily signalized during the preparation of this study to accommodate the detour route for the King George VI Lift Bridge Rehabilitation Project, the County requested that the intersections also be analyzed under signalized control. Both intersections would also operate well under existing traffic conditions if

permanently signalized, however, it is noted that, the intersections would have higher average delay with signals than without since the current traffic volumes are so low.

- Significant background traffic growth is expected as a result of the following developments/plans:
 - ‘Seaglass’ residential development (510 dwelling units)
 - ‘Lakeview’ mixed use development (60 dwelling units and 1,800 ft² commercial)
 - Harbour Secondary Plan (Phase 1 in 2028 - 178 dwelling units and 20,274 ft² commercial, and Phase 2 in 2040 - 795 dwelling units and 29,276 ft² commercial)
 - An unnamed residential development (96 dwelling units)
 - ‘Little Creek West Lands’ development (302 dwelling units)

In total, the above background developments are expected to generate 1272 trips during the AM peak hour, 1933 trips during the PM peak hour, and 2170 trips during the holiday peak hour.

- Traffic signal warrants from the Ontario Traffic Manual (Book 12) were analyzed for the Carlow Road and Warren Street, and Colborne Street and Warren Street intersections and the traffic volumes will not meet the justification for traffic signals under existing traffic conditions or any of the future traffic scenarios considered in this study.
- Based on MTO warrant analysis, a northbound left turn lane on Colborne Street is warranted with 25 m of storage at Warren Street during the existing holiday peak hour. Since the peak holiday condition only occurs for a short period of time, we suggest that the County consider adding the lane once the warrant is met for the PM peak hour, which is expected to occur prior to 2028 due to background traffic growth. A storage length of 30 m is recommended which should accommodate the 2040 total traffic PM peak hour condition.
- Analysis of the future background and total traffic conditions confirmed that the Carlow Road and Warren Street intersection should continue to operate well as an all-way stop control intersection through 2040 with all movements maintaining a Level of Service C or better.
- Analysis of the future background and total traffic conditions for the Colborne Street and Warren Street intersection showed that the intersection will operate acceptably with stop control through 2040 for the AM and PM peak hours, although with higher average delay (LOS F) on the eastbound movement during the PM peak hour, which is not uncommon for unsignalized connections to busy arterial roads. However, the critical eastbound movement may reach capacity during the holiday peak hour in 2028, which may be tolerable for a short-lived peak season condition, but would require mitigation once Phase 2 of the Harbour Secondary Plan begins to develop beyond 2028. Therefore, we recommend that the County plan for the installation of traffic signals at Colborne Street and Warren Street around the year 2028, but monitor the intersection operations via future transportation impact studies related to the Harbour Secondary Plan area developments and update the timeline as necessary. If not already implemented by the time signals are to be installed, the northbound left turn lane on Colborne Street should also be installed at the same time, and consideration should be given to installing an eastbound left turn lane, which may be necessary to accommodate the full build-out of the Harbour Secondary Plan (2040 holiday peak hour traffic).
- The proposed Lake Line and Street ‘A’ intersection will operate well beyond the horizon period. Sightlines at the intersection location are sufficient for safe operation and the anticipated traffic volumes do not warrant the installation of any auxiliary lanes.

- The sidewalks within the proposed subdivision will provide good service for pedestrians, but there is no existing sidewalk on Lake Line, therefore it is recommended that consideration be given to the construction of a sidewalk on Lake Line between Street 'A' and Carlow Road to provide a connection to the existing sidewalk network.
- Overall, the forecasted site traffic is not expected to introduce any operational problems on the surrounding road network and no road improvements are specifically required to accommodate the proposed development.

8 LIMITATIONS

This Report was prepared by Strik, Baldinelli, Moniz Ltd. (the Consultant) for Strathroy Turf Farms Limited (owner), the Municipality of Central Elgin and the County of Elgin. Use of this Report by any third party, or any reliance upon its findings, is solely the responsibility of that party. Strik, Baldinelli, Moniz Ltd. accepts no responsibility for damages, if any, suffered by a third party as a result of decisions made or actions undertaken as a result of this Report. Third party use of this Report, without the express written consent of the Consultant, denies any claims, whether in contract, tort, and/or any other cause of action in law, against the Consultant.

All findings and conclusions presented in this Report are based on information as it appeared during the period of the investigation. This Report is not intended to be exhaustive in scope, or to imply a risk-free development. It should be recognized that the passage of time may alter the opinions, conclusions, and/or recommendations provided herein.

The analysis was limited to the documents referenced herein. Strik, Baldinelli, Moniz Ltd. accepts no responsibility for the accuracy of the information provided by others. All opinions, conclusions, and/or recommendations presented in this Report are based on the information available at the time of the review.

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Appendix A – Traffic Data

Sources:

Parsons, Lake Line Residential Development – Transportation Impact Memo, January 3, 2018

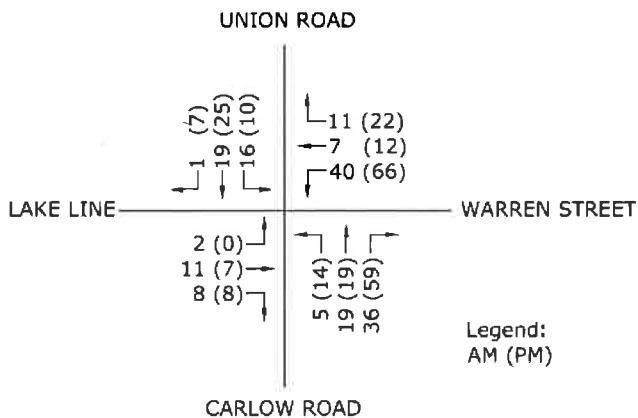
Dillon Consulting Limited, ‘Little Creek West Lands’ Transportation Impact Study, February 2019

Traffic Count for Carlow Road and Warren Street - Tuesday November 21, 2017

Existing Conditions

The subject site is located in a primarily residential area and is adjacent to the Port Stanley Public School and the Kettle Creek Golf and Country Club. The Port Stanley Arena/Community Centre is located on Carlow Road south of Lake Line. All roadways within the study area have a two-lane cross-section and are posted at 50km/h. The intersection of Union Road/Carlow Road and Lake Line/Warren Street is controlled by an all-way stop condition. Warren Street and Carlow Road serve as an alternate route into Port Stanley from Colborne Street.

To establish existing traffic patterns in the area, Parsons completed a turning movement survey at the intersection of Union Road/Carlow Road and Lake Line/Warren Street on Tuesday November 21, 2017 during the AM and PM peak hours. The goal of the survey was to capture conditions on a typical weekday when school was in session. A summary of the turning movements is presented below in **Figure 2** and the data is attached to this memo as **Appendix B**.

Figure 2 – Peak Hour Turning Movement Counts

It should be noted that Port Stanley receives a significant volume of tourist traffic during the summer months. This intersection likely experiences spikes in vehicular traffic during these periods.

Trip Generation and Distribution

The proposed development will consist of 130 detached single-family homes with an access point to Lake Line. Peak hour trips for the development were generated using the Institute of Transportation Engineers (ITE) Trip Generation Manual, 9th Edition. This manual provides rates and equations for various land use types to calculate peak hour trips to and from a site. The rates are based on surveys submitted to ITE by public agencies, developers, consulting firms and associations. The projected peak hour trips for the proposed development are summarized below in **Table 1**.

Table 1 – Trip Generation

Land Use	Peak Hour	Calculation Method	Total Trips	In/Out %	Trips In	Trips Out
210 Single-Family Detached Housing	AM	Equation	101	25/75	25	76
	PM	Equation	133	63/37	84	49



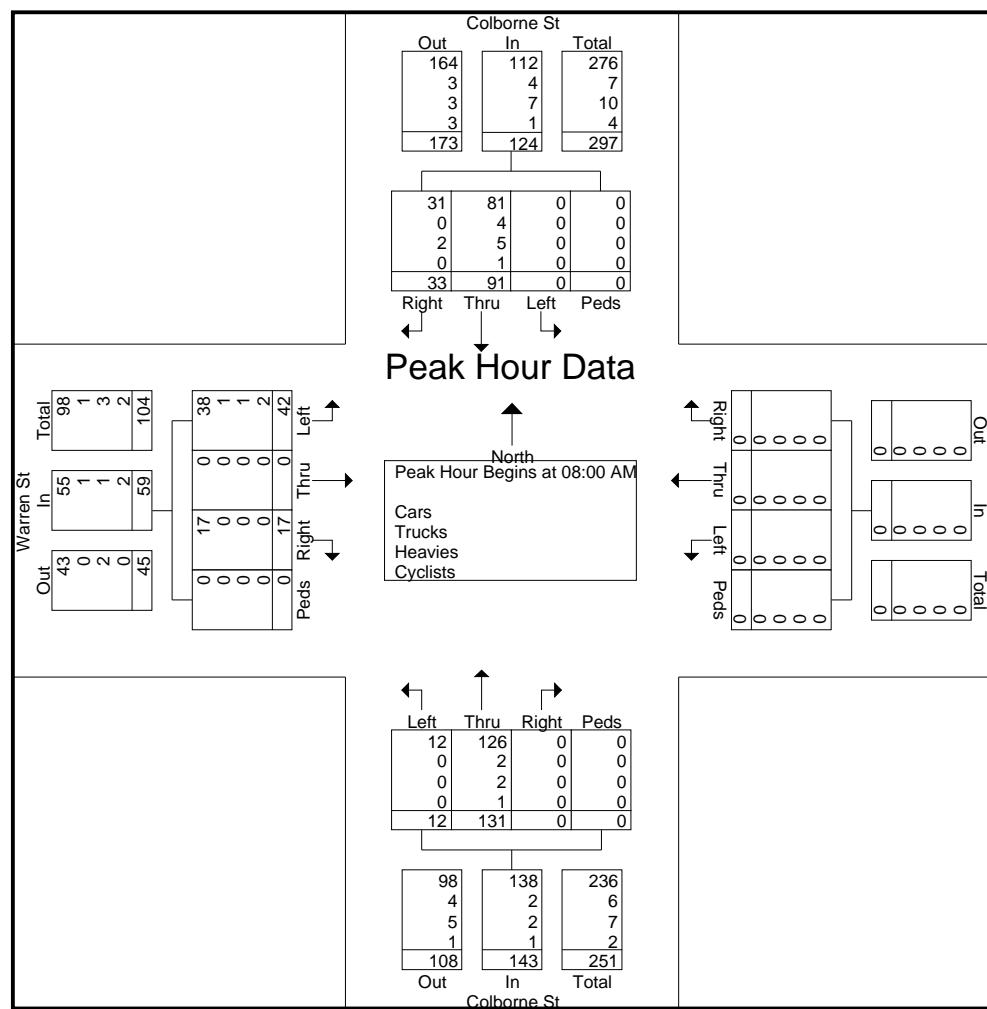


Horizon Data Services Ltd

318 Simonston Boulevard
Thornhill ON L3T 4T5
(416) 840-6619

"We do not estimate...we count"

File Name : Warren St at Colborne St
Site Code : 00000000
Start Date : 8/2/2018
Page No : 5



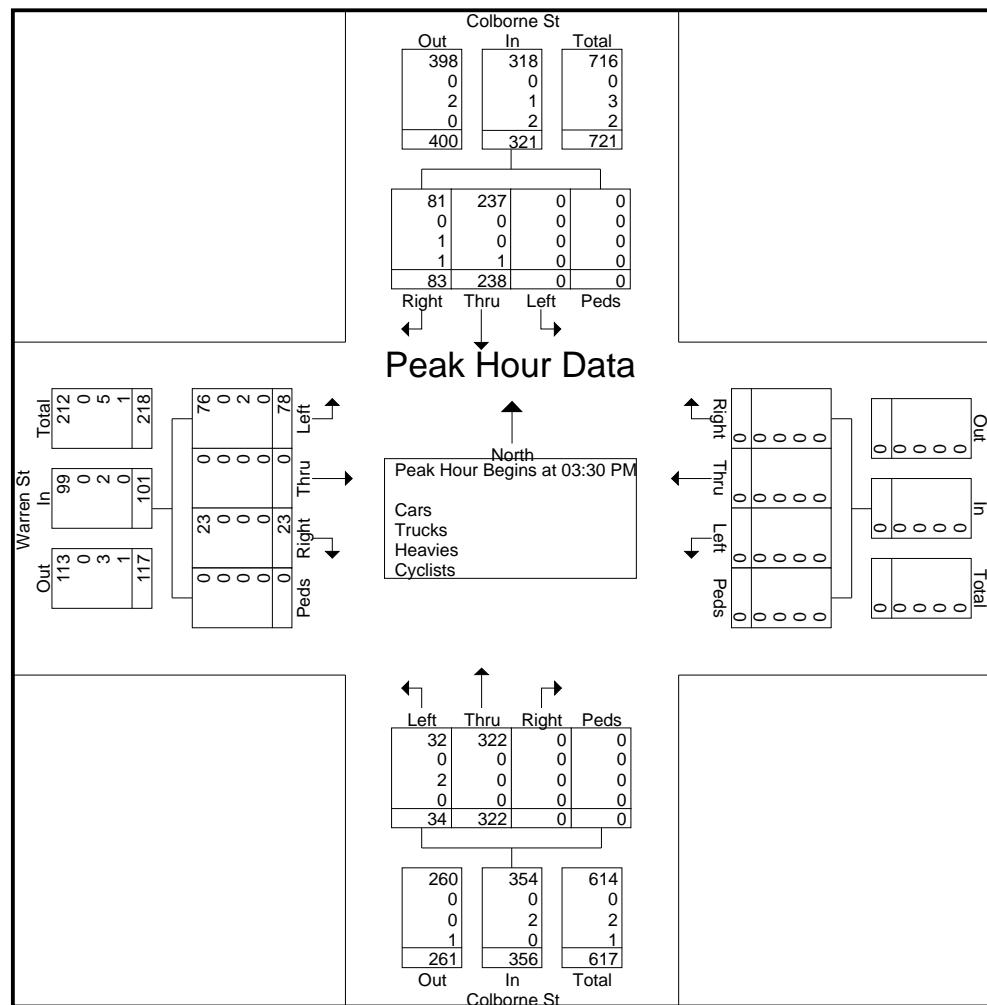


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(416) 840-6619

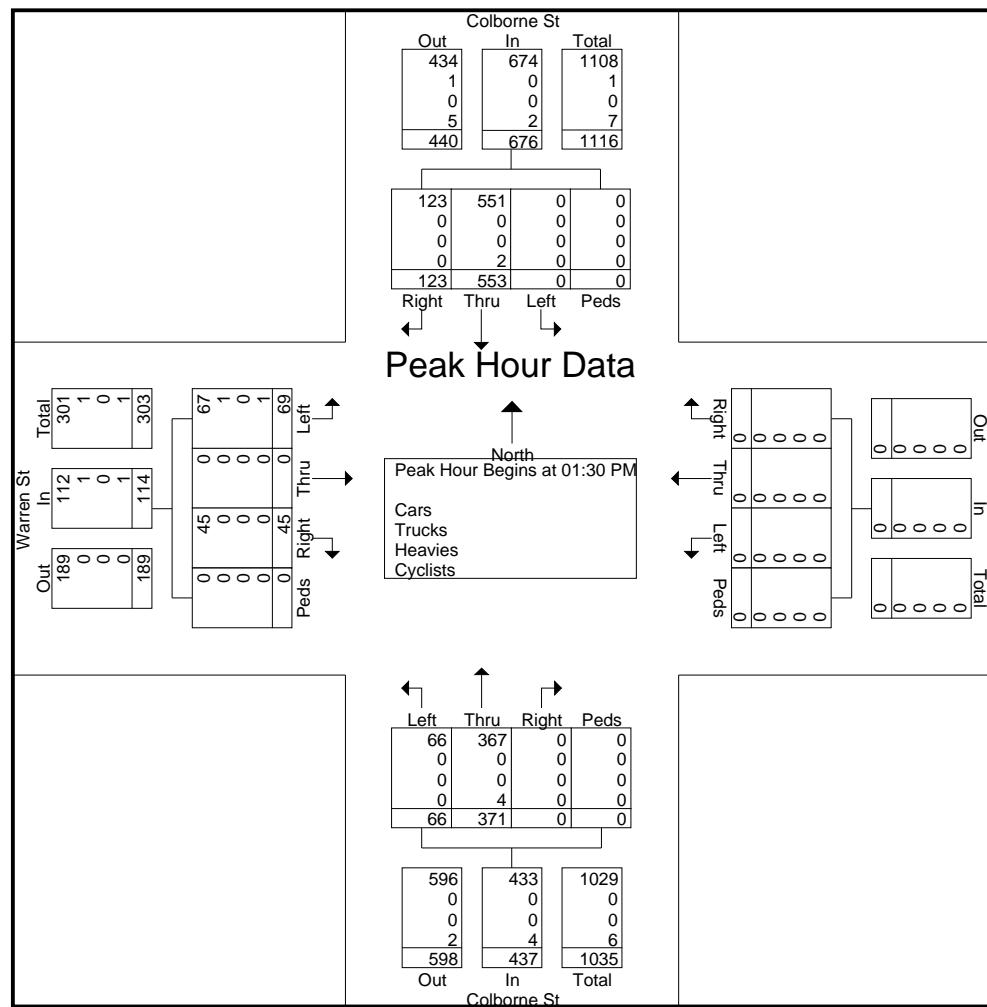
"We do not estimate...we count"

File Name : Warren St at Colborne St

Site Code : 00000000

Start Date : 8/5/2018

Page No : 5



Appendix B – Synchro Output Reports - Existing Traffic

HCM Unsignalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2021 AM Traffic

Unsignalized

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	2	13	10	49	9	13	6	23	44	19	23	1
Future Volume (vph)	2	13	10	49	9	13	6	23	44	19	23	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	14	11	53	10	14	7	25	48	21	25	1
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1							
Volume Total (vph)	27	77	32	48	47							
Volume Left (vph)	2	53	7	0	21							
Volume Right (vph)	11	14	0	48	1							
Hadj (s)	-0.20	0.06	0.14	-0.67	0.11							
Departure Headway (s)	4.1	4.3	4.9	4.1	4.4							
Degree Utilization, x	0.03	0.09	0.04	0.05	0.06							
Capacity (veh/h)	850	816	709	846	790							
Control Delay (s)	7.2	7.7	6.9	6.1	7.7							
Approach Delay (s)	7.2	7.7	6.5		7.7							
Approach LOS	A	A	A		A							
Intersection Summary												
Delay			7.2									
Level of Service			A									
Intersection Capacity Utilization			26.3%		ICU Level of Service				A			
Analysis Period (min)			15									

Intersection

Intersection Delay, s/veh 7.5
Intersection LOS A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔	↑		↔	
Traffic Vol, veh/h	2	13	10	49	9	13	6	23	44	19	23	1
Future Vol, veh/h	2	13	10	49	9	13	6	23	44	19	23	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	2	14	11	53	10	14	7	25	48	21	25	1
Number of Lanes	0	1	0	0	1	0	0	1	1	0	1	0
Approach	EB			WB			NB			SB		
Opposing Approach	WB			EB			SB			NB		
Opposing Lanes	1			1			1			2		
Conflicting Approach Left	SB			NB			EB			WB		
Conflicting Lanes Left	1			2			1			1		
Conflicting Approach Right	NB			SB			WB			EB		
Conflicting Lanes Right	2			1			1			1		
HCM Control Delay	7.2			7.7			7.3			7.7		
HCM LOS	A			A			A			A		

Lane	NBLn1	NBLn2	EBLn1	WBLn1	SBLn1
Vol Left, %	21%	0%	8%	69%	44%
Vol Thru, %	79%	0%	52%	13%	53%
Vol Right, %	0%	100%	40%	18%	2%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	29	44	25	71	43
LT Vol	6	0	2	49	19
Through Vol	23	0	13	9	23
RT Vol	0	44	10	13	1
Lane Flow Rate	32	48	27	77	47
Geometry Grp	7	7	2	2	5
Degree of Util (X)	0.042	0.054	0.03	0.09	0.056
Departure Headway (Hd)	4.845	4.04	3.985	4.198	4.351
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	734	879	883	843	814
Service Time	2.607	1.802	2.077	2.276	2.426
HCM Lane V/C Ratio	0.044	0.055	0.031	0.091	0.058
HCM Control Delay	7.8	7	7.2	7.7	7.7
HCM Lane LOS	A	A	A	A	A
HCM 95th-tile Q	0.1	0.2	0.1	0.3	0.2

HCM Unsigned Intersection Capacity Analysis

2: Colborne St/Sunset Rd & Warren St

2021 AM Traffic

Unsigned



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y			Y	Y	Y
Traffic Volume (veh/h)	53	17	12	165	92	33
Future Volume (Veh/h)	53	17	12	165	92	33
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	58	18	13	179	100	36
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	305	100	136			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	305	100	136			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	91	98	99			
cM capacity (veh/h)	681	956	1448			
Direction, Lane #	EB 1	NB 1	SB 1	SB 2		
Volume Total	76	192	100	36		
Volume Left	58	13	0	0		
Volume Right	18	0	0	36		
cSH	731	1448	1700	1700		
Volume to Capacity	0.10	0.01	0.06	0.02		
Queue Length 95th (m)	2.6	0.2	0.0	0.0		
Control Delay (s)	10.5	0.6	0.0	0.0		
Lane LOS	B	A				
Approach Delay (s)	10.5	0.6	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay		2.3				
Intersection Capacity Utilization		26.7%	ICU Level of Service		A	
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2021 PM Traffic
Unsignalized

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop	Yield			Stop
Traffic Volume (vph)	0	9	10	80	15	27	17	23	72	12	30	9
Future Volume (vph)	0	9	10	80	15	27	17	23	72	12	30	9
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	10	11	87	16	29	18	25	78	13	33	10
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1							
Volume Total (vph)	21	132	43	78	56							
Volume Left (vph)	0	87	18	0	13							
Volume Right (vph)	11	29	0	78	10							
Hadj (s)	-0.28	0.03	0.24	-0.67	-0.03							
Departure Headway (s)	4.2	4.4	5.1	4.2	4.5							
Degree Utilization, x	0.02	0.16	0.06	0.09	0.07							
Capacity (veh/h)	819	796	673	814	765							
Control Delay (s)	7.3	8.2	7.3	6.5	7.8							
Approach Delay (s)	7.3	8.2	6.8		7.8							
Approach LOS	A	A	A		A							
Intersection Summary												
Delay						7.5						
Level of Service						A						
Intersection Capacity Utilization				29.7%			ICU Level of Service					A
Analysis Period (min)					15							

Intersection

Intersection Delay, s/veh 7.9
Intersection LOS A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	9	10	80	15	27	17	23	72	12	30	9
Future Vol, veh/h	0	9	10	80	15	27	17	23	72	12	30	9
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	10	11	87	16	29	18	25	78	13	33	10
Number of Lanes	0	1	0	0	1	0	0	1	1	0	1	0
Approach												
Opposing Approach	EB		WB		NB			SB				
Opposing Lanes	WB		EB		SB			NB				
Conflicting Approach Left	1		1		1			2				
Conflicting Lanes Left	SB		NB		EB			WB				
Conflicting Approach Right	1		2		1			1				
Conflicting Lanes Right	NB		SB		WB			EB				
HCM Control Delay	2		1		1			1				
HCM LOS	7.3		8.2		7.7			7.8				
	A		A		A			A				

Lane	NBLn1	NBLn2	EBLn1	WBLn1	SBLn1
Vol Left, %	42%	0%	0%	66%	24%
Vol Thru, %	57%	0%	47%	12%	59%
Vol Right, %	0%	100%	53%	22%	18%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	40	72	19	122	51
LT Vol	17	0	0	80	12
Through Vol	23	0	9	15	30
RT Vol	0	72	10	27	9
Lane Flow Rate	43	78	21	133	55
Geometry Grp	7	7	2	2	5
Degree of Util (X)	0.062	0.092	0.024	0.161	0.069
Departure Headway (Hd)	5.156	4.24	4.168	4.359	4.458
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	699	850	861	826	806
Service Time	2.856	1.94	2.182	2.369	2.472
HCM Lane V/C Ratio	0.062	0.092	0.024	0.161	0.068
HCM Control Delay	8.2	7.4	7.3	8.2	7.8
HCM Lane LOS	A	A	A	A	A
HCM 95th-tile Q	0.2	0.3	0.1	0.6	0.2

HCM Unsigned Intersection Capacity Analysis

2: Colborne St/Sunset Rd & Warren St

2021 PM Traffic

Unsigned



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y			Y	Y	Y
Traffic Volume (veh/h)	79	23	35	327	268	84
Future Volume (Veh/h)	79	23	35	327	268	84
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	86	25	38	355	291	91
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	722	291	382			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	722	291	382			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	77	97	97			
cM capacity (veh/h)	381	748	1176			
Direction, Lane #	EB 1	NB 1	SB 1	SB 2		
Volume Total	111	393	291	91		
Volume Left	86	38	0	0		
Volume Right	25	0	0	91		
cSH	428	1176	1700	1700		
Volume to Capacity	0.26	0.03	0.17	0.05		
Queue Length 95th (m)	7.8	0.8	0.0	0.0		
Control Delay (s)	16.3	1.1	0.0	0.0		
Lane LOS	C	A				
Approach Delay (s)	16.3	1.1	0.0			
Approach LOS	C					
Intersection Summary						
Average Delay		2.5				
Intersection Capacity Utilization		49.0%	ICU Level of Service		A	
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2021 Saturday Traffic
Unsignalized

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop	Yield			Stop
Traffic Volume (vph)	0	11	12	126	23	42	17	23	89	15	38	11
Future Volume (vph)	0	11	12	126	23	42	17	23	89	15	38	11
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	12	13	137	25	46	18	25	97	16	41	12
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1							
Volume Total (vph)	25	208	43	97	69							
Volume Left (vph)	0	137	18	0	16							
Volume Right (vph)	13	46	0	97	12							
Hadj (s)	-0.28	0.03	0.24	-0.67	-0.02							
Departure Headway (s)	4.4	4.5	5.4	4.4	4.7							
Degree Utilization, x	0.03	0.26	0.06	0.12	0.09							
Capacity (veh/h)	775	770	639	765	717							
Control Delay (s)	7.5	9.0	7.5	6.9	8.2							
Approach Delay (s)	7.5	9.0	7.1		8.2							
Approach LOS	A	A	A		A							
Intersection Summary												
Delay												8.2
Level of Service												A
Intersection Capacity Utilization				34.2%		ICU Level of Service						A
Analysis Period (min)					15							

Intersection

Intersection Delay, s/veh 8.5
Intersection LOS A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖			↖			↖	↖		↖	
Traffic Vol, veh/h	0	11	12	126	23	42	17	23	89	15	38	11
Future Vol, veh/h	0	11	12	126	23	42	17	23	89	15	38	11
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	12	13	137	25	46	18	25	97	16	41	12
Number of Lanes	0	1	0	0	1	0	0	1	1	0	1	0
Approach		EB		WB			NB			SB		
Opposing Approach		WB		EB			SB			NB		
Opposing Lanes		1		1			1			2		
Conflicting Approach Left		SB		NB			EB			WB		
Conflicting Lanes Left		1		2			1			1		
Conflicting Approach Right		NB		SB			WB			EB		
Conflicting Lanes Right		2		1			1			1		
HCM Control Delay		7.5		9			8			8.2		
HCM LOS		A		A			A			A		

Lane	NBLn1	NBLn2	EBLn1	WBLn1	SBLn1
Vol Left, %	42%	0%	0%	66%	23%
Vol Thru, %	57%	0%	48%	12%	59%
Vol Right, %	0%	100%	52%	22%	17%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	40	89	23	191	64
LT Vol	17	0	0	126	15
Through Vol	23	0	11	23	38
RT Vol	0	89	12	42	11
Lane Flow Rate	43	97	25	208	70
Geometry Grp	7	7	2	2	5
Degree of Util (X)	0.065	0.119	0.03	0.257	0.09
Departure Headway (Hd)	5.353	4.436	4.348	4.451	4.682
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	670	809	824	810	766
Service Time	3.076	2.158	2.373	2.468	2.708
HCM Lane V/C Ratio	0.064	0.12	0.03	0.257	0.091
HCM Control Delay	8.4	7.8	7.5	9	8.2
HCM Lane LOS	A	A	A	A	A
HCM 95th-tile Q	0.2	0.4	0.1	1	0.3

HCM Unsigned Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2021 Saturday Traffic
Unsigned



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y			Y	Y	Y
Traffic Volume (veh/h)	70	46	67	377	561	125
Future Volume (Veh/h)	70	46	67	377	561	125
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	76	50	73	410	610	136
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1166	610	746			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1166	610	746			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	61	90	92			
cM capacity (veh/h)	196	494	862			
Direction, Lane #	EB 1	NB 1	SB 1	SB 2		
Volume Total	126	483	610	136		
Volume Left	76	73	0	0		
Volume Right	50	0	0	136		
cSH	258	862	1700	1700		
Volume to Capacity	0.49	0.08	0.36	0.08		
Queue Length 95th (m)	18.9	2.1	0.0	0.0		
Control Delay (s)	31.6	2.4	0.0	0.0		
Lane LOS	D	A				
Approach Delay (s)	31.6	2.4	0.0			
Approach LOS	D					
Intersection Summary						
Average Delay		3.8				
Intersection Capacity Utilization		69.8%	ICU Level of Service		C	
Analysis Period (min)		15				

Timings

2021 AM Traffic

Signalized

1: Carlow Rd/Union Road & Lake Line/Warren St



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations									
Traffic Volume (vph)	2	13	49	9	6	23	44	19	23
Future Volume (vph)	2	13	49	9	6	23	44	19	23
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	pm+ov	Perm	NA
Protected Phases		4	3	8		2	3		6
Permitted Phases		4		8		2		2	6
Detector Phase		4	4	3	8	2	2	3	6
Switch Phase									
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	11.0	9.0	11.0	11.0	11.0	9.0	11.0	11.0
Total Split (s)	20.0	20.0	15.0	35.0	25.0	25.0	15.0	25.0	25.0
Total Split (%)	33.3%	33.3%	25.0%	58.3%	41.7%	41.7%	25.0%	41.7%	41.7%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)		0.0		0.0		0.0	0.0		0.0
Total Lost Time (s)		6.0		6.0		6.0	4.0		6.0
Lead/Lag	Lag	Lag	Lead				Lead		
Lead-Lag Optimize?	Yes	Yes	Yes				Yes		
Recall Mode	Min								
Act Effect Green (s)		5.9		15.5		6.4	18.0		6.4
Actuated g/C Ratio		0.17		0.46		0.19	0.53		0.19
v/c Ratio		0.09		0.10		0.10	0.05		0.16
Control Delay		10.4		5.1		12.2	1.6		12.7
Queue Delay		0.0		0.0		0.0	0.0		0.0
Total Delay		10.4		5.1		12.2	1.6		12.7
LOS	B		A		B	A		B	
Approach Delay		10.4		5.1		5.9		12.7	
Approach LOS		B		A		A		B	

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 33.9

Natural Cycle: 40

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.16

Intersection Signal Delay: 7.5

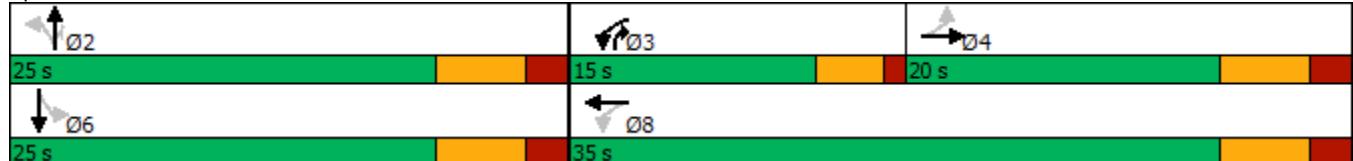
Intersection LOS: A

Intersection Capacity Utilization 29.6%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 1: Carlow Rd/Union Road & Lake Line/Warren St



Queues

2021 AM Traffic

Signalized

1: Carlow Rd/Union Road & Lake Line/Warren St



Lane Group	EBT	WBT	NBT	NBR	SBT
Lane Group Flow (vph)	27	77	32	48	47
v/c Ratio	0.09	0.10	0.10	0.05	0.16
Control Delay	10.4	5.1	12.2	1.6	12.7
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	10.4	5.1	12.2	1.6	12.7
Queue Length 50th (m)	0.8	1.7	1.5	0.0	2.1
Queue Length 95th (m)	4.5	5.8	5.5	2.1	7.2
Internal Link Dist (m)	59.2	392.2	126.4		76.1
Turn Bay Length (m)				30.0	
Base Capacity (vph)	717	1450	964	1124	887
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	0.04	0.05	0.03	0.04	0.05

Intersection Summary

HCM Signalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2021 AM Traffic

Signalized

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	2	13	10	49	9	13	6	23	44	19	23	1
Future Volume (vph)	2	13	10	49	9	13	6	23	44	19	23	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0			6.0	4.0		6.0	
Lane Util. Factor	1.00				1.00			1.00	1.00		1.00	
Frt	0.94				0.98			1.00	0.85		1.00	
Flt Protected	1.00				0.97			0.99	1.00		0.98	
Satd. Flow (prot)		1773				1776			1863	1601		1837
Flt Permitted		0.96				0.91			0.91	1.00		0.84
Satd. Flow (perm)		1717				1679			1716	1601		1579
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2	14	11	53	10	14	7	25	48	21	25	1
RTOR Reduction (vph)	0	9	0	0	8	0	0	0	31	0	1	0
Lane Group Flow (vph)	0	18	0	0	69	0	0	32	17	0	46	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	pm+ov	Perm	NA	
Protected Phases		4			3	8			2	3		6
Permitted Phases	4				8			2		2	6	
Actuated Green, G (s)		5.9				15.4			6.4	11.9		6.4
Effective Green, g (s)		5.9				15.4			6.4	11.9		6.4
Actuated g/C Ratio		0.17				0.46			0.19	0.35		0.19
Clearance Time (s)		6.0				6.0			6.0	4.0		6.0
Vehicle Extension (s)		3.0				3.0			3.0	3.0		3.0
Lane Grp Cap (vph)	299				780			324	563		298	
v/s Ratio Prot				c0.01					0.00			
v/s Ratio Perm		0.01			c0.03			0.02	0.01		c0.03	
v/c Ratio		0.06			0.09			0.10	0.03		0.15	
Uniform Delay, d1		11.6			5.2			11.3	7.2		11.4	
Progression Factor		1.00			1.00			1.00	1.00		1.00	
Incremental Delay, d2		0.1			0.0			0.1	0.0		0.2	
Delay (s)		11.7			5.3			11.5	7.2		11.7	
Level of Service		B			A			B	A		B	
Approach Delay (s)		11.7			5.3			8.9			11.7	
Approach LOS		B			A			A			B	
Intersection Summary												
HCM 2000 Control Delay		8.6			HCM 2000 Level of Service				A			
HCM 2000 Volume to Capacity ratio		0.13										
Actuated Cycle Length (s)		33.8			Sum of lost time (s)				16.0			
Intersection Capacity Utilization		29.6%			ICU Level of Service				A			
Analysis Period (min)		15										
c Critical Lane Group												

Timings
2: Colborne St/Sunset Rd & Warren St

2021 AM Traffic

Signalized



Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Configurations	Y	Y	Y	Y	Y
Traffic Volume (vph)	53	12	165	92	33
Future Volume (vph)	53	12	165	92	33
Turn Type	Prot	pm+pt	NA	NA	Perm
Protected Phases	4	5	2	6	
Permitted Phases			2		6
Detector Phase	4	5	2	6	6
Switch Phase					
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	9.0	11.0	11.0	11.0
Total Split (s)	22.0	9.0	38.0	29.0	29.0
Total Split (%)	36.7%	15.0%	63.3%	48.3%	48.3%
Yellow Time (s)	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0		6.0	6.0	6.0
Lead/Lag	Lead		Lag	Lag	
Lead-Lag Optimize?	Yes		Yes	Yes	
Recall Mode	None	None	Max	Max	Max
Act Effect Green (s)	7.3		40.4	40.4	40.4
Actuated g/C Ratio	0.14		0.77	0.77	0.77
v/c Ratio	0.29		0.13	0.07	0.03
Control Delay	19.0		4.1	4.0	1.9
Queue Delay	0.0		0.0	0.0	0.0
Total Delay	19.0		4.1	4.0	1.9
LOS	B		A	A	A
Approach Delay	19.0		4.1	3.5	
Approach LOS	B		A	A	

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 52.6

Natural Cycle: 40

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.29

Intersection Signal Delay: 6.7

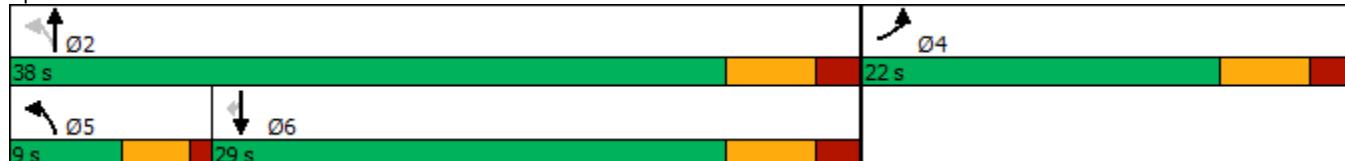
Intersection LOS: A

Intersection Capacity Utilization 30.2%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 2: Colborne St/Sunset Rd & Warren St



Queues
2: Colborne St/Sunset Rd & Warren St

2021 AM Traffic

Signalized



Lane Group	EBL	NBT	SBT	SBR
Lane Group Flow (vph)	76	192	100	36
v/c Ratio	0.29	0.13	0.07	0.03
Control Delay	19.0	4.1	4.0	1.9
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	19.0	4.1	4.0	1.9
Queue Length 50th (m)	4.8	6.0	2.9	0.0
Queue Length 95th (m)	13.8	13.9	8.0	2.4
Internal Link Dist (m)	392.2	65.6	88.3	
Turn Bay Length (m)			40.0	
Base Capacity (vph)	546	1423	1445	1237
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.14	0.13	0.07	0.03

Intersection Summary

HCM Signalized Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2021 AM Traffic
Signalized

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	53	17	12	165	92	33
Future Volume (vph)	53	17	12	165	92	33
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0			6.0	6.0	6.0
Lane Util. Factor	1.00			1.00	1.00	1.00
Frt	0.97			1.00	1.00	0.85
Flt Protected	0.96			1.00	1.00	1.00
Satd. Flow (prot)	1756			1877	1883	1601
Flt Permitted	0.96			0.99	1.00	1.00
Satd. Flow (perm)	1756			1856	1883	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	58	18	13	179	100	36
RTOR Reduction (vph)	16	0	0	0	0	11
Lane Group Flow (vph)	60	0	0	192	100	25
Turn Type	Prot	pm+pt	NA	NA	Perm	
Protected Phases	4		5	2	6	
Permitted Phases			2		6	
Actuated Green, G (s)	5.0			38.0	38.0	38.0
Effective Green, g (s)	5.0			38.0	38.0	38.0
Actuated g/C Ratio	0.09			0.69	0.69	0.69
Clearance Time (s)	6.0			6.0	6.0	6.0
Vehicle Extension (s)	3.0			3.0	3.0	3.0
Lane Grp Cap (vph)	159			1282	1300	1106
v/s Ratio Prot	c0.03				0.05	
v/s Ratio Perm			c0.10		0.02	
v/c Ratio	0.38			0.15	0.08	0.02
Uniform Delay, d1	23.5			2.9	2.8	2.7
Progression Factor	1.00			1.00	1.00	1.00
Incremental Delay, d2	1.5			0.1	0.1	0.0
Delay (s)	25.0			3.0	2.9	2.7
Level of Service	C			A	A	A
Approach Delay (s)	25.0			3.0	2.8	
Approach LOS	C			A	A	
Intersection Summary						
HCM 2000 Control Delay		7.1		HCM 2000 Level of Service		A
HCM 2000 Volume to Capacity ratio		0.19				
Actuated Cycle Length (s)		55.0		Sum of lost time (s)		16.0
Intersection Capacity Utilization		30.2%		ICU Level of Service		A
Analysis Period (min)		15				
c Critical Lane Group						

Timings

2021 PM Traffic

Signalized

1: Carlow Rd/Union Road & Lake Line/Warren St



Lane Group	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations	↑↓		↑↓		↑↓	↑↓		↑↓
Traffic Volume (vph)	9	80	15	17	23	72	12	30
Future Volume (vph)	9	80	15	17	23	72	12	30
Turn Type	NA	pm+pt	NA	Perm	NA	pm+ov	Perm	NA
Protected Phases	4	3	8		2	3		6
Permitted Phases				2		2	6	
Detector Phase	4	3	8	2	2	3	6	6
Switch Phase								
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	9.0	11.0	11.0	11.0	9.0	11.0	11.0
Total Split (s)	19.0	15.0	34.0	26.0	26.0	15.0	26.0	26.0
Total Split (%)	31.7%	25.0%	56.7%	43.3%	43.3%	25.0%	43.3%	43.3%
Yellow Time (s)	4.0	3.0	4.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	1.0	2.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0		0.0	0.0		0.0
Total Lost Time (s)	6.0		6.0		6.0	4.0		6.0
Lead/Lag	Lag	Lead				Lead		
Lead-Lag Optimize?	Yes	Yes				Yes		
Recall Mode	Min							
Act Effect Green (s)	5.8		15.4		6.4	18.0		6.4
Actuated g/C Ratio	0.17		0.46		0.19	0.53		0.19
v/c Ratio	0.07		0.23		0.14	0.09		0.17
Control Delay	9.8		5.7		12.7	1.6		11.4
Queue Delay	0.0		0.0		0.0	0.0		0.0
Total Delay	9.8		5.7		12.7	1.6		11.4
LOS	A		A		B	A		B
Approach Delay	9.8		5.7		5.6			11.4
Approach LOS	A		A		A			B

