TRANSPORTATION ASSESSMENT REPORT

Montrose Road (Regional Road 98) and
Lyons Creek Road (Regional Road 47)/Biggar Road

Municipal Class Environmental Assessment and Detailed Design

November 2021

Prepared For: Region of Niagara

Prepared By:

Imran Salam, P.Eng. PMP
Senior Transportation Engineer

Matthew Di Maria, C. Tech.
Traffic Technologist

Reviewed By:

Altaf Hussain, P.Eng.
Principal, Transportation Engineer

Version	Date	Description
1	November 2020	Draft for Review
2	January 2021	Revised Draft for Review
3	February 2021	Final Draft
4	November 2021	Final Report

Table of Contents

1 Introduction 1

1.1 Project Description 1

1.2 Planning Context 2

1.3 Study Objectives 2

1.4 Assumptions and Analysis Methodologies 2

1.4.1 Transportation Impact Study Guidelines 4

2 Existing and Future Conditions 4

2.1 Transit Networks 4

2.2 Active Transportation Network 5

2.3 Road Network 6

2.4 Parking 9

2.5 Review of Speed Study Data 9

2.5.1 Montrose Road 9

2.5.2 Lyons Creek Road 9

2.6 Traffic Data 9

2.7 Land Uses, Major Trip Generators and Planned Developments 10

2.8 Traffic Forecasts 11

2.9 Roadway Corridor Capacity Analysis 12

2.9.1 Montrose Road 12

2.9.2 Lyons Creek Road & Biggar Road 13

2.10 Intersection Capacity Analysis 14

2.10.1 Signalized Intersections 14

2.10.2 Unsignalized IntersEctions 16

3 Functional Traffic Design 17

3.1 Roadway Corridor Capacity 17

3.1.1 Montrose Road 17

3.1.2 Lyons Creek Road/Biggar Road 18

3.2 CPR Crossing Warrant Calculations 19

3.3 Intersection Control Assessment 20

3.3.1 Signal Warrant Analysis 20

3.3.2 Roundabout Feasibility 21

3.4 Left Turn Lane Warrant Analysis 30

3.5 Proposed Functional Design 30

3.5.1 Preliminary Traffic Analysis 30

3.5.2 Detailed Traffic Analysis 35
3.6 Summary of Analysis Conclusions 43
4 Conclusions & Recommendations 47
4.1 Analysis Conclusions 47
4.1.1 Road Widening 47
4.1.2 Intersection Control 47
4.1.3 Intersection Spacing and Configuration 48
4.2 Recommended Improvements 48
4.2.1 Road Widening 48
4.2.2 Intersection Improvements 48

LIST OF FIGURES

Figure 1-1. Montrose Road Transportation Assessment Study Area 1
Figure 2-1. Niagara Region Transit Route Map 5
Figure 2-2. Strategic Cycling Network - Niagara Region TMP 6
Figure 2-3. Existing and Planned Road Network 8
Figure 2-4. Schedule A – Future Land Use - Niagara Falls Official Plan 11
Figure 3-1. Montrose Road & Lyons Creek/Biggar Road Intersection – Roundabout Traffic Volumes 22
Figure 3-2. Montrose Road & Lyons Creek Road/Biggar Road Roundabout Intersection – SIDRA Lane Level of Service Plot 23
Figure 3-3. Lyons Creek/Biggar Road & QEW FEB Off-ramp Intersection – Roundabout Traffic Volumes 24
Figure 3-4. Lyons Creek Road & QEW FEB Off-ramp Roundabout Intersection – SIDRA Lane Level of Service Plot 25
Figure 3-5. Lyons Creek/Biggar Road & QEW TB Off-ramp Intersection – Roundabout Traffic Volumes 26
Figure 3-6. Lyons Creek Road & QEW TB Off-ramp Roundabout Intersection – SIDRA Lane Level of Service Plot 27
Figure 3-7. Montrose Road & Niagara Square Entrance Intersection – Roundabout Traffic Volumes 28
Figure 3-8. Montrose Road & Niagara Square Entrance, 2-Lane Roundabout Intersection – SIDRA Lane Level of Service Plot 28
Figure 3-9. Montrose Road & Niagara Square Entrance, Spiral Roundabout Intersection – SIDRA Lane Level of Service Plot 29
Figure 3-10. Preliminary Future lane Configurations and Intersection Control 31
Figure 3-11: Preliminary Draft Design of QEW Ramp Terminal Roundabouts 35
Figure 3-12: Scenario – 1; Channelized QEW Ramp with Auxiliary Westbound Lane (for FEB) Along Lyons Creek Road 37
Figure 3-13: Scenario – 2; Classic T-Intersection QEW Ramps with Auxiliary Westbound Lane (for FEB) Along Lyons Creek Road 37
Figure 3-14: Scenario – 3; T-Intersection QEW Ramps without Auxiliary Westbound Lane (for FEB) Along Lyons Creek Road 38
Figure 3-15: Lyons Creek Road & Willodell Road Intersection – Preferred Design 41
Figure 3-16: Preferred Traffic Controls – McLeod Road to Canadian Drive Segment 42
Figure 3-17: Future lane Configuration – Revised Functional Requirements 46

LIST OF TABLES

Table 1-1. Signalized Intersection Level of Service Characteristics 3
Table 1-2. Unsignalized Intersection Level of Service Characteristics 3
Table 1-3. Lane Capacity Level of Service Characteristics 4
Table 2-1. Intersection Turning Movement Counts – Count Dates and Sources 10
Table 2-2. Montrose Road–Midblock Road capacity analysis, AM Peak Hour 12
Table 2-3. Montrose Road – Midblock Road capacity analysis, PM Peak Hour 13
Table 2-4. Lyons Creek Road/Biggar Road – Midblock Road capacity analysis, AM Peak Hour 14
Table 2-5. Lyons Creek Road/Biggar Road – Midblock Road capacity analysis, PM Peak Hour 14
Table 2-6. Signalized Intersection Capacity Analysis – Existing (2019) and Future (2026 & 2041) Do Nothing Conditions 15
Table 2-7. Unsignalized Intersection Capacity Analysis – Existing 2019 and Future (2026 & 2041) Do Nothing Conditions 16
Table 3-1. Montrose Road Capacity Analysis – 2026 & 2041 Proposed Lane Configuration 18
Table 3-2. Lyons Creek Road/Biggar Road Capacity Analysis – 2026 & 2041 Proposed Lane Configurations 19
Table 3-3: CPR Track Grade Separation Warrant Calculations 19
Table 3-4. Signal Warrant Analysis 20
Table 3-5. Volume Thresholds for Determining the Number of Entry Lanes Required 21
Table 3-6. Left Turn Lane Warrant analysis Summary 30
Table 3-7. Signalized Intersection Capacity Analysis –Future (2026 & 2041) Conditions with Improvements 32
Table 3-8. Unsignalized Intersection Capacity Analysis – Future (2026 & 2041) Conditions with Improvements 34
Table 3-9: QEW Ramp Terminals Roundabout Intersections – ARCADY analysis 2041 Traffic Conditions 36
Table 3-10: Scenario 3 - Summary of SimTraffic Analysis 39
Table 3-11: Summary of SimTraffic Analysis – QEW TB Off-ramp Signalized 40
Table 3-12: Right in/Right out/Left in Willowdel Intersection - Sensitivity Analysis WBL Queue Comparison 42
Table 3-13: Niagara Square Drive Roundabout - ARCADY Analysis 43
Table 3-14: Montrose Road and Canadian Drive Intersection - SimTraffic Analysis 43
Table 4-1: Recommended Road Widening 48
Table 4-2: Recommended Intersection Improvements 49

LIST OF APPENDICES

Appendix A – Speed Studies Reports
Appendix B – Existing (2019) Raw Traffic Volumes and Balanced Volumes
Appendix B – Existing (2019) Raw Traffic Volumes and Balanced Volumes
Appendix C – Signal Timings Plans
Appendix D – Future (2026 and 2041) Traffic Forecasts
Appendix E – Synchro Reports, Existing (2019) Conditions, 2026 & 2041 Do Nothing Conditions
Appendix F – Signal Warrants Analysis
Appendix G – Roundabout Feasibility, SIDRA LOS, Lane Use and Performance Reports
Appendix H – Left Turn Lane Warrants
Appendix I – Synchro Reports, Future (2026 and 2041) Conditions with Improvements
Appendix J – Technical Memorandum, ARCADY Analysis of Roundabouts at the QEW Terminals
Appendix K – Response to MTO Comments on Draft DTA Version 3
Appendix L – ARCADY Analysis of Niagara Square Drive Roundabout

1 Introduction

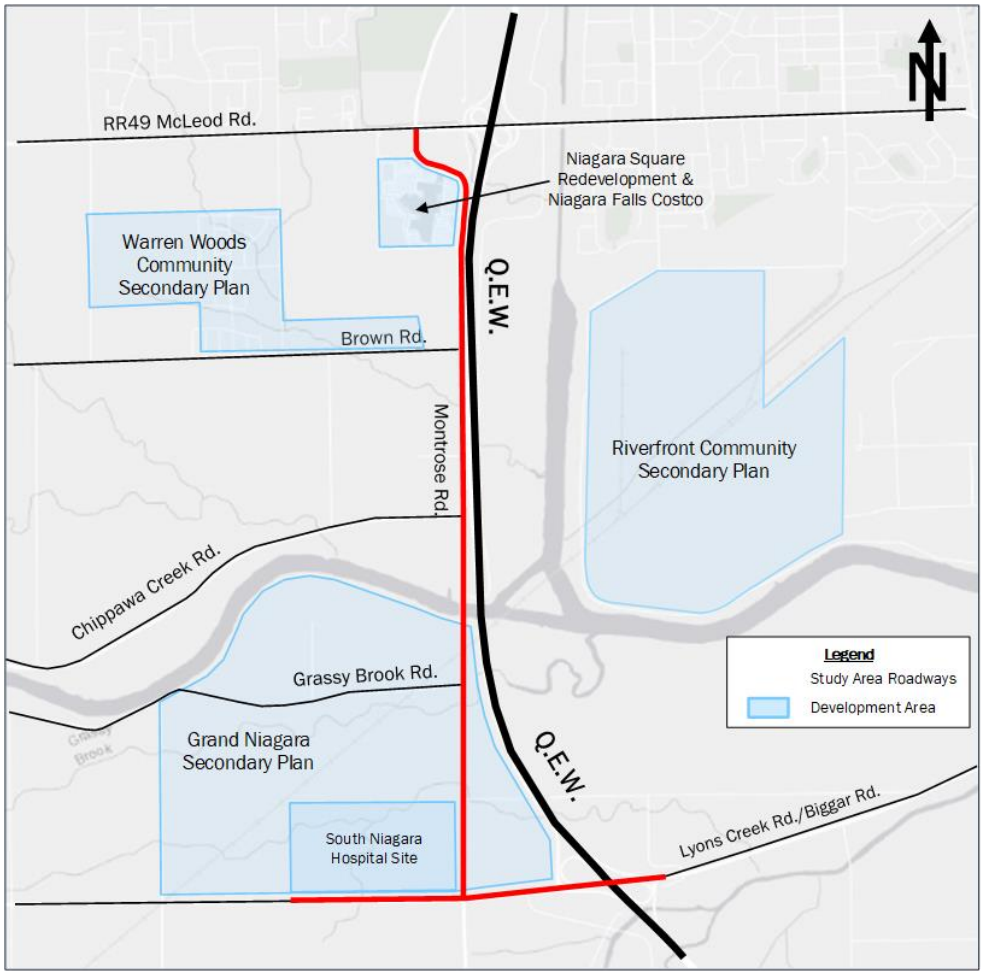
1.1 Project Description

Parsons has been retained by Niagara Region (the Region) to complete a Schedule C Municipal Class Environmental Assessment (MCEA) Study, Preliminary and Detailed Design, and Contract Document Preparation for Regional Road 98 (Montrose Road) and Regional Road 47 (Lyons Creek Road/Biggar Road, in the City of Niagara Falls.

A Detailed Transportation Assessment (DTA) is needed to identify suitable transportation and municipal infrastructure solutions for the study area to service significant development planned over the coming years, including the South Niagara Hospital Site (SNH), the Niagara Square Redevelopment and Niagara Falls Costco, the Grand Niagara Secondary Plan (GNSP) and the Riverfront Community Secondary Plan. The project study area is presented in **Figure 1-1**.

Version 1 (November 2020) of the draft report was based on the traffic impact assessment of GNSP completed in January 2017, and the SNH traffic assessment completed in December 2019. A revised SNH traffic assessment was completed in December 2020. Niagara Region had directed to update the Version 1 to reflect the changes in the revised GNSP and SNH traffic assessments. All subsequent revisions present the revised analyses and traffic design accordingly.

FIGURE 1-1. MONTROSE ROAD TRANSPORTATION ASSESSMENT STUDY AREA



1.2 Planning Context

The Montrose Road and Lyons Creek Road / Biggar Road Municipal Class Environmental Assessment (MCEA) is supported by planning policies at the provincial, regional, and local level. Provincial Plans, specifically the Provincial Policy Statement and A Place to Grow: The Growth Plan for the Greater Golden Horseshoe, provide direction and guidance on land use planning issues, including where and how to direct and manage growth to support communities. At the regional level, the Region's Official Plan (OP), Transportation Master Plan (TMP), How We Go, and the Region's growth plan, How We Grow, were reviewed to understand the Region's vision, and plans for the study area. The OP provides direction on managing growth and land use. The TMP sets out the strategic vision for transportation in the Niagara Region over the next 25 years, including recommended road improvements and guidance on the function of various roadways. The study area is in the City of Niagara Falls, therefore local plans also play a role in shaping the area's transportation infrastructure. In particular, the City of Niagara Falls Official Plan and the Grand Niagara Secondary Plan, at the southern end of the study area, outline the City's planning vision and development plans.

1.3 Study Objectives

The study objectives as part of this DTA include:

- Review the existing (2019) transportation infrastructure conditions and identify the capacity and operational deficiencies.
- Develop traffic forecasts through ground-up approach incorporating the future travel demand sourced from the respective traffic impact studies (TIS) completed for the various planned developments within the study area.
- Consolidate the travel demand from the respective TISs ensuring consistency of assumptions related to trip generations, distribution, and assignment.
- Conduct a sensitivity analysis for the impact of visitors'/patients' hospital trips on the QEW ramp terminals at the Lyons Creek Road interchange.
- Conduct roadway corridor capacity analysis for the (2026) and (2041) horizons to determine future widening requirements along the Montrose Road and the Lyons Creek Road segments within the study area.
- Undertake operational analyses for the future (2026) and (2041) horizon years and provide the recommended lane configurations for the study area intersections including storage lane lengths for auxiliary lanes.
- Evaluate the implementation of a roundabout control option at the Montrose Road & Lyons Creek Road/Biggar Road intersection, Lyons Creek Road & QEW Southbound off-ramp intersection and Lyons Creek Road & QEW Northbound off-ramp intersection.

1.4 Assumptions and Analysis Methodologies

The traffic analysis conducted for this study considers the capacity and level of service for intersections. Intersections were analyzed using the procedures of the Highway Capacity Manual (HCM) methodologies for signalized and unsignalized intersections, as implemented in the Synchro / SimTraffic 10 software developed by Trafficware.

Level of Service (LOS) can be characterized for each intersection approach and each lane group. Control delay alone is used to characterize LOS for the entire intersection or an approach. Control delay and volume-to-capacity (V/C) ratio are used to characterize LOS for a lane group. Delay quantifies the variations in travel time due to traffic signal control. It is also a surrogate measure of driver discomfort and fuel consumption. The volume-to-capacity (V/C) ratio quantifies the degree to which the capacity of each signal phase is utilized by a defined lane group. **Table 1-1** summarizes the characteristics of each level of service at signalized intersections.

TABLE 1-1. SIGNALIZED INTERSECTION LEVEL OF SERVICE CHARACTERISTICS

Level Service	Features	Control delay (sec/veh)
A	Describes operations with very low control delay, up to 10 seconds / vehicle. This level of service occurs when progression is extremely favorable, and most vehicles arrive during the green phase. Most vehicles do not stop at all at this LOS. Short cycle lengths may also contribute to low delay.	≤ 10
B	Describes operations with control delay greater than 10 seconds and up to 20 seconds /vehicle. This level generally occurs with good progression, short cycle lengths, or both. More vehicles stop at this level than at LOS A, causing longer average delays.	> 10 to 20
C	Describes operations with control delay greater than 20 seconds and up to 35 seconds/vehicle. These higher delays may result from fair progression, longer cycle lengths, or both. Individual cycle failures may begin to appear at this level. The number of vehicles stopping is significant, though many still pass through the intersection without stopping.	> 20 to 35
D	Describes operations with control delay greater than 35 seconds and up to 55 seconds/vehicle. At level D, the influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavourable progression, long cycle lengths, or high V/C ratios. Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures become noticeable.	> 35 to 55
E	Describes operations with control delay greater than 55 seconds and up to 80 seconds/vehicle. This level is considered by many agencies to be the limit of acceptable delay. These high delay values generally indicate poor progression, long cycle lengths, and high V/C ratios. Individual cycle failures are frequent occurrences.	> 55 to 80
F	LOS F describes operations with control delay in excess of 80 seconds/vehicle. This oversaturation, considered to be unacceptable to most drivers, occurs when arrival flow rates exceed the design capacity of the intersection. It may also occur at high V/C ratios below 1.0 with many individual cycle failures. Poor progression and long cycle lengths may also be major contributing factors to such high delay levels.	> 80

Source: Highway Capacity Manual (HCM) 2000

The LOS criteria for unsignalized intersections are somewhat different from the criteria for signalized intersections because the perceptions of facility users differ. The expectation is that a signalized intersection is designed to carry higher traffic volumes and will present greater delay than an unsignalized intersection. Unsignalized intersections are also associated with more uncertainty for users, as delays are less predictable than at signalized junctions. This uncertainty can reduce driver's delay tolerance. Table 1-2 summarizes the characteristics of each level of service at unsignalized intersections.

TABLE 1-2. UNSIGNALIZED INTERSECTION LEVEL OF SERVICE CHARACTERISTICS

Level of Service	Expected Delay to Minor Street Traffic	Average Control Delay 'd' (sec/veh)
A	Little or no delays	0 ≤ 10
B	Short traffic delays	10 ≤ 15
C	Average traffic delays	15 ≤ 25
D	Long traffic delays	25 ≤ 35
E	Very long traffic delays	35 ≤ 50

Level of Service	Expected Delay to Minor Street Traffic	Average Control Delay 'd' (sec/veh)
F	Extreme delays with queuing which may cause congestion affecting other traffic movements in the intersection	> 50

Source: Highway Capacity Manual (HCM) 2000

Roadway corridor operations are generally assessed based on the lane capacity analysis. Lane capacity analysis at the mid-block sections are based on the ratio of the link volume and theoretical lane capacity (V/C). Table 1-3 shows planning level corridor LOS based on estimated V/C values.

TABLE 1-3. LANE CAPACITY LEVEL OF SERVICE CHARACTERISTICS

Volumes to Capacity Ratios (V/C)	LOS	General Conditions
< 0.75	A to C	Stable flows with acceptable delays
0.75 < 0.85	D	Approaching unstable flows and tolerable delays
0.85 < 1.00	E	Unstable flows and intolerable delays
≥ 1.00	F	Forced flows and significant delays

1.4.1 TRANSPORTATION IMPACT STUDY GUIDELINES

Based on the Niagara Region Guidelines for Transportation Impact Studies, May 2012, and the Ministry of Transportation Ontario (MTO) Traffic Impact Study Guidelines, September 2014, the following parameters were utilized within our analysis and to report the critical movements potentially requiring improvements:

Traffic Analysis Software Settings

- Saturation Flow Rate: 1,750 vphpl
- Total Lost Time: 4 seconds
- Peak Hour Factor: 0.92

Operational Analysis (Signalized and Unsignalized Intersections)

- A volume to capacity ratio greater than 0.85 for through, through and right and right-turn movements
- A volume to capacity ratio greater than 0.90 for dedicated left-turn movements
- A volume to capacity ratio greater than 0.75 for ramp terminal approaches
- Movements expected to operate at LOS "D" or worse or where the estimated 95th percentile queues exceed storage capacity

2 Existing and Future Conditions

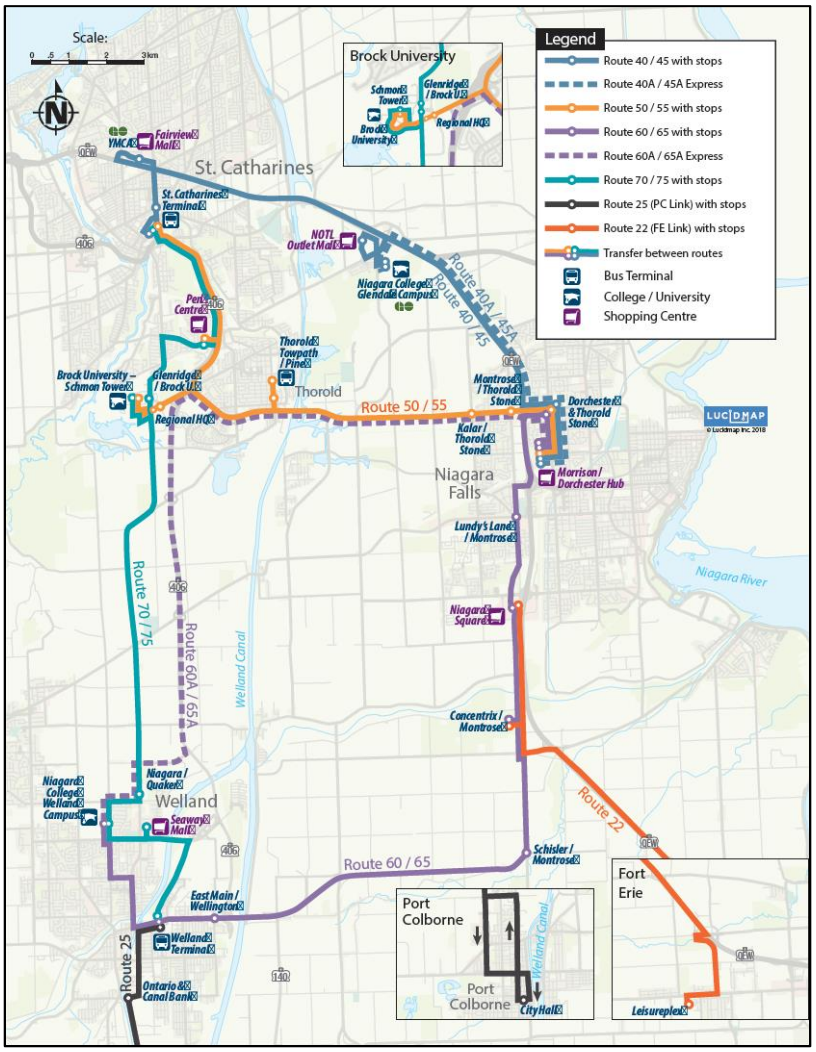
2.1 Transit Networks

Within the study area there are two transit routes which run along Montrose Road and Lyons Creek Road/Biggar Road. Both routes are part of the Niagara Region transit service which connects major hubs like bus terminals, shopping centres and college/universities between the municipalities in the Niagara Region. The first route, 60/65 runs along

Montrose Road and connects major hubs between Niagara Falls and Welland. There are two stops for this route along Montrose Road including a stop at Niagara Square and a stop at the Concentrix, Arrow Games and Bazaar & Novelty building. The second route, known as Route 22 begins at Niagara Square and runs along Montrose Road to Lyons Creek Road to the Queen Elizabeth Way and terminates at the Leisureplex in Fort Erie. Both routes run Monday to Saturday with no operation on Sundays and departure times run on an hourly schedule. The Niagara Region Transit Route Map presenting the routes is shown on **Figure 2-1**.

Currently, the City of Niagara Falls Transit service only operates routes along Montrose Road as far south as the Niagara Square Inter-Municipal Transit terminal located on Canadian Drive and operates no routes along Lyons Creek Road.

FIGURE 2-1. NIAGARA REGION TRANSIT ROUTE MAP



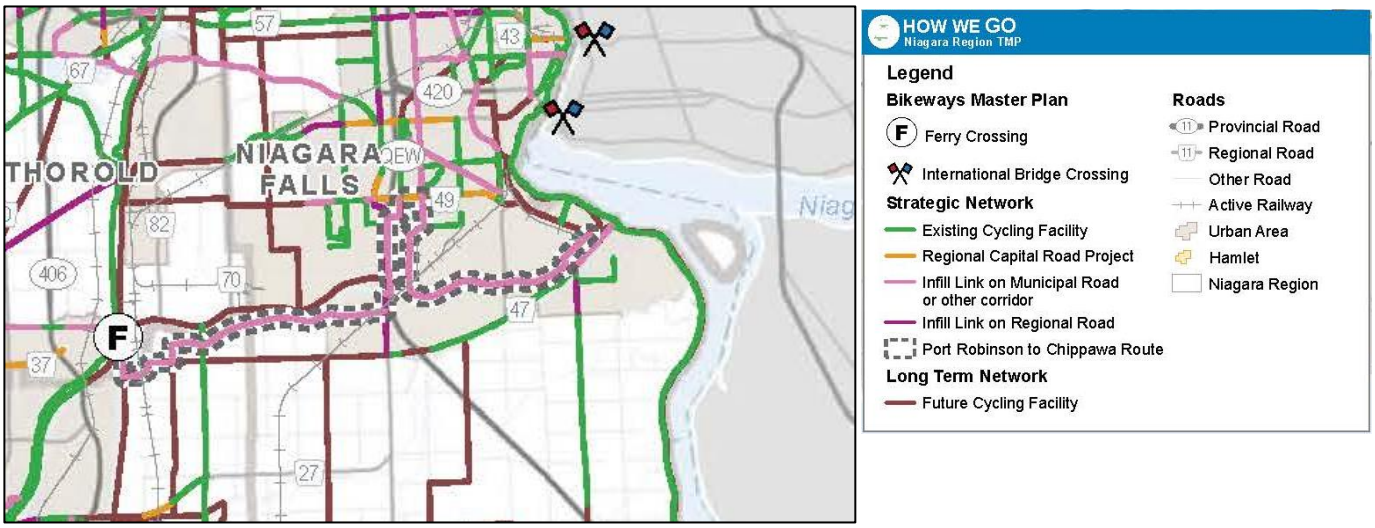
2.2 Active Transportation Network

None of the study roads have sidewalks and bike lanes except the section of Montrose Road adjacent to Niagara Square which has a 1.2m sidewalk along west side of the road. The Niagara Region TMP identifies Montrose Road as an 'infill link' to improve connections to other network facilities.

A short 500 metre section of Montrose Road between Oakwood Drive and Grassy Brook Road has been identified as part of the Port Robinson to Chippawa Route previously outlined in the Regional Bicycle Master Plan Network. Within the Strategic Cycling Network Development Technical Paper as part of the TMP, the facility type identified for Montrose Road from McLeod Road to Canadian Drive is a multi-use trail while from Canadian Drive to Lyons Creek Road/Biggar Road is classified as a paved shoulder.

The sections of Lyons Creek Road east of Montrose Road and Biggar Road west of Montrose Road are identified as future cycling facilities in the Niagara Region TMP, however, the type of facility is not identified. The cycling facilities for the Transportation Assessment study area as presented in the Niagara Region TMP are shown in **Figure 2-2**.

FIGURE 2-2. STRATEGIC CYCLING NETWORK - NIAGARA REGION TMP



A separate memorandum (not included with this report) discusses the future active transportation alternatives along the study corridor. Recommendations from that memo will be incorporated into the preliminary design.

2.3 Road Network

<u>Montrose Road</u>

Montrose Road between McLeod Road and the entrance to Niagara Square is currently a four-lane divided arterial roadway with an urban cross-section and posted speed limit of 50 km/hr. The section of Montrose Road from south of the entrance to Niagara Square to Lyons Creek Road/Biggar Road is currently an undivided two-lane arterial road with a rural cross-section. The posted speed limit along the roadway between Canadian Drive and Chippawa Creek Road is 60 km/hr which transitions to 70 km/hr south of Chippawa Creek Road and finally transitions to 80 km/hr south of Reixinger Road to Lyons Creek Road/Biggar Road. Between Niagara Square Drive and Oakwood Drive, Montrose Road immediately abuts and parallels the QEW provincial freeway. There is an at-grade Canadian Pacific Rail (CPR) crossing approximately 180 m north of Grassy Brook Road. According to the information provided by CPR, the track is non-mainline with a speed of 10 mph having up to two trains per day in both directions.

<u>McLeod Road</u>

McLeod Road is an east-west arterial road with a six-lane divided roadway to the east of Montrose Road and four-lane divided roadway to the west of Montrose Road. McLeod Road has an urban cross-section and the posted speed limit is 50 km/hr. Immediately east of McLeod Road's intersection with Montrose Road, there is a Parclo A-4 interchange with the QEW allowing turning movements in all directions between McLeod Road and the QEW.

Niagara Square Drive

A one-way (southbound only) local roadway that consists of both an urban (west side) and rural cross-section (east side), Niagara Square Drive is a two-lane roadway and although not posted, is assumed to have a speed limit of 50km/hr. Niagara Square Drive extends immediately south of the QEW/McLeod Road S-E/W off ramp and connects to Montrose Road.

Canadian Drive

Canadian Drive is a two-lane local roadway that connects Montrose Road with Pin Oak Drive which together surround the current Niagara Square property providing multiple access points. Canadian Drive has an urban cross-section and is assumed to have a posted speed of 50 km/hr. A number of bus bays were constructed in 2020 on the north side of Canadian Drive and now form the Niagara Square Inter-Municipal Transit terminal.

Brown Road

Providing access to newly developed residential subdivisions to the west of Montrose Road, Brown Road is a two-lane local roadway which consists of both an urban and rural cross-section profile. The posted speed limit is 60 km/hr.

Chippawa Creek Road

Chippawa Creek Road is a two-lane arterial roadway which runs westerly nearly parallel to the Welland River and connects Montrose Road with the community of Port Robinson to the west of the study area. Consisting of a rural-cross section, Chippawa Creek Road also has a posted speed limit of 50 km/hr.

Oakwood Drive

A two-lane local roadway which runs southerly from McLeod Road along the east side and parallel to the QEW and passes under the QEW connecting with Montrose Road south of Chippawa Creek Road, Oakwood Drive has a posted speed limit of 60 km/hr and a rural cross-section.

Grassy Brook Road

Grassy Brook Road also runs parallel to the Welland River and provides access to the Grand Niagara Golf Club from Montrose Road. Grassy Brook Road is a local roadway with a rural cross-section and a posted speed limit of 40 km/hr. Currently it is a dead-end road and does not connect to other municipal streets.

Reixinger Road

Reixinger Road is a one-lane local roadway with a rural cross-section. Reixinger Road runs east from Montrose Road and ends in a cul-de-sac at the QEW. The speed limit is assumed to be 50 km/hr as there are no posted speed limit signs.

Lyons Creek Road

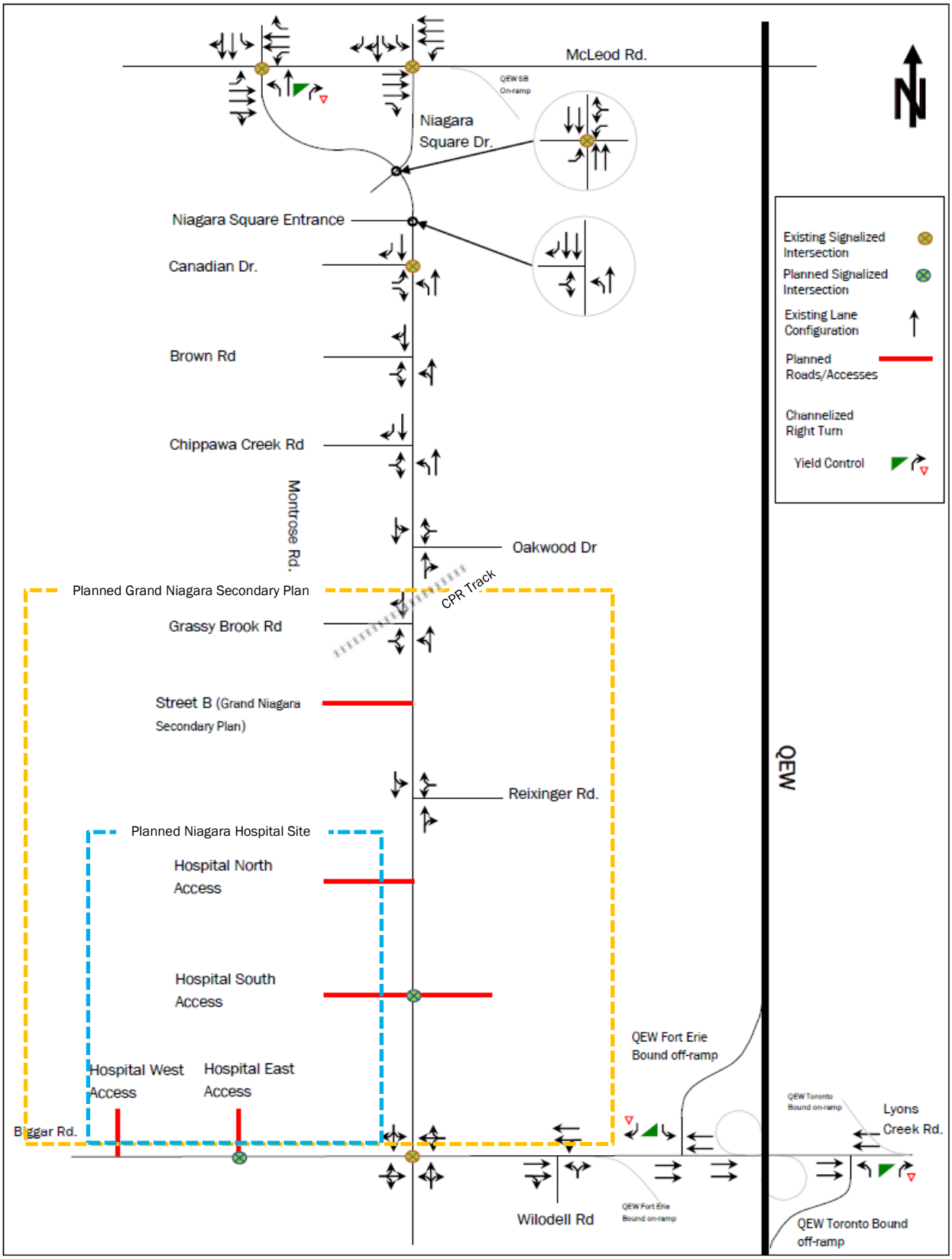
Lyons Creek Road runs east from Montrose Road and is an undivided arterial Niagara Region roadway with a two-lane rural cross section at its approach to the intersection of Montrose Road. East of this intersection, at the interchange with the QEW, Lyons Creek Road widens to a four-lane cross-section. The posted speed along the roadway is 80 km/hr.

Biggar Road

Biggar Road runs west from Montrose Road (continuing westerly from the Lyons Creek Road alignment) and is an undivided local municipal roadway with a two-lane rural cross section. East of this intersection, at the interchange with the QEW, Lyons Creek Road widens to a four-lane cross-section. The posted speed along the roadway is 80 km/hr from Montrose Road to Moyer Road.

Study area intersections, existing lane configurations and planned roads/accesses are presented in **Figure 2-3**.

FIGURE 2-3. EXISTING AND PLANNED ROAD NETWORK



2.4 Parking

There is no parking permitted along Montrose Road and Lyons Creek Road within the study area. It is noted that there are no plans to allow the parking along the Montrose Road and Lyons Creek Road corridors in the future.

2.5 Review of Speed Study Data

The following presents a summary of speed data from the 24-hour automatic traffic recorder studies (ATR) provided by the Niagara Region. The data is included in **Appendix A**.

2.5.1 MONTROSE ROAD

- **Between Canadian Drive and McLeod Road**. The study was conducted in April 2019. Posted speed in this section is 50 km/h. The average of recorded speeds in this segment ranges between 58 – 64 km/h. The study recorded 85-93% of the vehicles exceeding the posted speed of 50 km/h. The 85th percentile speed ranges between 67 – 74 km/h.
- **Between Chippawa Creek Road and Canadian Drive**. The study was conducted in April 2019. Posted speed in this section is 60 km/h. The average of recorded speeds in this segment ranges between 66 – 67 km/h. The study recorded 73-76% of the vehicles exceeding the posted speed of 60 km/h. The 85th percentile speed ranges between 75 – 88 km/h.
- **Between Lyons Creek Road and Chippawa Creek Drive**. The study was conducted in April 2019. Posted speed in this section is 80 km/h. The average of recorded speeds in this segment ranges between 85 – 86 km/h. The study recorded 65-72% of the vehicles exceeding the posted speed of 80 km/h. The 85th percentile speed is 98 km/h.

2.5.2 LYONS CREEK ROAD

- **Between Montrose Road and Stanley Avenue**. The study was conducted in April 2019. Posted speed in this section is 80 km/h. The average of recorded speeds in this segment ranges between 84 – 90 km/h. The study recorded 63-81% of the vehicles exceeding the posted speed of 80 km/h. The 85th percentile speed ranges between 94–103 km/h.

2.6 Traffic Data

Due to the Covid-19 pandemic, traffic demand on roads in 2020 was low and did not represent the normal peak conditions, therefore current counts were not conducted as part of this study. Turning movement counts (TMCs) for the study area intersections were sourced from the respective TISs previously completed for the planned developments. Intersections along with the count dates and the source are listed in **Table 2-1**. QEW ramp terminals with at Lyons Creek Road have been referred in this report as QEW Fort Erie Bound (FEB) off-ramp and QEW Toronto Bound (TB) off-ramp.

Standard industry practice of volume balancing and 1% growth rate referenced from recently completed TISs in the area were employed to update the older than two years counts. Volume balancing was conducted for locations having unjustified volume imbalance greater than 10%.

Turning movement diagrams showing existing raw volumes and existing (2019) balanced (approximately) volumes are provided in **Appendix B**.

Signal timing plans for the signalized intersections were provided by the Niagara Region. These plans are included in **Appendix C**.

TABLE 2-1. INTERSECTION TURNING MOVEMENT COUNTS – COUNT DATES AND SOURCES

Intersection	Source	Count date
Signalized Intersections		
Montrose Road and Lyons Creek Road/Biggar Road	South Niagara Hospital TIS	June 12, 2019
Montrose Road and McLeod Road	Niagara Region	May 29, 2019
Montrose Road and Niagara Square Drive	Niagara Square TIS	November 28, 2018
McLeod Road and Niagara Square Drive		
Unsignalized Intersections		
Montrose Road and Grassy Brook Road	South Niagara Hospital TIS	June 12, 2019
Montrose Road and Oakwood Drive		
Lyons Creek Road and QEW Fort Erie Bound (FEB) off-ramp		
Lyons Creek Road and QEW Toronto Bound (TB) off-ramp		
Montrose Road and Reixinger Road	Estimated*	
Montrose Road and Brown Road		
Montrose Road and Chippawa Creek Road	Grand Niagara Secondary Plan TIS	September 03, 2015
Lyons Creek Road and Willodell Road		September 17, 2015
Montrose Road and Canadian Drive	Niagara Square TIS	November 28, 2018
Montrose Road and Niagara Square Entrance		

* TMCs for Reixinger Road and Brown Road were not available in any of the previous TISs. These were estimated based on the land uses in the vicinity of these intersections using ITE trip generation rates.

2.7 Land Uses, Major Trip Generators and Planned Developments

The existing land uses along Montrose Road and Lyons Creek Road/Biggar Road consist of a mixture of commercial, residential, agriculture, employment and industrial lands. At the north end of the Montrose Road study area, commercial is the predominant land use with the former Niagara Square property which is currently being redeveloped to include a Costco Warehouse store along with existing commercial uses including other big box stores, the Cineplex Odeon Theatre, Mandarin Restaurant and the former Hoops Sports Bar and Grill.

Between Brown Road and Chippawa Creek Road, the existing land uses fronting along Montrose Road are mainly agriculture and employment with the Panoramic Properties and SWS buildings having entrances off Blackburn Parkway. Blackburn Parkway primarily serves as an access for these properties with total two-way trips ranging between 20-40 vehicles during the peak hours. The road currently connects to Heartland Forest Road with a proposed industrial park on both sides. Details about the traffic demand and the timeframe of the industrial park development have not been made available to the study team. As such this DTA does not include any analyses and recommendations for the future

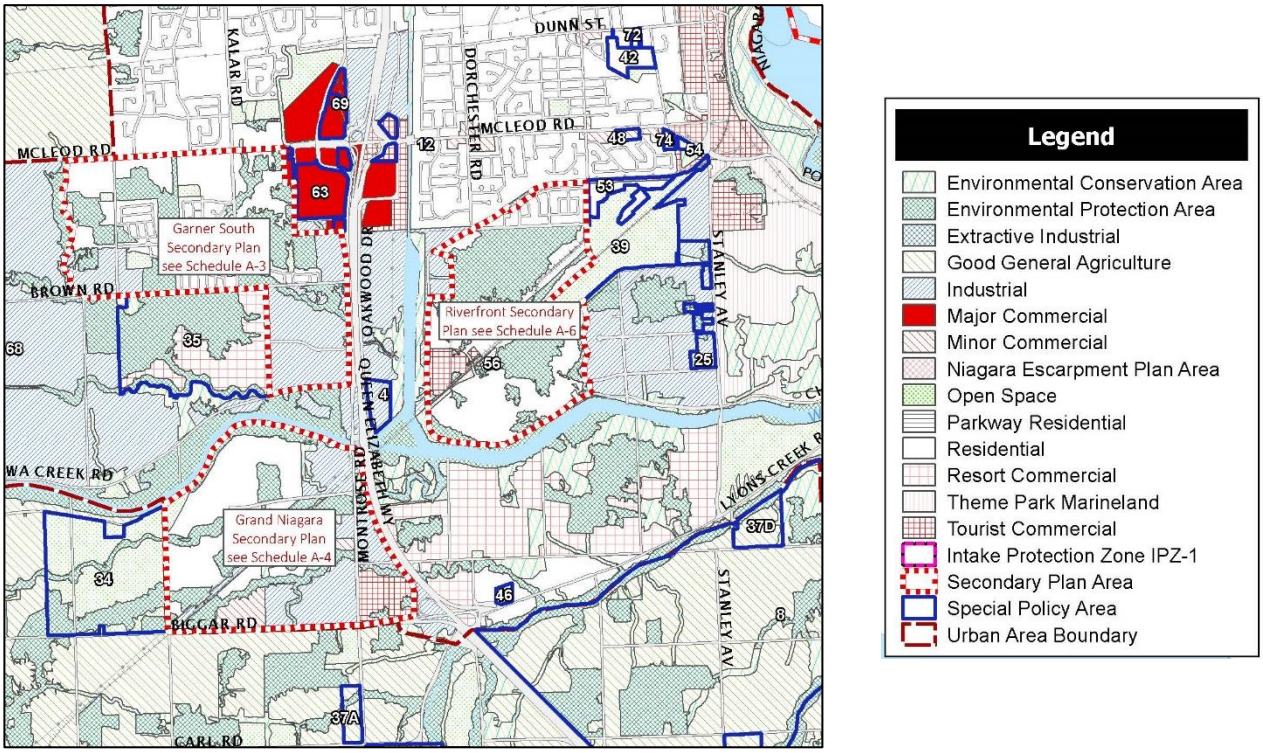
Blackburn Parkway intersection design. We understand that a traffic impact study will be conducted to determine the required transportation infrastructure to support the industrial park development.

Land uses south of Chippawa Creek Road to Lyons Creek Road consist of agriculture and employment with the E.S. Fox, Concentrix, Arrow Games and Bazaar & Novelty buildings plus some industrial uses. This section of Montrose Road is also the location of significant future development related to the South Niagara Hospital and the Grand Niagara Secondary Plan which are to be located in the northwest and northeast corners of Montrose Road and Lyons Creek Road/Biggar Road intersection. These lands have been designated for future development as hospital employment, prestige employment, mixed use, residential low/medium density and environmental/open spaces uses.

Lastly, the section of Lyons Creek Road/Biggar Road within the study area comprises of mainly residential and agricultural land uses.

Figure 2-4 presents the future land uses within the study area as identified in Schedule A of the City of Niagara Falls Official Plan amended April 2019.

FIGURE 2-4. SCHEDULE A – FUTURE LAND USE - NIAGARA FALLS OFFICIAL PLAN



2.8 Traffic Forecasts

Traffic forecasts for 2026 and 2041 horizons were developed through a ground-up approach following the methodology detailed in the forecasting memorandum for the DTA Version 1, included as **Appendix D**. Similar methodology was used to develop the revised forecasts for all the subsequent revisions of this report, as explained below.

- Consistent with the TISs for the planned developments within the study area, 1% compound annual growth rate was applied to the existing TMCs for all movements to estimate future 2026 and 2041 background traffic.
- Traffic demand sourced from the following approved/planned developments' respective TISs was added to the background traffic to develop future total traffic forecasts.

- Niagara Square Redevelopment and Niagara Falls Costco (completed August 2019)
- Grand Niagara Secondary Plan (completed June 2017) – Site volumes without the proposed hospital as shown in Figure 16 and 17 of the TIS.
- South Niagara Hospital (completed December 2020)
- Riverfront Community Secondary Plan (completed 2017)
- Warren Woods Community Secondary Plan (completed August 2014) - 65% built and occupied at the time of the traffic counts consistent with the assumptions in the South Niagara Hospital TIS.

- Full build-out was assumed for all the developments for 2026 horizon except for the Grand Niagara Secondary Plan which was assumed to be 50% complete for 2026 and 100% for 2041.
- The respective TISs of various developments were completed at different points in time; therefore certain refinements were needed to consolidate the traffic demand as explained below:
  - **Niagara Square Redevelopment**: AM trips estimates are not available in the respective TIS. For the DTA, AM trips were estimated using ITE trip generation rates, distributed, and assigned following the distribution determined in the TIS.
  - **Grand Niagara Secondary Plan:** The TIS does not consider the trips interaction with the Niagara Square Mall. The interaction was estimated by BA Group for the revised SNH TIS (December 2020) based on their proprietary data for Costco warehouses. The interaction details have been provided to Parsons through a memorandum included in **Appendix D**. Accordingly, the GNSP trips were deleted from the external network and reassigned to the Montrose Road segment between SHNSP and Niagara Square Mall.

Turning movement diagrams showing future (2026 and 2041) revised traffic forecasts are provided in **Appendix D.**

2.9 Roadway Corridor Capacity Analysis

The following sections discuss the midblock road capacity under existing (2019) and widening requirements under future (2026 and 2041) traffic conditions. For the analysis, capacity of a lane has been assumed to be 850 vehicles per lane per hour. Segments having V/C ratio exceeding 0.85 are deemed to be approaching capacity and hence warrant capacity enhancement and are shown in the red text.

2.9.1 MONTROSE ROAD

Montrose has two lanes per direction from McLeod Road intersection to the Niagara Square Entrance. For the remaining entire length within the study area, Montrose Road has one lane per direction. **Tables 2-2** and **2-3** present the volume to capacity (V/C) ratio comparison under AM and PM peak hour conditions, respectively, for various Montrose Road segments.

Under existing conditions, Montrose Road operates within capacity, however, capacity enhancement/road widening will be required under both 2026 and 2041 conditions to accommodate the traffic from the planned developments in addition to general background traffic growth.

TABLE 2-2. MONTROSE ROAD–MIDBLOCK ROAD CAPACITY ANALYSIS, AM PEAK HOUR

Road Segment		No of Lanes	Capacity	Existing (2019) Conditions				2026 Conditions (Do Nothing)				2041 Conditions (Do Nothing)			
				Traffic Volume		V/C		Traffic Volume		V/C		Traffic Volume		V/C	
From	To			NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
McLeod Rd	Niagara Square Entrance	2	1700	275	219	0.16	0.13	550	523	0.32	0.31	791	744	0.47	0.44
Niagara Square Entrance	Brown Rd	1	850	339	232	0.39	0.27	648	538	0.76	0.63	899	760	1.05	0.89

Road Segment		No of Lanes	Capacity	Existing (2019) Conditions				2026 Conditions (Do Nothing)				2041 Conditions (Do Nothing)			
From	To			Traffic Volume		V/C		Traffic Volume		V/C		Traffic Volume		V/C	
				NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
Brown Rd	Chippawa Creek Rd	1	850	184	203	0.21	0.24	466	508	0.55	0.60	693	725	0.81	0.85
Chippawa Creek Rd	Oakwood Dr	1	850	178	171	0.21	0.20	450	463	0.53	0.54	676	676	0.79	0.79
Oakwood Dr	Grassy Brook Rd	1	850	262	201	0.31	0.24	594	535	0.70	0.63	886	808	1.04	0.95
Grassy Brook Rd	Lyons Creek Rd	1	850	303	181	0.35	0.21	Divided into "Grassy Brook Rd – Hospital Entrance" and "Hospital Entrance – Lyons Creek Rd" segments below.							
Grassy Brook Rd	Hospital Entrance	1	850	-	-	-	-	629	390	0.74	0.46	765	512	0.90	0.60
Hospital Entrance	Lyons Creek Rd	1	850	-	-	-	-	1126	500	1.32	0.59	1309	605	1.54	0.71

TABLE 2-3. MONTROSE ROAD – MIDBLOCK ROAD CAPACITY ANALYSIS, PM PEAK HOUR

Road Segment		No of Lanes	Capacity	Existing (2019) Conditions				2026 Conditions (Do Nothing)				2041 Conditions (Do Nothing)			
From	To			Traffic Volume		V/C		Traffic Volume		V/C		Traffic Volume		V/C	
				NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
McLeod Rd	Niagara Square Entrance	2	1700	382	410	0.22	0.24	987	1059	0.58	0.62	1254	1317	0.74	0.77
Niagara Square Entrance	Brown Rd	1	850	347	385	0.41	0.45	813	828	0.95	0.97	1113	1129	1.31	1.32
Brown Rd	Chippawa Creek Rd	1	850	235	289	0.34	0.28	665	695	0.78	0.81	946	981	1.11	1.15
Chippawa Creek Rd	Oakwood Dr	1	850	240	321	0.28	0.38	649	713	0.76	0.84	919	1005	1.08	1.18
Oakwood Dr	Grassy Brook Rd	1	850	304	455	0.35	0.54	726	910	0.85	1.07	1144	1277	1.34	1.50
Grassy Brook Rd	Lyons Creek Rd	1	850	250	468	0.29	0.55	Divided into "Grassy Brook Rd – Hospital Entrance" and "Hospital Entrance – Lyons Creek Rd" segments below.							
Grassy Brook Rd	Hospital Entrance	1	850	-	-	-	-	559	818	0.65	0.96	702	998	0.82	1.17
Hospital Entrance	Lyons Creek Rd	1	850	-	-	-	-	712	1234	0.84	1.45	845	1455	0.99	1.71

2.9.2 LYONS CREEK ROAD & BIGGAR ROAD

Biggar Road to the west of Montrose Road and Lyons Creek Road to the east to Willodell Road have one lane per direction. From Willodell Road easterly to QEW TB off-ramp, Lyons Creek Road has two lanes per direction within the study area. Tables 2-4 and 2-5 present the volume to capacity (V/C) ratio comparison under AM and PM peak hour conditions, respectively.

Under existing (2019) conditions, the Lyons Creek Road/Biggar Road segments within the study area operate within capacity, however, capacity enhancement/road widening will be warranted under both the future 2026 and 2041 conditions.

TABLE 2-4. LYONS CREEK ROAD/BIGGAR ROAD – MIDBLOCK ROAD CAPACITY ANALYSIS, AM PEAK HOUR

Road Segment		No of Lanes	Capacity	Existing Conditions				2026 Conditions (Do Nothing)				2041 Conditions (Do Nothing)			
From	To			Traffic Volume		V/C		Traffic Volume		V/C		Traffic Volume		V/C	
				EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
Hospital Entrance	Montrose Rd	1	850	-	-	-	-	600	493	0.71	0.58	624	772	0.73	0.91
Montrose Rd	Willodell Rd	1	850	588	490	0.69	0.58	967	1345	1.14	1.58	1150	1590	1.35	1.87
Willodell Rd	QEW FEB off-ramp	2	1700	591	529	0.35	0.31	970	1388	0.57	0.81	1154	1639	0.68	0.96
QEW FEB off-ramp	QEW TB off-ramp	2	1700	703	264	0.41	0.15	998	611	0.59	0.36	1193	686	0.70	0.40

TABLE 2-5. LYONS CREEK ROAD/BIGGAR ROAD – MIDBLOCK ROAD CAPACITY ANALYSIS, PM PEAK HOUR

Road Segment		No of Lanes	Capacity	Existing Conditions				2026 Conditions (Do Nothing)				2041 Conditions (Do Nothing)			
From	To			Traffic Volume		V/C		Traffic Volume		V/C		Traffic Volume		V/C	
				EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
Hospital Entrance	Montrose Rd	1	850	-	-	-	-	592	621	0.69	0.73	783	806	0.92	0.94
Montrose Rd	Willodell Rd	1	850	594	880	0.69	1.03	1429	1383	1.68	1.62	1677	1619	1.97	1.90
Willodell Rd	QEW FEB off-ramp	2	1700	616	908	0.36	0.53	1452	1412	0.85	0.83	1703	1654	1.00	0.97
QEW FEB off-ramp	QEW TB off-ramp	2	1700	935	313	0.55	0.18	1546	593	0.91	0.35	1840	664	1.08	0.39

2.10 Intersection Capacity Analysis

2.10.1 SIGNALIZED INTERSECTIONS

A summary of the Synchro results for the signalized intersection operations is presented in **Table 2-6**. In addition to intersection's measures of effectiveness (MOE), critical movements having LOS "D" or worse and V/C ratio 0.85 or worse as defined in the Niagara Region TIS Guidelines (May 2012), are also listed along with respective MOEs. Detailed Synchro reports are provided as **Appendix E**.

All signalized intersections except the Montrose Road and Lyons Creek Road/Biggar Road intersection, are operating acceptably under existing conditions. Under existing conditions, the Montrose Road and Lyons Creek Road/Biggar Road intersection is at capacity during AM peak hour and over capacity during PM peak hour. Westbound movement is over capacity during AM peak hour while westbound and southbound movements are over capacity during PM peak hour. The intersection and all movements are over capacity during both the future (2026) and (2041) conditions. The existing lane configuration is not sufficient to accommodate the future traffic from the hospital and the other planned developments.

Montrose Road and McLeod Road intersection is forecast to exceed capacity under the future (2026) and (2041) conditions during PM peak conditions which is a common experience within developed urban environments.

The intersection of Montrose Road with Canadian Drive was recently signalized in late 2020. The intersections has been analyzed as signalized for 2026 and 2041 horizons. With existing (2019) lane configurations, the intersection is forecast to operate within capacity for 2026 horizon, however, it is overcapacity during 2041 PM peak hour.

TABLE 2-6. SIGNALIZED INTERSECTION CAPACITY ANALYSIS – EXISTING (2019) AND FUTURE (2026 & 2041) DO NOTHING CONDITIONS

Intersection	AM Peak Hour									PM Peak Hour								
	Overall			Critical Movements						Overall			Critical Movements					
	V/C	Delay (s)	LOS	Dir	V/C	Delay (s)	LOS	Queue (m) 50th	Queue (m) 95th	V/C	Delay (s)	LOS	Dir	V/C	Delay (s)	LOS	Queue (m) 50th	Queue (m) 95th
Existing 2019																		
Montrose Rd & Lyons Creek Rd/Biggar Rd	0.97	50	D	WB	1.03	76	E	108	173	1.60	274	F	WB	2.10	534	F	276	349
				NB	0.90	45	D	82	149				SB	1.16	124	F	114	175
Montrose Rd & Niagara Square Dr	0.66	23	C	-	-	-	-	-	-	0.61	12	B	-	-	-	-	-	-
Montrose Rd & McLeod Rd	0.64	25	C	-	-	-	-	-	-	0.86	31	C	WBT	0.88	39	D	73	103
				-	-	-	-	-	-				NBL	0.21	35	D	3	10
				-	-	-	-	-	-				NBT	0.58	41	D	20	40
				-	-	-	-	-	-				NBR	0.16	35	D	0	22
2026 Conditions (Do Nothing)																		
Montrose Rd & Lyons Creek Rd/Biggar Rd	2.61	599	F	EB	1.84	432	F	242	314	4.69	1173	F	EB	1.24	165	F	237	311
				WB	2.82	869	F	734	816				WB	4.24	1505	F	693	774
				NB	1.37	219	F	353	433				NB	1.16	130	F	267	345
				SB	2.42	692	F	199	270				SB	5.15	1920	F	675	757
Montrose Rd & Canadian Dr.	0.47	14	B	-	-	-	-	-	-	0.71	20	C	-	-	-	-	-	-
Montrose Rd & Niagara Square Dr	0.69	13	B	-	-	-	-	-	-	0.86	19	B	WBL	0.85	24	C	25	46
													NBT	0.87	20	C	35	66
Montrose Rd & McLeod Rd	0.78	27	C	-	-	-	-	-	-	1.10	69	E	EBL	0.97	128	F	16	44
				-	-	-	-	-	-				EBTR	0.97	72	E	108	137
				-	-	-	-	-	-				WBL	1.02	107	F	48	102
				-	-	-	-	-	-				WBT	0.92	58	E	138	177
				-	-	-	-	-	-				WBR	0.34	36	D	13	43
				-	-	-	-	-	-				NBL	0.36	37	D	16	28
				-	-	-	-	-	-				NBT	0.71	51	D	79	113
				-	-	-	-	-	-				NBR	1.04	109	F	120	193
				-	-	-	-	-	-				SBL	1.04	87	F	84	163
2041 Conditions (Do Nothing)																		
Montrose Rd & Lyons Creek Rd/Biggar Rd	3.34	835	F	EB	2.33	651	F	245	321	5.98	1582	F	EB	1.57	307	F	347	425
				WB	3.43	1140	F	903	984				WB	5.26	1968	F	861	942
				NB	1.56	301	F	424	506				NB	1.29	184	F	321	401
				SB	3.26	1072	F	284	359				SB	6.69	2612	F	838	920
Montrose Rd & Canadian Dr.	0.69	23	C	NBT	0.91	29	C	98	179	1.17	55	E	EBL	0.71	48	D	34	63
				-	-	-	-	-	-				EBR	0.50	40	D	12	46
				-	-	-	-	-	-				NBL	1.25	170	F	44	92
				-	-	-	-	-	-				NBT	0.89	25	C	122	218
				-	-	-	-	-	-				SBT	1.06	71	E	164	233
Montrose Rd & Niagara Square Dr	0.79	15	B	-	-	-	-	-	-	0.95	29	C	WBL	0.95	37	D	46	76
													NBT	0.96	32	C	71	113
Montrose Rd & McLeod Rd	0.89	37	D	EBL	0.76	45	D	13	38	1.49	123	F	EBL	1.28	240	F	25	61
				WBT	0.88	42	D	85	123				EBTR	1.02	84	F	128	158
				NBR	0.92	62	E	60	123				WBL	1.44	267	F	74.2	127.8

Intersection	AM Peak Hour									PM Peak Hour								
	Overall			Critical Movements						Overall			Critical Movements					
	V/C	Delay (s)	LOS	Dir	V/C	Delay (s)	LOS	Queue (m)		V/C	Delay (s)	LOS	Dir	V/C	Delay (s)	LOS	Queue (m)	
								50th	95th								50th	95th
				-	-	-	-	-	-				WBT	1.13	120	F	189	231
				-	-	-	-	-	-				WBR	0.47	40	D	29	65
				-	-	-	-	-	-				NBT	0.76	48	D	102	142
				-	-	-	-	-	-				NBR	1.36	222	F	236	313
				-	-	-	-	-	-				SBL	1.28	240	F	25	61

2.10.2 UNSIGNALIZED INTERSECTIONS

Table 2-7 summarizes the Synchro results for the unsignalized intersections presenting the MOEs for the movements of interest. Detailed Synchro reports are provided as Appendix E.

Under existing conditions, all movements at all the intersections are operating well with residual capacity except the SBL (south bound left) movement at QEW FEB off-ramp at Lyons Creek Road during PM peak hour.

Under the future (2026) and (2041) conditions, Montrose Road intersections at Grassy Brook Road, Oakwood Drive, Chippawa Creek Road, Brown Road and Niagara Square Entrance are forecast to experience excessive delays to minor street movements resulting in lengthy queues, in most cases.

QEW FEB off-ramp at Lyons Creek Road is predicted to have both SBR (south bound right) and SBL movements to be constrained under both the future horizon years, while NBL (north bound left) movement is constrained at QEW TB off-ramp at Lyons Creek Road.

TABLE 2-7. UNSIGNALIZED INTERSECTION CAPACITY ANALYSIS – EXISTING 2019 AND FUTURE (2026 & 2041) DO NOTHING CONDITIONS

Intersection	Existing Conditions					2026 Conditions (Do Nothing)					2041 Conditions (Do Nothing)				
	Dir	Delay (s)	95th Queue	V/C	LOS	Dir	Delay (s)	95th Queue	V/C	LOS	Dir	Delay (s)	95th Queue	V/C	LOS
AM Peak Hour															
Montrose Rd & Reixinger Rd	WBL	10.9	0.1	0.00	B	WBL	10.7	0.3	0.01	B	WBL	11.9	0.7	0.03	B
	SBL	0.1	0.0	0.00	A	SBL	0.3	0.2	0.01	A	SBL	0.4	0.3	0.01	A
Montrose Rd & Grassy Brook Rd	EBL	0.0	0.0	0.00	A	EBL	55.9	48.1	0.80	F	EBL	810.9	293.8	2.67	F
	NBL	0.4	0.2	0.01	A	NBL	0.9	0.8	0.03	A	NBL	1.7	1.5	0.06	A
Montrose Rd & Oakwood Dr	WBL	11.7	2.3	0.09	B	WBL	23.5	6.5	0.23	C	WBL	63.2	19.5	0.54	F
	SBL	0.8	0.3	0.01	A	SBL	0.5	0.4	0.02	A	SBL	0.7	0.6	0.03	A
Montrose Rd & Chippawa Creek Rd	EBL	11.0	3.4	0.13	B	EBL	21.4	10.6	0.33	C	EBL	62.0	31.8	0.69	F
	NBL	7.7	0.6	0.03	A	NBL	8.6	0.8	0.04	A	NBL	9.5	1.2	0.05	A
Montrose Rd & Brown Rd	EBL	13.1	7.4	0.25	B	EBL	79.3	64.3	0.93	F	EBL	517.6	162.0	1.97	F
	NBL	0.2	0.1	0.00	A	NBL	1.1	0.9	0.04	A	NBL	1.2	1.1	0.05	A
Montrose Rd & Canadian Dr.	EBL	10.2	2.6	0.10	B	Intersection analysed as signalised									
	NBL	2.2	1.5	0.06	A										
Montrose Rd & Niagara Square Entrance	EBL	12.6	0.5	0.02	B	EBL	28.1	1.7	0.07	D	EBL	152.9	9.1	0.36	F
	EBR	8.9	0.1	0.00	A	EBR	10	0	0	B	EBR	11	0.2	0.01	B
	NBL	7.7	0.2	0.01	A	NBL	8.6	0.5	0.02	A	NBL	9.5	0.7	0.03	A

Intersection	Existing Conditions					2026 Conditions (Do Nothing)					2041 Conditions (Do Nothing)				
	Dir	Delay (s)	95th Queue	V/C	LOS	Dir	Delay (s)	95th Queue	V/C	LOS	Dir	Delay (s)	95th Queue	V/C	LOS
Lyons Creek Rd & Willodell Rd	WBL	2.3	1.1	0.05	A	WBL	1.9	1.7	0.07	A	WBL	2.6	2.4	0.10	A
	NBL	10.9	1.0	0.04	B	NBL	16.9	2.0	0.08	C	NBL	25.1	4.0	0.15	D
Lyons Creek Rd & QEW FEB off-ramp	SBL	17.4	11.7	0.35	C	SBL	102.8	65.7	0.98	F	SBL	272.5	112.4	1.42	F
	SBR	11.3	12.9	0.37	B	SBR	174.0	283.7	1.32	F	SBR	337.4	486.4	1.70	F
Lyons Creek Rd & QEW TB off-ramp	NBL	13.1	4.4	0.16	B	NBL	38.1	42.3	0.73	E	NBL	71.9	68.4	0.93	F
	NBR	9.5	1.1	0.05	A	NBR	10.4	2.3	0.09	B	NBR	10.8	2.7	0.11	B
PM Peak Hour															
Montrose Rd & Reixinger Rd	WBL	12.1	0.1	0.00	B	WBL	12.9	2.0	0.08	B	WBL	18.2	6.1	0.21	C
	SBL	0.0	0.0	0.00	A	SBL	0.0	0.0	0.00	A	SBL	0.1	0.1	0.00	A
Montrose Rd & Grassy Brook Rd	EBL	14.3	1.2	0.05	B	EBL	409.1	143.3	1.73	F	EBL	Err	Err	6.55	F
	NBL	0.2	0.1	0.00	A	NBL	0.5	0.5	0.02	A	NBL	1.5	1.2	0.05	A
Montrose Rd & Oakwood Dr	WBL	17.6	12.9	0.37	C	WBL	268.1	89.8	1.37	F	WBL	Err	Err	4.12	F
	SBL	0.8	0.5	0.02	A	SBL	1.0	0.9	0.04	A	SBL	2.2	1.5	0.06	A
Montrose Rd & Chippawa Creek Rd	EBL	12.1	4.0	0.15	B	EBL	47.1	25.5	0.60	E	EBL	360.2	78.4	1.50	F
	NBL	8.0	0.7	0.03	A	NBL	9.4	1.1	0.05	A	NBL	10.9	1.8	0.07	B
Montrose Rd & Brown Rd	EBL	14.7	6.0	0.21	B	EBL	358.6	121.2	1.60	F	EBL	Err	Err	4.22	F
	NBL	0.6	0.3	0.01	A	NBL	2.0	1.9	0.08	A	NBL	3.5	2.7	0.11	A
Montrose Rd & Canadian Dr.	EBL	12.4	6.7	0.23	B	Intersection analysed as signalised									
	NBL	2.2	1.5	0.06	A										
Montrose Rd & Niagara Square Entrance	EBL	17.8	6.7	0.23	C	EBL	Err	Err	6.51	F	EBL	Err	Err	32.49	F
	EBR	9.7	0.8	0.03	A	EBR	13.7	3.0	0.12	B	EBR	14.4	3.6	0.14	B
	NBL	8.3	0.4	0.02	A	NBL	11.5	2.3	0.09	B	NBL	13.4	3.5	0.13	B
Lyons Creek Rd & Willodell Rd	WBL	1.3	0.9	0.04	A	WBL	2.6	2.2	0.09	A	WBL	4.4	3.4	0.13	A
	NBL	12.6	1.5	0.06	B	NBL	56.5	10.1	0.34	F	NBL	133.5	20.2	0.63	F
Lyons Creek Rd & QEW FEB off-ramp	SBL	55.6	69.2	0.89	F	SBL	812.0	319.7	2.68	F	SBL	Err	Err	4.10	F
	SBR	22.0	58.8	0.77	C	SBR	185.6	303.2	1.35	F	SBR	341.0	497.3	1.71	F
Lyons Creek Rd & QEW TB off-ramp	NBL	20.0	4.6	0.17	C	NBL	115.1	45.4	0.90	F	NBL	267.4	72	1.31	F
	NBR	11.0	1.8	0.07	B	NBR	14.4	6.4	0.22	B	NBR	15.9	7.9	0.26	C

3 Functional Traffic Design

This section presents traffic design requirements for the functional improvements needed along the Montrose Road and the Lyons Creek Road / Biggar Road segments within the study area. The design includes road widening, intersection lane configurations, intersection control, and estimated storage lengths and these are based on the future (2026) and (2041) traffic volumes.

3.1 Roadway Corridor Capacity

3.1.1 MONTROSE ROAD

As discussed earlier, in establishing the need for the widening, segments having V/C ratio exceeding 0.85 were deemed to be approaching capacity and therefore considered for capacity enhancement.

Montrose Road already has two lanes per direction from McLeod Road intersection to the Niagara Square Entrance. Road capacity analysis with one additional lane per direction from Niagara Square Entrance to Lyons Creek Road is presented in **Table 3 -1.** Widening of one lane in each direction along Montrose Road would increase capacity to 1,700 vehicles per hour per direction and provide the V/C ratio lower than 0.85 with some residual capacity.

TABLE 3-1. MONTROSE ROAD CAPACITY ANALYSIS – 2026 & 2041 PROPOSED LANE CONFIGURATION

Road Segment		2026 Horizon						2041 Horizon					
From	To	Traffic Volume		V/C Do Nothing		V/C With Widening		Traffic Volume		V/C Do Nothing		V/C With Widening	
		NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
AM Peak Hour													
McLeod Rd	Niagara Square Entrance	550	523	0.32	0.31	0.32	0.31	791	744	0.47	0.44	0.47	0.44
Niagara Square Entrance	Brown Rd	648	538	0.76	0.63	0.38	0.32	899	760	1.05	0.89	0.53	0.45
Brown Rd	Chippawa Creek Rd	466	508	0.55	0.60	0.27	0.30	693	725	0.81	0.85	0.41	0.43
Chippawa Creek Rd	Oakwood Dr	450	463	0.53	0.54	0.26	0.27	676	676	0.79	0.79	0.40	0.40
Oakwood Dr	Grassy Brook Rd	594	535	0.70	0.63	0.35	0.31	886	808	1.04	0.95	0.52	0.48
Grassy Brook Rd	Hospital Entrance	629	390	0.74	0.46	0.37	0.23	765	512	0.90	0.60	0.45	0.30
Hospital Entrance	Lyons Creek Rd	1126	500	1.32	0.59	0.66	0.29	1309	605	1.54	0.71	0.77	0.36
PM Peak Hour													
McLeod Rd	Niagara Square Entrance	987	1059	0.58	0.62	0.58	0.62	1254	1317	0.74	0.77	0.74	0.77
Niagara Square Entrance	Brown Rd	813	828	0.95	0.97	0.48	0.49	1113	1129	1.31	1.32	0.65	0.66
Brown Rd	Chippawa Creek Rd	665	695	0.78	0.81	0.39	0.41	946	981	1.11	1.15	0.56	0.58
Chippawa Creek Rd	Oakwood Dr	649	713	0.76	0.84	0.38	0.42	919	1005	1.08	1.18	0.54	0.59
Oakwood Dr	Grassy Brook Rd	726	910	0.85	1.07	0.43	0.54	1144	1277	1.34	1.50	0.67	0.75
Grassy Brook Rd	Hospital Entrance	559	818	0.65	0.96	0.33	0.48	702	998	0.82	1.17	0.41	0.59
Hospital Entrance	Lyons Creek Rd	712	1234	0.84	1.45	0.42	0.73	845	1455	0.99	1.71	0.50	0.86

3.1.2 LYONS CREEK ROAD/BIGGAR ROAD

Table 3-2 presents the capacity analysis for Lyons Creek Road/Biggar Road. Biggar Road (Hospital Access – Montrose Road segment) to the west of Montrose Road is proposed to be widened from one lane to two lanes per direction increasing capacity to 1,700 vehicles per hour in both directions. Lyons Creek Road from Montrose Road easterly to Willodell Road is proposed to be widened to two lanes per direction providing 1,700 vehicles per hour per direction capacity.

Except a westbound merge lane proposed for the WB traffic merging on Lyons Creek Road from the QEW FEB off-ramp, no widening is proposed to the east of Willodell Road where Lyons Creek Road already has two lane cross-section per

direction with capacity of 1,700 vehicles per hour. This segment is shown to be at capacity under 2041 conditions however, such localized conditions are expected during peak times. Also, the V/C ratio calculation is deterministic assuming whole demand on the respective segment instantaneously, while the traffic demand would be distributed over time. As such, additional capacity for these localized instances was not considered in the analysis.

TABLE 3-2. LYONS CREEK ROAD/BIGGAR ROAD CAPACITY ANALYSIS – 2026 & 2041 PROPOSED LANE CONFIGURATIONS

Road Segment		2026 Horizon						2041 Horizon					
From	To	Traffic Volume		V/C Do Nothing		V/C With Widening		Traffic Volume		V/C Do Nothing		V/C With Widening	
		EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
AM Peak Hour													
Hospital Entrance	Montrose Rd	600	493	0.71	0.58	0.35	0.29	624	772	0.73	0.91	0.38	0.45
Montrose Rd	Willodell Rd	967	1345	1.14	1.58	0.57	0.79	1150	1590	1.35	1.87	0.68	0.93
Willodell Rd	QEW FEB off-ramp	970	1388	0.57	0.81	0.57	0.54	1154	1639	0.68	0.96	0.68	0.64
QEW FEB off-ramp	QEW TB off-ramp	998	611	0.59	0.36	0.58	0.36	1193	686	0.70	0.40	0.70	0.40
PM Peak Hour													
Hospital Entrance	Montrose Rd	592	621	0.69	0.73	0.34	0.37	783	806	0.92	0.94	0.46	0.47
Montrose Rd	Willodell Rd	1429	1383	1.68	1.62	0.84	0.81	1677	1619	1.97	1.90	0.99	0.95
Willodell Rd	QEW FEB off-ramp	1452	1412	0.85	0.83	0.85	0.55	1703	1654	1.00	0.97	1.00	0.64
QEW FEB off-ramp	QEW TB off-ramp	1546	593	0.91	0.35	0.91	0.35	1840	664	1.08	0.39	1.08	0.39

3.2 CPR Crossing Warrant Calculations

Grade separation warrant calculation for the CPR single-track crossing the Montrose Road north of Grassy Brook Road was conducted based on Exposure Index (EI) calculated according to Transport Canada guidelines. In Canada, most municipalities and road authorities consider grade separation to be warranted when EI exceeds 200,000. The EI calculations are summarized in **Table 3-3,** which suggest that grade separation is not warranted. AADT was estimated based on 2026 and 2041 traffic forecasts, while the train frequency was provided by CPR. Heavy vehicles were assumed to be 15% NB and 13% SB as per existing traffic data.

TABLE 3-3: CPR TRACK GRADE SEPARATION WARRANT CALCULATIONS

Year	Hourly Peak Volume		Total Volume	Heavy Vehicles (PCUs)	AADT	Train Frequency (per day)	EI	Grade Separation warranted?
	NB	SB						
	a	b	c = (a+b)	d	e = (c+d)*10	f	g = (e*f)	h
2026	784	910	1694	474	21,683	2	43,366	NO
2041	1144	1277	2421	678	30,989	2	61,978	NO

3.3 Intersection Control Assessment

3.3.1 SIGNAL WARRANT ANALYSIS

In determining whether a signalized traffic control is warranted for the study area unsignalized intersections, "Justification 7 – Projected Volumes" was used from OTM Book 12 Traffic Signals. The warrant analysis was based on average hour volume calculated from AM and PM peak hour volume projections. Table 3-4 presents the warrant analysis while a detailed warrant analysis is attached as Appendix F.

As discussed earlier, the existing intersection of Montrose Road with Canadian Drive has recently been signalized, therefore the intersection is not included in the warrant analysis.

Additionally, the following two future intersections were recommended to be signalized in the South Niagara Hospital TIS and were also not included in the warrant analysis.

- Montrose Road and Hospital South Access
- Biggar Road and Hospital East Access

Signal warrant analysis suggests that, except for the Lyons Creek Road intersection at QEW FEB off-ramp, signalized controls are not warranted at any of the unsignalized intersections. Table 3-4 also presents the actual compliance rate to provide an understanding of how close the intersections would be to meeting the warrant thresholds.

TABLE 3-4. SIGNAL WARRANT ANALYSIS

Intersection	Configuration	2026 Horizon					2041 Horizon				
		Justification 7 Met?	Warrant Compliance				Justification 7 Met?	Warrant Compliance			
			1A	1B	2A	2B		1A	1B	2A	2B
Montrose Rd and Hospital North Access	T Intersection	NO	45%	8%	42%	1%	NO	56%	8%	53%	1%
Montrose Rd and Reixinger Rd	T Intersection	NO	46%	4%	45%	4%	NO	58%	7%	56%	8%
Montrose Rd and Street B	T Intersection	NO	39%	5%	37%	3%	NO	50%	9%	47%	6%
Montrose Rd and Grassy Brook Rd	T Intersection	NO	66%	36%	55%	50%	NO	96%	71%	76%	100%
Montrose Rd and Oakwood Dr	T Intersection	NO	64%	18%	59%	24%	NO	92%	21%	86%	27%
Montrose Rd and Chippawa Creek Rd	T Intersection	NO	58%	17%	53%	16%	NO	81%	19%	76%	18%
Montrose Rd and Brown Rd	T Intersection	NO	68%	35%	58%	41%	NO	93%	39%	82%	45%
Montrose Rd and Niagara Sq Entrance	T Intersection	NO	74%	20%	68%	24%	NO	97%	22%	91%	25%
Biggar Rd and Hospital West Access	T Intersection	NO	36%	7%	34%	4%	NO	36%	7%	34%	4%
Lyons Creek Rd and Willodell Rd	T Intersection	NO	100%	5%	100%	1%	NO	100%	5%	100%	1%
Lyons Creek Rd and QEW FEB Off-ramp	T Intersection	YES	100%	100%	69%	78%	YES	100%	100%	82%	87%

Intersection	Configuration	2026 Horizon					2041 Horizon				
		Justification 7 Met?	Warrant Compliance				Justification 7 Met?	Warrant Compliance			
			1A	1B	2A	2B		1A	1B	2A	2B
Lyons Creek Rd and QEW TB off-ramp	T Intersection	NO	65%	42%	53%	43%	NO	73%	46%	59%	48%

3.3.2 ROUNDABOUT FEASIBILITY

Design outcomes of roundabout implementation analyses are generally related to operational/safety improvements and aesthetic or placemaking upgrades. Various site contexts that are considered for a roundabout intersection control from an operational improvement perspective include, but are not limited to the following:

- Intersections with documented safety concerns
- Intersections with relatively balanced traffic volumes
- Intersections with high percentage of turning movements, particularly left turns
- Intersections where widening the approaches may be difficult or cost prohibitive, such as at bridge terminals

The following intersections within the study area which have the above noted characteristics were considered potential candidate locations for a roundabout feasibility assessment from an operational perspective. It is noted that no safety concerns are known for these sites:

- Montrose Road & Lyons Creek/Biggar Road intersection
- Lyons Creek Road & QEW FEB off-ramp intersection
- Lyons Creek Road & QEW TB off-ramp intersection

In addition to above intersections, in order to have better access management and increase intersection spacing, a design option was considered to relocate the Niagara Square Entrance as a fourth leg of the existing Montrose Road & Niagara Square Drive intersection. As the intersection will have a significant proportion of left turns, roundabout feasibility assessment was also conducted for this intersection.

3.3.2.1 Feasibility Assessment Approach

Feasibility analysis was conducted for the 2041 horizon year employing the methodology provided in Roundabouts: An Informational Guide (National Cooperative Highway Research Program (NCHRP) Report 672) and in the Transportation Association of Canada (TAC) Canadian Roundabout Design Guide (January 2017). The methodology provides planning estimates of lane requirements and a planning-level comparison of the operational performance of intersection control modes. The planning level lane requirements are shown in Table 3-5.

TABLE 3-5. VOLUME THRESHOLDS FOR DETERMINING THE NUMBER OF ENTRY LANES REQUIRED

Sum of Entering and Circulating Vehicles	Lanes Required
< 1000 veh/h	Single- lane entry likely to be sufficient
1000 – 1300 veh/h	Two lanes may be required. Single lane may be sufficient based upon more detailed analysis
1300 – 1800 veh/h	Two-lane entry likely to be sufficient
Above 1800 veh/h	More than two lanes may be required

The following are some considerations for the preliminary feasibility assessment of using a roundabout as an intersection control method, from operational perspective:

- More detailed analysis and capacity evaluation should be conducted if more than one lane is required on any approach.
- A roundabout will always provide a higher capacity and lower delays than all-way stop-control (AWSC) operating with the same traffic volumes.
- A roundabout is unlikely to offer better performance in terms of lower overall delays than two-way stop-control (TWSC) at intersections with minor movements (including cross street entry and major street left turns) that are not experiencing, nor predicted to experience, operational problems under TWSC.
- A single lane roundabout may be assumed to operate within its capacity at any intersection that does not exceed the peak-hour volume warrant for signals.
- A roundabout that operates within its capacity will generally produce lower delays than a signalized intersection operating with the same traffic volumes.

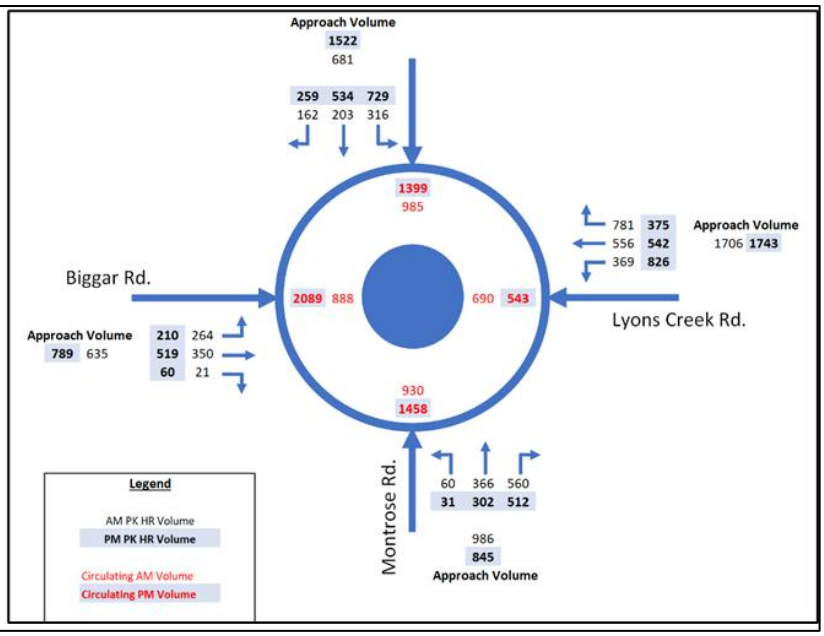
3.3.2.2 Montrose Road & Lyons Creek Road/Biggar Road Intersection

A roundabout at this intersection would need more than two lanes for all approaches, and therefore further analysis was conducted using Sidra software. **Figure 3-1** shows the TMCs, approach and circulating volumes and their sum in Passenger Car Units (PCU) for each approach.

FIGURE 3-1. MONTROSE ROAD & LYONS CREEK/BIGGAR ROAD INTERSECTION – ROUNDABOUT TRAFFIC VOLUMES

Sidra analysis was conducted for the PM peak hour being critical. A three-lane roundabout was modelled with NBR and

Approach		AM Peak Hour	PM Peak Hour
East	Entering Volume	1706	1743
	Circulating Volume	690	543
	Total	2396	2286
North	Entering Volume	681	1522
	Circulating Volume	985	1399
	Total	1666	2921
West	Entering Volume	635	789
	Circulating Volume	888	2089
	Total	1523	2878
South	Entering Volume	986	845
	Circulating Volume	930	1458
	Total	1916	2303

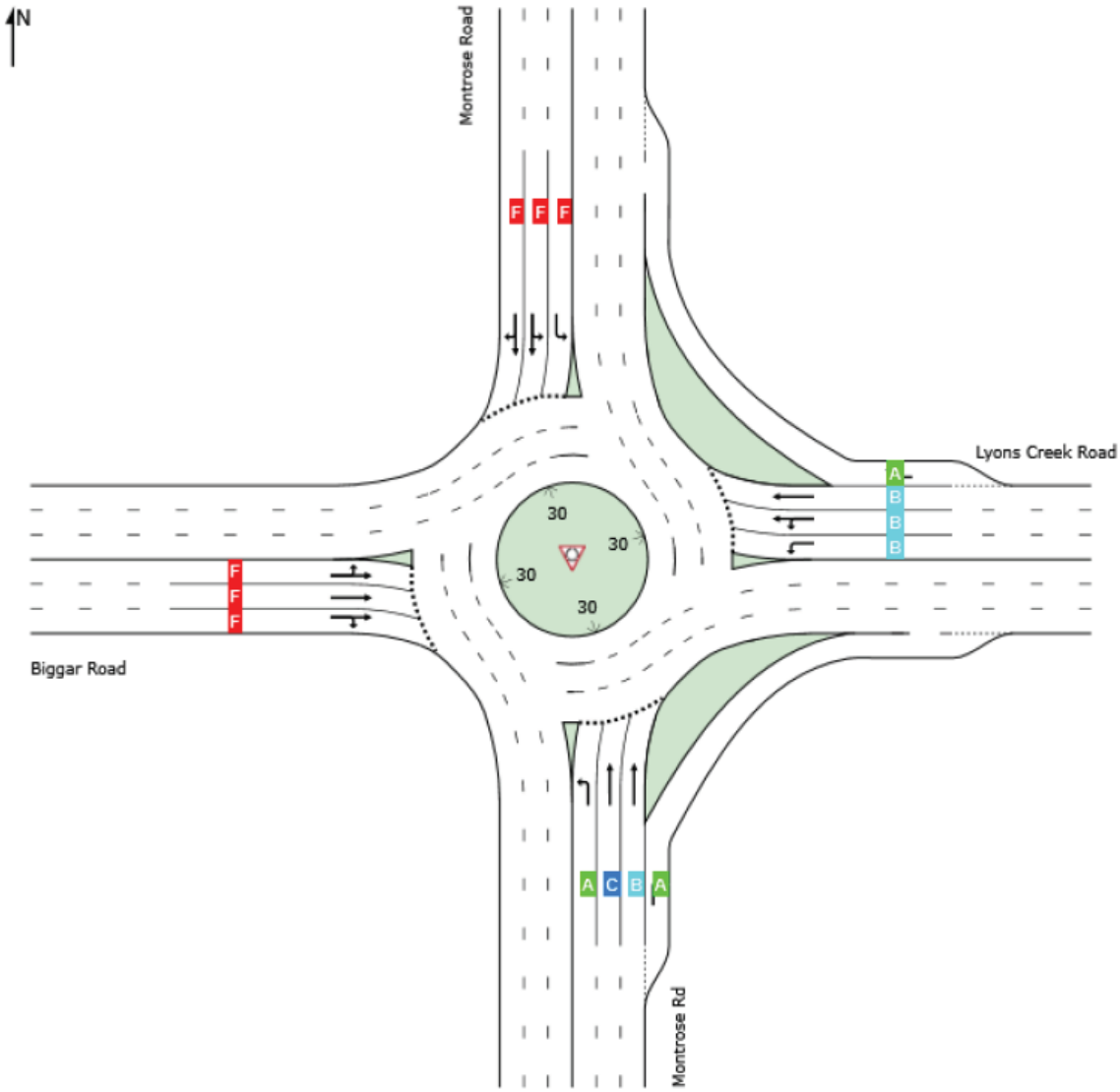


WBR movements as free channelized movements. The roundabout intersection operates over capacity with V/C as 1.57. Sidra "Lane Level of Service" plot is shown in **Figure 3-2** while detailed lane use and performance summary is provided in **Appendix G**.

FIGURE 3-2. MONTROSE ROAD & LYONS CREEK ROAD/BIGGAR ROAD ROUNDABOUT INTERSECTION – SIDRA LANE LEVEL OF SERVICE PLOT

	Approaches				Intersection
	South	East	North	West	
LOS	A	B	F	F	F

AM Peak Hour



A roundabout at this intersection is not deemed operationally feasible for the following reasons:

- Over-capacity operations during PM peak hour.
- Significantly long queues ranging between 500-600 metres on the north approach during PM peak hour, blocking the hospital entrances.
- Roundabouts are not able to provide emergency vehicle precedence similar to traffic signal pre-emption to support the hospital emergency vehicle operations.
- A Roundabout having more than three lanes is not considered feasible due to significantly large footprint.

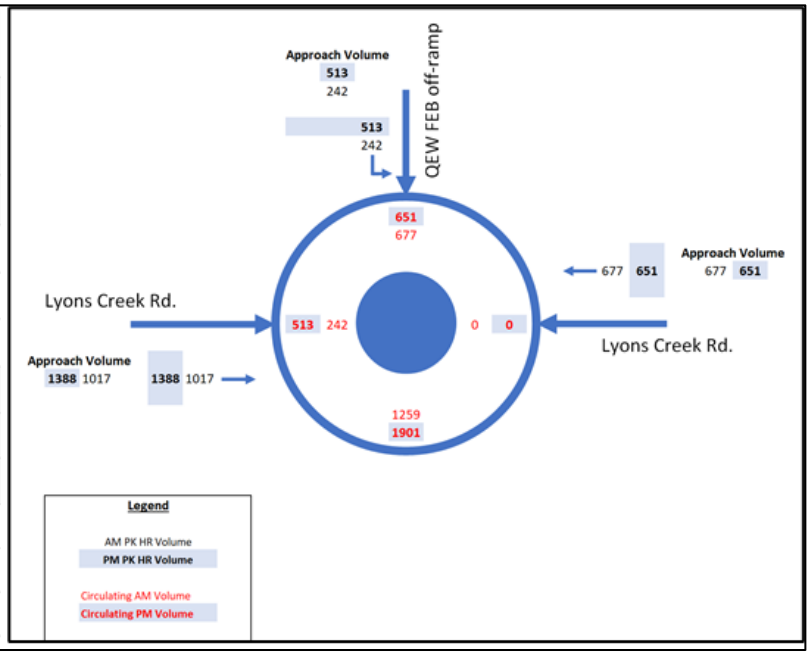
3.3.2.3 Lyons Creek Road & QEW FEB Off-ramp

A roundabout at this intersection may need more than two entry lanes for the west approach. The sum of the entering and circulating volumes for the north approach is in the range of 900-1200 vehicles and, as such, a one lane entry may be sufficient but needs to be confirmed based on further capacity analysis. A further analysis was conducted using Sidra software and is discussed later in this section.

Figure 3-3 shows the TMCs, approach and circulating volumes and their sum in Passenger Car Units (PCU) for each approach. The SBR movement is free and therefore has not been included in the north approach volumes entering the roundabout.

FIGURE 3-3. LYONS CREEK/BIGGAR ROAD & QEW FEB OFF-RAMP INTERSECTION – ROUNDABOUT TRAFFIC VOLUMES

Approach		AM Peak Hour	PM Peak Hour
East	Entering Volume	677	651
	Circulating Volume	0	0
	Total	677	651
North	Entering Volume	242	513
	Circulating Volume	677	651
	Total	919	1164
West	Entering Volume	1017	1388
	Circulating Volume	242	513
	Total	1259	1901
South	Entering Volume	0	0
	Circulating Volume	1259	1901
	Total	1259	1901



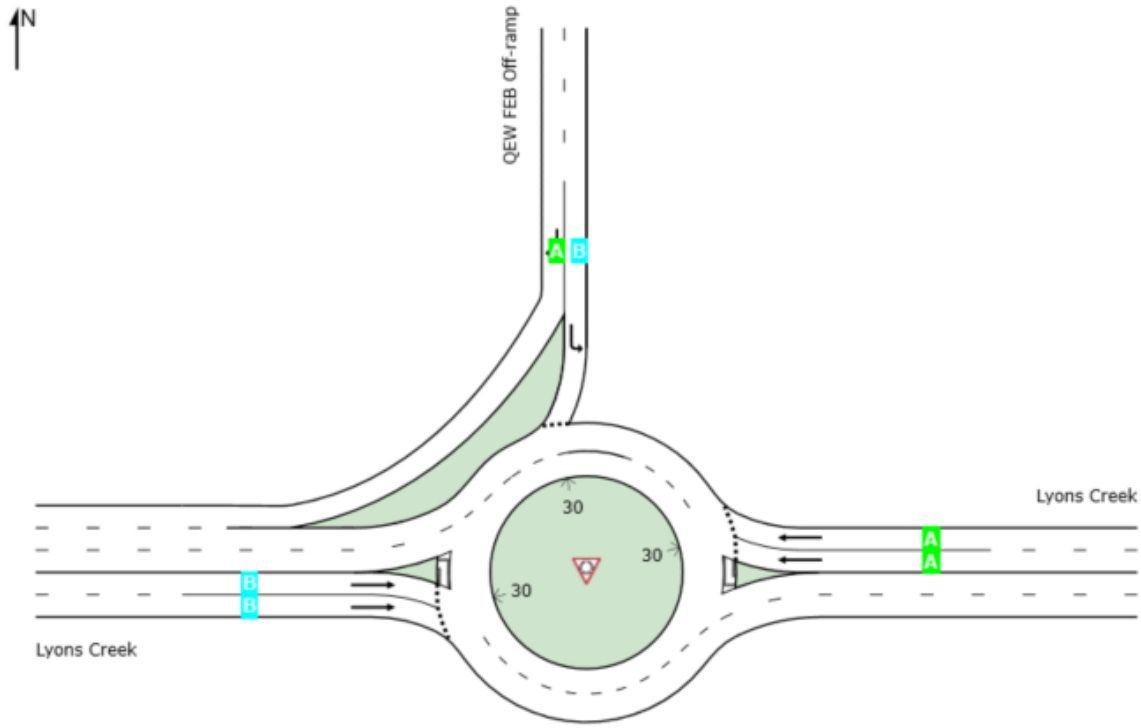
Sidra analysis was conducted for the PM peak hour being critical. The roundabout intersection would operate within capacity with V/C as 0.84 and LOS "A". The predicted delay to SBL movement is approximately 16 sec with approximately 35 m long queue. The predicted eastbound 95th queue length is 75 m.

As stated in the feasibility approach above, a roundabout that operates within its capacity will generally produce lower delays than a signalized intersection operating with the same traffic volumes. The average roundabout intersection delay is 9 seconds while the 2041 PM peak hour delay predicted for a signalized traffic control at this intersection is 16 seconds (see Section 3.4.1). As such the implementation of a roundabout at this intersection is deemed feasible from an operational perspective.

Sidra "Lane Level of Service" plot is shown in **Figure 3-4** while detailed lane use and performance summary is provided in **Appendix G**.

FIGURE 3-4. LYONS CREEK ROAD & QEW FEB OFF-RAMP ROUNDABOUT INTERSECTION – SIDRA LANE LEVEL OF SERVICE PLOT

	Approaches			Intersection
	East	North	West	
LOS	A	A	B	A



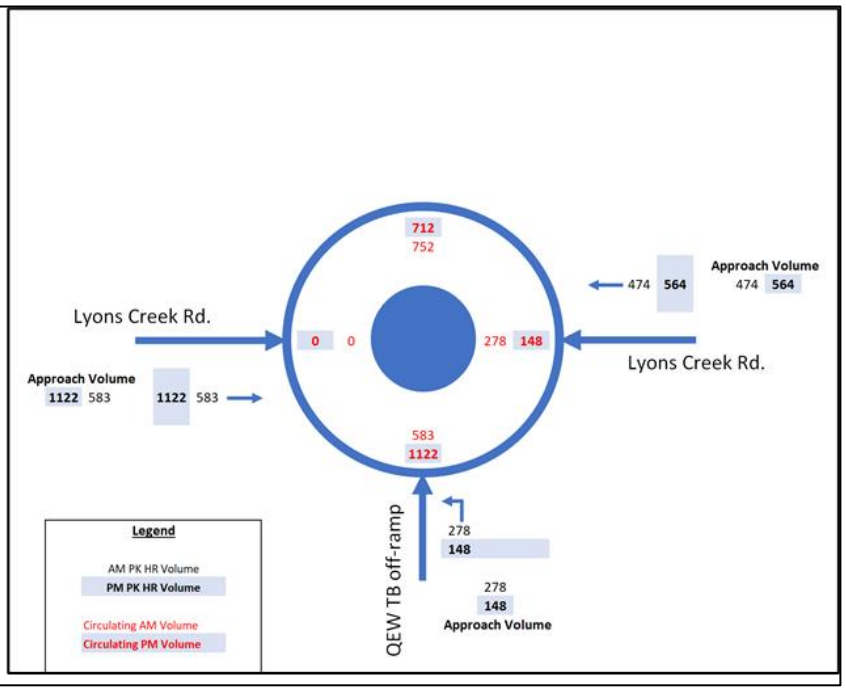
3.3.2.4 Lyons Creek Road & QEW TB Off-ramp

A roundabout at this intersection would need one lane entry for the east approach, whereas the existing approach has two lanes. The sum of the entering and circulating volumes for the south approach is in the range of 850-1,300 vehicles and as such one entry lane may be sufficient based on further capacity analysis. This further analysis was conducted using Sidra software and is noted below.

Figure 3-5 shows the TMCs, approach and circulating volumes and their sum in Passenger Car Units (PCU) for each approach. The NBR movement is free and therefore has not been included in the south approach volumes entering the roundabout.

FIGURE 3-5. LYONS CREEK/BIGGAR ROAD & QEW TB OFF-RAMP INTERSECTION – ROUNDABOUT TRAFFIC VOLUMES

Approach		AM Peak Hour	PM Peak Hour
East	Entering Volume	474	564
	Circulating Volume	278	148
	Total	752	712
North	Entering Volume	0	0
	Circulating Volume	752	712
	Total	752	712
West	Entering Volume	583	1122
	Circulating Volume	0	0
	Total	583	1122
South	Entering Volume	278	148
	Circulating Volume	583	1122
	Total	861	1270

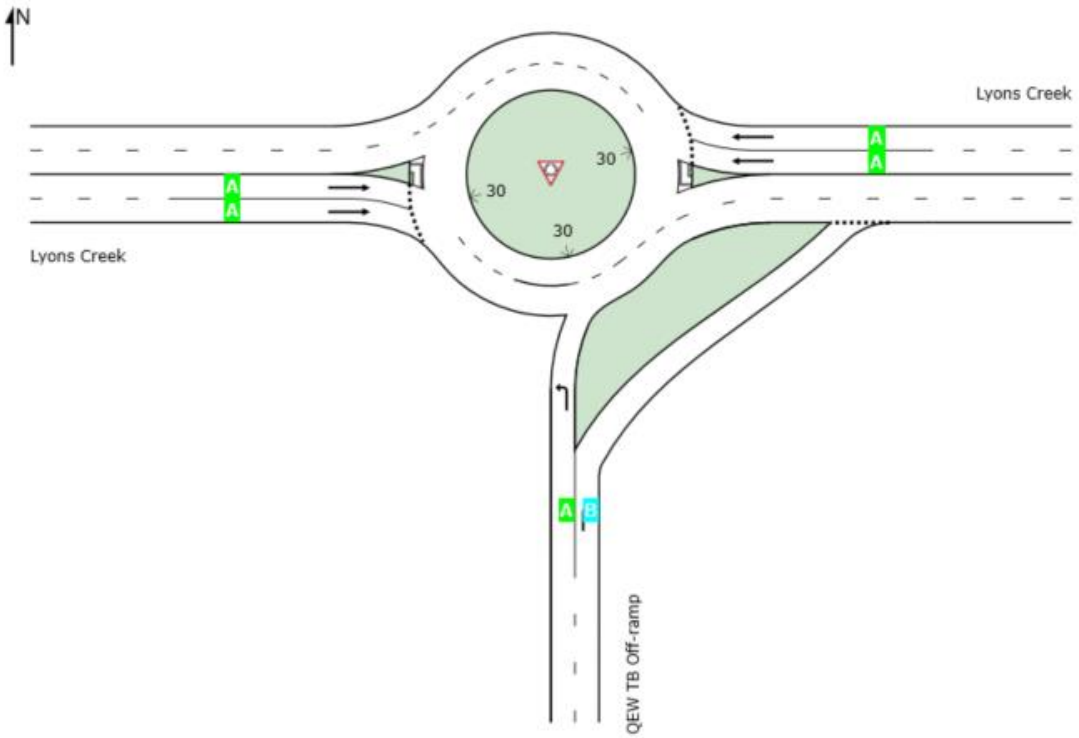


Sidra analysis was conducted for the PM peak hour being critical. The analysis suggests one entry lane is sufficient for the south approach. The roundabout intersection would operate well within capacity with V/C as 0.42 and LOS "A". The predicted delay to NBL movement is approximately 11 sec with practically no queue. The Sidra "Lane Level of Service" plot is shown in **Figure 3-6** while the detailed lane use and performance summary is provided in **Appendix G**.