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 33.8

Natural Cycle: 40

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.23

Intersection Signal Delay: 6.9

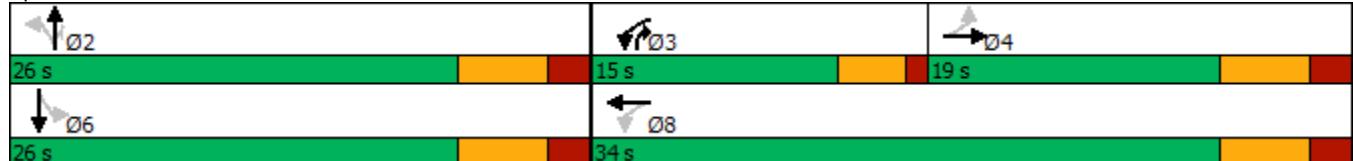
Intersection LOS: A

Intersection Capacity Utilization 33.0%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 1: Carlow Rd/Union Road & Lake Line/Warren St



Queues

2021 PM Traffic

Signalized

1: Carlow Rd/Union Road & Lake Line/Warren St



Lane Group	EBT	WBT	NBT	NBR	SBT
Lane Group Flow (vph)	21	132	43	78	56
v/c Ratio	0.07	0.23	0.14	0.09	0.17
Control Delay	9.8	5.7	12.7	1.6	11.4
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	9.8	5.7	12.7	1.6	11.4
Queue Length 50th (m)	0.5	2.8	2.0	0.0	2.1
Queue Length 95th (m)	3.8	8.6	6.7	2.8	7.5
Internal Link Dist (m)	59.2	392.2	126.4		76.1
Turn Bay Length (m)			30.0		
Base Capacity (vph)	681	975	936	1134	992
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	0.03	0.14	0.05	0.07	0.06

Intersection Summary

HCM Signalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2021 PM Traffic

Signalized

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	9	10	80	15	27	17	23	72	12	30	9
Future Volume (vph)	0	9	10	80	15	27	17	23	72	12	30	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0			6.0	4.0		6.0	
Lane Util. Factor	1.00				1.00			1.00	1.00		1.00	
Frt	0.93				0.97			1.00	0.85		0.98	
Flt Protected	1.00				0.97			0.98	1.00		0.99	
Satd. Flow (prot)		1750				1769			1845	1601		1817
Flt Permitted		1.00				0.59			0.84	1.00		0.91
Satd. Flow (perm)		1750				1085			1579	1601		1668
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	10	11	87	16	29	18	25	78	13	33	10
RTOR Reduction (vph)	0	9	0	0	16	0	0	0	51	0	8	0
Lane Group Flow (vph)	0	12	0	0	116	0	0	43	27	0	48	0
Turn Type	NA		pm+pt	NA		Perm	NA	pm+ov	Perm	NA		
Protected Phases	4			3	8			2	3		6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	5.9				15.4			6.4	11.9		6.4	
Effective Green, g (s)	5.9				15.4			6.4	11.9		6.4	
Actuated g/C Ratio	0.17				0.46			0.19	0.35		0.19	
Clearance Time (s)	6.0				6.0			6.0	4.0		6.0	
Vehicle Extension (s)	3.0				3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)	305			605			298	563		315		
v/s Ratio Prot	0.01		c0.03					0.01				
v/s Ratio Perm			c0.06				0.03	0.01		c0.03		
v/c Ratio	0.04			0.19			0.14	0.05		0.15		
Uniform Delay, d1	11.6			5.5			11.4	7.2		11.4		
Progression Factor	1.00			1.00			1.00	1.00		1.00		
Incremental Delay, d2	0.1			0.2			0.2	0.0		0.2		
Delay (s)	11.6			5.6			11.6	7.3		11.7		
Level of Service	B		A				B	A		B		
Approach Delay (s)	11.6			5.6			8.8			11.7		
Approach LOS	B		A				A			B		
Intersection Summary												
HCM 2000 Control Delay	8.2			HCM 2000 Level of Service				A				
HCM 2000 Volume to Capacity ratio	0.21											
Actuated Cycle Length (s)	33.8			Sum of lost time (s)				16.0				
Intersection Capacity Utilization	33.0%			ICU Level of Service				A				
Analysis Period (min)	15											
c Critical Lane Group												

Timings
2: Colborne St/Sunset Rd & Warren St

2021 PM Traffic

Signalized



Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Configurations	Y	Y	Y	Y	Y
Traffic Volume (vph)	79	35	327	268	84
Future Volume (vph)	79	35	327	268	84
Turn Type	Prot	pm+pt	NA	NA	Perm
Protected Phases	4	5	2	6	
Permitted Phases			2		6
Detector Phase	4	5	2	6	6
Switch Phase					
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	9.0	11.0	11.0	11.0
Total Split (s)	18.0	9.0	42.0	33.0	33.0
Total Split (%)	30.0%	15.0%	70.0%	55.0%	55.0%
Yellow Time (s)	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0		6.0	6.0	6.0
Lead/Lag	Lead		Lag	Lag	
Lead-Lag Optimize?	Yes		Yes	Yes	
Recall Mode	None	Min	Min	Min	Min
Act Effect Green (s)	7.9		21.6	11.6	11.6
Actuated g/C Ratio	0.22		0.61	0.33	0.33
v/c Ratio	0.27		0.36	0.47	0.16
Control Delay	14.2		6.5	14.0	4.1
Queue Delay	0.0		0.0	0.0	0.0
Total Delay	14.2		6.5	14.0	4.1
LOS	B		A	B	A
Approach Delay	14.2		6.5	11.6	
Approach LOS	B		A	B	

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 35.4

Natural Cycle: 40

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.47

Intersection Signal Delay: 9.6

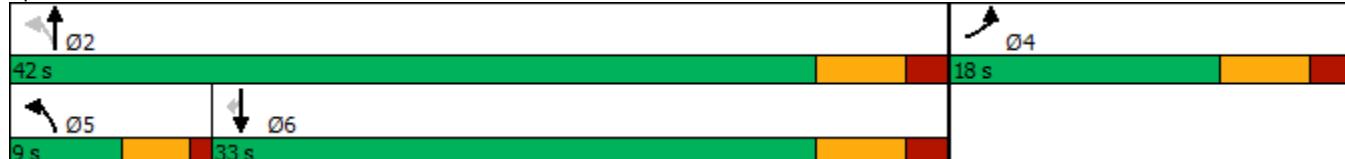
Intersection LOS: A

Intersection Capacity Utilization 54.0%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 2: Colborne St/Sunset Rd & Warren St



Queues
2: Colborne St/Sunset Rd & Warren St

2021 PM Traffic

Signalized



Lane Group	EBL	NBT	SBT	SBR
Lane Group Flow (vph)	111	393	291	91
v/c Ratio	0.27	0.36	0.47	0.16
Control Delay	14.2	6.5	14.0	4.1
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	14.2	6.5	14.0	4.1
Queue Length 50th (m)	5.2	14.2	16.3	0.0
Queue Length 95th (m)	16.2	31.3	34.7	6.5
Internal Link Dist (m)	392.2	65.6	88.3	
Turn Bay Length (m)			40.0	
Base Capacity (vph)	673	1628	1457	1260
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.16	0.24	0.20	0.07

Intersection Summary

HCM Signalized Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2021 PM Traffic
Signalized

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	79	23	35	327	268	84
Future Volume (vph)	79	23	35	327	268	84
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0			6.0	6.0	6.0
Lane Util. Factor	1.00			1.00	1.00	1.00
Frt	0.97			1.00	1.00	0.85
Flt Protected	0.96			1.00	1.00	1.00
Satd. Flow (prot)	1758			1874	1883	1601
Flt Permitted	0.96			0.96	1.00	1.00
Satd. Flow (perm)	1758			1804	1883	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	86	25	38	355	291	91
RTOR Reduction (vph)	20	0	0	0	0	62
Lane Group Flow (vph)	91	0	0	393	291	29
Turn Type	Prot	pm+pt	NA	NA	Perm	
Protected Phases	4		5	2	6	
Permitted Phases			2		6	
Actuated Green, G (s)	4.3			21.6	12.1	12.1
Effective Green, g (s)	4.3			21.6	12.1	12.1
Actuated g/C Ratio	0.11			0.57	0.32	0.32
Clearance Time (s)	6.0			6.0	6.0	6.0
Vehicle Extension (s)	3.0			3.0	3.0	3.0
Lane Grp Cap (vph)	199			1038	601	511
v/s Ratio Prot	c0.05			c0.05	c0.15	
v/s Ratio Perm				0.16	0.02	
v/c Ratio	0.46			0.38	0.48	0.06
Uniform Delay, d1	15.7			4.5	10.4	8.9
Progression Factor	1.00			1.00	1.00	1.00
Incremental Delay, d2	1.7			0.2	0.6	0.0
Delay (s)	17.4			4.7	11.0	9.0
Level of Service	B			A	B	A
Approach Delay (s)	17.4			4.7	10.5	
Approach LOS	B			A	B	
Intersection Summary						
HCM 2000 Control Delay	8.8			HCM 2000 Level of Service	A	
HCM 2000 Volume to Capacity ratio	0.48					
Actuated Cycle Length (s)	37.9			Sum of lost time (s)	16.0	
Intersection Capacity Utilization	54.0%			ICU Level of Service	A	
Analysis Period (min)	15					
c Critical Lane Group						

Timings

2021 SAT Traffic

Signalized

1: Carlow Rd/Union Road & Lake Line/Warren St



Lane Group	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations	↑↓	↔	↔	↔	↑↓	↑↓	↔	↑↓
Traffic Volume (vph)	11	126	23	17	23	89	15	38
Future Volume (vph)	11	126	23	17	23	89	15	38
Turn Type	NA	pm+pt	NA	Perm	NA	pm+ov	Perm	NA
Protected Phases	4	3	8		2	3		6
Permitted Phases				2		2	6	
Detector Phase	4	3	8	2	2	3	6	6
Switch Phase								
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	9.0	11.0	11.0	11.0	9.0	11.0	11.0
Total Split (s)	23.0	15.0	38.0	22.0	22.0	15.0	22.0	22.0
Total Split (%)	38.3%	25.0%	63.3%	36.7%	36.7%	25.0%	36.7%	36.7%
Yellow Time (s)	4.0	3.0	4.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	1.0	2.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0		0.0	0.0		0.0
Total Lost Time (s)	6.0		6.0		6.0	4.0		6.0
Lead/Lag	Lag	Lead				Lead		
Lead-Lag Optimize?	Yes	Yes				Yes		
Recall Mode	Min							
Act Effect Green (s)	5.9		15.5		6.6	18.2		6.6
Actuated g/C Ratio	0.17		0.45		0.19	0.53		0.19
v/c Ratio	0.08		0.41		0.14	0.11		0.21
Control Delay	9.9		7.7		12.7	1.6		11.7
Queue Delay	0.0		0.0		0.0	0.0		0.0
Total Delay	9.9		7.7		12.7	1.6		11.7
LOS	A		A		B	A		B
Approach Delay	9.9		7.7		5.0			11.7
Approach LOS	A		A		A			B

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 34.1

Natural Cycle: 40

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.41

Intersection Signal Delay: 7.6

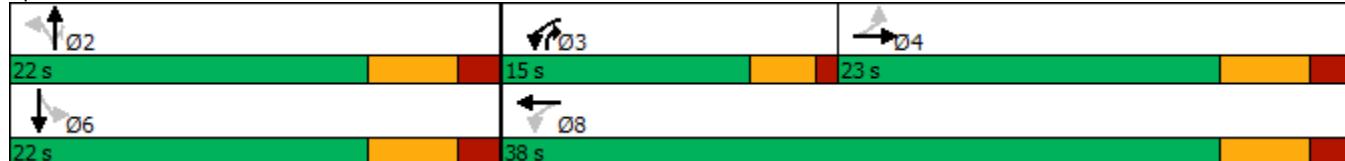
Intersection LOS: A

Intersection Capacity Utilization 37.6%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 1: Carlow Rd/Union Road & Lake Line/Warren St



Queues

2021 SAT Traffic

Signalized

1: Carlow Rd/Union Road & Lake Line/Warren St



Lane Group	EBT	WBT	NBT	NBR	SBT
Lane Group Flow (vph)	25	208	43	97	69
v/c Ratio	0.08	0.41	0.14	0.11	0.21
Control Delay	9.9	7.7	12.7	1.6	11.7
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	9.9	7.7	12.7	1.6	11.7
Queue Length 50th (m)	0.6	5.0	2.0	0.0	2.6
Queue Length 95th (m)	4.2	13.2	6.8	3.2	8.8
Internal Link Dist (m)	59.2	392.2	126.4		76.1
Turn Bay Length (m)			30.0		
Base Capacity (vph)	881	902	737	1139	790
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	0.03	0.23	0.06	0.09	0.09

Intersection Summary

HCM Signalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2021 SAT Traffic
Signalized

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	11	12	126	23	42	17	23	89	15	38	11
Future Volume (vph)	0	11	12	126	23	42	17	23	89	15	38	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0			6.0	4.0		6.0	
Lane Util. Factor	1.00				1.00			1.00	1.00		1.00	
Frt	0.93				0.97			1.00	0.85		0.98	
Flt Protected	1.00				0.97			0.98	1.00		0.99	
Satd. Flow (prot)		1751				1769			1845	1601		1818
Flt Permitted		1.00				0.47			0.83	1.00		0.91
Satd. Flow (perm)		1751				856			1568	1601		1669
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	12	13	137	25	46	18	25	97	16	41	12
RTOR Reduction (vph)	0	11	0	0	20	0	0	0	62	0	10	0
Lane Group Flow (vph)	0	14	0	0	188	0	0	43	35	0	59	0
Turn Type	NA		pm+pt	NA		Perm	NA	pm+ov	Perm	NA		
Protected Phases	4			3	8			2	3		6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	5.9				15.5			6.6	12.2		6.6	
Effective Green, g (s)	5.9				15.5			6.6	12.2		6.6	
Actuated g/C Ratio	0.17				0.45			0.19	0.36		0.19	
Clearance Time (s)	6.0				6.0			6.0	4.0		6.0	
Vehicle Extension (s)	3.0				3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)	302				539			303	572		323	
v/s Ratio Prot	0.01			c0.06					0.01			
v/s Ratio Perm				c0.10				0.03	0.01		c0.04	
v/c Ratio	0.05			0.35				0.14	0.06		0.18	
Uniform Delay, d1	11.8			6.0				11.4	7.2		11.5	
Progression Factor	1.00			1.00				1.00	1.00		1.00	
Incremental Delay, d2	0.1			0.4				0.2	0.0		0.3	
Delay (s)	11.8			6.4				11.6	7.2		11.8	
Level of Service	B			A				B	A		B	
Approach Delay (s)	11.8			6.4				8.6			11.8	
Approach LOS	B			A				A			B	
Intersection Summary												
HCM 2000 Control Delay	8.2				HCM 2000 Level of Service				A			
HCM 2000 Volume to Capacity ratio	0.35											
Actuated Cycle Length (s)	34.1				Sum of lost time (s)				16.0			
Intersection Capacity Utilization	37.6%				ICU Level of Service				A			
Analysis Period (min)	15											
c Critical Lane Group												

Timings
2: Colborne St/Sunset Rd & Warren St

2021 SAT Traffic
Signalized



Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Configurations	Y	Y	Y	Y	Y
Traffic Volume (vph)	70	67	377	561	125
Future Volume (vph)	70	67	377	561	125
Turn Type	Prot	pm+pt	NA	NA	Perm
Protected Phases	4	5	2	6	
Permitted Phases			2		6
Detector Phase	4	5	2	6	6
Switch Phase					
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	11.0	11.0	11.0	11.0
Total Split (s)	13.0	11.0	47.0	36.0	36.0
Total Split (%)	21.7%	18.3%	78.3%	60.0%	60.0%
Yellow Time (s)	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0		6.0	6.0	6.0
Lead/Lag	Lead		Lag	Lag	
Lead-Lag Optimize?	Yes		Yes	Yes	
Recall Mode	None	Min	Min	Min	Min
Act Effect Green (s)	7.0		30.6	20.2	20.2
Actuated g/C Ratio	0.15		0.66	0.44	0.44
v/c Ratio	0.42		0.52	0.75	0.18
Control Delay	20.5		6.9	17.7	2.4
Queue Delay	0.0		0.0	0.0	0.0
Total Delay	20.5		6.9	17.7	2.4
LOS	C	A	B	A	
Approach Delay	20.5		6.9	14.9	
Approach LOS	C	A	B		

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 46.4

Natural Cycle: 60

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.75

Intersection Signal Delay: 12.6

Intersection LOS: B

Intersection Capacity Utilization 74.8%

ICU Level of Service D

Analysis Period (min) 15

Splits and Phases: 2: Colborne St/Sunset Rd & Warren St



Queues
2: Colborne St/Sunset Rd & Warren St

2021 SAT Traffic
Signalized



Lane Group	EBL	NBT	SBT	SBR
Lane Group Flow (vph)	126	483	610	136
v/c Ratio	0.42	0.52	0.75	0.18
Control Delay	20.5	6.9	17.7	2.4
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	20.5	6.9	17.7	2.4
Queue Length 50th (m)	6.6	18.0	43.0	0.0
Queue Length 95th (m)	21.6	30.1	71.6	6.2
Internal Link Dist (m)	392.2	65.6	88.3	
Turn Bay Length (m)			40.0	
Base Capacity (vph)	322	1173	1260	1116
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.39	0.41	0.48	0.12

Intersection Summary

HCM Signalized Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2021 SAT Traffic
Signalized

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	70	46	67	377	561	125
Future Volume (vph)	70	46	67	377	561	125
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0			6.0	6.0	6.0
Lane Util. Factor	1.00			1.00	1.00	1.00
Frt	0.95			1.00	1.00	0.85
Flt Protected	0.97			0.99	1.00	1.00
Satd. Flow (prot)	1730			1869	1883	1601
Flt Permitted	0.97			0.71	1.00	1.00
Satd. Flow (perm)	1730			1343	1883	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	76	50	73	410	610	136
RTOR Reduction (vph)	40	0	0	0	0	77
Lane Group Flow (vph)	86	0	0	483	610	59
Turn Type	Prot	pm+pt	NA	NA	Perm	
Protected Phases	4	5	2	6		
Permitted Phases		2		6		
Actuated Green, G (s)	4.9		30.5	20.5	20.5	
Effective Green, g (s)	4.9		30.5	20.5	20.5	
Actuated g/C Ratio	0.10		0.64	0.43	0.43	
Clearance Time (s)	6.0		6.0	6.0	6.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	178		930	814	692	
v/s Ratio Prot	c0.05		c0.07	c0.32		
v/s Ratio Perm		0.27		0.04		
v/c Ratio	0.48		0.52	0.75	0.08	
Uniform Delay, d1	20.1		4.5	11.3	7.9	
Progression Factor	1.00		1.00	1.00	1.00	
Incremental Delay, d2	2.0		0.5	3.8	0.1	
Delay (s)	22.1		5.0	15.1	8.0	
Level of Service	C		A	B	A	
Approach Delay (s)	22.1		5.0	13.8		
Approach LOS	C		A	B		
Intersection Summary						
HCM 2000 Control Delay	11.4		HCM 2000 Level of Service		B	
HCM 2000 Volume to Capacity ratio	0.68					
Actuated Cycle Length (s)	47.4		Sum of lost time (s)		16.0	
Intersection Capacity Utilization	74.8%		ICU Level of Service		D	
Analysis Period (min)	15					
c Critical Lane Group						

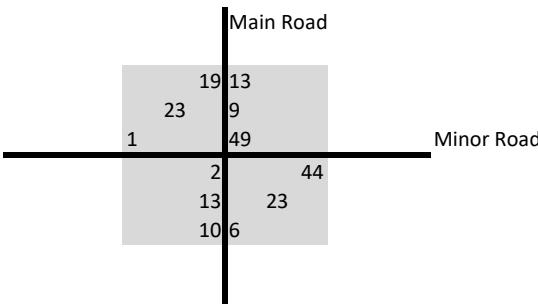
Appendix C – Traffic Signal Warrant Analysis

TRAFFIC SIGNAL WARRANT ANALYSIS - PROJECTED VOLUMES

Analysis Year/Condition: 2021 AM/PM Location: Carlow Rd / Warren Street (Port Stanley)

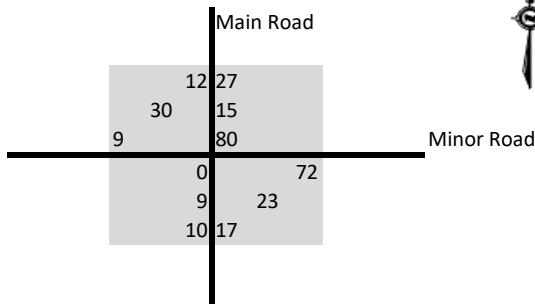
Scenario: Existing Intersection and Traffic Volumes
 Main Road Direction: North / South Number of Lanes on Main Road: 1
 Tee Intersection?: No Flow Condition: Restricted Flow (Urban)

AM Peak Hour Volumes



Pedestrians crossing Main Road:

PM Peak Hour Volumes



Pedestrians crossing Main Road:



Ontario Traffic Manual Book 12 - Justification 7 - Projected Volumes:

Justification 1: Minimum Vehicular Volume		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW			
		Volume Requirement	480	X	600	900			
1A (All Approaches)	Average Hourly Volume		129				18%	100%	NO
	Volume Requirement		120	X	120	170	35%	100%	
1B (Minor Street Approaches)	Average Hourly Volume		59						

Justification 2: Delay to Cross Traffic		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW			
		Volume Requirement	480	X	600	900			
2A (Main Road Approaches)	Average Hourly Volume		70				10%	100%	NO
	Volume Requirement		50	X	50	75			
2B (Traffic Crossing Main Road)	Average Hourly Volume		40				53%	100%	

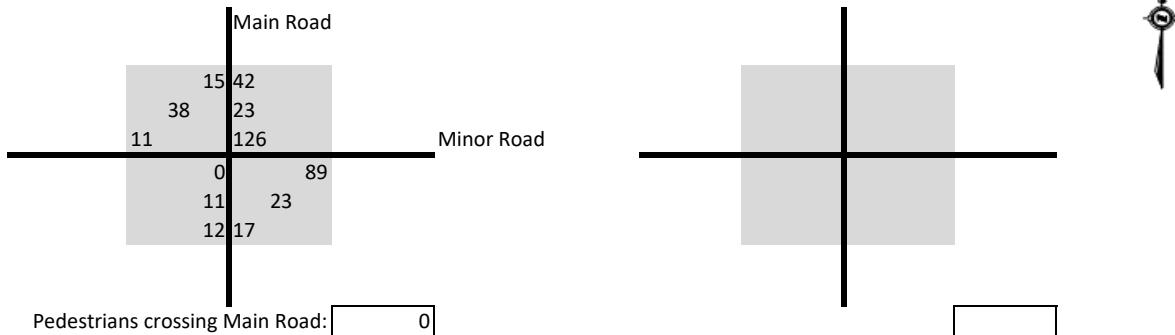
Results	
Traffic signals are not warranted.	

TRAFFIC SIGNAL WARRANT ANALYSIS - PROJECTED VOLUMES

Analysis Year/Condition: 2021 Holiday Location: Carlow Rd / Warren Street (Port Stanley)

Scenario: Existing Intersection and Traffic Volumes
 Main Road Direction: North / South Number of Lanes on Main Road: 1
 Tee Intersection?: No Flow Condition: Restricted Flow (Urban)

Holiday Peak Hour Volumes



Ontario Traffic Manual Book 12 - Justification 7 - Projected Volumes:

Justification 1: Minimum Vehicular Volume		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW			
		Volume Requirement	480	X	600	900			
1A (All Approaches)	Average Hourly Volume		204				28%	100%	NO
	Volume Requirement	120	X	170	120	170	63%	100%	
1B (Minor Street Approaches)	Average Hourly Volume		107						

Justification 2: Delay to Cross Traffic		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW			
		Volume Requirement	480	X	600	900			
2A (Main Road Approaches)	Average Hourly Volume		97				13%	100%	NO
	Volume Requirement	50	X	75	50	75	100%	100%	
2B (Traffic Crossing Main Road)	Average Hourly Volume		75						

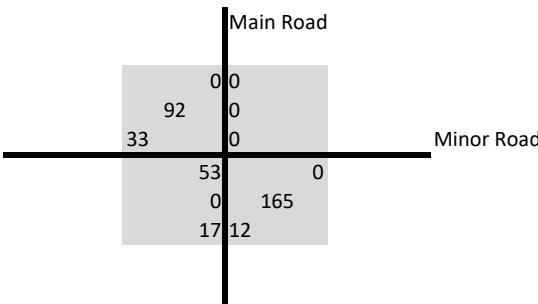
Results	
Traffic signals are not warranted.	

TRAFFIC SIGNAL WARRANT ANALYSIS - PROJECTED VOLUMES

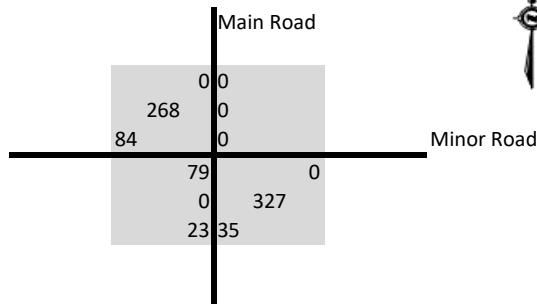
Analysis Year/Condition: 2021 AM/PM Location: Colborne St / Warren Street (Port Stanley)

Scenario: Existing Intersection and Traffic Volumes
 Main Road Direction: North / South Number of Lanes on Main Road: 1
 Tee Intersection?: Yes Flow Condition: Restricted Flow (Urban)

AM Peak Hour Volumes



PM Peak Hour Volumes



Ontario Traffic Manual Book 12 - Justification 7 - Projected Volumes:

Justification 1: Minimum Vehicular Volume		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?	
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW				
		Volume Requirement	480	720	600	900				
1A (All Approaches)		Average Hourly Volume		X			41%	100%	NO	
		Volume Requirement	180	255	180	255	17%	100%		
1B (Minor Street Approaches)		Average Hourly Volume		X						
		Volume Requirement	50	75	50	75				

Justification 2: Delay to Cross Traffic		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?	
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW				
		Volume Requirement	480	720	600	900				
2A (Main Road Approaches)		Average Hourly Volume		X			35%	100%	NO	
		Volume Requirement	254							
2B (Traffic Crossing Main Road)		Average Hourly Volume	50	75	50	75	44%	100%		
		Volume Requirement		X						

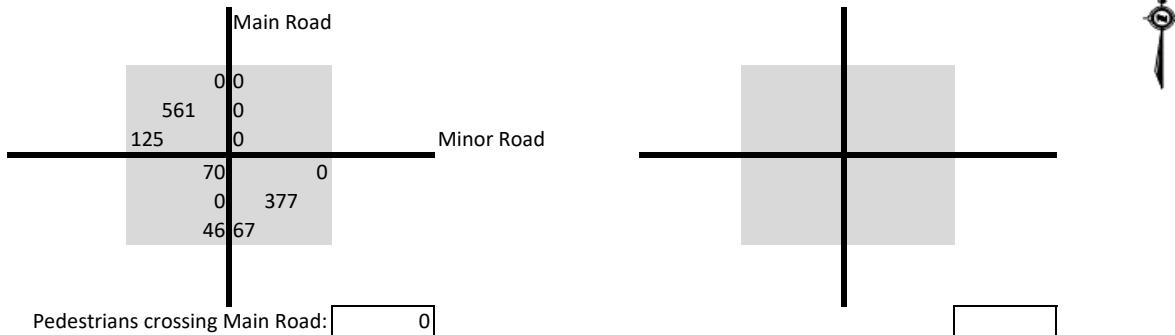
Results	
Traffic signals are not warranted.	

TRAFFIC SIGNAL WARRANT ANALYSIS - PROJECTED VOLUMES

Analysis Year/Condition: 2021 Holiday Location: Colborne St / Warren Street (Port Stanley)

Scenario: Existing Intersection and Traffic Volumes
 Main Road Direction: North / South Number of Lanes on Main Road: 1
 Tee Intersection?: Yes Flow Condition: Restricted Flow (Urban)

Holiday Peak Hour Volumes



Ontario Traffic Manual Book 12 - Justification 7 - Projected Volumes:

Justification 1: Minimum Vehicular Volume		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW			
		Volume Requirement	480	X	600	900			
1A (All Approaches)	Average Hourly Volume			623			87%	100%	NO
	Volume Requirement	180	255	180	255		23%	100%	
1B (Minor Street Approaches)	Average Hourly Volume			X					
	Volume Requirement			58					

Justification 2: Delay to Cross Traffic		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW			
		Volume Requirement	480	X	600	900			
2A (Main Road Approaches)	Average Hourly Volume			565			78%	100%	NO
	Volume Requirement	50	75	50	75		47%	100%	
2B (Traffic Crossing Main Road)	Average Hourly Volume			X					
	Volume Requirement			35					

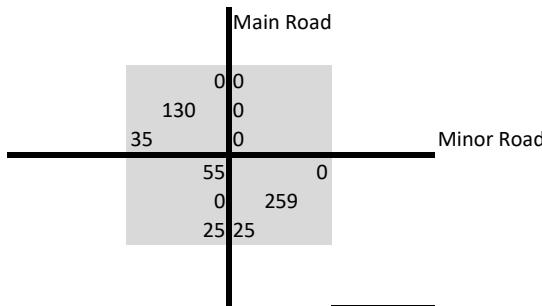
Results	
Traffic signals are not warranted.	

TRAFFIC SIGNAL WARRANT ANALYSIS - PROJECTED VOLUMES

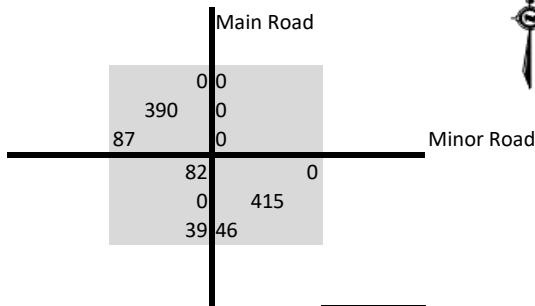
Analysis Year/Condition: 2028 AM/PM Background Location: Colborne St / Warren Street (Port Stanley)

Scenario: Existing Intersection with Future Traffic
 Main Road Direction: North / South Number of Lanes on Main Road: 1
 Tee Intersection?: Yes Flow Condition: Restricted Flow (Urban)

AM Peak Hour Volumes



PM Peak Hour Volumes



Ontario Traffic Manual Book 12 - Justification 7 - Projected Volumes:

Justification 1: Minimum Vehicular Volume		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?	
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW				
		Volume Requirement	480	720	600	900				
1A (All Approaches)		Average Hourly Volume		X			55%	120%	NO	
		Volume Requirement	180	255	180	255				
1B (Minor Street Approaches)		Average Hourly Volume		X			20%	120%		
		Volume Requirement	50							

Justification 2: Delay to Cross Traffic		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?	
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW				
		Volume Requirement	480	720	600	900				
2A (Main Road Approaches)		Average Hourly Volume		X			48%	120%	NO	
		Volume Requirement	50	75	50	75				
2B (Traffic Crossing Main Road)		Average Hourly Volume		X			45%	120%		
		Volume Requirement	34							

Results

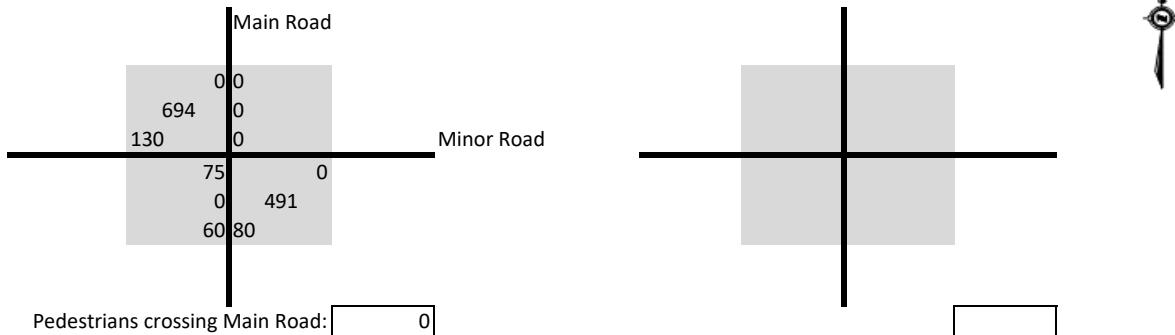
Traffic signals are not warranted.

TRAFFIC SIGNAL WARRANT ANALYSIS - PROJECTED VOLUMES

Analysis Year/Condition: 2028 Holiday Background Location: Colborne St / Warren Street (Port Stanley)

Scenario: Existing Intersection with Future Traffic
 Main Road Direction: North / South Number of Lanes on Main Road: 1
 Tee Intersection?: Yes Flow Condition: Restricted Flow (Urban)

Holiday Peak Hour Volumes



Ontario Traffic Manual Book 12 - Justification 7 - Projected Volumes:

Justification 1: Minimum Vehicular Volume		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?	
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW				
		1A (All Approaches)	Volume Requirement	480	720	600	900	106%	120%	NO
1B (Minor Street Approaches)		Average Hourly Volume		X						
		Volume Requirement	180	255	180	255	27%	120%		
		Average Hourly Volume		X						
			68							

Justification 2: Delay to Cross Traffic		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?	
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW				
		2A (Main Road Approaches)	Volume Requirement	480	720	600	900	97%	120%	NO
2B (Traffic Crossing Main Road)		Average Hourly Volume		X						
		Volume Requirement	50	75	50	75	64%	120%		
		Average Hourly Volume		X						
			48							

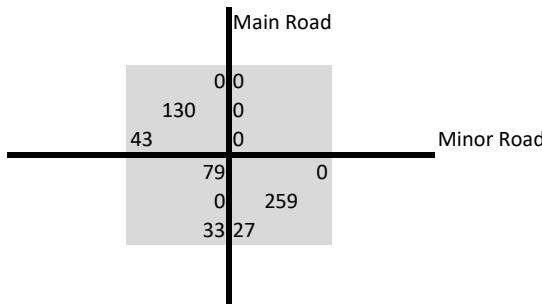
Results	
Traffic signals are not warranted.	

TRAFFIC SIGNAL WARRANT ANALYSIS - PROJECTED VOLUMES

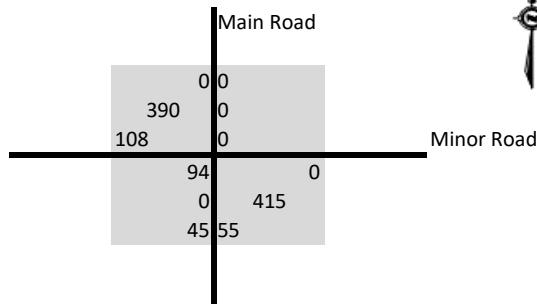
Analysis Year/Condition: 2028 AM/PM Total Location: Colborne St / Warren Street (Port Stanley)

Scenario: Existing Intersection with Future Traffic
 Main Road Direction: North / South Number of Lanes on Main Road: 1
 Tee Intersection?: Yes Flow Condition: Restricted Flow (Urban)

AM Peak Hour Volumes



PM Peak Hour Volumes



Ontario Traffic Manual Book 12 - Justification 7 - Projected Volumes:

Justification 1: Minimum Vehicular Volume		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?	
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW				
		Volume Requirement	480	720	600	900				
1A (All Approaches)		Average Hourly Volume		X			58%	120%	NO	
			420							
1B (Minor Street Approaches)		Volume Requirement	180	255	180	255	25%	120%		
		Average Hourly Volume		X						
			63							

Justification 2: Delay to Cross Traffic		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?	
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW				
		Volume Requirement	480	720	600	900				
2A (Main Road Approaches)		Average Hourly Volume		X			50%	120%	NO	
			357							
2B (Traffic Crossing Main Road)		Volume Requirement	50	75	50	75	57%	120%		
		Average Hourly Volume		X						
			43							

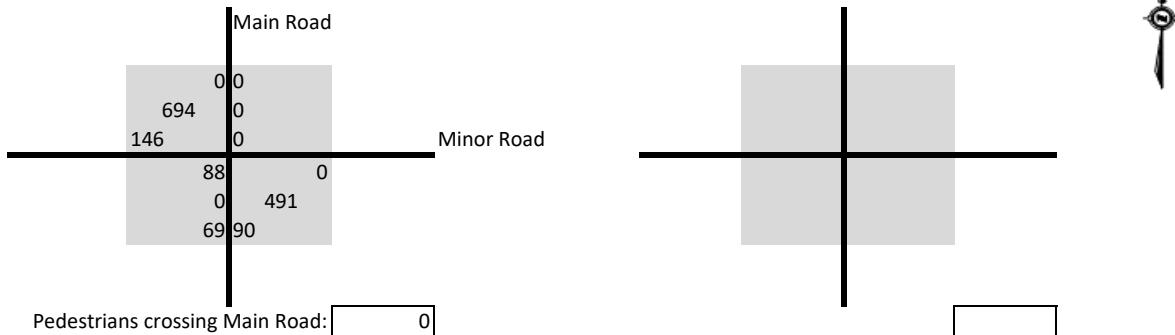
Results	
Traffic signals are not warranted.	

TRAFFIC SIGNAL WARRANT ANALYSIS - PROJECTED VOLUMES

Analysis Year/Condition: 2028 Holiday Total Location: Colborne St / Warren Street (Port Stanley)

Scenario: Existing Intersection with Future Traffic
 Main Road Direction: North / South Number of Lanes on Main Road: 1
 Tee Intersection?: Yes Flow Condition: Restricted Flow (Urban)

Holiday Peak Hour Volumes



Ontario Traffic Manual Book 12 - Justification 7 - Projected Volumes:

Justification 1: Minimum Vehicular Volume		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW			
		Volume Requirement	480	720	600	900			
1A (All Approaches)		Average Hourly Volume		X			110%	120%	NO
		Volume Requirement	180	255	180	255	31%		
1B (Minor Street Approaches)		Average Hourly Volume		X				120%	NO
		Volume Requirement	789						
		Average Hourly Volume	79						

Justification 2: Delay to Cross Traffic		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW			
		Volume Requirement	480	720	600	900			
2A (Main Road Approaches)		Average Hourly Volume		X			99%	120%	NO
		Volume Requirement	711						
2B (Traffic Crossing Main Road)		Average Hourly Volume	50	75	50	75	73%	120%	NO
		Volume Requirement		X					
		Average Hourly Volume		55					

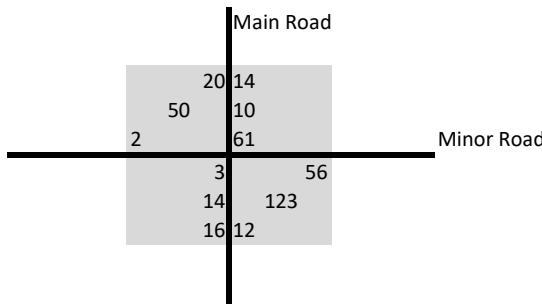
Results	
Traffic signals are not warranted.	

TRAFFIC SIGNAL WARRANT ANALYSIS - PROJECTED VOLUMES

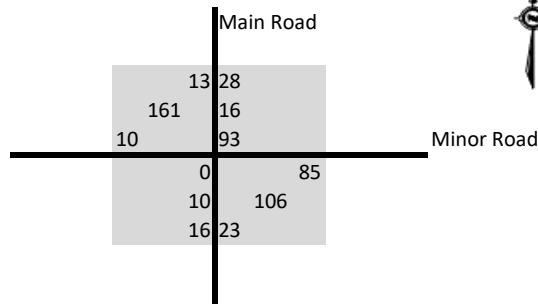
Analysis Year/Condition: 2028 AM/PM Background Location: Carlow Rd / Warren Street (Port Stanley)

Scenario: Existing Intersection with Future Traffic
 Main Road Direction: North / South Number of Lanes on Main Road: 1
 Tee Intersection?: No Flow Condition: Restricted Flow (Urban)

AM Peak Hour Volumes



PM Peak Hour Volumes



Ontario Traffic Manual Book 12 - Justification 7 - Projected Volumes:

Justification 1: Minimum Vehicular Volume		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW			
		Volume Requirement	480	720	600	900			
1A (All Approaches)		Average Hourly Volume		X			33%	120%	NO
		Volume Requirement	120	170	120	170	41%		
1B (Minor Street Approaches)		Average Hourly Volume		X			120%	120%	NO
		Volume Requirement	50	75	50	75			

Justification 2: Delay to Cross Traffic		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW			
		Volume Requirement	480	720	600	900			
2A (Main Road Approaches)		Average Hourly Volume		X			23%	120%	NO
		Volume Requirement	165						
2B (Traffic Crossing Main Road)		Average Hourly Volume	50	75	50	75	63%	120%	NO
		Volume Requirement		X					

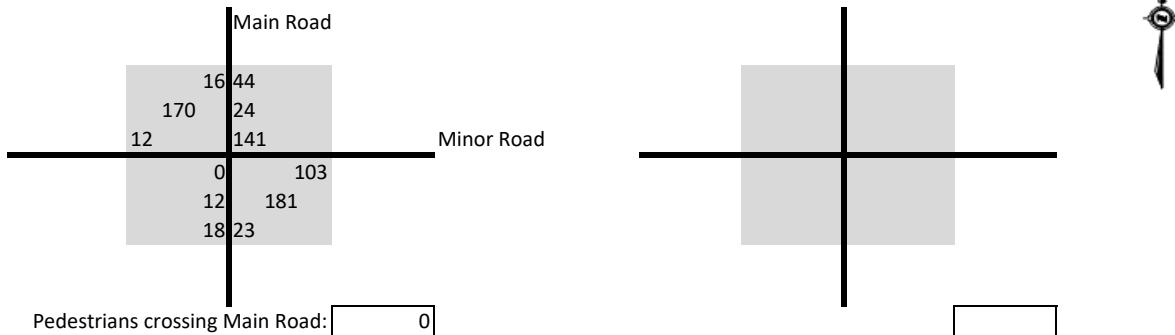
Results	
Traffic signals are not warranted.	