The south approach at the intersection is currently stop-controlled. As will be presented in Section 3.5.1.2, the delay experienced by stop-controlled NBL movement is predicted to be approximately 267 seconds during 2041 PM peak hour with a 72 metres queue length. A roundabout at this intersection would significantly improve the operations of the NBL with no impacts to eastbound and westbound movements on Lyons Creek Road. As such a roundabout at this intersection is deemed feasible from an operational standpoint.

FIGURE 3-6. LYONS CREEK ROAD & QEW TB OFF-RAMP ROUNDABOUT INTERSECTION – SIDRA LANE LEVEL OF SERVICE PLOT

	Approaches			Intersection
	South	East	West	
LOS	A	A	A	A



3.3.2.5 Montrose Road & Niagara Square Drive Intersection

For all approaches except the east approach (Niagara Square Drive), two-lane entries are likely to be sufficient while more than two lanes may be required for the east approach. Sidra analysis was conducted for the PM peak hour being critical to confirm the entry lanes. **Figure 3-7** shows the TMCs, approach and circulating volumes and their sum in Passenger Car Units (PCU) for each approach.

Sidra analysis suggests that two lanes are not sufficient for the east approach. The resulting queue is forecasted to be 250 metres long extending back into the upstream McLeod Road & QEW FEB off-ramp. The Sidra "Lane Level of Service" plot is shown in **Figure 3-8**.

FIGURE 3-7. MONTROSE ROAD & NIAGARA SQUARE ENTRANCE INTERSECTION – ROUNDABOUT TRAFFIC VOLUMES

Approach		AM Peak Hour	PM Peak Hour
East	Entering Volume	488	818
	Circulating Volume	865	1353
	Total	1353	2171
North	Entering Volume	337	552
	Circulating Volume	509	876
	Total	846	1428
West	Entering Volume	21	310
	Circulating Volume	758	969
	Total	779	1279
South	Entering Volume	848	1099
	Circulating Volume	17	254
	Total	865	1353

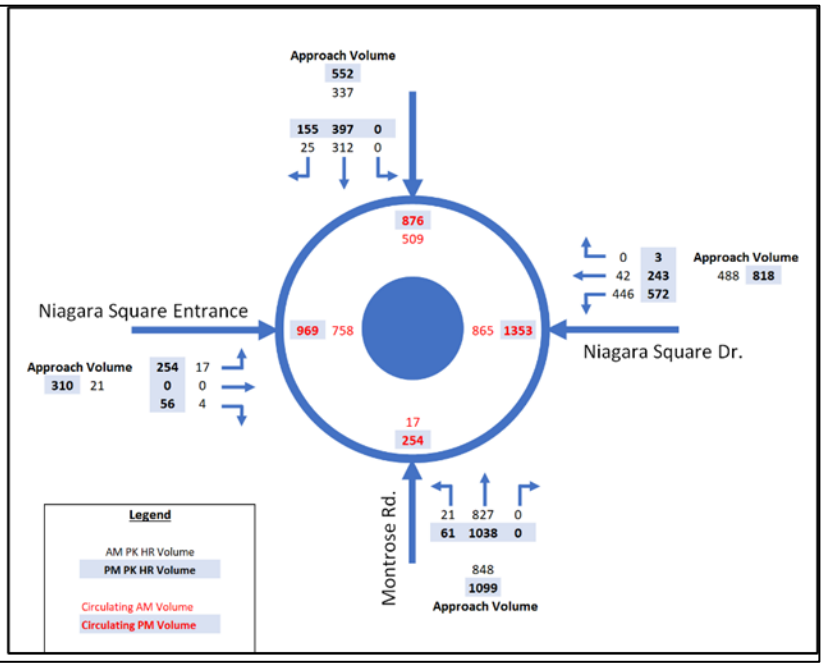
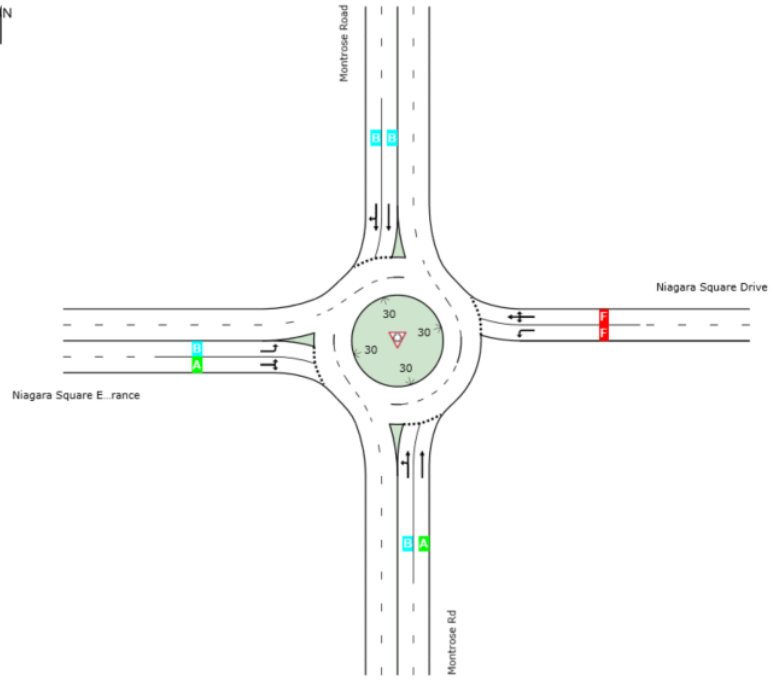


FIGURE 3-8. MONTROSE ROAD & NIAGARA SQUARE ENTRANCE, 2-LANE ROUNDABOUT INTERSECTION – SIDRA LANE LEVEL OF SERVICE PLOT

	Approaches				Intersection
	South	East	North	West	
LOS	B	F	B	A	E

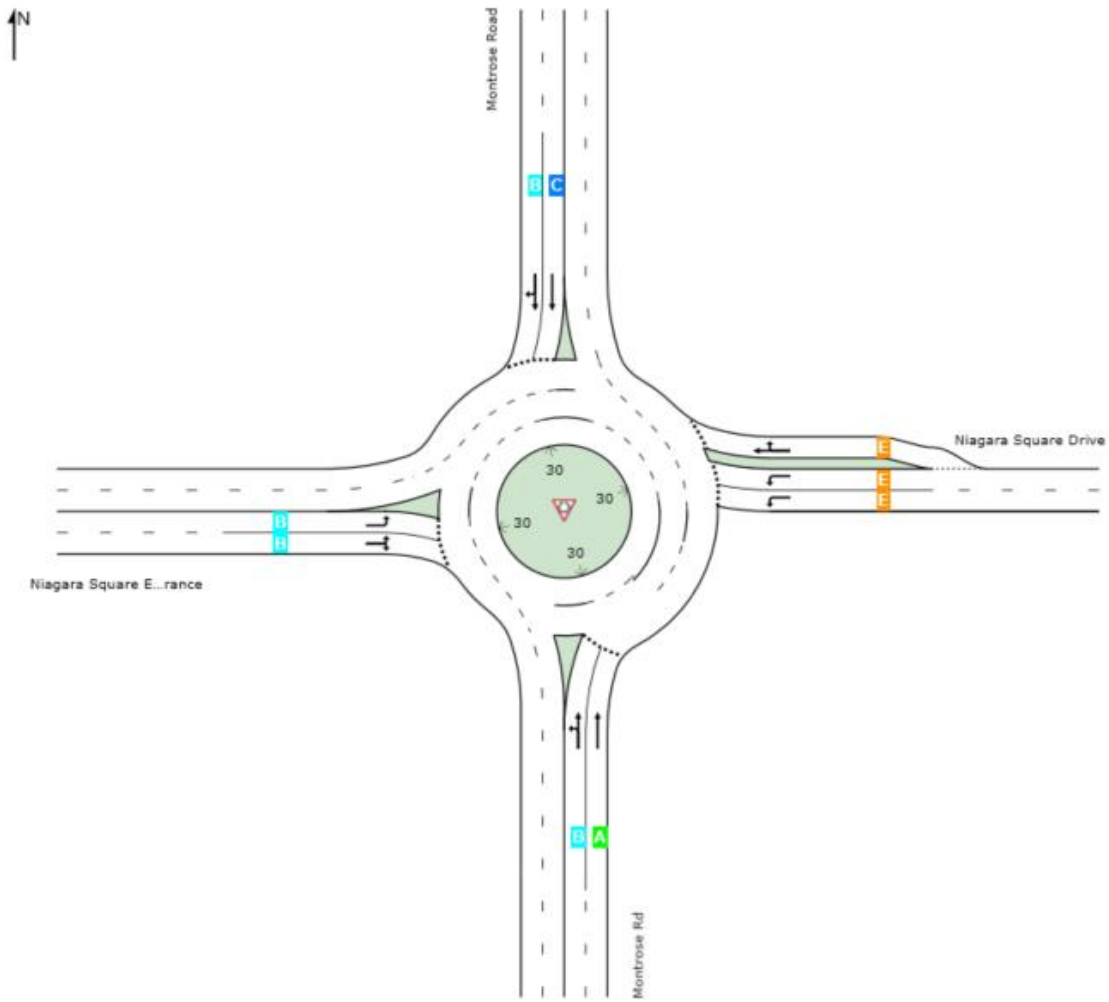


A spiral roundabout would be feasible at this location having three entry lanes on the east approach and three circulating lanes in the northern half of the roundabout between the east and west approaches. A 50 metres long third lane on the east approach would be sufficient. The resulting queues on the east approach range between 40-50 metres, with the intersection V/C as 0.82 and LOS C. The Sidra "Lane Level of Service" plot is shown in **Figure 3-9** while detailed lane usage and performance summary is provided in **Appendix G**.

As the roundabout is forecast to operate within capacity, it is anticipated that it will produce lower delays than a signalized intersection at this intersection as discussed in the feasibility approaches identified at the beginning of **Section 3.3.2**.

FIGURE 3-9. MONTROSE ROAD & NIAGARA SQUARE ENTRANCE, SPIRAL ROUNDABOUT INTERSECTION – SIDRA LANE LEVEL OF SERVICE PLOT

	Approaches				Intersection
	South	East	North	West	
LOS	B	E	B	B	C



3.4 Left Turn Lane Warrant Analysis

Left turn lane warrants were conducted for the unsignalized intersections which did not meet the signalization warrants. The warrants were conducted according to the methodology given in Appendix 9A of MTO Design Supplement for TAC Geometric Design Guide for Canadian Roads – June 2017. Table 3-6 presents a summary of the warrant analysis while detailed warrant analysis is attached as Appendix H.

TABLE 3-6. LEFT TURN LANE WARRANT ANALYSIS SUMMARY

Intersection	Direction	2026 Horizon		2041 Horizon	
		Warranted?	Storage length (m)	Warranted?	Storage length (m)
Montrose Rd and Hospital North Access	Northbound Left	Yes	25		25
Montrose Rd and Street B	Northbound Left	No	-	Yes	15
Montrose Rd and Grassy Brook Rd	Northbound Left	Yes	15		15
Montrose Rd and Oakwood Dr	Southbound Left	Yes	15		15
Montrose Rd and Chippawa Creek Rd	Northbound Left	Yes	15		15
Montrose Rd and Brown Rd	Northbound Left	Yes	15		25
Biggar Rd and Hospital West Access	Eastbound Left	Yes	15		15
Lyons Creek Rd and Willodell Rd	Westbound Left	Yes	25		25

3.5 Proposed Functional Design

Traffic functional requirements were finalized through an iterative process. The process included, conducting a preliminary traffic analysis to determine functional components; developing the preliminary design of the functional components based on the relevant geometric design standards and site restrictions; and then revaluating the traffic operations performance of the preliminary design. The comments from relevant reviewing agencies were also incorporated during the re-evaluation. In some instances, multiple iterations were necessary.

3.5.1 PRELIMINARY TRAFFIC ANALYSIS

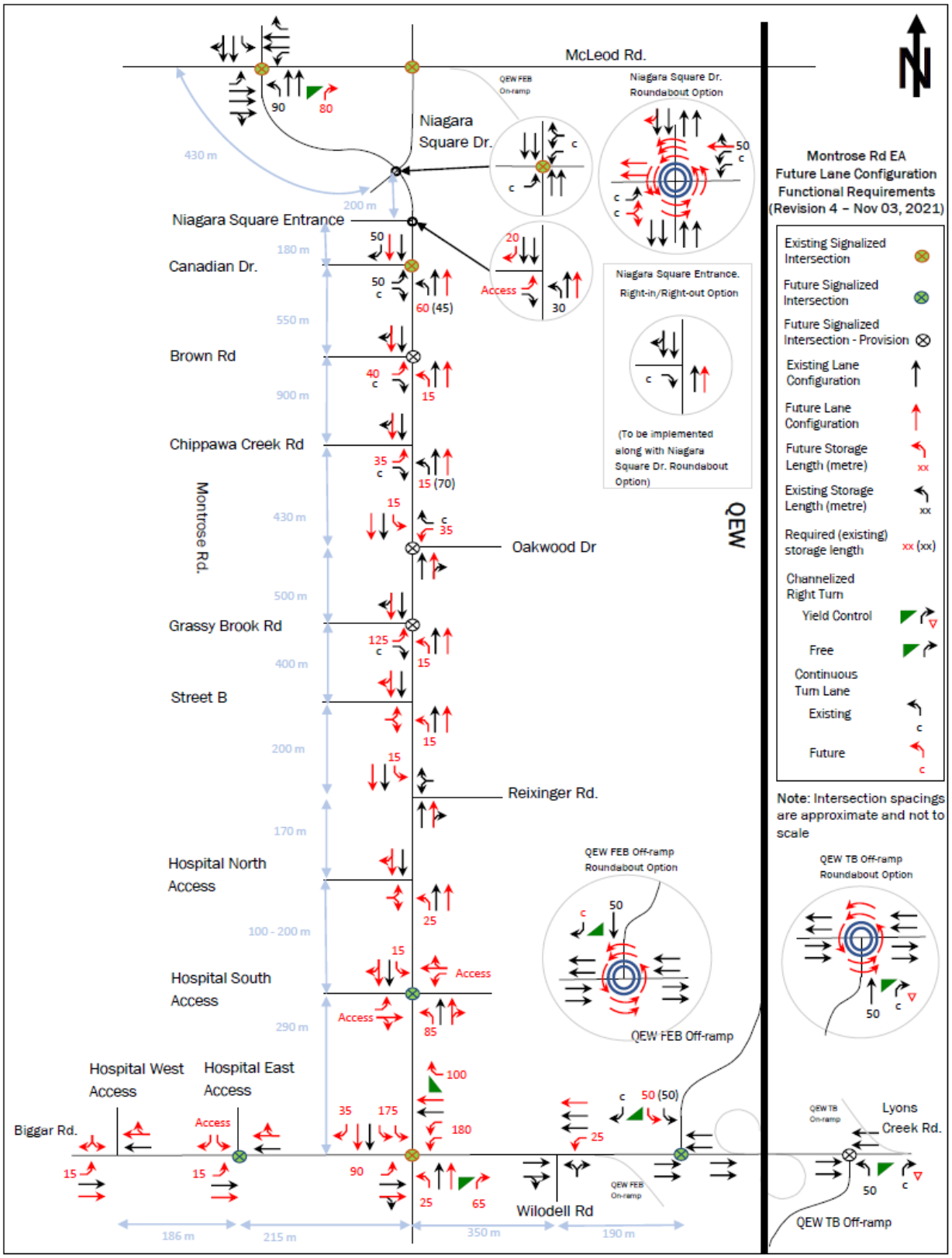
Synchro intersection capacity analysis was conducted for the future (2026) and (2041) traffic conditions to evaluate the operational performance of the improvements determined in the previous sections and to further refine and optimize the functional design. The schematic of the preliminary proposed future lane configurations, approximate intersection spacing (centre to centre) and traffic control requirements is shown in Figure 3-10.

3.5.1.1 Signalized Intersections

Signal cycle lengths and split timings were adjusted and optimized to allow more green time to the heavy movements while achieving the optimal intersection performance at the same time. Signal timing parameters noted in Section 3.4 of the Niagara Region Traffic Signal Standards – January 2014 were adhered to while optimizing the signal timings. We understand that the detailed signal timing design will be undertaken by the relevant departments of the Niagara Region.

Synchro analysis results are summarized in Table 3-7. Synchro results for 2026 traffic conditions are also presented for comparison. Detailed synchro reports are provided in Appendix I.

FIGURE 3-10. PRELIMINARY FUTURE LANE CONFIGURATIONS AND INTERSECTION CONTROL



With the proposed improvements, most signalized intersections are operating within capacity.

Montrose Road and Lyons Creek/Biggar Road intersection is forecast to be somewhat over capacity under 2041 conditions. The overall delay is 67 s with LOS "E" during AM peak hour and 82 s with LOS "F" during PM peak hour. SBL and WBL movements are heavy turning movements and require dual turning lanes. The queues for these movements reach up to 180 m and are not predicted to extend into upstream intersections. Such operational conditions are expected during peak times at gateway intersections such as Montrose Road and Lyons Creek/Biggar Road intersection and therefore no further capacity improvement measures were considered. The intersection may be monitored for potential signal timing optimization and operational solutions to improve capacity and LOS.

QEW FEB Off-ramp and Lyons Creek Road intersection is also predicted to be overcapacity; however the overall delay ranges between 11-16 s with LOS "B" which is acceptable. All movements are operating within capacity with maximum LOS "C". The SBR movements is proposed to be a free movement with a merge lane proposed along WB Lyons Creek Road. SBL movement is proposed to have dual left turn lanes with 50 m storage. A roundabout at this intersection was found operationally feasible as discussed in Section 3.2.2.3; further feasibility was assessed during preliminary design and subsequent traffic analysis using ARCADY software.

The McLeod Road and Montrose Road intersection is forecast to operate moderately over capacity which is expected within developed urban environments. For the future (2026) conditions, only signal timings were improved. For the future (2041), a second northbound through lane was added to match the recently constructed lane configuration on the north approach. A northbound free right turn is also proposed to add capacity to the intersection.

TABLE 3-7. SIGNALIZED INTERSECTION CAPACITY ANALYSIS –FUTURE (2026 & 2041) CONDITIONS WITH IMPROVEMENTS

Intersection	AM Peak Hour									PM Peak Hour								
	Overall			Critical Movements						Overall			Critical Movements					
	V/C	Delay (s)	LOS	Dir	V/C	Delay (s)	LOS	Queue (m) 50th	Queue (m) 95th	V/C	Delay (s)	LOS	Dir	V/C	Delay (s)	LOS	Queue (m) 50th	Queue (m) 95th
2026 Horizon																		
Montrose Rd & Lyons Creek Rd/Biggar Rd	0.88	48	D	EBL	1.01	102	F	51	100	0.92	67	E	EBL	0.64	53	D	27	41
				WBL	0.97	91	F	37	65				EBTR	0.97	94	F	72	108
				NBL	0.30	41	D	11	24				WBL	1.02	97	F	106	144
				NBT	0.53	42	D	35	50				WBT	0.41	38	D	53	70
				NBR	0.61	49	D	17	75				WBR	0.34	38	D	16	45
				SBL	0.96	97	F	28	52				NBL	0.23	58	E	7	18
				-	-	-	-	-	-				NBT	0.59	63	E	41	57
				-	-	-	-	-	-				NBR	0.57	67	E	16	74
				-	-	-	-	-	-				SBL	1.01	96	F	100	139
Montrose Rd & Canadian Dr.	0.26	10	A	-	-	-	-	-	-	0.61	16	B	-	-	-	-	-	-
Montrose Rd & Niagara Square Dr	0.69	13	B	-	-	-	-	-	-	0.85	19	B	WBL	0.85	24	C	25	51
													NBT	0.86	19	B	35	66
Montrose Rd & McLeod Rd	0.78	27	C	-	-	-	-	-	-	1.10	70	E	EBL	0.97	128	F	16	45
				-	-	-	-	-	-				EBTR	0.97	72	E	108	136
				-	-	-	-	-	-				WBL	1.02	107	F	49	102
				-	-	-	-	-	-				WBT	0.92	58	E	138	177
				-	-	-	-	-	-				WBR	0.34	36	D	14	43
				-	-	-	-	-	-				NBL	0.36	37	D	16	28
				-	-	-	-	-	-				NBT	0.71	51	D	79	113
				-	-	-	-	-	-				NBR	1.04	109	F	120	193
				-	-	-	-	-	-				SBL	1.04	90	F	84	163
	0.69	19	B	NBL	0.85	25	C	32	72	0.80	27	C	NBL	0.87	47	D	11	34

Intersection	AM Peak Hour									PM Peak Hour								
	Overall			Critical Movements						Overall			Critical Movements					
	V/C	Delay (s)	LOS	Dir	V/C	Delay (s)	LOS	Queue (m) 50th	Queue (m) 95th	V/C	Delay (s)	LOS	Dir	V/C	Delay (s)	LOS	Queue (m) 50th	Queue (m) 95th
Montrose Rd & Hospital South Access				-	-	-	-	-	-				SBT	0.92	36	D	49	82
Biggar Rd & Hospital East Access	0.32	11	B	-	-	-	-	-	-	0.45	14	B	-	-	-	-	-	-
Lyons Creek Rd & QEW FEB off-ramp	0.97	11	B	-	-	-	-	-	-	0.90	12	B	-	-	-	-	-	-
2041																		
Montrose Rd & Lyons Creek Rd/Biggar Rd	1.10	67	E	EBL	1.10	115	F	35	85	1.07	82	F	EBL	0.75	54	D	39	58
				EBTR	0.58	36	D	32	46				EBT	1.08	120	F	99	137
				WBL	1.47	272	F	46	73				WBL	1.23	173	F	140	179
				WBT	0.75	38	D	50	68				WBT	0.56	44	D	71	96
				SBL	1.46	273	F	36	60				NBL	0.28	60	E	9	20
				-	-	-	-	-	-				NBT	0.65	64	E	45	62
				-	-	-	-	-	-				SBL	1.19	160	F	134	173
Montrose Rd & Canadian Dr.	0.37	12	B							0.83	24	C	NBL	0.89	42	D	18	57
				-	-	-	-	-	-				SBT	0.86	32	C	55	85
Montrose Rd & Niagara Square Dr	0.80	16	B	-	-	-	-	-	-	0.91	26	C	WBL	0.91	34	C	54	90
				-	-	-	-	-	-				NBT	0.92	26	C	78	124
Montrose Rd & McLeod Rd	0.91	24	C	NBT	0.67	36	D	22	37	1.15	55.5	E	EBL	0.84	67	E	15	42
				SBL	0.89	60	E	24	62				EBTR	0.89	52	D	109	136
				-	-	-	-	-	-				WBL	0.92	71	E	47	103
				-	-	-	-	-	-				WBT	0.89	46	D	143	195
				-	-	-	-	-	-				NBL	0.58	50	D	19	32
				-	-	-	-	-	-				NBT	0.90	76	E	57	76
				-	-	-	-	-	-				SBL	1.27	179	F	130	199
				-	-	-	-	-	-				SBTR	0.61	43	D	63	81
Montrose Rd & Hospital South Access	0.74	25	C	NBL	0.91	32	C	33	83	0.89	32	C	WBL	0.77	60	E	12	36
				-	-	-	-	-	-				NBL	0.86	45	D	12	43
				-	-	-	-	-	-				SBT	0.96	42	D	71	112
Biggar Rd & Hospital East Access	0.38	9	A	SBL	0.39	40	D	14	29	0.58	16	B	-	-	-	-	-	-
Lyons Creek Rd & QEW FEB off-ramp	1.12	11	B	-	-	-	-	-	-	1.08	16	B	EBT	0.90	22	C	71	117

3.5.1.2 Unsignalized Intersections

A summary of Synchro analysis results is presented in **Table 3-8**. Intersections at Niagara Square Entrance, Brown Road, Oakwood Drive, Grassy Brook Road and QEW TB off-ramp are anticipated to have excessive delays to minor street traffic under the future (2041) conditions. These intersections do not meet the warrants for signalization in the 2041 horizon year because crossing volumes fall short of the threshold. Due to significant delays at the crossing roadways, these intersections, except the Niagara Square Entrance intersection, are proposed to have provisions for traffic signals installation and should be monitored for actual traffic volumes. With development of active transportation and transit infrastructure, crossing volumes including pedestrians are likely to increase which may warrant the installation of traffic signals at these intersections. The storage lengths for these intersections shown in **Figure 3-10** are based on signalized capacity analysis. Detailed Synchro reports are provided in **Appendix I**.

Owing to proximity to the Canadian Drive signalized intersection, Region did not support the signalization of the Niagara Square Entrance intersection during their review of the Niagara Square Redevelopment TIS. Excessive delays are likely to cause motorists accepting unsafe gaps making very aggressive left turns. For safer operations, this entrance is recommended to be a Right-in Right-out Only (RIRO) access with a continuous median from the Niagara Square Drive intersection to the Canadian Drive intersection.

TABLE 3-8. UNSIGNALIZED INTERSECTION CAPACITY ANALYSIS – FUTURE (2026 & 2041) CONDITIONS WITH IMPROVEMENTS

Intersection	2026					2041				
	Dir	Delay (s)	95th Queue	V/C	LOS	Dir	Delay (s)	95th Queue	V/C	LOS
AM Peak Hour										
Montrose Rd & Reixinger Rd	WBL	11.3	0.4	0.02	B	WBL	11.4	0.6	0.03	B
	SBL	8.4	0.2	0.01	A	SBL	8.6	0.3	0.01	A
Montrose Rd & Grassy Brook Rd	EBL	16.6	15.5	0.42	C	EBL	96.8	112.5	1.07	F
	NBL	8.7	0.8	0.03	A	NBL	9.9	1.5	0.06	A
Montrose Rd & Oakwood Dr	WBL	18.7	4.9	0.18	C	WBL	36.6	12.2	0.37	E
	SBL	8.8	0.4	0.02	A	SBL	10.1	0.6	0.03	B
Montrose Rd & Chippawa Creek Rd	EBL	17.1	8.0	0.26	C	EBL	36.3	20.9	0.52	E
	NBL	8.6	0.8	0.04	A	NBL	9.5	1.2	0.05	A
Montrose Rd & Brown Rd	EBL	40.7	42.2	0.74	E	EBL	239.8	117.9	1.37	F
	NBL	8.7	0.9	0.04	A	NBL	9.6	1.1	0.05	A
Montrose Rd & Niagara Square Entrance	EBL	14.5	0.8	0.03	C	EBL	20.4	1.3	0.05	C
	EBR	9.8	0.1	0.0	A	EBR	10.7	0.1	0.01	B
	NBL	8.6	0.5	0.02	A	NBL	9.5	0.7	0.03	A
Lyons Creek Rd & Willodell Rd	WBL	10.7	1.7	0.07	B	WBL	11.8	2.4	0.09	B
	NBL	15.0	1.7	0.07	B	NBL	19.2	2.8	0.11	C
Lyons Creek Rd & QEW TB off-ramp	NBL	38.1	42.3	0.73	E	NBL	71.9	68.4	0.93	F
	NBR	10.4	2.3	0.09	B	NBR	10.8	2.7	0.11	B
Montrose Rd & Street B	EBL	10.6	1.4	0.06	B	EBL	11.9	3.6	0.14	B
	NBL	8.1	0.4	0.02	A	NBL	8.6	0.9	0.04	A
Montrose Rd & Hospital North Access	EBL	10.1	1.2	0.05	B	EBL	10.5	1.3	0.05	B
	NBL	8.6	3.9	0.15	A	NBL	9.2	4.4	0.16	A
Biggar Road & Hospital West Access	EBL	8.3	0.4	0.02	A	EBL	8.9	0.5	0.02	A
	SBL	9.7	0.5	0.02	A	SBL	10.5	0.6	0.02	B
PM Peak Hour										
Montrose Rd & Reixinger Rd	WBL	12.3	1.8	0.07	B	WBL	13.8	4.1	0.15	B
	SBL	8.3	0.0	0.00	A	SBL	8.5	0.1	0.00	A
Montrose Rd & Grassy Brook Rd	EBL	37.3	41.4	0.72	E	EBL	441.4	245.3	1.87	F
	NBL	10.2	0.5	0.02	B	EBR	15.2	2.4	0.09	C
	-	-	-	-	-	NBL	12.6	1.2	0.05	B
Montrose Rd & Oakwood Dr	WBL	96.8	56.4	0.93	F	WBL	691.8	124.6	2.26	F
	SBL	9.7	0.9	0.04	A	WBR	13.9	1.7	0.07	B
	-	-	-	-	-	SBL	11.8	1.5	0.06	B
Montrose Rd & Chippawa Creek Rd	EBL	27.2	15.4	0.43	D	EBL	136.0	34.5	0.84	F
	NBL	9.4	1.1	0.05	A	EBR	13.2	2.8	0.11	B
	-	-	-	-	-	NBL	10.9	1.8	0.07	B
	EBL	162.1	85.8	1.16	F	EBL	760.3	131.8	2.41	F

Intersection	2026					2041				
	Dir	Delay (s)	95th Queue	V/C	LOS	Dir	Delay (s)	95th Queue	V/C	LOS
Montrose Rd & Brown Rd	NBL	10.1	1.9	0.08	B	EBR	14.4	3.5	0.13	B
	-	-	-	-	-	NBL	12.0	2.7	0.11	B
Montrose Rd & Niagara Square Entrance	EBL	160.1	77.3	1.13	F	EBL	655.5	143	2.22	F
	EBR	11.2	2.1	0.09	B	EBR	12.8	3	0.12	B
	NBL	11.5	2.3	0.09	B	NBL	13.7	3.6	0.14	B
Lyons Creek Rd & Willodell Rd	WBL	13.7	2.1	0.08	B	WBL	16.9	3.4	0.13	C
	NBL	34.8	6.3	0.23	D	NBL	66.7	12.7	0.41	F
Lyons Creek Rd & QEW TB off-ramp	NBL	115.1	45.4	0.90	F	NBL	267.4	72	1.31	F
	NBR	14.4	6.4	0.22	B	NBR	15.9	7.9	0.26	C
Montrose Rd & Street B	EBL	12.8	1.8	0.07	B	EBL	15.4	4.7	0.17	C
	NBL	9.4	0.6	0.03	A	NBL	10.3	1.4	0.06	B
Montrose Rd & Hospital North Access	EBL	12.7	4.9	0.18	B	EBL	14.4	5.9	0.21	B
	NBL	9.8	2.0	0.08	A	NBL	10.8	2.4	0.10	B
Biggar Road & Hospital West Access	EBL	8.8	0.2	0.01	A	EBL	9.4	0.2	0.01	A
	SBL	16.0	6.4	0.22	C	SBL	28.4	6.7	0.23	D
	-	-	-	-	-	SBR	11.5	1.9	0.08	B

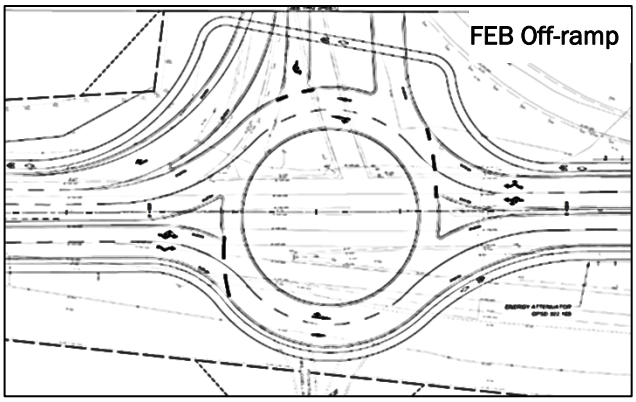
3.5.2 DETAILED TRAFFIC ANALYSIS

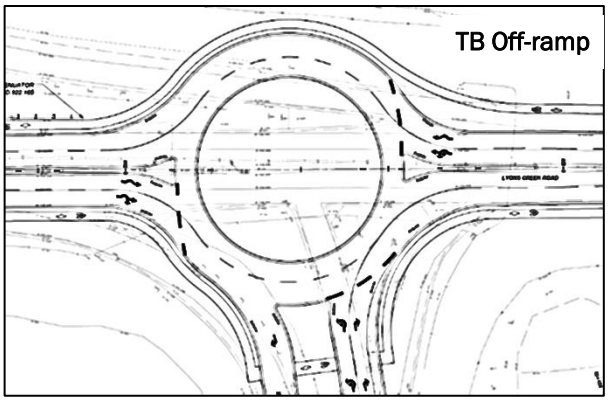
Detailed traffic analyses of the preliminary draft design of select locations were conducted incorporating the relevant comments from various review agencies. Several technical memoranda were submitted to present the findings and results of the detailed traffic analyses. This section provides the summary of the analyses discussed in the respective memoranda.

3.5.2.1 ARCADY Analysis – Roundabouts at QEW Terminals at Lyons Creek Road

Preliminary sizing and feasibility assessment of roundabout intersection control at both QEW terminals at Lyons Creek Road was conducted using SIDRA software. Following the development of preliminary draft design of the roundabouts at the QEW terminals, shown in **Figure 3-11**, a detailed operational assessment of the roundabouts was conducted using MTO's approved ARCADY software which depends on the geometric parameters of a roundabout for capacity calculations. The technical memorandum is included in **Appendix J**.

FIGURE 3-11: PRELIMINARY DRAFT DESIGN OF QEW RAMP TERMINAL ROUNDABOUTS





The ARCADY analysis results under 2041 traffic conditions are presented in **Table 3-9**. Both roundabouts are predicted to operate well during the AM peak hour. During the PM peak hour conditions, the QEW FEB Off-ramp roundabout is shown to be over-capacity with overall LOS F, while the eastbound approach experiences capacity constraints at both the intersections.

At QEW FEB Off-ramp roundabout, the eastbound approach is over capacity during PM peak hour with average delay of 125 s. The mean queue is forecast to be 560 m which exceeds the 540 m (approximately) spacing between the FEB Off-ramp and the upstream Lyons Creek Road and Montrose Road intersection. The maximum 95th percentile queue is predicted to be 1,140 m (152 PCE). Therefore, the eastbound queues from this roundabout are anticipated to interfere with the operation of the upstream Lyons Creak Road Montrose Road intersection.

TABLE 3-9: QEW RAMP TERMINALS ROUNDABOUT INTERSECTIONS – ARCADY ANALYSIS 2041 TRAFFIC CONDITIONS

AM Peak Hour								PM Peak Hour							
Overall		Approach						Overall		Approach					
Delay (s)	LOS	Direction	V/C	Delay (s)	LOS	Queue (PCE)*		Delay (s)	LOS	Direction	V/C	Delay (s)	LOS	Queue (PCE)*	
						Mean	95th							Mean	95th
Lyons Creek Road and QEW Fort Erie Bound Off-ramp Intersection															
4.82	A	Eastbound	0.65	5.19	A	0.9 (8m)	3.1 (23m)	57.61	F	Eastbound	1.07	124.45	F	74.5 (560m)	152.1 (1140m)
		Westbound	0.38	2.95	A	0.7 (8m)	3.0 (23m)			Westbound	0.38	3.06	A	0.7 (8m)	3 (23m)
		Southbound	0.27	5.57	A	0.4 (8m)	1.3 (10m)			Southbound	0.57	8.63	A	1.3 (8m)	2.4 (18m)
Lyons Creek Road and QEW Toronto Bound Off-ramp Intersection															
4.40	A	Eastbound	0.68	5.73	A	2.1 (15m)	4.0 (30m)	33.23	D	Eastbound	0.99	51.46	F	28.2 (212m)	110.8 (830m)
		Westbound	0.41	3.28	A	0.7 (8m)	2.8 (23m)			Westbound	0.44	3.05	A	0.8 (8m)	2.1 (15m)
		Northbound	0.17	2.04	A	0.2 (8m)	0.5 (8m)			Northbound	0.16	2.67	A	0.2 (8m)	0.5 (8m)

At the QEW TB Off-ramp intersection, the eastbound approach is at capacity during the PM peak hour with average delay of 51.46 s. The maximum mean queue is 212 m (28.2 PCE). The maximum 95th percentile queue is forecast to be 830 m (110.8 PCE) which exceeds the approximate *500 m* spacing between the FEB Off-ramp and TB Off-ramp intersections. The 95th percentile queue exceeds 500 m length (67 PCE) for 25-30 minutes during the PM peak hour and therefore is anticipated to interfere with the operation of the upstream FEB Off-ramp roundabout intersection.

Based on the ARCADY traffic analysis, it was inferred that the roundabouts as proposed in the preliminary draft design, were not operationally feasible. However, maintaining the existing West-FEB On-ramp as well as providing a channelized bypass lane at the QEW TB Off-ramp roundabout for EBR turning movement resolved the capacity and queueing issues under 2041 traffic conditions.

Roundabouts at the two ramp terminals were not carried forward as a preferred intersection control due to following considerations:

- Significant queuing at both roundabouts impacting the operation of the upstream intersections.
- Queueing was also a concern beyond traffic operational efficiency due to the need for EMS vehicles to have ready access to the proposed SNH.
- Options were reviewed to remove certain movements from the roundabouts; however, these were determined to be geometrically deficient and would have significant impacts on property and cause the closure of Willodell Road.

3.5.2.2 SimTraffic Analysis – Lyons Creek/Biggar Road Segment and SNH Entrances

MTO's comments on the draft DTA Report (Version 3) requested a SimTraffic review of the Lyons Creek/Biggar Road segment intersections and both SNH entrances; the Willodell Road intersection as right-in/right-out. The MTO's comments and detailed responses are included in **Appendix K**. As part of the MTO's review of the proposed preliminary design of the ramp terminals, they also requested the analysis of the ramp terminals with a classic T-intersection configuration.

The following three scenarios were modelled in SimTraffic:

- **Scenario 1**: Channelized QEW Ramp terminals, shown in **Figure 3-12**, with an auxiliary westbound lane for SB right-turn volumes along the Lyons Creek Road segment between Montrose Road and QEW FEB off-ramp. The Synchro analysis presented in **Table 3-7** pertains to this scenario. Considering the Complete Street Design guidelines of Niagara Region, the lane configuration of Montrose Road and Lyons Creek Road intersection was modified from that presented in **Figure 3-10**. The east to north as well as the south to east channelized right turns were converted to permitted right turns passing through the intersection.

FIGURE 3-12: SCENARIO – 1; CHANNELIZED QEW RAMP WITH AUXILIARY WESTBOUND LANE (FOR FEB) ALONG LYONS CREEK ROAD

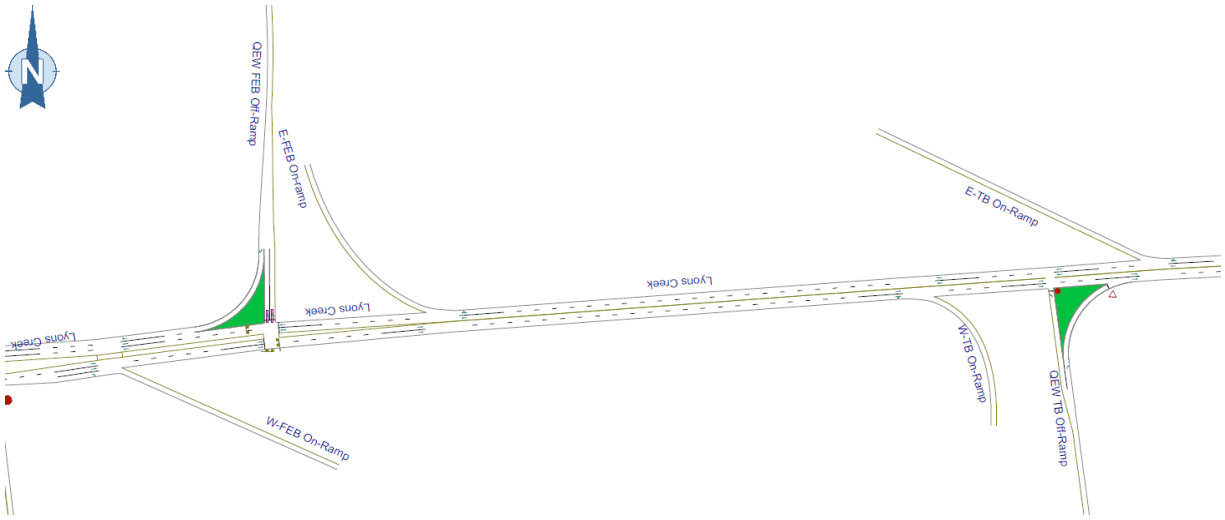
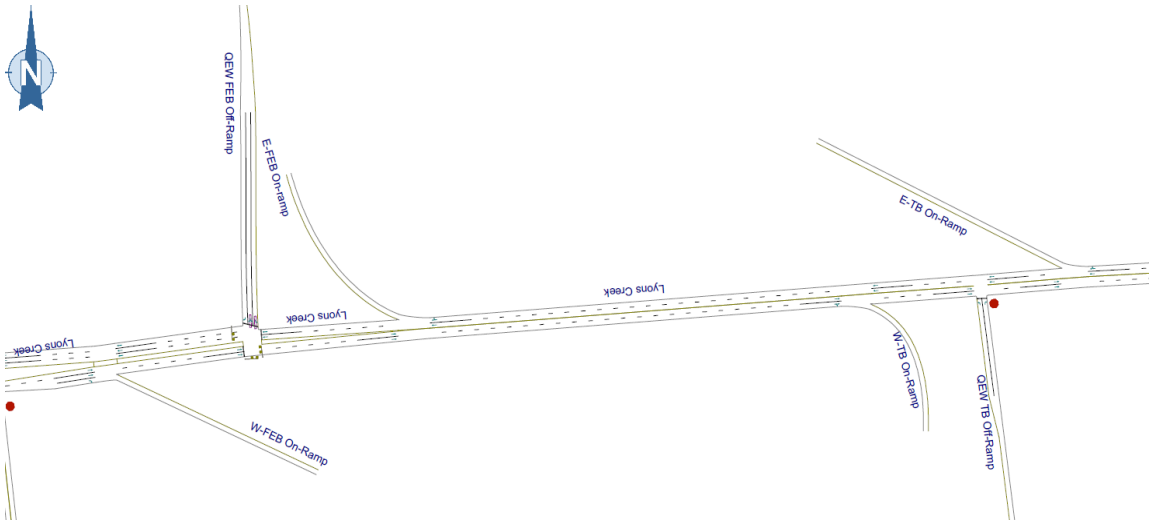
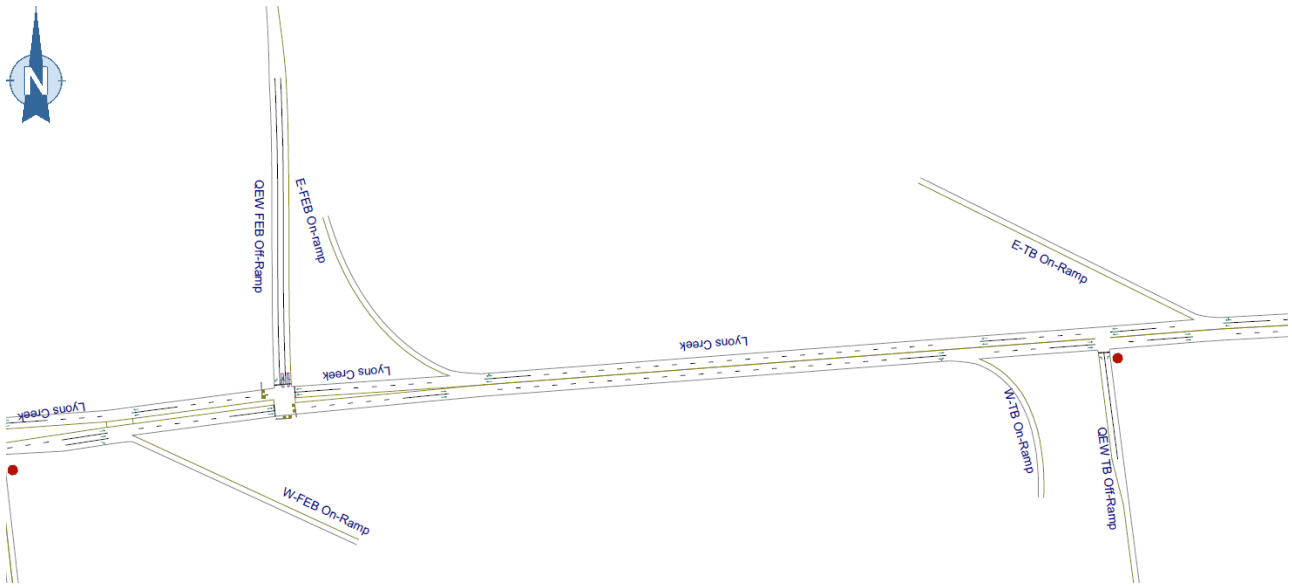


FIGURE 3-13: SCENARIO – 2; CLASSIC T-INTERSECTION QEW RAMPS WITH AUXILIARY WESTBOUND LANE (FOR FEB) ALONG LYONS CREEK ROAD



- **Scenario 2:** Same as Scenario 1 but QEW both ramp terminals were modelled as classic T-intersections. Centre lane for the QEW FEB off-ramp was modelled as a shared right-left turn lane. Lane configuration is shown in **Figure 3-13**.
- **Scenario 3:** Same as Scenario 2 but without the auxiliary westbound lane along the Lyons Creek Road segment between Montrose Road and QEW FEB off-ramp. The lane configuration is shown in **Figure 3-14**.

FIGURE 3-14: SCENARIO – 3; T-INTERSECTION QEW RAMPS WITHOUT AUXILIARY WESTBOUND LANE (FOR FEB) ALONG LYONS CREEK ROAD



Scenario 3 was the preferred lane configuration due to the following:

- The WB left-turn volumes at Lyons Creek Road and Montrose Road intersection are significantly high. The auxiliary westbound lane along Lyons Creek Road in Scenario 1 and 2 potentially poses weaving concerns for those SB right-turn volumes at QEW FEB Off-ramp, which will be eventually turning WB left at the Montrose Road intersection.
- Operational performance of QEW FEB Off-ramp in Scenario 3 is although slightly worse than that in other scenarios but it does not have any system wide negative impacts.
- T-intersection at Toronto Bound (TB) off-ramp is shown to perform better than the channelized off-ramp (Scenario -1). The better performance perhaps could be attributed to a higher delay to the eastbound vehicles at FEB Off-ramp in Scenario 2 & 3 than in Scenario 1, thus allowing increased number of gaps to the northbound vehicles at TB off-ramp.

SimTraffic results for Scenario 3 are summarized in **Table 3-10**. Please see **Appendix K** for the results of Scenario 1 and Scenario 2 as well as the detailed SimTraffic reports.

TABLE 3-10: SCENARIO 3 - SUMMARY OF SIMTRAFFIC ANALYSIS

Intersection	AM Peak Hour									PM Peak Hour								
	Overall		Turning Movements							Overall		Turning Movements						
	Delay (s)	LOS	Dir	Delay (s)	LOS	Queue (m) Ave-rage	Queue (m) Max	Queue (m) 95th	Link Length (m)	Delay (s)	LOS	Dir	Delay (s)	LOS	Queue (m) Ave-rage	Queue (m) Max	Queue (m) 95th	Link Length (m)
Montrose Rd & Lyons Creek Rd/Biggar Rd	56	E	EBL	88	F	72	134	132	180	81	F	EBL	54	D	43	88	75	180
			EBT	41	D	40	119	89				EBT	57	E	64	108	93	
			EBR	9	A	2	10	6				EBR	17	B	8	57	29	
			WBL	48	D	45	76	67	311			WBL	174	F	188	240	265	311
			WBT	25	C	99	227	207				WBT	27	C	102	212	228	
			WBR	71	E	179	271	283				WBR	8	A	23	53	44	
			NBL	48	D	13	34	29	320			NBL	65	E	8	25	19	320
			NBT	52	D	54	83	75				NBT	57	E	45	162	110	
			NBR	23	C	60	118	105				NBR	47	D	98	159	150	
			SBL	74	E	45	76	75	264			SBL	220	F	209	230	276	264
			SBT	24	C	14	36	29				SBT	30	C	201	270	368	
			SBR	13	B	12	34	25				SBR	15	B	20	50	38	
Montrose Road and Hospital South Access	17	B	EBL	23	C	1.4	9	6	Access	53	D	EBL	28	C	42	96	130	Access
			EBR	6	A	12	29	22				EBR	85	F	83	122	140	
			WBL	23	C	3	15	11				WBL	53	D	22	54	45	
			WBR	5	A	1	9	6				WBR	6	A	6	29	18	
			NBL	24	C	47	87	78	264			NBL	33	C	30	59	51	264
			NBT	12	B	27	58	47				NBT	13	B	26	57	45	
			NBTR	9	A	31	56	49				NBTR	10	A	31	60	50	
			SBL	15	B	8	19	16	198			SBL	58	E	7	106	52	198
			SBT	24	C	36	65	58				SBT	76	E	149	191	243	
			SBR	6	A	3	11	9				SBR	17	B	2	36	16	
Montrose Road and Hospital East Access	14	B	EBL	24	C	10	47	30	184	11	B	EBL	24	C	4	18	14	184
			EBT	16	B	28	70	63				EBT	10	A	23	38	25	
			WBT	15	B	27	56	46	181			WBT	14	B	29	56	28	181
			WBR	8	A	16	36	29				WBR	7	A	9	23	50	
			SBL	11	B	10	24	20	Access			SBL	10	A	18	35	18	Access
			SBR	5	A	4	14	11				SBR	5	A	7	21	7	
QEW FEB Off-Ramp & Lyons Creek Rd (T-Intersection Ramp, Signalized)	27	C	EBT	29	C	75	98	102	187	52	D	EBT	30	C	94	108	105	187
			WBT	18	B	41	70	62	100			WBT	16	B	45	68	68	100
			SBL	32	C	73	144	130	450			SBL	68	E	150	205	208	450
			SBLR	-	-	94	158	140				SBLR	-	-	170	224	224	
			SBR	38	D	88	139	131				SBR	96	F	156	208	212	
QEW TB Off-Ramp & Lyons Creek Rd	14	B	EBT	2	A	0	4	2	75	46	E	EBT	2	A	0	0	0	75
			WBT	1	A	0	7	4	57			WBT	1	A	0	0	0	57
			NBL	63	F	57	113	123	283			NBL	470	F	93	100	117	283

Intersection	AM Peak Hour									PM Peak Hour								
	Overall		Turning Movements							Overall		Turning Movements						
	Delay (s)	LOS	Dir	Delay (s)	LOS	Queue (m)			Link Length (m)	Delay (s)	LOS	Dir	Delay (s)	LOS	Queue (m)			Link Length (m)
						Ave-rage	Max	95th							Ave-rage	Max	95th	
(T-Intersection Ramp, Unsignalized)			NBR	4	A	14	47	57				NBR	182	F	206	277	374	

The northbound left (NBL) movement at QEW TB Off-ramp is shown to experience excessive delay of 470 s (8 min). Motorists in such circumstances are most likely to accept unsafe gaps resorting to very aggressive left turn maneuvers and it was also indicated by MTO that a signal control will be preferred at this intersection for a safe operation. Although, a signal control is not warranted at this intersection under 2041 traffic conditions, it is recommended to have provisions for traffic signals installation and should be monitored for actual traffic volumes. Traffic signals should be installed when warranted based on the actual volumes or if needed to address the operational concerns.

Installation of a traffic signal at the QEW TB Off-ramp would also benefit operations of the FEB Off-ramp resulting into improved LOS. Table 3-11 summarizes the SimTraffic operations for both QEW ramp terminal with QEW TB Off-ramp as a signalized intersection.

TABLE 3-11: SUMMARY OF SIMTRAFFIC ANALYSIS – QEW TB OFF-RAMP SIGNALIZED

Intersection	AM Peak Hour									PM Peak Hour								
	Overall		Turning Movements							Overall		Turning Movements						
	Delay (s)	LOS	Dir	Delay (s)	LOS	Queue (m)			Link Length (m)	Delay (s)	LOS	Dir	Delay (s)	LOS	Queue (m)			Link Length (m)
						Ave-rage	Max	95th							Ave-rage	Max	95th	
QEW FEB Off-Ramp & Lyons Creek Rd (T-Intersection Ramp, Signalized)	27	C	EBT	29	C	73	105	100	187	52	D	EBT	32	C	94	109	110	187
			WBT	17	B	42	70	63	100			WBT	18	B	49	74	71	100
			SBL	30	C	72	137	124	450			SBL	56	E	118	161	156	450
			SBLR	-	-	93	154	134				SBLR	-	-	140	181	175	
			SBR	37	D	87	146	126				SBR	70	E	125	164	158	
QEW TB Off-Ramp & Lyons Creek Rd (T-Intersection Ramp, Signalized)	14	B	EBT	7	A	21	43	36	75	46	E	EBT	6	A	27	55	47	75
			WBT	6	A	18	38	34	57			WBT	4	A	16	37	32	57
			NBL	17	B	31	50	49	283			NBL	30	C	27	53	46	283
			NBR	6	A	10	31	29				NBR	9	A	18	67	41	

In summary, the following is inferred from the SimTraffic analysis of the Lyons Creek/Biggar Road segment.

- The operations of the QEW ramp terminals will not be impacted by the queues from Montrose Road and Lyons Creek Road intersection. The longest maximum predicted westbound queue is 271 m for the westbound right turn movement during the AM peak hour. The approximate length of the Lyons Creek Road segment between Willodell Road and Montrose Road is 300 m, therefore the longest maximum predicted queue would not extend easterly beyond Willodell Road.
- The predicted queues on both off-ramps are not expected to extend back to the QEW main line.

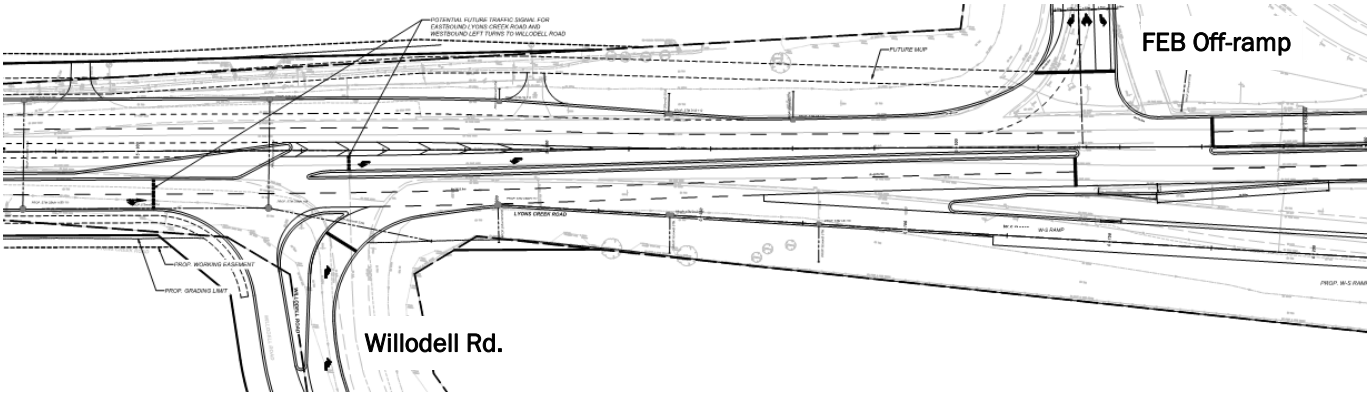
3.5.2.3 Willodell Road Intersection

Willodell Road is an existing municipal road which has been in existence for many years. According to the MTO's comments referred in Section 3.5.2.3, the Willodell Road intersection was modelled as right-in/right-out (RIRO) only. The option of restricting the Willodell Road intersection to RIRO only was presented at Public Information Centre (PIC) – 3.

Considerable concern with this option was expressed by many of the existing owners of properties south of Lyons Creek Road due to significant out of way travel and shifting of traffic patterns onto existing local roads.

Several concept options were reviewed to determine a potential solution to the concerns of the existing users. The preferred solution developed in consultation with MTO is shown in **Figure 3-15**.

FIGURE 3-15: LYONS CREEK ROAD & WILLODELL ROAD INTERSECTION – PREFERRED DESIGN



No change has been proposed in the location of Lyons Creek Road and Willodell Road intersection other than a shift of the intersection by approximately 20m to the west to accommodate revised turning radii. The Montrose Road and Lyons Creek Road/Biggar Road EA does not propose or foresee any change in the land-use being served by the existing Willodell Road. The current City of Niagara Falls Official Plan indicates that southern limit of the urban boundary is generally along Lyons Creek Road within the area of Willodell Road. Currently, the City of Niagara Falls is not intending to revise the proposed land use and the Official Plan in this area within the foreseeable future. It is recognized that this situation could change due to the development of the new South Niagara Hospital and other proposed development north and south of Lyons Creek Road at which time the intersection's location, design and traffic operations will be reviewed through relevant planning and traffic studies. In summary, existing conditions as defined by MTO Access Management Guidelines, are being maintained and accommodated at Willodell Road/Lyons Creek Road intersection, with design improvements for additional safety and operational efficiency.

The preferred design includes the following design improvements such that the operation of the intersection does not interfere with the operation of the QEW FEB Off-ramp:

- A dedicated turn lane with 75 m of storage length for the WBL movement to separate turning vehicles from the through vehicles on WB Lyons Creek Road. In the event the unsignalized configuration creates operational issues, a one-direction traffic signal (eastbound) could be installed to create turning movement opportunities for the WBL movement. The sensitivity analysis summarized in **Table 3-12**, indicates that the 75m storage is sufficient to accommodate a traffic queue resulting from a:
    - 75% increase in the WBL demand in case of an unsignalized control at the intersection.
    - 200% increase in the WBL demand in case of signalized control.
- The left-turn movement from Willodell Road will be restricted to protect the functional area of Montrose Road and Lyons Creek Road intersection.

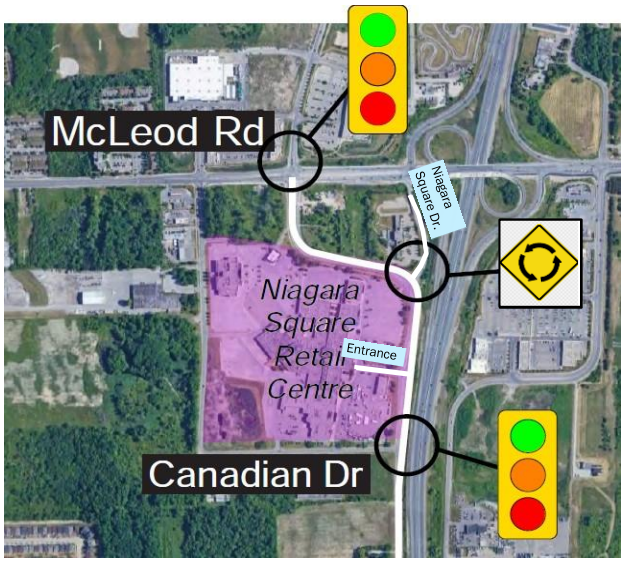
TABLE 3-12: RIGHT IN/RIGHT OUT/LEFT IN WILLOWDEL INTERSECTION - SENSITIVITY ANALYSIS WBL QUEUE COMPARISON

WBL Volume 2041 PM Peak Hour	Increase in WBL Volume	Delay (s)	LOS	Queue (m)			Storage Length (m)	Link Length (m)
				Average	Maximum	95th		
Unsignalized								
41	0	84	F	12	34	27	75	187
60	50%	149	F	25	59	56		
70	75%	122	F	28	61	59		
Signalized								
41	0	30	C	8	21	18	75	187
100	150%	30	C	17	38	32		
120	200%	31	C	21	45	37		

3.5.2.4 Niagara Square Drive Roundabout and Canadian Drive Intersection

As mentioned in Section 3.3.2, to have better access management and facilitate safe and efficient traffic flow on the Montrose Road segment from McLeod Road to Canadian Drive, one of the preliminary design options proposed relocating the Niagara Square Entrance as a fourth leg of the existing Montrose Road & Niagara Square Drive intersection. Section 3.3.2.5 determined a roundabout as a feasible option for the proposed intersection.

FIGURE 3-16: PREFERRED TRAFFIC CONTROLS – MCLEOD ROAD TO CANADIAN DRIVE SEGMENT



To minimize left turns and enhance traffic flow safety, the preferred preliminary design provides a continuous median between intersections along the McLeod Road to Canadian Drive segment. Therefore, to facilitate safe access to properties abutting northbound Montrose Road between Niagara Square Drive and McLeod Road, the preferred design includes a spiral roundabout at the Montrose Road and Niagara Square Drive intersection. To address any concerns associated with the back-up into the roundabout from traffic flow within the Niagara Square property, the Region Staff preferred that the roundabout would not have direct access to or from Niagara Square as shown in **Figure 3-16.** The existing Niagara Square Entrance will be converted to RIRO only entrance as discussed in Section 3.5.1.2.

The northbound left turning traffic at Niagara Square Entrance is anticipated to make a U-turn at roundabout to become the southbound right at Niagara Square Entrance. Alternatively, the traffic can switch to Montrose Road and Canadian Drive intersection subsequently accessing Niagara Square off the driveways connecting to Canadian Drive. Westbound left exiting traffic from Niagara Square Mall is expected to exit through the site accesses on Canadian Drive to the south and eventually become northbound through traffic at the proposed roundabout.

The technical memoranda describing detailed traffic redistribution, ARCADY analysis for the roundabout and SimTraffic analysis for the Canadian Drive intersection are included in **Appendix L**. **Table 3-13** and **Table 3-14** summarize the ARCADY and SimTraffic Analysis, respectively, for 2041 traffic conditions.

The roundabout is predicted to operate well during both the AM and PM peak hours under 2041 traffic conditions. The westbound (Niagara Square Drive) queue is forecast to be 186 m. The distance from the roundabout to the upstream QEW N-E/W Off-ramp at McLeod Road is approximately 250 m; therefore, the queue on the westbound approach will not impact the operation of the McLeod Road off-ramp.

TABLE 3-13: NIAGARA SQUARE DRIVE ROUNDABOUT - ARCADY ANALYSIS

AM Peak Hour								PM Peak Hour							
Overall		Approach						Overall		Approach					
Delay (s)	LOS	Direction	V/C	Delay (s)	LOS	Queue (PCE)*		Delay (s)	LOS	Direction	V/C	Delay (s)	LOS	Queue (PCE)*	
						Mean	95th							Mean	95th
3.43	A	Northbound	0.42	3.13	A	0.8 (6m)	2.5 (19m)	9.83	A	Northbound	0.68	5.41	A	2.1 (16m)	4.2 (32m)
		Westbound	0.36	4.22	A	0.6 (5m)	2.8 (21m)			Westbound	0.83	20.65	C	4.8 (36m)	24.8 (186m)
		Southbound	0.17	2.99	A	0.3 (2m)	0.6 (5m)			Southbound	0.37	4.20	A	0.7 (5m)	3.1 (23m)

The Canadian Drive intersection is predicted to operate well as shown in **Table 3-14**, during both the AM and PM peak hours under 2041 traffic conditions. The required storage length for the EBL lane is 100 m while the existing storage length is 50 m. Similarly, the NBL storage will need to be increased to 65 m from the existing 45 m storage length. The existing 50 m SBR storage length is predicted to be sufficient under future traffic conditions.

TABLE 3-14: MONTROSE ROAD AND CANADIAN DRIVE INTERSECTION - SIMTRAFFIC ANALYSIS

AM Peak Hour								PM Peak Hour							
Overall		Turning Movements						Overall		Turning Movements					
Delay (s)	LOS	Dir	Delay (s)	LOS	Queue (m)			Delay (s)	LOS	Dir	Delay (s)	LOS	Queue (m)		
					Ave-rage	Max	95th						Ave-rage	Max	95th
12	B	EBL	11	B	3	16	11	22	B	EBL	33	C	68	116	107
		EBR	6	A	11	24	20			EBR	13	B	34	105	78
		NBL	14	B	16	30	28			NBL	30	C	40	79	65
		NBT	10	B	25	53	40			NBT	13	B	36	65	56
		SBT	16	B	36	56	50			SBT	29	C	57	93	82
		SBR	3	A	4	10	11			SBR	8	A	17	47	33

3.6 Summary of Analysis Conclusions

Traffic design was based on the 2041 ultimate traffic conditions for the AM and PM peak hours, however, interim future (2026) traffic conditions were also evaluated as the South Niagara Hospital is expected to be operational by that year. Roadway corridor capacity analysis was conducted to determine the widening requirements. Signal warrant analyses were conducted to establish the signalization requirements. Roundabout intersection control feasibility was conducted for four potential candidate locations. Left turn lane warrants were conducted for unsignalized intersections.

Synchro intersection capacity analysis was conducted to evaluate performance of the future network and intersections. Detailed ARCADY and SimTraffic analyses were conducted for select locations. Proposed functional requirements are presented in **Figure 3-17**. Below is the summary of the traffic analysis conducted and presented in this report.

- Widening of Montrose Road of one lane in each direction within the study area will be warranted by 2026 horizon.
- Grade separation is not warranted for the CPR crossing north of Grassy Brook Road.
- A preliminary feasibility assessment determined that a roundabout at the existing Montrose Road & Niagara Square Drive intersection with a full-move Niagara Square Entrance as the fourth leg would be operationally

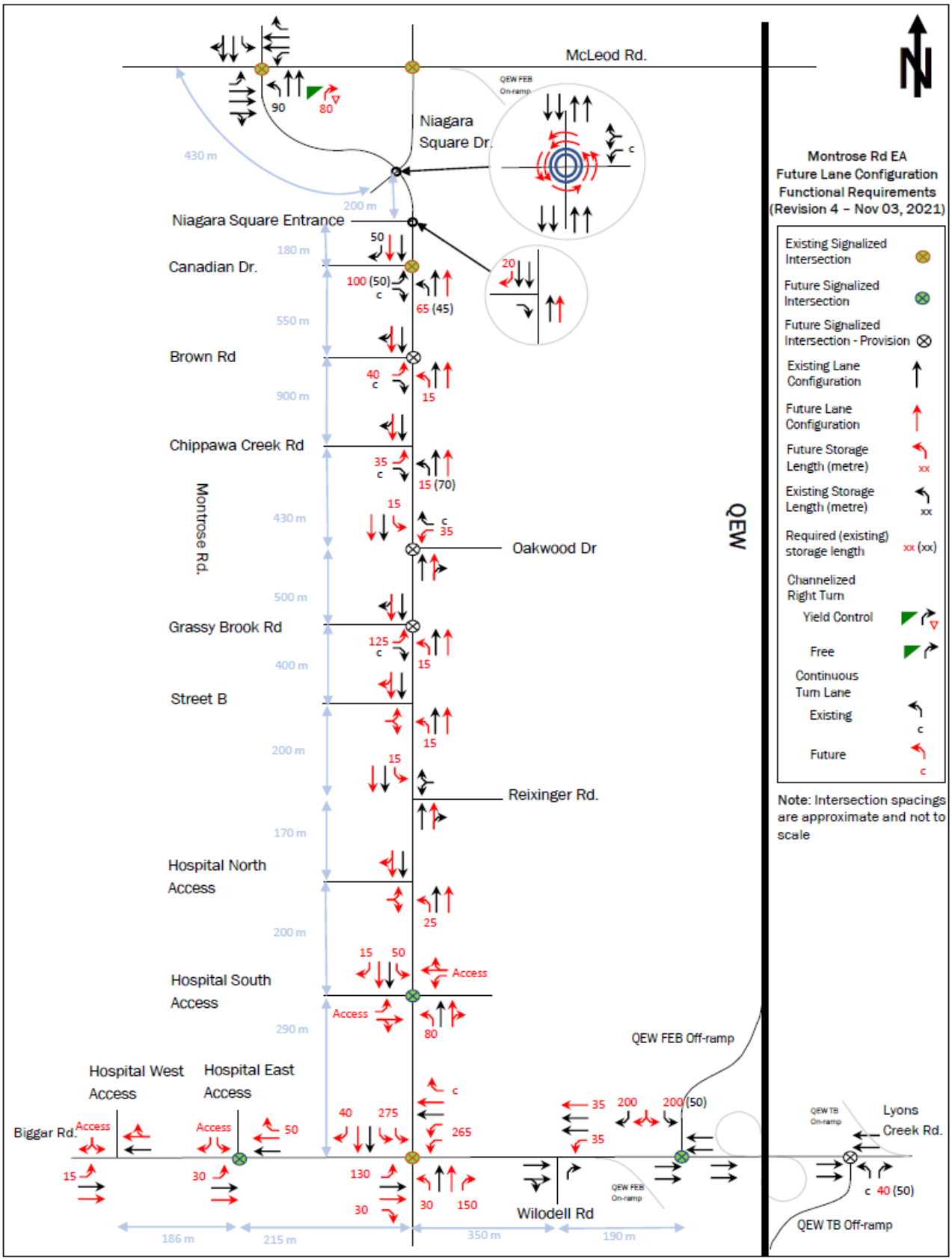
feasible. The preferred design includes a spiral roundabout at the Montrose Road and Niagara Square Drive intersection to facilitate safe access to properties abutting northbound Montrose Road between Niagara Square Drive and McLeod Road. However, to preclude any concerns associated with the back-up into the roundabout from the traffic flow within the Niagara Square property, the direct access to or from Niagara Square to the roundabout is not provided.

- The unsignalized Niagara Square Entrance intersection shows excessive delays to minor street traffic under 2041 traffic conditions, however, it does not meet the signalization warrants. Region does not support signals at this intersection due to proximity to the Canadian Drive signalized intersection, and therefore, it is recommended to convert this entrance to RIRO for safer operations.
- As a result of RIRO conversion, the northbound left turning traffic at Niagara Square Entrance is expected to make a U-turn at the Niagara Square Drive roundabout to become the southbound right at Niagara Square Entrance. The roundabout is predicted to operate well with the redistributed traffic during both the AM and PM peak hours under 2041 traffic conditions. The westbound (Niagara Square Drive) queue is forecast to be 186 m will not impact the upstream QEW N-E/W Off-ramp at McLeod Road.
- Alternatively, the northbound left turning traffic at Niagara Square Entrance traffic can switch to Montrose Road and Canadian Drive intersection subsequently accessing Niagara Square off the driveways connecting to Canadian Drive. Westbound left exiting traffic from Niagara Square Mall is expected to exit through the site accesses on Canadian Drive to the south and eventually become northbound through traffic at the Niagara Square Drive roundabout. The Canadian Drive intersection is predicted to operate well with the redistributed traffic during both the AM and PM peak hours under the 2041 traffic conditions.
- The unsignalized intersections at Brown Road, Oakwood Drive and Grassy Brook Road are shown to have excessive delay to minor street traffic under the future (2041) traffic conditions. These intersections do not meet the warrants for signalization in 2041 because crossing volumes fall short of threshold. These intersections are proposed to have provision for traffic signals and should be monitored for actual traffic volumes. With development of active transportation and transit infrastructure, crossing volumes including pedestrians are likely to increase which may warrant the installation of traffic signals at these intersections.
- Widening along Biggar Road /Lyons Creek Road and Montrose Road corridors within the study area would be needed by 2026. Biggar Road to the west of Montrose Road intersection would need widening from one lane to two lanes per direction. Lyons Creek Road from Montrose Road easterly to Willodell Road would need to be widened to two lanes per direction.
- No widening is needed to the east of Willodell Road where Lyons Creek Road already has two lane cross-section per direction.
- A preliminary feasibility assessment determined that the roundabouts at both QEW ramp terminals on Lyons Creek Road would be operationally feasible. However, detailed ARCADY analysis suggested that the roundabouts would not be a viable traffic control. Roundabouts at the two ramp terminals were not carried forward as a preferred intersection control due to following considerations:
    - Significant queuing at both roundabouts impacting the operation of the upstream intersections.
    - Queueing was also a concern beyond traffic operational efficiency due to the need for EMS vehicles to have ready access to the proposed SNH.
    - Options were reviewed to remove certain movements from the roundabouts however these were determined to be geometrically deficient and would have significant impacts on property and cause the closure of Willodell Road intersection.
- A classic T-intersection configuration is a preferred design for the QEW ramp terminals in order to minimize lane changes westbound on Lyons Creek Road to access the left turn lanes at Montrose Road.
- The intersection at the QEW FEB off-ramp would need signalization by 2026. Signals are not warranted at the QEW TB off-ramp for either of 2026 or 2041 horizons, however the northbound left (NBL) movement at QEW TB Off-ramp is shown to experience excessive delay of 470 s (8 min) under the ultimate 2041 conditions. Motorists in such circumstances are most likely to accept unsafe gaps resorting to very aggressive left turn maneuvers. MTO has indicated their preference for this intersection to be signalized for safe operations. Therefore, the QEW TB Off-ramp intersection is proposed to have provision for traffic signals due to excessive delays to the NBL

movement. The intersection should be monitored for actual traffic volumes and traffic signals be installed when either warranted based on the actual volumes or if needed to address the operational concerns.

- No change has been proposed in the location of Lyons Creek Road and Willodell Road intersection other than a shift of the intersection by approximately 20m to the west to accommodate revised turning radii. The Montrose Road and Lyons Creek Road/Biggar Road EA does not propose or foresee any change in the land-use being served by the existing Willodell Road. Existing conditions as defined by MTO Access Management Guidelines, are being maintained and accommodated at Willodell Road/Lyons Creek Road intersection, with design improvements for additional safety and operational efficiency. The preferred design includes following design improvements such that the operation of the intersection does not interfere with the operation of the QEW FEB Off-ramp:
    - A dedicated turn lane with 75 m of storage length for the WBL movement to separate turning vehicles from the through vehicles on WB Lyons Creek Road.
    - The left-turn movement from Willodell Road will be restricted to protect the functional area of Montrose Road and Lyons Creek Road intersection.
- The operations of the QEW ramp terminals will not be impacted by the queues from Montrose Road and Lyons Creek Road intersection as well the Willodell Road intersection. Also, the predicted queues on both off-ramps are not anticipated to extend back to the QEW main line.
- A three-lane roundabout feasibility was assessed for Montrose Road and Lyons Creek/Biggar Road intersection. A roundabout at this intersection is not deemed operationally feasible for the following reasons:
    - Over-capacity operations during PM peak hour.
    - Significantly long queues ranging between 500-600 metres on the north approach during PM peak hour, blocking the hospital entrances.
    - Roundabouts are not able to provide emergency vehicle precedence similar to traffic signal pre-emption to support the hospital emergency vehicle operations.
    - A roundabout having more than three lanes is not considered feasible at this location due to significantly large footprint.

FIGURE 3-17: FUTURE LANE CONFIGURATION – REVISED FUNCTIONAL REQUIREMENTS



4 Conclusions & Recommendations

The report summarized the work completed as part of Detailed Transportation Assessment in support of Montrose Road & Lyons Creek Road/Biggar Road MCEA. Following are main findings and proposed improvements resulting from the assessment work.

4.1 Analysis Conclusions

4.1.1 ROAD WIDENING

- Montrose Road will need widening to two lanes per direction by 2026.
- Grade separation is not warranted for the CPR crossing north of Grassy Brook Road.
- Widening along Biggar/ Road Lyons Creek Road and Montrose Road corridors within the study area will be needed by 2026.
- Biggar Road corridor to the west of Montrose Road would need widening from one lane to two lanes per direction.
- Lyons Creek Road from Montrose Road easterly to Willodell Road would need to be widened to two lanes per direction.
- No widening is considered to the east of Willodell Road where Lyons Creek Road already has a two-lane cross-section per direction.

4.1.2 INTERSECTION CONTROL

- Roundabouts at the QEW terminals along Lyons Creek Road are not operationally feasible as they are expected to produce significant queuing at both roundabouts impacting the operation of the upstream intersections.
- The intersection at the QEW FEB off-ramp would need signalization by 2026. Signals are not warranted for the QEW TB off-ramp for either of the 2026 and 2041 horizons. The northbound left (NBL) movement at QEW TB Off-ramp is shown to experience excessive delay of 470 s (8 min) under the ultimate 2041 conditions which could most likely cause the drivers to accept unsafe gaps. MTO has indicated their preference for this intersection to be signalized for safe operations. The QEW TB Off-ramp intersection is, therefore, proposed to have provision for traffic signals due to excessive delays to NBL movement. The intersection should be monitored for actual traffic volumes and traffic signals be installed when warranted based on the actual volumes or if needed to address the operational concerns.
- A roundabout at Montrose Road and Lyons Creek/Biggar Road intersection is not operationally feasible due to the following:
    - Over-capacity operations during PM peak hour.
    - Significantly long queues ranging between 500-600 metres on the north approach during PM peak hour, blocking the hospital entrances.
    - Roundabouts are not able to provide emergency vehicle precedence similar to traffic signal pre-emption to support the hospital emergency vehicle operations.
    - A roundabout having more than three lanes is not considered feasible at this location due to significantly large footprint.
- A roundabout at the existing Montrose Road & Niagara Square Drive intersection with a full-move Niagara Square Entrance as fourth leg is operationally feasible. However, to address any concerns associated with the back-up into the roundabout from traffic flow within the Niagara Square property, a direct access to/from Niagara Square is not preferred.
- The unsignalized Niagara Square Entrance intersection shows excessive delays to minor street traffic under 2041 traffic conditions, however, it does not meet the signalization warrants. Region does not support signals at this intersection due to proximity to the Canadian Drive signalized intersection, and therefore, it is recommended to convert this entrance to RIRO for safer operations.

- Unsignalized intersections at Brown Road, Oakwood Drive, Grassy Brook Road, and QEW TB off-ramp do not meet the warrants for signalization in 2041, however they are shown to have excessive delay to the respective minor street traffic. With development of active transportation and transit infrastructure, crossing volumes including pedestrians are likely to increase which may warrant signals at these intersections. Therefore, keeping a provision for traffic signals at these intersections and monitoring for actual traffic volumes would facilitate installation of traffic signals when needed.

4.1.3 INTERSECTION SPACING AND CONFIGURATION

All intersections are forecast to operate acceptably with the proposed improvements. The resultant queues are acceptable when compared to intersection spacing including both existing and planned intersections. The operations of the QEW ramp terminals will not be impacted by the queues from Montrose Road and Lyons Creek Road intersection as well the Willodell Road intersection. Also, the predicted queues on both off-ramps are not anticipated to extend back to the QEW main line.

4.2 Recommended Improvements

Proposed road widening, intersection control, lane configurations and storage lengths are shown in **Figure 3-17**. The recommended improvements are summarized below.

4.2.1 ROAD WIDENING

Table 4-1 summarizes the recommended road widening along Montrose Road, Lyons Creek Road and Biggar Road corridors. The recommended widening is required by 2026 horizon. No additional widening is recommended for 2041 horizon.

TABLE 4-1: RECOMMENDED ROAD WIDENING

Road Segment		Recommended Improvements
From	To	
Montrose Road		
McLeod Rd	Niagara Square Entrance	No Change
Niagara Square Entrance	Lyons Creek Road/Biggar Road	Add one lane in each direction
Lyons Creek Road/Biggar Road		
Hospital West Access	Willodell Rd	Add one lane in each direction
Willodell Rd	QEW FEB off-ramp	No change except a 35m westbound pocket lane at the Willodell Road intersection
QEW FEB off-ramp	QEW TB off-ramp	No Change

4.2.2 INTERSECTION IMPROVEMENTS

Summary of the recommended intersection controls and lane configurations is given in **Table 4-2**.

TABLE 4-2: RECOMMENDED INTERSECTION IMPROVEMENTS

Intersection	Recommend Intersection Control		Recommended Lane Configuration Improvements	
	2026 Horizon	2041 Horizon	2026 Horizon	2041 Horizon
Signalized Intersections				
Montrose Rd & Lyons Creek Rd/Biggar Rd	No Change		• Add one through lane and exclusive left and right turn lanes on all the approaches • Dual left turn lanes on the east and north approaches	
Montrose Rd & Niagara Square Dr	A two-lane roundabout		See **Figure 3-17** for the roundabout lane configurations	
Montrose Rd & McLeod Rd	No Change		Add one through northbound lane on the south approach	
Montrose Rd & Canadian Dr.	No Change		Add one through lane on the north and south approaches	
Unsignalized Intersections				
Montrose Rd & Reixinger Rd	No Change		• Add one through lane on the north and south approaches. • Exclusive left turn lane on the north approach.	
Montrose Rd & Grassy Brook Rd	No Change	Signals may be needed. Keep provision during construction	• Add one through lane on the north and south approaches. • Exclusive left turn lane on the south and west approaches	
Montrose Rd & Oakwood Dr	No Change	Signals may be needed. Keep provision during construction	• Add one through lane on the north and south approaches. • Exclusive left turn lane on the north and east approaches	
Montrose Rd & Chippawa Creek Rd	No Change		• Add one through lane on the north and south approaches (convert existing exclusive right turn lane on the north approach into shared through-right lane). • Exclusive left turn lane on the west approach.	
Montrose Rd & Brown Rd	No Change	Signals may be needed. Keep provision during construction	• Add one through lane on the north and south approaches. • Exclusive left turn lane on the south and west approaches	
Montrose Rd & Niagara Square Entrance	Unsignalized Right-in/Right-out		• Add one through lane on the south approach • Exclusive right turn lane on the north approach	
Lyons Creek Rd & Willodell Rd	No Change		• Add one pocket lane and exclusive left turn lane on the east approach • Restrict left turn from Willodell Road	
Lyons Creek Rd & QEW FEB off-ramp	Traffic Signals		• Convert to T-intersection with three lanes on the north approach • One exclusive left and right turn, and centre lane as shared left-right turn lane	
Lyons Creek Rd & QEW TB off-ramp	Signals may be needed. Keep provision during construction and install when needed.		• Convert to T-intersection with two lanes on the south approach • One exclusive right turn, and the left lane as continuous left turn lane	

Intersection	Recommend Intersection Control		Recommended Lane Configuration Improvements	
	2026 Horizon	2041 Horizon	2026 Horizon	2041 Horizon
New Intersections				
Montrose Rd & Hospital South Access	Signals as recommended by The South Niagara Hospital TIS		• Add one through lane on the north and south approaches. • Exclusive left turn lanes on the north and south approaches.	
Montrose Rd & Hospital North Access	Stop-controlled Access		• Add one through lane on the north and south approaches. • Exclusive left turn lane on the south approach	
Montrose Rd & Street B	Stop-controlled Access		• Add one through lane on the north and south approaches. • Exclusive left turn lane on the south approach	
Biggar Rd & Hospital East Access	Signals as recommended by The South Niagara Hospital TIS		• Add one through lane on the east and west approaches. • Exclusive right and left turn lane on the east and west approaches respectively	
Biggar Road & Hospital West Access	Stop-controlled Access		• Add one through lane on the east and west approaches. • Exclusive left turn lane on the west approach	

APPENDIX A

SPEED STUDIES REPORTS

PARSONS

MH Corbin Traffic Analyzer Study
Computer Generated Summary Report
City: Niagara Region
Street: 610164 - NB
Location: 7405

A study of vehicle traffic was conducted with the device having serial number 402531. The study was done in the NB lane at 610164 - NB in Niagara Region, ON in county. The study began on 2019-04-17 at 12:00 AM and concluded on 2019-04-18 at 12:00 AM, lasting a total of 24.00 hours. Traffic statistics were recorded in 15 minute time periods. The total recorded volume showed 3,314 vehicles passed through the location with a peak volume of 99 on 2019-04-17 at [07:45 AM-08:00 AM] and a minimum volume of 0 on 2019-04-17 at [01:30 AM-01:45 AM]. The AADT count for this study was 3,314.

SPEED

Chart 1 lists the values of the speed bins and the total traffic volume for each bin. At least half the vehicles were traveling in the 80 - 85 KM/H range or lower. The average speed for all classifed vehicles was 85 KM/H with 65.96% vehicles exceeding the posted speed of 80 KM/H. 48.99% percent of the total vehicles were traveling in excess of 89 KM/H. The mode speed for this traffic study was 80KM/H and the 85th percentile was 97.92 KM/H.

< to 39	40 to 44	45 to 49	50 to 54	55 to 59	60 to 64	65 to 69	70 to 74	75 to 79	80 to 84	85 to 89	90 to 94	95 to 99	100 to 104	105 to >
5	4	5	24	30	105	202	319	433	562	443	422	445	151	161

CHART 1

CLASSIFICATION

Chart 2 lists the values of the classification bins and the total traffic volume accumulated for each bin.
Most of the vehicles classified during the study were Passenger Vehicles. The number of Passenger Vehicles in the study was 2803 which represents 85 percent of the total classified vehicles. The number of Small Trucks in the study was 148 which represents 4 percent of the total classified vehicles. The number of Trucks/Buses in the study was 242 which represents 7 percent of the total classified vehicles. The number of Tractor Trailers in the study was 118 which represents 4 percent of the total classified vehicles.

< to 4.9	5.0 to 7.9	8.0 to 9.9	10.0 to 12.9	13.0 to 15.9	16.0 to 18.9	19.0 to 21.9	22.0 to >							
663	2140	148	242	69	19	11	19							

CHART 2

HEADWAY

During the peak traffic period, on 2019-04-17 at [07:45 AM-08:00 AM] the average headway between vehicles was 9 seconds. During the slowest traffic period, on 2019-04-17 at [01:30 AM-01:45 AM] the average headway between vehicles was 900 seconds.

WEATHER

The roadway surface temperature over the period of the study varied between 2.00 and 26.00 degrees C.

MH Corbin Traffic Analyzer Study
Computer Generated Summary Report
City: Niagara Region
Street: 610164 - SB
Location: 7405

A study of vehicle traffic was conducted with the device having serial number 403588. The study was done in the SB lane at 610164 - SB in Niagara Region, ON in county. The study began on 2019-04-17 at 12:00 AM and concluded on 2019-04-18 at 12:00 AM, lasting a total of 24.00 hours. Traffic statistics were recorded in 15 minute time periods. The total recorded volume showed 3,326 vehicles passed through the location with a peak volume of 108 on 2019-04-17 at [05:00 PM-05:15 PM] and a minimum volume of 0 on 2019-04-17 at [02:45 AM-03:00 AM]. The AADT count for this study was 3,326.

SPEED

Chart 1 lists the values of the speed bins and the total traffic volume for each bin. At least half the vehicles were traveling in the 90 - 95 KM/H range or lower. The average speed for all classifed vehicles was 86 KM/H with 71.86% vehicles exceeding the posted speed of 80 KM/H. 55.01% percent of the total vehicles were traveling in excess of 89 KM/H. The mode speed for this traffic study was 90KM/H and the 85th percentile was 97.85 KM/H.

< to 39	40 to 44	45 to 49	50 to 54	55 to 59	60 to 64	65 to 69	70 to 74	75 to 79	80 to 84	85 to 89	90 to 94	95 to 99	100 to 104	105 to >
1	1	9	13	24	50	137	265	430	557	509	575	418	139	177

CHART 1

CLASSIFICATION

Chart 2 lists the values of the classification bins and the total traffic volume accumulated for each bin.

Most of the vehicles classified during the study were Passenger Vehicles. The number of Passenger Vehicles in the study was 2948 which represents 89 percent of the total classified vehicles. The number of Small Trucks in the study was 100 which represents 3 percent of the total classified vehicles. The number of Trucks/Buses in the study was 165 which represents 5 percent of the total classified vehicles. The number of Tractor Trailers in the study was 92 which represents 3 percent of the total classified vehicles.

< to 4.9	5.0 to 7.9	8.0 to 9.9	10.0 to 12.9	13.0 to 15.9	16.0 to 18.9	19.0 to 21.9	22.0 to >							
931	2017	100	165	47	7	15	23							

CHART 2

HEADWAY

During the peak traffic period, on 2019-04-17 at [05:00 PM-05:15 PM] the average headway between vehicles was 8.257 seconds. During the slowest traffic period, on 2019-04-17 at [02:45 AM-03:00 AM] the average headway between vehicles was 900 seconds.

WEATHER

The roadway surface temperature over the period of the study varied between 2.00 and 27.00 degrees C.

MH Corbin Traffic Analyzer Study
Computer Generated Summary Report
City: Niagara Region
Street: 610579 - NB
Location: 7447

A study of vehicle traffic was conducted with the device having serial number 135166. The study was done in the NB lane at 610579 - NB in Niagara Region, ON in county. The study began on 2019-04-02 at 12:00 AM and concluded on 2019-04-03 at 12:00 AM, lasting a total of 24.00 hours. Traffic statistics were recorded in 15 minute time periods. The total recorded volume showed 2,806 vehicles passed through the location with a peak volume of 83 on 2019-04-02 at [05:00 PM-05:15 PM] and a minimum volume of 0 on 2019-04-02 at [02:15 AM-02:30 AM]. The AADT count for this study was 2,806.

SPEED

Chart 1 lists the values of the speed bins and the total traffic volume for each bin. At least half the vehicles were traveling in the 60 - 65 KM/H range or lower. The average speed for all classifed vehicles was 66 KM/H with 75.93% vehicles exceeding the posted speed of 60 KM/H. 2.47% percent of the total vehicles were traveling in excess of 89 KM/H. The mode speed for this traffic study was 60KM/H and the 85th percentile was 75.66 KM/H.

< to 39	40 to 44	45 to 49	50 to 54	55 to 59	60 to 64	65 to 69	70 to 74	75 to 79	80 to 84	85 to 89	90 to 94	95 to 99	100 to 104	105 to >
8	7	36	225	397	678	576	414	265	121	33	25	10	1	0

CHART 1

CLASSIFICATION

Chart 2 lists the values of the classification bins and the total traffic volume accumulated for each bin.
Most of the vehicles classified during the study were Passenger Vehicles. The number of Passenger Vehicles in the study was 2516 which represents 90 percent of the total classified vehicles. The number of Small Trucks in the study was 131 which represents 5 percent of the total classified vehicles. The number of Trucks/Buses in the study was 64 which represents 2 percent of the total classified vehicles. The number of Tractor Trailers in the study was 85 which represents 3 percent of the total classified vehicles.

< to 4.9	5.0 to 7.9	8.0 to 9.9	10.0 to 12.9	13.0 to 15.9	16.0 to 18.9	19.0 to 21.9	22.0 to >							
1293	1223	131	64	40	31	13	1							

CHART 2

HEADWAY

During the peak traffic period, on 2019-04-02 at [05:00 PM-05:15 PM] the average headway between vehicles was 10.714 seconds. During the slowest traffic period, on 2019-04-02 at [02:15 AM-02:30 AM] the average headway between vehicles was 900 seconds.

WEATHER

The roadway surface temperature over the period of the study varied between 1.00 and 24.00 degrees C.

MH Corbin Traffic Analyzer Study
Computer Generated Summary Report
City: Niagara Region
Street: 610579 - SB
Location: 7447

A study of vehicle traffic was conducted with the device having serial number 134643. The study was done in the SB lane at 610579 - SB in Niagara Region, ON in county. The study began on 2019-04-02 at 12:00 AM and concluded on 2019-04-03 at 12:00 AM, lasting a total of 24.00 hours. Traffic statistics were recorded in 15 minute time periods. The total recorded volume showed 2,073 vehicles passed through the location with a peak volume of 58 on 2019-04-02 at [04:00 PM-04:15 PM] and a minimum volume of 0 on 2019-04-02 at [03:30 AM-03:45 AM]. The AADT count for this study was 2,073.

SPEED

Chart 1 lists the values of the speed bins and the total traffic volume for each bin. At least half the vehicles were traveling in the 70 - 75 KM/H range or lower. The average speed for all classifed vehicles was 67 KM/H with 73.24% vehicles exceeding the posted speed of 60 KM/H. 21.24% percent of the total vehicles were traveling in excess of 89 KM/H. The mode speed for this traffic study was 70KM/H and the 85th percentile was 88.53 KM/H.

< to 39	40 to 44	45 to 49	50 to 54	55 to 59	60 to 64	65 to 69	70 to 74	75 to 79	80 to 84	85 to 89	90 to 94	95 to 99	100 to 104	105 to >
232	107	32	62	76	126	188	245	238	192	167	106	93	38	0

CHART 1

CLASSIFICATION

Chart 2 lists the values of the classification bins and the total traffic volume accumulated for each bin.
Most of the vehicles classified during the study were Passenger Vehicles. The number of Passenger Vehicles in the study was 1625 which represents 85 percent of the total classified vehicles. The number of Small Trucks in the study was 160 which represents 8 percent of the total classified vehicles. The number of Trucks/Buses in the study was 66 which represents 3 percent of the total classified vehicles. The number of Tractor Trailers in the study was 51 which represents 3 percent of the total classified vehicles.

< to 4.9	5.0 to 7.9	8.0 to 9.9	10.0 to 12.9	13.0 to 15.9	16.0 to 18.9	19.0 to 21.9	22.0 to >							
781	844	160	66	30	8	3	10							

CHART 2

HEADWAY

During the peak traffic period, on 2019-04-02 at [04:00 PM-04:15 PM] the average headway between vehicles was 15.254 seconds. During the slowest traffic period, on 2019-04-02 at [03:30 AM-03:45 AM] the average headway between vehicles was 900 seconds.

WEATHER

The roadway surface temperature over the period of the study varied between 1.00 and 24.00 degrees C.

MH Corbin Traffic Analyzer Study
Computer Generated Summary Report
City: Niagara Region
Street: 610704 - NB
Location: 7455

A study of vehicle traffic was conducted with the device having serial number 403607. The study was done in the NB lane at 610704 - NB in Niagara Region, ON in county. The study began on 2019-04-17 at 12:00 AM and concluded on 2019-04-18 at 12:00 AM, lasting a total of 24.00 hours. Traffic statistics were recorded in 15 minute time periods. The total recorded volume showed 2,571 vehicles passed through the location with a peak volume of 78 on 2019-04-17 at [05:00 PM-05:15 PM] and a minimum volume of 0 on 2019-04-17 at [02:45 AM-03:00 AM]. The AADT count for this study was 2,571.

SPEED

Chart 1 lists the values of the speed bins and the total traffic volume for each bin. At least half the vehicles were traveling in the 50 - 55 KM/H range or lower. The average speed for all classifed vehicles was 58 KM/H with 85.28% vehicles exceeding the posted speed of 50 KM/H. 0.43% percent of the total vehicles were traveling in excess of 89 KM/H. The mode speed for this traffic study was 50KM/H and the 85th percentile was 67.91 KM/H.

< to 39	40 to 44	45 to 49	50 to 54	55 to 59	60 to 64	65 to 69	70 to 74	75 to 79	80 to 84	85 to 89	90 to 94	95 to 99	100 to 104	105 to >
32	115	228	600	541	478	292	158	69	23	11	0	0	0	0

CHART 1

CLASSIFICATION

Chart 2 lists the values of the classification bins and the total traffic volume accumulated for each bin.

Most of the vehicles classified during the study were Passenger Vehicles. The number of Passenger Vehicles in the study was 2313 which represents 91 percent of the total classified vehicles. The number of Small Trucks in the study was 50 which represents 2 percent of the total classified vehicles. The number of Trucks/Buses in the study was 106 which represents 4 percent of the total classified vehicles. The number of Tractor Trailers in the study was 78 which represents 3 percent of the total classified vehicles.

< to 4.9	5.0 to 7.9	8.0 to 9.9	10.0 to 12.9	13.0 to 15.9	16.0 to 18.9	19.0 to 21.9	22.0 to >							
1258	1055	50	106	17	37	21	3							

CHART 2

HEADWAY

During the peak traffic period, on 2019-04-17 at [05:00 PM-05:15 PM] the average headway between vehicles was 11.392 seconds. During the slowest traffic period, on 2019-04-17 at [02:45 AM-03:00 AM] the average headway between vehicles was 900 seconds.

WEATHER

The roadway surface temperature over the period of the study varied between 0.00 and 32.00 degrees C.

MH Corbin Traffic Analyzer Study
Computer Generated Summary Report
City: Niagara Region
Street: 610704 - SB
Location: 7455

A study of vehicle traffic was conducted with the device having serial number 403593. The study was done in the SB lane at 610704 - SB in Niagara Region, ON in county. The study began on 2019-04-17 at 12:00 AM and concluded on 2019-04-18 at 12:00 AM, lasting a total of 24.00 hours. Traffic statistics were recorded in 15 minute time periods. The total recorded volume showed 2,580 vehicles passed through the location with a peak volume of 64 on 2019-04-17 at [03:30 PM-03:45 PM] and a minimum volume of 0 on 2019-04-17 at [02:30 AM-02:45 AM]. The AADT count for this study was 2,580.

SPEED

Chart 1 lists the values of the speed bins and the total traffic volume for each bin. At least half the vehicles were traveling in the 60 - 65 KM/H range or lower. The average speed for all classifed vehicles was 64 KM/H with 93.82% vehicles exceeding the posted speed of 50 KM/H. 1.60% percent of the total vehicles were traveling in excess of 89 KM/H. The mode speed for this traffic study was 60KM/H and the 85th percentile was 74.56 KM/H.

< to 39	40 to 44	45 to 49	50 to 54	55 to 59	60 to 64	65 to 69	70 to 74	75 to 79	80 to 84	85 to 89	90 to 94	95 to 99	100 to 104	105 to >
39	45	67	260	395	513	455	330	185	114	39	0	0	0	0

CHART 1

CLASSIFICATION

Chart 2 lists the values of the classification bins and the total traffic volume accumulated for each bin.

Most of the vehicles classified during the study were Passenger Vehicles. The number of Passenger Vehicles in the study was 2257 which represents 92 percent of the total classified vehicles. The number of Small Trucks in the study was 46 which represents 2 percent of the total classified vehicles. The number of Trucks/Buses in the study was 66 which represents 3 percent of the total classified vehicles. The number of Tractor Trailers in the study was 73 which represents 3 percent of the total classified vehicles.

< to 4.9	5.0 to 7.9	8.0 to 9.9	10.0 to 12.9	13.0 to 15.9	16.0 to 18.9	19.0 to 21.9	22.0 to >							
1142	1115	46	66	25	8	28	12							

CHART 2

HEADWAY

During the peak traffic period, on 2019-04-17 at [03:30 PM-03:45 PM] the average headway between vehicles was 13.846 seconds. During the slowest traffic period, on 2019-04-17 at [02:30 AM-02:45 AM] the average headway between vehicles was 900 seconds.

WEATHER

The roadway surface temperature over the period of the study varied between 1.00 and 30.00 degrees C.

MH Corbin Traffic Analyzer Study
Computer Generated Summary Report
City: Niagara Region
Street: 610703 - NB
Location: 7454

A study of vehicle traffic was conducted with the device having serial number 400177. The study was done in the NB lane at 610703 - NB in Niagara Region, ON in county. The study began on 2019-04-02 at 12:00 AM and concluded on 2019-04-03 at 12:00 AM, lasting a total of 24.00 hours. Traffic statistics were recorded in 15 minute time periods. The total recorded volume showed 2,421 vehicles passed through the location with a peak volume of 70 on 2019-04-02 at [05:00 PM-05:15 PM] and a minimum volume of 0 on 2019-04-02 at [03:00 AM-03:15 AM]. The AADT count for this study was 2,421.

SPEED

Chart 1 lists the values of the speed bins and the total traffic volume for each bin. At least half the vehicles were traveling in the 60 - 65 KM/H range or lower. The average speed for all classifed vehicles was 61 KM/H with 88.95% vehicles exceeding the posted speed of 50 KM/H. 1.60% percent of the total vehicles were traveling in excess of 89 KM/H. The mode speed for this traffic study was 60KM/H and the 85th percentile was 73.39 KM/H.

< to 39	40 to 44	45 to 49	50 to 54	55 to 59	60 to 64	65 to 69	70 to 74	75 to 79	80 to 84	85 to 89	90 to 94	95 to 99	100 to 104	105 to >
90	39	134	372	388	468	336	288	136	91	38	0	0	0	0

CHART 1

CLASSIFICATION

Chart 2 lists the values of the classification bins and the total traffic volume accumulated for each bin.
Most of the vehicles classified during the study were Passenger Vehicles. The number of Passenger Vehicles in the study was 1815 which represents 76 percent of the total classified vehicles. The number of Small Trucks in the study was 189 which represents 8 percent of the total classified vehicles. The number of Trucks/Buses in the study was 210 which represents 9 percent of the total classified vehicles. The number of Tractor Trailers in the study was 166 which represents 7 percent of the total classified vehicles.

< to 4.9	5.0 to 7.9	8.0 to 9.9	10.0 to 12.9	13.0 to 15.9	16.0 to 18.9	19.0 to 21.9	22.0 to >							
611	1204	189	210	72	32	31	31							

CHART 2

HEADWAY

During the peak traffic period, on 2019-04-02 at [05:00 PM-05:15 PM] the average headway between vehicles was 12.676 seconds. During the slowest traffic period, on 2019-04-02 at [03:00 AM-03:15 AM] the average headway between vehicles was 900 seconds.