TRAFFIC SIGNAL WARRANT ANALYSIS - PROJECTED VOLUMES

Analysis Year/Condition: 2028 Holiday Background Location: Carlow Rd / Warren Street (Port Stanley)

Scenario: Existing Intersection with Future Traffic
 Main Road Direction: North / South Number of Lanes on Main Road: 1
 Tee Intersection?: No Flow Condition: Restricted Flow (Urban)

Holiday Peak Hour Volumes



Ontario Traffic Manual Book 12 - Justification 7 - Projected Volumes:

Justification 1: Minimum Vehicular Volume		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW			
		Volume Requirement	480	X	600	900			
1A (All Approaches)	Average Hourly Volume		372				52%	120%	NO
	Volume Requirement	120	170	120	170		71%	120%	
1B (Minor Street Approaches)	Average Hourly Volume		X						
	Volume Requirement	120	120						

Justification 2: Delay to Cross Traffic		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW			
		Volume Requirement	480	X	600	900			
2A (Main Road Approaches)	Average Hourly Volume		253				35%	120%	NO
	Volume Requirement	50	75	50	75		111%	120%	
2B (Traffic Crossing Main Road)	Average Hourly Volume		X						
	Volume Requirement	83							

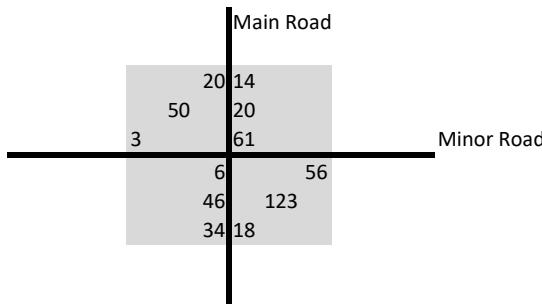
Results	
Traffic signals are not warranted.	

TRAFFIC SIGNAL WARRANT ANALYSIS - PROJECTED VOLUMES

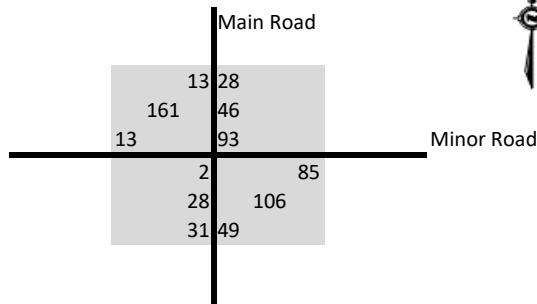
Analysis Year/Condition: 2028 AM/PM Total Location: Carlow Rd / Warren Street (Port Stanley)

Scenario: Existing Intersection with Future Traffic
 Main Road Direction: North / South Number of Lanes on Main Road: 1
 Tee Intersection?: No Flow Condition: Restricted Flow (Urban)

AM Peak Hour Volumes



PM Peak Hour Volumes



Ontario Traffic Manual Book 12 - Justification 7 - Projected Volumes:

Justification 1: Minimum Vehicular Volume		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW			
		Volume Requirement	480	720	600	900			
1A (All Approaches)		Average Hourly Volume		X			38%	120%	NO
		Volume Requirement	120	170	120	170	60%		
1B (Minor Street Approaches)		Average Hourly Volume		X				120%	NO
		Volume Requirement	102						

Justification 2: Delay to Cross Traffic		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW			
		Volume Requirement	480	720	600	900			
2A (Main Road Approaches)		Average Hourly Volume		X			24%	120%	NO
		Volume Requirement	174						
2B (Traffic Crossing Main Road)		Average Hourly Volume	50	75	50	75	85%	120%	NO
		Volume Requirement		X					
		Average Hourly Volume		64					

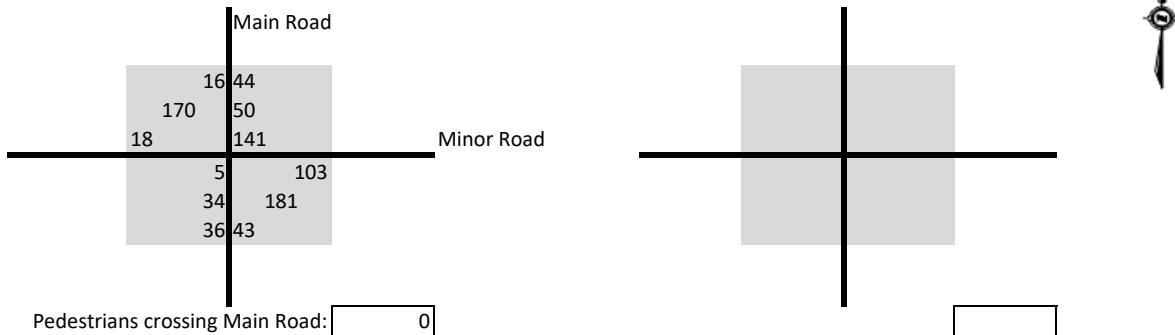
Results	
Traffic signals are not warranted.	

TRAFFIC SIGNAL WARRANT ANALYSIS - PROJECTED VOLUMES

Analysis Year/Condition: 2028 Holiday Total Location: Carlow Rd / Warren Street (Port Stanley)

Scenario: Existing Intersection with Future Traffic
 Main Road Direction: North / South Number of Lanes on Main Road: 1
 Tee Intersection?: No Flow Condition: Restricted Flow (Urban)

Holiday Peak Hour Volumes



Ontario Traffic Manual Book 12 - Justification 7 - Projected Volumes:

Justification 1: Minimum Vehicular Volume		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW			
		Volume Requirement	480	X	600	900			
1A (All Approaches)		Average Hourly Volume	421				58%	120%	NO
		Volume Requirement	120	X	120	170	91%	120%	
1B (Minor Street Approaches)		Average Hourly Volume	155						

Justification 2: Delay to Cross Traffic		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW			
		Volume Requirement	480	X	600	900			
2A (Main Road Approaches)		Average Hourly Volume	266				37%	120%	NO
		Volume Requirement	50	X	50	75			
2B (Traffic Crossing Main Road)		Average Hourly Volume	98				131%	120%	

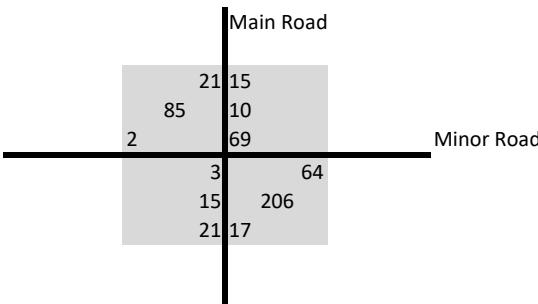
Results	
Traffic signals are not warranted.	

TRAFFIC SIGNAL WARRANT ANALYSIS - PROJECTED VOLUMES

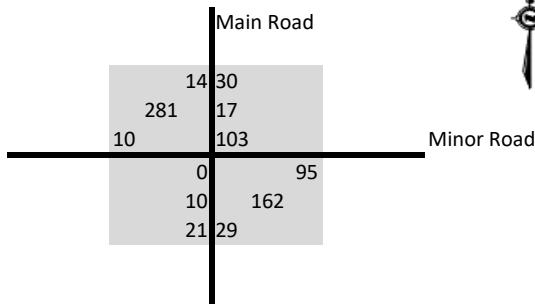
Analysis Year/Condition: 2040 AM/PM Background Location: Carlow Rd / Warren Street (Port Stanley)

Scenario: Existing Intersection with Future Traffic
 Main Road Direction: North / South Number of Lanes on Main Road: 1
 Tee Intersection?: No Flow Condition: Restricted Flow (Urban)

AM Peak Hour Volumes



PM Peak Hour Volumes



Ontario Traffic Manual Book 12 - Justification 7 - Projected Volumes:

Justification 1: Minimum Vehicular Volume		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW			
		Volume Requirement	480	X	600	900			
1A (All Approaches)		Average Hourly Volume	325				45%	120%	NO
		Volume Requirement	120	X	120	170	46%	120%	
1B (Minor Street Approaches)		Average Hourly Volume	79						

Justification 2: Delay to Cross Traffic		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW			
		Volume Requirement	480	X	600	900			
2A (Main Road Approaches)		Average Hourly Volume	247				34%	120%	NO
		Volume Requirement	50	X	50	75	69%	120%	
2B (Traffic Crossing Main Road)		Average Hourly Volume	52						

Results

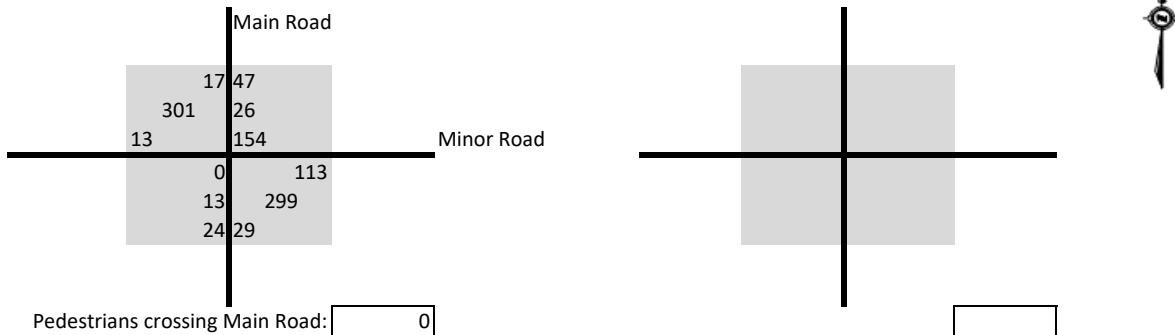
Traffic signals are not warranted.

TRAFFIC SIGNAL WARRANT ANALYSIS - PROJECTED VOLUMES

Analysis Year/Condition: 2040 Holiday Background Location: Carlow Rd / Warren Street (Port Stanley)

Scenario: Existing Intersection with Future Traffic
 Main Road Direction: North / South Number of Lanes on Main Road: 1
 Tee Intersection?: No Flow Condition: Restricted Flow (Urban)

Holiday Peak Hour Volumes



Ontario Traffic Manual Book 12 - Justification 7 - Projected Volumes:

Justification 1: Minimum Vehicular Volume		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW			
		Volume Requirement	480	x	600	900			
1A (All Approaches)	Average Hourly Volume		518				72%	120%	NO
	Volume Requirement	120	x	170	120	170	78%	120%	
1B (Minor Street Approaches)	Average Hourly Volume		132						

Justification 2: Delay to Cross Traffic		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW			
		Volume Requirement	480	x	600	900			
2A (Main Road Approaches)	Average Hourly Volume		386				54%	120%	NO
	Volume Requirement	50	x	75	50	75	120%	120%	
2B (Traffic Crossing Main Road)	Average Hourly Volume		90						

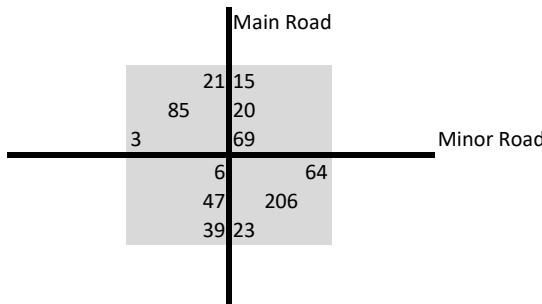
Results	
Traffic signals are not warranted.	

TRAFFIC SIGNAL WARRANT ANALYSIS - PROJECTED VOLUMES

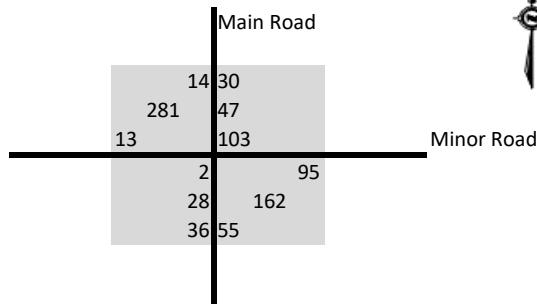
Analysis Year/Condition: 2040 AM/PM Total Location: Carlow Rd / Warren Street (Port Stanley)

Scenario: Existing Intersection with Future Traffic
 Main Road Direction: North / South Number of Lanes on Main Road: 1
 Tee Intersection?: No Flow Condition: Restricted Flow (Urban)

AM Peak Hour Volumes



PM Peak Hour Volumes



Ontario Traffic Manual Book 12 - Justification 7 - Projected Volumes:

Justification 1: Minimum Vehicular Volume		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW			
		Volume Requirement	480	X	600	900			NO
1A (All Approaches)	Average Hourly Volume						51%	120%	
	Volume Requirement		366						
1B (Minor Street Approaches)	Average Hourly Volume		120	X	120	170	65%	120%	NO
	Volume Requirement								

Justification 2: Delay to Cross Traffic		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW			
		Volume Requirement	480	X	600	900			NO
2A (Main Road Approaches)	Average Hourly Volume						36%	120%	
	Volume Requirement		256						
2B (Traffic Crossing Main Road)	Average Hourly Volume		50	X	50	75	92%	120%	NO
	Volume Requirement								

Results

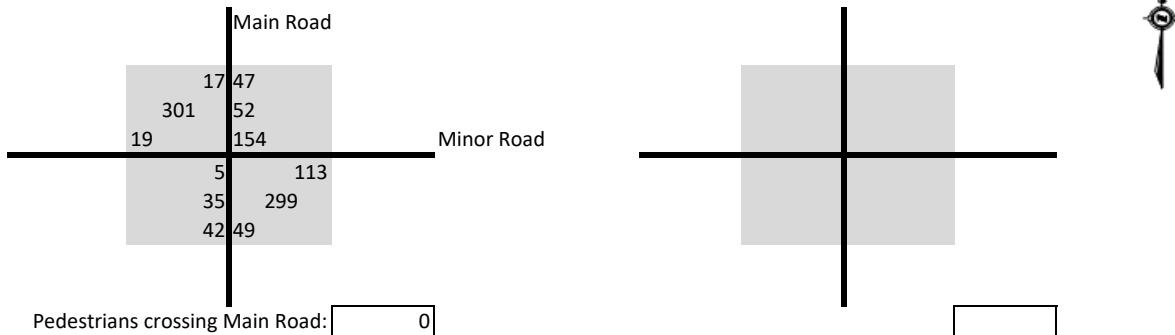
Traffic signals are not warranted.

TRAFFIC SIGNAL WARRANT ANALYSIS - PROJECTED VOLUMES

Analysis Year/Condition: 2040 Holiday Total Location: Carlow Rd / Warren Street (Port Stanley)

Scenario: Existing Intersection with Future Traffic
 Main Road Direction: North / South Number of Lanes on Main Road: 1
 Tee Intersection?: No Flow Condition: Restricted Flow (Urban)

Holiday Peak Hour Volumes



Ontario Traffic Manual Book 12 - Justification 7 - Projected Volumes:

Justification 1: Minimum Vehicular Volume		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW			
		Volume Requirement	480	X	600	900			
1A (All Approaches)	Average Hourly Volume		567				79%	120%	NO
	Volume Requirement	120	X	170	120	170	99%	120%	
1B (Minor Street Approaches)	Average Hourly Volume		168						

Justification 2: Delay to Cross Traffic		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW			
		Volume Requirement	480	X	600	900			
2A (Main Road Approaches)	Average Hourly Volume		399				55%	120%	NO
	Volume Requirement	50	X	75	50	75	141%	120%	
2B (Traffic Crossing Main Road)	Average Hourly Volume		106						

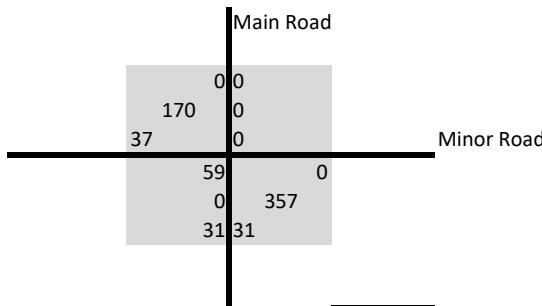
Results	
Traffic signals are not warranted.	

TRAFFIC SIGNAL WARRANT ANALYSIS - PROJECTED VOLUMES

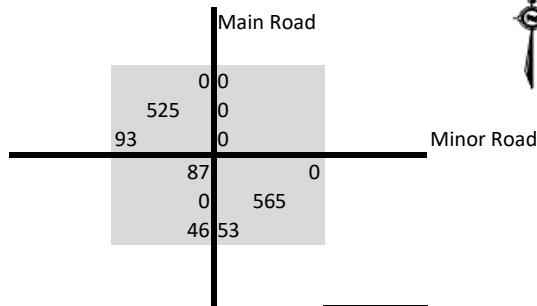
Analysis Year/Condition: 2040 AM/PM Background Location: Colborne St / Warren Street (Port Stanley)

Scenario: Existing Intersection with Future Traffic
 Main Road Direction: North / South Number of Lanes on Main Road: 1
 Tee Intersection?: Yes Flow Condition: Restricted Flow (Urban)

AM Peak Hour Volumes



PM Peak Hour Volumes



Ontario Traffic Manual Book 12 - Justification 7 - Projected Volumes:

Justification 1: Minimum Vehicular Volume		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?	
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW				
		1A (All Approaches)	Volume Requirement	480	720	600	900	71%	120%	NO
Justification 1: Minimum Vehicular Volume				X						
	Average Hourly Volume		514							
Justification 1: Minimum Vehicular Volume		1B (Minor Street Approaches)	Volume Requirement	180	255	180	255	22%	120%	
				X						
		Average Hourly Volume		56						

Justification 2: Delay to Cross Traffic		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?	
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW				
		2A (Main Road Approaches)	Volume Requirement	480	720	600	900	64%	120%	NO
Justification 2: Delay to Cross Traffic				X						
	Average Hourly Volume		458							
Justification 2: Delay to Cross Traffic		2B (Traffic Crossing Main Road)	Volume Requirement	50	75	50	75	49%	120%	
				X						
		Average Hourly Volume		37						

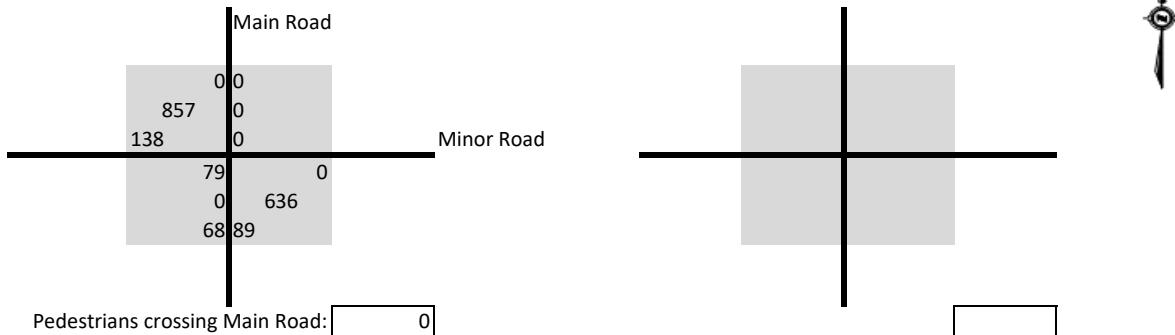
Results	
Traffic signals are not warranted.	

TRAFFIC SIGNAL WARRANT ANALYSIS - PROJECTED VOLUMES

Analysis Year/Condition: 2040 Holiday Background Location: Colborne St / Warren Street (Port Stanley)

Scenario: Existing Intersection with Future Traffic
 Main Road Direction: North / South Number of Lanes on Main Road: 1
 Tee Intersection?: Yes Flow Condition: Restricted Flow (Urban)

Holiday Peak Hour Volumes



Ontario Traffic Manual Book 12 - Justification 7 - Projected Volumes:

Justification 1: Minimum Vehicular Volume		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW			
		Volume Requirement	480	X	600	900			
1A (All Approaches)	Average Hourly Volume		934				130%	120%	NO
	Volume Requirement	180	255	180	255		29%	120%	
1B (Minor Street Approaches)	Average Hourly Volume		X						
	Volume Requirement		74						

Justification 2: Delay to Cross Traffic		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW			
		Volume Requirement	480	X	600	900			
2A (Main Road Approaches)	Average Hourly Volume		860				119%	120%	NO
	Volume Requirement	50	75	50	75		68%	120%	
2B (Traffic Crossing Main Road)	Average Hourly Volume		X						
	Volume Requirement		51						

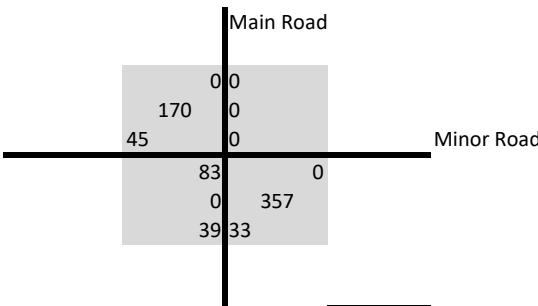
Results	
Traffic signals are not warranted.	

TRAFFIC SIGNAL WARRANT ANALYSIS - PROJECTED VOLUMES

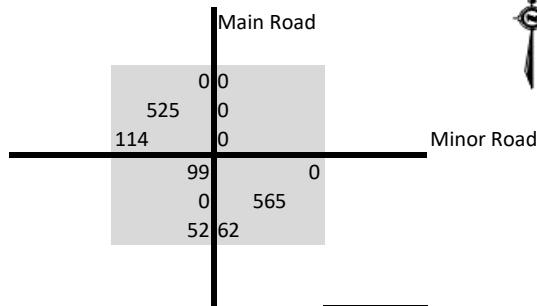
Analysis Year/Condition: 2040 AM/PM Total Location: Colborne St / Warren Street (Port Stanley)

Scenario: Existing Intersection with Future Traffic
 Main Road Direction: North / South Number of Lanes on Main Road: 1
 Tee Intersection?: Yes Flow Condition: Restricted Flow (Urban)

AM Peak Hour Volumes



PM Peak Hour Volumes



Ontario Traffic Manual Book 12 - Justification 7 - Projected Volumes:

Justification 1: Minimum Vehicular Volume		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW			
		Volume Requirement	480	X	600	900			NO
1A (All Approaches)	Average Hourly Volume		536				74%	120%	
	Volume Requirement		180	X	180	255	27%	120%	
1B (Minor Street Approaches)	Average Hourly Volume		68						

Justification 2: Delay to Cross Traffic		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW			
		Volume Requirement	480	X	600	900			NO
2A (Main Road Approaches)	Average Hourly Volume		468				65%	120%	
	Volume Requirement		50	X	50	75	61%	120%	
2B (Traffic Crossing Main Road)	Average Hourly Volume		46						

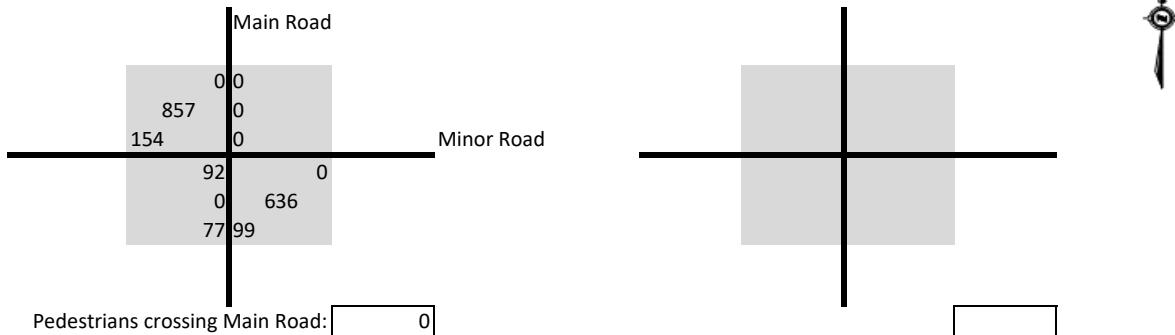
Results
Traffic signals are not warranted.

TRAFFIC SIGNAL WARRANT ANALYSIS - PROJECTED VOLUMES

Analysis Year/Condition: 2040 Holiday Total Location: Colborne St / Warren Street (Port Stanley)

Scenario: Existing Intersection with Future Traffic
 Main Road Direction: North / South Number of Lanes on Main Road: 1
 Tee Intersection?: Yes Flow Condition: Restricted Flow (Urban)

Holiday Peak Hour Volumes



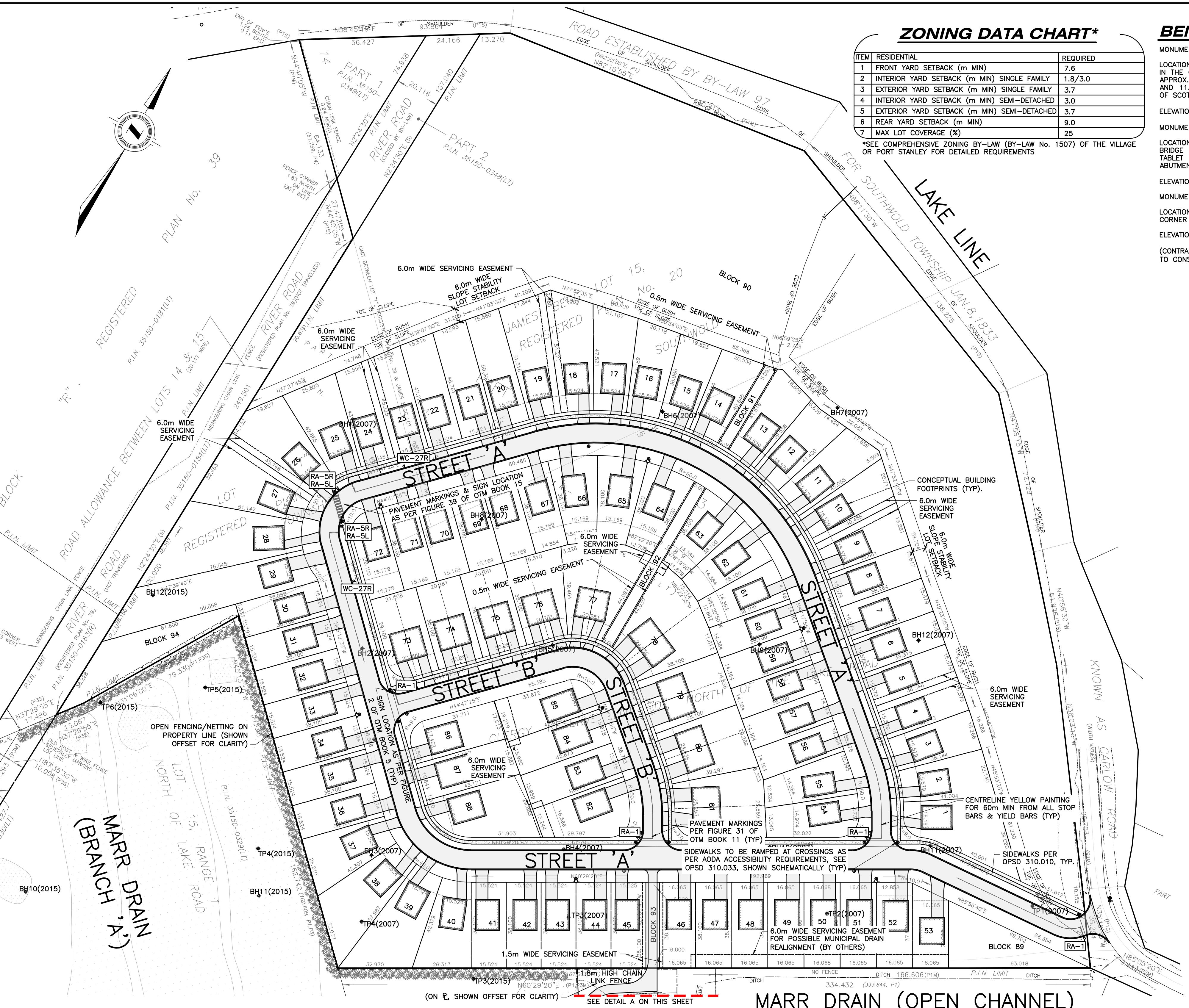
Ontario Traffic Manual Book 12 - Justification 7 - Projected Volumes:

Justification 1: Minimum Vehicular Volume		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?	
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW				
		1A (All Approaches)	Volume Requirement	480	720	600	900	133%	120%	NO
			Average Hourly Volume		X					
1B (Minor Street Approaches)		Volume Requirement	180	255	180	255	33%	120%	NO	
			Average Hourly Volume		X					

Justification 2: Delay to Cross Traffic		Lane Condition	1 Lanes		2 or More Lanes		Percent Fulfilled	Minimum Requirement	Signals Warranted?	
		Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW				
		2A (Main Road Approaches)	Volume Requirement	480	720	600	900	121%	120%	NO
			Average Hourly Volume		X					
2B (Traffic Crossing Main Road)		Volume Requirement	50	75	50	75	77%	120%	NO	
			Average Hourly Volume		X					

Results	
Traffic signals are not warranted.	

Appendix D – Subdivision Plan



BENCHMARKS:

MONUMENT NAME: 01019915404 (GEODETIC BENCHMARK)
LOCATION: BRASS CAP ON THE SOUTH SIDE OF LAKE ROAD, IN THE COUNTY OF ELGIN, IN THE TOWNSHIP OF SOUTHWOLD, APPROX. 8.0m SOUTH OF THE CENTRELINE OF LAKE ROAD AND 11.8m EAST OF THE PRODUCTION OF THE CENTRELINE OF SCOTCH ROAD.
ELEVATION: 214.432m (CGVD28:78)

MONUMENT NAME: 0011926U1648 (GEODETIC BENCHMARK)
LOCATION: PORT STANLEY LONDON & PORT STANLEY RAILWAY, BRIDGE OVER KETTLE CREEK, 0.8km NORTH OF STATION, TABLET IN EAST END OF BRIDGE SEAT OF SOUTH CONCRETE ABUTMENT, 30cm FROM NORTH EDGE.

ELEVATION: 178.167m (CGVD28:78)
MONUMENT NAME: SITE BENCHMARK
LOCATION: WITNESS SIB 1.000m SOUTH OF NORTHWEST CORNER OF MUN. 37719 LAKE ROAD, PORT STANLEY
ELEVATION: 214.742m
(CONTRACTOR TO CONFIRM BENCHMARK INFORMATION PRIOR TO CONSTRUCTION)

LEGAL INFORMATION

PART OF CLERGY RESERVE LOT "D" NORTH OF THE LAKE ROAD
PART OF JAMES BEGG LOTS 14 & 15 REGISTERED PLAN No. 20 (MIDD) AND PART OF ROAD ALLOWANCE BETWEEN LOTS 14 & 15 NORTH OF THE LAKE ROAD AND ALL OF LOT "T", REGISTERED PLAN No.39 IN THE MUNICIPALITY OF CENTRAL ELGIN COUNTY OF ELGIN
N.T.S.

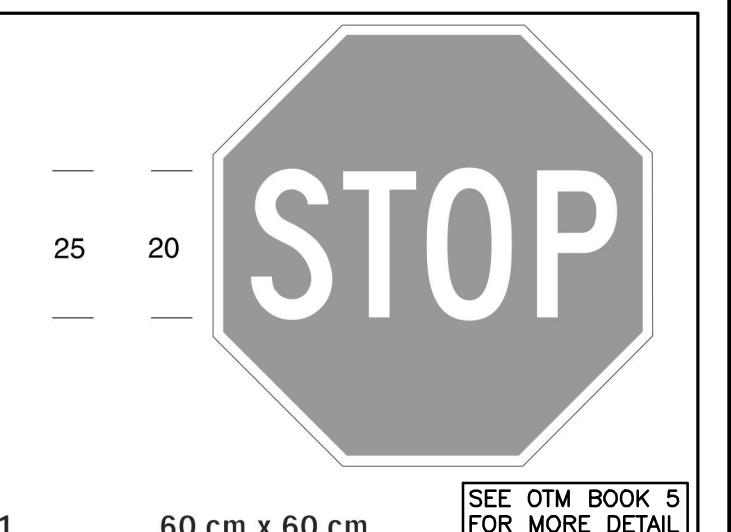
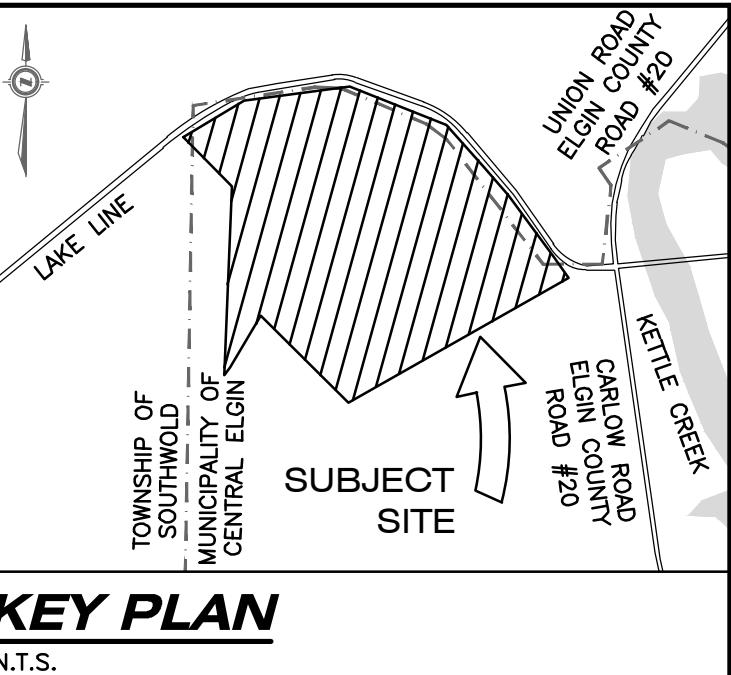


Figure 31 - Approaches to Unsignalized Urban Intersections

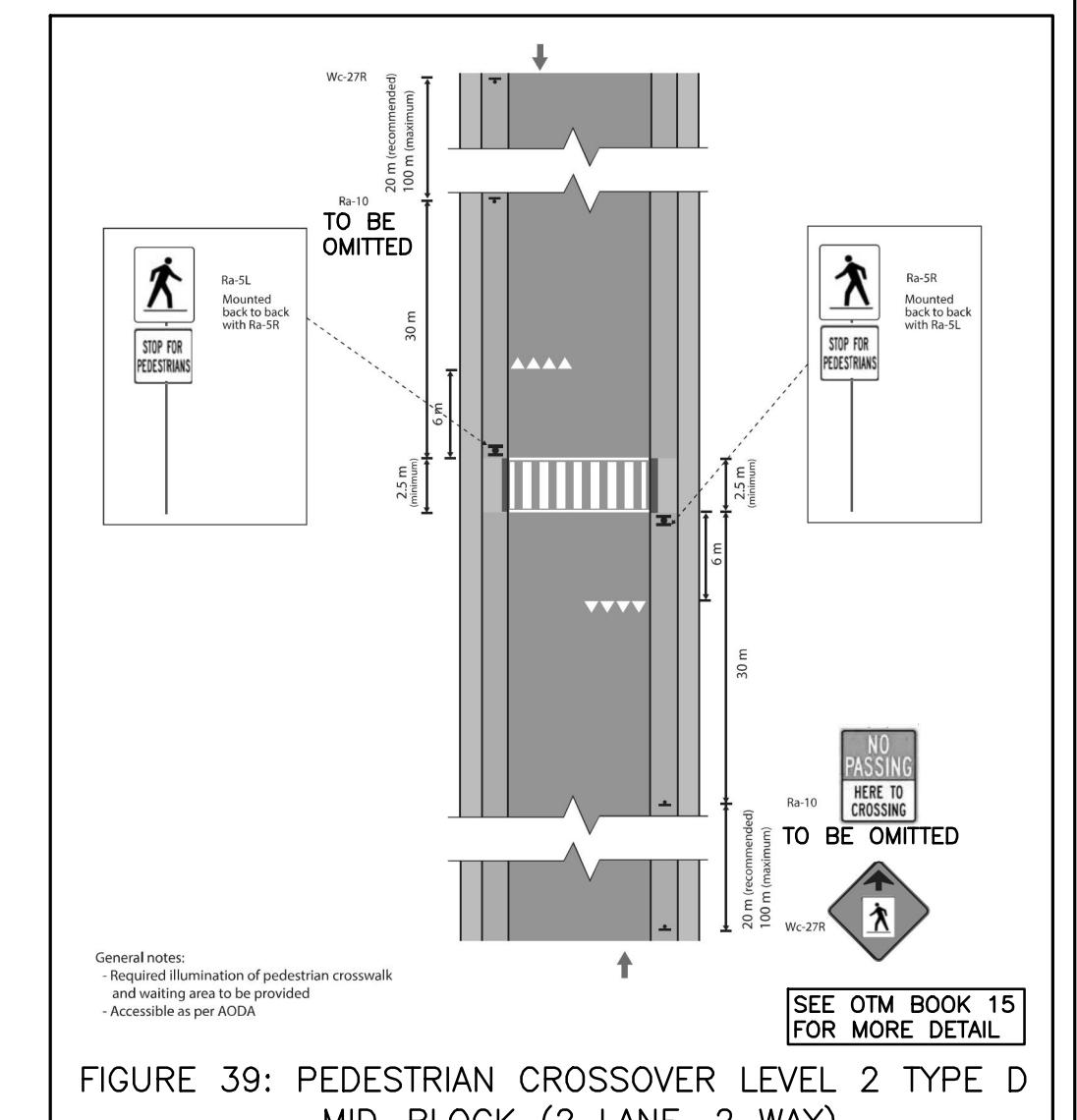
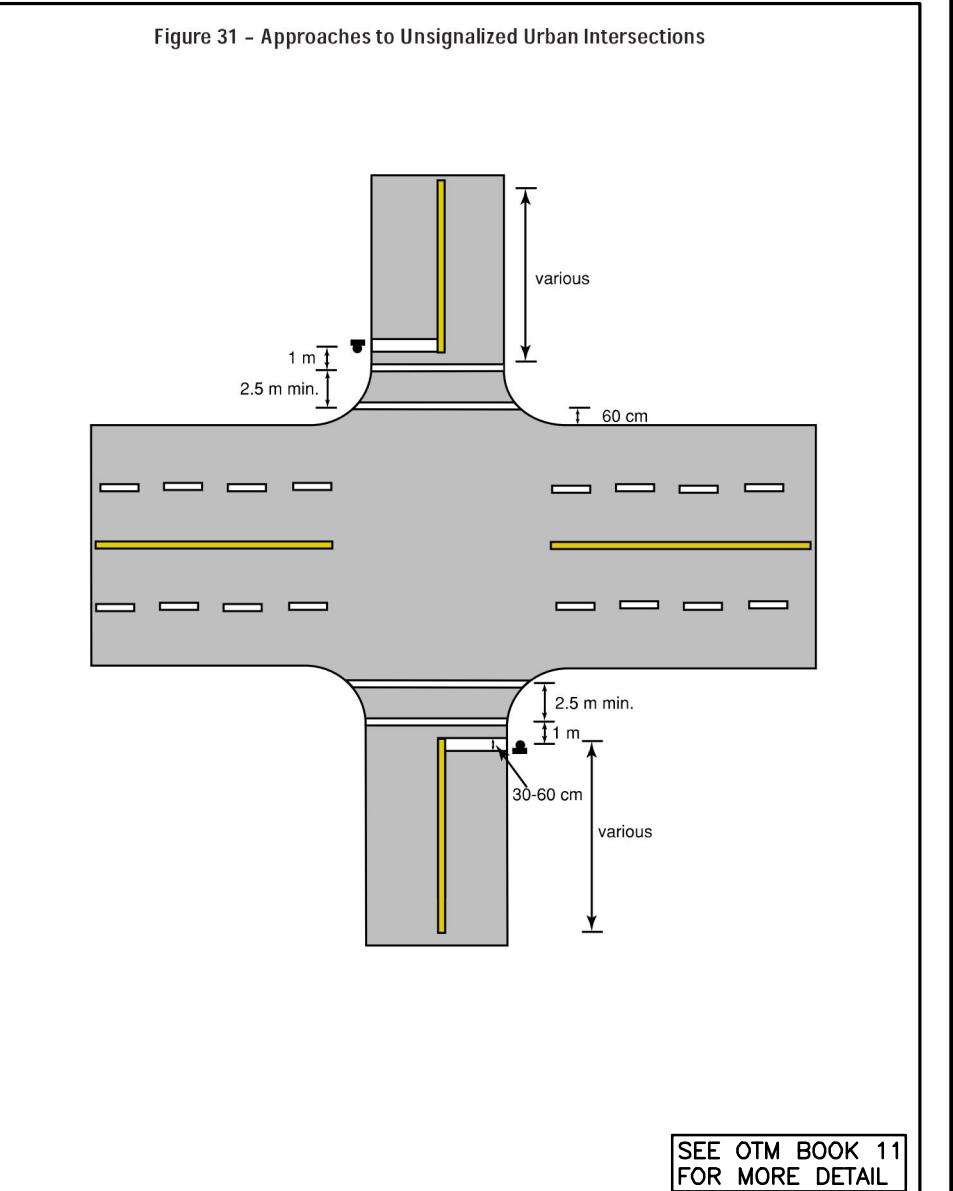