WEATHER

The roadway surface temperature over the period of the study varied between 2.00 and 18.00 degrees C.

MH Corbin Traffic Analyzer Study
Computer Generated Summary Report
City: Niagara Region
Street: 610703 - SB
Location: 7454

A study of vehicle traffic was conducted with the device having serial number 130995. The study was done in the SB lane at 610703 - SB in Niagara Region, ON in county. The study began on 2019-04-02 at 12:00 AM and concluded on 2019-04-03 at 12:00 AM, lasting a total of 24.00 hours. Traffic statistics were recorded in 15 minute time periods. The total recorded volume showed 2,696 vehicles passed through the location with a peak volume of 67 on 2019-04-02 at [05:00 PM-05:15 PM] and a minimum volume of 1 on 2019-04-02 at [01:15 AM-01:30 AM]. The AADT count for this study was 2,696.

SPEED

Chart 1 lists the values of the speed bins and the total traffic volume for each bin. At least half the vehicles were traveling in the 60 - 65 KM/H range or lower. The average speed for all classifed vehicles was 62 KM/H with 93.48% vehicles exceeding the posted speed of 50 KM/H. 0.79% percent of the total vehicles were traveling in excess of 89 KM/H. The mode speed for this traffic study was 60KM/H and the 85th percentile was 71.46 KM/H.

< to 39	40 to 44	45 to 49	50 to 54	55 to 59	60 to 64	65 to 69	70 to 74	75 to 79	80 to 84	85 to 89	90 to 94	95 to 99	100 to 104	105 to >
13	43	117	433	478	605	477	304	114	48	21	0	0	0	0

CHART 1

CLASSIFICATION

Chart 2 lists the values of the classification bins and the total traffic volume accumulated for each bin.

Most of the vehicles classified during the study were Passenger Vehicles. The number of Passenger Vehicles in the study was 2507 which represents 94 percent of the total classified vehicles. The number of Small Trucks in the study was 52 which represents 2 percent of the total classified vehicles. The number of Trucks/Buses in the study was 35 which represents 1 percent of the total classified vehicles. The number of Tractor Trailers in the study was 59 which represents 2 percent of the total classified vehicles.

< to 4.9	5.0 to 7.9	8.0 to 9.9	10.0 to 12.9	13.0 to 15.9	16.0 to 18.9	19.0 to 21.9	22.0 to >							
1106	1401	52	35	18	14	25	2							

CHART 2

HEADWAY

During the peak traffic period, on 2019-04-02 at [05:00 PM-05:15 PM] the average headway between vehicles was 13.235 seconds. During the slowest traffic period, on 2019-04-02 at [01:15 AM-01:30 AM] the average headway between vehicles was 450 seconds.

WEATHER

The roadway surface temperature over the period of the study varied between 3.00 and 18.00 degrees C.

MH Corbin Traffic Analyzer Study
Computer Generated Summary Report
City: Niagara Region
Street: 610167 - NB
Location: 7560

A study of vehicle traffic was conducted with the device having serial number 403750. The study was done in the NB lane at 610167 - NB in Niagara Region, ON in county. The study began on 2019-04-17 at 12:00 AM and concluded on 2019-04-18 at 12:00 AM, lasting a total of 24.00 hours. Traffic statistics were recorded in 15 minute time periods. The total recorded volume showed 4,371 vehicles passed through the location with a peak volume of 106 on 2019-04-17 at [05:15 PM-05:30 PM] and a minimum volume of 1 on 2019-04-17 at [01:30 AM-01:45 AM]. The AADT count for this study was 4,371.

SPEED

Chart 1 lists the values of the speed bins and the total traffic volume for each bin. At least half the vehicles were traveling in the 75 - 80 KM/H range or lower. The average speed for all classifed vehicles was 84 KM/H with 63.52% vehicles exceeding the posted speed of 80 KM/H. 46.56% percent of the total vehicles were traveling in excess of 89 KM/H. The mode speed for this traffic study was 75KM/H and the 85th percentile was 94.95 KM/H.

< to 39	40 to 44	45 to 49	50 to 54	55 to 59	60 to 64	65 to 69	70 to 74	75 to 79	80 to 84	85 to 89	90 to 94	95 to 99	100 to 104	105 to >
3	0	5	18	35	96	256	394	779	737	746	631	372	150	125

CHART 1

CLASSIFICATION

Chart 2 lists the values of the classification bins and the total traffic volume accumulated for each bin.

Most of the vehicles classified during the study were Passenger Vehicles. The number of Passenger Vehicles in the study was 4003 which represents 92 percent of the total classified vehicles. The number of Small Trucks in the study was 71 which represents 2 percent of the total classified vehicles. The number of Trucks/Buses in the study was 121 which represents 3 percent of the total classified vehicles. The number of Tractor Trailers in the study was 152 which represents 3 percent of the total classified vehicles.

< to 4.9	5.0 to 7.9	8.0 to 9.9	10.0 to 12.9	13.0 to 15.9	16.0 to 18.9	19.0 to 21.9	22.0 to >							
1380	2623	71	121	42	23	37	50							

CHART 2

HEADWAY

During the peak traffic period, on 2019-04-17 at [05:15 PM-05:30 PM] the average headway between vehicles was 8.411 seconds. During the slowest traffic period, on 2019-04-17 at [01:30 AM-01:45 AM] the average headway between vehicles was 450 seconds.

WEATHER

The roadway surface temperature over the period of the study varied between 2.00 and 26.00 degrees C.

MH Corbin Traffic Analyzer Study
Computer Generated Summary Report
City: Niagara Region
Street: 610167 - SB
Location: 7560

A study of vehicle traffic was conducted with the device having serial number 403613. The study was done in the SB lane at 610167 - SB in Niagara Region, ON in county. The study began on 2019-04-17 at 12:00 AM and concluded on 2019-04-18 at 12:00 AM, lasting a total of 24.00 hours. Traffic statistics were recorded in 15 minute time periods. The total recorded volume showed 4,269 vehicles passed through the location with a peak volume of 142 on 2019-04-17 at [04:00 PM-04:15 PM] and a minimum volume of 0 on 2019-04-17 at [01:45 AM-02:00 AM]. The AADT count for this study was 4,269.

SPEED

Chart 1 lists the values of the speed bins and the total traffic volume for each bin. At least half the vehicles were traveling in the 90 - 95 KM/H range or lower. The average speed for all classifed vehicles was 90 KM/H with 81.48% vehicles exceeding the posted speed of 80 KM/H. 70.88% percent of the total vehicles were traveling in excess of 89 KM/H. The mode speed for this traffic study was 90KM/H and the 85th percentile was 103.44 KM/H.

< to 39	40 to 44	45 to 49	50 to 54	55 to 59	60 to 64	65 to 69	70 to 74	75 to 79	80 to 84	85 to 89	90 to 94	95 to 99	100 to 104	105 to >
3	3	6	17	14	43	115	193	394	451	659	780	651	417	509

CHART 1

CLASSIFICATION

Chart 2 lists the values of the classification bins and the total traffic volume accumulated for each bin.
Most of the vehicles classified during the study were Passenger Vehicles. The number of Passenger Vehicles in the study was 3823 which represents 90 percent of the total classified vehicles. The number of Small Trucks in the study was 113 which represents 3 percent of the total classified vehicles. The number of Trucks/Buses in the study was 132 which represents 3 percent of the total classified vehicles. The number of Tractor Trailers in the study was 187 which represents 4 percent of the total classified vehicles.

< to 4.9	5.0 to 7.9	8.0 to 9.9	10.0 to 12.9	13.0 to 15.9	16.0 to 18.9	19.0 to 21.9	22.0 to >							
945	2878	113	132	70	25	33	59							

CHART 2

HEADWAY

During the peak traffic period, on 2019-04-17 at [04:00 PM-04:15 PM] the average headway between vehicles was 6.294 seconds. During the slowest traffic period, on 2019-04-17 at [01:45 AM-02:00 AM] the average headway between vehicles was 900 seconds.

WEATHER

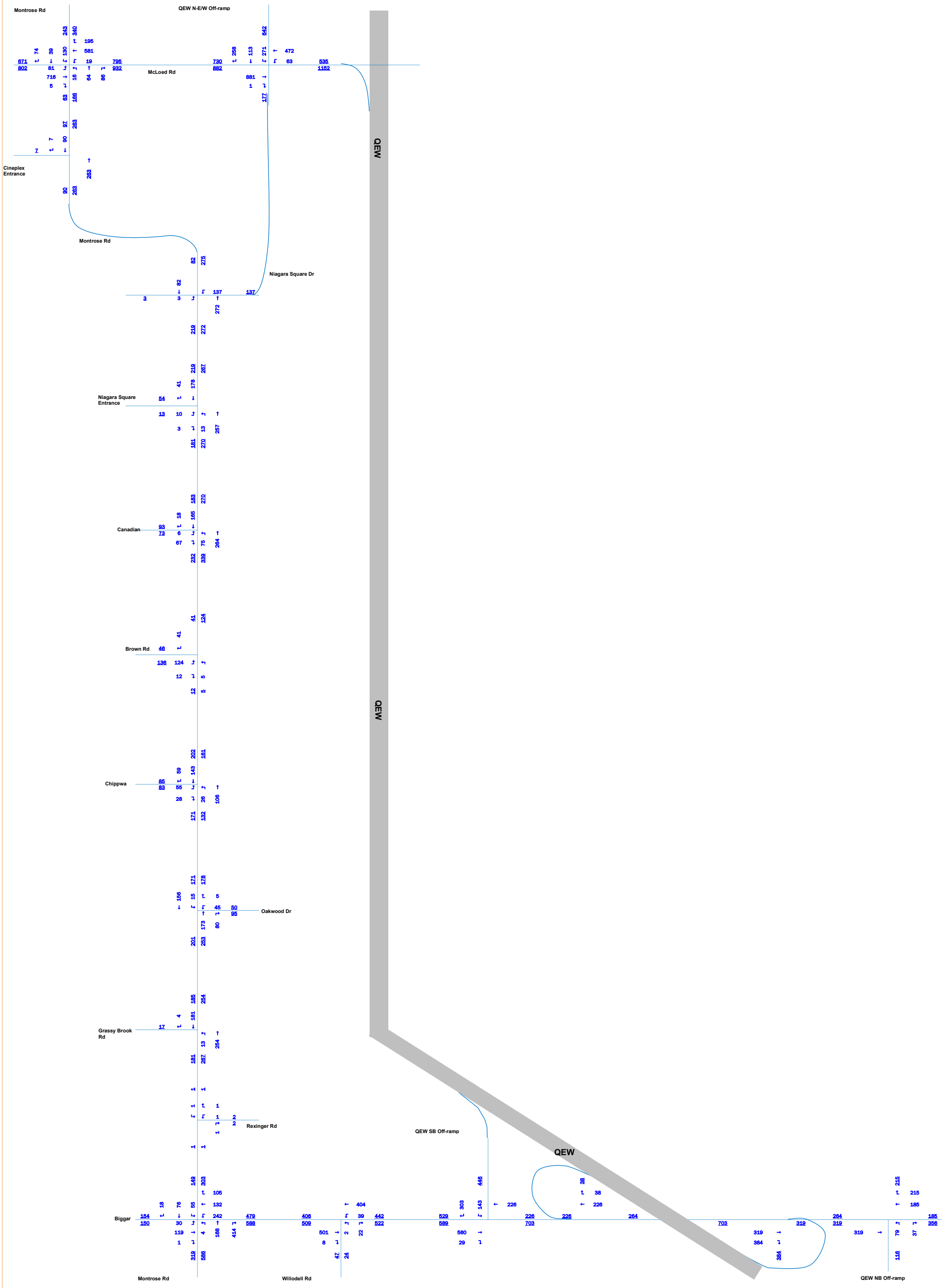
The roadway surface temperature over the period of the study varied between 1.00 and 27.00 degrees C.

APPENDIX B

EXISTING (2019) RAW & BALANCED TRAFFIC VOLUMES

PARSONS

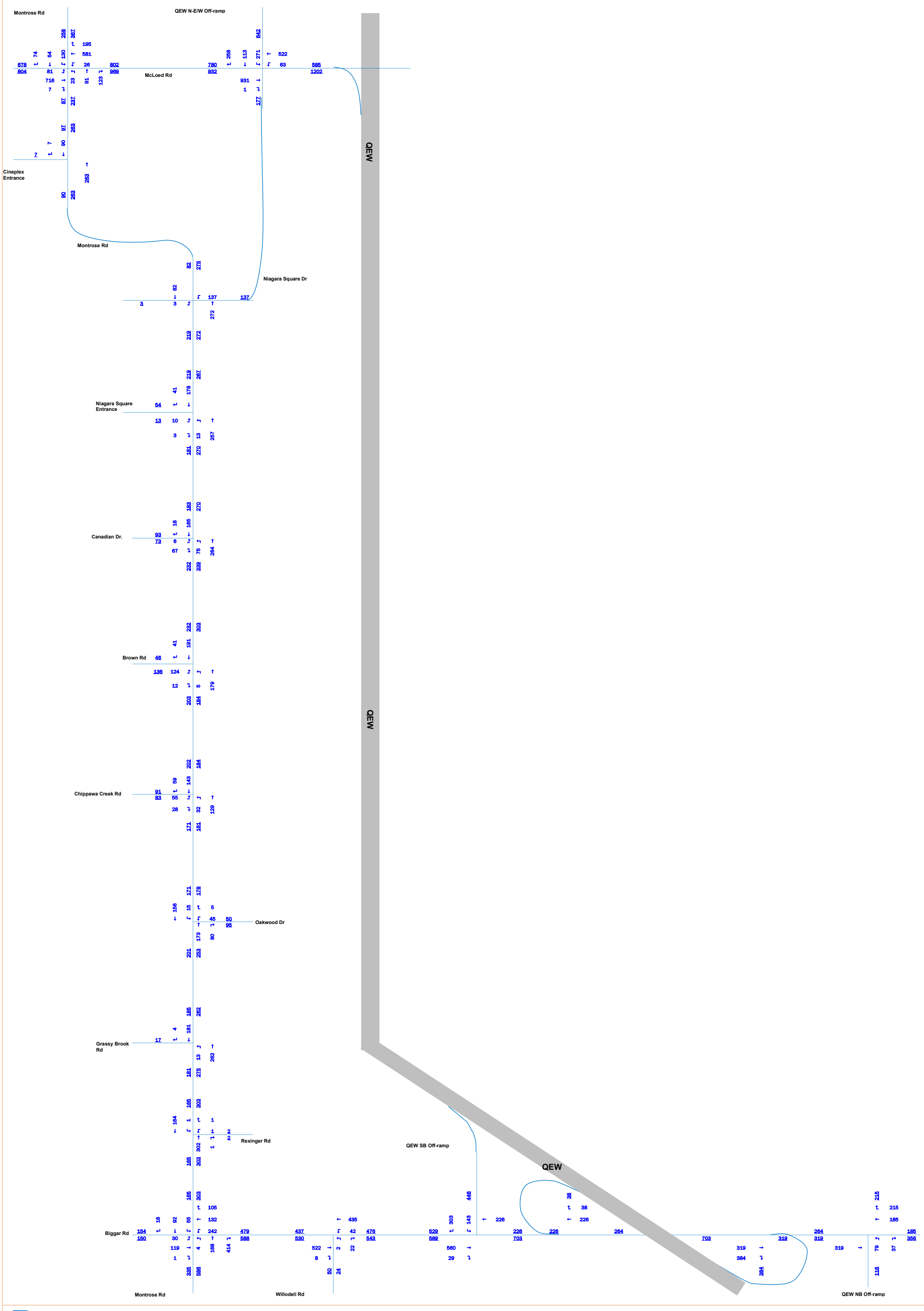
Montrose Road & Lyons Creek Road/Biggar Road EA - Detailed Transportation Assessment



PARSONS

Existing (2019) Raw Traffic - Weekday AM Peak Hour

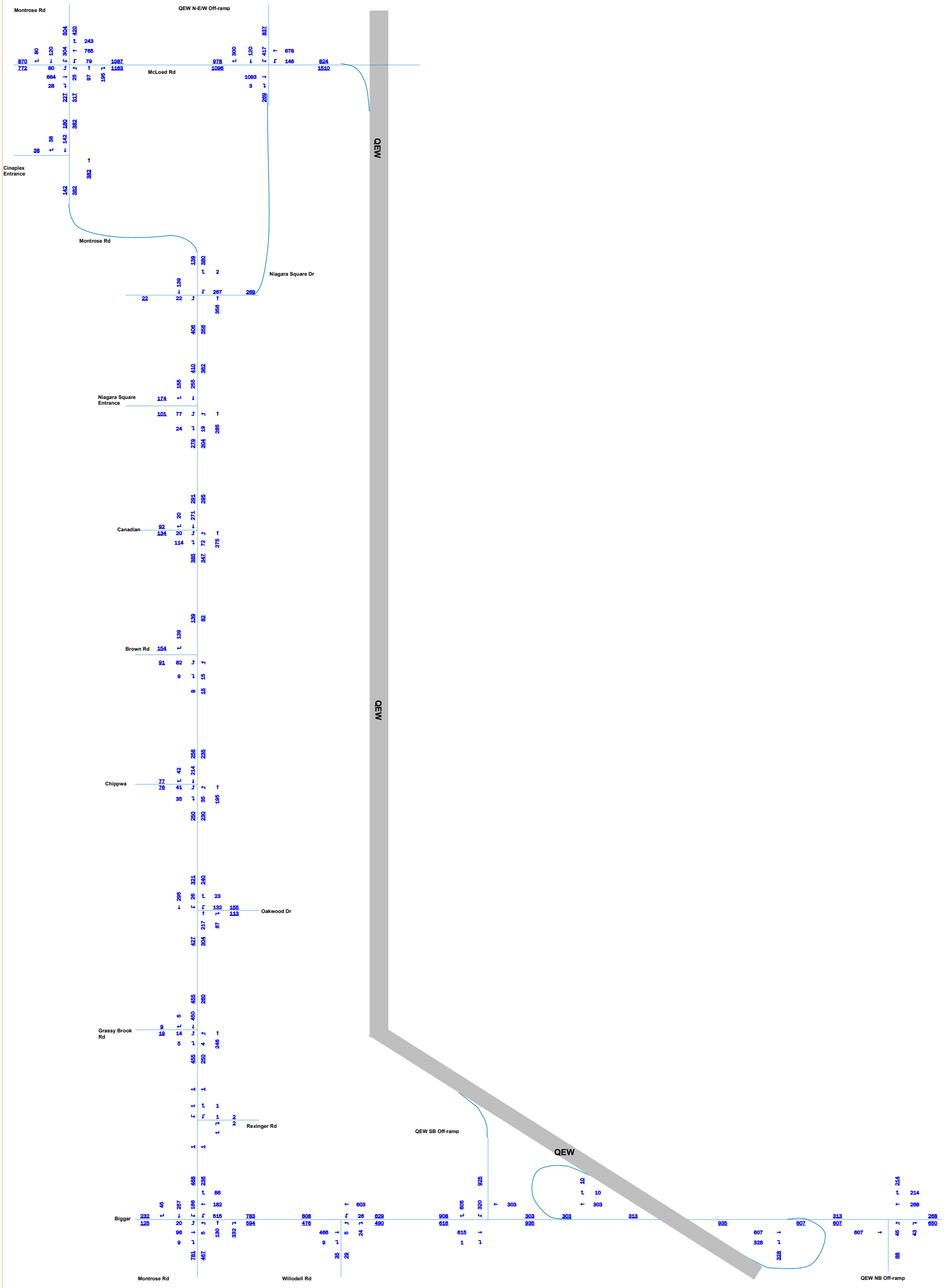
Montrose Road & Lyons Creek Road/Biggar Road EA - Detailed Transportation Assessment



PARSONS

Existing (2019) Balanced Traffic - Weekday AM Peak Hour

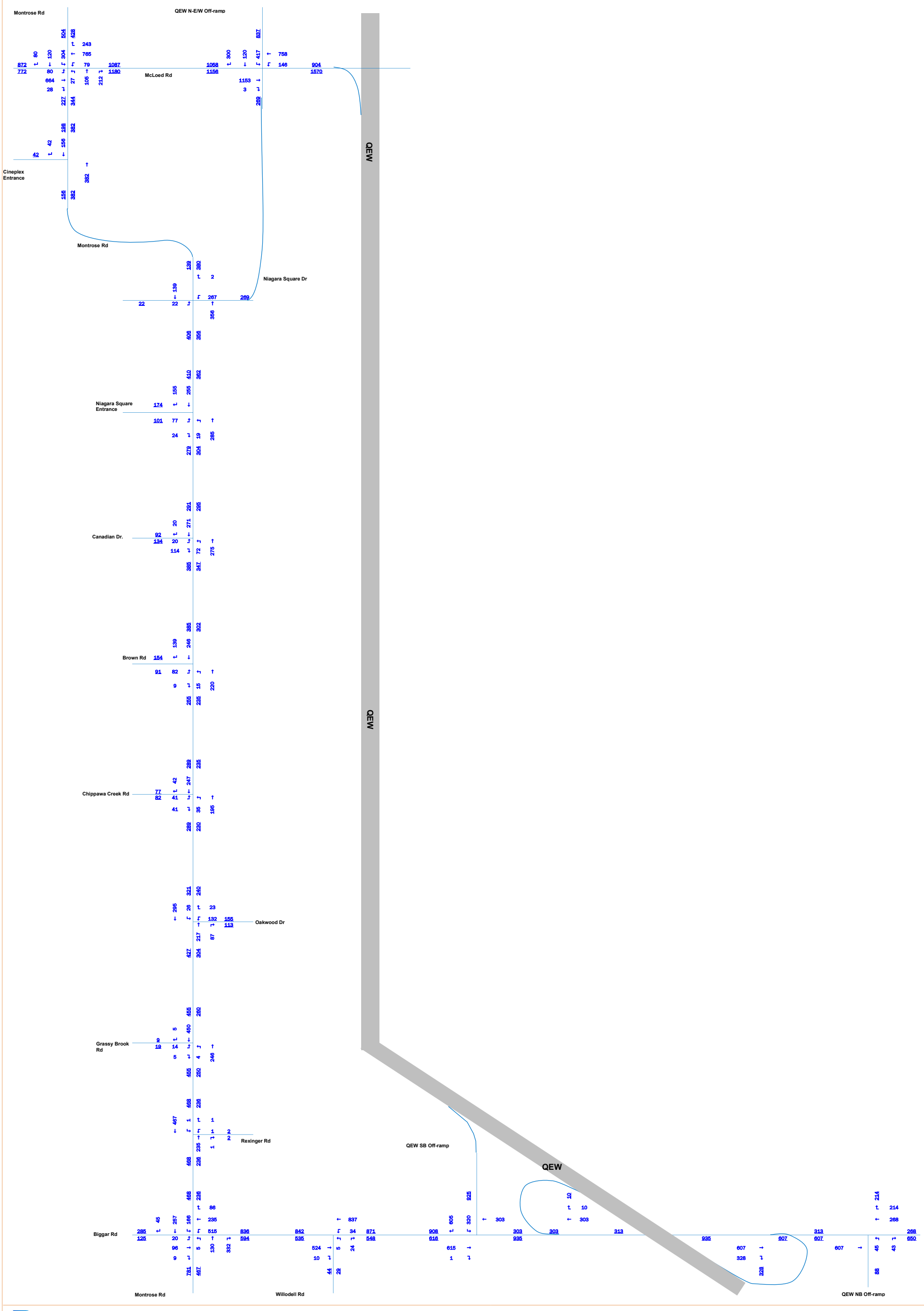
Montrose Road & Lyons Creek Road/Biggar Road EA - Detailed Transportation Assessment



PARSONS

Existing (2019) Raw Traffic - Weekday PM Peak Hour

Montrose Road & Lyons Creek Road/Biggar Road EA - Detailed Transportation Assessment



PARSONS

Existing (2019) Balanced Traffic - Weekday PM Peak Hour

APPENDIX C

SIGNAL TIMINGS PLANS

PARSONS

Signal Code: 047098						
Intersection: RR47 (LYON'S CREEK RD.) & RR98 (MONTROSE RD.)						
Municipality: niagarafalls						
Owner: Region						
Last Modified: 4/28/2020 3:39:40 PM						
Timing Parameters	EBD & WBD LYON'S CREEK RD.	NBD & SBD MONTROSE RD.	n/a	n/a	n/a	n/a
Min Green	10	10	0	0	0	0
Walk	8	10	0	0	0	0
Ped Clearance	12	15	0	0	0	0
Vehicle Ext.	6	6	0	0	0	0
Max Green	40	45	0	0	0	0
Yellow	4.1	4.1	0	0	0	0
All Red	2.2	2.2	0	0	0	0

		Offset
Minimum Cycle	32.6	0
Pedestrian Cycle	57.6	
Maximum Cycle	97.6	0
Operation	FA	

Installed On:
2/12/2009
Count Date:
8/26/2015

FA = Fully Actuated **SA = Semi Actuated** **FT = Fixed Time**

***Note: you need to change the paper orientation from Portriat to Landscape**

Copyright 2001 © Regional Niagara

Signal Code: 098NSQ						
Intersection: RR98 (MONTROSE RD.) & NIAGARA SQUARE BLVD.						
Municipality: niagarafalls						
Owner: region						
Last Modified: 1/10/2019 1:54:26 PM						
Timing Parameters	NBD & SBD THRU MONTROSE RD.	EBD & WBD NIAGARA SQUARE BLVD.	n/a	n/a	n/a	n/a
Min Green	8	8	0	0	0	0
Walk	0	8	0	0	0	0
Ped Clearance	0	11	0	0	0	0
Vehicle Ext.	2.3	2.1	0	0	0	0
Max Green	16	23	0	0	0	0
Yellow	3.5	3.2	0	0	0	0
All Red	2	2	0	0	0	0

		Offset
Minimum Cycle	26.7	0
Pedestrian Cycle	29.7	
Maximum Cycle	49.7	0
Operation	FA	

Installed On:
7/16/2009
Count Date:
--/--/----

FA = Fully Actuated SA = Semi Actuated FT = Fixed Time

*Note: you need to change the paper orientation from Portriat to Landscape

Copyright 2001 © Regional Niagara

Signal Code: 098MCL						
Intersection: RR98(Montrose Rd.) & McLeod Rd.						
Municipality: niagarafalls						
Owner: region						
Last Modified: 1/10/2019 1:41:05 PM						
Timing Parameters	EBD & WBD ADVANCE McLEOD RD.	EBD & WBD THRU McLEOD RD.	NBD & SBD ADVANCE MONTROSE RD.	NBD & SBD THRU MONTROSE RD.	n/a	n/a
Min Green	6	10	6	8	0	0
Walk	0	12	0	14	0	0
Ped Clearance	0	20	0	24	0	0
Vehicle Ext.	2.5	2.5	2.5	2.5	0	0
Max Green	10	40	20	29	0	0
Yellow	3	4.1	3	4.1	0	0
All Red	0	3.3	0	3.5	0	0

		Offset
Minimum Cycle	33	0
Pedestrian Cycle	85	
Maximum Cycle	120	0
Operation	FA	

Installed On:
3/7/2018
Count Date:
9/8/2009

FA = Fully Actuated SA = Semi Actuated FT = Fixed Time

*Note: you need to change the paper orientation from Portriat to Landscape

Copyright 2001 © Regional Niagara

Signal Code: 049QES						
Intersection: RR49 (McLEOD RD.) & QEW WEST OFF RAMP						
Municipality: niagarafalls						
Owner: MTO						
Last Modified: 1/10/2019 1:50:33 PM						
Timing Parameters	WBD ADV McLEOD	EBD & WBD McLEOD	SBD QEW OFF RAMP	n/a	n/a	n/a
Min Green	6	20	10	0	0	0
Walk	0	10	14	0	0	0
Ped Clearance	0	16	25	0	0	0
Vehicle Ext.	2.5	2.5	2.5	0	0	0
Max Green	12	34	26	0	0	0
Yellow	3	4.8	5	0	0	0
All Red	0	3.5	3.7	0	0	0

		Offset
Minimum Cycle	28.3	0
Pedestrian Cycle	34.3	
Maximum Cycle	92	0
Operation	FA	

Installed On:
3/7/2018
Count Date:
--/--/----

FA = Fully Actuated SA = Semi Actuated FT = Fixed Time

*Note: you need to change the paper orientation from Portriat to Landscape

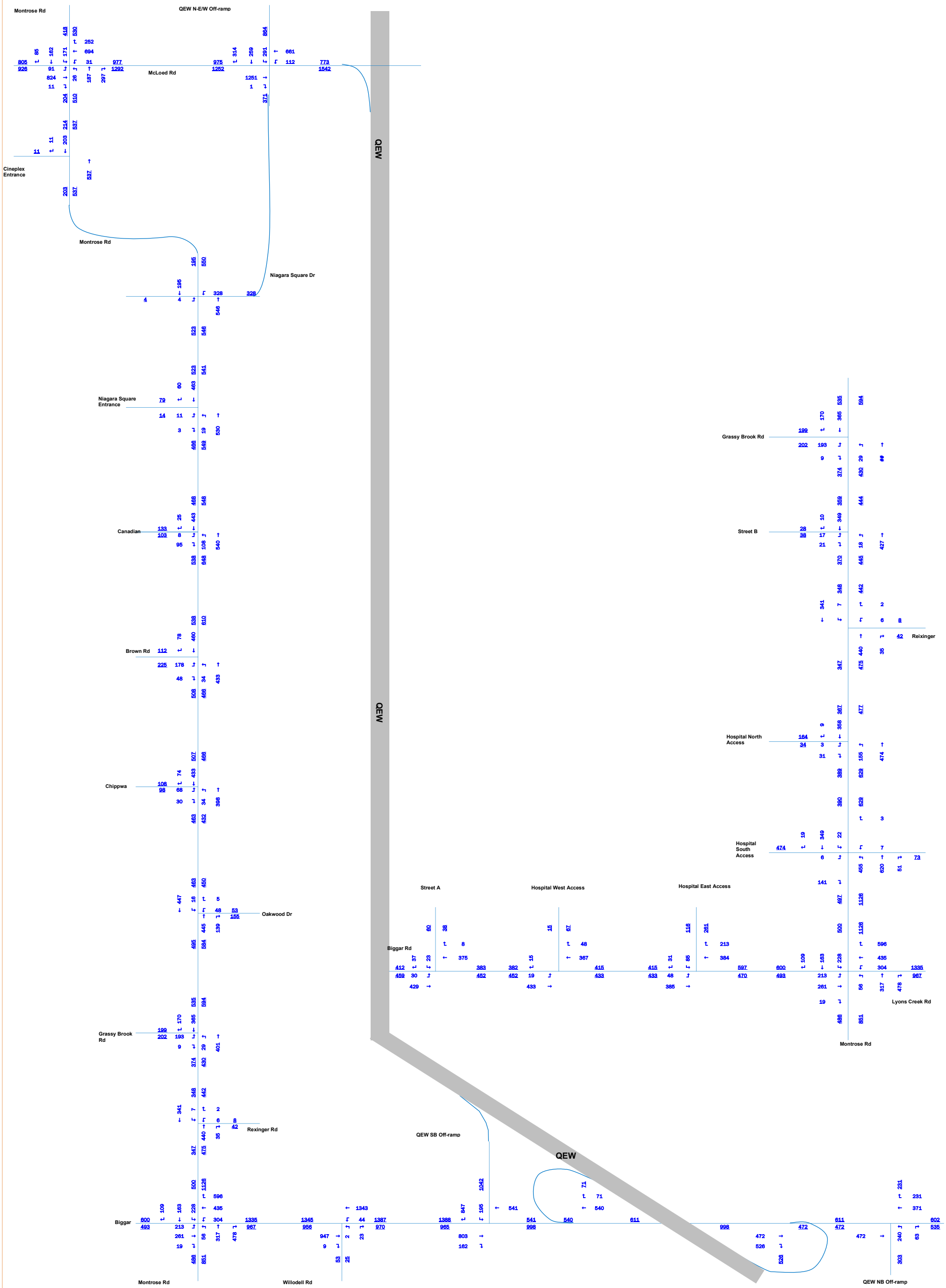
Copyright 2001 © Regional Niagara

APPENDIX D

FUTURE (2026 & 2041) TRAFFIC FORECASTS

PARSONS

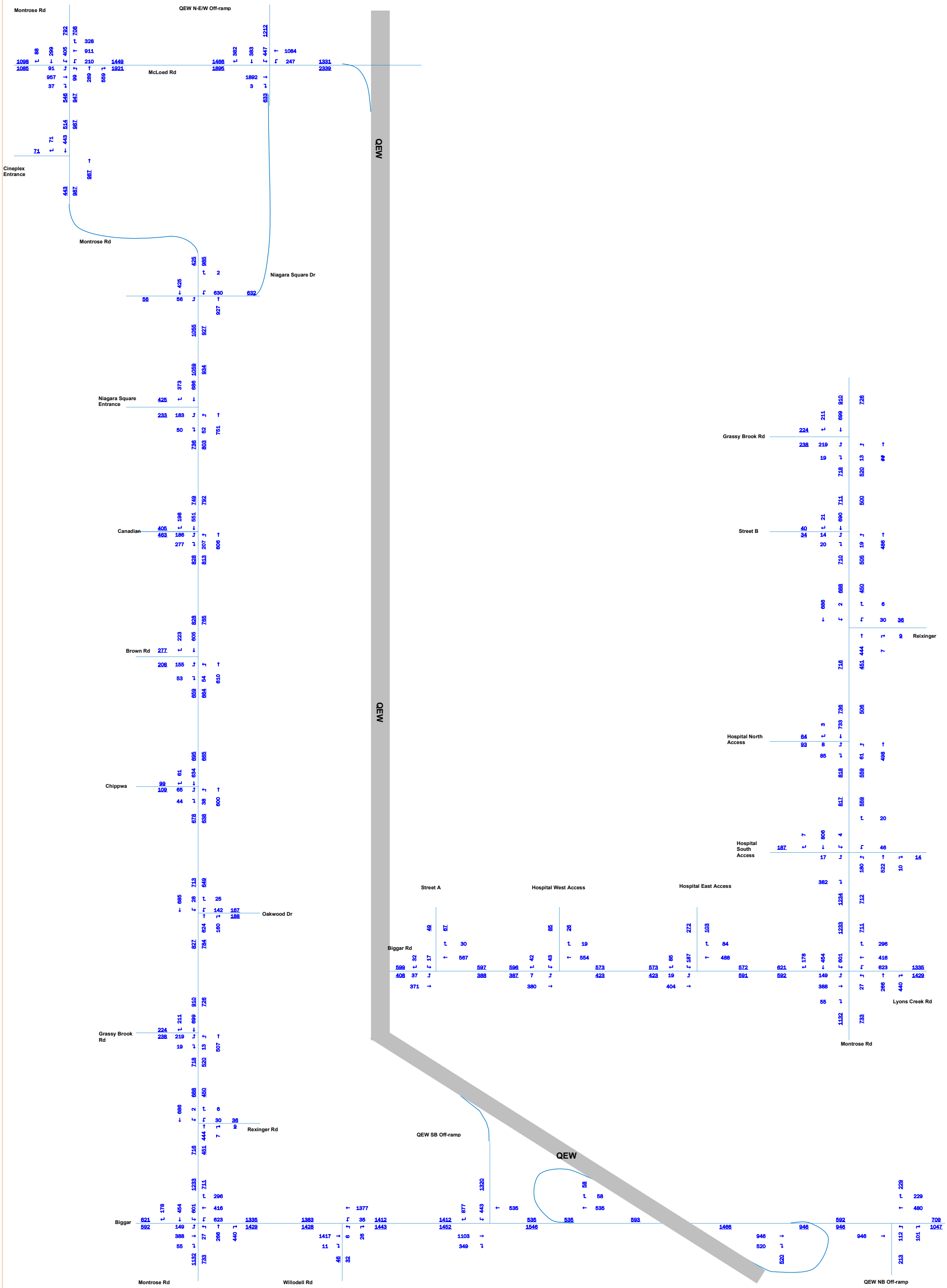
Montrose Road & Lyons Creek Road/Biggar Road EA - Detailed Transportation Assessment



PARSONS

2026 Traffic Forecasts (Revised) - Weekday AM Peak Hour

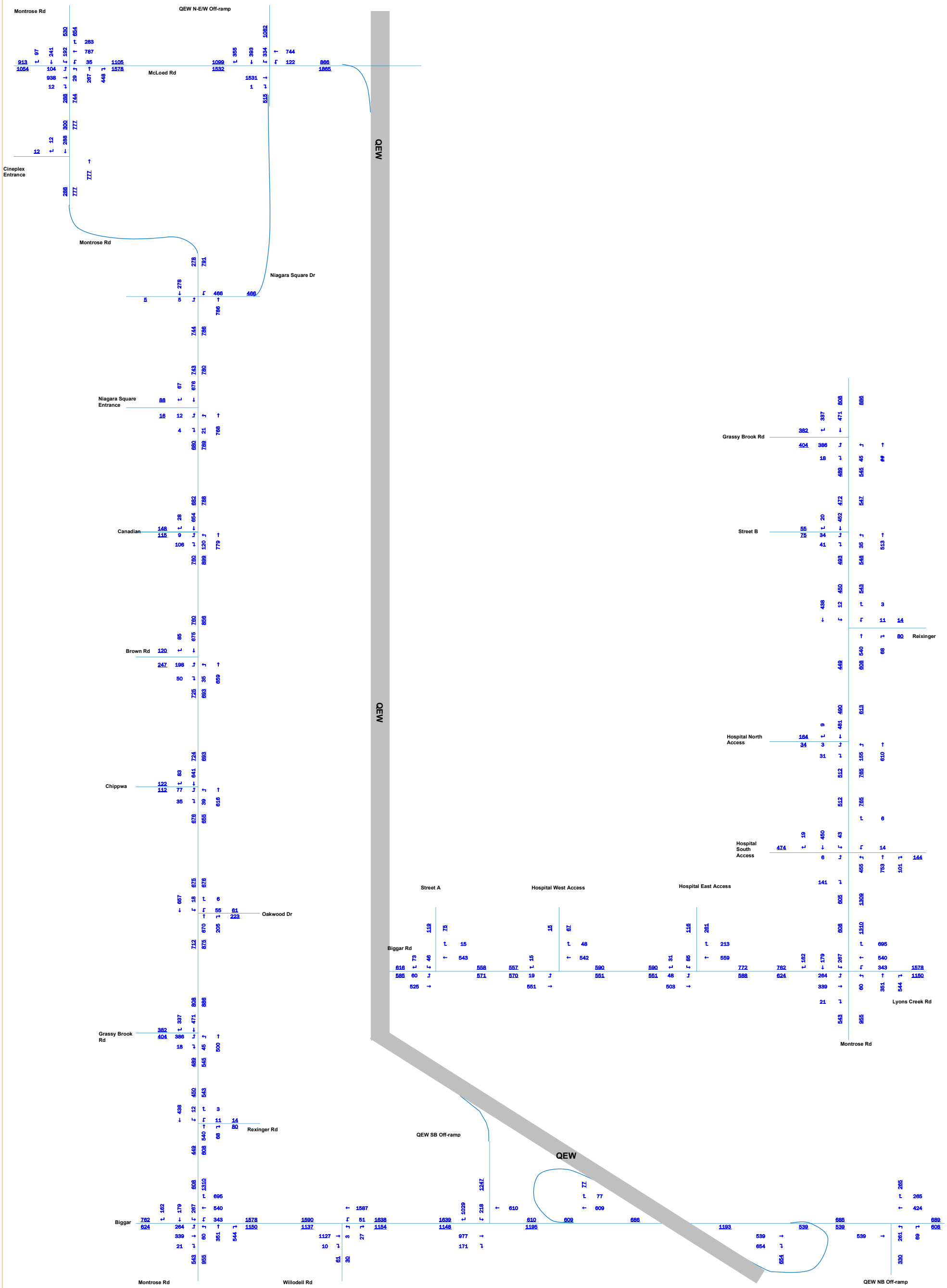
Montrose Road & Lyons Creek Road/Biggar Road EA - Detailed Transportation Assessment



PARSONS

2026 Traffic Forecasts (Revised) - Weekday PM Peak Hour

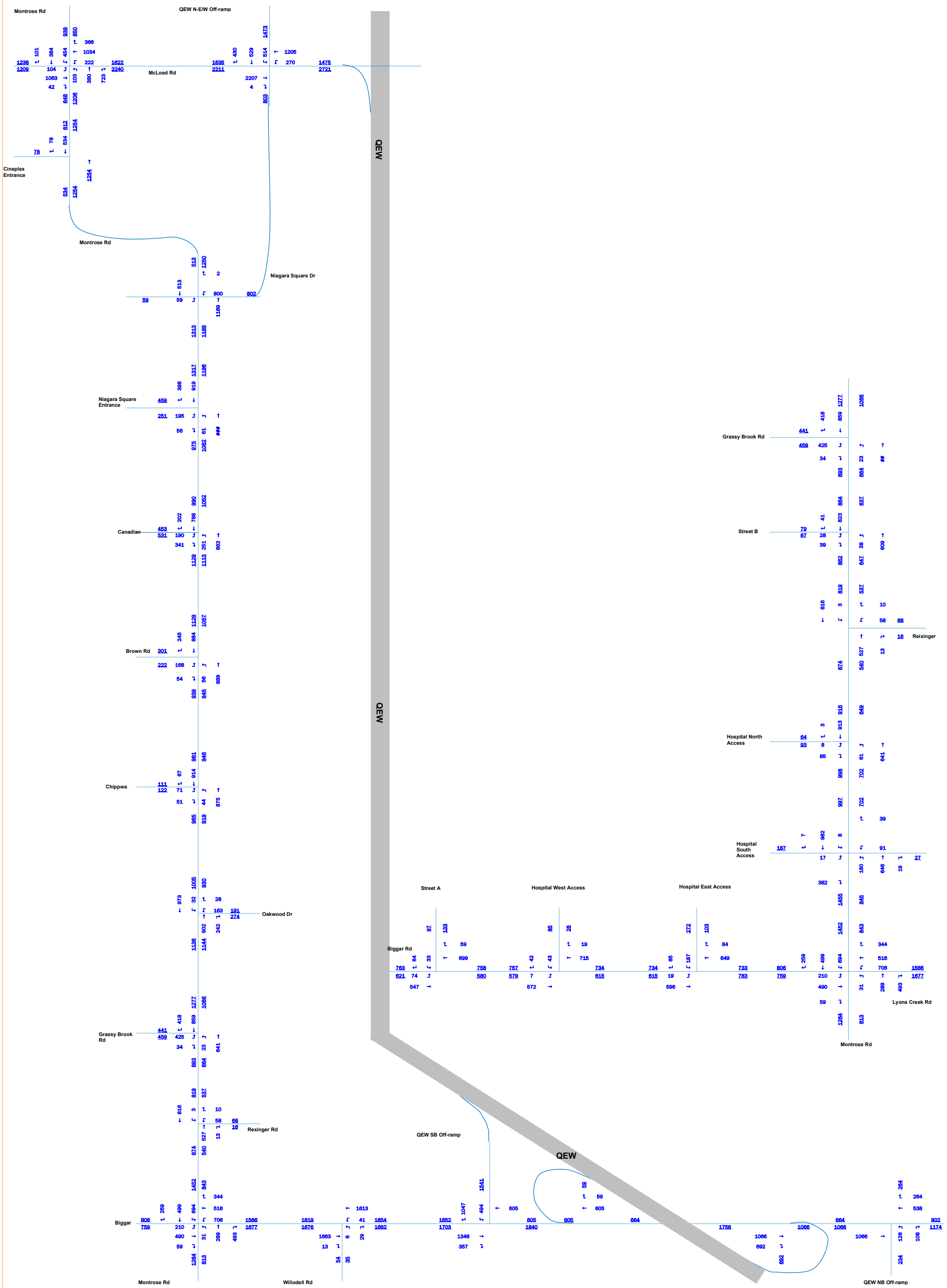
Montrose Road & Lyons Creek Road/Biggar Road EA - Detailed Transportation Assessment



PARSONS

2041 Traffic Forecasts (Revised) - Weekday AM Peak Hour

Montrose Road & Lyons Creek Road/Biggar Road EA - Detailed Transportation Assessment



PARSONS

2041 Traffic Forecasts (Revised) - Weekday PM Peak Hour

Memorandum

TO:
Imran Salam
Senior Transportation Engineer
Parsons Inc.

FROM:
Emily J. Ecker, P.Eng

PROJECT:
7018-10
South Niagara Hospital

DATE:
December 18, 2020

SUBJECT: SOUTH NIAGARA BACKGROUND TRAFFIC LAYERS

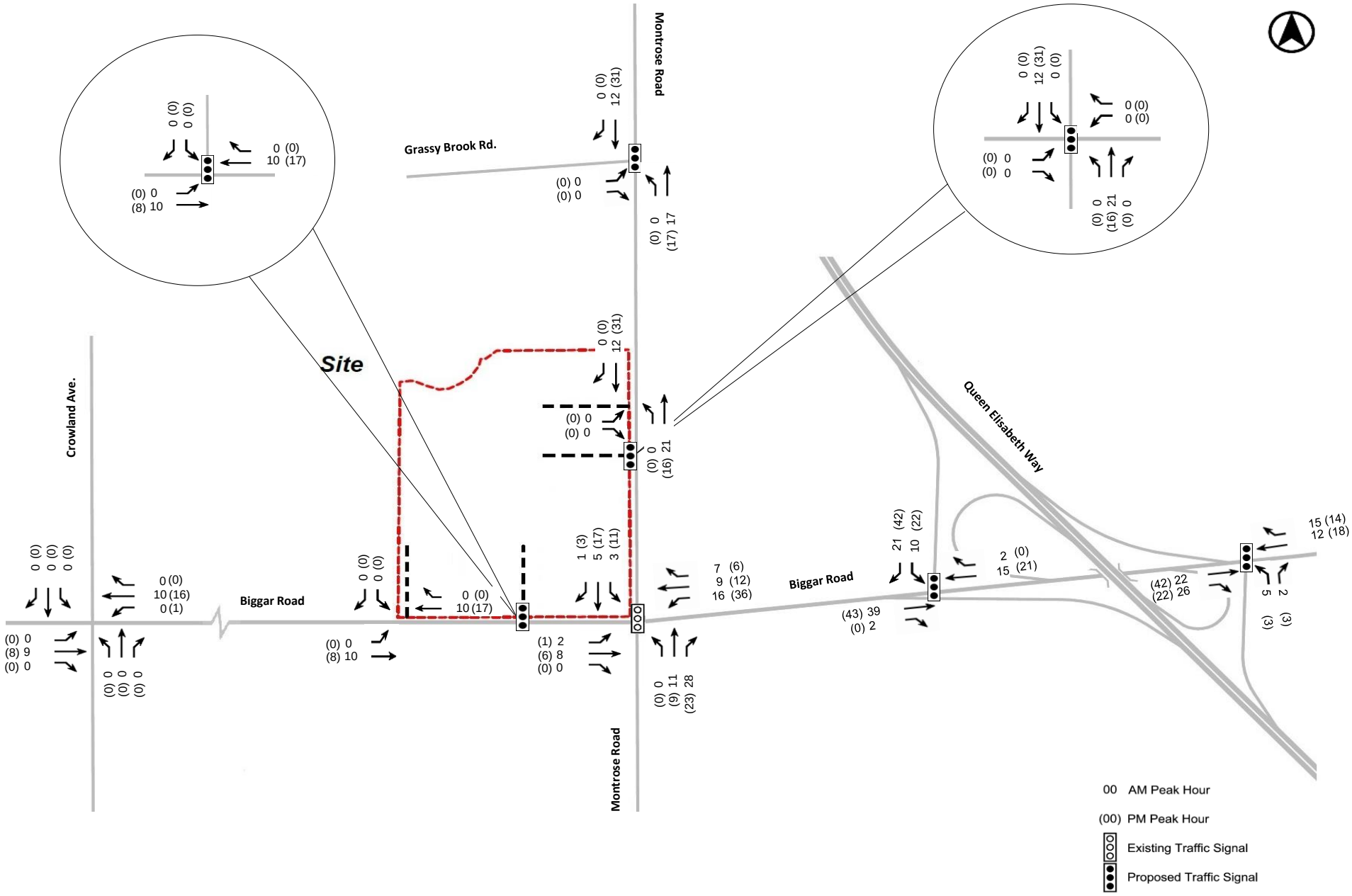
Imran:

Please find enclosed the breakdown of the background traffic layers from our analysis.

The description of each layer is summarized in **Table 1**.