FIGURE 39: PEDESTRIAN CROSSOVER LEVEL 2 TYPE D - MID-BLOCK (2 LANE, 2 WAY)

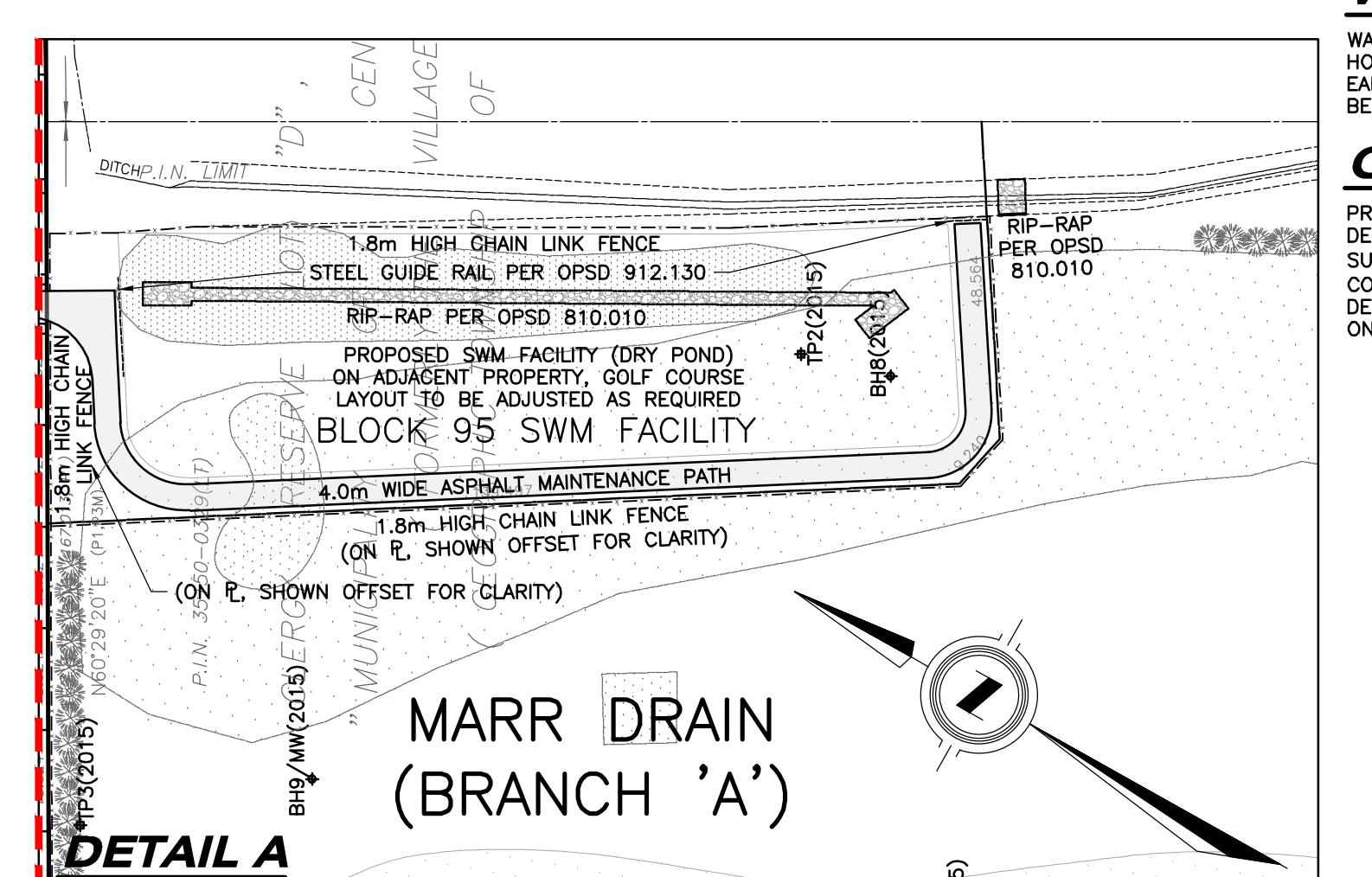


WASTE REMOVAL

WASTE TO BE STORED IN DWELLINGS AND HOMEOWNER TO PLACE AT CURB NO EARLIER THAN 6:00PM THE EVENING BEFORE THE DAY OF MUNICIPAL PICK-UP

CANADA POST

PROPOSED DWELLINGS WILL RECEIVE MAIL DELIVERY TO CENTRALIZED CANADA POST SUPERBOXES ON CAST-IN-PLACE CONCRETE PAD(S). LOCATION(S) TO BE DETERMINED BY CANADA POST AND DETAIL ON SHEET 17



DETAIL A

REFER TO NOTES, LEGEND, AND DETAILS ON SHEET 1, 17, 18 & 19

AS CONSTRUCTED SERVICES	COMPLETION	No.	REVISIONS	D/M/Y	BY	CONSULTANT
DESIGN	JSF/KJC	1	ISSUED FOR ENGINEERING SUBMISSION	17/02/21	JSF	
DRAWN	JSF	2	CONCEPTUAL ZONING DATA CHART ADDED	08/03/21	JSF	
CHECKED	KAM	3	FOR PRE-SUBMISSION CONSULTATION MEETING	05/04/21	JSF	
APPROVED	NGU	4	ISSUED FOR DRAFT PLAN APPLICATION	16/07/21	JSF	
DATE	08/02/2021					
CAD	SBM-18-0530					

STRIK BALDINELLI
sbm MONIZ
PLANNING • CIVIL • STRUCTURAL • MECHANICAL • ELECTRICAL
1599 Adelaide St. N. Unit 301, London, Ontario, N5X 4E8
Tel: (519) 471-6667 Fax: (519) 471-0034
Email: sbm@sbmltd.ca

**PRELIMINARY
NOT FOR
CONSTRUCTION**



THE CORPORATION OF THE MUNICIPALITY OF
CENTRAL ELGIN

SCALE
10.0 0 20.0m
1:1000
10.0 0 20.0m

SUBDIVISION PLAN

KETTLE CREEK SUBDIVISION
37719 LAKE LINE
PORT STANLEY, ONTARIO

PROJECT No.
SBM-18-0530
SHEET No.
2
PLAN FILE No.
—

Appendix E – Sightline Analysis Worksheets

Sightline Analysis - TAC 2017

Major Road: Lake Line
 Minor Road/Access: Proposed Street A

Project Number: SBM-18-0530
 Date: May 20, 2021

Inputs:

Major Road Design Speed: **60** km/h
 Design/Analysis Vehicle: **Passenger Car**
 Minor Approach Grade %: **3 or less**
 Number of Lanes to Cross: **1**

Assumptions:

Roads intersect at an angle greater than 60 degrees.

Available Sight Distance: **150** m to the right* **155** m to the left
 *unrestricted to upstream intersection

Analysis:

Case B1 - Left Turn From Stop

Time Gaps (s)	Scenario Extensions			
	Base	Grade	# Lanes	Total
Passenger Car	7.5	0	0	7.5
Single-Unit Truck	9.5	0	0	9.5
Combination Truck (WB20)	11.5	0	0	11.5

Intersection Sight Distance Requirement

Calculated: **125** m

Design Value: **130** m

Case B2 - Right Turn From Stop

Time Gaps (s)	Scenario Extensions			
	Base	Grade	# Lanes	Total
Passenger Car	6.5	0	-	6.5
Single-Unit Truck	8.5	0	-	8.5
Combination Truck (WB20)	10.5	0	-	10.5

Intersection Sight Distance Requirement

Calculated: **108** m

Design Value: **110** m

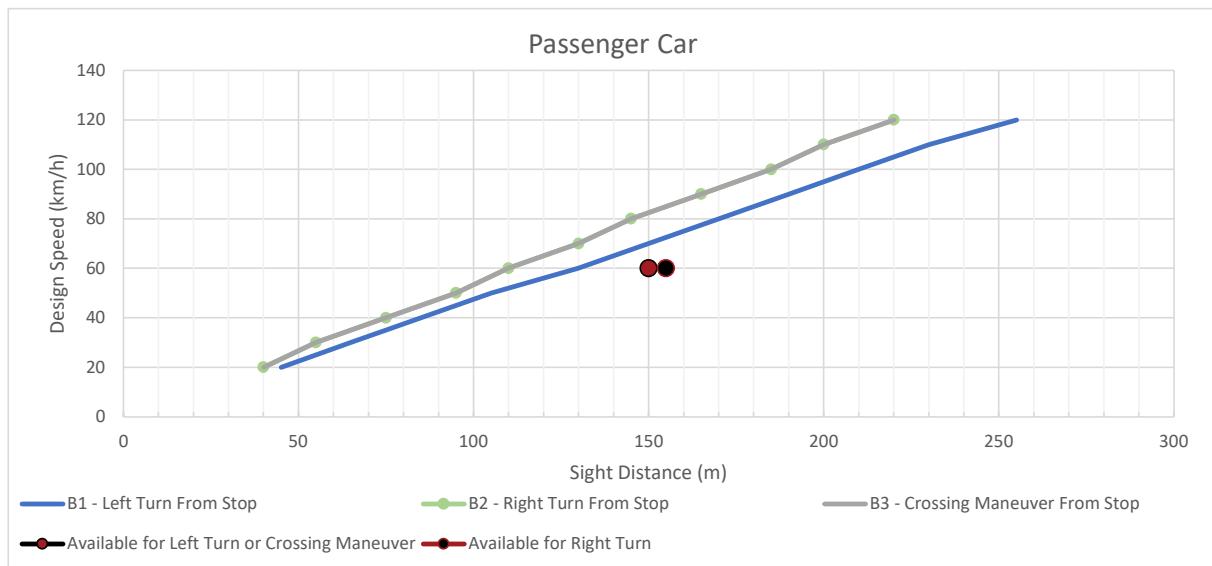
Case B3 - Crossing Maneuver From Stop

Time Gaps (s)	Scenario Extensions			
	Base	Grade	# Lanes	Total
Passenger Car	6.5	0	0	6.5
Single-Unit Truck	8.5	0	0	8.5
Combination Truck (WB20)	10.5	0	0	10.5

Intersection Sight Distance Requirement

Calculated: **108** m

Design Value: **110** m



Results

The available sight distance exceeds the requirements.

Appendix F – Synchro Output Reports - 2028 Background Traffic

HCM Unsignalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2028 AM Background Traffic

Unsignalized



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop				Stop
Traffic Volume (vph)	3	14	16	61	10	14	12	123	56	20	50	2
Future Volume (vph)	3	14	16	61	10	14	12	123	56	20	50	2
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	3	15	17	66	11	15	13	134	61	22	54	2
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1							
Volume Total (vph)	35	92	147	61	78							
Volume Left (vph)	3	66	13	0	22							
Volume Right (vph)	17	15	0	61	2							
Hadj (s)	-0.24	0.08	0.08	-0.67	0.08							
Departure Headway (s)	4.4	4.7	5.0	4.2	4.6							
Degree Utilization, x	0.04	0.12	0.20	0.07	0.10							
Capacity (veh/h)	748	719	705	825	743							
Control Delay (s)	7.6	8.3	8.0	6.3	8.1							
Approach Delay (s)	7.6	8.3	7.5		8.1							
Approach LOS	A	A	A		A							
Intersection Summary												
Delay						7.8						
Level of Service						A						
Intersection Capacity Utilization				32.4%			ICU Level of Service					A
Analysis Period (min)					15							

Intersection

Intersection Delay, s/veh 8.3

Intersection LOS A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	3	14	16	61	10	14	12	123	56	20	50	2
Future Vol, veh/h	3	14	16	61	10	14	12	123	56	20	50	2
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	3	15	17	66	11	15	13	134	61	22	54	2
Number of Lanes	0	1	0	0	1	0	0	1	1	0	1	0
Approach												
Opposing Approach	WB			WB			NB			SB		
Opposing Lanes	1			1			1			2		
Conflicting Approach Left	SB			NB			EB			WB		
Conflicting Lanes Left	1			2			1			1		
Conflicting Approach Right	NB			SB			WB			EB		
Conflicting Lanes Right	2			1			1			1		
HCM Control Delay	7.7			8.3			8.4			8.1		
HCM LOS	A			A			A			A		

Lane	NBLn1	NBLn2	EBLn1	WBLn1	SBLn1
Vol Left, %	9%	0%	9%	72%	28%
Vol Thru, %	91%	0%	42%	12%	69%
Vol Right, %	0%	100%	48%	16%	3%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	135	56	33	85	72
LT Vol	12	0	3	61	20
Through Vol	123	0	14	10	50
RT Vol	0	56	16	14	2
Lane Flow Rate	147	61	36	92	78
Geometry Grp	7	7	2	2	5
Degree of Util (X)	0.202	0.071	0.044	0.12	0.1
Departure Headway (Hd)	4.948	4.201	4.437	4.682	4.606
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	728	855	808	767	779
Service Time	2.664	1.917	2.46	2.701	2.626
HCM Lane V/C Ratio	0.202	0.071	0.045	0.12	0.1
HCM Control Delay	8.9	7.2	7.7	8.3	8.1
HCM Lane LOS	A	A	A	A	A
HCM 95th-tile Q	0.8	0.2	0.1	0.4	0.3

HCM Unsigned Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2028 AM Background Traffic
Unsigned

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	55	25	25	259	130	35
Future Volume (Veh/h)	55	25	25	259	130	35
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	60	27	27	282	141	38
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	477	141	179			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	477	141	179			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	89	97	98			
cM capacity (veh/h)	536	907	1397			
Direction, Lane #	EB 1	NB 1	SB 1	SB 2		
Volume Total	87	309	141	38		
Volume Left	60	27	0	0		
Volume Right	27	0	0	38		
cSH	614	1397	1700	1700		
Volume to Capacity	0.14	0.02	0.08	0.02		
Queue Length 95th (m)	3.7	0.4	0.0	0.0		
Control Delay (s)	11.8	0.8	0.0	0.0		
Lane LOS	B	A				
Approach Delay (s)	11.8	0.8	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay		2.2				
Intersection Capacity Utilization		36.4%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2028 PM Background Traffic

Unsignalized



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop				Stop
Traffic Volume (vph)	0	10	16	93	16	28	23	106	85	13	161	10
Future Volume (vph)	0	10	16	93	16	28	23	106	85	13	161	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	11	17	101	17	30	25	115	92	14	175	11
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1							
Volume Total (vph)	28	148	140	92	200							
Volume Left (vph)	0	101	25	0	14							
Volume Right (vph)	17	30	0	92	11							
Hadj (s)	-0.33	0.05	0.12	-0.67	0.02							
Departure Headway (s)	4.8	5.0	5.3	4.5	4.8							
Degree Utilization, x	0.04	0.21	0.21	0.11	0.26							
Capacity (veh/h)	668	667	656	766	722							
Control Delay (s)	8.0	9.3	8.4	6.9	9.4							
Approach Delay (s)	8.0	9.3	7.8		9.4							
Approach LOS	A	A	A		A							
Intersection Summary												
Delay												8.7
Level of Service												A
Intersection Capacity Utilization				37.5%			ICU Level of Service					A
Analysis Period (min)												15

Intersection

Intersection Delay, s/veh 9.1

Intersection LOS A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖			↖		↖	↖	↖		↖	
Traffic Vol, veh/h	0	10	16	93	16	28	23	106	85	13	161	10
Future Vol, veh/h	0	10	16	93	16	28	23	106	85	13	161	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	11	17	101	17	30	25	115	92	14	175	11
Number of Lanes	0	1	0	0	1	0	0	1	1	0	1	0
Approach	EB		WB			NB			SB			
Opposing Approach	WB		EB			SB			NB			
Opposing Lanes	1		1			1			2			
Conflicting Approach Left	SB		NB			EB			WB			
Conflicting Lanes Left	1		2			1			1			
Conflicting Approach Right	NB		SB			WB			EB			
Conflicting Lanes Right	2		1			1			1			
HCM Control Delay	8		9.3			8.7			9.5			
HCM LOS	A		A			A			A			

Lane	NBLn1	NBLn2	EBLn1	WBLn1	SBLn1
Vol Left, %	18%	0%	0%	68%	7%
Vol Thru, %	82%	0%	38%	12%	88%
Vol Right, %	0%	100%	62%	20%	5%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	129	85	26	137	184
LT Vol	23	0	0	93	13
Through Vol	106	0	10	16	161
RT Vol	0	85	16	28	10
Lane Flow Rate	140	92	28	149	200
Geometry Grp	7	7	2	2	5
Degree of Util (X)	0.204	0.114	0.037	0.206	0.263
Departure Headway (Hd)	5.245	4.451	4.771	4.976	4.726
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	683	803	746	719	758
Service Time	2.987	2.192	2.83	3.02	2.767
HCM Lane V/C Ratio	0.205	0.115	0.038	0.207	0.264
HCM Control Delay	9.3	7.8	8	9.3	9.5
HCM Lane LOS	A	A	A	A	A
HCM 95th-tile Q	0.8	0.4	0.1	0.8	1.1

HCM Unsigned Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2028 PM Background Traffic
Unsigned

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	82	39	46	415	390	87
Future Volume (Veh/h)	82	39	46	415	390	87
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	89	42	50	451	424	95
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	975	424	519			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	975	424	519			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	66	93	95			
cM capacity (veh/h)	266	630	1047			
Direction, Lane #	EB 1	NB 1	SB 1	SB 2		
Volume Total	131	501	424	95		
Volume Left	89	50	0	0		
Volume Right	42	0	0	95		
cSH	326	1047	1700	1700		
Volume to Capacity	0.40	0.05	0.25	0.06		
Queue Length 95th (m)	14.2	1.1	0.0	0.0		
Control Delay (s)	23.3	1.4	0.0	0.0		
Lane LOS	C	A				
Approach Delay (s)	23.3	1.4	0.0			
Approach LOS	C					
Intersection Summary						
Average Delay		3.2				
Intersection Capacity Utilization		61.8%		ICU Level of Service		B
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2028 Saturday Background Traffic
Unsignalized

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop				Stop
Traffic Volume (vph)	0	12	18	141	24	44	23	181	103	16	170	12
Future Volume (vph)	0	12	18	141	24	44	23	181	103	16	170	12
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	13	20	153	26	48	25	197	112	17	185	13
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1							
Volume Total (vph)	33	227	222	112	215							
Volume Left (vph)	0	153	25	0	17							
Volume Right (vph)	20	48	0	112	13							
Hadj (s)	-0.33	0.04	0.09	-0.67	0.01							
Departure Headway (s)	5.3	5.3	5.6	4.8	5.2							
Degree Utilization, x	0.05	0.34	0.34	0.15	0.31							
Capacity (veh/h)	586	626	620	711	655							
Control Delay (s)	8.6	11.0	10.3	7.5	10.5							
Approach Delay (s)	8.6	11.0	9.3		10.5							
Approach LOS	A	B	A		B							
Intersection Summary												
Delay												10.1
Level of Service												B
Intersection Capacity Utilization				48.1%			ICU Level of Service					A
Analysis Period (min)												15

Intersection

Intersection Delay, s/veh 10.4

Intersection LOS B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖			↖		↖	↖	↖		↖	
Traffic Vol, veh/h	0	12	18	141	24	44	23	181	103	16	170	12
Future Vol, veh/h	0	12	18	141	24	44	23	181	103	16	170	12
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	13	20	153	26	48	25	197	112	17	185	13
Number of Lanes	0	1	0	0	1	0	0	1	1	0	1	0
Approach		EB		WB			NB			SB		
Opposing Approach		WB		EB			SB			NB		
Opposing Lanes		1		1			1			2		
Conflicting Approach Left		SB		NB			EB			WB		
Conflicting Lanes Left		1		2			1			1		
Conflicting Approach Right		NB		SB			WB			EB		
Conflicting Lanes Right		2		1			1			1		
HCM Control Delay		8.6		11			10.2			10.5		
HCM LOS		A		B			B			B		

Lane	NBLn1	NBLn2	EBLn1	WBLn1	SBLn1
Vol Left, %	11%	0%	0%	67%	8%
Vol Thru, %	89%	0%	40%	11%	86%
Vol Right, %	0%	100%	60%	21%	6%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	204	103	30	209	198
LT Vol	23	0	0	141	16
Through Vol	181	0	12	24	170
RT Vol	0	103	18	44	12
Lane Flow Rate	222	112	33	227	215
Geometry Grp	7	7	2	2	5
Degree of Util (X)	0.338	0.147	0.048	0.332	0.305
Departure Headway (Hd)	5.493	4.73	5.346	5.265	5.1
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	650	749	674	677	697
Service Time	3.279	2.516	3.346	3.352	3.192
HCM Lane V/C Ratio	0.342	0.15	0.049	0.335	0.308
HCM Control Delay	11.1	8.3	8.6	11	10.5
HCM Lane LOS	B	A	A	B	B
HCM 95th-tile Q	1.5	0.5	0.2	1.5	1.3

HCM Unsigned Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2028 Saturday Background Traffic
Unsigned

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	75	60	80	491	694	130
Future Volume (Veh/h)	75	60	80	491	694	130
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	82	65	87	534	754	141
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1462	754	895			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1462	754	895			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	35	84	89			
cM capacity (veh/h)	126	409	758			
Direction, Lane #	EB 1	NB 1	SB 1	SB 2		
Volume Total	147	621	754	141		
Volume Left	82	87	0	0		
Volume Right	65	0	0	141		
cSH	181	758	1700	1700		
Volume to Capacity	0.81	0.11	0.44	0.08		
Queue Length 95th (m)	42.5	2.9	0.0	0.0		
Control Delay (s)	77.8	2.9	0.0	0.0		
Lane LOS	F	A				
Approach Delay (s)	77.8	2.9	0.0			
Approach LOS	F					
Intersection Summary						
Average Delay		8.0				
Intersection Capacity Utilization		84.6%		ICU Level of Service		E
Analysis Period (min)		15				

Timings

1: Carlow Rd/Union Road & Lake Line/Warren St

2028 AM Background Traffic

Signalized



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations									
Traffic Volume (vph)	3	14	61	10	12	123	56	20	50
Future Volume (vph)	3	14	61	10	12	123	56	20	50
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	pm+ov	Perm	NA
Protected Phases		4	3	8		2	3		6
Permitted Phases		4		8		2		2	6
Detector Phase		4	4	3	8	2	2	3	6
Switch Phase									
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	11.0	9.0	11.0	11.0	11.0	9.0	11.0	11.0
Total Split (s)	18.0	18.0	13.0	31.0	29.0	29.0	13.0	29.0	29.0
Total Split (%)	30.0%	30.0%	21.7%	51.7%	48.3%	48.3%	21.7%	48.3%	48.3%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)		0.0		0.0		0.0	0.0		0.0
Total Lost Time (s)		6.0		6.0		6.0	4.0		6.0
Lead/Lag	Lag	Lag	Lead				Lead		
Lead-Lag Optimize?	Yes	Yes	Yes				Yes		
Recall Mode	Min								
Act Effect Green (s)		6.0		15.6		8.1	19.7		8.1
Actuated g/C Ratio	0.17		0.44		0.23	0.55		0.23	
v/c Ratio	0.12		0.13		0.36	0.07		0.21	
Control Delay	10.7		6.3		14.4	1.7		12.6	
Queue Delay		0.0		0.0		0.0	0.0		0.0
Total Delay	10.7		6.3		14.4	1.7		12.6	
LOS	B		A		B	A		B	
Approach Delay	10.7		6.3		10.6			12.6	
Approach LOS	B		A		B			B	

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 35.8

Natural Cycle: 40

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.36

Intersection Signal Delay: 10.0

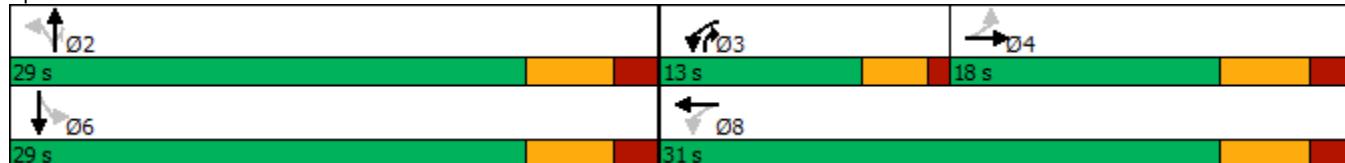
Intersection LOS: B

Intersection Capacity Utilization 37.7%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 1: Carlow Rd/Union Road & Lake Line/Warren St



Queues

1: Carlow Rd/Union Road & Lake Line/Warren St

2028 AM Background Traffic

Signalized



Lane Group	EBT	WBT	NBT	NBR	SBT
Lane Group Flow (vph)	35	92	147	61	78
v/c Ratio	0.12	0.13	0.36	0.07	0.21
Control Delay	10.7	6.3	14.4	1.7	12.6
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	10.7	6.3	14.4	1.7	12.6
Queue Length 50th (m)	0.9	2.4	7.2	0.0	3.6
Queue Length 95th (m)	5.8	8.2	17.5	2.7	10.6
Internal Link Dist (m)	59.2	392.2	126.4		76.1
Turn Bay Length (m)			30.0		
Base Capacity (vph)	578	1138	1165	1058	1034
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	0.08	0.13	0.06	0.08

Intersection Summary

HCM Signalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2028 AM Background Traffic
Signalized

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	3	14	16	61	10	14	12	123	56	20	50	2
Future Volume (vph)	3	14	16	61	10	14	12	123	56	20	50	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					6.0			6.0	4.0		6.0	
Lane Util. Factor		1.00				1.00		1.00	1.00		1.00	
Frt		0.93				0.98		1.00	0.85		1.00	
Flt Protected		1.00				0.97		1.00	1.00		0.99	
Satd. Flow (prot)		1752				1778		1875	1601		1851	
Flt Permitted		0.96				0.86		0.96	1.00		0.85	
Satd. Flow (perm)		1685				1592		1808	1601		1602	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	3	15	17	66	11	15	13	134	61	22	54	2
RTOR Reduction (vph)	0	14	0	0	8	0	0	0	38	0	2	0
Lane Group Flow (vph)	0	21	0	0	84	0	0	147	23	0	76	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	pm+ov	Perm	NA	
Protected Phases		4			3	8			2	3		6
Permitted Phases	4				8			2		2	6	
Actuated Green, G (s)		6.0				15.6			8.1	13.7		8.1
Effective Green, g (s)		6.0				15.6			8.1	13.7		8.1
Actuated g/C Ratio		0.17				0.44			0.23	0.38		0.23
Clearance Time (s)		6.0				6.0			6.0	4.0		6.0
Vehicle Extension (s)		3.0				3.0			3.0	3.0		3.0
Lane Grp Cap (vph)	283				724			410	614		363	
v/s Ratio Prot				c0.02					0.01			
v/s Ratio Perm	0.01			c0.03				c0.08	0.01		0.05	
v/c Ratio	0.07				0.12			0.36	0.04		0.21	
Uniform Delay, d1	12.5				6.0			11.6	6.9		11.2	
Progression Factor	1.00				1.00			1.00	1.00		1.00	
Incremental Delay, d2	0.1				0.1			0.5	0.0		0.3	
Delay (s)	12.6				6.0			12.2	6.9		11.5	
Level of Service	B				A			B	A		B	
Approach Delay (s)	12.6				6.0			10.6			11.5	
Approach LOS	B				A			B			B	
Intersection Summary												
HCM 2000 Control Delay		9.9			HCM 2000 Level of Service			A				
HCM 2000 Volume to Capacity ratio		0.24										
Actuated Cycle Length (s)		35.7			Sum of lost time (s)			16.0				
Intersection Capacity Utilization		37.7%			ICU Level of Service			A				
Analysis Period (min)		15										
c Critical Lane Group												

Timings
2: Colborne St/Sunset Rd & Warren St

2028 AM Background Traffic

Signalized



Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Configurations	Y	Y	Y	Y	Y
Traffic Volume (vph)	55	25	259	130	35
Future Volume (vph)	55	25	259	130	35
Turn Type	Prot	pm+pt	NA	NA	Perm
Protected Phases	4	5	2	6	
Permitted Phases			2		6
Detector Phase	4	5	2	6	6
Switch Phase					
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	9.0	11.0	11.0	11.0
Total Split (s)	21.0	9.0	39.0	30.0	30.0
Total Split (%)	35.0%	15.0%	65.0%	50.0%	50.0%
Yellow Time (s)	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0		6.0	6.0	6.0
Lead/Lag	Lead		Lag	Lag	
Lead-Lag Optimize?	Yes		Yes	Yes	
Recall Mode	None	None	Max	Max	Max
Act Effect Green (s)	7.4		41.4	41.4	41.4
Actuated g/C Ratio	0.14		0.77	0.77	0.77
v/c Ratio	0.33		0.22	0.10	0.03
Control Delay	18.6		4.3	4.0	1.9
Queue Delay	0.0		0.0	0.0	0.0
Total Delay	18.6		4.3	4.0	1.9
LOS	B		A	A	A
Approach Delay	18.6		4.3	3.6	
Approach LOS	B		A	A	

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 53.7

Natural Cycle: 40

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.33

Intersection Signal Delay: 6.3

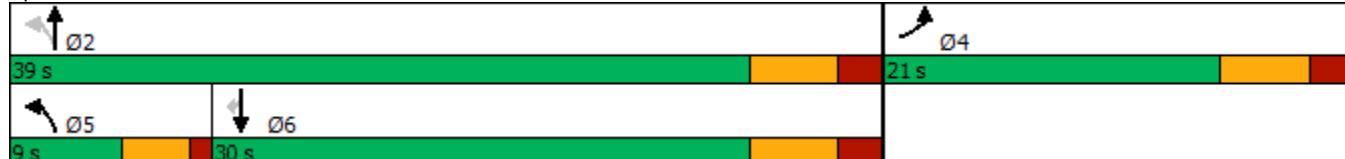
Intersection LOS: A

Intersection Capacity Utilization 41.4%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 2: Colborne St/Sunset Rd & Warren St



Queues
2: Colborne St/Sunset Rd & Warren St

2028 AM Background Traffic

Signalized



Lane Group	EBL	NBT	SBT	SBR
Lane Group Flow (vph)	87	309	141	38
v/c Ratio	0.33	0.22	0.10	0.03
Control Delay	18.6	4.3	4.0	1.9
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	18.6	4.3	4.0	1.9
Queue Length 50th (m)	5.1	10.4	4.3	0.0
Queue Length 95th (m)	14.8	22.8	10.7	2.5
Internal Link Dist (m)	392.2	65.6	88.3	
Turn Bay Length (m)			40.0	
Base Capacity (vph)	506	1411	1450	1241
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.17	0.22	0.10	0.03

Intersection Summary

HCM Signalized Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2028 AM Background Traffic
Signalized

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	55	25	25	259	130	35
Future Volume (vph)	55	25	25	259	130	35
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0			6.0	6.0	6.0
Lane Util. Factor	1.00			1.00	1.00	1.00
Frt	0.96			1.00	1.00	0.85
Flt Protected	0.97			1.00	1.00	1.00
Satd. Flow (prot)	1744			1875	1883	1601
Flt Permitted	0.97			0.97	1.00	1.00
Satd. Flow (perm)	1744			1832	1883	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	60	27	27	282	141	38
RTOR Reduction (vph)	25	0	0	0	0	12
Lane Group Flow (vph)	62	0	0	309	141	26
Turn Type	Prot	pm+pt	NA	NA	Perm	
Protected Phases	4		5	2	6	
Permitted Phases			2		6	
Actuated Green, G (s)	5.1			39.0	39.0	39.0
Effective Green, g (s)	5.1			39.0	39.0	39.0
Actuated g/C Ratio	0.09			0.70	0.70	0.70
Clearance Time (s)	6.0			6.0	6.0	6.0
Vehicle Extension (s)	3.0			3.0	3.0	3.0
Lane Grp Cap (vph)	158			1273	1309	1112
v/s Ratio Prot	c0.04				0.07	
v/s Ratio Perm			c0.17		0.02	
v/c Ratio	0.40			0.24	0.11	0.02
Uniform Delay, d1	24.0			3.1	2.8	2.6
Progression Factor	1.00			1.00	1.00	1.00
Incremental Delay, d2	1.6			0.1	0.2	0.0
Delay (s)	25.7			3.2	3.0	2.7
Level of Service	C			A	A	A
Approach Delay (s)	25.7			3.2	2.9	
Approach LOS	C			A	A	
Intersection Summary						
HCM 2000 Control Delay		6.5		HCM 2000 Level of Service		A
HCM 2000 Volume to Capacity ratio		0.29				
Actuated Cycle Length (s)		56.1		Sum of lost time (s)		16.0
Intersection Capacity Utilization		41.4%		ICU Level of Service		A
Analysis Period (min)		15				
c Critical Lane Group						

Timings

2028 PM Background Traffic

Signalized

1: Carlow Rd/Union Road & Lake Line/Warren St



Lane Group	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations	↑↓	↔	↔	←	↑	↑	↔	↓
Traffic Volume (vph)	10	93	16	23	106	85	13	161
Future Volume (vph)	10	93	16	23	106	85	13	161
Turn Type	NA	pm+pt	NA	Perm	NA	pm+ov	Perm	NA
Protected Phases	4	3	8		2	3		6
Permitted Phases				2		2	6	
Detector Phase	4	3	8	2	2	3	6	6
Switch Phase								
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	9.0	11.0	11.0	11.0	9.0	11.0	11.0
Total Split (s)	18.0	12.0	30.0	30.0	30.0	12.0	30.0	30.0
Total Split (%)	30.0%	20.0%	50.0%	50.0%	50.0%	20.0%	50.0%	50.0%
Yellow Time (s)	4.0	3.0	4.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	1.0	2.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0		0.0	0.0		0.0
Total Lost Time (s)	6.0		6.0		6.0	4.0		6.0
Lead/Lag	Lag	Lead				Lead		
Lead-Lag Optimize?	Yes	Yes				Yes		
Recall Mode	Min							
Act Effect Green (s)	5.9		15.5		9.1	20.7		9.1
Actuated g/C Ratio	0.16		0.42		0.25	0.56		0.25
v/c Ratio	0.10		0.30		0.34	0.10		0.44
Control Delay	10.6		8.1		13.7	1.4		14.7
Queue Delay	0.0		0.0		0.0	0.0		0.0
Total Delay	10.6		8.1		13.7	1.4		14.7
LOS	B		A		B	A		B
Approach Delay	10.6		8.1		8.8			14.7
Approach LOS	B		A		A			B

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 36.7

Natural Cycle: 40

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.44

Intersection Signal Delay: 10.7

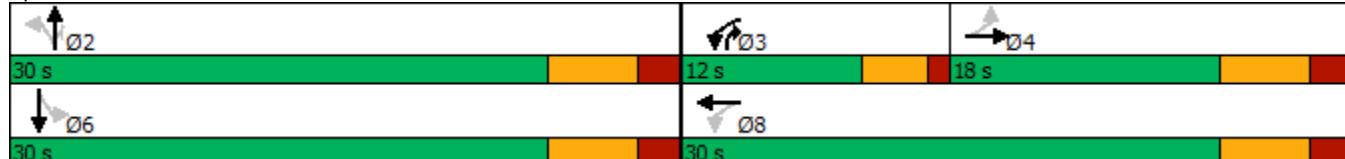
Intersection LOS: B

Intersection Capacity Utilization 40.8%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 1: Carlow Rd/Union Road & Lake Line/Warren St



Queues

1: Carlow Rd/Union Road & Lake Line/Warren St

2028 PM Background Traffic

Signalized



Lane Group	EBT	WBT	NBT	NBR	SBT
Lane Group Flow (vph)	28	148	140	92	200
v/c Ratio	0.10	0.30	0.34	0.10	0.44
Control Delay	10.6	8.1	13.7	1.4	14.7
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	10.6	8.1	13.7	1.4	14.7
Queue Length 50th (m)	0.6	4.2	6.8	0.0	9.7
Queue Length 95th (m)	5.1	12.8	16.8	3.1	22.2
Internal Link Dist (m)	59.2	392.2	126.4		76.1
Turn Bay Length (m)			30.0		
Base Capacity (vph)	579	705	1105	1044	1188
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	0.05	0.21	0.13	0.09	0.17

Intersection Summary

HCM Signalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2028 PM Background Traffic
Signalized

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	10	16	93	16	28	23	106	85	13	161	10
Future Volume (vph)	0	10	16	93	16	28	23	106	85	13	161	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0			6.0	4.0		6.0	
Lane Util. Factor	1.00				1.00			1.00	1.00		1.00	
Frt	0.92				0.97			1.00	0.85		0.99	
Flt Protected	1.00				0.97			0.99	1.00		1.00	
Satd. Flow (prot)	1729				1771			1867	1601		1863	
Flt Permitted	1.00				0.51			0.89	1.00		0.96	
Satd. Flow (perm)	1729				936			1682	1601		1803	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	11	17	101	17	30	25	115	92	14	175	11
RTOR Reduction (vph)	0	14	0	0	14	0	0	0	55	0	5	0
Lane Group Flow (vph)	0	14	0	0	134	0	0	140	37	0	195	0
Turn Type	NA		pm+pt	NA		Perm	NA	pm+ov	Perm	NA		
Protected Phases	4			3	8			2	3		6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	5.9				15.5			9.1	14.7		9.1	
Effective Green, g (s)	5.9				15.5			9.1	14.7		9.1	
Actuated g/C Ratio	0.16				0.42			0.25	0.40		0.25	
Clearance Time (s)	6.0				6.0			6.0	4.0		6.0	
Vehicle Extension (s)	3.0				3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)	278				524			418	643		448	
v/s Ratio Prot	0.01			c0.04					0.01			
v/s Ratio Perm				c0.07				0.08	0.01		c0.11	
v/c Ratio	0.05			0.25				0.33	0.06		0.44	
Uniform Delay, d1	13.0			6.8				11.3	6.7		11.6	
Progression Factor	1.00			1.00				1.00	1.00		1.00	
Incremental Delay, d2	0.1			0.3				0.5	0.0		0.7	
Delay (s)	13.1			7.1				11.7	6.7		12.3	
Level of Service	B			A				B	A		B	
Approach Delay (s)	13.1			7.1				9.8			12.3	
Approach LOS	B			A				A			B	
Intersection Summary												
HCM 2000 Control Delay	10.1				HCM 2000 Level of Service				B			
HCM 2000 Volume to Capacity ratio	0.38											
Actuated Cycle Length (s)	36.6				Sum of lost time (s)				16.0			
Intersection Capacity Utilization	40.8%				ICU Level of Service				A			
Analysis Period (min)	15											
c Critical Lane Group												

Timings
2: Colborne St/Sunset Rd & Warren St

2028 PM Background Traffic

Signalized



Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Configurations	Y	Y	Y	Y	Y
Traffic Volume (vph)	82	46	415	390	87
Future Volume (vph)	82	46	415	390	87
Turn Type	Prot	pm+pt	NA	NA	Perm
Protected Phases	4	5	2	6	
Permitted Phases			2		6
Detector Phase	4	5	2	6	6
Switch Phase					
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	9.0	11.0	11.0	11.0
Total Split (s)	16.0	9.0	44.0	35.0	35.0
Total Split (%)	26.7%	15.0%	73.3%	58.3%	58.3%
Yellow Time (s)	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0		6.0	6.0	6.0
Lead/Lag	Lead		Lag	Lag	
Lead-Lag Optimize?	Yes		Yes	Yes	
Recall Mode	None	Min	Min	Min	Min
Act Effect Green (s)	8.0		24.8	14.9	14.9
Actuated g/C Ratio	0.19		0.59	0.36	0.36
v/c Ratio	0.36		0.47	0.63	0.15
Control Delay	17.0		7.7	16.6	3.4
Queue Delay	0.0		0.0	0.0	0.0
Total Delay	17.0		7.7	16.6	3.4
LOS	B		A	B	A
Approach Delay	17.0		7.7	14.2	
Approach LOS	B		A	B	

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 41.7

Natural Cycle: 40

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.63

Intersection Signal Delay: 11.7

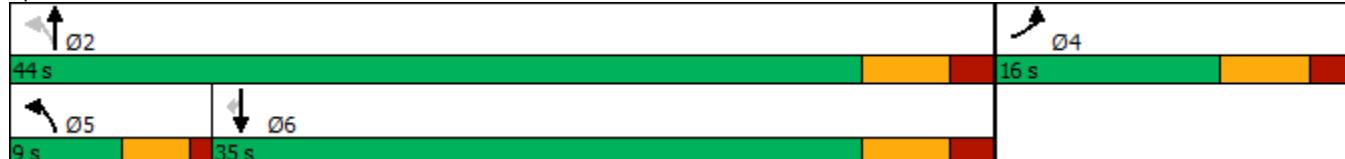
Intersection LOS: B

Intersection Capacity Utilization 66.8%

ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 2: Colborne St/Sunset Rd & Warren St



Queues
2: Colborne St/Sunset Rd & Warren St

2028 PM Background Traffic

Signalized



Lane Group	EBL	NBT	SBT	SBR
Lane Group Flow (vph)	131	501	424	95
v/c Ratio	0.36	0.47	0.63	0.15
Control Delay	17.0	7.7	16.6	3.4
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	17.0	7.7	16.6	3.4
Queue Length 50th (m)	6.5	19.9	26.4	0.0
Queue Length 95th (m)	20.5	39.7	50.0	6.1
Internal Link Dist (m)	392.2	65.6	88.3	
Turn Bay Length (m)			40.0	
Base Capacity (vph)	482	1533	1330	1159
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.27	0.33	0.32	0.08

Intersection Summary

HCM Signalized Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2028 PM Background Traffic
Signalized

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	82	39	46	415	390	87
Future Volume (vph)	82	39	46	415	390	87
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0			6.0	6.0	6.0
Lane Util. Factor	1.00			1.00	1.00	1.00
Frt	0.96			1.00	1.00	0.85
Flt Protected	0.97			1.00	1.00	1.00
Satd. Flow (prot)	1743			1874	1883	1601
Flt Permitted	0.97			0.94	1.00	1.00
Satd. Flow (perm)	1743			1765	1883	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	89	42	50	451	424	95
RTOR Reduction (vph)	29	0	0	0	0	61
Lane Group Flow (vph)	102	0	0	501	424	34
Turn Type	Prot	pm+pt	NA	NA	Perm	
Protected Phases	4		5	2	6	
Permitted Phases			2		6	
Actuated Green, G (s)	6.0			24.7	15.2	15.2
Effective Green, g (s)	6.0			24.7	15.2	15.2
Actuated g/C Ratio	0.14			0.58	0.36	0.36
Clearance Time (s)	6.0			6.0	6.0	6.0
Vehicle Extension (s)	3.0			3.0	3.0	3.0
Lane Grp Cap (vph)	244			1035	670	569
v/s Ratio Prot	c0.06			c0.06	c0.23	
v/s Ratio Perm			0.22		0.02	
v/c Ratio	0.42			0.48	0.63	0.06
Uniform Delay, d1	16.8			5.3	11.4	9.0
Progression Factor	1.00			1.00	1.00	1.00
Incremental Delay, d2	1.2			0.4	2.0	0.0
Delay (s)	17.9			5.6	13.4	9.1
Level of Service	B			A	B	A
Approach Delay (s)	17.9			5.6	12.6	
Approach LOS	B			A	B	
Intersection Summary						
HCM 2000 Control Delay	10.2			HCM 2000 Level of Service	B	
HCM 2000 Volume to Capacity ratio	0.58					
Actuated Cycle Length (s)	42.7			Sum of lost time (s)	16.0	
Intersection Capacity Utilization	66.8%			ICU Level of Service	C	
Analysis Period (min)	15					
c Critical Lane Group						

Timings

2028 SAT Background Traffic

Signalized

1: Carlow Rd/Union Road & Lake Line/Warren St



Lane Group	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations	↑↓	↔	↔	←	↑	↑	↔	↓
Traffic Volume (vph)	12	141	24	23	181	103	16	170
Future Volume (vph)	12	141	24	23	181	103	16	170
Turn Type	NA	pm+pt	NA	Perm	NA	pm+ov	Perm	NA
Protected Phases	4	3	8		2	3		6
Permitted Phases				2		2	6	
Detector Phase	4	3	8	2	2	3	6	6
Switch Phase								
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	9.0	11.0	11.0	11.0	9.0	11.0	11.0
Total Split (s)	21.0	10.0	31.0	29.0	29.0	10.0	29.0	29.0
Total Split (%)	35.0%	16.7%	51.7%	48.3%	48.3%	16.7%	48.3%	48.3%
Yellow Time (s)	4.0	3.0	4.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	1.0	2.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0		0.0		0.0	
Total Lost Time (s)	6.0		6.0		6.0		4.0	6.0
Lead/Lag	Lag	Lead				Lead		
Lead-Lag Optimize?	Yes	Yes				Yes		
Recall Mode	Min							
Act Effect Green (s)	6.5		16.1		10.1	21.8		10.1
Actuated g/C Ratio	0.17		0.42		0.26	0.57		0.26
v/c Ratio	0.11		0.48		0.48	0.12		0.46
Control Delay	10.7		11.2		15.9	1.5		15.0
Queue Delay	0.0		0.0		0.0	0.0		0.0
Total Delay	10.7		11.2		15.9	1.5		15.0
LOS	B		B		A			B
Approach Delay	10.7		11.2		11.1			15.0
Approach LOS	B		B		B			B

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 38.4

Natural Cycle: 40

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.48

Intersection Signal Delay: 12.1

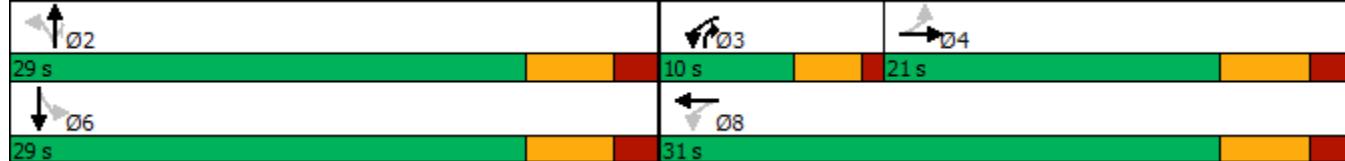
Intersection LOS: B

Intersection Capacity Utilization 51.5%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 1: Carlow Rd/Union Road & Lake Line/Warren St



Queues

1: Carlow Rd/Union Road & Lake Line/Warren St

2028 SAT Background Traffic

Signalized



Lane Group	EBT	WBT	NBT	NBR	SBT
Lane Group Flow (vph)	33	227	222	112	215
v/c Ratio	0.11	0.48	0.48	0.12	0.46
Control Delay	10.7	11.2	15.9	1.5	15.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	10.7	11.2	15.9	1.5	15.0
Queue Length 50th (m)	0.7	7.5	11.4	0.0	10.6
Queue Length 95th (m)	5.8	21.1	27.4	4.0	26.0
Internal Link Dist (m)	59.2	392.2	126.4		76.1
Turn Bay Length (m)			30.0		
Base Capacity (vph)	696	673	1064	974	1083
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	0.05	0.34	0.21	0.11	0.20

Intersection Summary

HCM Signalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2028 SAT Background Traffic
Signalized

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	12	18	141	24	44	23	181	103	16	170	12
Future Volume (vph)	0	12	18	141	24	44	23	181	103	16	170	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0			6.0	4.0		6.0	
Lane Util. Factor	1.00				1.00			1.00	1.00		1.00	
Frt	0.92				0.97			1.00	0.85		0.99	
Flt Protected	1.00				0.97			0.99	1.00		1.00	
Satd. Flow (prot)	1729				1770			1873	1601		1861	
Flt Permitted	1.00				0.48			0.93	1.00		0.95	
Satd. Flow (perm)	1729				881			1755	1601		1781	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	13	20	153	26	48	25	197	112	17	185	13
RTOR Reduction (vph)	0	17	0	0	16	0	0	0	66	0	4	0
Lane Group Flow (vph)	0	16	0	0	211	0	0	222	46	0	211	0
Turn Type	NA		pm+pt	NA		Perm	NA	pm+ov	Perm	NA		
Protected Phases	4			3	8			2	3		6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	6.5				16.1			10.1	15.7		10.1	
Effective Green, g (s)	6.5				16.1			10.1	15.7		10.1	
Actuated g/C Ratio	0.17				0.42			0.26	0.41		0.26	
Clearance Time (s)	6.0				6.0			6.0	4.0		6.0	
Vehicle Extension (s)	3.0				3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)	294				501			464	658		470	
v/s Ratio Prot	0.01			c0.06					0.01			
v/s Ratio Perm				c0.12				c0.13	0.02		0.12	
v/c Ratio	0.06			0.42				0.48	0.07		0.45	
Uniform Delay, d1	13.3			7.8				11.8	6.8		11.7	
Progression Factor	1.00			1.00				1.00	1.00		1.00	
Incremental Delay, d2	0.1			0.6				0.8	0.0		0.7	
Delay (s)	13.4			8.3				12.6	6.9		12.4	
Level of Service	B			A				B	A		B	
Approach Delay (s)	13.4			8.3				10.7			12.4	
Approach LOS	B			A				B			B	
Intersection Summary												
HCM 2000 Control Delay	10.6				HCM 2000 Level of Service				B			
HCM 2000 Volume to Capacity ratio	0.51											
Actuated Cycle Length (s)	38.2				Sum of lost time (s)				16.0			
Intersection Capacity Utilization	51.5%				ICU Level of Service				A			
Analysis Period (min)	15											
c Critical Lane Group												

Timings
2: Colborne St/Sunset Rd & Warren St

2028 SAT Background Traffic

Signalized



Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Configurations	Y	Y	Y	Y	Y
Traffic Volume (vph)	75	80	491	694	130
Future Volume (vph)	75	80	491	694	130
Turn Type	Prot	pm+pt	NA	NA	Perm
Protected Phases	4	5	2	6	
Permitted Phases			2		6
Detector Phase	4	5	2	6	6
Switch Phase					
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	11.0	11.0	11.0	11.0
Total Split (s)	12.0	11.0	48.0	37.0	37.0
Total Split (%)	20.0%	18.3%	80.0%	61.7%	61.7%
Yellow Time (s)	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0		6.0	6.0	6.0
Lead/Lag	Lead		Lag	Lag	
Lead-Lag Optimize?	Yes		Yes	Yes	
Recall Mode	None	Min	Min	Min	Min
Act Effect Green (s)	6.5		35.3	25.0	25.0
Actuated g/C Ratio	0.13		0.70	0.50	0.50
v/c Ratio	0.55		0.76	0.81	0.16
Control Delay	27.9		13.4	19.2	2.1
Queue Delay	0.0		0.0	0.0	0.0
Total Delay	27.9		13.4	19.2	2.1
LOS	C		B	B	A
Approach Delay	27.9		13.4	16.5	
Approach LOS	C		B	B	

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 50.5

Natural Cycle: 60

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.81

Intersection Signal Delay: 16.3

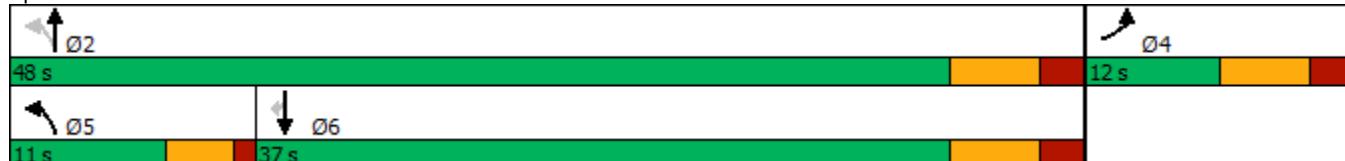
Intersection LOS: B

Intersection Capacity Utilization 89.6%

ICU Level of Service E

Analysis Period (min) 15

Splits and Phases: 2: Colborne St/Sunset Rd & Warren St



Queues
2: Colborne St/Sunset Rd & Warren St

2028 SAT Background Traffic

Signalized



Lane Group	EBL	NBT	SBT	SBR
Lane Group Flow (vph)	147	621	754	141
v/c Ratio	0.55	0.76	0.81	0.16
Control Delay	27.9	13.4	19.2	2.1
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	27.9	13.4	19.2	2.1
Queue Length 50th (m)	9.0	23.7	57.2	0.0
Queue Length 95th (m)	#32.5	#45.5	95.8	6.0
Internal Link Dist (m)	392.2	65.6	88.3	
Turn Bay Length (m)			40.0	
Base Capacity (vph)	269	927	1231	1095
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.55	0.67	0.61	0.13

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2028 SAT Background Traffic
Signalized

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	75	60	80	491	694	130
Future Volume (vph)	75	60	80	491	694	130
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0			6.0	6.0	6.0
Lane Util. Factor	1.00			1.00	1.00	1.00
Frt	0.94			1.00	1.00	0.85
Flt Protected	0.97			0.99	1.00	1.00
Satd. Flow (prot)	1723			1870	1883	1601
Flt Permitted	0.97			0.57	1.00	1.00
Satd. Flow (perm)	1723			1082	1883	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	82	65	87	534	754	141
RTOR Reduction (vph)	49	0	0	0	0	72
Lane Group Flow (vph)	98	0	0	621	754	69
Turn Type	Prot	pm+pt	NA	NA	Perm	
Protected Phases	4		5	2	6	
Permitted Phases			2		6	
Actuated Green, G (s)	4.3			35.3	25.3	25.3
Effective Green, g (s)	4.3			35.3	25.3	25.3
Actuated g/C Ratio	0.08			0.68	0.49	0.49
Clearance Time (s)	6.0			6.0	6.0	6.0
Vehicle Extension (s)	3.0			3.0	3.0	3.0
Lane Grp Cap (vph)	143			831	923	784
v/s Ratio Prot	c0.06			c0.09	0.40	
v/s Ratio Perm				c0.42	0.04	
v/c Ratio	0.69			0.75	0.82	0.09
Uniform Delay, d1	23.0			5.3	11.2	7.0
Progression Factor	1.00			1.00	1.00	1.00
Incremental Delay, d2	12.9			3.7	5.7	0.0
Delay (s)	35.9			9.0	16.8	7.1
Level of Service	D			A	B	A
Approach Delay (s)	35.9			9.0	15.3	
Approach LOS	D			A	B	
Intersection Summary						
HCM 2000 Control Delay	14.8			HCM 2000 Level of Service	B	
HCM 2000 Volume to Capacity ratio	0.81					
Actuated Cycle Length (s)	51.6			Sum of lost time (s)	16.0	
Intersection Capacity Utilization	89.6%			ICU Level of Service	E	
Analysis Period (min)	15					

c Critical Lane Group

Appendix G – Synchro Output Reports - 2028 Total Traffic

HCM Unsignalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2028 AM Total Traffic

Unsignalized

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop				Stop
Traffic Volume (vph)	6	46	34	61	20	14	18	123	56	20	50	3
Future Volume (vph)	6	46	34	61	20	14	18	123	56	20	50	3
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	7	50	37	66	22	15	20	134	61	22	54	3
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1							
Volume Total (vph)	94	103	154	61	79							
Volume Left (vph)	7	66	20	0	22							
Volume Right (vph)	37	15	0	61	3							
Hadj (s)	-0.19	0.07	0.10	-0.67	0.07							
Departure Headway (s)	4.6	4.8	5.2	4.4	4.8							
Degree Utilization, x	0.12	0.14	0.22	0.07	0.11							
Capacity (veh/h)	732	700	670	781	703							
Control Delay (s)	8.2	8.6	8.4	6.5	8.4							
Approach Delay (s)	8.2	8.6	7.9		8.4							
Approach LOS	A	A	A		A							
Intersection Summary												
Delay												8.2
Level of Service												A
Intersection Capacity Utilization				33.3%			ICU Level of Service					A
Analysis Period (min)												15

Intersection

Intersection Delay, s/veh 8.6
Intersection LOS A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	6	46	34	61	20	14	18	123	56	20	50	3
Future Vol, veh/h	6	46	34	61	20	14	18	123	56	20	50	3
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	7	50	37	66	22	15	20	134	61	22	54	3
Number of Lanes	0	1	0	0	1	0	0	1	1	0	1	0
Approach												
Opposing Approach	EB			WB			NB			SB		
Opposing Lanes	WB			EB			SB			NB		
Conflicting Approach Left	1			1			1			2		
Conflicting Lanes Left	SB			NB			EB			WB		
Conflicting Approach Right	1			2			1			1		
Conflicting Lanes Right	NB			SB			WB			EB		
HCM Control Delay	2			1			1			1		
HCM LOS	8.2			A			8.6			8.8		
	A			A			A			A		

Lane	NBLn1	NBLn2	EBLn1	WBLn1	SBLn1
Vol Left, %	13%	0%	7%	64%	27%
Vol Thru, %	87%	0%	53%	21%	68%
Vol Right, %	0%	100%	40%	15%	4%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	141	56	86	95	73
LT Vol	18	0	6	61	20
Through Vol	123	0	46	20	50
RT Vol	0	56	34	14	3
Lane Flow Rate	153	61	93	103	79
Geometry Grp	7	7	2	2	5
Degree of Util (X)	0.219	0.074	0.118	0.137	0.105
Departure Headway (Hd)	5.136	4.368	4.54	4.785	4.783
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	699	819	789	749	748
Service Time	2.866	2.098	2.571	2.817	2.82
HCM Lane V/C Ratio	0.219	0.074	0.118	0.138	0.106
HCM Control Delay	9.3	7.4	8.2	8.6	8.4
HCM Lane LOS	A	A	A	A	A
HCM 95th-tile Q	0.8	0.2	0.4	0.5	0.4

HCM Unsigned Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2028 AM Total Traffic

Unsigned



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y			Y	Y	Y
Traffic Volume (veh/h)	79	33	27	259	130	43
Future Volume (Veh/h)	79	33	27	259	130	43
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	86	36	29	282	141	47
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	481	141	188			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	481	141	188			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	84	96	98			
cM capacity (veh/h)	533	907	1386			
Direction, Lane #	EB 1	NB 1	SB 1	SB 2		
Volume Total	122	311	141	47		
Volume Left	86	29	0	0		
Volume Right	36	0	0	47		
cSH	606	1386	1700	1700		
Volume to Capacity	0.20	0.02	0.08	0.03		
Queue Length 95th (m)	5.7	0.5	0.0	0.0		
Control Delay (s)	12.4	0.9	0.0	0.0		
Lane LOS	B	A				
Approach Delay (s)	12.4	0.9	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay		2.9				
Intersection Capacity Utilization		38.4%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
3: Street A & Lake Line

2028 AM Total Traffic
Unsignalized

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	→	↓	↖	←	↗	↑
Traffic Volume (veh/h)	31	0	17	22	0	53
Future Volume (Veh/h)	31	0	17	22	0	53
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)	34	0	18	24	0	58
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume		34		94	34	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol		34		94	34	
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		100	94	
cM capacity (veh/h)		1578		895	1039	
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	34	42	58			
Volume Left	0	18	0			
Volume Right	0	0	58			
cSH	1700	1578	1039			
Volume to Capacity	0.02	0.01	0.06			
Queue Length 95th (m)	0.0	0.3	1.3			
Control Delay (s)	0.0	3.2	8.7			
Lane LOS		A	A			
Approach Delay (s)	0.0	3.2	8.7			
Approach LOS		A				
Intersection Summary						
Average Delay		4.7				
Intersection Capacity Utilization		18.8%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2028 PM Total Traffic
Unsignalized

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop				Stop
Traffic Volume (vph)	2	28	31	93	46	28	49	106	85	13	161	13
Future Volume (vph)	2	28	31	93	46	28	49	106	85	13	161	13
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	30	34	101	50	30	53	115	92	14	175	14
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1							
Volume Total (vph)	66	181	168	92	203							
Volume Left (vph)	2	101	53	0	14							
Volume Right (vph)	34	30	0	92	14							
Hadj (s)	-0.27	0.05	0.19	-0.67	0.01							
Departure Headway (s)	5.1	5.2	5.6	4.7	5.0							
Degree Utilization, x	0.09	0.26	0.26	0.12	0.28							
Capacity (veh/h)	634	641	616	721	677							
Control Delay (s)	8.6	10.0	9.3	7.2	10.0							
Approach Delay (s)	8.6	10.0	8.6		10.0							
Approach LOS	A	A	A		A							
Intersection Summary												
Delay												9.3
Level of Service												A
Intersection Capacity Utilization				44.2%			ICU Level of Service					A
Analysis Period (min)												15

Intersection

Intersection Delay, s/veh 9.7
Intersection LOS A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	2	28	31	93	46	28	49	106	85	13	161	13
Future Vol, veh/h	2	28	31	93	46	28	49	106	85	13	161	13
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	2	30	34	101	50	30	53	115	92	14	175	14
Number of Lanes	0	1	0	0	1	0	0	1	1	0	1	0
Approach												
Opposing Approach	WB			EB			NB			SB		
Opposing Lanes	1			1			1			2		
Conflicting Approach Left	SB			NB			EB			WB		
Conflicting Lanes Left	1			2			1			1		
Conflicting Approach Right	NB			SB			WB			EB		
Conflicting Lanes Right	2			1			1			1		
HCM Control Delay	8.6			10			9.5			10		
HCM LOS	A			A			A			A		

Lane	NBLn1	NBLn2	EBLn1	WBLn1	SBLn1
Vol Left, %	32%	0%	3%	56%	7%
Vol Thru, %	68%	0%	46%	28%	86%
Vol Right, %	0%	100%	51%	17%	7%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	155	85	61	167	187
LT Vol	49	0	2	93	13
Through Vol	106	0	28	46	161
RT Vol	0	85	31	28	13
Lane Flow Rate	168	92	66	182	203
Geometry Grp	7	7	2	2	5
Degree of Util (X)	0.258	0.12	0.092	0.259	0.28
Departure Headway (Hd)	5.523	4.657	5.009	5.137	4.959
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	647	763	707	693	720
Service Time	3.293	2.427	3.097	3.207	3.031
HCM Lane V/C Ratio	0.26	0.121	0.093	0.263	0.282
HCM Control Delay	10.2	8.1	8.6	10	10
HCM Lane LOS	B	A	A	A	A
HCM 95th-tile Q	1	0.4	0.3	1	1.1

HCM Unsigned Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2028 PM Total Traffic
Unsigned

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	94	45	55	415	390	108
Future Volume (Veh/h)	94	45	55	415	390	108
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	102	49	60	451	424	117
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	995	424	541			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	995	424	541			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	60	92	94			
cM capacity (veh/h)	256	630	1028			
Direction, Lane #	EB 1	NB 1	SB 1	SB 2		
Volume Total	151	511	424	117		
Volume Left	102	60	0	0		
Volume Right	49	0	0	117		
cSH	317	1028	1700	1700		
Volume to Capacity	0.48	0.06	0.25	0.07		
Queue Length 95th (m)	18.6	1.4	0.0	0.0		
Control Delay (s)	26.3	1.6	0.0	0.0		
Lane LOS	D	A				
Approach Delay (s)	26.3	1.6	0.0			
Approach LOS	D					
Intersection Summary						
Average Delay		4.0				
Intersection Capacity Utilization		63.4%		ICU Level of Service		B
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
3: Street A & Lake Line

2028 PM Total Traffic
Unsignalized

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	25	0	59	48	0	35
Future Volume (Veh/h)	25	0	59	48	0	35
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)	27	0	64	52	0	38
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume		27		207	27	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol		27		207	27	
tC, single (s)		4.1		6.4	6.2	
tC, 2 stage (s)						
tF (s)		2.2		3.5	3.3	
p0 queue free %		96		100	96	
cM capacity (veh/h)		1587		750	1048	
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	27	116	38			
Volume Left	0	64	0			
Volume Right	0	0	38			
cSH	1700	1587	1048			
Volume to Capacity	0.02	0.04	0.04			
Queue Length 95th (m)	0.0	1.0	0.9			
Control Delay (s)	0.0	4.2	8.6			
Lane LOS		A	A			
Approach Delay (s)	0.0	4.2	8.6			
Approach LOS		A				
Intersection Summary						
Average Delay		4.5				
Intersection Capacity Utilization		22.5%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2028 Saturday Total Traffic
Unsignalized

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop				Stop
Traffic Volume (vph)	5	34	36	141	50	44	43	181	103	16	170	18
Future Volume (vph)	5	34	36	141	50	44	43	181	103	16	170	18
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	37	39	153	54	48	47	197	112	17	185	20
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1							
Volume Total (vph)	81	255	244	112	222							
Volume Left (vph)	5	153	47	0	17							
Volume Right (vph)	39	48	0	112	20							
Hadj (s)	-0.24	0.04	0.13	-0.67	0.00							
Departure Headway (s)	5.7	5.6	5.9	5.1	5.5							
Degree Utilization, x	0.13	0.40	0.40	0.16	0.34							
Capacity (veh/h)	554	599	580	666	609							
Control Delay (s)	9.5	12.2	11.6	7.9	11.3							
Approach Delay (s)	9.5	12.2	10.5		11.3							
Approach LOS	A	B	B		B							
Intersection Summary												
Delay						11.1						
Level of Service						B						
Intersection Capacity Utilization				49.9%			ICU Level of Service					A
Analysis Period (min)						15						

Intersection

Intersection Delay, s/veh 11.5

Intersection LOS B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	34	36	141	50	44	43	181	103	16	170	18
Future Vol, veh/h	5	34	36	141	50	44	43	181	103	16	170	18
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	37	39	153	54	48	47	197	112	17	185	20
Number of Lanes	0	1	0	0	1	0	0	1	1	0	1	0
Approach												
Opposing Approach	WB			EB			NB			SB		
Opposing Lanes	1			1			1			2		
Conflicting Approach Left	SB			NB			EB			WB		
Conflicting Lanes Left	1			2			1			1		
Conflicting Approach Right	NB			SB			WB			EB		
Conflicting Lanes Right	2			1			1			1		
HCM Control Delay	9.5			12.3			11.4			11.4		
HCM LOS	A			B			B			B		

Lane	NBLn1	NBLn2	EBLn1	WBLn1	SBLn1
Vol Left, %	19%	0%	7%	60%	8%
Vol Thru, %	81%	0%	45%	21%	83%
Vol Right, %	0%	100%	48%	19%	9%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	224	103	75	235	204
LT Vol	43	0	5	141	16
Through Vol	181	0	34	50	170
RT Vol	0	103	36	44	18
Lane Flow Rate	243	112	82	255	222
Geometry Grp	7	7	2	2	5
Degree of Util (X)	0.4	0.159	0.128	0.396	0.339
Departure Headway (Hd)	5.91	5.104	5.653	5.584	5.504
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	609	702	633	644	652
Service Time	3.645	2.839	3.705	3.624	3.544
HCM Lane V/C Ratio	0.399	0.16	0.13	0.396	0.34
HCM Control Delay	12.6	8.8	9.5	12.3	11.4
HCM Lane LOS	B	A	A	B	B
HCM 95th-tile Q	1.9	0.6	0.4	1.9	1.5

HCM Unsigned Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2028 Saturday Total Traffic
Unsigned

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	88	69	90	491	694	146
Future Volume (Veh/h)	88	69	90	491	694	146
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	96	75	98	534	754	159
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1484	754	913			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1484	754	913			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	20	82	87			
cM capacity (veh/h)	119	409	746			
Direction, Lane #	EB 1	NB 1	SB 1	SB 2		
Volume Total	171	632	754	159		
Volume Left	96	98	0	0		
Volume Right	75	0	0	159		
cSH	173	746	1700	1700		
Volume to Capacity	0.99	0.13	0.44	0.09		
Queue Length 95th (m)	59.8	3.4	0.0	0.0		
Control Delay (s)	119.1	3.3	0.0	0.0		
Lane LOS	F	A				
Approach Delay (s)	119.1	3.3	0.0			
Approach LOS	F					
Intersection Summary						
Average Delay		13.1				
Intersection Capacity Utilization		86.4%		ICU Level of Service		E
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
3: Street A & Lake Line

2028 Saturday Total Traffic
Unsignalized



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑→			↑←	↑←	
Traffic Volume (veh/h)	29	0	52	58	0	45
Future Volume (Veh/h)	29	0	52	58	0	45
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)	32	0	57	63	0	49
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume		32		209	32	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol		32		209	32	
tC, single (s)		4.1		6.4	6.2	
tC, 2 stage (s)						
tF (s)		2.2		3.5	3.3	
p0 queue free %		96		100	95	
cM capacity (veh/h)		1580		751	1042	
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	32	120	49			
Volume Left	0	57	0			
Volume Right	0	0	49			
cSH	1700	1580	1042			
Volume to Capacity	0.02	0.04	0.05			
Queue Length 95th (m)	0.0	0.9	1.1			
Control Delay (s)	0.0	3.6	8.6			
Lane LOS		A	A			
Approach Delay (s)	0.0	3.6	8.6			
Approach LOS		A				
Intersection Summary						
Average Delay		4.3				
Intersection Capacity Utilization		22.6%		ICU Level of Service		A
Analysis Period (min)		15				

Timings

2028 AM Total Traffic

Signalized

1: Carlow Rd/Union Road & Lake Line/Warren St



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations									
Traffic Volume (vph)	6	46	61	20	18	123	56	20	50
Future Volume (vph)	6	46	61	20	18	123	56	20	50
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	pm+ov	Perm	NA
Protected Phases		4	3	8		2	3		6
Permitted Phases		4		8		2		2	6
Detector Phase		4	4	3	8	2	2	3	6
Switch Phase									
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	11.0	9.0	11.0	11.0	11.0	9.0	11.0	11.0
Total Split (s)	19.0	19.0	12.0	31.0	29.0	29.0	12.0	29.0	29.0
Total Split (%)	31.7%	31.7%	20.0%	51.7%	48.3%	48.3%	20.0%	48.3%	48.3%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)		0.0		0.0		0.0	0.0		0.0
Total Lost Time (s)		6.0		6.0		6.0	4.0		6.0
Lead/Lag	Lag	Lag	Lead				Lead		
Lead-Lag Optimize?	Yes	Yes	Yes				Yes		
Recall Mode	Min								
Act Effect Green (s)	6.8		16.4		8.5	20.1		8.5	
Actuated g/C Ratio	0.18		0.44		0.23	0.54		0.23	
v/c Ratio	0.27		0.14		0.38	0.07		0.21	
Control Delay	11.6		6.4		15.3	1.9		13.0	
Queue Delay	0.0		0.0		0.0	0.0		0.0	
Total Delay	11.6		6.4		15.3	1.9		13.0	
LOS	B		A		B	A		B	
Approach Delay	11.6		6.4		11.5			13.0	
Approach LOS	B		A		B			B	

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 37

Natural Cycle: 40

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.38

Intersection Signal Delay: 10.7

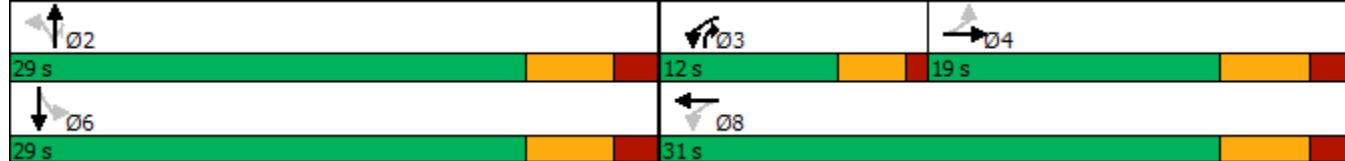
Intersection LOS: B

Intersection Capacity Utilization 38.6%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 1: Carlow Rd/Union Road & Lake Line/Warren St



Queues

2028 AM Total Traffic

Signalized

1: Carlow Rd/Union Road & Lake Line/Warren St



Lane Group	EBT	WBT	NBT	NBR	SBT
Lane Group Flow (vph)	94	103	154	61	79
v/c Ratio	0.27	0.14	0.38	0.07	0.21
Control Delay	11.6	6.4	15.3	1.9	13.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	11.6	6.4	15.3	1.9	13.0
Queue Length 50th (m)	3.0	2.8	7.9	0.0	3.7
Queue Length 95th (m)	11.6	9.2	19.5	3.0	11.3
Internal Link Dist (m)	59.2	392.2	126.4		76.1
Turn Bay Length (m)			30.0		
Base Capacity (vph)	631	1106	1109	1000	1003
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	0.15	0.09	0.14	0.06	0.08

Intersection Summary

HCM Signalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2028 AM Total Traffic

Signalized

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	6	46	34	61	20	14	18	123	56	20	50	3
Future Volume (vph)	6	46	34	61	20	14	18	123	56	20	50	3
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					6.0			6.0		4.0		6.0
Lane Util. Factor		1.00				1.00			1.00		1.00	
Frt		0.95				0.98			1.00	0.85		0.99
Flt Protected		1.00				0.97			0.99	1.00		0.99
Satd. Flow (prot)		1777				1789			1871	1601		1848
Flt Permitted		0.96				0.86			0.94	1.00		0.85
Satd. Flow (perm)		1715				1592			1772	1601		1600
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	7	50	37	66	22	15	20	134	61	22	54	3
RTOR Reduction (vph)	0	30	0	0	8	0	0	0	38	0	2	0
Lane Group Flow (vph)	0	64	0	0	95	0	0	154	23	0	77	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	pm+ov	Perm	NA	
Protected Phases		4			3			8		2	3	
Permitted Phases		4			8				2	2	6	
Actuated Green, G (s)		6.8				16.4			8.5	14.1		8.5
Effective Green, g (s)		6.8				16.4			8.5	14.1		8.5
Actuated g/C Ratio		0.18				0.44			0.23	0.38		0.23
Clearance Time (s)		6.0				6.0			6.0	4.0		6.0
Vehicle Extension (s)		3.0				3.0			3.0	3.0		3.0
Lane Grp Cap (vph)	316				737			408	611		368	
v/s Ratio Prot				c0.02						0.01		
v/s Ratio Perm		c0.04			0.04				c0.09	0.01		0.05
v/c Ratio		0.20			0.13				0.38	0.04		0.21
Uniform Delay, d1		12.8			6.0			12.0	7.1		11.5	
Progression Factor		1.00			1.00			1.00	1.00		1.00	
Incremental Delay, d2		0.3			0.1			0.6	0.0		0.3	
Delay (s)		13.1			6.1			12.6	7.2		11.8	
Level of Service		B			A				B	A		B
Approach Delay (s)		13.1			6.1			11.0			11.8	
Approach LOS		B			A				B		B	
Intersection Summary												
HCM 2000 Control Delay		10.5			HCM 2000 Level of Service				B			
HCM 2000 Volume to Capacity ratio		0.26										
Actuated Cycle Length (s)		36.9			Sum of lost time (s)				16.0			
Intersection Capacity Utilization		38.6%			ICU Level of Service				A			
Analysis Period (min)		15										
c Critical Lane Group												

Timings
2: Colborne St/Sunset Rd & Warren St

2028 AM Total Traffic

Signalized



Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Configurations	Y	Y	Y	Y	Y
Traffic Volume (vph)	79	27	259	130	43
Future Volume (vph)	79	27	259	130	43
Turn Type	Prot	pm+pt	NA	NA	Perm
Protected Phases	4	5	2	6	
Permitted Phases			2		6
Detector Phase	4	5	2	6	6
Switch Phase					
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	9.0	11.0	11.0	11.0
Total Split (s)	22.0	9.0	38.0	29.0	29.0
Total Split (%)	36.7%	15.0%	63.3%	48.3%	48.3%
Yellow Time (s)	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0		6.0	6.0	6.0
Lead/Lag	Lead		Lag	Lag	
Lead-Lag Optimize?	Yes		Yes	Yes	
Recall Mode	None	None	Max	Max	Max
Act Effect Green (s)	8.2		36.2	36.2	36.2
Actuated g/C Ratio	0.16		0.68	0.68	0.68
v/c Ratio	0.41		0.25	0.11	0.04
Control Delay	19.2		5.5	4.9	2.0
Queue Delay	0.0		0.0	0.0	0.0
Total Delay	19.2		5.5	4.9	2.0
LOS	B		A	A	A
Approach Delay	19.2		5.5	4.2	
Approach LOS	B		A	A	

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 52.9

Natural Cycle: 40

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.41

Intersection Signal Delay: 7.8

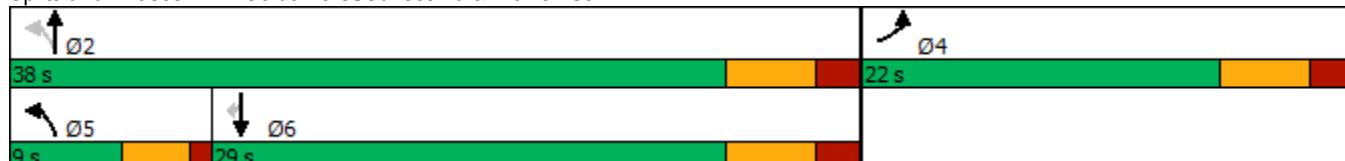
Intersection LOS: A

Intersection Capacity Utilization 43.4%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 2: Colborne St/Sunset Rd & Warren St



Queues
2: Colborne St/Sunset Rd & Warren St

2028 AM Total Traffic

Signalized



Lane Group	EBL	NBT	SBT	SBR
Lane Group Flow (vph)	122	311	141	47
v/c Ratio	0.41	0.25	0.11	0.04
Control Delay	19.2	5.5	4.9	2.0
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	19.2	5.5	4.9	2.0
Queue Length 50th (m)	7.5	11.1	4.5	0.0
Queue Length 95th (m)	18.9	24.8	11.5	3.0
Internal Link Dist (m)	392.2	65.6	88.3	
Turn Bay Length (m)			40.0	
Base Capacity (vph)	552	1251	1289	1111
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.22	0.25	0.11	0.04

Intersection Summary

HCM Signalized Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2028 AM Total Traffic
Signalized

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	79	33	27	259	130	43
Future Volume (vph)	79	33	27	259	130	43
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0			6.0	6.0	6.0
Lane Util. Factor	1.00			1.00	1.00	1.00
Frt	0.96			1.00	1.00	0.85
Flt Protected	0.97			1.00	1.00	1.00
Satd. Flow (prot)	1747			1875	1883	1601
Flt Permitted	0.97			0.97	1.00	1.00
Satd. Flow (perm)	1747			1827	1883	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	86	36	29	282	141	47
RTOR Reduction (vph)	30	0	0	0	0	17
Lane Group Flow (vph)	92	0	0	311	141	30
Turn Type	Prot	pm+pt	NA	NA	Perm	
Protected Phases	4		5	2	6	
Permitted Phases			2		6	
Actuated Green, G (s)	7.1			35.0	35.0	35.0
Effective Green, g (s)	7.1			35.0	35.0	35.0
Actuated g/C Ratio	0.13			0.65	0.65	0.65
Clearance Time (s)	6.0			6.0	6.0	6.0
Vehicle Extension (s)	3.0			3.0	3.0	3.0
Lane Grp Cap (vph)	229			1181	1218	1035
v/s Ratio Prot	c0.05				0.07	
v/s Ratio Perm			c0.17		0.02	
v/c Ratio	0.40			0.26	0.12	0.03
Uniform Delay, d1	21.6			4.1	3.6	3.4
Progression Factor	1.00			1.00	1.00	1.00
Incremental Delay, d2	1.2			0.1	0.2	0.1
Delay (s)	22.7			4.2	3.8	3.5
Level of Service	C			A	A	A
Approach Delay (s)	22.7			4.2	3.8	
Approach LOS	C			A	A	
Intersection Summary						
HCM 2000 Control Delay		7.7		HCM 2000 Level of Service		A
HCM 2000 Volume to Capacity ratio		0.32				
Actuated Cycle Length (s)		54.1		Sum of lost time (s)		16.0
Intersection Capacity Utilization		43.4%		ICU Level of Service		A
Analysis Period (min)		15				
c Critical Lane Group						

HCM Unsignalized Intersection Capacity Analysis
3: Street A & Lake Line

2028 AM Total Traffic
Signalized

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	31	0	17	22	0	53
Future Volume (Veh/h)	31	0	17	22	0	53
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)	34	0	18	24	0	58
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)			83			
pX, platoon unblocked						
vC, conflicting volume		34		94	34	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol		34		94	34	
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		100	94	
cM capacity (veh/h)		1578		895	1039	
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	34	42	58			
Volume Left	0	18	0			
Volume Right	0	0	58			
cSH	1700	1578	1039			
Volume to Capacity	0.02	0.01	0.06			
Queue Length 95th (m)	0.0	0.3	1.3			
Control Delay (s)	0.0	3.2	8.7			
Lane LOS		A	A			
Approach Delay (s)	0.0	3.2	8.7			
Approach LOS		A				
Intersection Summary						
Average Delay		4.7				
Intersection Capacity Utilization		18.8%		ICU Level of Service		A
Analysis Period (min)		15				

Timings

2028 PM Total Traffic

Signalized

1: Carlow Rd/Union Road & Lake Line/Warren St



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations									
Traffic Volume (vph)	2	28	93	46	49	106	85	13	161
Future Volume (vph)	2	28	93	46	49	106	85	13	161
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	pm+ov	Perm	NA
Protected Phases		4	3	8		2	3		6
Permitted Phases		4		8		2		2	6
Detector Phase		4	4	3	8	2	2	3	6
Switch Phase									
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	11.0	9.0	11.0	11.0	11.0	9.0	11.0	11.0
Total Split (s)	18.0	18.0	12.0	30.0	30.0	30.0	12.0	30.0	30.0
Total Split (%)	30.0%	30.0%	20.0%	50.0%	50.0%	50.0%	20.0%	50.0%	50.0%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)		0.0		0.0		0.0	0.0		0.0
Total Lost Time (s)		6.0		6.0		6.0	4.0		6.0
Lead/Lag	Lag	Lag	Lead				Lead		
Lead-Lag Optimize?	Yes	Yes	Yes				Yes		
Recall Mode	Min								
Act Effect Green (s)		6.4		16.0		9.3	20.9		9.3
Actuated g/C Ratio		0.17		0.43		0.25	0.56		0.25
v/c Ratio		0.20		0.27		0.43	0.10		0.45
Control Delay		10.7		7.9		15.6	1.6		15.1
Queue Delay		0.0		0.0		0.0	0.0		0.0
Total Delay		10.7		7.9		15.6	1.6		15.1
LOS	B		A		B	A		B	
Approach Delay		10.7		7.9		10.6			15.1
Approach LOS		B		A		B		B	