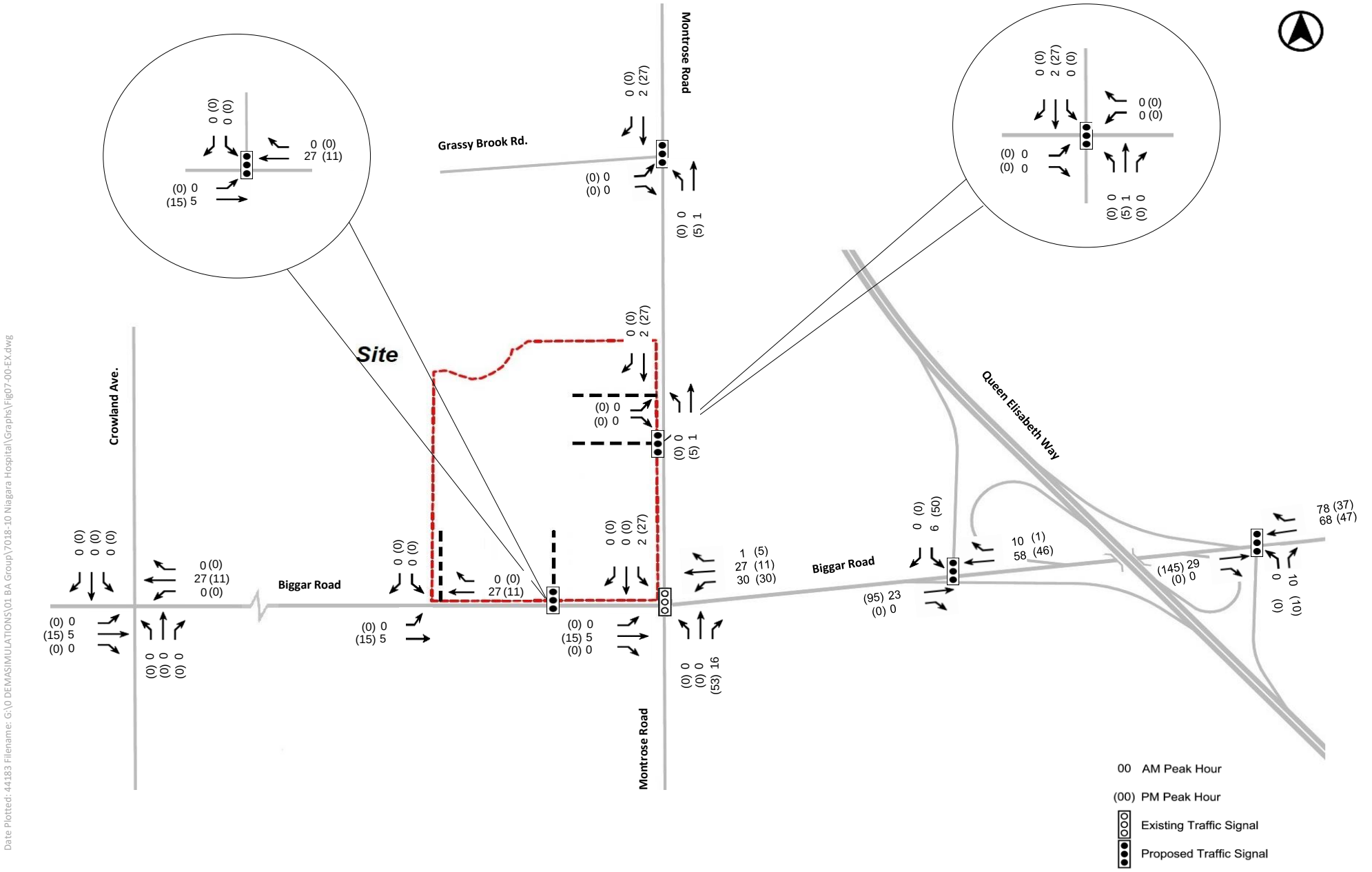
TABLE 1 BACKGROUND TRAFFIC LAYERS

Layer	Description
Corridor Growth	1% per annum assigned to the Biggar Road and Montrose Road corridors
Riverfront Development	750 residential units (likely density)
Warren Woods Development	1,245 residential units 65% built and occupied at the time of the traffic counts
WSP Site Development	Grand Niagara Secondary Plan traffic (WSP June 2017 figure 17)
Hospital East Driveway	Re-addition of GNSP traffic at east leg of Hospital driveway reassigned based on GNSP distribution
Niagara Square Site Impact	Total Niagara Square traffic
Negative Hospital Employment Diverted Link	50% of Employment Niagara Square linked trips from Hospital volumes removal from network
Negative Residential Diverted Link	100% of residential South Square link trips from GNSP volumes removal from network
Negative WSP Employment Diverted Link	50% of Employment Niagara Square linked trips from GNSP volumes removal from network
Positive Hospital Employment Diverted Link	Addition of Hospital linked trips to Niagara Square (50% of Employment Niagara Square linked trips)
Positive Residential Diverted Link	Addition of residential linked trips to Niagara Square
Positive WSP Employment Diverted Link	Addition of GNSP linked trips to Niagara Square (50% of Employment Niagara Square linked trips)
Niagara Square Total Diversion	Total diverted link trips (sum of employment + residential)



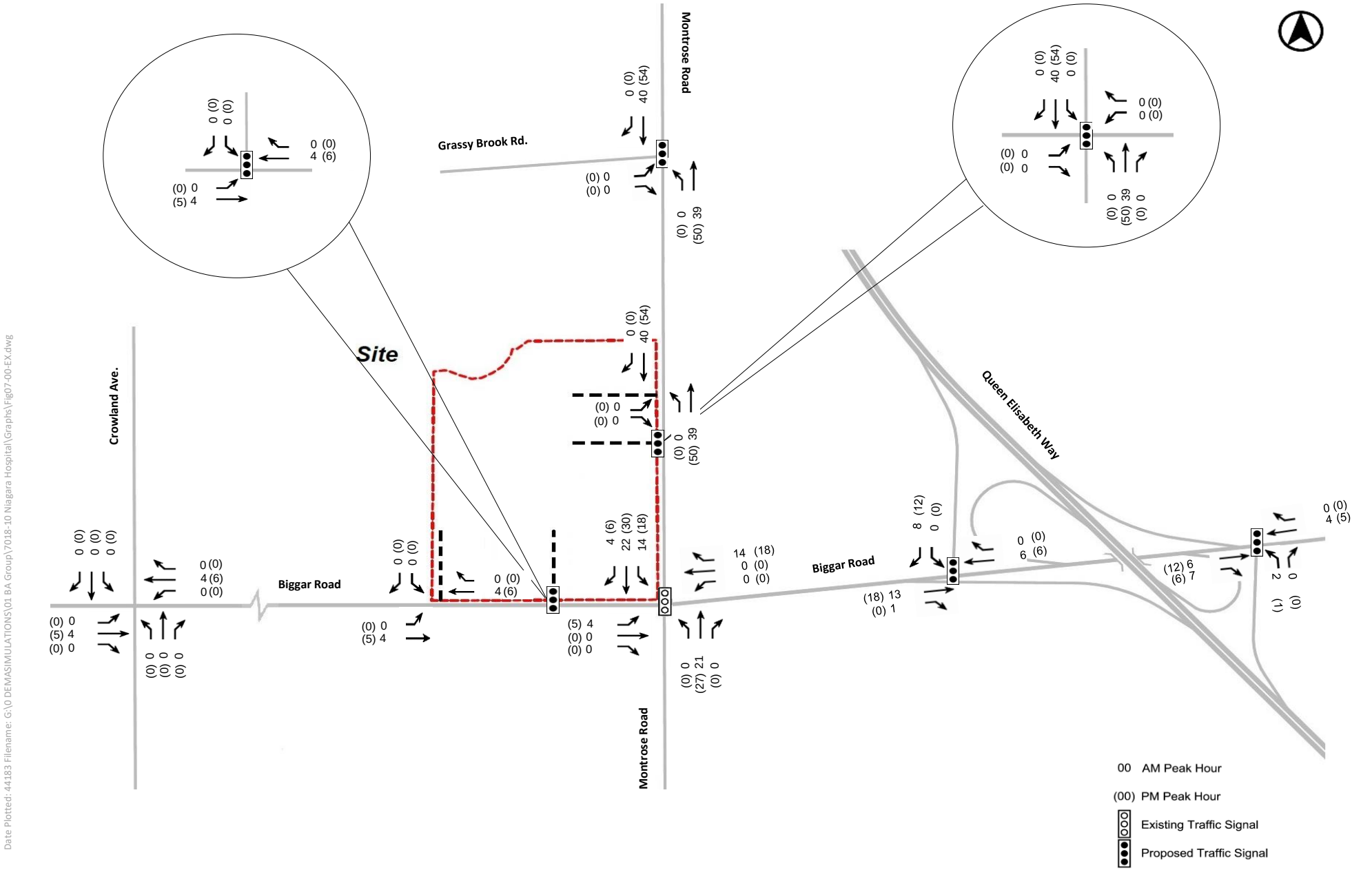
Date Plotted: 44183 Filename: G:\0 DEMASIMULATIONS\01 BA Group\7018-10 Niagara Hospital\Graphs\Fig07-00-EX.dwg

Corridor Growth

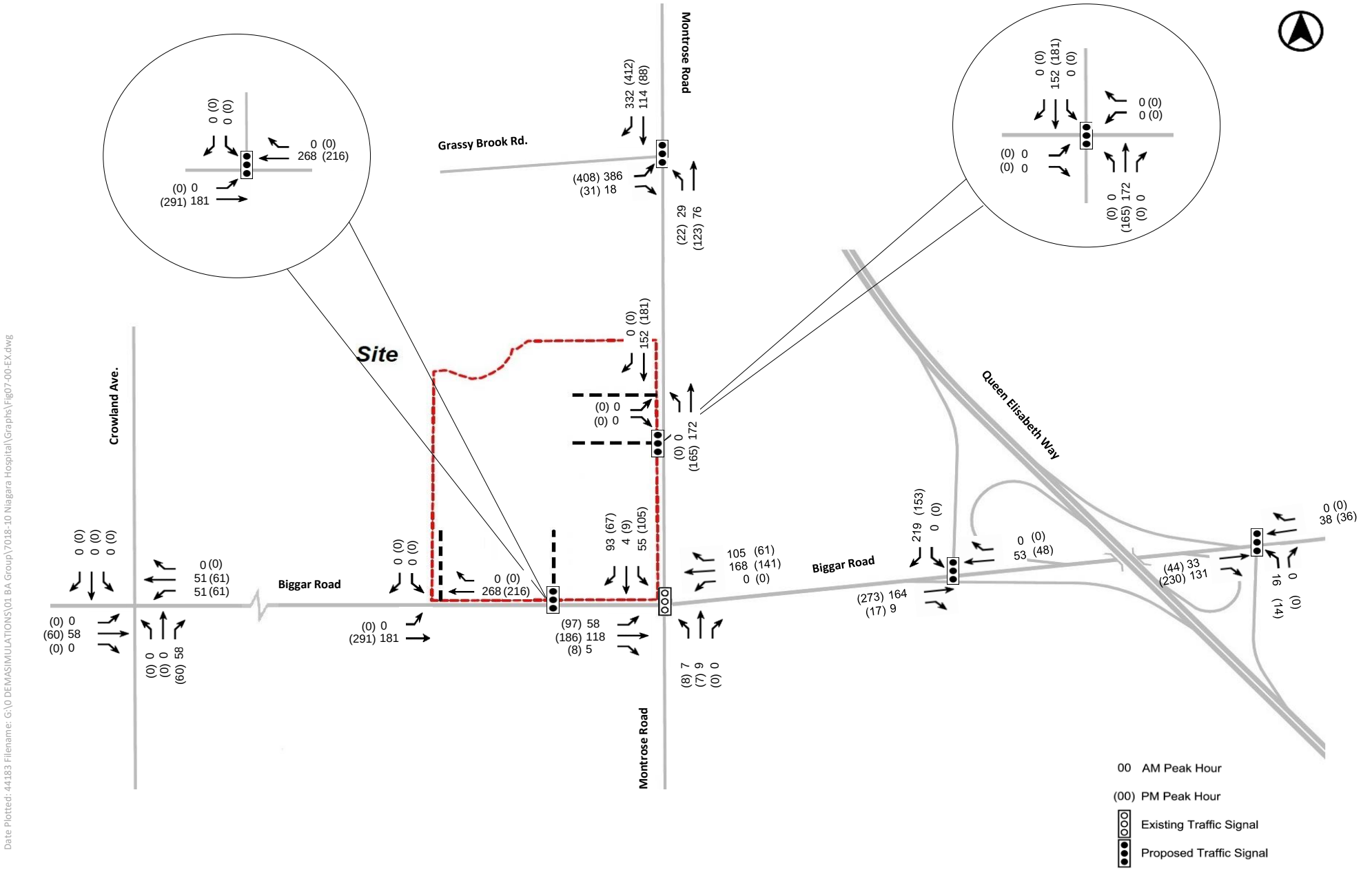


Date Plotted: 44183 Filename: G:\0 DEMASIMULATIONS\01 BA Group\7018-10 Niagara Hospital\Graphs\Fig07-00-EX.dwg

River Front Development

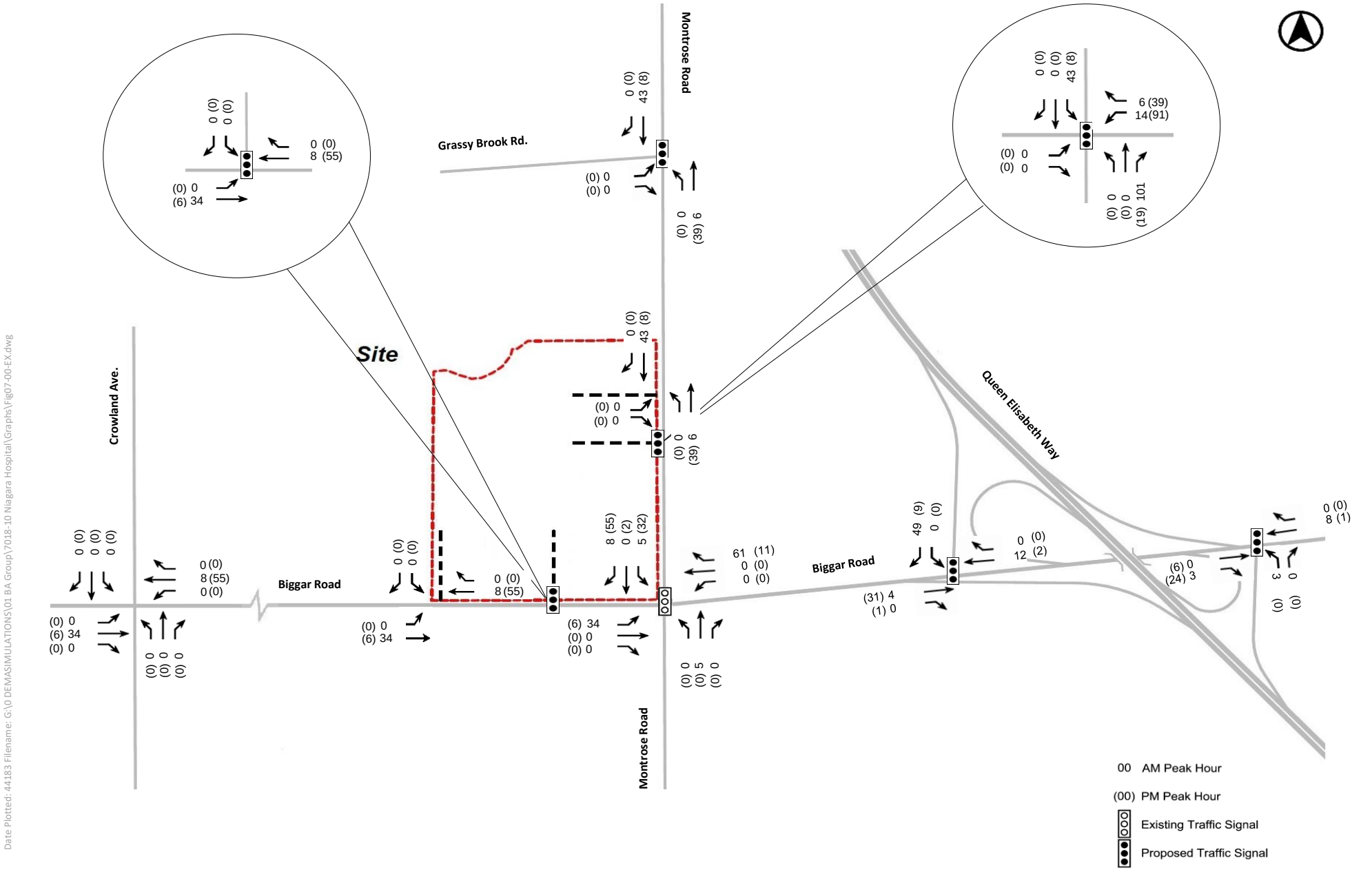


Date Plotted: 44183 Filename: G:\0 DEMASIMULATIONS\01 BA Group\7018-10 Niagara Hospital\Graphs\Fig07-00-EX.dwg



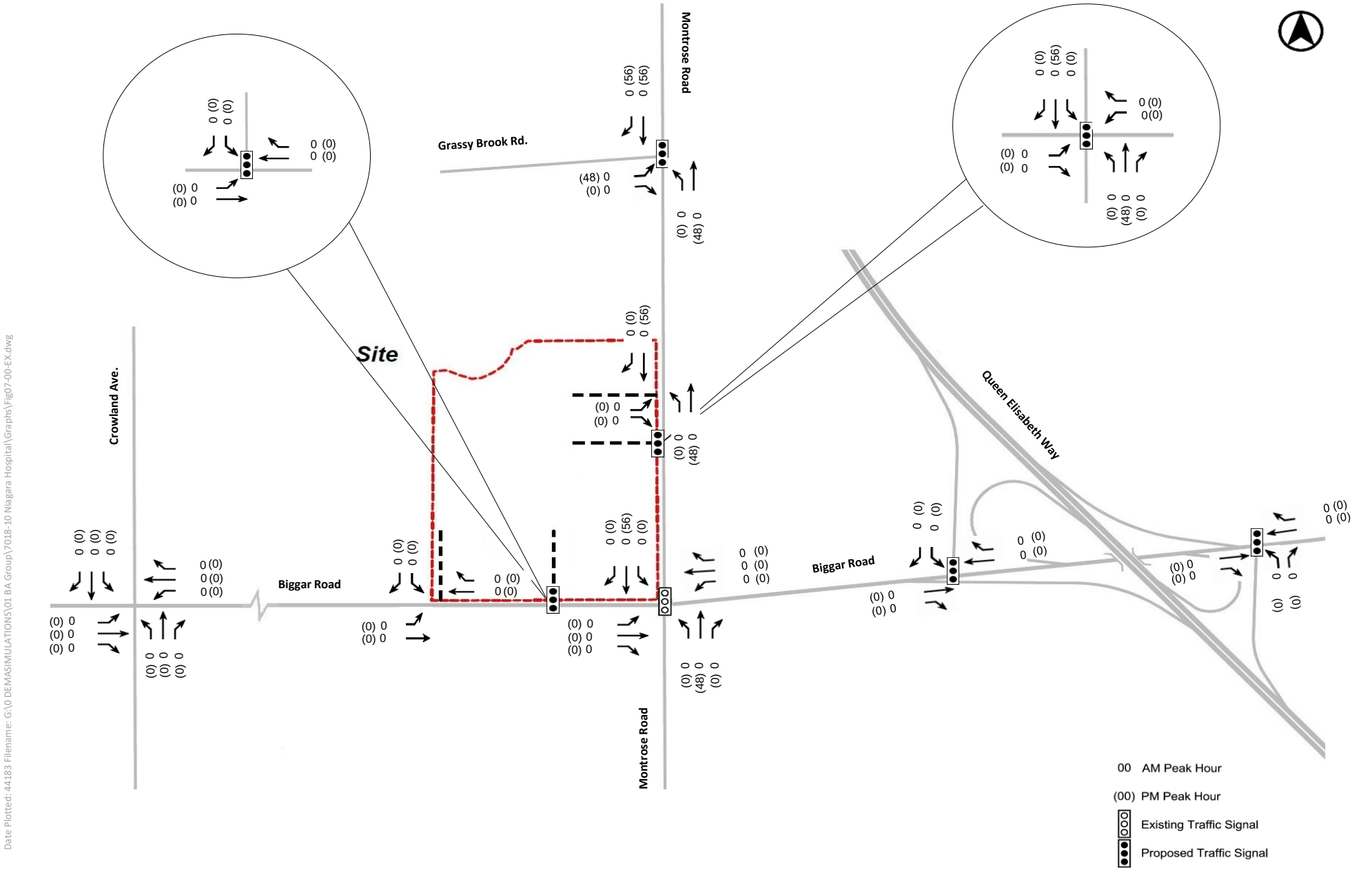
Date Plotted: 44183 Filename: G:\0 DEMASIMULATIONS\01 BA Group\7018-10 Niagara Hospital\Graphs\Fig07-00-EX.dwg

WSP Site Development



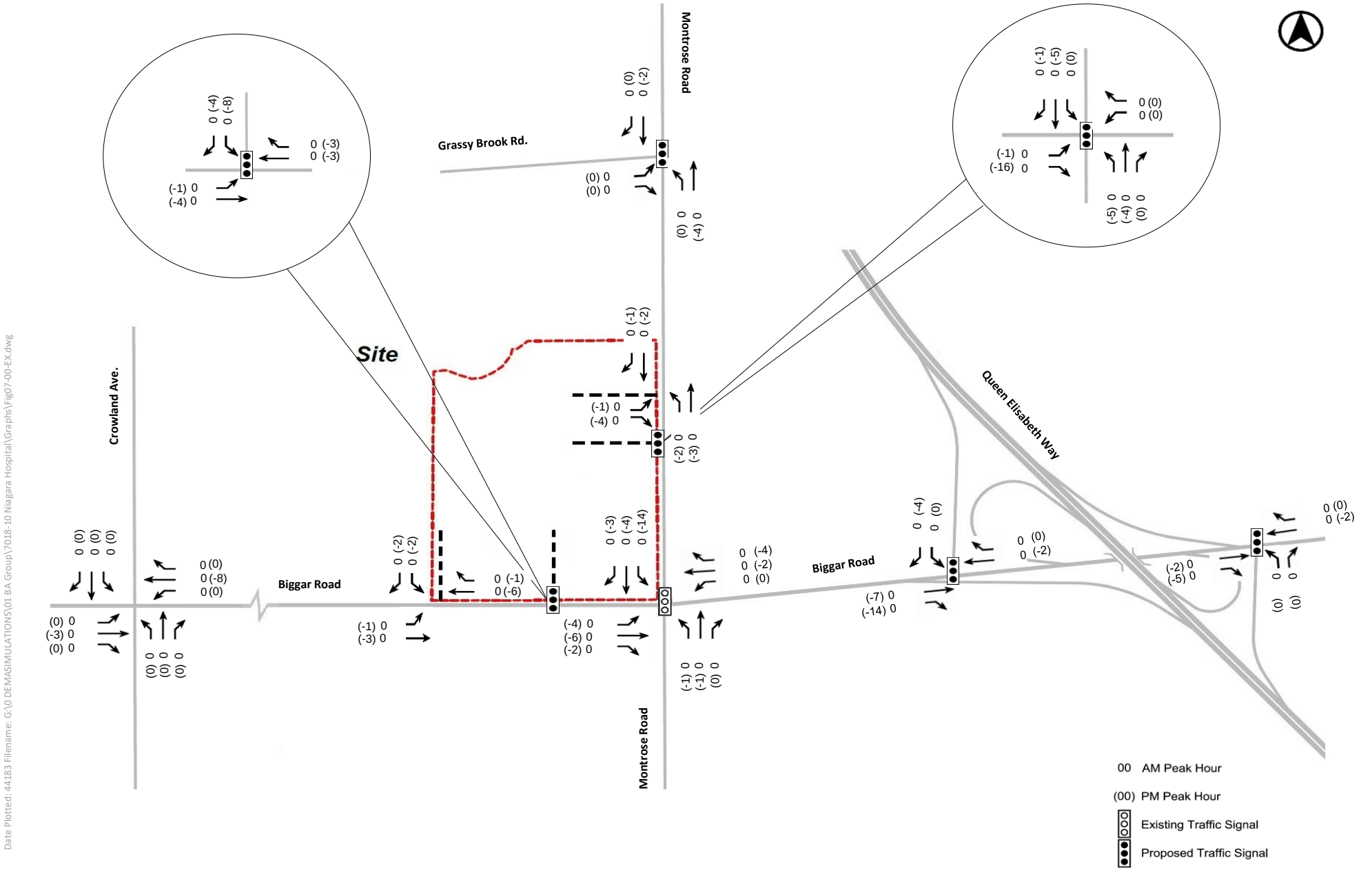
Date Plotted: 44183 Filename: G:\0 DEMAS\MULATIONS\01 BA Group\7018-10 Niagara Hospital\Graphs\Fig07-00-EX.dwg

Hospital Driveway East Access



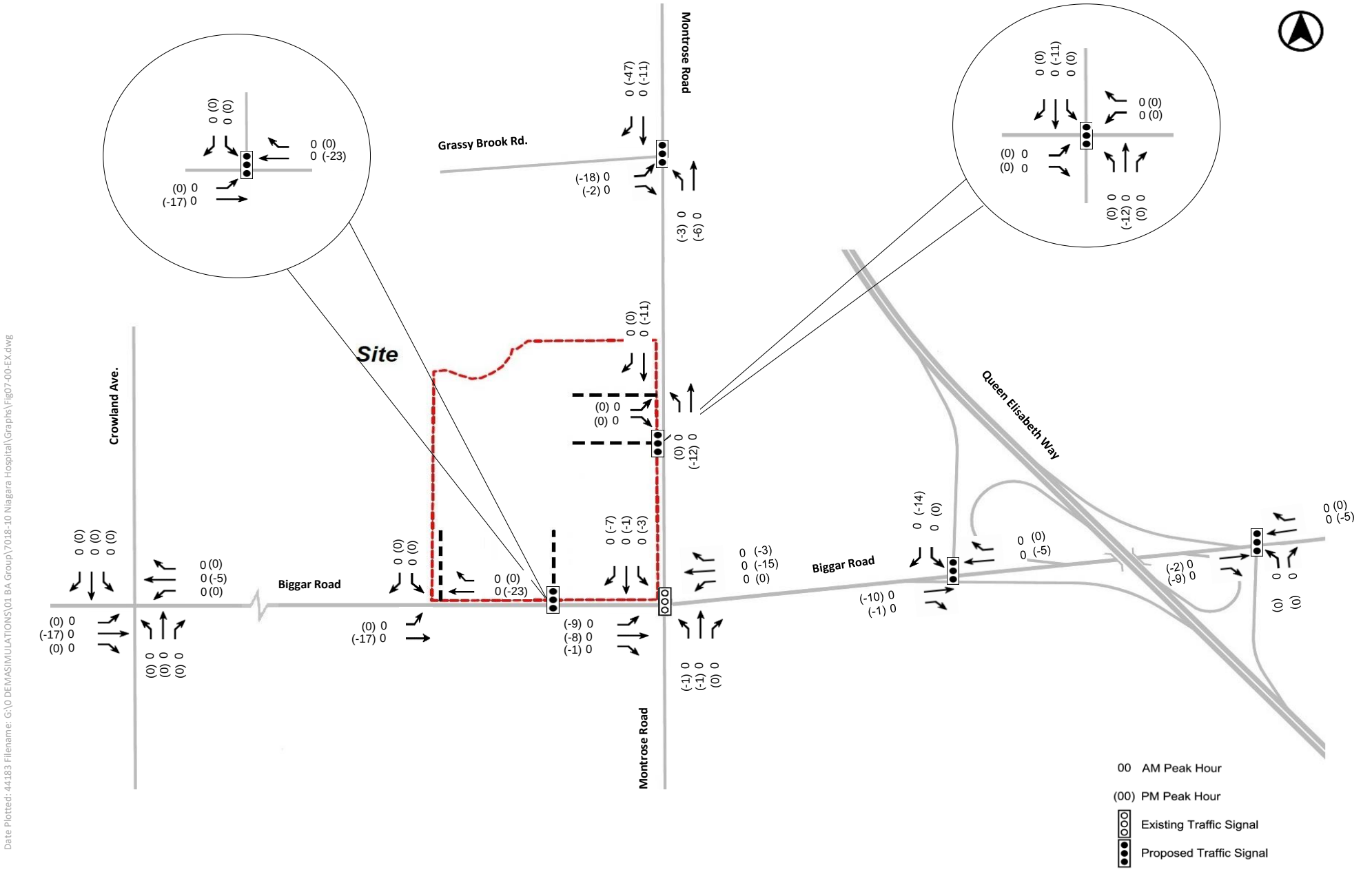
Date Plotted: 44183 Filename: G:\0 DEMAS\MULATIONS\01 BA Group\7018-10 Niagara Hospital\Graphs\Fig07-00-EX.dwg

Niagara Square Site Impact



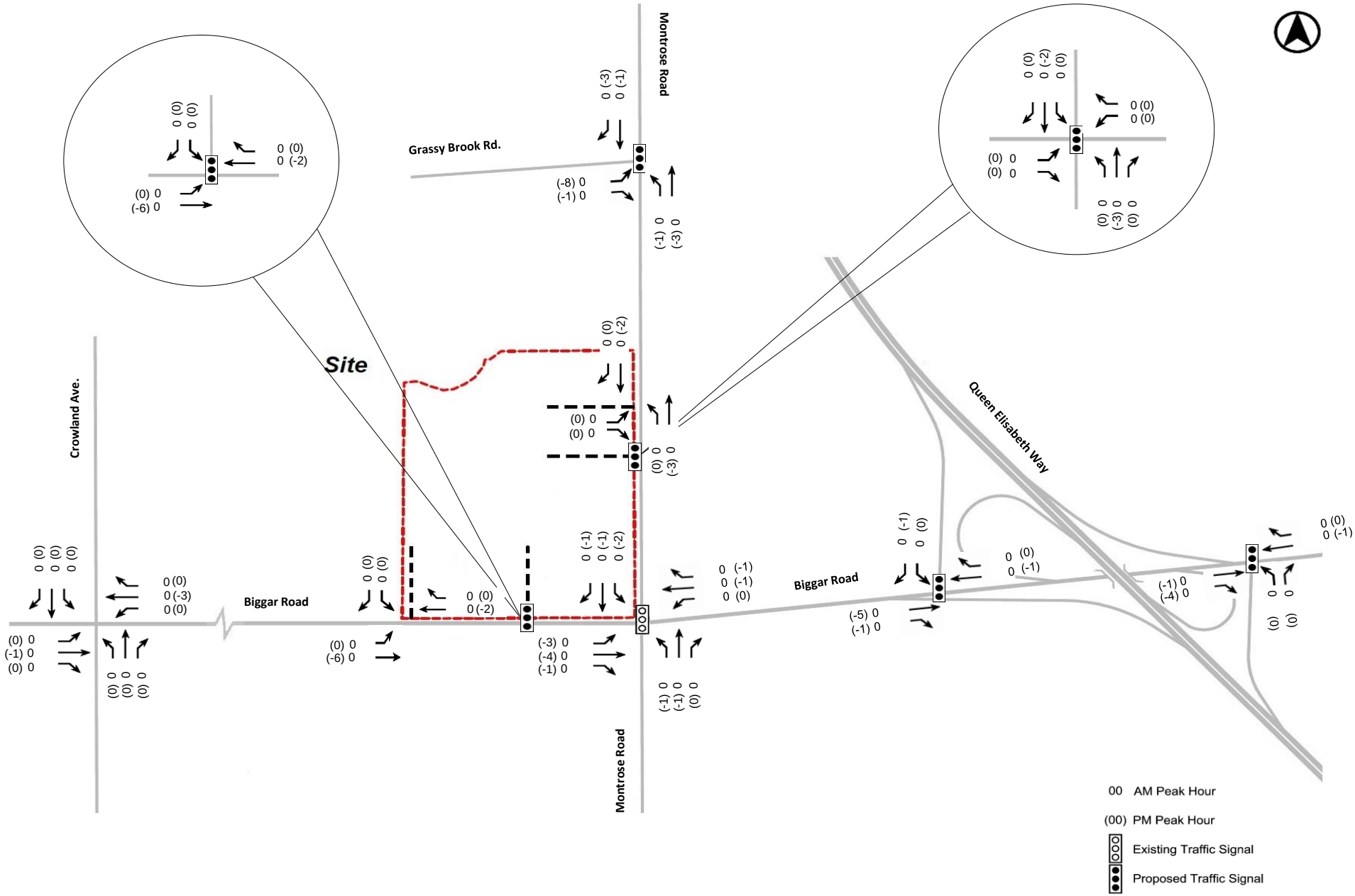
Date Plotted: 44183 Filename: G:\0 DEMASIMULATIONS\01 BA Group\7018-10 Niagara Hospital\Graphs\Fig07-00-EX.dwg

Negative Hospital Employment Diverted Link



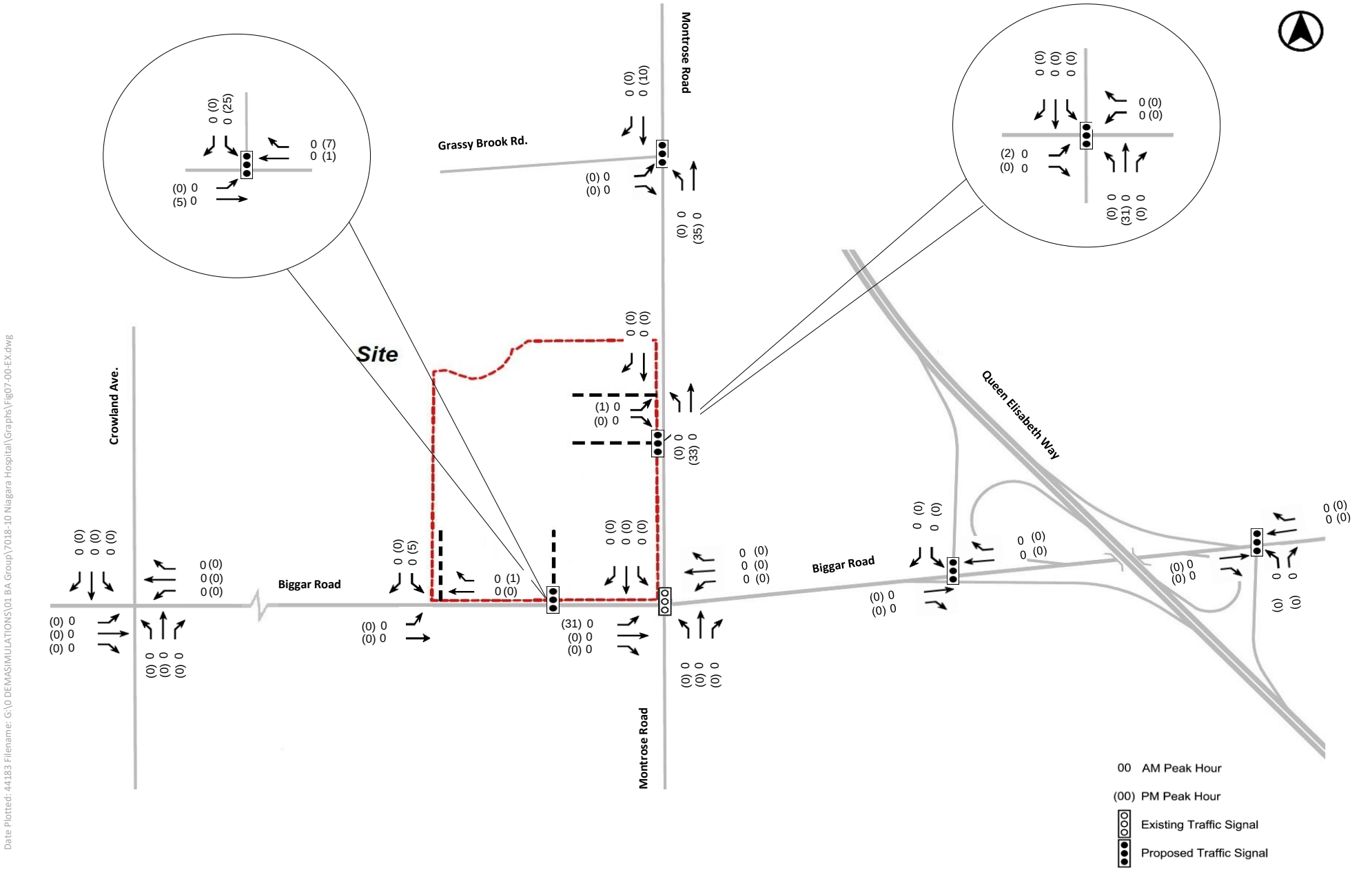
Date Plotted: 44183 Filename: G:\0 DEMAS\MULATIONS\01 BA Group\7018-10 Niagara Hospital\Graphs\Fig07-00-EX.dwg

Negative Residential Diverted Link



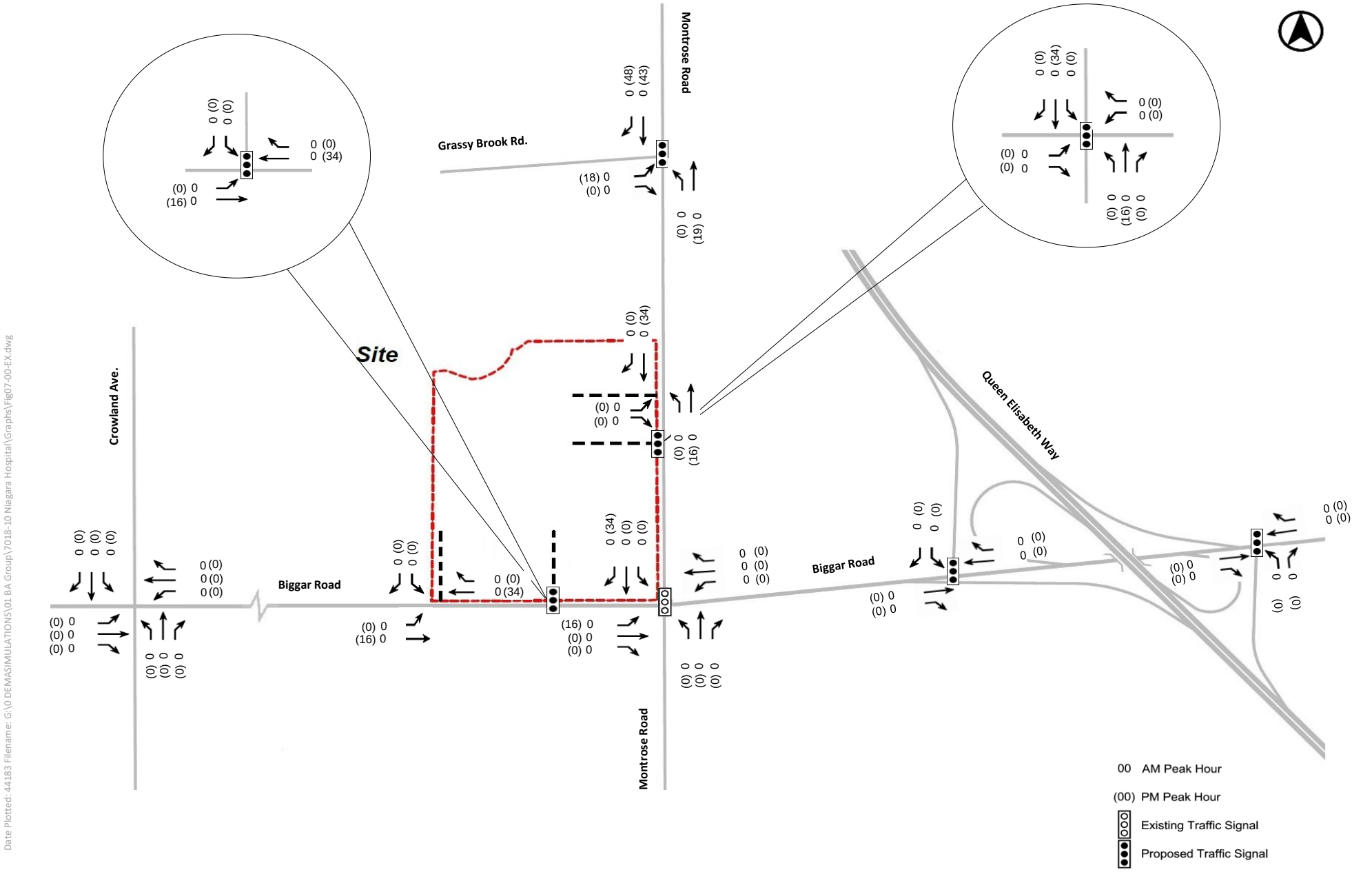
Date Plotted: 44183 Filename: G:\0 DEMASIMULATIONS\01 BA Group\7018-10 Niagara Hospital\Graphs\Fig07-00-EX.dwg

Negative WSP Employment Diverted Link



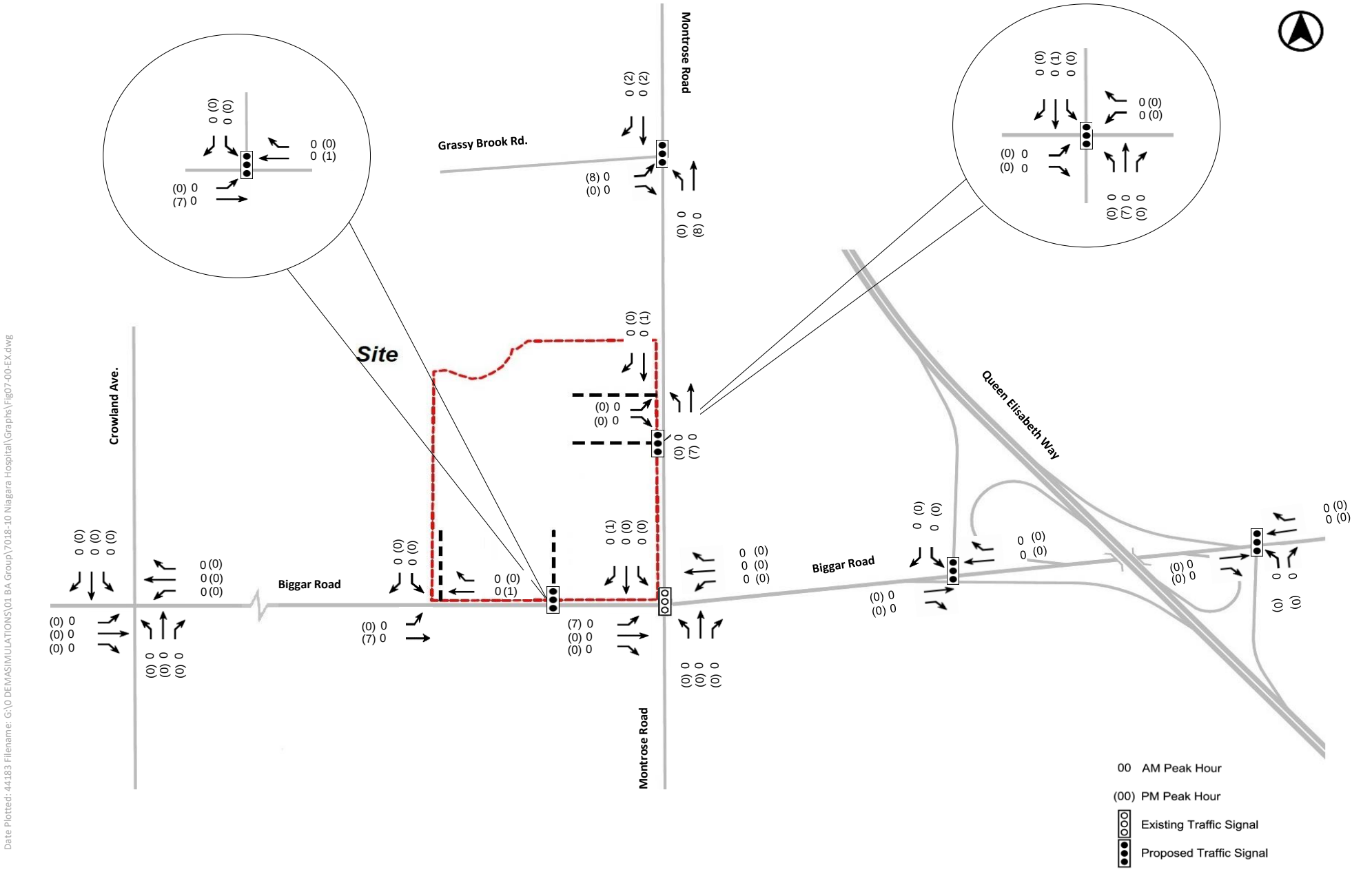
Date Plotted: 44183 Filename: G:\0 DEMAS\MULATIONS\01 BA Group\7018-10 Niagara Hospital\Graphs\Fig07-00-EX.dwg

Positive Hospital Employment Diverted Link



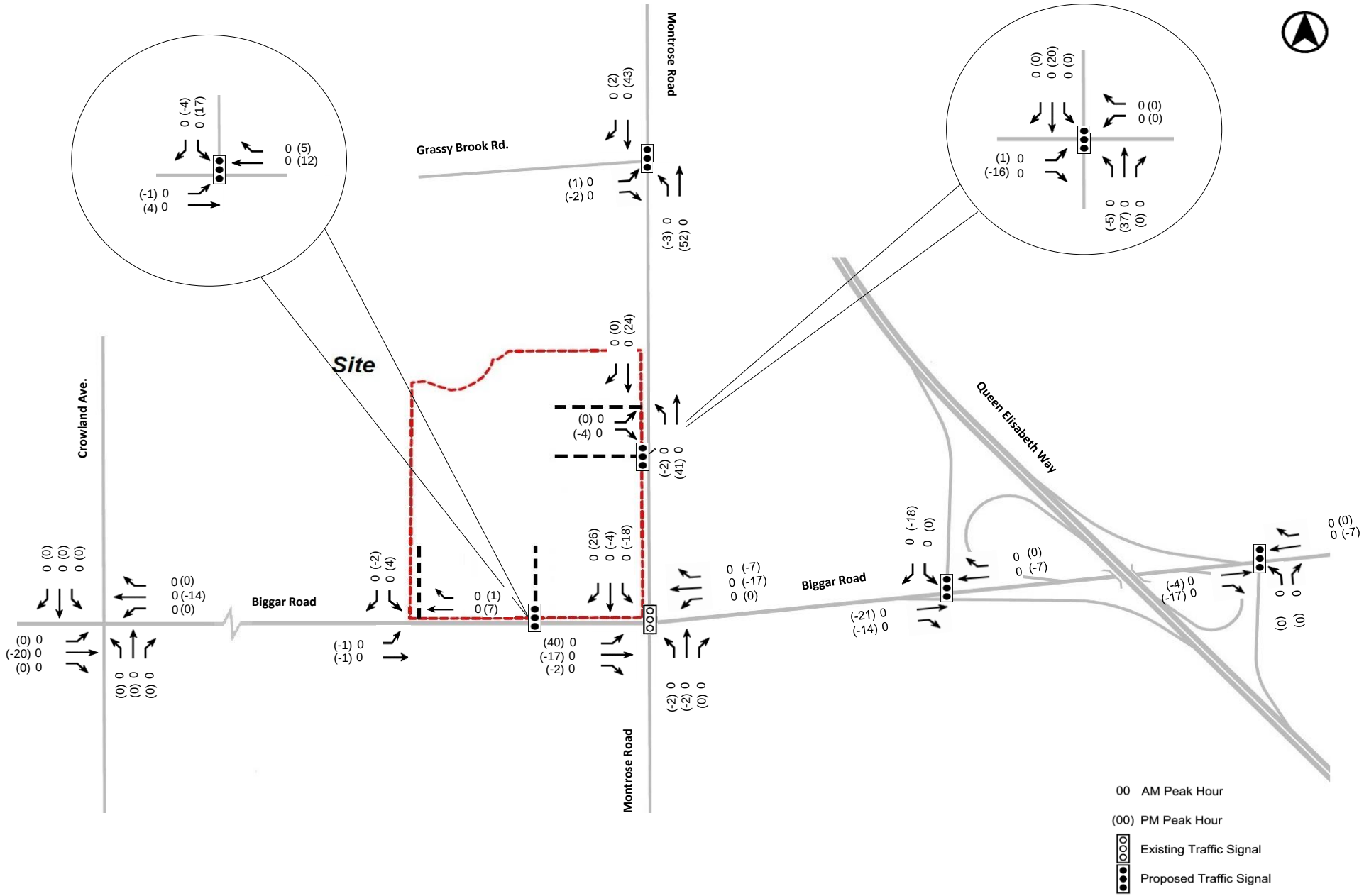
Date Plotted: 44183 Filename: G:\0 DEMAS\MULATIONS\01 BA Group\7018-10 Niagara Hospital\Graphs\Fig07-00-EX.dwg

Positive Residential Diverted Link



Date Plotted: 44183 Filename: G:\0 DEMAS\MULATIONS\01 BA Group\7018-10 Niagara Hospital\Graphs\Fig07-00-EX.dwg

Positive WSP Employment Diverted Link



Date Plotted: 44183 Filename: G:\0 DEMASIMULATIONS\01 BA Group\7018-10 Niagara Hospital\Graphs\Fig07-00-EX.dwg

Niagara Square TOTAL Diversion

1393 North Service Road East, Suite 103, Oakville, ON, L6H 1A7
Direct: +1 905.569.4122 / www.parsons.com

Technical Memo

Date: September 18, 2020 Our Reference # 4773511

To: Jordon Frost – Region of Niagara

From: Altaf Hussain – Parsons
Imran Salam - Parsons

Copy: Richard Goertz – Parsons
Noris Bot - Parsons

Subject: **Montrose Road, Lyons Creek Road/Biggar Road Municipal Class Environmental Assessment & Detail Design –Traffic Demand Forecasts for the Detailed Transportation Assessment (DTA)**

The Municipality of Niagara Region has retained Parsons to conduct a Municipal Class Environmental Assessment (EA) & Detailed Design for the reconstruction of Montrose Road from Lyons Creek Road to McLeod Road and for reconstruction of Lyons Creek road from the QEW interchange to the western limits of South Niagara Hospital. A Detailed Transportation Assessment (DTA) is being conducted under existing (2019) and future (2026 and 2041) traffic conditions in order to determine the roadway functional design components and traffic control facilities to meet the future traffic needs.

This memorandum summarizes the approach and methodology employed for future traffic forecast and presents the resulting traffic forecasts for the horizon year 2026 and 2041.

Forecasting Approach

As the Niagara Region's Transportation Master Plan (TMP) is based on a growth plan, the intent of the DTA is to take a ground-up approach to identify specific transportation infrastructure needs based on information available today. Therefore, various transportation impact studies (TIS) within the study limits have been consolidated to be used as inputs for the traffic forecast using the following methodology:

- Existing (2019) turning movement counts (TMCs) obtained from multiple sources discussed further below, were compiled, and adjusted/balanced within 10% approach volumes difference where needed.
- 1% compound annual growth rate was applied to the existing TMCs for all movements to estimate future 2026 and 2041 background traffic.
- Approved/planned developments' traffic demand sourced from the respective TISs was added to the background traffic to develop future total traffic forecasts.

Existing (2019) TMCs

Existing TMCs for the weekday AM and PM peak hours were sourced from the various TISs previously completed for respective planned developments in the area. TMC sources and count dates are summarized in Table 1. Standard industry practice of volume balancing and 1% compound annual growth rate referenced from recently completed TISs in the area were employed to develop the existing (2019) counts.. The TISs reviewed are listed further below under planned developments section. Volume balancing was conducted for locations having unjustified volume imbalance greater than 10%. Existing 2019 adjusted TMCs are provided in Attachment 1.

TABLE 1: STUDY INTERSECTION TRAFFIC DATA SOURCE AND COLLECTION DATE

Intersection	Source	Count Date
Signalized		
Montrose Road at Lyons Creek Road/Biggar Road	South Niagara Hospital TIS	June 12, 2019
Montrose Road at Niagara Square Drive	Niagara Square Mall Redevelopment TIS	November 28, 2018
Montrose Road at McLeod Road	Niagara Region	May 29, 2019
McLeod Road at QEW SB Off-ramp	Niagara Square Mall Redevelopment TIS	November 28, 2018
Unsignalized		
Montrose Road at Reixinger Road	Estimated*	
Montrose Road at Grassy Brook Road	South Niagara Hospital TIS	June 12, 2019
Montrose Road at Oakwood Drive		
Montrose Road at Chippawa Creek Road	Grand Niagara Secondary Plan TIS	September 03, 2015
Montrose Road at Brown Road	Estimated*	
Montrose Road at Canadian Drive	Niagara Square Mall Redevelopment TIS	November 28, 2018
Montrose Road at Niagara Square Entrance		
Lyons Creek Road at Wilodell Road	Grand Niagara Secondary Plan TIS	September 17, 2015
Lyons Creek Road at QEW SB Off-ramp	South Niagara Hospital TIS	June 12, 2019
Lyons Creek Road at QEW NB Off-ramp		

* TMCs for Reixinger Road and Brown Road were not available in any of the previous TISs. These were estimated based on the land uses in the vicinity of these intersections using ITE trip generation rates.

Approved/Planned Developments

Following approved/planned developments illustrated in Figure 1, have identified impacts on study area intersections and are included in the DTA traffic forecast accordingly.

- Niagara Square Redevelopment and Niagara Falls Costco
- Grand Niagara Secondary Plan
- South Niagara Hospital
- Riverfront Community Secondary Plan

The traffic demand estimated in the respective TISs has been included to develop future traffic forecast for the DTA. The respective TISs were completed at different points in time so it is noted that certain refinements were needed to combine the traffic demands appropriately for the DTA as explained below.

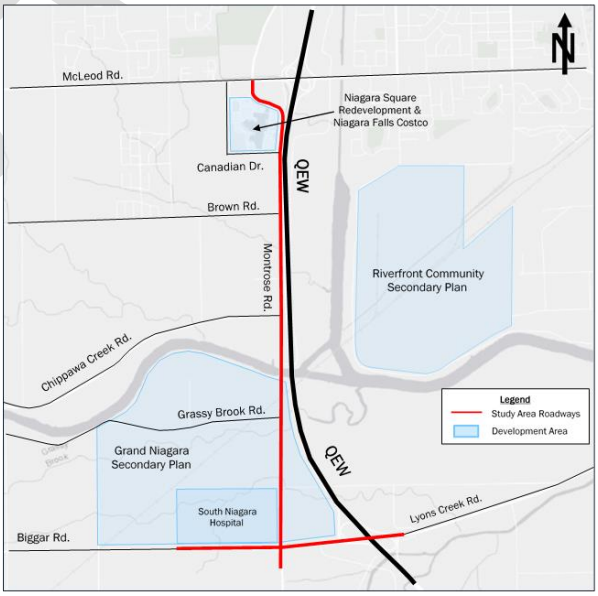


FIGURE 1: PLANNED DEVELOPMENTS

- **Niagara Square Redevelopment**: AM trips estimates are not available in the respective TIS. For the DTA, AM trips have been estimated using ITE trip generation rates, distributed and assigned following the distribution determined in the TIS.
- **Grand Niagara Secondary Plan**
  - The TIS was completed in 2015 which also estimated traffic forecasts for the planned South Niagara Hospital. A latest TIS was conducted for the hospital in 2019 which has been included in the DTA, therefore the hospital trips from the Grand Niagara Secondary Plan TIS have not been included.
  - Elementary school trips are assigned in the TIS to the streets external to the secondary plan. For the DTA the school trips have been removed from the external streets network.

DRAFT

- It is noted that trips interaction with the Niagara Square Mall was not estimated. For the DTA, the interaction trips have been estimated using ITE attraction rates (AM 1%, PM 42%) between residential and retail land uses. The trips have been proportionately deleted from the outer network and re-assigned to the Montrose Road segment between the Secondary Plan area and the Niagara Square.

South Niagara Hospital Trip Distribution Review

The South Niagara Hospital TIS utilized employee trip distribution for all the estimated hospital trips and did not modify the distribution to account for the proportion of the trips that will be made by patients and/or visitors to the hospital. Although majority of the trips generated during the peak hours result from the employees, it was the intent of this DTA to review the sensitivity of the travel patterns to ascertain whether the use of employee trip distribution results in over estimation of the demand for QEW NB terminal at Lyons Creek Road. Sensitivity analysis assumes one third of the hospital trips as patient/visitor trips that is consistent with the visitors parking estimated for the hospital. The trip estimates are presented in Table 2.

TABLE 2: SOUTH NIAGARA HOSPITAL – VISITORS/PATIENTS TRIPS ESTIMATES

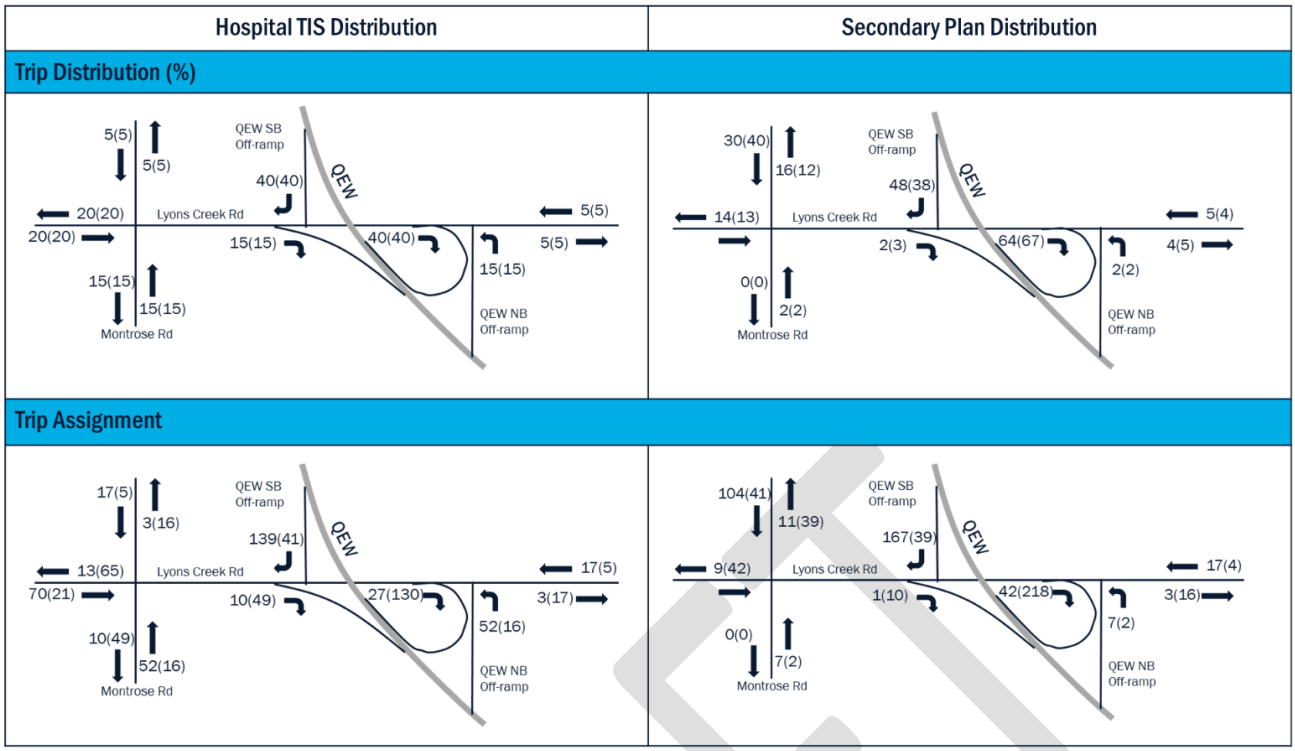
		Hospital TIS Trips	Visitor/Patient Trips (33%)	Employee Trips (67%)
AM	In	1055	348	707
	Out	202	67	135
PM	In	311	103	208
	Out	985	325	660

To review the sensitivity of travel patterns with respect to the remediation measures required for the QEW terminals at Lyons Creek Road, the visitors/patient trips were assigned to the network using both the Hospital TIS distribution and the TTS 2011 distribution used by the Grand Niagara Secondary Plan TIS. The comparison of both the trip distribution and the trip assignment is presented in Figure 2.

With the secondary plan trip distribution, trips increase from 139 to 167 for the SB Off-ramp while PM trips decrease by only 2 trips. For NB Off-ramp the decrease is 45 trips and 14 trips during AM and PM, respectively. There is no change for easterly trips on Lyons Creek road.

As shown in Table 3., the overall net change in the future total traffic volume on ramp terminals with modified trip distribution is not significant except for the NB Off-ramp. Pending the future conditions analysis, any significant change in LOS is not envisaged for the QEW terminals at the Lyons Creek Road.

DRAFT



Legend: AM(PM) – xx (xx)

TABLE 3: NET CHANGE IN 2041 TOTAL RAMP TRAFFIC WITH MODEFIED TRIP DOSTRIBUTION

Ramp Terminal	AM			PM		
	2041 Total Traffic	Change in Trips	Percent Change	2041 Total Traffic	Change in Trips	Percent Change
SB Off-ramp	1870	+ 28	+1.5%	1732	- 2	No Change
NB Off-ramp	355	- 45	-13%	226	- 14	- 6%

Modal Split

Grand Niagara Secondary Plan TIS assumed 10% modal share for non-auto modes that accounted for transit, cycling, walking any other form of non-SOV trips. Due diligence was performed to ascertain whether this assumption is still valid to carry forward for the DTA. City of Niagara Falls Transportation Master Plan (2011) assumes following non-auto modal shares for the 2031 horizon:

- Transit Improvements Only – 10%
- Transit Improvements plus TDM – 18%

Auto modal share extracted from 2016 Transportation Tomorrow Survey (TTS) for planning districts 56 (Thorold), 57 (Niagara Falls) and 58 (Welland) is approximately 75%. The 25% share of non-auto modes, appears to be on the higher side and given the assumptions within the Transportation Master Plan, a conservative 10% non-auto mode share is considered appropriate.

FIGURE 2: HOSPITAL VISITORS/PATIENTS TRIPS DISTRIBUTION AND ASSIGNMENT

Demand Forecasts

To develop future forecasts, existing (2019) traffic volumes were grown by 1% compound per annum to account for general background traffic growth. This is consistent with the previous TISs completed for the planned developments within the DTA study area. Traffic demand resulting from the approved/planned developments was added to the background traffic to estimate future total traffic demand. Following developments build-out have been assumed for horizon year 2026 and 2041:

- 2026 Horizon
  - 50% Grand Niagara Secondary Plan
  - 100% Riverfront Community Secondary Plan
  - 100% South Niagara Hospital
  - 100% Niagara Square Redevelopment and Niagara Falls Costco
- 2041 Horizon
  - 100% Grand Niagara Secondary Plan
  - 100% Riverfront Community Secondary Plan
  - 100% South Niagara Hospital
  - 100% Niagara Square Redevelopment and Niagara Falls Costco

AM and PM peak hour volumes for the 2026 and 2041 years are provided in Attachment 2.

Attachment(s)/Enclosure

Attachment 1 – Existing Adjusted Traffic Counts
Attachment 2 – 2026 and 2041 Traffic Forecasts

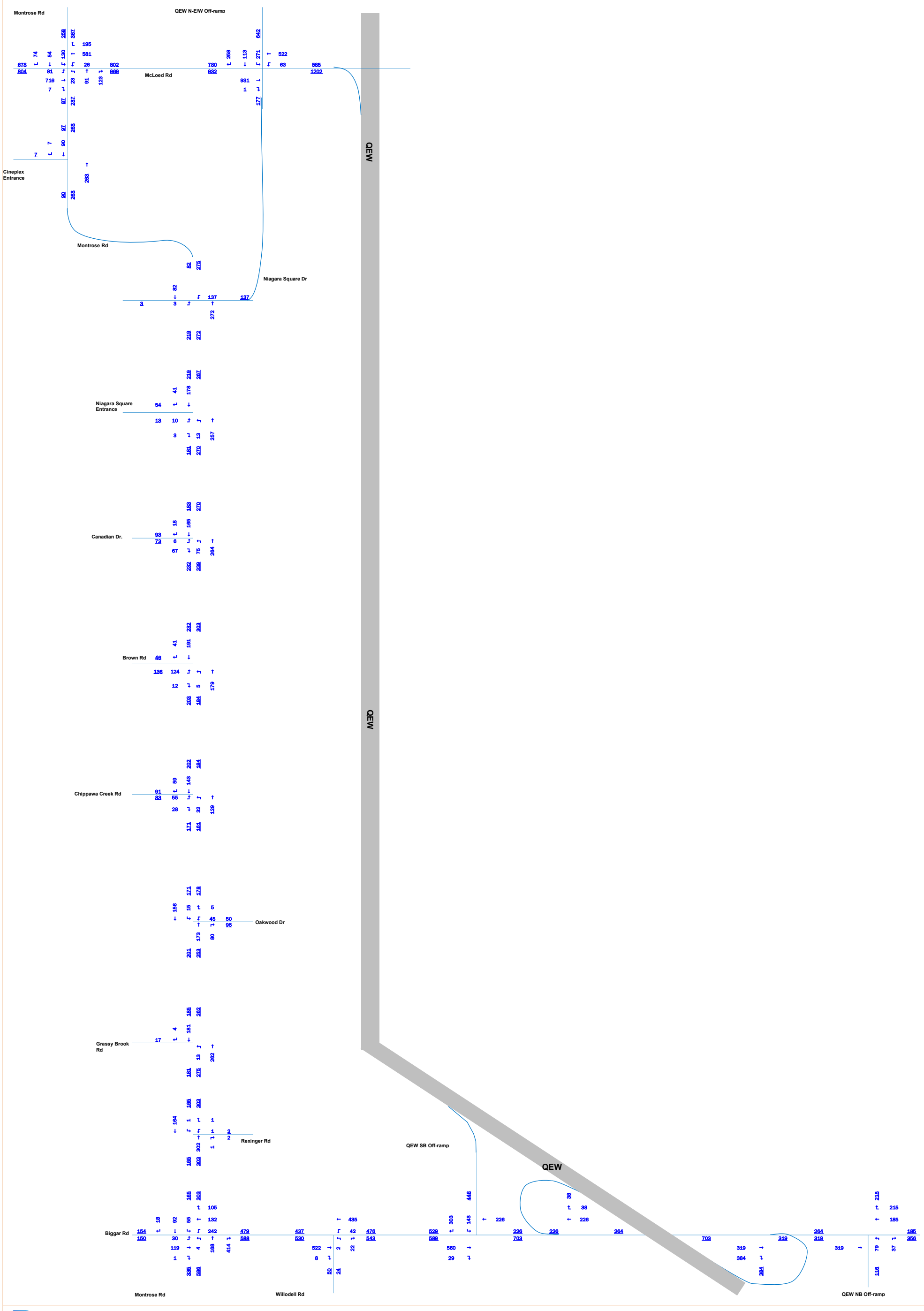
DRAFT

ATTACHMENT 1

EXISTING (2019) ADJUSTED TRAFFIC COUNTS

PARSONS

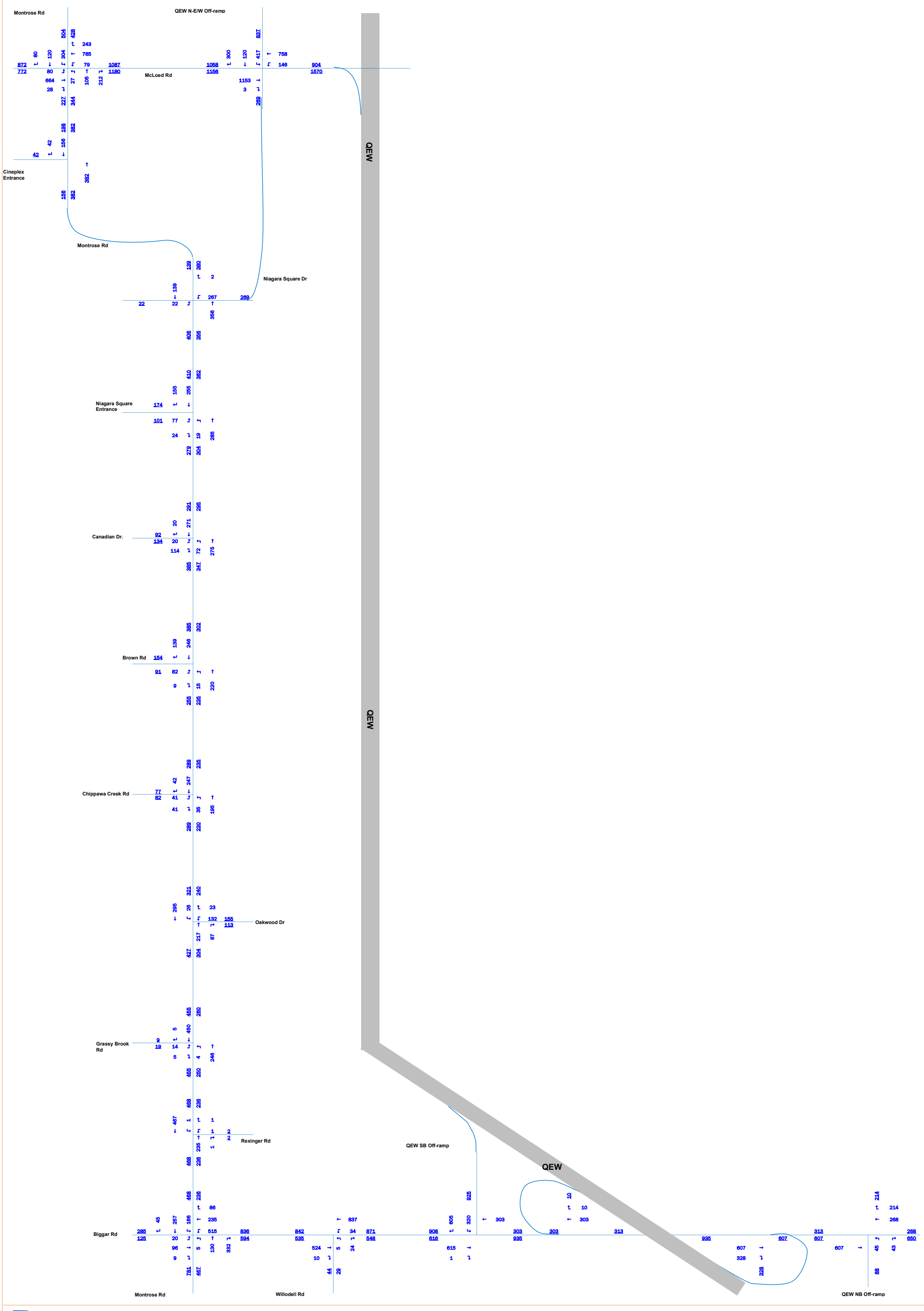
Montrose Road & Lyons Creek Road/Biggar Road EA - Detailed Transportation Assessment



PARSONS

Existing (2019) Traffic - Weekday AM Peak Hour

Montrose Road & Lyons Creek Road/Biggar Road EA - Detailed Transportation Assessment



PARSONS

Existing (2019) Traffic - Weekday PM Peak Hour

ATTACHMENT 2

2026 AND 2041 TRAFFIC FORECASTS

PARSONS

Montrose Rd
QEW N-E/W Off-ramp
McLoed Rd
Cineplex Entrance
Montrose Rd
Niagara Square Dr
QEW
Niagara Square Entrance
Canadian Dr.
Brown Rd
Chippwa Creek Rd
Oakwood Dr
See the Inset
Grassy Brook Rd
Rexinger Rd
Biggar Rd
Montrose Rd
Willodell Rd
Inset - Grand Niagara Secondary Plan and Hospital Access Streets
Grassy Brook Rd
Street B
Reixinger
Hospital North Access
Hospital South Access
Street A
Hospital West Access
Hospital East Access
Biggar Rd
Lyons Creek Rd
Montrose Rd
QEW SB Off-ramp
QEW
Lyons Creek Rd
Lyons Creek Rd
QEW NB Off-ramp

Montrose Rd
QEW N-E/W Off-ramp
McLoed Rd
Cineplex Entrance
Montrose Rd
Niagara Square Dr
QEW
Niagara Square Entrance
Canadian Dr
Brown Rd
Chippwa Creek Rd
Oakwood Dr
Inset - Grand Niagara Secondary Plan and Hospital Access Streets
Grassy Brook Rd
Street B
Reixinger
Hospital North Access
Hospital South Access
Street A
Hospital West Access
Hospital East Access
Biggar Rd
Lyons Creek Rd
Montrose Rd
See the Inset
Grassy Brook Rd
Rexinger Rd
Biggar Rd
Montrose Rd
Willodell Rd
QEW SB Off-ramp
QEW
Lyons Creek Rd
Lyons Creek Rd
QEW NB Off-ramp

Montrose Road & Lyons Creek Road/Biggar Road EA - Detailed Transportation Assessment

PARSONS

2041 Traffic Forecasts - Weekday AM Peak Hour

PARSONS

2041 Traffic Forecasts - Weekday PM Peak Hour

APPENDIX E

SYNCHRO REPORTS, EXISTING (2019), AND 2026 & 2041 DO NOTHING CONDITIONS

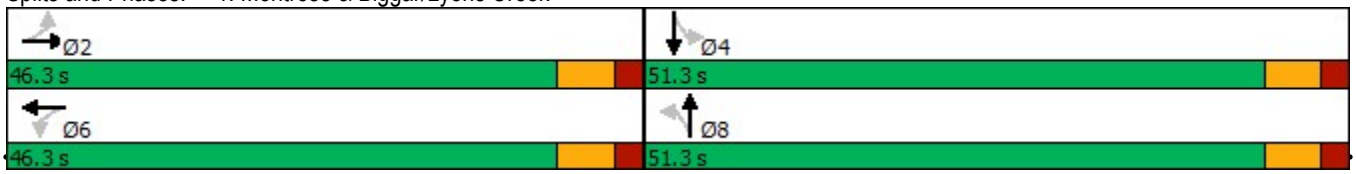
PARSONS

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	30	119	242	132	4	168	55	92
Future Volume (vph)	30	119	242	132	4	168	55	92
Lane Group Flow (vph)	0	163	0	520	0	637	0	180
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		2		6		8		4
Permitted Phases	2		6		8		4	
Detector Phase	2	2	6	6	8	8	4	4
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	26.3	26.3	26.3	26.3	31.3	31.3	31.3	31.3
Total Split (s)	46.3	46.3	46.3	46.3	51.3	51.3	51.3	51.3
Total Split (%)	47.4%	47.4%	47.4%	47.4%	52.6%	52.6%	52.6%	52.6%
Yellow Time (s)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
All-Red Time (s)	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Lost Time Adjust (s)		3.0		3.0		3.0		3.0
Total Lost Time (s)		9.3		9.3		9.3		9.3
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	Max	Max	Max	Max	None	None	None	None
v/c Ratio		0.27		1.03		0.92		0.50
Control Delay		21.5		78.2		39.1		25.3
Queue Delay		0.0		0.0		0.0		0.0
Total Delay		21.5		78.2		39.1		25.3
Queue Length 50th (m)		20.6		~107.8		82.2		22.3
Queue Length 95th (m)		36.8		#172.6		#149.1		41.7
Internal Link Dist (m)		355.5		233.5		313.4		537.6
Turn Bay Length (m)								
Base Capacity (vph)		598		504		799		424
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		1.03		0.80		0.42

Intersection Summary

Cycle Length: 97.6
Actuated Cycle Length: 91.5
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Montrose & Biggar/Lyons Creek



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	30	119	1	242	132	105	4	168	414	55	92	18
Future Volume (vph)	30	119	1	242	132	105	4	168	414	55	92	18
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		9.3			9.3			9.3			9.3	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		1.00			1.00			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		1.00			0.97			0.90			0.98	
Flt Protected		0.99			0.98			1.00			0.98	
Satd. Flow (prot)		1710			1565			1550			1511	
Flt Permitted		0.85			0.76			1.00			0.59	
Satd. Flow (perm)		1468			1215			1548			907	
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)	33	129	1	263	143	114	4	183	450	60	100	20
RTOR Reduction (vph)	0	0	0	0	10	0	0	95	0	0	5	0
Lane Group Flow (vph)	0	163	0	0	510	0	0	542	0	0	175	0
Confl. Bikes (#/hr)												1
Heavy Vehicles (%)	0%	3%	0%	7%	3%	12%	0%	4%	3%	18%	13%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)		40.3			40.3			38.5			38.5	
Effective Green, g (s)		37.3			37.3			35.5			35.5	
Actuated g/C Ratio		0.41			0.41			0.39			0.39	
Clearance Time (s)		6.3			6.3			6.3			6.3	
Vehicle Extension (s)		6.0			6.0			6.0			6.0	
Lane Grp Cap (vph)		599			495			601			352	
v/s Ratio Prot												
v/s Ratio Perm		0.11			c0.42			c0.35			0.19	
v/c Ratio		0.27			1.03			0.90			0.50	
Uniform Delay, d1		18.0			27.1			26.3			21.2	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		1.1			48.4			18.2			3.1	
Delay (s)		19.1			75.5			44.5			24.3	
Level of Service		B			E			D			C	
Approach Delay (s)		19.1			75.5			44.5			24.3	
Approach LOS		B			E			D			C	

Intersection Summary			
HCM 2000 Control Delay	50.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	91.4	Sum of lost time (s)	18.6
Intersection Capacity Utilization	104.2%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	1	1	302	1	1	164
Future Volume (Veh/h)	1	1	302	1	1	164
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)	1	1	328	1	1	178
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	508	328			329	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	508	328			329	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	100			100	
cM capacity (veh/h)	527	718			1242	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	2	329	179
Volume Left	1	0	1
Volume Right	1	1	0
cSH	608	1700	1242
Volume to Capacity	0.00	0.19	0.00
Queue Length 95th (m)	0.1	0.0	0.0
Control Delay (s)	10.9	0.0	0.1
Lane LOS	B		A
Approach Delay (s)	10.9	0.0	0.1
Approach LOS	B		

Intersection Summary			
Average Delay	0.1		
Intersection Capacity Utilization	32.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	0	13	262	181	4
Future Volume (Veh/h)	0	0	13	262	181	4
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)	0	0	14	285	197	4
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	512	199	201			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	512	199	201			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	100	99			
cM capacity (veh/h)	520	847	1383			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	0	299	201
Volume Left	0	14	0
Volume Right	0	0	4
cSH	1700	1383	1700
Volume to Capacity	0.00	0.01	0.12
Queue Length 95th (m)	0.0	0.2	0.0
Control Delay (s)	0.0	0.4	0.0
Lane LOS	A	A	
Approach Delay (s)	0.0	0.4	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	32.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	45	5	173	80	15	156
Future Volume (Veh/h)	45	5	173	80	15	156
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)	49	5	188	87	16	170
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	434	232			275	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	434	232			275	
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	99			99	
cM capacity (veh/h)	576	813			1300	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	54	275	186
Volume Left	49	0	16
Volume Right	5	87	0
cSH	592	1700	1300
Volume to Capacity	0.09	0.16	0.01
Queue Length 95th (m)	2.3	0.0	0.3
Control Delay (s)	11.7	0.0	0.8
Lane LOS	B		A
Approach Delay (s)	11.7	0.0	0.8
Approach LOS	B		

Intersection Summary			
Average Delay	1.5		
Intersection Capacity Utilization	37.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	55	28	32	129	143	59
Future Volume (Veh/h)	55	28	32	129	143	59
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	30	35	140	155	64
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	365	155	219			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	365	155	219			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	90	97	97			
cM capacity (veh/h)	622	896	1362			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	90	35	140	155	64
Volume Left	60	35	0	0	0
Volume Right	30	0	0	0	64
cSH	693	1362	1700	1700	1700
Volume to Capacity	0.13	0.03	0.08	0.09	0.04
Queue Length 95th (m)	3.4	0.6	0.0	0.0	0.0
Control Delay (s)	11.0	7.7	0.0	0.0	0.0
Lane LOS	B	A			
Approach Delay (s)	11.0	1.5		0.0	
Approach LOS	B				

Intersection Summary			
Average Delay	2.6		
Intersection Capacity Utilization	34.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	124	12	5	179	191	41
Future Volume (Veh/h)	124	12	5	179	191	41
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)	135	13	5	195	208	45
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	436	230	253			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	436	230	253			
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	98	100			
cM capacity (veh/h)	579	814	1324			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	148	200	253
Volume Left	135	5	0
Volume Right	13	0	45
cSH	595	1324	1700
Volume to Capacity	0.25	0.00	0.15
Queue Length 95th (m)	7.4	0.1	0.0
Control Delay (s)	13.1	0.2	0.0
Lane LOS	B	A	
Approach Delay (s)	13.1	0.2	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	3.3		
Intersection Capacity Utilization	34.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	6	67	75	264	165	18
Future Volume (Veh/h)	6	67	75	264	165	18
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)	7	73	82	287	179	20
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	630	179	199			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	630	179	199			
tC, single (s)	6.7	6.3	4.1			
tC, 2 stage (s)						
tF (s)	3.8	3.4	2.2			
p0 queue free %	98	91	94			
cM capacity (veh/h)	376	854	1361			

Direction, Lane #	EB 1	NB 1	SB 1	SB 2
Volume Total	80	369	179	20
Volume Left	7	82	0	0
Volume Right	73	0	0	20
cSH	768	1361	1700	1700
Volume to Capacity	0.10	0.06	0.11	0.01
Queue Length 95th (m)	2.6	1.5	0.0	0.0
Control Delay (s)	10.2	2.2	0.0	0.0
Lane LOS	B	A		
Approach Delay (s)	10.2	2.2	0.0	
Approach LOS	B			

Intersection Summary			
Average Delay	2.5		
Intersection Capacity Utilization	51.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	10	3	13	257	178	41
Future Volume (Veh/h)	10	3	13	257	178	41
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)	11	3	14	279	193	45
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)					222	
pX, platoon unblocked						
vC, conflicting volume	522	119	238			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	522	119	238			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	100	99			
cM capacity (veh/h)	484	917	1341			

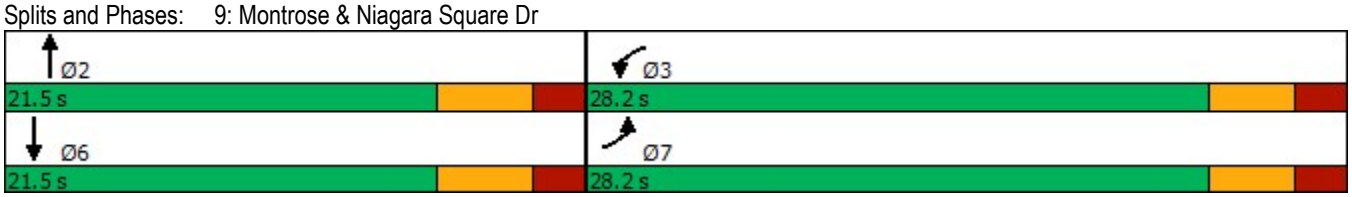
Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	11	3	14	279	129	109
Volume Left	11	0	14	0	0	0
Volume Right	0	3	0	0	0	45
cSH	484	917	1341	1700	1700	1700
Volume to Capacity	0.02	0.00	0.01	0.16	0.08	0.06
Queue Length 95th (m)	0.5	0.1	0.2	0.0	0.0	0.0
Control Delay (s)	12.6	8.9	7.7	0.0	0.0	0.0
Lane LOS	B	A	A			
Approach Delay (s)	11.8		0.4		0.0	
Approach LOS	B					

Intersection Summary			
Average Delay	0.5		
Intersection Capacity Utilization	29.7%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	WBL	NBT	SBT
Lane Configurations				
Traffic Volume (vph)	3	137	272	82
Future Volume (vph)	3	137	272	82
Lane Group Flow (vph)	3	149	296	89
Turn Type	Prot	Prot	NA	NA
Protected Phases	7	3	2	6
Permitted Phases				
Detector Phase	7	3	2	6
Switch Phase				
Minimum Initial (s)	8.0	8.0	8.0	8.0
Minimum Split (s)	13.2	13.2	13.5	13.5
Total Split (s)	28.2	28.2	21.5	21.5
Total Split (%)	56.7%	56.7%	43.3%	43.3%
Yellow Time (s)	3.2	3.2	3.5	3.5
All-Red Time (s)	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	3.0	3.0	3.0	3.0
Total Lost Time (s)	8.2	8.2	8.5	8.5
Lead/Lag				
Lead-Lag Optimize?				
Recall Mode	None	None	None	None
v/c Ratio	0.01	0.21	0.40	0.14
Control Delay	9.0	9.6	10.5	9.2
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	9.0	9.6	10.5	9.2
Queue Length 50th (m)	0.1	2.6	5.7	1.6
Queue Length 95th (m)	1.0	6.0	10.6	4.0
Internal Link Dist (m)			198.2	233.7
Turn Bay Length (m)				
Base Capacity (vph)	1421	2626	1870	1641
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	0.00	0.06	0.16	0.05

Intersection Summary
Cycle Length: 49.7
Actuated Cycle Length: 22.9
Natural Cycle: 40
Control Type: Actuated-Uncoordinated

Splits and Phases: 9: Montrose & Niagara Square Dr



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	3	0	0	137	0	0	0	272	0	0	82	0
Future Volume (vph)	3	0	0	137	0	0	0	272	0	0	82	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	8.2			8.2				8.5			8.5	
Lane Util. Factor	1.00			0.97				0.95			0.95	
Frt	1.00			1.00				1.00			1.00	
Flt Protected	0.95			0.95				1.00			1.00	
Satd. Flow (prot)	1681			3106				3113			2733	
Flt Permitted	0.95			0.95				1.00			1.00	
Satd. Flow (perm)	1681			3106				3113			2733	
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	0	0	149	0	0	0	296	0	0	89	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	3	0	0	149	0	0	0	296	0	0	89	0
Heavy Vehicles (%)	0%	0%	0%	5%	0%	0%	0%	8%	0%	0%	23%	0%
Turn Type	Prot			Prot				NA			NA	
Protected Phases	7			3				2			6	
Permitted Phases												
Actuated Green, G (s)	4.1			4.1				6.5			6.5	
Effective Green, g (s)	1.1			1.1				3.5			3.5	
Actuated g/C Ratio	0.05			0.05				0.16			0.16	
Clearance Time (s)	5.2			5.2				5.5			5.5	
Vehicle Extension (s)	2.1			2.1				2.3			2.3	
Lane Grp Cap (vph)	86			160				511			449	
v/s Ratio Prot	0.00			c0.05				c0.10			0.03	
v/s Ratio Perm												
v/c Ratio	0.03			0.93				0.58			0.20	
Uniform Delay, d1	9.6			10.1				8.2			7.7	
Progression Factor	1.00			1.00				1.00			1.00	
Incremental Delay, d2	0.1			50.7				1.2			0.1	
Delay (s)	9.7			60.7				9.4			7.8	
Level of Service	A			E				A			A	
Approach Delay (s)		9.7			60.7			9.4			7.8	
Approach LOS		A			E			A			A	

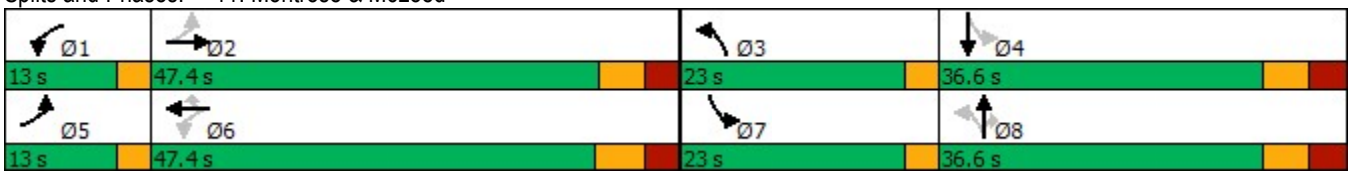
Intersection Summary			
HCM 2000 Control Delay	23.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	21.3	Sum of lost time (s)	16.7
Intersection Capacity Utilization	25.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	81	716	26	581	195	23	91	123	130	54
Future Volume (vph)	81	716	26	581	195	23	91	123	130	54
Lane Group Flow (vph)	88	786	28	632	212	25	99	134	141	139
Turn Type	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA
Protected Phases	5	2	1	6		3	8		7	4
Permitted Phases	2		6		6	8		8	4	
Detector Phase	5	2	1	6	6	3	8	8	7	4
Switch Phase										
Minimum Initial (s)	6.0	10.0	6.0	10.0	10.0	6.0	8.0	8.0	6.0	8.0
Minimum Split (s)	10.0	39.4	10.0	39.7	39.7	10.0	45.6	45.6	10.0	45.6
Total Split (s)	13.0	47.4	13.0	47.4	47.4	23.0	36.6	36.6	23.0	36.6
Total Split (%)	10.8%	39.5%	10.8%	39.5%	39.5%	19.2%	30.5%	30.5%	19.2%	30.5%
Yellow Time (s)	3.0	4.1	3.0	4.4	4.4	3.0	4.1	4.1	3.0	4.1
All-Red Time (s)	0.0	3.3	0.0	3.3	3.3	0.0	3.5	3.5	0.0	3.5
Lost Time Adjust (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	6.0	10.4	6.0	10.7	10.7	6.0	10.6	10.6	6.0	10.6
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	None	None	None
v/c Ratio	0.33	0.54	0.15	0.83	0.43	0.09	0.60	0.52	0.38	0.18
Control Delay	15.9	22.0	14.3	36.6	6.9	18.5	50.1	15.2	20.5	13.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	15.9	22.0	14.3	36.6	6.9	18.5	50.1	15.2	20.5	13.4
Queue Length 50th (m)	6.3	26.7	2.0	42.3	0.0	2.1	13.2	0.0	13.0	3.0
Queue Length 95th (m)	17.2	55.2	7.3	72.1	15.8	7.7	32.9	16.0	29.9	11.8
Internal Link Dist (m)		257.8		244.2			112.3			232.4
Turn Bay Length (m)	55.0		140.0			90.0			140.0	
Base Capacity (vph)	294	2575	251	1819	884	574	629	601	491	1073
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.30	0.31	0.11	0.35	0.24	0.04	0.16	0.22	0.29	0.13

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 70.4
Natural Cycle: 110
Control Type: Actuated-Uncoordinated

Splits and Phases: 11: Montrose & McLoed



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	81	716	7	26	581	195	23	91	123	130	54	74
Future Volume (vph)	81	716	7	26	581	195	23	91	123	130	54	74
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	10.4		6.0	10.7	10.7	6.0	10.6	10.6	6.0	10.6	
Lane Util. Factor	1.00	0.91		1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.91	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1437	4586		1226	3264	1419	1681	1594	1319	1556	2594	
Flt Permitted	0.30	1.00		0.34	1.00	1.00	0.66	1.00	1.00	0.43	1.00	
Satd. Flow (perm)	454	4586		442	3264	1419	1175	1594	1319	704	2594	
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)	88	778	8	28	632	212	25	99	134	141	59	80
RTOR Reduction (vph)	0	1	0	0	0	160	0	0	116	0	59	0
Lane Group Flow (vph)	88	785	0	28	632	52	25	99	18	141	80	0
Confl. Peds. (#/hr)			2	2								
Heavy Vehicles (%)	17%	5%	20%	37%	3%	6%	0%	11%	14%	8%	23%	15%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2			6		6	8		8	4		
Actuated Green, G (s)	31.0	25.7		23.4	21.1	21.1	14.9	12.8	12.8	27.5	22.4	
Effective Green, g (s)	26.3	22.7		18.1	18.1	18.1	9.8	9.8	9.8	24.5	19.4	
Actuated g/C Ratio	0.36	0.31		0.25	0.25	0.25	0.13	0.13	0.13	0.33	0.26	
Clearance Time (s)	3.0	7.4		3.0	7.7	7.7	3.0	7.6	7.6	3.0	7.6	
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	210	1416		108	803	349	156	212	175	335	684	
v/s Ratio Prot	c0.02	c0.17			c0.19			0.06		c0.05	0.03	
v/s Ratio Perm	0.13			0.06		0.04	0.02		0.01	c0.09		
v/c Ratio	0.42	0.55		0.26	0.79	0.15	0.16	0.47	0.10	0.42	0.12	
Uniform Delay, d1	16.4	21.2		22.3	25.9	21.7	28.2	29.4	28.0	18.2	20.5	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.0	0.4		0.9	4.9	0.1	0.4	1.2	0.2	0.6	0.1	
Delay (s)	17.4	21.6		23.2	30.8	21.8	28.6	30.6	28.2	18.9	20.6	
Level of Service	B	C		C	C	C	C	C	C	B	C	
Approach Delay (s)		21.1			28.4			29.1			19.7	
Approach LOS		C			C			C			B	

Intersection Summary			
HCM 2000 Control Delay	24.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	73.5	Sum of lost time (s)	33.3
Intersection Capacity Utilization	64.7%	ICU Level of Service	C
Analysis Period (min)	15		

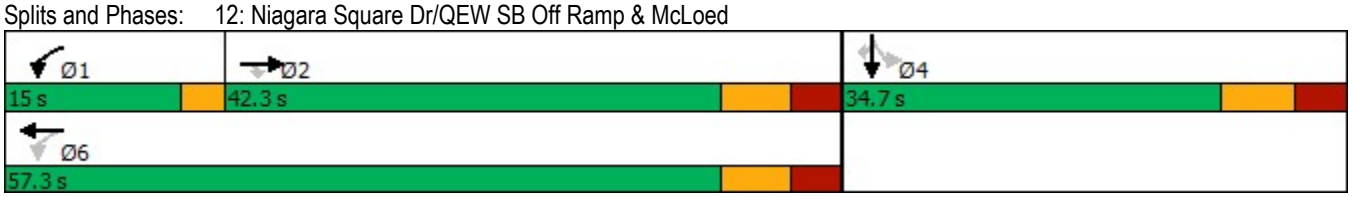
c Critical Lane Group

Lane Group	EBT	EBR	WBL	WBT	SBL	SBT	SBR
Lane Configurations							
Traffic Volume (vph)	931	1	63	522	271	113	258
Future Volume (vph)	931	1	63	522	271	113	258
Lane Group Flow (vph)	1012	1	68	567	295	210	193
Turn Type	NA	Perm	pm+pt	NA	Perm	NA	Perm
Protected Phases	2		1	6		4	
Permitted Phases		2	6		4		4
Detector Phase	2	2	1	6	4	4	4
Switch Phase							
Minimum Initial (s)	20.0	20.0	6.0	20.0	10.0	10.0	10.0
Minimum Split (s)	34.3	34.3	10.0	34.3	47.7	47.7	47.7
Total Split (s)	42.3	42.3	15.0	57.3	34.7	34.7	34.7
Total Split (%)	46.0%	46.0%	16.3%	62.3%	37.7%	37.7%	37.7%
Yellow Time (s)	4.8	4.8	3.0	4.8	5.0	5.0	5.0
All-Red Time (s)	3.5	3.5	0.0	3.5	3.7	3.7	3.7
Lost Time Adjust (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	11.3	11.3	6.0	11.3	11.7	11.7	11.7
Lead/Lag	Lag	Lag	Lead				
Lead-Lag Optimize?	Yes	Yes	Yes				
Recall Mode	None	None	None	None	None	None	None
v/c Ratio	0.67	0.00	0.28	0.30	0.51	0.69	0.47
Control Delay	21.6	18.0	11.2	12.2	26.8	33.1	8.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	21.6	18.0	11.2	12.2	26.8	33.1	8.4
Queue Length 50th (m)	37.0	0.1	3.3	13.7	15.6	19.2	0.0
Queue Length 95th (m)	64.2	1.2	10.7	26.1	31.2	47.4	16.1
Internal Link Dist (m)	244.2			227.3		107.7	
Turn Bay Length (m)		110.0	40.0				45.0
Base Capacity (vph)	2413	687	352	3549	1220	601	662
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.42	0.00	0.19	0.16	0.24	0.35	0.29

Intersection Summary

Cycle Length: 92
Actuated Cycle Length: 61.6
Natural Cycle: 95
Control Type: Actuated-Uncoordinated

Splits and Phases: 12: Niagara Square Dr/QEW SB Off Ramp & McLoed



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	931	1	63	522	0	0	0	0	271	113	258
Future Volume (vph)	0	931	1	63	522	0	0	0	0	271	113	258
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		11.3	11.3	6.0	11.3					11.7	11.7	11.7
Lane Util. Factor		0.91	1.00	1.00	0.91					0.97	0.95	0.95
Frpb, ped/bikes		1.00	1.00	1.00	1.00					1.00	1.00	1.00
Flpb, ped/bikes		1.00	1.00	1.00	1.00					1.00	1.00	1.00
Frt		1.00	0.85	1.00	1.00					1.00	0.94	0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (prot)		4557	1297	1514	4515					3106	1472	1387
Flt Permitted		1.00	1.00	0.21	1.00					0.95	1.00	1.00
Satd. Flow (perm)		4557	1297	334	4515					3106	1472	1387
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	1012	1	68	567	0	0	0	0	295	123	280
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	30	157
Lane Group Flow (vph)	0	1012	1	68	567	0	0	0	0	295	180	36
Confl. Peds. (#/hr)	1					1						
Heavy Vehicles (%)	0%	6%	16%	11%	7%	0%	0%	0%	0%	5%	10%	3%
Turn Type		NA	Perm	pm+pt	NA					Perm	NA	Perm
Protected Phases		2		1	6						4	
Permitted Phases			2	6						4		4
Actuated Green, G (s)		23.6	23.6	30.5	30.5					14.6	14.6	14.6
Effective Green, g (s)		20.6	20.6	27.5	27.5					11.6	11.6	11.6
Actuated g/C Ratio		0.33	0.33	0.44	0.44					0.19	0.19	0.19
Clearance Time (s)		8.3	8.3	3.0	8.3					8.7	8.7	8.7
Vehicle Extension (s)		2.5	2.5	2.5	2.5					2.5	2.5	2.5
Lane Grp Cap (vph)		1511	430	165	1999					580	274	259
v/s Ratio Prot		c0.22		0.01	c0.13						c0.12	
v/s Ratio Perm			0.00	0.18						0.09		0.03
v/c Ratio		0.67	0.00	0.41	0.28					0.51	0.66	0.14
Uniform Delay, d1		17.8	13.9	12.5	11.0					22.7	23.4	21.1
Progression Factor		1.00	1.00	1.00	1.00					1.00	1.00	1.00
Incremental Delay, d2		1.0	0.0	1.2	0.1					0.5	5.0	0.2
Delay (s)		18.9	13.9	13.7	11.1					23.2	28.4	21.3
Level of Service		B	B	B	B					C	C	C
Approach Delay (s)		18.8			11.4			0.0			24.2	
Approach LOS		B			B			A			C	

Intersection Summary			
HCM 2000 Control Delay	18.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	62.1	Sum of lost time (s)	29.0
Intersection Capacity Utilization	60.9%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	522	8	42	435	2	22
Future Volume (Veh/h)	522	8	42	435	2	22
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)	567	9	46	473	2	24
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)	352					
pX, platoon unblocked						
vC, conflicting volume			576		900	288
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			576		900	288
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			95		99	97
cM capacity (veh/h)			1007		269	715

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	378	198	204	315	26
Volume Left	0	0	46	0	2
Volume Right	0	9	0	0	24
cSH	1700	1700	1007	1700	634
Volume to Capacity	0.22	0.12	0.05	0.19	0.04
Queue Length 95th (m)	0.0	0.0	1.1	0.0	1.0
Control Delay (s)	0.0	0.0	2.3	0.0	10.9
Lane LOS			A		B
Approach Delay (s)	0.0		0.9		10.9
Approach LOS					B

Intersection Summary			
Average Delay	0.7		
Intersection Capacity Utilization	51.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	560	226	0	143	303
Future Volume (Veh/h)	0	560	226	0	143	303
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	609	246	0	155	329
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	246				550	123
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	246				550	123
tC, single (s)	4.1				7.0	7.0
tC, 2 stage (s)						
tF (s)	2.2				3.6	3.3
p0 queue free %	100				65	63
cM capacity (veh/h)	1332				444	899

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	304	304	123	123	155	329
Volume Left	0	0	0	0	155	0
Volume Right	0	0	0	0	0	329
cSH	1700	1700	1700	1700	444	899
Volume to Capacity	0.18	0.18	0.07	0.07	0.35	0.37
Queue Length 95th (m)	0.0	0.0	0.0	0.0	11.7	12.9
Control Delay (s)	0.0	0.0	0.0	0.0	17.4	11.3
Lane LOS					C	B
Approach Delay (s)	0.0		0.0		13.3	
Approach LOS					B	

Intersection Summary			
Average Delay	4.8		
Intersection Capacity Utilization	38.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	319	0	0	185	79	37
Future Volume (Veh/h)	319	0	0	185	79	37
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)	347	0	0	201	86	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			347		448	174
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			347		448	174
tC, single (s)			4.1		6.9	7.0
tC, 2 stage (s)						
tF (s)			2.2		3.6	3.3
p0 queue free %			100		84	95
cM capacity (veh/h)			1223		529	837

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	174	174	100	100	86	40
Volume Left	0	0	0	0	86	0
Volume Right	0	0	0	0	0	40
cSH	1700	1700	1700	1700	529	837
Volume to Capacity	0.10	0.10	0.06	0.06	0.16	0.05
Queue Length 95th (m)	0.0	0.0	0.0	0.0	4.4	1.1
Control Delay (s)	0.0	0.0	0.0	0.0	13.1	9.5
Lane LOS					B	A
Approach Delay (s)	0.0		0.0		12.0	
Approach LOS					B	