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 37.4

Natural Cycle: 40

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.45

Intersection Signal Delay: 11.2

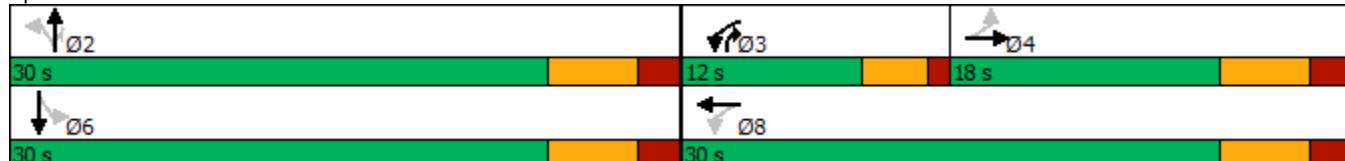
Intersection LOS: B

Intersection Capacity Utilization 48.3%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 1: Carlow Rd/Union Road & Lake Line/Warren St



Queues

2028 PM Total Traffic

Signalized

1: Carlow Rd/Union Road & Lake Line/Warren St



Lane Group	EBT	WBT	NBT	NBR	SBT
Lane Group Flow (vph)	66	181	168	92	203
v/c Ratio	0.20	0.27	0.43	0.10	0.45
Control Delay	10.7	7.9	15.6	1.6	15.1
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	10.7	7.9	15.6	1.6	15.1
Queue Length 50th (m)	1.7	5.7	8.6	0.0	10.0
Queue Length 95th (m)	8.9	16.0	20.8	3.4	23.4
Internal Link Dist (m)	59.2	392.2	126.4		76.1
Turn Bay Length (m)			30.0		
Base Capacity (vph)	578	971	1025	1035	1164
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	0.11	0.19	0.16	0.09	0.17

Intersection Summary

HCM Signalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2028 PM Total Traffic
Signalized

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	2	28	31	93	46	28	49	106	85	13	161	13
Future Volume (vph)	2	28	31	93	46	28	49	106	85	13	161	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0			6.0	4.0		6.0	
Lane Util. Factor	1.00				1.00			1.00	1.00		1.00	
Frt	0.93				0.98			1.00	0.85		0.99	
Flt Protected	1.00				0.97			0.98	1.00		1.00	
Satd. Flow (prot)		1750				1791			1854	1601		1859
Flt Permitted		0.98				0.78			0.84	1.00		0.96
Satd. Flow (perm)		1718				1438			1585	1601		1797
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2	30	34	101	50	30	53	115	92	14	175	14
RTOR Reduction (vph)	0	28	0	0	11	0	0	0	55	0	5	0
Lane Group Flow (vph)	0	38	0	0	170	0	0	168	37	0	198	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	pm+ov	Perm	NA	
Protected Phases		4			3	8			2	3		6
Permitted Phases	4				8			2		2	6	
Actuated Green, G (s)		6.4				16.0			9.3	14.9		9.3
Effective Green, g (s)		6.4				16.0			9.3	14.9		9.3
Actuated g/C Ratio		0.17				0.43			0.25	0.40		0.25
Clearance Time (s)		6.0				6.0			6.0	4.0		6.0
Vehicle Extension (s)		3.0				3.0			3.0	3.0		3.0
Lane Grp Cap (vph)	294				669			395	639		448	
v/s Ratio Prot				c0.04					0.01			
v/s Ratio Perm		0.02			c0.07			0.11	0.01		c0.11	
v/c Ratio		0.13			0.25			0.43	0.06		0.44	
Uniform Delay, d1		13.1			6.8			11.8	6.9		11.8	
Progression Factor		1.00			1.00			1.00	1.00		1.00	
Incremental Delay, d2		0.2			0.2			0.7	0.0		0.7	
Delay (s)		13.3			7.0			12.5	6.9		12.5	
Level of Service		B			A			B	A		B	
Approach Delay (s)		13.3			7.0			10.5			12.5	
Approach LOS		B			A			B			B	
Intersection Summary												
HCM 2000 Control Delay		10.5			HCM 2000 Level of Service			B				
HCM 2000 Volume to Capacity ratio		0.38										
Actuated Cycle Length (s)		37.3			Sum of lost time (s)			16.0				
Intersection Capacity Utilization		48.3%			ICU Level of Service			A				
Analysis Period (min)		15										
c Critical Lane Group												

Timings
2: Colborne St/Sunset Rd & Warren St

2028 PM Total Traffic

Signalized



Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Configurations	Y	Y	Y	Y	Y
Traffic Volume (vph)	94	55	415	390	108
Future Volume (vph)	94	55	415	390	108
Turn Type	Prot	pm+pt	NA	NA	Perm
Protected Phases	4	5	2	6	
Permitted Phases			2		6
Detector Phase	4	5	2	6	6
Switch Phase					
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	9.0	11.0	11.0	11.0
Total Split (s)	17.0	9.0	43.0	34.0	34.0
Total Split (%)	28.3%	15.0%	71.7%	56.7%	56.7%
Yellow Time (s)	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0		6.0	6.0	6.0
Lead/Lag	Lead		Lag	Lag	
Lead-Lag Optimize?	Yes		Yes	Yes	
Recall Mode	None	Min	Min	Min	Min
Act Effect Green (s)	8.5		25.0	15.1	15.1
Actuated g/C Ratio	0.20		0.59	0.36	0.36
v/c Ratio	0.40		0.50	0.63	0.18
Control Delay	17.8		8.3	16.9	3.4
Queue Delay	0.0		0.0	0.0	0.0
Total Delay	17.8		8.3	16.9	3.4
LOS	B		A	B	A
Approach Delay	17.8		8.3	14.0	
Approach LOS	B		A	B	

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 42.4

Natural Cycle: 45

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.63

Intersection Signal Delay: 12.0

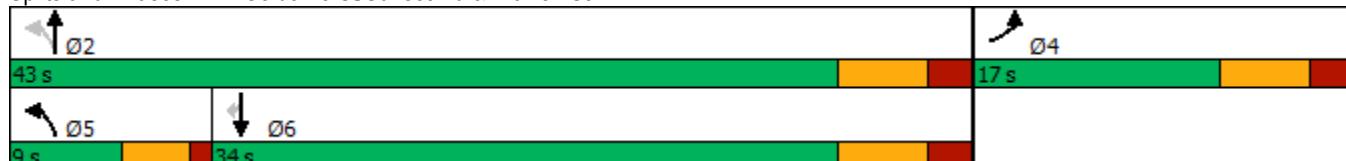
Intersection LOS: B

Intersection Capacity Utilization 68.4%

ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 2: Colborne St/Sunset Rd & Warren St



Queues
2: Colborne St/Sunset Rd & Warren St

2028 PM Total Traffic

Signalized



Lane Group	EBL	NBT	SBT	SBR
Lane Group Flow (vph)	151	511	424	117
v/c Ratio	0.40	0.50	0.63	0.18
Control Delay	17.8	8.3	16.9	3.4
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	17.8	8.3	16.9	3.4
Queue Length 50th (m)	7.9	21.3	27.0	0.0
Queue Length 95th (m)	23.7	42.9	51.5	6.9
Internal Link Dist (m)	392.2	65.6	88.3	
Turn Bay Length (m)			40.0	
Base Capacity (vph)	521	1446	1281	1126
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.29	0.35	0.33	0.10

Intersection Summary

HCM Signalized Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2028 PM Total Traffic
Signalized

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	94	45	55	415	390	108
Future Volume (vph)	94	45	55	415	390	108
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0			6.0	6.0	6.0
Lane Util. Factor	1.00			1.00	1.00	1.00
Frt	0.96			1.00	1.00	0.85
Flt Protected	0.97			0.99	1.00	1.00
Satd. Flow (prot)	1742			1872	1883	1601
Flt Permitted	0.97			0.91	1.00	1.00
Satd. Flow (perm)	1742			1718	1883	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	102	49	60	451	424	117
RTOR Reduction (vph)	30	0	0	0	0	75
Lane Group Flow (vph)	121	0	0	511	424	42
Turn Type	Prot	pm+pt	NA	NA	Perm	
Protected Phases	4		5	2	6	
Permitted Phases			2		6	
Actuated Green, G (s)	6.4			25.0	15.5	15.5
Effective Green, g (s)	6.4			25.0	15.5	15.5
Actuated g/C Ratio	0.15			0.58	0.36	0.36
Clearance Time (s)	6.0			6.0	6.0	6.0
Vehicle Extension (s)	3.0			3.0	3.0	3.0
Lane Grp Cap (vph)	256			1009	672	571
v/s Ratio Prot	c0.07			c0.06	c0.23	
v/s Ratio Perm			0.23		0.03	
v/c Ratio	0.47			0.51	0.63	0.07
Uniform Delay, d1	17.0			5.5	11.6	9.2
Progression Factor	1.00			1.00	1.00	1.00
Incremental Delay, d2	1.4			0.4	1.9	0.1
Delay (s)	18.3			5.9	13.5	9.3
Level of Service	B			A	B	A
Approach Delay (s)	18.3			5.9	12.6	
Approach LOS	B			A	B	
Intersection Summary						
HCM 2000 Control Delay	10.5			HCM 2000 Level of Service	B	
HCM 2000 Volume to Capacity ratio	0.59					
Actuated Cycle Length (s)	43.4			Sum of lost time (s)	16.0	
Intersection Capacity Utilization	68.4%			ICU Level of Service	C	
Analysis Period (min)	15					
c Critical Lane Group						

HCM Unsignalized Intersection Capacity Analysis
3: Street A & Lake Line

2028 PM Total Traffic
Signalized

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	25	0	59	48	0	35
Future Volume (Veh/h)	25	0	59	48	0	35
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)	27	0	64	52	0	38
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)			83			
pX, platoon unblocked						
vC, conflicting volume		27		207	27	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol		27		207	27	
tC, single (s)		4.1		6.4	6.2	
tC, 2 stage (s)						
tF (s)		2.2		3.5	3.3	
p0 queue free %		96		100	96	
cM capacity (veh/h)		1587		750	1048	
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	27	116	38			
Volume Left	0	64	0			
Volume Right	0	0	38			
cSH	1700	1587	1048			
Volume to Capacity	0.02	0.04	0.04			
Queue Length 95th (m)	0.0	1.0	0.9			
Control Delay (s)	0.0	4.2	8.6			
Lane LOS		A	A			
Approach Delay (s)	0.0	4.2	8.6			
Approach LOS		A				
Intersection Summary						
Average Delay		4.5				
Intersection Capacity Utilization		22.5%		ICU Level of Service		A
Analysis Period (min)		15				

Timings

2028 SAT Total Traffic

Signalized

1: Carlow Rd/Union Road & Lake Line/Warren St



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations									
Traffic Volume (vph)	5	34	141	50	43	181	103	16	170
Future Volume (vph)	5	34	141	50	43	181	103	16	170
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	pm+ov	Perm	NA
Protected Phases		4	3	8		2	3		6
Permitted Phases		4		8		2		2	6
Detector Phase		4	4	3	8	2	2	3	6
Switch Phase									
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	11.0	9.0	11.0	11.0	11.0	9.0	11.0	11.0
Total Split (s)	22.0	22.0	9.0	31.0	29.0	29.0	9.0	29.0	29.0
Total Split (%)	36.7%	36.7%	15.0%	51.7%	48.3%	48.3%	15.0%	48.3%	48.3%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)		0.0		0.0		0.0	0.0		0.0
Total Lost Time (s)		6.0		6.0		6.0	4.0		6.0
Lead/Lag	Lag	Lag	Lead				Lead		
Lead-Lag Optimize?	Yes	Yes	Yes				Yes		
Recall Mode	Min								
Act Effect Green (s)	6.8		15.9		10.8	22.0		10.8	
Actuated g/C Ratio	0.17		0.41		0.28	0.57		0.28	
v/c Ratio	0.25		0.43		0.52	0.12		0.44	
Control Delay	11.5		10.7		16.4	1.5		14.1	
Queue Delay	0.0		0.0		0.0	0.0		0.0	
Total Delay	11.5		10.7		16.4	1.5		14.1	
LOS	B		B		B	A		B	
Approach Delay	11.5		10.7		11.7			14.1	
Approach LOS	B		B		B			B	

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 38.9

Natural Cycle: 40

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.52

Intersection Signal Delay: 12.0

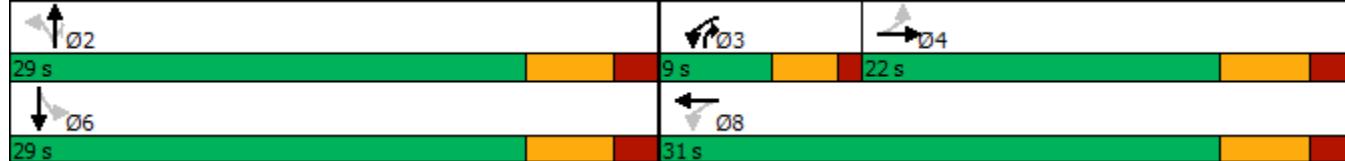
Intersection LOS: B

Intersection Capacity Utilization 53.2%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 1: Carlow Rd/Union Road & Lake Line/Warren St



Queues

2028 SAT Total Traffic

Signalized

1: Carlow Rd/Union Road & Lake Line/Warren St



Lane Group	EBT	WBT	NBT	NBR	SBT
Lane Group Flow (vph)	81	255	244	112	222
v/c Ratio	0.25	0.43	0.52	0.12	0.44
Control Delay	11.5	10.7	16.4	1.5	14.1
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	11.5	10.7	16.4	1.5	14.1
Queue Length 50th (m)	2.3	9.3	12.9	0.0	10.9
Queue Length 95th (m)	11.0	25.4	29.3	4.0	25.4
Internal Link Dist (m)	59.2	392.2	126.4		76.1
Turn Bay Length (m)			30.0		
Base Capacity (vph)	722	906	1007	952	1067
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	0.11	0.28	0.24	0.12	0.21

Intersection Summary

HCM Signalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2028 SAT Total Traffic
Signalized

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	5	34	36	141	50	44	43	181	103	16	170	18
Future Volume (vph)	5	34	36	141	50	44	43	181	103	16	170	18
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					6.0	6.0		6.0	4.0		6.0	
Lane Util. Factor		1.00				1.00		1.00	1.00		1.00	
Frt		0.94				0.97		1.00	0.85		0.99	
Flt Protected		1.00				0.97		0.99	1.00		1.00	
Satd. Flow (prot)		1756				1782		1865	1601		1853	
Flt Permitted		0.95				0.72		0.89	1.00		0.95	
Satd. Flow (perm)		1678				1324		1682	1601		1776	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	37	39	153	54	48	47	197	112	17	185	20
RTOR Reduction (vph)	0	32	0	0	14	0	0	0	66	0	7	0
Lane Group Flow (vph)	0	49	0	0	241	0	0	244	46	0	215	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	pm+ov	Perm	NA	
Protected Phases		4			3	8			2	3		6
Permitted Phases	4				8			2		2	6	
Actuated Green, G (s)		6.8				15.9			10.8	15.9		10.8
Effective Green, g (s)		6.8				15.9			10.8	15.9		10.8
Actuated g/C Ratio		0.18				0.41			0.28	0.41		0.28
Clearance Time (s)		6.0				6.0			6.0	4.0		6.0
Vehicle Extension (s)		3.0				3.0			3.0	3.0		3.0
Lane Grp Cap (vph)	294				604			469	657		495	
v/s Ratio Prot				c0.05					0.01			
v/s Ratio Perm	0.03			c0.11				c0.15	0.02		0.12	
v/c Ratio	0.17			0.40				0.52	0.07		0.43	
Uniform Delay, d1	13.5			8.0				11.8	6.9		11.4	
Progression Factor	1.00			1.00				1.00	1.00		1.00	
Incremental Delay, d2	0.3			0.4				1.0	0.0		0.6	
Delay (s)	13.8			8.5				12.8	7.0		12.1	
Level of Service	B			A				B	A		B	
Approach Delay (s)	13.8			8.5				11.0			12.1	
Approach LOS	B			A				B			B	
Intersection Summary												
HCM 2000 Control Delay		10.8			HCM 2000 Level of Service				B			
HCM 2000 Volume to Capacity ratio		0.52										
Actuated Cycle Length (s)		38.7			Sum of lost time (s)				16.0			
Intersection Capacity Utilization		53.2%			ICU Level of Service				A			
Analysis Period (min)		15										
c Critical Lane Group												

Timings
2: Colborne St/Sunset Rd & Warren St

2028 SAT Total Traffic

Signalized



Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Configurations	Y	Y	Y	Y	Y
Traffic Volume (vph)	88	90	491	694	146
Future Volume (vph)	88	90	491	694	146
Turn Type	Prot	pm+pt	NA	NA	Perm
Protected Phases	4	5	2	6	
Permitted Phases			2		6
Detector Phase	4	5	2	6	6
Switch Phase					
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	11.0	11.0	11.0	11.0
Total Split (s)	12.0	11.0	48.0	37.0	37.0
Total Split (%)	20.0%	18.3%	80.0%	61.7%	61.7%
Yellow Time (s)	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0		6.0	6.0	6.0
Lead/Lag	Lead		Lag	Lag	
Lead-Lag Optimize?	Yes		Yes	Yes	
Recall Mode	None	Min	Min	Min	Min
Act Effect Green (s)	6.1		36.1	26.5	26.5
Actuated g/C Ratio	0.11		0.66	0.49	0.49
v/c Ratio	0.72		0.90	0.82	0.18
Control Delay	39.0		26.1	20.4	2.0
Queue Delay	0.0		0.0	0.0	0.0
Total Delay	39.0		26.1	20.4	2.0
LOS	D	C	C	A	
Approach Delay	39.0		26.1	17.2	
Approach LOS	D	C	B		

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 54.4

Natural Cycle: 60

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.90

Intersection Signal Delay: 22.6

Intersection LOS: C

Intersection Capacity Utilization 91.4%

ICU Level of Service F

Analysis Period (min) 15

Splits and Phases: 2: Colborne St/Sunset Rd & Warren St



Queues
2: Colborne St/Sunset Rd & Warren St

2028 SAT Total Traffic

Signalized



Lane Group	EBL	NBT	SBT	SBR
Lane Group Flow (vph)	171	632	754	159
v/c Ratio	0.72	0.90	0.82	0.18
Control Delay	39.0	26.1	20.4	2.0
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	39.0	26.1	20.4	2.0
Queue Length 50th (m)	12.4	24.2	57.2	0.0
Queue Length 95th (m)	#40.8	#60.1	95.8	6.4
Internal Link Dist (m)	392.2	65.6	88.3	
Turn Bay Length (m)			40.0	
Base Capacity (vph)	239	818	1108	1008
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.72	0.77	0.68	0.16

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2028 SAT Total Traffic
Signalized

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	88	69	90	491	694	146
Future Volume (vph)	88	69	90	491	694	146
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0			6.0	6.0	6.0
Lane Util. Factor	1.00			1.00	1.00	1.00
Frt	0.94			1.00	1.00	0.85
Flt Protected	0.97			0.99	1.00	1.00
Satd. Flow (prot)	1724			1869	1883	1601
Flt Permitted	0.97			0.51	1.00	1.00
Satd. Flow (perm)	1724			967	1883	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	96	75	98	534	754	159
RTOR Reduction (vph)	46	0	0	0	0	81
Lane Group Flow (vph)	125	0	0	632	754	78
Turn Type	Prot	pm+pt	NA	NA	Perm	
Protected Phases	4		5	2	6	
Permitted Phases			2		6	
Actuated Green, G (s)	6.1			36.1	26.5	26.5
Effective Green, g (s)	6.1			36.1	26.5	26.5
Actuated g/C Ratio	0.11			0.67	0.49	0.49
Clearance Time (s)	6.0			6.0	6.0	6.0
Vehicle Extension (s)	3.0			3.0	3.0	3.0
Lane Grp Cap (vph)	194			737	920	782
v/s Ratio Prot	c0.07			c0.09	0.40	
v/s Ratio Perm				c0.48	0.05	
v/c Ratio	0.64			0.86	0.82	0.10
Uniform Delay, d1	23.0			7.0	11.8	7.4
Progression Factor	1.00			1.00	1.00	1.00
Incremental Delay, d2	7.1			9.7	5.8	0.1
Delay (s)	30.1			16.8	17.6	7.5
Level of Service	C			B	B	A
Approach Delay (s)	30.1			16.8	15.8	
Approach LOS	C			B	B	
Intersection Summary						
HCM 2000 Control Delay	17.6			HCM 2000 Level of Service	B	
HCM 2000 Volume to Capacity ratio	0.90					
Actuated Cycle Length (s)	54.2			Sum of lost time (s)	16.0	
Intersection Capacity Utilization	91.4%			ICU Level of Service	F	
Analysis Period (min)	15					
c Critical Lane Group						

HCM Unsignalized Intersection Capacity Analysis

3: Street A & Lake Line

2028 SAT Total Traffic

Signalized



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑ ↘			↖ ↗	↖ ↗	
Traffic Volume (veh/h)	29	0	52	58	0	45
Future Volume (Veh/h)	29	0	52	58	0	45
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)	32	0	57	63	0	49
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)			83			
pX, platoon unblocked						
vC, conflicting volume		32		209	32	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol		32		209	32	
tC, single (s)		4.1		6.4	6.2	
tC, 2 stage (s)						
tF (s)		2.2		3.5	3.3	
p0 queue free %		96		100	95	
cM capacity (veh/h)		1580		751	1042	
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	32	120	49			
Volume Left	0	57	0			
Volume Right	0	0	49			
cSH	1700	1580	1042			
Volume to Capacity	0.02	0.04	0.05			
Queue Length 95th (m)	0.0	0.9	1.1			
Control Delay (s)	0.0	3.6	8.6			
Lane LOS		A	A			
Approach Delay (s)	0.0	3.6	8.6			
Approach LOS		A				
Intersection Summary						
Average Delay		4.3				
Intersection Capacity Utilization		22.6%		ICU Level of Service		A
Analysis Period (min)		15				

Appendix H – Synchro Output Reports - 2040 Background Traffic

HCM Unsignalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2040 AM Background Traffic

Unsignalized



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop				Stop
Traffic Volume (vph)	3	15	21	69	10	15	17	206	64	21	85	2
Future Volume (vph)	3	15	21	69	10	15	17	206	64	21	85	2
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	3	16	23	75	11	16	18	224	70	23	92	2
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1							
Volume Total (vph)	42	102	242	70	117							
Volume Left (vph)	3	75	18	0	23							
Volume Right (vph)	23	16	0	70	2							
Hadj (s)	-0.28	0.09	0.07	-0.67	0.06							
Departure Headway (s)	4.8	5.0	5.1	4.3	4.8							
Degree Utilization, x	0.06	0.14	0.34	0.08	0.16							
Capacity (veh/h)	681	658	692	805	714							
Control Delay (s)	8.1	8.9	9.4	6.5	8.7							
Approach Delay (s)	8.1	8.9	8.8		8.7							
Approach LOS	A	A	A		A							
Intersection Summary												
Delay						8.7						
Level of Service						A						
Intersection Capacity Utilization				39.5%			ICU Level of Service					A
Analysis Period (min)						15						

Intersection

Intersection Delay, s/veh 9.2

Intersection LOS A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	3	15	21	69	10	15	17	206	64	21	85	2
Future Vol, veh/h	3	15	21	69	10	15	17	206	64	21	85	2
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	3	16	23	75	11	16	18	224	70	23	92	2
Number of Lanes	0	1	0	0	1	0	0	1	1	0	1	0
Approach												
Opposing Approach	WB			WB			NB			SB		
Opposing Lanes	1			1			1			2		
Conflicting Approach Left	SB			NB			EB			WB		
Conflicting Lanes Left	1			2			1			1		
Conflicting Approach Right	NB			SB			WB			EB		
Conflicting Lanes Right	2			1			1			1		
HCM Control Delay	8.1			8.9			9.7			8.7		
HCM LOS	A			A			A			A		

Lane	NBLn1	NBLn2	EBLn1	WBLn1	SBLn1
Vol Left, %	8%	0%	8%	73%	19%
Vol Thru, %	92%	0%	38%	11%	79%
Vol Right, %	0%	100%	54%	16%	2%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	223	64	39	94	108
LT Vol	17	0	3	69	21
Through Vol	206	0	15	10	85
RT Vol	0	64	21	15	2
Lane Flow Rate	242	70	42	102	117
Geometry Grp	7	7	2	2	5
Degree of Util (X)	0.339	0.083	0.056	0.143	0.156
Departure Headway (Hd)	5.034	4.293	4.766	5.035	4.773
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	715	833	749	711	750
Service Time	2.766	2.024	2.811	3.074	2.811
HCM Lane V/C Ratio	0.338	0.084	0.056	0.143	0.156
HCM Control Delay	10.3	7.4	8.1	8.9	8.7
HCM Lane LOS	B	A	A	A	A
HCM 95th-tile Q	1.5	0.3	0.2	0.5	0.6

HCM Unsigned Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2040 AM Background Traffic
Unsigned

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	59	31	31	357	170	37
Future Volume (Veh/h)	59	31	31	357	170	37
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	64	34	34	388	185	40
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	641	185	225			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	641	185	225			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	85	96	97			
cM capacity (veh/h)	428	857	1344			
Direction, Lane #	EB 1	NB 1	SB 1	SB 2		
Volume Total	98	422	185	40		
Volume Left	64	34	0	0		
Volume Right	34	0	0	40		
cSH	518	1344	1700	1700		
Volume to Capacity	0.19	0.03	0.11	0.02		
Queue Length 95th (m)	5.3	0.6	0.0	0.0		
Control Delay (s)	13.6	0.9	0.0	0.0		
Lane LOS	B	A				
Approach Delay (s)	13.6	0.9	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay		2.3				
Intersection Capacity Utilization		44.6%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2040 PM Background Traffic

Unsignalized



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop				Stop			Stop			Stop
Traffic Volume (vph)	0	10	21	103	17	30	29	162	95	14	281	10
Future Volume (vph)	0	10	21	103	17	30	29	162	95	14	281	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	11	23	112	18	33	32	176	103	15	305	11
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1							
Volume Total (vph)	34	163	208	103	331							
Volume Left (vph)	0	112	32	0	15							
Volume Right (vph)	23	33	0	103	11							
Hadj (s)	-0.37	0.05	0.11	-0.67	0.02							
Departure Headway (s)	5.4	5.5	5.5	4.8	5.0							
Degree Utilization, x	0.05	0.25	0.32	0.14	0.46							
Capacity (veh/h)	572	591	626	722	694							
Control Delay (s)	8.7	10.4	9.9	7.3	12.2							
Approach Delay (s)	8.7	10.4	9.1		12.2							
Approach LOS	A	B	A		B							
Intersection Summary												
Delay						10.5						
Level of Service						B						
Intersection Capacity Utilization				48.6%			ICU Level of Service					A
Analysis Period (min)						15						

Intersection

Intersection Delay, s/veh 10.8

Intersection LOS B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	10	21	103	17	30	29	162	95	14	281	10
Future Vol, veh/h	0	10	21	103	17	30	29	162	95	14	281	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	11	23	112	18	33	32	176	103	15	305	11
Number of Lanes	0	1	0	0	1	0	0	1	1	0	1	0
Approach												
Opposing Approach	WB		EB		WB		NB		SB			
Opposing Lanes	1		1		1		1		2			
Conflicting Approach Left	SB		NB				EB		WB			
Conflicting Lanes Left	1		2				1		1			
Conflicting Approach Right	NB		SB				WB		EB			
Conflicting Lanes Right	2		1				1		1			
HCM Control Delay	8.7		10.4				9.9		12.1			
HCM LOS	A		B				A		B			

Lane	NBLn1	NBLn2	EBLn1	WBLn1	SBLn1
Vol Left, %	15%	0%	0%	69%	5%
Vol Thru, %	85%	0%	32%	11%	92%
Vol Right, %	0%	100%	68%	20%	3%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	191	95	31	150	305
LT Vol	29	0	0	103	14
Through Vol	162	0	10	17	281
RT Vol	0	95	21	30	10
Lane Flow Rate	208	103	34	163	332
Geometry Grp	7	7	2	2	5
Degree of Util (X)	0.314	0.134	0.051	0.248	0.453
Departure Headway (Hd)	5.452	4.669	5.412	5.472	4.918
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	654	759	666	649	726
Service Time	3.236	2.453	3.412	3.567	2.998
HCM Lane V/C Ratio	0.318	0.136	0.051	0.251	0.457
HCM Control Delay	10.7	8.2	8.7	10.4	12.1
HCM Lane LOS	B	A	A	B	B
HCM 95th-tile Q	1.3	0.5	0.2	1	2.4

HCM Unsigned Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2040 PM Background Traffic
Unsigned

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	87	46	53	565	525	93
Future Volume (Veh/h)	87	46	53	565	525	93
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	95	50	58	614	571	101
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1301	571	672			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1301	571	672			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	43	90	94			
cM capacity (veh/h)	166	520	919			
Direction, Lane #	EB 1	NB 1	SB 1	SB 2		
Volume Total	145	672	571	101		
Volume Left	95	58	0	0		
Volume Right	50	0	0	101		
cSH	217	919	1700	1700		
Volume to Capacity	0.67	0.06	0.34	0.06		
Queue Length 95th (m)	31.4	1.5	0.0	0.0		
Control Delay (s)	49.5	1.6	0.0	0.0		
Lane LOS	E	A				
Approach Delay (s)	49.5	1.6	0.0			
Approach LOS	E					
Intersection Summary						
Average Delay		5.6				
Intersection Capacity Utilization		77.9%		ICU Level of Service		D
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2040 Saturday Background Traffic
Unsignalized

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop	Yield			Stop
Traffic Volume (vph)	0	13	24	154	26	47	29	299	113	17	301	13
Future Volume (vph)	0	13	24	154	26	47	29	299	113	17	301	13
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	14	26	167	28	51	32	325	123	18	327	14
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1							
Volume Total (vph)	40	246	357	123	359							
Volume Left (vph)	0	167	32	0	18							
Volume Right (vph)	26	51	0	123	14							
Hadj (s)	-0.36	0.05	0.08	-0.67	0.02							
Departure Headway (s)	6.3	6.1	6.0	5.3	5.7							
Degree Utilization, x	0.07	0.42	0.60	0.18	0.56							
Capacity (veh/h)	454	537	573	658	611							
Control Delay (s)	9.8	13.5	16.3	8.2	15.7							
Approach Delay (s)	9.8	13.5	14.2		15.7							
Approach LOS	A	B	B		C							
Intersection Summary												
Delay												14.4
Level of Service												B
Intersection Capacity Utilization				56.7%			ICU Level of Service					B
Analysis Period (min)												15

Intersection

Intersection Delay, s/veh 14.8

Intersection LOS B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	13	24	154	26	47	29	299	113	17	301	13
Future Vol, veh/h	0	13	24	154	26	47	29	299	113	17	301	13
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	14	26	167	28	51	32	325	123	18	327	14
Number of Lanes	0	1	0	0	1	0	0	1	1	0	1	0
Approach												
Opposing Approach	WB		EB		WB		NB		SB			
Opposing Lanes	1		1		1		1		2			
Conflicting Approach Left	SB		NB				EB		WB			
Conflicting Lanes Left	1		2				1		1			
Conflicting Approach Right	NB		SB				WB		EB			
Conflicting Lanes Right	2		1				1		1			
HCM Control Delay	9.9		13.6				15.1		15.7			
HCM LOS	A		B				C		C			

Lane	NBLn1	NBLn2	EBLn1	WBLn1	SBLn1
Vol Left, %	9%	0%	0%	68%	5%
Vol Thru, %	91%	0%	35%	11%	91%
Vol Right, %	0%	100%	65%	21%	4%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	328	113	37	227	331
LT Vol	29	0	0	154	17
Through Vol	299	0	13	26	301
RT Vol	0	113	24	47	13
Lane Flow Rate	357	123	40	247	360
Geometry Grp	7	7	2	2	5
Degree of Util (X)	0.593	0.178	0.071	0.421	0.562
Departure Headway (Hd)	5.983	5.228	6.314	6.142	5.628
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	603	683	563	585	640
Service Time	3.738	2.982	4.404	4.205	3.685
HCM Lane V/C Ratio	0.592	0.18	0.071	0.422	0.563
HCM Control Delay	17.1	9.1	9.9	13.6	15.7
HCM Lane LOS	C	A	A	B	C
HCM 95th-tile Q	3.9	0.6	0.2	2.1	3.5

HCM Unsigned Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2040 Saturday Background Traffic
Unsigned

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	79	68	89	636	857	138
Future Volume (Veh/h)	79	68	89	636	857	138
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	86	74	97	691	932	150
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1817	932	1082			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1817	932	1082			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	0	77	85			
cM capacity (veh/h)	73	323	645			
Direction, Lane #	EB 1	NB 1	SB 1	SB 2		
Volume Total	160	788	932	150		
Volume Left	86	97	0	0		
Volume Right	74	0	0	150		
cSH	113	645	1700	1700		
Volume to Capacity	1.41	0.15	0.55	0.09		
Queue Length 95th (m)	85.0	4.0	0.0	0.0		
Control Delay (s)	298.7	4.0	0.0	0.0		
Lane LOS	F	A				
Approach Delay (s)	298.7	4.0	0.0			
Approach LOS	F					
Intersection Summary						
Average Delay		25.1				
Intersection Capacity Utilization		102.0%		ICU Level of Service		G
Analysis Period (min)		15				

Timings

1: Carlow Rd/Union Road & Lake Line/Warren St

2040 AM Background Traffic

Signalized



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations									
Traffic Volume (vph)	3	15	69	10	17	206	64	21	85
Future Volume (vph)	3	15	69	10	17	206	64	21	85
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	pm+ov	Perm	NA
Protected Phases		4	3	8		2	3		6
Permitted Phases		4		8		2		2	6
Detector Phase		4	4	3	8	2	2	3	6
Switch Phase									
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	11.0	9.0	11.0	11.0	11.0	9.0	11.0	11.0
Total Split (s)	15.0	15.0	11.0	26.0	34.0	34.0	11.0	34.0	34.0
Total Split (%)	25.0%	25.0%	18.3%	43.3%	56.7%	56.7%	18.3%	56.7%	56.7%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)		0.0		0.0		0.0	0.0		0.0
Total Lost Time (s)		6.0		6.0		6.0	4.0		6.0
Lead/Lag	Lag	Lag	Lead				Lead		
Lead-Lag Optimize?	Yes	Yes	Yes				Yes		
Recall Mode	Min								
Act Effect Green (s)	6.1		15.8		10.1	21.8		10.1	
Actuated g/C Ratio	0.16		0.42		0.27	0.57		0.27	
v/c Ratio	0.14		0.16		0.50	0.07		0.26	
Control Delay	11.2		7.5		15.7	1.5		12.4	
Queue Delay	0.0		0.0		0.0	0.0		0.0	
Total Delay	11.2		7.5		15.7	1.5		12.4	
LOS	B		A		B	A		B	
Approach Delay	11.2		7.5		12.5			12.4	
Approach LOS	B		A		B			B	

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 38

Natural Cycle: 40

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.50

Intersection Signal Delay: 11.5

Intersection LOS: B

Intersection Capacity Utilization 44.5%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 1: Carlow Rd/Union Road & Lake Line/Warren St



Queues

1: Carlow Rd/Union Road & Lake Line/Warren St

2040 AM Background Traffic

Signalized



Lane Group	EBT	WBT	NBT	NBR	SBT
Lane Group Flow (vph)	42	102	242	70	117
v/c Ratio	0.14	0.16	0.50	0.07	0.26
Control Delay	11.2	7.5	15.7	1.5	12.4
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	11.2	7.5	15.7	1.5	12.4
Queue Length 50th (m)	1.0	3.1	12.6	0.0	5.6
Queue Length 95th (m)	6.9	10.3	27.4	2.8	14.4
Internal Link Dist (m)	59.2	392.2	126.4		76.1
Turn Bay Length (m)			30.0		
Base Capacity (vph)	418	830	1351	1006	1231
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	0.10	0.12	0.18	0.07	0.10

Intersection Summary

HCM Signalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2040 AM Background Traffic
Signalized

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	3	15	21	69	10	15	17	206	64	21	85	2
Future Volume (vph)	3	15	21	69	10	15	17	206	64	21	85	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					6.0			6.0	4.0		6.0	
Lane Util. Factor		1.00				1.00		1.00	1.00		1.00	
Frt		0.93				0.98		1.00	0.85		1.00	
Flt Protected		1.00				0.96		1.00	1.00		0.99	
Satd. Flow (prot)				1738			1778		1876	1601		1861
Flt Permitted				0.96			0.82		0.97	1.00		0.88
Satd. Flow (perm)				1680			1503		1819	1601		1658
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	3	16	23	75	11	16	18	224	70	23	92	2
RTOR Reduction (vph)	0	19	0	0	9	0	0	0	41	0	1	0
Lane Group Flow (vph)	0	23	0	0	93	0	0	242	29	0	116	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	pm+ov	Perm	NA	
Protected Phases		4			3			8		2	3	6
Permitted Phases		4			8				2	2	6	
Actuated Green, G (s)		6.1				15.7			10.1	15.7		10.1
Effective Green, g (s)		6.1				15.7			10.1	15.7		10.1
Actuated g/C Ratio		0.16				0.42			0.27	0.42		0.27
Clearance Time (s)		6.0				6.0			6.0	4.0		6.0
Vehicle Extension (s)		3.0				3.0			3.0	3.0		3.0
Lane Grp Cap (vph)	271				665				486	664		443
v/s Ratio Prot				c0.02						0.01		
v/s Ratio Perm		0.01			c0.04				c0.13	0.01		0.07
v/c Ratio		0.08			0.14				0.50	0.04		0.26
Uniform Delay, d1		13.5			6.9				11.7	6.6		10.9
Progression Factor		1.00			1.00				1.00	1.00		1.00
Incremental Delay, d2		0.1			0.1				0.8	0.0		0.3
Delay (s)		13.6			7.0				12.5	6.6		11.2
Level of Service		B			A				B	A		B
Approach Delay (s)		13.6			7.0				11.2			11.2
Approach LOS		B			A				B			B
Intersection Summary												
HCM 2000 Control Delay		10.6			HCM 2000 Level of Service				B			
HCM 2000 Volume to Capacity ratio		0.33										
Actuated Cycle Length (s)		37.8			Sum of lost time (s)				16.0			
Intersection Capacity Utilization		44.5%			ICU Level of Service				A			
Analysis Period (min)		15										
c Critical Lane Group												

Timings
2: Colborne St/Sunset Rd & Warren St

2040 AM Background Traffic

Signalized



Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Configurations	Y	Y	Y	Y	Y
Traffic Volume (vph)	59	31	357	170	37
Future Volume (vph)	59	31	357	170	37
Turn Type	Prot	pm+pt	NA	NA	Perm
Protected Phases	4	5	2	6	
Permitted Phases			2		6
Detector Phase	4	5	2	6	6
Switch Phase					
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	9.0	11.0	11.0	11.0
Total Split (s)	18.0	9.0	42.0	33.0	33.0
Total Split (%)	30.0%	15.0%	70.0%	55.0%	55.0%
Yellow Time (s)	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0		6.0	6.0	6.0
Lead/Lag	Lead		Lag	Lag	
Lead-Lag Optimize?	Yes		Yes	Yes	
Recall Mode	None	None	Max	Max	Max
Act Effect Green (s)	7.7		40.4	40.4	40.4
Actuated g/C Ratio	0.14		0.71	0.71	0.71
v/c Ratio	0.37		0.32	0.14	0.03
Control Delay	19.6		5.4	4.4	1.8
Queue Delay	0.0		0.0	0.0	0.0
Total Delay	19.6		5.4	4.4	1.8
LOS	B		A	A	A
Approach Delay	19.6		5.4	3.9	
Approach LOS	B		A	A	

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 56.6

Natural Cycle: 40

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.37

Intersection Signal Delay: 6.8

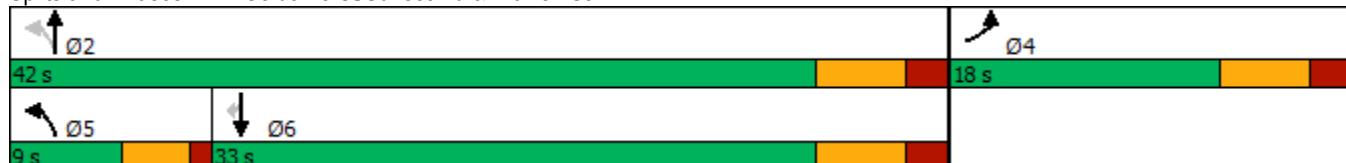
Intersection LOS: A

Intersection Capacity Utilization 49.6%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 2: Colborne St/Sunset Rd & Warren St



Queues
2: Colborne St/Sunset Rd & Warren St

2040 AM Background Traffic

Signalized



Lane Group	EBL	NBT	SBT	SBR
Lane Group Flow (vph)	98	422	185	40
v/c Ratio	0.37	0.32	0.14	0.03
Control Delay	19.6	5.4	4.4	1.8
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	19.6	5.4	4.4	1.8
Queue Length 50th (m)	5.9	15.5	5.8	0.0
Queue Length 95th (m)	16.6	33.2	13.9	2.6
Internal Link Dist (m)	392.2	65.6	88.3	
Turn Bay Length (m)			40.0	
Base Capacity (vph)	395	1301	1342	1153
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.25	0.32	0.14	0.03

Intersection Summary

HCM Signalized Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2040 AM Background Traffic
Signalized

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	59	31	31	357	170	37
Future Volume (vph)	59	31	31	357	170	37
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0			6.0	6.0	6.0
Lane Util. Factor	1.00			1.00	1.00	1.00
Frt	0.95			1.00	1.00	0.85
Flt Protected	0.97			1.00	1.00	1.00
Satd. Flow (prot)	1738			1876	1883	1601
Flt Permitted	0.97			0.97	1.00	1.00
Satd. Flow (perm)	1738			1826	1883	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	64	34	34	388	185	40
RTOR Reduction (vph)	30	0	0	0	0	13
Lane Group Flow (vph)	68	0	0	422	185	27
Turn Type	Prot	pm+pt	NA	NA	Perm	
Protected Phases	4		5	2	6	
Permitted Phases			2		6	
Actuated Green, G (s)	6.6			39.1	39.1	39.1
Effective Green, g (s)	6.6			39.1	39.1	39.1
Actuated g/C Ratio	0.11			0.68	0.68	0.68
Clearance Time (s)	6.0			6.0	6.0	6.0
Vehicle Extension (s)	3.0			3.0	3.0	3.0
Lane Grp Cap (vph)	198		1237	1276	1084	
v/s Ratio Prot	c0.04			0.10		
v/s Ratio Perm			c0.23		0.02	
v/c Ratio	0.34		0.34	0.14	0.03	
Uniform Delay, d1	23.6		3.9	3.3	3.0	
Progression Factor	1.00		1.00	1.00	1.00	
Incremental Delay, d2	1.0		0.2	0.2	0.0	
Delay (s)	24.6		4.1	3.6	3.1	
Level of Service	C		A	A	A	
Approach Delay (s)	24.6		4.1	3.5		
Approach LOS	C		A	A		
Intersection Summary						
HCM 2000 Control Delay	6.6		HCM 2000 Level of Service		A	
HCM 2000 Volume to Capacity ratio	0.37					
Actuated Cycle Length (s)	57.7		Sum of lost time (s)		16.0	
Intersection Capacity Utilization	49.6%		ICU Level of Service		A	
Analysis Period (min)	15					
c Critical Lane Group						

Timings

2040 PM Background Traffic

Signalized

1: Carlow Rd/Union Road & Lake Line/Warren St



Lane Group	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations	↑↓	↔	↔	←	↑	↗	↖	↓
Traffic Volume (vph)	10	103	17	29	162	95	14	281
Future Volume (vph)	10	103	17	29	162	95	14	281
Turn Type	NA	pm+pt	NA	Perm	NA	pm+ov	Perm	NA
Protected Phases	4	3	8		2	3		6
Permitted Phases				2		2	6	
Detector Phase	4	3	8	2	2	3	6	6
Switch Phase								
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	9.0	11.0	11.0	11.0	9.0	11.0	11.0
Total Split (s)	18.0	9.0	27.0	33.0	33.0	9.0	33.0	33.0
Total Split (%)	30.0%	15.0%	45.0%	55.0%	55.0%	15.0%	55.0%	55.0%
Yellow Time (s)	4.0	3.0	4.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	1.0	2.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0		0.0	0.0		0.0
Total Lost Time (s)	6.0		6.0		6.0	4.0		6.0
Lead/Lag	Lag	Lead				Lead		
Lead-Lag Optimize?	Yes	Yes				Yes		
Recall Mode	Min							
Act Effect Green (s)	6.2		15.3		12.2	23.3		12.2
Actuated g/C Ratio	0.16		0.39		0.31	0.59		0.31
v/c Ratio	0.12		0.39		0.40	0.10		0.58
Control Delay	11.1		11.5		13.1	1.3		15.9
Queue Delay	0.0		0.0		0.0	0.0		0.0
Total Delay	11.1		11.5		13.1	1.3		15.9
LOS	B		B		A			B
Approach Delay	11.1		11.5		9.2			15.9
Approach LOS	B		B		A			B

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 39.6

Natural Cycle: 40

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.58

Intersection Signal Delay: 12.4

Intersection LOS: B

Intersection Capacity Utilization 51.9%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 1: Carlow Rd/Union Road & Lake Line/Warren St



Queues

1: Carlow Rd/Union Road & Lake Line/Warren St

2040 PM Background Traffic

Signalized



Lane Group	EBT	WBT	NBT	NBR	SBT
Lane Group Flow (vph)	34	163	208	103	331
v/c Ratio	0.12	0.39	0.40	0.10	0.58
Control Delay	11.1	11.5	13.1	1.3	15.9
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	11.1	11.5	13.1	1.3	15.9
Queue Length 50th (m)	0.6	5.7	10.3	0.0	17.4
Queue Length 95th (m)	6.2	17.9	23.3	3.3	36.2
Internal Link Dist (m)	59.2	392.2	126.4		76.1
Turn Bay Length (m)			30.0		
Base Capacity (vph)	540	542	1182	984	1265
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	0.30	0.18	0.10	0.26

Intersection Summary

HCM Signalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2040 PM Background Traffic

Signalized

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	10	21	103	17	30	29	162	95	14	281	10
Future Volume (vph)	0	10	21	103	17	30	29	162	95	14	281	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0			6.0	4.0		6.0	
Lane Util. Factor	1.00				1.00			1.00	1.00		1.00	
Frt	0.91				0.97			1.00	0.85		1.00	
Flt Protected	1.00				0.97			0.99	1.00		1.00	
Satd. Flow (prot)		1711				1771			1869	1601		1871
Flt Permitted		1.00				0.47			0.91	1.00		0.98
Satd. Flow (perm)		1711				861			1715	1601		1832
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	11	23	112	18	33	32	176	103	15	305	11
RTOR Reduction (vph)	0	19	0	0	14	0	0	0	58	0	3	0
Lane Group Flow (vph)	0	15	0	0	149	0	0	208	45	0	328	0
Turn Type	NA		pm+pt	NA		Perm	NA	pm+ov	Perm	NA		
Protected Phases	4			3	8			2	3		6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	6.2				15.3			12.2	17.3		12.2	
Effective Green, g (s)	6.2				15.3			12.2	17.3		12.2	
Actuated g/C Ratio	0.16				0.39			0.31	0.44		0.31	
Clearance Time (s)	6.0				6.0			6.0	4.0		6.0	
Vehicle Extension (s)	3.0				3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)	268				450			529	701		565	
v/s Ratio Prot	0.01			c0.04					0.01			
v/s Ratio Perm				c0.09				0.12	0.02		c0.18	
v/c Ratio	0.05			0.33				0.39	0.06		0.58	
Uniform Delay, d1	14.2			8.5				10.7	6.4		11.5	
Progression Factor	1.00			1.00				1.00	1.00		1.00	
Incremental Delay, d2	0.1			0.4				0.5	0.0		1.5	
Delay (s)	14.2			8.9				11.2	6.5		13.0	
Level of Service	B			A				B	A		B	
Approach Delay (s)	14.2			8.9				9.6			13.0	
Approach LOS	B			A				A			B	
Intersection Summary												
HCM 2000 Control Delay	11.0				HCM 2000 Level of Service				B			
HCM 2000 Volume to Capacity ratio	0.51											
Actuated Cycle Length (s)	39.5				Sum of lost time (s)				16.0			
Intersection Capacity Utilization	51.9%				ICU Level of Service				A			
Analysis Period (min)		15										
c Critical Lane Group												

Timings
2: Colborne St/Sunset Rd & Warren St

2040 PM Background Traffic

Signalized



Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Configurations	Y	Y	Y	Y	Y
Traffic Volume (vph)	87	53	565	525	93
Future Volume (vph)	87	53	565	525	93
Turn Type	Prot	pm+pt	NA	NA	Perm
Protected Phases	4	5	2	6	
Permitted Phases			2		6
Detector Phase	4	5	2	6	6
Switch Phase					
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	9.0	11.0	11.0	11.0
Total Split (s)	15.0	9.0	45.0	36.0	36.0
Total Split (%)	25.0%	15.0%	75.0%	60.0%	60.0%
Yellow Time (s)	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0		6.0	6.0	6.0
Lead/Lag	Lead		Lag	Lag	
Lead-Lag Optimize?	Yes		Yes	Yes	
Recall Mode	None	Min	Min	Min	Min
Act Effect Green (s)	8.1		29.5	19.5	19.5
Actuated g/C Ratio	0.17		0.64	0.42	0.42
v/c Ratio	0.44		0.66	0.72	0.14
Control Delay	21.2		10.1	17.6	2.7
Queue Delay	0.0		0.0	0.0	0.0
Total Delay	21.2		10.1	17.6	2.7
LOS	C		B	B	A
Approach Delay	21.2		10.1	15.3	
Approach LOS	C		B	B	

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 46.4

Natural Cycle: 50

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.72

Intersection Signal Delay: 13.5

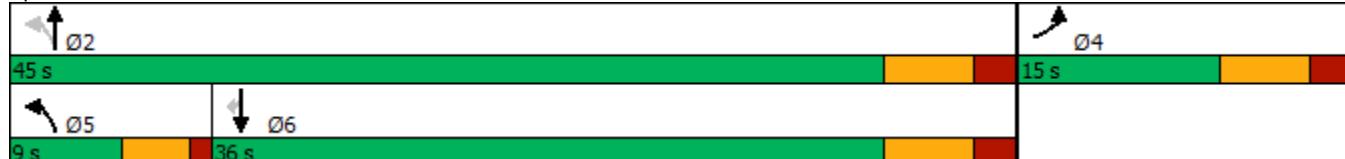
Intersection LOS: B

Intersection Capacity Utilization 82.9%

ICU Level of Service E

Analysis Period (min) 15

Splits and Phases: 2: Colborne St/Sunset Rd & Warren St



Queues
2: Colborne St/Sunset Rd & Warren St

2040 PM Background Traffic

Signalized



Lane Group	EBL	NBT	SBT	SBR
Lane Group Flow (vph)	145	672	571	101
v/c Ratio	0.44	0.66	0.72	0.14
Control Delay	21.2	10.1	17.6	2.7
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	21.2	10.1	17.6	2.7
Queue Length 50th (m)	8.7	31.9	40.4	0.0
Queue Length 95th (m)	25.4	55.1	68.8	5.7
Internal Link Dist (m)	392.2	65.6	88.3	
Turn Bay Length (m)			40.0	
Base Capacity (vph)	402	1290	1257	1102
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.36	0.52	0.45	0.09

Intersection Summary

HCM Signalized Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2040 PM Background Traffic
Signalized

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	87	46	53	565	525	93
Future Volume (vph)	87	46	53	565	525	93
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0			6.0	6.0	6.0
Lane Util. Factor	1.00			1.00	1.00	1.00
Frt	0.95			1.00	1.00	0.85
Flt Protected	0.97			1.00	1.00	1.00
Satd. Flow (prot)	1739			1875	1883	1601
Flt Permitted	0.97			0.83	1.00	1.00
Satd. Flow (perm)	1739			1570	1883	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	95	50	58	614	571	101
RTOR Reduction (vph)	32	0	0	0	0	58
Lane Group Flow (vph)	113	0	0	672	571	43
Turn Type	Prot	pm+pt	NA	NA	Perm	
Protected Phases	4		5	2	6	
Permitted Phases			2		6	
Actuated Green, G (s)	6.0			29.5	20.0	20.0
Effective Green, g (s)	6.0			29.5	20.0	20.0
Actuated g/C Ratio	0.13			0.62	0.42	0.42
Clearance Time (s)	6.0			6.0	6.0	6.0
Vehicle Extension (s)	3.0			3.0	3.0	3.0
Lane Grp Cap (vph)	219			1010	792	674
v/s Ratio Prot	c0.06			c0.08	0.30	
v/s Ratio Perm			c0.34		0.03	
v/c Ratio	0.51			0.67	0.72	0.06
Uniform Delay, d1	19.4			5.8	11.4	8.2
Progression Factor	1.00			1.00	1.00	1.00
Incremental Delay, d2	2.0			1.7	3.3	0.0
Delay (s)	21.4			7.5	14.7	8.2
Level of Service	C			A	B	A
Approach Delay (s)	21.4			7.5	13.7	
Approach LOS	C			A	B	
Intersection Summary						
HCM 2000 Control Delay	11.6			HCM 2000 Level of Service	B	
HCM 2000 Volume to Capacity ratio	0.72					
Actuated Cycle Length (s)	47.5			Sum of lost time (s)	16.0	
Intersection Capacity Utilization	82.9%			ICU Level of Service	E	
Analysis Period (min)	15					

c Critical Lane Group

Timings

2040 SAT Background Traffic

Signalized

1: Carlow Rd/Union Road & Lake Line/Warren St



Lane Group	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations	↑↓	↑↓	↑↓	←→	↑↓	↑↓	↑↓	↑↓
Traffic Volume (vph)	13	154	26	29	299	113	17	301
Future Volume (vph)	13	154	26	29	299	113	17	301
Turn Type	NA	pm+pt	NA	Perm	NA	pm+ov	Perm	NA
Protected Phases	4	3	8		2	3		6
Permitted Phases				2		2	6	
Detector Phase	4	3	8	2	2	3	6	6
Switch Phase								
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	9.0	11.0	11.0	11.0	9.0	11.0	11.0
Total Split (s)	21.0	9.0	30.0	30.0	30.0	9.0	30.0	30.0
Total Split (%)	35.0%	15.0%	50.0%	50.0%	50.0%	15.0%	50.0%	50.0%
Yellow Time (s)	4.0	3.0	4.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	1.0	2.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0		0.0	0.0		0.0
Total Lost Time (s)	6.0		6.0		6.0	4.0		6.0
Lead/Lag	Lag	Lead				Lead		
Lead-Lag Optimize?	Yes	Yes				Yes		
Recall Mode	Min							
Act Effect Green (s)	7.6		16.9		13.9	25.2		13.9
Actuated g/C Ratio	0.18		0.39		0.32	0.58		0.32
v/c Ratio	0.12		0.56		0.63	0.12		0.62
Control Delay	10.7		15.3		18.1	1.7		17.5
Queue Delay	0.0		0.0		0.0	0.0		0.0
Total Delay	10.7		15.3		18.1	1.7		17.5
LOS	B		B		A			B
Approach Delay	10.7		15.3		13.9			17.5
Approach LOS	B		B		B			B

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 43.2

Natural Cycle: 45

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.63

Intersection Signal Delay: 15.3

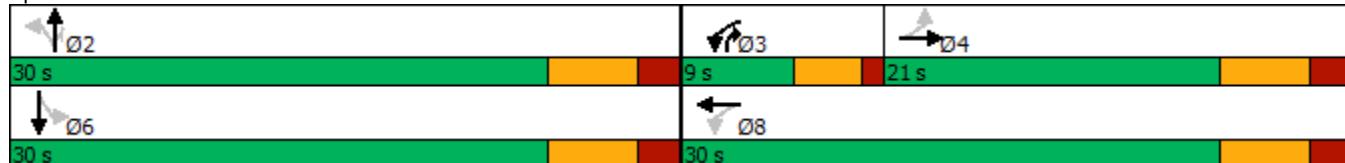
Intersection LOS: B

Intersection Capacity Utilization 60.0%

ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 1: Carlow Rd/Union Road & Lake Line/Warren St



Queues

1: Carlow Rd/Union Road & Lake Line/Warren St

2040 SAT Background Traffic

Signalized



Lane Group	EBT	WBT	NBT	NBR	SBT
Lane Group Flow (vph)	40	246	357	123	359
v/c Ratio	0.12	0.56	0.63	0.12	0.62
Control Delay	10.7	15.3	18.1	1.7	17.5
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	10.7	15.3	18.1	1.7	17.5
Queue Length 50th (m)	0.8	10.1	19.7	0.0	19.4
Queue Length 95th (m)	7.0	29.0	49.3	5.0	48.9
Internal Link Dist (m)	59.2	392.2	126.4		76.1
Turn Bay Length (m)			30.0		
Base Capacity (vph)	633	605	1021	986	1041
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	0.41	0.35	0.12	0.34

Intersection Summary

HCM Signalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2040 SAT Background Traffic
Signalized

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	13	24	154	26	47	29	299	113	17	301	13
Future Volume (vph)	0	13	24	154	26	47	29	299	113	17	301	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0			6.0	4.0		6.0	
Lane Util. Factor	1.00				1.00			1.00	1.00		1.00	
Frt	0.91				0.97			1.00	0.85		0.99	
Flt Protected	1.00				0.97			1.00	1.00		1.00	
Satd. Flow (prot)		1718				1771			1875	1601		1869
Flt Permitted		1.00				0.51			0.94	1.00		0.97
Satd. Flow (perm)		1718				930			1778	1601		1810
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	14	26	167	28	51	32	325	123	18	327	14
RTOR Reduction (vph)	0	21	0	0	16	0	0	0	68	0	3	0
Lane Group Flow (vph)	0	19	0	0	230	0	0	357	55	0	356	0
Turn Type	NA		pm+pt	NA		Perm	NA	pm+ov	Perm	NA		
Protected Phases	4			3	8			2	3		6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	7.7				16.9			13.8	19.0		13.8	
Effective Green, g (s)	7.7				16.9			13.8	19.0		13.8	
Actuated g/C Ratio	0.18				0.40			0.32	0.44		0.32	
Clearance Time (s)	6.0				6.0			6.0	4.0		6.0	
Vehicle Extension (s)	3.0				3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)	309				470			574	712		584	
v/s Ratio Prot	0.01			c0.06					0.01			
v/s Ratio Perm				c0.13				c0.20	0.02		0.20	
v/c Ratio	0.06			0.49				0.62	0.08		0.61	
Uniform Delay, d1	14.5			9.7				12.2	6.8		12.2	
Progression Factor	1.00			1.00				1.00	1.00		1.00	
Incremental Delay, d2	0.1			0.8				2.1	0.0		1.9	
Delay (s)	14.6			10.5				14.3	6.9		14.1	
Level of Service	B			B				B	A		B	
Approach Delay (s)	14.6			10.5				12.4			14.1	
Approach LOS	B			B				B			B	
Intersection Summary												
HCM 2000 Control Delay	12.6				HCM 2000 Level of Service				B			
HCM 2000 Volume to Capacity ratio	0.62											
Actuated Cycle Length (s)	42.7				Sum of lost time (s)				16.0			
Intersection Capacity Utilization	60.0%				ICU Level of Service				B			
Analysis Period (min)	15											
c Critical Lane Group												

Timings
2: Colborne St/Sunset Rd & Warren St

2040 SAT Background Traffic

Signalized



Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Configurations	Y	Y	Y	Y	Y
Traffic Volume (vph)	79	89	636	857	138
Future Volume (vph)	79	89	636	857	138
Turn Type	Prot	pm+pt	NA	NA	Perm
Protected Phases	4	5	2	6	
Permitted Phases			2		6
Detector Phase	4	5	2	6	6
Switch Phase					
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	11.0	11.0	11.0	11.0
Total Split (s)	14.0	11.0	76.0	65.0	65.0
Total Split (%)	15.6%	12.2%	84.4%	72.2%	72.2%
Yellow Time (s)	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0		6.0	6.0	6.0
Lead/Lag	Lead		Lag	Lag	
Lead-Lag Optimize?	Yes		Yes	Yes	
Recall Mode	None	Min	Min	Min	Min
Act Effect Green (s)	8.0		66.2	56.6	56.6
Actuated g/C Ratio	0.09		0.77	0.66	0.66
v/c Ratio	0.82		0.96	0.76	0.14
Control Delay	64.0		33.5	14.8	1.9
Queue Delay	0.0		0.0	0.0	0.0
Total Delay	64.0		33.5	14.8	1.9
LOS	E		C	B	A
Approach Delay	64.0		33.5	13.0	
Approach LOS	E		C	B	

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 86.3

Natural Cycle: 90

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.96

Intersection Signal Delay: 25.0

Intersection LOS: C

Intersection Capacity Utilization 107.0%

ICU Level of Service G

Analysis Period (min) 15

Splits and Phases: 2: Colborne St/Sunset Rd & Warren St



Queues
2: Colborne St/Sunset Rd & Warren St

2040 SAT Background Traffic

Signalized



Lane Group	EBL	NBT	SBT	SBR
Lane Group Flow (vph)	160	788	932	150
v/c Ratio	0.82	0.96	0.76	0.14
Control Delay	64.0	33.5	14.8	1.9
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	64.0	33.5	14.8	1.9
Queue Length 50th (m)	21.1	40.4	91.8	1.7
Queue Length 95th (m)	#55.5	#99.2	138.8	7.2
Internal Link Dist (m)	392.2	65.6	88.3	
Turn Bay Length (m)			40.0	
Base Capacity (vph)	195	873	1323	1159
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.82	0.90	0.70	0.13

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis

2: Colborne St/Sunset Rd & Warren St

2040 SAT Background Traffic

Signalized



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y			Y	Y	Y
Traffic Volume (vph)	79	68	89	636	857	138
Future Volume (vph)	79	68	89	636	857	138
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0			6.0	6.0	6.0
Lane Util. Factor	1.00			1.00	1.00	1.00
Frt	0.94			1.00	1.00	0.85
Flt Protected	0.97			0.99	1.00	1.00
Satd. Flow (prot)	1720			1872	1883	1601
Flt Permitted	0.97			0.55	1.00	1.00
Satd. Flow (perm)	1720			1027	1883	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	86	74	97	691	932	150
RTOR Reduction (vph)	34	0	0	0	0	40
Lane Group Flow (vph)	126	0	0	788	932	110
Turn Type	Prot	pm+pt		NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases			2			6
Actuated Green, G (s)	8.0			66.2	56.7	56.7
Effective Green, g (s)	8.0			66.2	56.7	56.7
Actuated g/C Ratio	0.09			0.77	0.66	0.66
Clearance Time (s)	6.0			6.0	6.0	6.0
Vehicle Extension (s)	3.0			3.0	3.0	3.0
Lane Grp Cap (vph)	159			842	1238	1053
v/s Ratio Prot	c0.07			c0.06	0.49	
v/s Ratio Perm				c0.66	0.07	
v/c Ratio	0.79			0.94	0.75	0.10
Uniform Delay, d1	38.3			8.2	10.0	5.4
Progression Factor	1.00			1.00	1.00	1.00
Incremental Delay, d2	22.4			17.3	2.6	0.0
Delay (s)	60.7			25.6	12.6	5.5
Level of Service	E			C	B	A
Approach Delay (s)	60.7			25.6	11.6	
Approach LOS	E			C	B	
Intersection Summary						
HCM 2000 Control Delay	20.9			HCM 2000 Level of Service	C	
HCM 2000 Volume to Capacity ratio	0.96					
Actuated Cycle Length (s)	86.2			Sum of lost time (s)	16.0	
Intersection Capacity Utilization	107.0%			ICU Level of Service	G	
Analysis Period (min)	15					

c Critical Lane Group

Appendix I – Synchro Output Reports - 2040 Total Traffic

HCM Unsignalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2040 AM Total Traffic

Unsignalized

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop				Stop
Traffic Volume (vph)	6	47	39	69	20	15	23	206	64	21	85	3
Future Volume (vph)	6	47	39	69	20	15	23	206	64	21	85	3
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	7	51	42	75	22	16	25	224	70	23	92	3
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1							
Volume Total (vph)	100	113	249	70	118							
Volume Left (vph)	7	75	25	0	23							
Volume Right (vph)	42	16	0	70	3							
Hadj (s)	-0.20	0.08	0.08	-0.67	0.06							
Departure Headway (s)	4.9	5.2	5.3	4.5	5.0							
Degree Utilization, x	0.14	0.16	0.36	0.09	0.16							
Capacity (veh/h)	663	636	659	761	673							
Control Delay (s)	8.7	9.2	10.1	6.7	9.0							
Approach Delay (s)	8.7	9.2	9.3		9.0							
Approach LOS	A	A	A		A							
Intersection Summary												
Delay												9.2
Level of Service												A
Intersection Capacity Utilization				40.4%			ICU Level of Service					A
Analysis Period (min)												15

Intersection

Intersection Delay, s/veh 9.6
Intersection LOS A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	6	47	39	69	20	15	23	206	64	21	85	3
Future Vol, veh/h	6	47	39	69	20	15	23	206	64	21	85	3
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	7	51	42	75	22	16	25	224	70	23	92	3
Number of Lanes	0	1	0	0	1	0	0	1	1	0	1	0
Approach												
Opposing Approach	EB			WB			NB			SB		
Opposing Lanes	WB			EB			SB			NB		
Conflicting Approach Left	1			1			1			2		
Conflicting Lanes Left	SB			NB			EB			WB		
Conflicting Approach Right	1			2			1			1		
Conflicting Lanes Right	NB			SB			WB			EB		
Conflicting Lanes Right	2			1			1			1		
HCM Control Delay	8.7			9.2			10.2			9		
HCM LOS	A			A			B			A		

Lane	NBLn1	NBLn2	EBLn1	WBLn1	SBLn1
Vol Left, %	10%	0%	7%	66%	19%
Vol Thru, %	90%	0%	51%	19%	78%
Vol Right, %	0%	100%	42%	14%	3%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	229	64	92	104	109
LT Vol	23	0	6	69	21
Through Vol	206	0	47	20	85
RT Vol	0	64	39	15	3
Lane Flow Rate	249	70	100	113	118
Geometry Grp	7	7	2	2	5
Degree of Util (X)	0.361	0.086	0.136	0.162	0.164
Departure Headway (Hd)	5.228	4.473	4.896	5.157	4.972
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	685	797	728	692	717
Service Time	2.982	2.226	2.957	3.217	3.036
HCM Lane V/C Ratio	0.364	0.088	0.137	0.163	0.165
HCM Control Delay	10.9	7.7	8.7	9.2	9
HCM Lane LOS	B	A	A	A	A
HCM 95th-tile Q	1.6	0.3	0.5	0.6	0.6

HCM Unsigned Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2040 AM Total Traffic
Unsigned

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	83	39	33	357	170	45
Future Volume (Veh/h)	83	39	33	357	170	45
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	90	42	36	388	185	49
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	645	185	234			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	645	185	234			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	79	95	97			
cM capacity (veh/h)	425	857	1333			
Direction, Lane #	EB 1	NB 1	SB 1	SB 2		
Volume Total	132	424	185	49		
Volume Left	90	36	0	0		
Volume Right	42	0	0	49		
cSH	506	1333	1700	1700		
Volume to Capacity	0.26	0.03	0.11	0.03		
Queue Length 95th (m)	7.9	0.6	0.0	0.0		
Control Delay (s)	14.6	0.9	0.0	0.0		
Lane LOS	B	A				
Approach Delay (s)	14.6	0.9	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay		2.9				
Intersection Capacity Utilization		46.5%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
3: Street A & Lake Line

2040 AM Total Traffic
Unsignalized

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	38	0	17	28	0	53
Future Volume (Veh/h)	38	0	17	28	0	53
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)	41	0	18	30	0	58
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume		41		107	41	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol		41		107	41	
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		100	94	
cM capacity (veh/h)		1568		880	1030	
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	41	48	58			
Volume Left	0	18	0			
Volume Right	0	0	58			
cSH	1700	1568	1030			
Volume to Capacity	0.02	0.01	0.06			
Queue Length 95th (m)	0.0	0.3	1.4			
Control Delay (s)	0.0	2.8	8.7			
Lane LOS		A	A			
Approach Delay (s)	0.0	2.8	8.7			
Approach LOS		A				
Intersection Summary						
Average Delay		4.3				
Intersection Capacity Utilization		19.1%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2040 PM Total Traffic

Unsignalized

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop				Stop
Traffic Volume (vph)	2	28	36	103	47	30	55	162	95	14	281	13
Future Volume (vph)	2	28	36	103	47	30	55	162	95	14	281	13
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	30	39	112	51	33	60	176	103	15	305	14
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1							
Volume Total (vph)	71	196	236	103	334							
Volume Left (vph)	2	112	60	0	15							
Volume Right (vph)	39	33	0	103	14							
Hadj (s)	-0.29	0.05	0.16	-0.67	0.02							
Departure Headway (s)	5.7	5.8	5.9	5.1	5.3							
Degree Utilization, x	0.11	0.32	0.39	0.14	0.49							
Capacity (veh/h)	536	566	584	676	647							
Control Delay (s)	9.5	11.4	11.3	7.7	13.4							
Approach Delay (s)	9.5	11.4	10.2		13.4							
Approach LOS	A	B	B		B							
Intersection Summary												
Delay						11.5						
Level of Service						B						
Intersection Capacity Utilization				54.6%			ICU Level of Service				A	
Analysis Period (min)						15						

Intersection

Intersection Delay, s/veh 11.9
Intersection LOS B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	2	28	36	103	47	30	55	162	95	14	281	13
Future Vol, veh/h	2	28	36	103	47	30	55	162	95	14	281	13
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	2	30	39	112	51	33	60	176	103	15	305	14
Number of Lanes	0	1	0	0	1	0	0	1	1	0	1	0
Approach												
Opposing Approach	WB			EB			NB			SB		
Opposing Lanes	1			1			1			2		
Conflicting Approach Left	SB			NB			EB			WB		
Conflicting Lanes Left	1			2			1			1		
Conflicting Approach Right	NB			SB			WB			EB		
Conflicting Lanes Right	2			1			1			1		
HCM Control Delay	9.5			11.5			11.2			13.4		
HCM LOS	A			B			B			B		

Lane	NBLn1	NBLn2	EBLn1	WBLn1	SBLn1
Vol Left, %	25%	0%	3%	57%	5%
Vol Thru, %	75%	0%	42%	26%	91%
Vol Right, %	0%	100%	55%	17%	4%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	217	95	66	180	308
LT Vol	55	0	2	103	14
Through Vol	162	0	28	47	281
RT Vol	0	95	36	30	13
Lane Flow Rate	236	103	72	196	335
Geometry Grp	7	7	2	2	5
Degree of Util (X)	0.385	0.144	0.115	0.315	0.493
Departure Headway (Hd)	5.874	5.037	5.747	5.8	5.303
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	613	711	622	620	680
Service Time	3.61	2.772	3.798	3.841	3.339
HCM Lane V/C Ratio	0.385	0.145	0.116	0.316	0.493
HCM Control Delay	12.3	8.6	9.5	11.5	13.4
HCM Lane LOS	B	A	A	B	B
HCM 95th-tile Q	1.8	0.5	0.4	1.3	2.7

HCM Unsigned Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2040 PM Total Traffic
Unsigned



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	99	52	62	565	525	114
Future Volume (Veh/h)	99	52	62	565	525	114
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	108	57	67	614	571	124
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1319	571	695			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1319	571	695			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	33	89	93			
cM capacity (veh/h)	160	520	901			
Direction, Lane #	EB 1	NB 1	SB 1	SB 2		
Volume Total	165	681	571	124		
Volume Left	108	67	0	0		
Volume Right	57	0	0	124		
cSH	211	901	1700	1700		
Volume to Capacity	0.78	0.07	0.34	0.07		
Queue Length 95th (m)	41.9	1.8	0.0	0.0		
Control Delay (s)	64.9	1.9	0.0	0.0		
Lane LOS	F	A				
Approach Delay (s)	64.9	1.9	0.0			
Approach LOS	F					
Intersection Summary						
Average Delay		7.8				
Intersection Capacity Utilization		79.5%	ICU Level of Service		D	
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
3: Street A & Lake Line

2040 PM Total Traffic
Unsignalized

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	31	0	59	56	0	35
Future Volume (Veh/h)	31	0	59	56	0	35
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)	34	0	64	61	0	38
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None		None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume		34		223	34	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol		34		223	34	
tC, single (s)		4.1		6.4	6.2	
tC, 2 stage (s)						
tF (s)		2.2		3.5	3.3	
p0 queue free %		96		100	96	
cM capacity (veh/h)		1578		734	1039	
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	34	125	38			
Volume Left	0	64	0			
Volume Right	0	0	38			
cSH	1700	1578	1039			
Volume to Capacity	0.02	0.04	0.04			
Queue Length 95th (m)	0.0	1.0	0.9			
Control Delay (s)	0.0	3.9	8.6			
Lane LOS		A	A			
Approach Delay (s)	0.0	3.9	8.6			
Approach LOS		A				
Intersection Summary						
Average Delay		4.2				
Intersection Capacity Utilization		22.9%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2040 Saturday Total Traffic
Unsignalized

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop				Stop
Traffic Volume (vph)	5	35	42	154	52	47	49	299	113	17	301	19
Future Volume (vph)	5	35	42	154	52	47	49	299	113	17	301	19
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	38	46	167	57	51	53	325	123	18	327	21
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1							
Volume Total (vph)	89	275	378	123	366							
Volume Left (vph)	5	167	53	0	18							
Volume Right (vph)	46	51	0	123	21							
Hadj (s)	-0.26	0.04	0.10	-0.67	0.01							
Departure Headway (s)	6.9	6.6	6.5	5.7	6.1							
Degree Utilization, x	0.17	0.50	0.68	0.20	0.62							
Capacity (veh/h)	426	506	534	604	554							
Control Delay (s)	11.3	16.0	21.1	8.9	18.8							
Approach Delay (s)	11.3	16.0	18.1		18.8							
Approach LOS	B	C	C		C							
Intersection Summary												
Delay												17.3
Level of Service												C
Intersection Capacity Utilization				61.1%			ICU Level of Service					B
Analysis Period (min)												15

Intersection

Intersection Delay, s/veh 17.9

Intersection LOS C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	35	42	154	52	47	49	299	113	17	301	19
Future Vol, veh/h	5	35	42	154	52	47	49	299	113	17	301	19
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	38	46	167	57	51	53	325	123	18	327	21
Number of Lanes	0	1	0	0	1	0	0	1	1	0	1	0
Approach												
Opposing Approach	WB			WB			NB			SB		
Opposing Lanes	1			1			1			2		
Conflicting Approach Left	SB			NB			EB			WB		
Conflicting Lanes Left	1			2			1			1		
Conflicting Approach Right	NB			SB			WB			EB		
Conflicting Lanes Right	2			1			1			1		
HCM Control Delay	11.4			16.1			19.2			18.9		
HCM LOS	B			C			C			C		

Lane	NBLn1	NBLn2	EBLn1	WBLn1	SBLn1
Vol Left, %	14%	0%	6%	61%	5%
Vol Thru, %	86%	0%	43%	21%	89%
Vol Right, %	0%	100%	51%	19%	6%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	348	113	82	253	337
LT Vol	49	0	5	154	17
Through Vol	299	0	35	52	301
RT Vol	0	113	42	47	19
Lane Flow Rate	378	123	89	275	366
Geometry Grp	7	7	2	2	5
Degree of Util (X)	0.686	0.196	0.17	0.502	0.625
Departure Headway (Hd)	6.527	5.741	6.875	6.577	6.139
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	556	629	521	547	590
Service Time	4.227	3.441	4.938	4.623	4.18
HCM Lane V/C Ratio	0.68	0.196	0.171	0.503	0.62
HCM Control Delay	22.3	9.8	11.4	16.1	18.9
HCM Lane LOS	C	A	B	C	C
HCM 95th-tile Q	5.3	0.7	0.6	2.8	4.3

HCM Unsigned Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2040 Saturday Total Traffic
Unsigned



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y			Y	Y	Y
Traffic Volume (veh/h)	92	77	99	636	857	154
Future Volume (Veh/h)	92	77	99	636	857	154
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	100	84	108	691	932	167
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1839	932	1099			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1839	932	1099			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	0	74	83			
cM capacity (veh/h)	69	323	635			
Direction, Lane #	EB 1	NB 1	SB 1	SB 2		
Volume Total	184	799	932	167		
Volume Left	100	108	0	0		
Volume Right	84	0	0	167		
cSH	107	635	1700	1700		
Volume to Capacity	1.71	0.17	0.55	0.10		
Queue Length 95th (m)	109.2	4.6	0.0	0.0		
Control Delay (s)	425.5	4.5	0.0	0.0		
Lane LOS	F	A				
Approach Delay (s)	425.5	4.5	0.0			
Approach LOS	F					
Intersection Summary						
Average Delay		39.3				
Intersection Capacity Utilization		103.9%		ICU Level of Service		G
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
3: Street A & Lake Line

2040 Saturday Total Traffic
Unsignalized



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑→			←↑	↑←	
Traffic Volume (veh/h)	36	0	52	67	0	45
Future Volume (Veh/h)	36	0	52	67	0	45
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)	39	0	57	73	0	49
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume		39		226	39	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol		39		226	39	
tC, single (s)		4.1		6.4	6.2	
tC, 2 stage (s)						
tF (s)		2.2		3.5	3.3	
p0 queue free %		96		100	95	
cM capacity (veh/h)		1571		735	1033	
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	39	130	49			
Volume Left	0	57	0			
Volume Right	0	0	49			
cSH	1700	1571	1033			
Volume to Capacity	0.02	0.04	0.05			
Queue Length 95th (m)	0.0	0.9	1.1			
Control Delay (s)	0.0	3.4	8.7			
Lane LOS		A	A			
Approach Delay (s)	0.0	3.4	8.7			
Approach LOS		A				
Intersection Summary						
Average Delay		4.0				
Intersection Capacity Utilization		23.1%		ICU Level of Service		A
Analysis Period (min)		15				

Timings

2040 SAT Total Traffic

Signalized

1: Carlow Rd/Union Road & Lake Line/Warren St



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations									
Traffic Volume (vph)	5	35	154	52	49	299	113	17	301
Future Volume (vph)	5	35	154	52	49	299	113	17	301
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	pm+ov	Perm	NA
Protected Phases		4	3	8		2	3		6
Permitted Phases		4		8		2		2	6
Detector Phase		4	4	3	8	2	2	3	6
Switch Phase									
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	11.0	9.0	11.0	11.0	11.0	9.0	11.0	11.0
Total Split (s)	19.0	19.0	9.0	28.0	32.0	32.0	9.0	32.0	32.0
Total Split (%)	31.7%	31.7%	15.0%	46.7%	53.3%	53.3%	15.0%	53.3%	53.3%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)		0.0		0.0		0.0	0.0		0.0
Total Lost Time (s)		6.0		6.0		6.0	4.0		6.0
Lead/Lag	Lag	Lag	Lead				Lead		
Lead-Lag Optimize?	Yes	Yes	Yes				Yes		
Recall Mode	Min								
Act Effect Green (s)		7.4		16.7		14.8	26.2		14.8
Actuated g/C Ratio		0.17		0.38		0.34	0.60		0.34
v/c Ratio		0.28		0.50		0.66	0.12		0.60
Control Delay		12.7		14.2		18.4	1.5		16.3
Queue Delay		0.0		0.0		0.0	0.0		0.0
Total Delay		12.7		14.2		18.4	1.5		16.3
LOS	B	B		B	A		B		
Approach Delay		12.7		14.2		14.2			16.3
Approach LOS		B		B		B			B

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 43.9

Natural Cycle: 45

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.66

Intersection Signal Delay: 14.7

Intersection LOS: B

Intersection Capacity Utilization 64.5%

ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 1: Carlow Rd/Union Road & Lake Line/Warren St



Queues

2040 SAT Total Traffic

Signalized

1: Carlow Rd/Union Road & Lake Line/Warren St



Lane Group	EBT	WBT	NBT	NBR	SBT
Lane Group Flow (vph)	89	275	378	123	366
v/c Ratio	0.28	0.50	0.66	0.12	0.60
Control Delay	12.7	14.2	18.4	1.5	16.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	12.7	14.2	18.4	1.5	16.3
Queue Length 50th (m)	2.7	12.5	22.1	0.0	20.4
Queue Length 95th (m)	12.9	34.8	50.2	4.5	46.6
Internal Link Dist (m)	59.2	392.2	126.4		76.1
Turn Bay Length (m)			30.0		
Base Capacity (vph)	544	724	1041	1003	1104
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	0.16	0.38	0.36	0.12	0.33

Intersection Summary

HCM Signalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2040 SAT Total Traffic
Signalized

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	5	35	42	154	52	47	49	299	113	17	301	19
Future Volume (vph)	5	35	42	154	52	47	49	299	113	17	301	19
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					6.0		6.0		6.0	4.0		6.0
Lane Util. Factor		1.00				1.00			1.00	1.00		1.00
Frt		0.93				0.97			1.00	0.85		0.99
Flt Protected		1.00				0.97			0.99	1.00		1.00
Satd. Flow (prot)		1747				1782			1870	1601		1864
Flt Permitted		0.96				0.72			0.91	1.00		0.97
Satd. Flow (perm)		1679				1320			1708	1601		1807
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	38	46	167	57	51	53	325	123	18	327	21
RTOR Reduction (vph)	0	38	0	0	14	0	0	0	67	0	4	0
Lane Group Flow (vph)	0	51	0	0	261	0	0	378	56	0	362	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	pm+ov	Perm	NA	
Protected Phases		4			3		8			2	3	
Permitted Phases	4				8			2		2	6	
Actuated Green, G (s)		7.6				16.7			14.8	19.9		14.8
Effective Green, g (s)		7.6				16.7			14.8	19.9		14.8
Actuated g/C Ratio		0.17				0.38			0.34	0.46		0.34
Clearance Time (s)		6.0				6.0			6.0	4.0		6.0
Vehicle Extension (s)		3.0				3.0			3.0	3.0		3.0
Lane Grp Cap (vph)	293				560			581	732		614	
v/s Ratio Prot				c0.05					0.01			
v/s Ratio Perm	0.03			c0.12				c0.22	0.03		0.20	
v/c Ratio	0.17			0.47				0.65	0.08		0.59	
Uniform Delay, d1	15.3			10.1				12.2	6.6		11.8	
Progression Factor	1.00			1.00				1.00	1.00		1.00	
Incremental Delay, d2	0.3			0.6				2.6	0.0		1.5	
Delay (s)	15.6			10.7				14.8	6.7		13.3	
Level of Service	B			B				B	A		B	
Approach Delay (s)	15.6			10.7				12.8			13.3	
Approach LOS	B			B				B			B	
Intersection Summary												
HCM 2000 Control Delay		12.7			HCM 2000 Level of Service				B			
HCM 2000 Volume to Capacity ratio		0.63										
Actuated Cycle Length (s)		43.5			Sum of lost time (s)				16.0			
Intersection Capacity Utilization		64.5%			ICU Level of Service				C			
Analysis Period (min)		15										
c Critical Lane Group												

Timings
2: Colborne St/Sunset Rd & Warren St

2040 SAT Total Traffic
Signalized



Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Configurations	Y	Y	Y	Y	Y
Traffic Volume (vph)	92	99	636	857	154
Future Volume (vph)	92	99	636	857	154
Turn Type	Prot	pm+pt	NA	NA	Perm
Protected Phases	4	5	2	6	
Permitted Phases			2		6
Detector Phase	4	5	2	6	6
Switch Phase					
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	11.0	11.0	11.0	11.0
Total Split (s)	14.0	11.0	76.0	65.0	65.0
Total Split (%)	15.6%	12.2%	84.4%	72.2%	72.2%
Yellow Time (s)	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0		6.0	6.0	6.0
Lead/Lag	Lead		Lag	Lag	
Lead-Lag Optimize?	Yes		Yes	Yes	
Recall Mode	None	Min	Min	Min	Min
Act Effect Green (s)	8.0		70.0	60.5	60.5
Actuated g/C Ratio	0.09		0.78	0.67	0.67
v/c Ratio	0.99		0.99	0.74	0.15
Control Delay	98.9		40.7	14.1	1.9
Queue Delay	0.0		0.0	0.0	0.0
Total Delay	98.9		40.7	14.1	1.9
LOS	F		D	B	A
Approach Delay	98.9		40.7	12.2	
Approach LOS	F		D	B	

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 90

Natural Cycle: 90

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.99

Intersection Signal Delay: 30.8

Intersection LOS: C

Intersection Capacity Utilization 108.9%

ICU Level of Service G

Analysis Period (min) 15

Splits and Phases: 2: Colborne St/Sunset Rd & Warren St



Queues
2: Colborne St/Sunset Rd & Warren St

2040 SAT Total Traffic

Signalized



Lane Group	EBL	NBT	SBT	SBR
Lane Group Flow (vph)	184	799	932	167
v/c Ratio	0.99	0.99	0.74	0.15
Control Delay	98.9	40.7	14.1	1.9
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	98.9	40.7	14.1	1.9
Queue Length 50th (m)	25.9	41.4	91.8	1.9
Queue Length 95th (m)	#67.0	#111.1	138.8	7.7
Internal Link Dist (m)	392.2	65.6	88.3	
Turn Bay Length (m)			40.0	
Base Capacity (vph)	186	807	1265	1118
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.99	0.99	0.74	0.15

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2040 SAT Total Traffic
Signalized

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	92	77	99	636	857	154
Future Volume (vph)	92	77	99	636	857	154
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0			6.0	6.0	6.0
Lane Util. Factor	1.00			1.00	1.00	1.00
Frt	0.94			1.00	1.00	0.85
Flt Protected	0.97			0.99	1.00	1.00
Satd. Flow (prot)	1721			1871	1883	1601
Flt Permitted	0.97			0.53	1.00	1.00
Satd. Flow (perm)	1721			995	1883	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	100	84	108	691	932	167
RTOR Reduction (vph)	34	0	0	0	0	43
Lane Group Flow (vph)	150	0	0	799	932	124
Turn Type	Prot	pm+pt	NA	NA	Perm	
Protected Phases	4		5	2	6	
Permitted Phases			2		6	
Actuated Green, G (s)	8.0			70.0	60.5	60.5
Effective Green, g (s)	8.0			70.0	60.5	60.5
Actuated g/C Ratio	0.09			0.78	0.67	0.67
Clearance Time (s)	6.0			6.0	6.0	6.0
Vehicle Extension (s)	3.0			3.0	3.0	3.0
Lane Grp Cap (vph)	152			827	1265	1076
v/s Ratio Prot	c0.09			c0.06	0.49	
v/s Ratio Perm				c0.69	0.08	
v/c Ratio	0.99			0.97	0.74	0.12
Uniform Delay, d1	41.0			8.9	9.6	5.2
Progression Factor	1.00			1.00	1.00	1.00
Incremental Delay, d2	68.9			23.1	2.3	0.0
Delay (s)	109.9			32.0	11.9	5.3
Level of Service	F			C	B	A
Approach Delay (s)	109.9			32.0	10.9	
Approach LOS	F			C	B	
Intersection Summary						
HCM 2000 Control Delay	27.7			HCM 2000 Level of Service	C	
HCM 2000 Volume to Capacity ratio	1.01					
Actuated Cycle Length (s)	90.0			Sum of lost time (s)	16.0	
Intersection Capacity Utilization	108.9%			ICU Level of Service	G	
Analysis Period (min)			15			
c Critical Lane Group						

HCM Unsignalized Intersection Capacity Analysis

3: Street A & Lake Line

2040 SAT Total Traffic

Signalized



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑ ↗			↖ ↗	↖ ↗	
Traffic Volume (veh/h)	36	0	52	67	0	45
Future Volume (Veh/h)	36	0	52	67	0	45
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)	39	0	57	73	0	49
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)			83			
pX, platoon unblocked						
vC, conflicting volume		39		226	39	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol		39		226	39	
tC, single (s)		4.1		6.4	6.2	
tC, 2 stage (s)						
tF (s)		2.2		3.5	3.3	
p0 queue free %		96		100	95	
cM capacity (veh/h)		1571		735	1033	
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	39	130	49			
Volume Left	0	57	0			
Volume Right	0	0	49			
cSH	1700	1571	1033			
Volume to Capacity	0.02	0.04	0.05			
Queue Length 95th (m)	0.0	0.9	1.1			
Control Delay (s)	0.0	3.4	8.7			
Lane LOS		A	A			
Approach Delay (s)	0.0	3.4	8.7			
Approach LOS		A				
Intersection Summary						
Average Delay		4.0				
Intersection Capacity Utilization		23.1%		ICU Level of Service		A
Analysis Period (min)		15				

Timings

1: Carlow Rd/Union Road & Lake Line/Warren St

2040 AM Total Traffic

Signalized



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations									
Traffic Volume (vph)	6	47	69	20	23	206	64	21	85
Future Volume (vph)	6	47	69	20	23	206	64	21	85
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	pm+ov	Perm	NA
Protected Phases		4	3	8		2	3		6
Permitted Phases		4		8		2		2	6
Detector Phase		4	4	3	8	2	2	3	6
Switch Phase									
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	11.0	9.0	11.0	11.0	11.0	9.0	11.0	11.0
Total Split (s)	17.0	17.0	11.0	28.0	32.0	32.0	11.0	32.0	32.0
Total Split (%)	28.3%	28.3%	18.3%	46.7%	53.3%	53.3%	18.3%	53.3%	53.3%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)		0.0		0.0		0.0	0.0		0.0
Total Lost Time (s)		6.0		6.0		6.0	4.0		6.0
Lead/Lag	Lag	Lag	Lead				Lead		
Lead-Lag Optimize?	Yes	Yes	Yes				Yes		
Recall Mode	Min								
Act Effect Green (s)		7.0		16.7		10.6	22.3		10.6
Actuated g/C Ratio	0.18		0.42		0.27	0.57		0.27	
v/c Ratio	0.30		0.17		0.52	0.07		0.26	
Control Delay	12.5		7.7		16.6	1.7		12.8	
Queue Delay		0.0	0.0		0.0	0.0		0.0	
Total Delay	12.5		7.7		16.6	1.7		12.8	
LOS	B		A		B	A		B	
Approach Delay	12.5		7.7		13.3			12.8	
Approach LOS	B		A		B			B	

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 39.4

Natural Cycle: 40

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.52

Intersection Signal Delay: 12.1

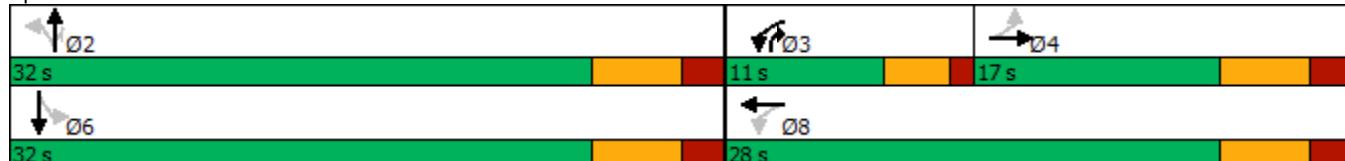
Intersection LOS: B

Intersection Capacity Utilization 45.3%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 1: Carlow Rd/Union Road & Lake Line/Warren St



Queues

2040 AM Total Traffic

Signalized

1: Carlow Rd/Union Road & Lake Line/Warren St



Lane Group	EBT	WBT	NBT	NBR	SBT
Lane Group Flow (vph)	100	113	249	70	118
v/c Ratio	0.30	0.17	0.52	0.07	0.26
Control Delay	12.5	7.7	16.6	1.7	12.8
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	12.5	7.7	16.6	1.7	12.8
Queue Length 50th (m)	3.3	3.6	13.6	0.0	5.8
Queue Length 95th (m)	13.1	11.6	30.1	3.1	15.4
Internal Link Dist (m)	59.2	392.2	126.4		76.1
Turn Bay Length (m)			30.0		
Base Capacity (vph)	513	891	1199	992	1111
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	0.19	0.13	0.21	0.07	0.11

Intersection Summary

HCM Signalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2040 AM Total Traffic
Signalized

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	6	47	39	69	20	15	23	206	64	21	85	3
Future Volume (vph)	6	47	39	69	20	15	23	206	64	21	85	3
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					6.0	6.0		6.0	4.0		6.0	
Lane Util. Factor		1.00				1.00		1.00	1.00		1.00	
Frt		0.94				0.98		1.00	0.85		1.00	
Flt Protected		1.00				0.97		1.00	1.00		0.99	
Satd. Flow (prot)		1770				1788		1874	1601		1859	
Flt Permitted		0.96				0.82		0.95	1.00		0.88	
Satd. Flow (perm)		1711				1521		1795	1601		1660	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	7	51	42	75	22	16	25	224	70	23	92	3
RTOR Reduction (vph)	0	34	0	0	9	0	0	0	41	0	2	0
Lane Group Flow (vph)	0	66	0	0	104	0	0	249	29	0	116	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	pm+ov	Perm	NA	
Protected Phases		4			3	8			2	3		6
Permitted Phases	4				8			2		2	6	
Actuated Green, G (s)		7.1				16.7			10.6	16.2		10.6
Effective Green, g (s)		7.1				16.7			10.6	16.2		10.6
Actuated g/C Ratio		0.18				0.42			0.27	0.41		0.27
Clearance Time (s)		6.0				6.0			6.0	4.0		6.0
Vehicle Extension (s)		3.0				3.0			3.0	3.0		3.0
Lane Grp Cap (vph)	309				684			484	659		447	
v/s Ratio Prot				c0.02					0.01			
v/s Ratio Perm		c0.04			0.04			c0.14	0.01		0.07	
v/c Ratio		0.21			0.15			0.51	0.04		0.26	
Uniform Delay, d1		13.7			6.9			12.2	6.9		11.3	
Progression Factor		1.00			1.00			1.00	1.00		1.00	
Incremental Delay, d2		0.3			0.1			0.9	0.0		0.3	
Delay (s)		14.1			7.0			13.1	6.9		11.6	
Level of Service		B			A			B	A		B	
Approach Delay (s)		14.1			7.0			11.7			11.6	
Approach LOS		B			A			B			B	
Intersection Summary												
HCM 2000 Control Delay		11.3			HCM 2000 Level of Service				B			
HCM 2000 Volume to Capacity ratio		0.34										
Actuated Cycle Length (s)		39.3			Sum of lost time (s)				16.0			
Intersection Capacity Utilization		45.3%			ICU Level of Service				A			
Analysis Period (min)		15										
c Critical Lane Group												

Timings
2: Colborne St/Sunset Rd & Warren St

2040 AM Total Traffic

Signalized



Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Configurations	Y	Y	Y	Y	Y
Traffic Volume (vph)	83	33	357	170	45
Future Volume (vph)	83	33	357	170	45
Turn Type	Prot	pm+pt	NA	NA	Perm
Protected Phases	4	5	2	6	
Permitted Phases			2		6
Detector Phase	4	5	2	6	6
Switch Phase					
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	9.0	11.0	11.0	11.0
Total Split (s)	19.0	9.0	41.0	32.0	32.0
Total Split (%)	31.7%	15.0%	68.3%	53.3%	53.3%
Yellow Time (s)	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0		6.0	6.0	6.0
Lead/Lag	Lead		Lag	Lag	
Lead-Lag Optimize?	Yes		Yes	Yes	
Recall Mode	None	None	Max	Max	Max
Act Effect Green (s)	8.6		39.2	39.2	39.2
Actuated g/C Ratio	0.15		0.70	0.70	0.70
v/c Ratio	0.45		0.33	0.14	0.04
Control Delay	20.9		6.0	4.9	1.9
Queue Delay	0.0		0.0	0.0	0.0
Total Delay	20.9		6.0	4.9	1.9
LOS	C		A	A	A
Approach Delay	20.9		6.0	4.3	
Approach LOS	C		A	A	

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 56.3

Natural Cycle: 40

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.45

Intersection Signal Delay: 8.0

Intersection LOS: A

Intersection Capacity Utilization 51.5%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 2: Colborne St/Sunset Rd & Warren St



Queues
2: Colborne St/Sunset Rd & Warren St

2040 AM Total Traffic

Signalized



Lane Group	EBL	NBT	SBT	SBR
Lane Group Flow (vph)	132	424	185	49
v/c Ratio	0.45	0.33	0.14	0.04
Control Delay	20.9	6.0	4.9	1.9
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	20.9	6.0	4.9	1.9
Queue Length 50th (m)	8.8	16.8	6.3	0.0
Queue Length 95th (m)	21.2	36.4	15.2	3.1
Internal Link Dist (m)	392.2	65.6	88.3	
Turn Bay Length (m)			40.0	
Base Capacity (vph)	430	1269	1312	1130
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.31	0.33	0.14	0.04

Intersection Summary

HCM Signalized Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2040 AM Total Traffic
Signalized

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	83	39	33	357	170	45
Future Volume (vph)	83	39	33	357	170	45
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0			6.0	6.0	6.0
Lane Util. Factor	1.00			1.00	1.00	1.00
Frt	0.96			1.00	1.00	0.85
Flt Protected	0.97			1.00	1.00	1.00
Satd. Flow (prot)	1743			1875	1883	1601
Flt Permitted	0.97			0.97	1.00	1.00
Satd. Flow (perm)	1743			1821	1883	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	90	42	36	388	185	49
RTOR Reduction (vph)	31	0	0	0	0	17
Lane Group Flow (vph)	101	0	0	424	185	32
Turn Type	Prot	pm+pt	NA	NA	Perm	
Protected Phases	4		5	2	6	
Permitted Phases			2		6	
Actuated Green, G (s)	7.5			38.1	38.1	38.1
Effective Green, g (s)	7.5			38.1	38.1	38.1
Actuated g/C Ratio	0.13			0.66	0.66	0.66
Clearance Time (s)	6.0			6.0	6.0	6.0
Vehicle Extension (s)	3.0			3.0	3.0	3.0
Lane Grp Cap (vph)	226		1204	1245	1058	
v/s Ratio Prot	c0.06			0.10		
v/s Ratio Perm		c0.23		0.02		
v/c Ratio	0.45		0.35	0.15	0.03	
Uniform Delay, d1	23.1		4.3	3.7	3.4	
Progression Factor	1.00		1.00	1.00	1.00	
Incremental Delay, d2	1.4		0.2	0.3	0.1	
Delay (s)	24.5		4.5	3.9	3.4	
Level of Service	C		A	A	A	
Approach Delay (s)	24.5		4.5	3.8		
Approach LOS	C		A	A		
Intersection Summary						
HCM 2000 Control Delay	7.6		HCM 2000 Level of Service		A	
HCM 2000 Volume to Capacity ratio	0.40					
Actuated Cycle Length (s)	57.6		Sum of lost time (s)		16.0	
Intersection Capacity Utilization	51.5%		ICU Level of Service		A	
Analysis Period (min)	15					
c Critical Lane Group						

HCM Unsignalized Intersection Capacity Analysis
3: Street A & Lake Line

2040 AM Total Traffic
Signalized

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	38	0	17	28	0	53
Future Volume (Veh/h)	38	0	17	28	0	53
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)	41	0	18	30	0	58
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)			83			
pX, platoon unblocked						
vC, conflicting volume		41		107	41	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol		41		107	41	
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		100	94	
cM capacity (veh/h)		1568		880	1030	
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	41	48	58			
Volume Left	0	18	0			
Volume Right	0	0	58			
cSH	1700	1568	1030			
Volume to Capacity	0.02	0.01	0.06			
Queue Length 95th (m)	0.0	0.3	1.4			
Control Delay (s)	0.0	2.8	8.7			
Lane LOS		A	A			
Approach Delay (s)	0.0	2.8	8.7			
Approach LOS		A				
Intersection Summary						
Average Delay		4.3				
Intersection Capacity Utilization		19.1%		ICU Level of Service		A
Analysis Period (min)		15				

Timings

2040 PM Total Traffic

Signalized

1: Carlow Rd/Union Road & Lake Line/Warren St



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations									
Traffic Volume (vph)	2	28	103	47	55	162	95	14	281
Future Volume (vph)	2	28	103	47	55	162	95	14	281
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	pm+ov	Perm	NA
Protected Phases		4	3	8		2	3		6
Permitted Phases		4		8		2		2	6
Detector Phase		4	4	3	8	2	2	3	6
Switch Phase									
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	11.0	9.0	11.0	11.0	11.0	9.0	11.0	11.0
Total Split (s)	18.0	18.0	9.0	27.0	33.0	33.0	9.0	33.0	33.0
Total Split (%)	30.0%	30.0%	15.0%	45.0%	55.0%	55.0%	15.0%	55.0%	55.0%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0	1.0	2.0	2.0
Lost Time Adjust (s)		0.0		0.0		0.0	0.0		0.0
Total Lost Time (s)		6.0		6.0		6.0	4.0		6.0
Lead/Lag	Lag	Lag	Lead				Lead		
Lead-Lag Optimize?	Yes	Yes	Yes				Yes		
Recall Mode	Min								
Act Effect Green (s)	6.5		15.6		12.2	23.4			12.2
Actuated g/C Ratio	0.16		0.39		0.30	0.58			0.30
v/c Ratio	0.23		0.34		0.49	0.11			0.60
Control Delay	11.6		10.5		15.2	1.4			16.4
Queue Delay	0.0		0.0		0.0	0.0			0.0
Total Delay	11.6		10.5		15.2	1.4			16.4
LOS	B		B		A				B
Approach Delay	11.6		10.5		11.0				16.4
Approach LOS	B		B		B				B

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 40

Natural Cycle: 40

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.60

Intersection Signal Delay: 12.9

Intersection LOS: B

Intersection Capacity Utilization 58.3%

ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 1: Carlow Rd/Union Road & Lake Line/Warren St



Queues

2040 PM Total Traffic

Signalized

1: Carlow Rd/Union Road & Lake Line/Warren St



Lane Group	EBT	WBT	NBT	NBR	SBT
Lane Group Flow (vph)	71	196	236	103	334
v/c Ratio	0.23	0.34	0.49	0.11	0.60
Control Delay	11.6	10.5	15.2	1.4	16.4
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	11.6	10.5	15.2	1.4	16.4
Queue Length 50th (m)	1.9	7.5	12.5	0.0	18.0
Queue Length 95th (m)	10.1	21.1	27.7	3.5	37.3
Internal Link Dist (m)	59.2	392.2	126.4		76.1
Turn Bay Length (m)			30.0		
Base Capacity (vph)	546	756	1073	977	1249
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	0.13	0.26	0.22	0.11	0.27

Intersection Summary

HCM Signalized Intersection Capacity Analysis
1: Carlow Rd/Union Road & Lake Line/Warren St

2040 PM Total Traffic

Signalized

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	2	28	36	103	47	30	55	162	95	14	281	13
Future Volume (vph)	2	28	36	103	47	30	55	162	95	14	281	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0			6.0	4.0		6.0	
Lane Util. Factor	1.00				1.00			1.00	1.00		1.00	
Frt	0.93				0.98			1.00	0.85		0.99	
Flt Protected	1.00				0.97			0.99	1.00		1.00	
Satd. Flow (prot)		1741				1790			1860	1601		1869
Flt Permitted		0.98				0.73			0.83	1.00		0.98
Satd. Flow (perm)		1711				1344			1572	1601		1827
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2	30	39	112	51	33	60	176	103	15	305	14
RTOR Reduction (vph)	0	33	0	0	12	0	0	0	58	0	3	0
Lane Group Flow (vph)	0	38	0	0	184	0	0	236	45	0	331	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA	pm+ov	Perm	NA	
Protected Phases		4			3	8			2	3		6
Permitted Phases	4				8			2		2	6	
Actuated Green, G (s)		6.5				15.6			12.2	17.3		12.2
Effective Green, g (s)		6.5				15.6			12.2	17.3		12.2
Actuated g/C Ratio		0.16				0.39			0.31	0.43		0.31
Clearance Time (s)		6.0				6.0			6.0	4.0		6.0
Vehicle Extension (s)		3.0				3.0			3.0	3.0		3.0
Lane Grp Cap (vph)	279				583			481	695		560	
v/s Ratio Prot				c0.04					0.01			
v/s Ratio Perm		0.02		c0.08				0.15	0.02		c0.18	
v/c Ratio		0.14		0.32				0.49	0.06		0.59	
Uniform Delay, d1		14.3		8.4				11.3	6.5		11.7	
Progression Factor		1.00			1.00			1.00	1.00		1.00	
Incremental Delay, d2		0.2		0.3				0.8	0.0		1.7	
Delay (s)		14.5		8.7				12.1	6.6		13.4	
Level of Service		B		A				B	A		B	
Approach Delay (s)		14.5		8.7				10.4			13.4	
Approach LOS		B		A				B			B	
Intersection Summary												
HCM 2000 Control Delay		11.4			HCM 2000 Level of Service				B			
HCM 2000 Volume to Capacity ratio		0.50										
Actuated Cycle Length (s)		39.8			Sum of lost time (s)				16.0			
Intersection Capacity Utilization		58.3%			ICU Level of Service				B			
Analysis Period (min)		15										
c Critical Lane Group												

Timings
2: Colborne St/Sunset Rd & Warren St

2040 PM Total Traffic

Signalized



Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Configurations	Y	Y	Y	Y	Y
Traffic Volume (vph)	99	62	565	525	114
Future Volume (vph)	99	62	565	525	114
Turn Type	Prot	pm+pt	NA	NA	Perm
Protected Phases	4	5	2	6	
Permitted Phases			2		6
Detector Phase	4	5	2	6	6
Switch Phase					
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	9.0	11.0	11.0	11.0
Total Split (s)	15.0	9.0	45.0	36.0	36.0
Total Split (%)	25.0%	15.0%	75.0%	60.0%	60.0%
Yellow Time (s)	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0	0.0	0.0
Total Lost Time (s)	6.0		6.0	6.0	6.0
Lead/Lag	Lead		Lag	Lag	
Lead-Lag Optimize?	Yes		Yes	Yes	
Recall Mode	None	Min	Min	Min	Min
Act Effect Green (s)	8.3		29.6	19.6	19.6
Actuated g/C Ratio	0.18		0.63	0.42	0.42
v/c Ratio	0.49		0.71	0.72	0.17
Control Delay	22.5		11.6	17.7	2.7
Queue Delay	0.0		0.0	0.0	
Total Delay	22.5		11.6	17.7	2.7
LOS	C	B	B	A	
Approach Delay	22.5		11.6	15.0	
Approach LOS	C	B	B		

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 46.7

Natural Cycle: 55

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.72

Intersection Signal Delay: 14.3

Intersection LOS: B

Intersection Capacity Utilization 84.5%

ICU Level of Service E

Analysis Period (min) 15

Splits and Phases: 2: Colborne St/Sunset Rd & Warren St



Queues
2: Colborne St/Sunset Rd & Warren St

2040 PM Total Traffic

Signalized



Lane Group	EBL	NBT	SBT	SBR
Lane Group Flow (vph)	165	681	571	124
v/c Ratio	0.49	0.71	0.72	0.17
Control Delay	22.5	11.6	17.7	2.7
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	22.5	11.6	17.7	2.7
Queue Length 50th (m)	10.4	34.0	41.5	0.0
Queue Length 95th (m)	#29.8	56.6	68.8	6.3
Internal Link Dist (m)	392.2	65.6	88.3	
Turn Bay Length (m)			40.0	
Base Capacity (vph)	400	1215	1251	1105
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.41	0.56	0.46	0.11

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2040 PM Total Traffic

Signalized



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	99	52	62	565	525	114
Future Volume (vph)	99	52	62	565	525	114
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0			6.0	6.0	6.0
Lane Util. Factor	1.00			1.00	1.00	1.00
Frt	0.95			1.00	1.00	0.85
Flt Protected	0.97			1.00	1.00	1.00
Satd. Flow (prot)	1739			1874	1883	1601
Flt Permitted	0.97			0.78	1.00	1.00
Satd. Flow (perm)	1739			1476	1883	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	108	57	67	614	571	124
RTOR Reduction (vph)	32	0	0	0	0	72
Lane Group Flow (vph)	133	0	0	681	571	52
Turn Type	Prot	pm+pt	NA	NA	Perm	
Protected Phases	4		5	2	6	
Permitted Phases			2		6	
Actuated Green, G (s)	6.1			29.5	20.0	20.0
Effective Green, g (s)	6.1			29.5	20.0	20.0
Actuated g/C Ratio	0.13			0.62	0.42	0.42
Clearance Time (s)	6.0			6.0	6.0	6.0
Vehicle Extension (s)	3.0			3.0	3.0	3.0
Lane Grp Cap (vph)	222			960	791	672
v/s Ratio Prot	c0.08			c0.08	0.30	
v/s Ratio Perm			c0.36		0.03	
v/c Ratio	0.60			0.71	0.72	0.08
Uniform Delay, d1	19.6			6.1	11.5	8.3
Progression Factor	1.00			1.00	1.00	1.00
Incremental Delay, d2	4.3			2.4	3.3	0.0
Delay (s)	23.9			8.6	14.8	8.3
Level of Service	C			A	B	A
Approach Delay (s)	23.9			8.6	13.6	
Approach LOS	C			A	B	
Intersection Summary						
HCM 2000 Control Delay	12.5			HCM 2000 Level of Service	B	
HCM 2000 Volume to Capacity ratio	0.77					
Actuated Cycle Length (s)	47.6			Sum of lost time (s)	16.0	
Intersection Capacity Utilization	84.5%			ICU Level of Service	E	
Analysis Period (min)	15					

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
3: Street A & Lake Line

2040 PM Total Traffic
Signalized



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑→	↓→	↑←	↓←	↑↖	↓↖
Traffic Volume (veh/h)	31	0	59	56	0	35
Future Volume (Veh/h)	31	0	59	56	0	35
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)	34	0	64	61	0	38
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)			83			
pX, platoon unblocked						
vC, conflicting volume		34		223	34	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol		34		223	34	
tC, single (s)		4.1		6.4	6.2	
tC, 2 stage (s)						
tF (s)		2.2		3.5	3.3	
p0 queue free %		96		100	96	
cM capacity (veh/h)		1578		734	1039	
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	34	125	38			
Volume Left	0	64	0			
Volume Right	0	0	38			
cSH	1700	1578	1039			
Volume to Capacity	0.02	0.04	0.04			
Queue Length 95th (m)	0.0	1.0	0.9			
Control Delay (s)	0.0	3.9	8.6			
Lane LOS		A	A			
Approach Delay (s)	0.0	3.9	8.6			
Approach LOS		A				
Intersection Summary						
Average Delay		4.2				
Intersection Capacity Utilization		22.9%		ICU Level of Service		A
Analysis Period (min)		15				

Appendix J – Synchro Output Reports – Potential Improvements

HCM Unsigned Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2028 Saturday Total Traffic
Unsignalized - With Improvements

Movement	EBL	EBC	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	88	69	90	491	694	146
Future Volume (Veh/h)	88	69	90	491	694	146
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	96	75	98	534	754	159
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1484	754	913			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1484	754	913			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	20	82	87			
cM capacity (veh/h)	119	409	746			
Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	96	75	98	534	754	159
Volume Left	96	0	98	0	0	0
Volume Right	0	75	0	0	0	159
cSH	119	409	746	1700	1700	1700
Volume to Capacity	0.80	0.18	0.13	0.31	0.44	0.09
Queue Length 95th (m)	35.8	5.0	3.4	0.0	0.0	0.0
Control Delay (s)	104.4	15.8	10.6	0.0	0.0	0.0
Lane LOS	F	C	B			
Approach Delay (s)	65.5		1.6		0.0	
Approach LOS	F					
Intersection Summary						
Average Delay			7.1			
Intersection Capacity Utilization		56.4%		ICU Level of Service		B
Analysis Period (min)		15				

HCM Unsigned Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2040 Saturday Total Traffic
Unsigned - With Improvements

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	92	77	99	636	857	154
Future Volume (Veh/h)	92	77	99	636	857	154
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	100	84	108	691	932	167
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1839	932	1099			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1839	932	1099			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	0	74	83			
cM capacity (veh/h)	69	323	635			
Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	100	84	108	691	932	167
Volume Left	100	0	108	0	0	0
Volume Right	0	84	0	0	0	167
cSH	69	323	635	1700	1700	1700
Volume to Capacity	1.45	0.26	0.17	0.41	0.55	0.10
Queue Length 95th (m)	63.6	7.7	4.6	0.0	0.0	0.0
Control Delay (s)	369.9	20.0	11.8	0.0	0.0	0.0
Lane LOS	F	C	B			
Approach Delay (s)	210.1		1.6		0.0	
Approach LOS	F					
Intersection Summary						
Average Delay			19.2			
Intersection Capacity Utilization		65.7%		ICU Level of Service		C
Analysis Period (min)		15				

Timings
2: Colborne St/Sunset Rd & Warren St

2028 SAT Total Traffic
Signalized - With Improvements

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↑ ↗	↗ ↘	↖ ↗	↑ ↗	↑ ↗	↗ ↘
Traffic Volume (vph)	88	69	90	491	694	146
Future Volume (vph)	88	69	90	491	694	146
Turn Type	Prot	Perm	pm+pt	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases			4	2		6
Detector Phase	4	4	5	2	6	6
Switch Phase						
Minimum Initial (s)	7.0	7.0	5.0	5.0	5.0	5.0
Minimum Split (s)	13.0	13.0	11.0	11.0	11.0	11.0
Total Split (s)	13.0	13.0	11.0	47.0	36.0	36.0
Total Split (%)	21.7%	21.7%	18.3%	78.3%	60.0%	60.0%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	Lag
Lead-Lag Optimize?			Yes		Yes	Yes
Recall Mode	None	None	Min	Min	Min	Min
Act Effect Green (s)	7.6	7.6	38.4	38.4	24.8	24.8
Actuated g/C Ratio	0.15	0.15	0.74	0.74	0.48	0.48
v/c Ratio	0.37	0.25	0.24	0.38	0.84	0.19
Control Delay	28.9	9.7	4.1	5.0	23.2	2.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.9	9.7	4.1	5.0	23.2	2.4
LOS	C	A	A	A	C	A
Approach Delay	20.5			4.8	19.6	
Approach LOS	C			A	B	

Intersection Summary

Cycle Length: 60

Actuated Cycle Length: 52.1

Natural Cycle: 60

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.84

Intersection Signal Delay: 14.2

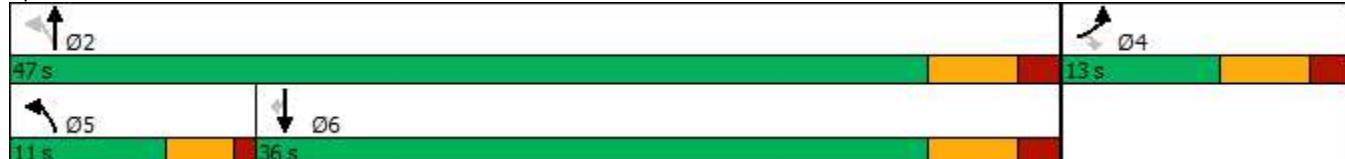
Intersection LOS: B

Intersection Capacity Utilization 60.7%

ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 2: Colborne St/Sunset Rd & Warren St



Queues
2: Colborne St/Sunset Rd & Warren St

2028 SAT Total Traffic
Signalized - With Improvements



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	96	75	98	534	754	159
v/c Ratio	0.37	0.25	0.24	0.38	0.84	0.19
Control Delay	28.9	9.7	4.1	5.0	23.2	2.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.9	9.7	4.1	5.0	23.2	2.4
Queue Length 50th (m)	9.9	0.0	2.4	20.5	63.8	0.1
Queue Length 95th (m)	22.3	9.7	5.3	33.9	#123.8	7.2
Internal Link Dist (m)	392.2			65.6	88.3	
Turn Bay Length (m)	40.0		40.0			40.0
Base Capacity (vph)	262	298	421	1441	1155	1043
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	0.37	0.25	0.23	0.37	0.65	0.15

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2028 SAT Total Traffic
Signalized - With Improvements

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↑ ↗	↑ ↗	↑ ↗	↑ ↗	↑ ↗	↑ ↗
Traffic Volume (vph)	88	69	90	491	694	146
Future Volume (vph)	88	69	90	491	694	146
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	4.0	6.0	6.0	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	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1789	1601	1789	1883	1883	1601
Flt Permitted	0.95	1.00	0.14	1.00	1.00	1.00
Satd. Flow (perm)	1789	1601	270	1883	1883	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	96	75	98	534	754	159
RTOR Reduction (vph)	0	68	0	0	0	83
Lane Group Flow (vph)	96	7	98	534	754	76
Turn Type	Prot	Perm	pm+pt	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2		6	
Actuated Green, G (s)	5.0	5.0	36.2	36.2	25.2	25.2
Effective Green, g (s)	5.0	5.0	36.2	36.2	25.2	25.2
Actuated g/C Ratio	0.09	0.09	0.68	0.68	0.47	0.47
Clearance Time (s)	6.0	6.0	4.0	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)	168	150	383	1281	891	758
v/s Ratio Prot	c0.05		0.03	c0.28	c0.40	
v/s Ratio Perm		0.00	0.14		0.05	
v/c Ratio	0.57	0.05	0.26	0.42	0.85	0.10
Uniform Delay, d1	23.1	21.9	6.5	3.8	12.3	7.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.6	0.1	0.4	0.2	7.5	0.1
Delay (s)	27.7	22.1	6.8	4.0	19.8	7.8
Level of Service	C	C	A	A	B	A
Approach Delay (s)	25.2			4.4	17.7	
Approach LOS	C			A	B	
Intersection Summary						
HCM 2000 Control Delay			13.6	HCM 2000 Level of Service		B
HCM 2000 Volume to Capacity ratio			0.74			
Actuated Cycle Length (s)			53.2	Sum of lost time (s)		16.0
Intersection Capacity Utilization			60.7%	ICU Level of Service		B
Analysis Period (min)			15			

c Critical Lane Group

Timings
2: Colborne St/Sunset Rd & Warren St

2040 SAT Total Traffic
Signalized - With Improvements



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↑ ↗	↗ ↘	↖ ↗	↑ ↗	↑ ↗	↗ ↘
Traffic Volume (vph)	92	77	99	636	857	154
Future Volume (vph)	92	77	99	636	857	154
Turn Type	Prot	Perm	pm+pt	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases			4	2		6
Detector Phase	4	4	5	2	6	6
Switch Phase						
Minimum Initial (s)	7.0	7.0	5.0	5.0	5.0	5.0
Minimum Split (s)	13.0	13.0	11.0	11.0	11.0	11.0
Total Split (s)	13.0	13.0	11.0	77.0	66.0	66.0
Total Split (%)	14.4%	14.4%	12.2%	85.6%	73.3%	73.3%
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	4.0	6.0	6.0	6.0
Lead/Lag			Lead		Lag	Lag
Lead-Lag Optimize?			Yes		Yes	Yes
Recall Mode	None	None	Min	Min	Min	Min
Act Effect Green (s)	7.5	7.5	54.0	53.8	40.3	40.3
Actuated g/C Ratio	0.11	0.11	0.80	0.79	0.59	0.59
v/c Ratio	0.51	0.33	0.32	0.46	0.83	0.17
Control Delay	45.5	13.5	4.5	4.6	19.3	2.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	45.5	13.5	4.5	4.6	19.3	2.2
LOS	D	B	A	A	B	A
Approach Delay	30.9			4.6	16.7	
Approach LOS	C			A	B	

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 67.9

Natural Cycle: 65

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.83

Intersection Signal Delay: 13.3

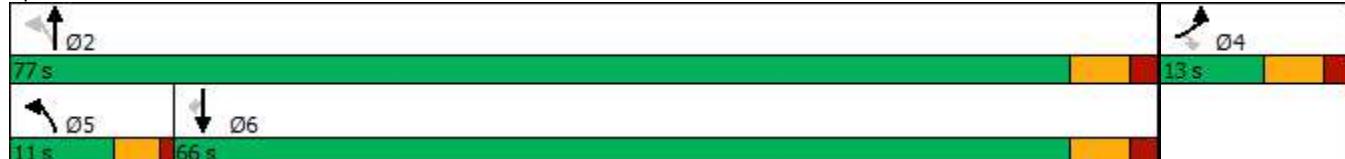
Intersection LOS: B

Intersection Capacity Utilization 69.8%

ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 2: Colborne St/Sunset Rd & Warren St



Queues
2: Colborne St/Sunset Rd & Warren St

2040 SAT Total Traffic
Signalized - With Improvements



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	100	84	108	691	932	167
v/c Ratio	0.51	0.33	0.32	0.46	0.83	0.17
Control Delay	45.5	13.5	4.5	4.6	19.3	2.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	45.5	13.5	4.5	4.6	19.3	2.2
Queue Length 50th (m)	12.5	0.0	2.7	30.1	93.8	1.7
Queue Length 95th (m)	#41.6	13.2	5.1	44.3	141.9	7.5
Internal Link Dist (m)	392.2			65.6	88.3	
Turn Bay Length (m)	40.0		40.0			40.0
Base Capacity (vph)	198	252	347	1770	1608	1387
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	0.51	0.33	0.31	0.39	0.58	0.12

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
2: Colborne St/Sunset Rd & Warren St

2040 SAT Total Traffic
Signalized - With Improvements

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↑	↑	↑	↑	↑	↑
Traffic Volume (vph)	92	77	99	636	857	154
Future Volume (vph)	92	77	99	636	857	154
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	4.0	6.0	6.0	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	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1789	1601	1789	1883	1883	1601
Flt Permitted	0.95	1.00	0.12	1.00	1.00	1.00
Satd. Flow (perm)	1789	1601	218	1883	1883	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	100	84	108	691	932	167
RTOR Reduction (vph)	0	78	0	0	0	56
Lane Group Flow (vph)	100	6	108	691	932	111
Turn Type	Prot	Perm	pm+pt	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2		6	
Actuated Green, G (s)	5.2	5.2	51.8	51.8	40.6	40.6
Effective Green, g (s)	5.2	5.2	51.8	51.8	40.6	40.6
Actuated g/C Ratio	0.08	0.08	0.75	0.75	0.59	0.59
Clearance Time (s)	6.0	6.0	4.0	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)	134	120	327	1413	1107	942
v/s Ratio Prot	c0.06		0.03	c0.37	c0.49	
v/s Ratio Perm		0.00	0.21		0.07	
v/c Ratio	0.75	0.05	0.33	0.49	0.84	0.12
Uniform Delay, d1	31.3	29.6	9.4	3.4	11.6	6.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	20.0	0.2	0.6	0.3	5.9	0.1
Delay (s)	51.3	29.8	10.0	3.7	17.5	6.3
Level of Service	D	C	B	A	B	A
Approach Delay (s)	41.5			4.5	15.8	
Approach LOS	D			A	B	
Intersection Summary						
HCM 2000 Control Delay			13.8	HCM 2000 Level of Service		B
HCM 2000 Volume to Capacity ratio			0.80			
Actuated Cycle Length (s)			69.0	Sum of lost time (s)		16.0
Intersection Capacity Utilization			69.8%	ICU Level of Service		C
Analysis Period (min)			15			
c Critical Lane Group						