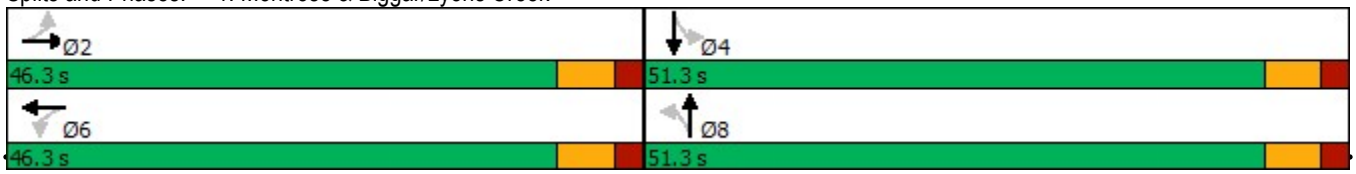
Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	38.8%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	20	96	515	235	5	130	166	257
Future Volume (vph)	20	96	515	235	5	130	166	257
Lane Group Flow (vph)	0	136	0	908	0	507	0	508
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		2		6		8		4
Permitted Phases	2		6		8		4	
Detector Phase	2	2	6	6	8	8	4	4
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	26.3	26.3	26.3	26.3	31.3	31.3	31.3	31.3
Total Split (s)	46.3	46.3	46.3	46.3	51.3	51.3	51.3	51.3
Total Split (%)	47.4%	47.4%	47.4%	47.4%	52.6%	52.6%	52.6%	52.6%
Yellow Time (s)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
All-Red Time (s)	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Lost Time Adjust (s)		3.0		3.0		3.0		3.0
Total Lost Time (s)		9.3		9.3		9.3		9.3
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	Max	Max	Max	Max	None	None	None	None
v/c Ratio		0.24		2.09		0.68		1.16
Control Delay		21.4		521.1		20.2		122.7
Queue Delay		0.0		0.0		0.0		0.0
Total Delay		21.4		521.1		20.2		122.7
Queue Length 50th (m)		16.6		~276.2		51.5		~114.0
Queue Length 95th (m)		30.3		#348.8		88.4		#175.4
Internal Link Dist (m)		355.5		233.5		313.4		537.6
Turn Bay Length (m)								
Base Capacity (vph)		559		434		748		438
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		0.24		2.09		0.68		1.16

Intersection Summary

Cycle Length: 97.6
Actuated Cycle Length: 97.6
Natural Cycle: 150
Control Type: Actuated-Uncoordinated
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Montrose & Biggar/Lyons Creek



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	20	96	9	515	235	86	5	130	332	166	257	45
Future Volume (vph)	20	96	9	515	235	86	5	130	332	166	257	45
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		9.3			9.3			9.3			9.3	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.99			0.99			0.90			0.99	
Flt Protected		0.99			0.97			1.00			0.98	
Satd. Flow (prot)		1660			1501			1534			1625	
Flt Permitted		0.88			0.73			1.00			0.61	
Satd. Flow (perm)		1468			1135			1527			1008	
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)	22	104	10	560	255	93	5	141	361	180	279	49
RTOR Reduction (vph)	0	3	0	0	4	0	0	91	0	0	4	0
Lane Group Flow (vph)	0	133	0	0	904	0	0	416	0	0	504	0
Heavy Vehicles (%)	0%	6%	1%	17%	5%	9%	0%	5%	4%	5%	7%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)		40.0			40.0			45.0			45.0	
Effective Green, g (s)		37.0			37.0			42.0			42.0	
Actuated g/C Ratio		0.38			0.38			0.43			0.43	
Clearance Time (s)		6.3			6.3			6.3			6.3	
Vehicle Extension (s)		6.0			6.0			6.0			6.0	
Lane Grp Cap (vph)		556			430			657			433	
v/s Ratio Prot												
v/s Ratio Perm		0.09			c0.80			0.27			c0.50	
v/c Ratio		0.24			2.10			0.63			1.16	
Uniform Delay, d1		20.7			30.3			21.8			27.8	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		1.0			503.5			3.3			96.4	
Delay (s)		21.7			533.8			25.1			124.2	
Level of Service		C			F			C			F	
Approach Delay (s)		21.7			533.8			25.1			124.2	
Approach LOS		C			F			C			F	

Intersection Summary			
HCM 2000 Control Delay	273.7	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.60		
Actuated Cycle Length (s)	97.6	Sum of lost time (s)	18.6
Intersection Capacity Utilization	137.5%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	1	1	235	1	1	467
Future Volume (Veh/h)	1	1	235	1	1	467
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)	1	1	255	1	1	508
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	766	256			256	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	766	256			256	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	100			100	
cM capacity (veh/h)	374	788			1321	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	2	256	509
Volume Left	1	0	1
Volume Right	1	1	0
cSH	507	1700	1321
Volume to Capacity	0.00	0.15	0.00
Queue Length 95th (m)	0.1	0.0	0.0
Control Delay (s)	12.1	0.0	0.0
Lane LOS	B		A
Approach Delay (s)	12.1	0.0	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	42.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	14	5	4	246	450	5
Future Volume (Veh/h)	14	5	4	246	450	5
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)	15	5	4	267	489	5
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	766	492	494			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	766	492	494			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	96	99	100			
cM capacity (veh/h)	372	581	1080			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	20	271	494
Volume Left	15	4	0
Volume Right	5	0	5
cSH	409	1080	1700
Volume to Capacity	0.05	0.00	0.29
Queue Length 95th (m)	1.2	0.1	0.0
Control Delay (s)	14.3	0.2	0.0
Lane LOS	B	A	
Approach Delay (s)	14.3	0.2	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	41.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	132	23	217	87	26	295
Future Volume (Veh/h)	132	23	217	87	26	295
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)	143	25	236	95	28	321
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	660	284			331	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	660	284			331	
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	97			98	
cM capacity (veh/h)	421	760			1240	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	168	331	349
Volume Left	143	0	28
Volume Right	25	95	0
cSH	451	1700	1240
Volume to Capacity	0.37	0.19	0.02
Queue Length 95th (m)	12.9	0.0	0.5
Control Delay (s)	17.6	0.0	0.8
Lane LOS	C		A
Approach Delay (s)	17.6	0.0	0.8
Approach LOS	C		

Intersection Summary			
Average Delay	3.8		
Intersection Capacity Utilization	61.4%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	41	41	35	195	247	42
Future Volume (Veh/h)	41	41	35	195	247	42
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)	45	45	38	212	268	46
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	556	268	314			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	556	268	314			
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	94	97			
cM capacity (veh/h)	481	776	1258			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	90	38	212	268	46
Volume Left	45	38	0	0	0
Volume Right	45	0	0	0	46
cSH	593	1258	1700	1700	1700
Volume to Capacity	0.15	0.03	0.12	0.16	0.03
Queue Length 95th (m)	4.0	0.7	0.0	0.0	0.0
Control Delay (s)	12.1	8.0	0.0	0.0	0.0
Lane LOS	B	A			
Approach Delay (s)	12.1	1.2		0.0	
Approach LOS	B				

Intersection Summary			
Average Delay	2.1		
Intersection Capacity Utilization	40.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	82	9	15	220	246	139
Future Volume (Veh/h)	82	9	15	220	246	139
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	10	16	239	267	151
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	614	342	418			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	614	342	418			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	80	99	99			
cM capacity (veh/h)	452	705	1152			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	99	255	418
Volume Left	89	16	0
Volume Right	10	0	151
cSH	469	1152	1700
Volume to Capacity	0.21	0.01	0.25
Queue Length 95th (m)	6.0	0.3	0.0
Control Delay (s)	14.7	0.6	0.0
Lane LOS	B	A	
Approach Delay (s)	14.7	0.6	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	2.1		
Intersection Capacity Utilization	43.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	20	114	72	275	271	20
Future Volume (Veh/h)	20	114	72	275	271	20
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)	22	124	78	299	295	22
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	750	295	317			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	750	295	317			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	94	83	94			
cM capacity (veh/h)	351	740	1232			

Direction, Lane #	EB 1	NB 1	SB 1	SB 2
Volume Total	146	377	295	22
Volume Left	22	78	0	0
Volume Right	124	0	0	22
cSH	634	1232	1700	1700
Volume to Capacity	0.23	0.06	0.17	0.01
Queue Length 95th (m)	6.7	1.5	0.0	0.0
Control Delay (s)	12.4	2.2	0.0	0.0
Lane LOS	B	A		
Approach Delay (s)	12.4	2.2	0.0	
Approach LOS	B			

Intersection Summary			
Average Delay	3.1		
Intersection Capacity Utilization	61.9%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	77	24	19	285	255	155
Future Volume (Veh/h)	77	24	19	285	255	155
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)	84	26	21	310	277	168
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)					222	
pX, platoon unblocked						
vC, conflicting volume	713	222	445			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	713	222	445			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	77	97	98			
cM capacity (veh/h)	364	787	1126			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	84	26	21	310	185	260
Volume Left	84	0	21	0	0	0
Volume Right	0	26	0	0	0	168
cSH	364	787	1126	1700	1700	1700
Volume to Capacity	0.23	0.03	0.02	0.18	0.11	0.15
Queue Length 95th (m)	6.7	0.8	0.4	0.0	0.0	0.0
Control Delay (s)	17.8	9.7	8.3	0.0	0.0	0.0
Lane LOS	C	A	A			
Approach Delay (s)	15.9		0.5		0.0	
Approach LOS	C					

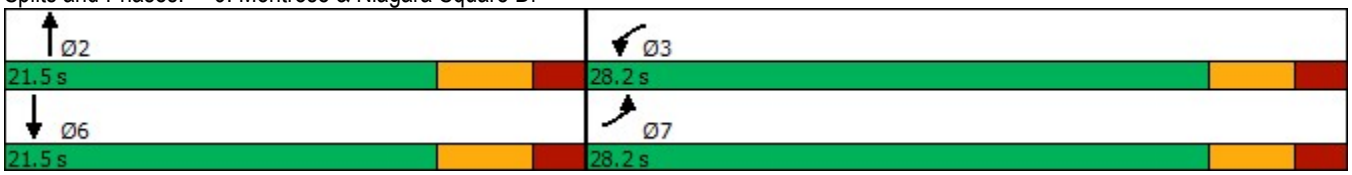
Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	35.1%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	WBL	WBT	NBT	SBT
Lane Configurations					
Traffic Volume (vph)	22	267	0	356	139
Future Volume (vph)	22	267	0	356	139
Lane Group Flow (vph)	24	290	2	387	151
Turn Type	Prot	Prot		NA	NA
Protected Phases	7	3		2	6
Permitted Phases					
Detector Phase	7	3		2	6
Switch Phase					
Minimum Initial (s)	8.0	8.0		8.0	8.0
Minimum Split (s)	13.2	13.2		13.5	13.5
Total Split (s)	28.2	28.2		21.5	21.5
Total Split (%)	56.7%	56.7%		43.3%	43.3%
Yellow Time (s)	3.2	3.2		3.5	3.5
All-Red Time (s)	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	3.0	3.0		3.0	3.0
Total Lost Time (s)	8.2	8.2		8.5	8.5
Lead/Lag					
Lead-Lag Optimize?					
Recall Mode	None	None		None	None
v/c Ratio	0.07	0.44	0.01	0.55	0.23
Control Delay	10.0	12.1	0.0	12.9	10.2
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	10.0	12.1	0.0	12.9	10.2
Queue Length 50th (m)	0.8	5.4	0.0	7.6	2.7
Queue Length 95th (m)	3.6	11.4	0.0	14.5	6.4
Internal Link Dist (m)			271.6	198.2	233.7
Turn Bay Length (m)					
Base Capacity (vph)	1312	2470	169	1692	1585
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	0.02	0.12	0.01	0.23	0.10

Intersection Summary

Cycle Length: 49.7
Actuated Cycle Length: 25.7
Natural Cycle: 40
Control Type: Actuated-Uncoordinated

Splits and Phases: 9: Montrose & Niagara Square Dr



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	22	0	0	267	0	2	0	356	0	0	139	0
Future Volume (vph)	22	0	0	267	0	2	0	356	0	0	139	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	8.2			8.2	7.0			8.5			8.5	
Lane Util. Factor	1.00			0.97	1.00			0.95			0.95	
Frt	1.00			1.00	0.85			1.00			1.00	
Flt Protected	0.95			0.95	1.00			1.00			1.00	
Satd. Flow (prot)	1681			3166	0			3233			3029	
Flt Permitted	0.95			0.95	1.00			1.00			1.00	
Satd. Flow (perm)	1681			3166	0			3233			3029	
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)	24	0	0	290	0	2	0	387	0	0	151	0
RTOR Reduction (vph)	0	0	0	0	2	0	0	0	0	0	0	0
Lane Group Flow (vph)	24	0	0	290	0	0	0	387	0	0	151	0
Heavy Vehicles (%)	0%	0%	0%	3%	0%	50%	0%	4%	0%	0%	11%	0%
Turn Type	Prot			Prot				NA			NA	
Protected Phases	7			3				2			6	
Permitted Phases												
Actuated Green, G (s)	6.2			6.2	0.0			8.7			8.7	
Effective Green, g (s)	3.2			3.2	0.0			5.7			5.7	
Actuated g/C Ratio	0.12			0.12	0.00			0.22			0.22	
Clearance Time (s)	5.2			5.2				5.5			5.5	
Vehicle Extension (s)	2.1			2.1				2.3			2.3	
Lane Grp Cap (vph)	210			395	0			719			674	
v/s Ratio Prot	0.01			c0.09				c0.12			0.05	
v/s Ratio Perm												
v/c Ratio	0.11			0.73	0.00			0.54			0.22	
Uniform Delay, d1	9.9			10.8	12.8			8.8			8.1	
Progression Factor	1.00			1.00	1.00			1.00			1.00	
Incremental Delay, d2	0.1			6.1	0.0			0.5			0.1	
Delay (s)	10.0			16.9	12.8			9.3			8.2	
Level of Service	B			B	B			A			A	
Approach Delay (s)		10.0			16.9			9.3			8.2	
Approach LOS		B			B			A			A	

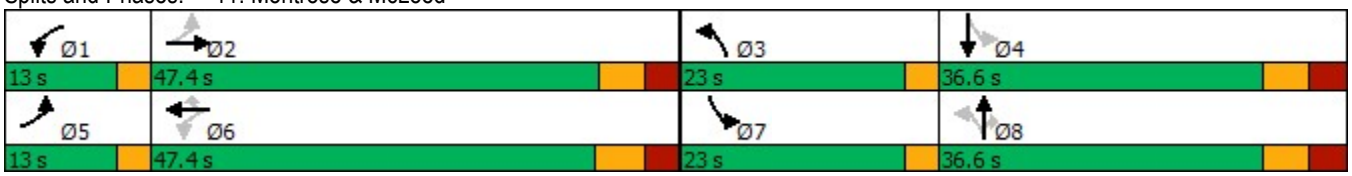
Intersection Summary			
HCM 2000 Control Delay	11.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	25.6	Sum of lost time (s)	16.7
Intersection Capacity Utilization	Err%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	80	664	79	765	243	27	105	212	304	120
Future Volume (vph)	80	664	79	765	243	27	105	212	304	120
Lane Group Flow (vph)	87	752	86	832	264	29	114	230	330	217
Turn Type	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA
Protected Phases	5	2	1	6		3	8		7	4
Permitted Phases	2		6		6	8		8	4	
Detector Phase	5	2	1	6	6	3	8	8	7	4
Switch Phase										
Minimum Initial (s)	6.0	10.0	6.0	10.0	10.0	6.0	8.0	8.0	6.0	8.0
Minimum Split (s)	10.0	39.4	10.0	39.7	39.7	10.0	45.6	45.6	10.0	45.6
Total Split (s)	13.0	47.4	13.0	47.4	47.4	23.0	36.6	36.6	23.0	36.6
Total Split (%)	10.8%	39.5%	10.8%	39.5%	39.5%	19.2%	30.5%	30.5%	19.2%	30.5%
Yellow Time (s)	3.0	4.1	3.0	4.4	4.4	3.0	4.1	4.1	3.0	4.1
All-Red Time (s)	0.0	3.3	0.0	3.3	3.3	0.0	3.5	3.5	0.0	3.5
Lost Time Adjust (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	6.0	10.4	6.0	10.7	10.7	6.0	10.6	10.6	6.0	10.6
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	None	None	None
v/c Ratio	0.42	0.54	0.31	0.87	0.43	0.12	0.69	0.65	0.71	0.23
Control Delay	20.3	27.2	17.1	40.9	5.7	22.6	63.6	15.5	31.9	18.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.3	27.2	17.1	40.9	5.7	22.6	63.6	15.5	31.9	18.4
Queue Length 50th (m)	8.2	39.4	8.1	72.7	0.0	3.1	20.0	0.0	43.3	9.5
Queue Length 95th (m)	17.7	56.5	17.5	103.1	16.7	9.6	40.7	22.0	#84.9	21.4
Internal Link Dist (m)		257.8		244.2			112.3			232.4
Turn Bay Length (m)	55.0		140.0			90.0			140.0	
Base Capacity (vph)	237	2080	313	1472	798	509	533	624	494	1030
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.37	0.36	0.27	0.57	0.33	0.06	0.21	0.37	0.67	0.21

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 87.1
Natural Cycle: 110
Control Type: Actuated-Uncoordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 11: Montrose & McLoed



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	80	664	28	79	765	243	27	105	212	304	120	80
Future Volume (vph)	80	664	28	79	765	243	27	105	212	304	120	80
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	10.4		6.0	10.7	10.7	6.0	10.6	10.6	6.0	10.6	
Lane Util. Factor	1.00	0.91		1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.94	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1514	4614		1541	3296	1460	1681	1685	1475	1664	3004	
Flt Permitted	0.21	1.00		0.35	1.00	1.00	0.62	1.00	1.00	0.43	1.00	
Satd. Flow (perm)	331	4614		570	3296	1460	1090	1685	1475	757	3004	
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)	87	722	30	86	832	264	29	114	230	330	130	87
RTOR Reduction (vph)	0	4	0	0	0	188	0	0	203	0	62	0
Lane Group Flow (vph)	87	748	0	86	832	76	29	114	27	330	155	0
Confl. Peds. (#/hr)			7	7								
Heavy Vehicles (%)	11%	4%	4%	9%	2%	3%	0%	5%	2%	1%	6%	4%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2			6		6	8		8	4		
Actuated Green, G (s)	36.0	29.3		34.5	28.4	28.4	16.8	13.3	13.3	35.0	28.5	
Effective Green, g (s)	30.0	26.3		28.5	25.4	25.4	10.8	10.3	10.3	32.0	25.5	
Actuated g/C Ratio	0.34	0.30		0.32	0.29	0.29	0.12	0.12	0.12	0.36	0.29	
Clearance Time (s)	3.0	7.4		3.0	7.7	7.7	3.0	7.6	7.6	3.0	7.6	
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	161	1372		217	947	419	136	196	171	435	866	
v/s Ratio Prot	c0.02	0.16		0.01	c0.25		0.00	0.07		c0.13	0.05	
v/s Ratio Perm	0.16			0.11		0.05	0.02		0.02	c0.14		
v/c Ratio	0.54	0.55		0.40	0.88	0.18	0.21	0.58	0.16	0.76	0.18	
Uniform Delay, d1	21.2	26.0		21.6	30.0	23.7	34.8	37.0	35.1	22.7	23.6	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	2.9	0.4		0.9	9.2	0.2	0.6	3.6	0.3	7.1	0.1	
Delay (s)	24.1	26.4		22.4	39.3	23.8	35.4	40.6	35.5	29.8	23.7	
Level of Service	C	C		C	D	C	D	D	D	C	C	
Approach Delay (s)		26.1			34.6			37.0			27.4	
Approach LOS		C			C			D			C	

Intersection Summary			
HCM 2000 Control Delay	31.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	88.4	Sum of lost time (s)	33.3
Intersection Capacity Utilization	75.7%	ICU Level of Service	D
Analysis Period (min)	15		

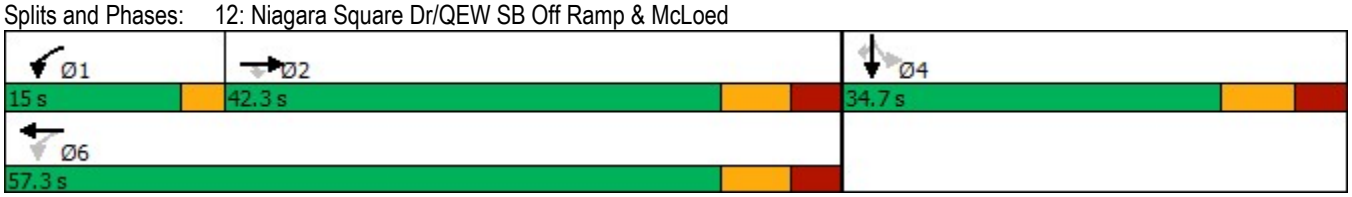
c Critical Lane Group

Lane Group	EBT	EBR	WBL	WBT	SBL	SBT	SBR
Lane Configurations							
Traffic Volume (vph)	1153	3	146	758	417	120	300
Future Volume (vph)	1153	3	146	758	417	120	300
Lane Group Flow (vph)	1253	3	159	824	453	238	218
Turn Type	NA	Perm	pm+pt	NA	Perm	NA	Perm
Protected Phases	2		1	6		4	
Permitted Phases		2	6		4		4
Detector Phase	2	2	1	6	4	4	4
Switch Phase							
Minimum Initial (s)	20.0	20.0	6.0	20.0	10.0	10.0	10.0
Minimum Split (s)	34.3	34.3	10.0	34.3	47.7	47.7	47.7
Total Split (s)	42.3	42.3	15.0	57.3	34.7	34.7	34.7
Total Split (%)	46.0%	46.0%	16.3%	62.3%	37.7%	37.7%	37.7%
Yellow Time (s)	4.8	4.8	3.0	4.8	5.0	5.0	5.0
All-Red Time (s)	3.5	3.5	0.0	3.5	3.7	3.7	3.7
Lost Time Adjust (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	11.3	11.3	6.0	11.3	11.7	11.7	11.7
Lead/Lag	Lag	Lag	Lead				
Lead-Lag Optimize?	Yes	Yes	Yes				
Recall Mode	None	None	None	None	None	None	None
v/c Ratio	0.81	0.01	0.68	0.36	0.75	0.73	0.61
Control Delay	28.1	19.0	24.8	12.6	37.1	38.0	21.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.1	19.0	24.8	12.6	37.1	38.0	21.3
Queue Length 50th (m)	56.9	0.3	9.8	24.4	30.9	27.0	12.4
Queue Length 95th (m)	89.7	2.2	25.9	39.6	51.3	56.8	37.1
Internal Link Dist (m)	244.2			227.3		107.7	
Turn Bay Length (m)		110.0	40.0				45.0
Base Capacity (vph)	2013	633	305	2987	1008	510	512
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.62	0.00	0.52	0.28	0.45	0.47	0.43

Intersection Summary

Cycle Length: 92
Actuated Cycle Length: 74.5
Natural Cycle: 95
Control Type: Actuated-Uncoordinated

Splits and Phases: 12: Niagara Square Dr/QEW SB Off Ramp & McLoed



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1153	3	146	758	0	0	0	0	417	120	300
Future Volume (vph)	0	1153	3	146	758	0	0	0	0	417	120	300
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		11.3	11.3	6.0	11.3					11.7	11.7	11.7
Lane Util. Factor		0.91	1.00	1.00	0.91					0.97	0.95	0.95
Frpb, ped/bikes		1.00	1.00	1.00	1.00					1.00	1.00	1.00
Flpb, ped/bikes		1.00	1.00	1.00	1.00					1.00	1.00	1.00
Frt		1.00	0.85	1.00	1.00					1.00	0.93	0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (prot)		4690	1475	1648	4690					3166	1509	1348
Flt Permitted		1.00	1.00	0.13	1.00					0.95	1.00	1.00
Satd. Flow (perm)		4690	1475	229	4690					3166	1509	1348
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	1253	3	159	824	0	0	0	0	453	130	326
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	35	98
Lane Group Flow (vph)	0	1253	3	159	824	0	0	0	0	453	203	120
Confl. Peds. (#/hr)	3					3						
Heavy Vehicles (%)	0%	3%	2%	2%	3%	0%	0%	0%	0%	3%	2%	6%
Turn Type		NA	Perm	pm+pt	NA					Perm	NA	Perm
Protected Phases		2		1	6						4	
Permitted Phases			2	6						4		4
Actuated Green, G (s)		27.9	27.9	39.6	39.6					17.4	17.4	17.4
Effective Green, g (s)		24.9	24.9	36.6	36.6					14.4	14.4	14.4
Actuated g/C Ratio		0.34	0.34	0.49	0.49					0.19	0.19	0.19
Clearance Time (s)		8.3	8.3	3.0	8.3					8.7	8.7	8.7
Vehicle Extension (s)		2.5	2.5	2.5	2.5					2.5	2.5	2.5
Lane Grp Cap (vph)		1578	496	222	2319					616	293	262
v/s Ratio Prot		c0.27		c0.06	0.18						0.13	
v/s Ratio Perm			0.00	0.30						c0.14		0.09
v/c Ratio		0.79	0.01	0.72	0.36					0.74	0.69	0.46
Uniform Delay, d1		22.2	16.3	12.0	11.5					28.0	27.7	26.3
Progression Factor		1.00	1.00	1.00	1.00					1.00	1.00	1.00
Incremental Delay, d2		2.8	0.0	9.8	0.1					4.3	6.4	0.9
Delay (s)		25.0	16.3	21.9	11.5					32.3	34.2	27.3
Level of Service		C	B	C	B					C	C	C
Approach Delay (s)		25.0			13.2			0.0			31.6	
Approach LOS		C			B			A			C	

Intersection Summary			
HCM 2000 Control Delay	23.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	74.0	Sum of lost time (s)	29.0
Intersection Capacity Utilization	70.6%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	524	10	34	837	5	24
Future Volume (Veh/h)	524	10	34	837	5	24
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)	570	11	37	910	5	26
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)	352					
pX, platoon unblocked						
vC, conflicting volume			581		1104	290
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			581		1104	290
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			96		98	96
cM capacity (veh/h)			1003		201	712

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	380	201	340	607	31
Volume Left	0	0	37	0	5
Volume Right	0	11	0	0	26
cSH	1700	1700	1003	1700	505
Volume to Capacity	0.22	0.12	0.04	0.36	0.06
Queue Length 95th (m)	0.0	0.0	0.9	0.0	1.5
Control Delay (s)	0.0	0.0	1.3	0.0	12.6
Lane LOS			A		B
Approach Delay (s)	0.0		0.5		12.6
Approach LOS					B

Intersection Summary			
Average Delay	0.5		
Intersection Capacity Utilization	63.1%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	615	303	0	320	605
Future Volume (Veh/h)	0	615	303	0	320	605
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	668	329	0	348	658
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	329				663	164
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	329				663	164
tC, single (s)	4.1				6.9	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				11	23
cM capacity (veh/h)	1242				390	851

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	334	334	164	164	348	658
Volume Left	0	0	0	0	348	0
Volume Right	0	0	0	0	0	658
cSH	1700	1700	1700	1700	390	851
Volume to Capacity	0.20	0.20	0.10	0.10	0.89	0.77
Queue Length 95th (m)	0.0	0.0	0.0	0.0	69.2	58.8
Control Delay (s)	0.0	0.0	0.0	0.0	55.6	22.0
Lane LOS					F	C
Approach Delay (s)	0.0		0.0		33.6	
Approach LOS					D	

Intersection Summary			
Average Delay	16.9		
Intersection Capacity Utilization	61.4%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	607	0	0	268	45	43
Future Volume (Veh/h)	607	0	0	268	45	43
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)	660	0	0	291	49	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			660		806	330
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			660		806	330
tC, single (s)			4.1		7.2	7.0
tC, 2 stage (s)						
tF (s)			2.2		3.7	3.4
p0 queue free %			100		83	93
cM capacity (veh/h)			938		289	651

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	330	330	146	146	49	47
Volume Left	0	0	0	0	49	0
Volume Right	0	0	0	0	0	47
cSH	1700	1700	1700	1700	289	651
Volume to Capacity	0.19	0.19	0.09	0.09	0.17	0.07
Queue Length 95th (m)	0.0	0.0	0.0	0.0	4.6	1.8
Control Delay (s)	0.0	0.0	0.0	0.0	20.0	11.0
Lane LOS					C	B
Approach Delay (s)	0.0		0.0		15.6	
Approach LOS					C	

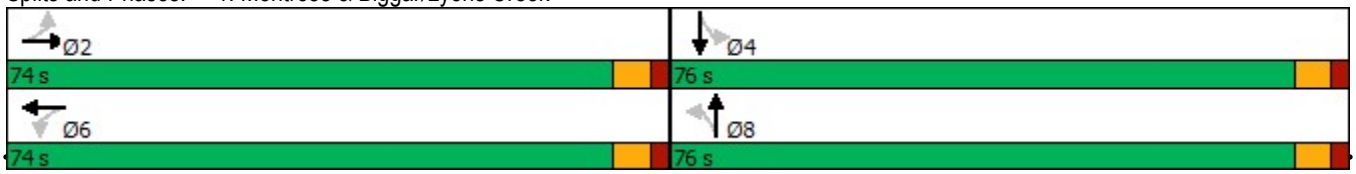
Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	61.4%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	213	261	304	435	56	317	228	163
Future Volume (vph)	213	261	304	435	56	317	228	163
Lane Group Flow (vph)	0	537	0	1451	0	926	0	543
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		2		6		8		4
Permitted Phases	2		6		8		4	
Detector Phase	2	2	6	6	8	8	4	4
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	26.3	26.3	26.3	26.3	31.3	31.3	31.3	31.3
Total Split (s)	74.0	74.0	74.0	74.0	76.0	76.0	76.0	76.0
Total Split (%)	49.3%	49.3%	49.3%	49.3%	50.7%	50.7%	50.7%	50.7%
Yellow Time (s)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
All-Red Time (s)	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Lost Time Adjust (s)		3.0		3.0		3.0		3.0
Total Lost Time (s)		9.3		9.3		9.3		9.3
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	Max	Max	Max	Max	None	None	None	None
v/c Ratio		1.83		2.75		1.36		2.38
Control Delay		415.3		813.5		202.9		656.6
Queue Delay		0.0		0.0		0.0		0.0
Total Delay		415.3		813.5		202.9		656.6
Queue Length 50th (m)		~242.3		~733.9		~353.0		~198.5
Queue Length 95th (m)		#314.2		#815.7		#433.0		#270.4
Internal Link Dist (m)		279.7		233.5		313.4		208.5
Turn Bay Length (m)								
Base Capacity (vph)		293		527		682		228
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		1.83		2.75		1.36		2.38

Intersection Summary

Cycle Length: 150
Actuated Cycle Length: 150
Natural Cycle: 150
Control Type: Actuated-Uncoordinated
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Montrose & Biggar/Lyons Creek



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	213	261	19	304	435	596	56	317	478	228	163	109
Future Volume (vph)	213	261	19	304	435	596	56	317	478	228	163	109
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		9.3			9.3			9.3			9.3	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		1.00			1.00			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.99			0.94			0.92			0.97	
Flt Protected		0.98			0.99			1.00			0.98	
Satd. Flow (prot)		1696			1523			1580			1486	
Flt Permitted		0.39			0.76			0.93			0.33	
Satd. Flow (perm)		678			1177			1467			500	
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)	232	284	21	330	473	648	61	345	520	248	177	118
RTOR Reduction (vph)	0	1	0	0	19	0	0	31	0	0	7	0
Lane Group Flow (vph)	0	536	0	0	1432	0	0	895	0	0	536	0
Confl. Bikes (#/hr)												1
Heavy Vehicles (%)	0%	3%	0%	7%	3%	12%	0%	4%	3%	18%	13%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)		67.7			67.7			69.7			69.7	
Effective Green, g (s)		64.7			64.7			66.7			66.7	
Actuated g/C Ratio		0.43			0.43			0.44			0.44	
Clearance Time (s)		6.3			6.3			6.3			6.3	
Vehicle Extension (s)		6.0			6.0			6.0			6.0	
Lane Grp Cap (vph)		292			507			652			222	
v/s Ratio Prot												
v/s Ratio Perm		0.79			c1.22			0.61			c1.07	
v/c Ratio		1.84			2.82			1.37			2.42	
Uniform Delay, d1		42.6			42.6			41.6			41.6	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		388.9			826.2			177.6			650.7	
Delay (s)		431.6			868.8			219.3			692.4	
Level of Service		F			F			F			F	
Approach Delay (s)		431.6			868.8			219.3			692.4	
Approach LOS		F			F			F			F	

Intersection Summary			
HCM 2000 Control Delay	599.2	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	2.61		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	18.6
Intersection Capacity Utilization	197.2%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	6	2	440	35	7	341
Future Volume (Veh/h)	6	2	440	35	7	341
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)	7	2	478	38	8	371
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)			69			185
pX, platoon unblocked	0.81	0.71			0.71	
vC, conflicting volume	884	497			516	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	209	97			123	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	99	100			99	
cM capacity (veh/h)	630	690			1055	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	9	516	379
Volume Left	7	0	8
Volume Right	2	38	0
cSH	642	1700	1055
Volume to Capacity	0.01	0.30	0.01
Queue Length 95th (m)	0.3	0.0	0.2
Control Delay (s)	10.7	0.0	0.3
Lane LOS	B		A
Approach Delay (s)	10.7	0.0	0.3
Approach LOS	B		

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	42.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	193	9	29	401	365	170
Future Volume (Veh/h)	193	9	29	401	365	170
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)	210	10	32	436	397	185
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	990	490	582			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	990	490	582			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	21	98	97			
cM capacity (veh/h)	267	583	1002			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	220	468	582
Volume Left	210	32	0
Volume Right	10	0	185
cSH	274	1002	1700
Volume to Capacity	0.80	0.03	0.34
Queue Length 95th (m)	48.1	0.8	0.0
Control Delay (s)	55.9	0.9	0.0
Lane LOS	F	A	
Approach Delay (s)	55.9	0.9	0.0
Approach LOS	F		

Intersection Summary			
Average Delay	10.0		
Intersection Capacity Utilization	72.7%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	48	5	445	139	16	447
Future Volume (Veh/h)	48	5	445	139	16	447
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)	52	5	484	151	17	486
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	1080	560			635	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1080	560			635	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	78	99			98	
cM capacity (veh/h)	239	532			958	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	57	635	503
Volume Left	52	0	17
Volume Right	5	151	0
cSH	252	1700	958
Volume to Capacity	0.23	0.37	0.02
Queue Length 95th (m)	6.5	0.0	0.4
Control Delay (s)	23.5	0.0	0.5
Lane LOS	C		A
Approach Delay (s)	23.5	0.0	0.5
Approach LOS	C		

Intersection Summary			
Average Delay	1.3		
Intersection Capacity Utilization	54.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	68	30	34	398	433	74
Future Volume (Veh/h)	68	30	34	398	433	74
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)	74	33	37	433	471	80
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	978	471	551			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	978	471	551			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	73	94	96			
cM capacity (veh/h)	270	597	1029			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	107	37	433	471	80
Volume Left	74	37	0	0	0
Volume Right	33	0	0	0	80
cSH	325	1029	1700	1700	1700
Volume to Capacity	0.33	0.04	0.25	0.28	0.05
Queue Length 95th (m)	10.6	0.8	0.0	0.0	0.0
Control Delay (s)	21.4	8.6	0.0	0.0	0.0
Lane LOS	C	A			
Approach Delay (s)	21.4	0.7		0.0	
Approach LOS	C				

Intersection Summary			
Average Delay	2.3		
Intersection Capacity Utilization	48.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	178	48	34	433	460	78
Future Volume (Veh/h)	178	48	34	433	460	78
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)	193	52	37	471	500	85
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	1088	542	585			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1088	542	585			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	17	90	96			
cM capacity (veh/h)	232	544	1000			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	245	508	585
Volume Left	193	37	0
Volume Right	52	0	85
cSH	264	1000	1700
Volume to Capacity	0.93	0.04	0.34
Queue Length 95th (m)	64.3	0.9	0.0
Control Delay (s)	79.3	1.1	0.0
Lane LOS	F	A	
Approach Delay (s)	79.3	1.1	0.0
Approach LOS	F		

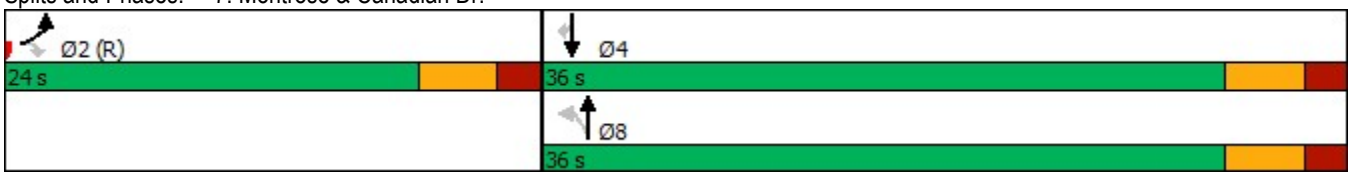
Intersection Summary			
Average Delay	14.9		
Intersection Capacity Utilization	80.7%	ICU Level of Service	D
Analysis Period (min)	15		

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	8	95	108	540	443	25
Future Volume (vph)	8	95	108	540	443	25
Lane Group Flow (vph)	9	103	117	587	482	27
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	2			8	4	
Permitted Phases		2	8			4
Minimum Split (s)	23.5	23.5	23.5	23.5	23.5	23.5
Total Split (s)	24.0	24.0	36.0	36.0	36.0	36.0
Total Split (%)	40.0%	40.0%	60.0%	60.0%	60.0%	60.0%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	2.0	2.0	2.0	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)	5.5	5.5	5.5	5.5	5.5	5.5
Lead/Lag						
Lead-Lag Optimize?						
v/c Ratio	0.02	0.20	0.34	0.71	0.57	0.04
Control Delay	14.8	5.1	12.2	17.1	13.7	3.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.8	5.1	12.2	17.1	13.7	3.5
Queue Length 50th (m)	0.7	0.0	7.0	45.4	33.8	0.0
Queue Length 95th (m)	3.3	8.6	17.2	78.9	58.3	3.0
Internal Link Dist (m)	249.7			540.4	157.6	
Turn Bay Length (m)	50.0		45.0			50.0
Base Capacity (vph)	389	508	349	832	840	702
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	0.02	0.20	0.34	0.71	0.57	0.04

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 60
Offset: 0 (0%), Referenced to phase 2:EBL and 6:, Start of Green
Natural Cycle: 60
Control Type: Pretimed

Splits and Phases: 7: Montrose & Canadian Dr.



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	8	95	108	540	443	25
Future Volume (vph)	8	95	108	540	443	25
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5	5.5
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)	1264	1419	1616	1638	1654	1355
Flt Permitted	0.95	1.00	0.40	1.00	1.00	1.00
Satd. Flow (perm)	1264	1419	687	1638	1654	1355
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	9	103	117	587	482	27
RTOR Reduction (vph)	0	71	0	0	0	13
Lane Group Flow (vph)	9	32	117	587	482	14
Heavy Vehicles (%)	33%	6%	4%	8%	7%	11%
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	2			8	4	
Permitted Phases		2	8			4
Actuated Green, G (s)	18.5	18.5	30.5	30.5	30.5	30.5
Effective Green, g (s)	18.5	18.5	30.5	30.5	30.5	30.5
Actuated g/C Ratio	0.31	0.31	0.51	0.51	0.51	0.51
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5
Lane Grp Cap (vph)	389	437	349	832	840	688
v/s Ratio Prot	0.01			c0.36	0.29	
v/s Ratio Perm		c0.02	0.17			0.01
v/c Ratio	0.02	0.07	0.34	0.71	0.57	0.02
Uniform Delay, d1	14.5	14.7	8.7	11.3	10.2	7.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	0.3	2.6	5.0	2.8	0.1
Delay (s)	14.6	15.0	11.3	16.3	13.1	7.4
Level of Service	B	B	B	B	B	A
Approach Delay (s)	15.0			15.5	12.8	
Approach LOS	B			B	B	

Intersection Summary			
HCM 2000 Control Delay	14.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.47		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	52.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	11	3	19	530	463	60
Future Volume (Veh/h)	11	3	19	530	463	60
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)	12	3	21	576	503	65
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)				182	222	
pX, platoon unblocked	0.74					
vC, conflicting volume	1154	284	568			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1030	284	568			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	93	100	98			
cM capacity (veh/h)	168	719	1014			

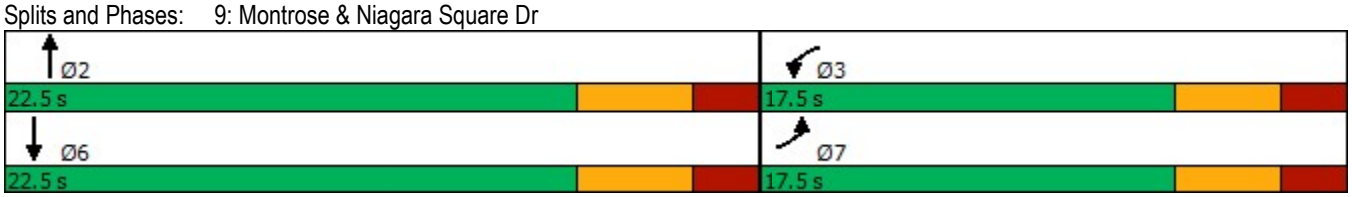
Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	12	3	21	576	335	233
Volume Left	12	0	21	0	0	0
Volume Right	0	3	0	0	0	65
cSH	168	719	1014	1700	1700	1700
Volume to Capacity	0.07	0.00	0.02	0.34	0.20	0.14
Queue Length 95th (m)	1.7	0.1	0.5	0.0	0.0	0.0
Control Delay (s)	28.1	10.0	8.6	0.0	0.0	0.0
Lane LOS	D	B	A			
Approach Delay (s)	24.5		0.3		0.0	
Approach LOS	C					

Intersection Summary			
Average Delay	0.5		
Intersection Capacity Utilization	47.0%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	WBL	NBT	SBT
Lane Configurations				
Traffic Volume (vph)	4	328	546	195
Future Volume (vph)	4	328	546	195
Lane Group Flow (vph)	4	357	593	212
Turn Type	Prot	Prot	NA	NA
Protected Phases	7	3	2	6
Permitted Phases				
Detector Phase	7	3	2	6
Switch Phase				
Minimum Initial (s)	8.0	8.0	8.0	8.0
Minimum Split (s)	13.2	13.2	13.5	13.5
Total Split (s)	17.5	17.5	22.5	22.5
Total Split (%)	43.8%	43.8%	56.3%	56.3%
Yellow Time (s)	3.2	3.2	3.5	3.5
All-Red Time (s)	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	3.0	3.0	3.0	3.0
Total Lost Time (s)	8.2	8.2	8.5	8.5
Lead/Lag				
Lead-Lag Optimize?				
Recall Mode	None	None	None	None
v/c Ratio	0.01	0.60	0.77	0.31
Control Delay	11.2	16.5	17.8	10.5
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	11.2	16.5	17.8	10.5
Queue Length 50th (m)	0.2	7.7	12.8	4.0
Queue Length 95th (m)	1.6	18.4	25.7	9.7
Internal Link Dist (m)			198.2	233.7
Turn Bay Length (m)				
Base Capacity (vph)	524	968	1462	1283
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	0.01	0.37	0.41	0.17

Intersection Summary
Cycle Length: 40
Actuated Cycle Length: 30.3
Natural Cycle: 40
Control Type: Actuated-Uncoordinated

Splits and Phases: 9: Montrose & Niagara Square Dr



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	4	0	0	328	0	0	0	546	0	0	195	0
Future Volume (vph)	4	0	0	328	0	0	0	546	0	0	195	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	8.2			8.2				8.5			8.5	
Lane Util. Factor	1.00			0.97				0.95			0.95	
Frt	1.00			1.00				1.00			1.00	
Flt Protected	0.95			0.95				1.00			1.00	
Satd. Flow (prot)	1681			3106				3113			2733	
Flt Permitted	0.95			0.95				1.00			1.00	
Satd. Flow (perm)	1681			3106				3113			2733	
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)	4	0	0	357	0	0	0	593	0	0	212	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	4	0	0	357	0	0	0	593	0	0	212	0
Heavy Vehicles (%)	0%	0%	0%	5%	0%	0%	0%	8%	0%	0%	23%	0%
Turn Type	Prot			Prot				NA			NA	
Protected Phases	7			3				2			6	
Permitted Phases												
Actuated Green, G (s)	8.8			8.8				10.6			10.6	
Effective Green, g (s)	5.8			5.8				7.6			7.6	
Actuated g/C Ratio	0.19			0.19				0.25			0.25	
Clearance Time (s)	5.2			5.2				5.5			5.5	
Vehicle Extension (s)	2.1			2.1				2.3			2.3	
Lane Grp Cap (vph)	323			598				786			690	
v/s Ratio Prot	0.00			c0.11				c0.19			0.08	
v/s Ratio Perm												
v/c Ratio	0.01			0.60				0.75			0.31	
Uniform Delay, d1	9.8			11.1				10.4			9.1	
Progression Factor	1.00			1.00				1.00			1.00	
Incremental Delay, d2	0.0			1.1				3.8			0.1	
Delay (s)	9.8			12.2				14.2			9.3	
Level of Service	A			B				B			A	
Approach Delay (s)		9.8			12.2			14.2			9.3	
Approach LOS		A			B			B			A	

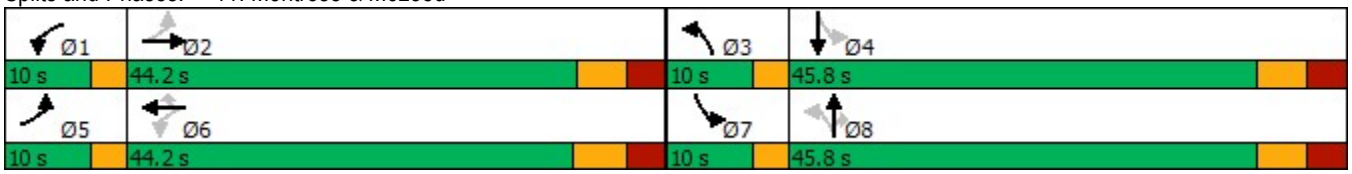
Intersection Summary			
HCM 2000 Control Delay	12.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	30.1	Sum of lost time (s)	16.7
Intersection Capacity Utilization	39.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	91	824	31	694	252	26	187	297	171	162
Future Volume (vph)	91	824	31	694	252	26	187	297	171	162
Lane Group Flow (vph)	99	908	34	754	274	28	203	323	186	268
Turn Type	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA
Protected Phases	5	2	1	6		3	8		7	4
Permitted Phases	2		6		6	8		8	4	
Detector Phase	5	2	1	6	6	3	8	8	7	4
Switch Phase										
Minimum Initial (s)	6.0	10.0	6.0	10.0	10.0	6.0	8.0	8.0	6.0	8.0
Minimum Split (s)	10.0	39.4	10.0	39.7	39.7	10.0	45.6	45.6	10.0	45.6
Total Split (s)	10.0	44.2	10.0	44.2	44.2	10.0	45.8	45.8	10.0	45.8
Total Split (%)	9.1%	40.2%	9.1%	40.2%	40.2%	9.1%	41.6%	41.6%	9.1%	41.6%
Yellow Time (s)	3.0	4.1	3.0	4.4	4.4	3.0	4.1	4.1	3.0	4.1
All-Red Time (s)	0.0	3.3	0.0	3.3	3.3	0.0	3.5	3.5	0.0	3.5
Lost Time Adjust (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	6.0	10.4	6.0	10.7	10.7	6.0	10.6	10.6	6.0	10.6
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	None	None	None
v/c Ratio	0.45	0.61	0.18	0.80	0.45	0.09	0.76	0.81	0.60	0.35
Control Delay	20.5	24.0	14.3	32.5	5.7	18.4	49.7	28.0	31.5	18.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.5	24.0	14.3	32.5	5.7	18.4	49.7	28.0	31.5	18.7
Queue Length 50th (m)	7.3	40.2	2.4	51.5	0.0	2.5	27.7	14.0	18.6	9.8
Queue Length 95th (m)	18.6	63.3	8.1	83.0	16.3	8.7	55.9	48.3	#43.8	25.9
Internal Link Dist (m)		257.8		244.2			112.3			232.4
Turn Bay Length (m)	45.0		140.0			90.0			140.0	
Base Capacity (vph)	226	2192	201	1546	816	337	793	764	311	1366
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.44	0.41	0.17	0.49	0.34	0.08	0.26	0.42	0.60	0.20

Intersection Summary

Cycle Length: 110
Actuated Cycle Length: 74.3
Natural Cycle: 110
Control Type: Actuated-Uncoordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 11: Montrose & McLoed



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	91	824	11	31	694	252	26	187	297	171	162	85
Future Volume (vph)	91	824	11	31	694	252	26	187	297	171	162	85
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	10.4		6.0	10.7	10.7	6.0	10.6	10.6	6.0	10.6	
Lane Util. Factor	1.00	0.91		1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1437	4582		1227	3264	1419	1681	1594	1319	1556	2652	
Flt Permitted	0.27	1.00		0.30	1.00	1.00	0.59	1.00	1.00	0.47	1.00	
Satd. Flow (perm)	403	4582		390	3264	1419	1038	1594	1319	763	2652	
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)	99	896	12	34	754	274	28	203	323	186	176	92
RTOR Reduction (vph)	0	1	0	0	0	195	0	0	174	0	67	0
Lane Group Flow (vph)	99	907	0	34	754	79	28	203	149	186	201	0
Confl. Peds. (#/hr)			2	2								
Heavy Vehicles (%)	17%	5%	20%	37%	3%	6%	0%	11%	14%	8%	23%	15%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2			6		6	8		8	4		
Actuated Green, G (s)	32.6	27.3		28.7	25.2	25.2	19.9	17.7	17.7	28.1	22.9	
Effective Green, g (s)	26.6	24.3		22.7	22.2	22.2	14.7	14.7	14.7	24.3	19.9	
Actuated g/C Ratio	0.35	0.32		0.30	0.29	0.29	0.19	0.19	0.19	0.32	0.26	
Clearance Time (s)	3.0	7.4		3.0	7.7	7.7	3.0	7.6	7.6	3.0	7.6	
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	170	1447		120	942	409	198	304	252	286	686	
v/s Ratio Prot	c0.02	0.20		0.00	c0.23			0.13		c0.04	0.08	
v/s Ratio Perm	0.18			0.08		0.06	0.03		0.11	c0.17		
v/c Ratio	0.58	0.63		0.28	0.80	0.19	0.14	0.67	0.59	0.65	0.29	
Uniform Delay, d1	20.4	22.4		20.2	25.3	20.6	25.9	28.8	28.4	22.5	22.9	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	4.2	0.7		0.9	4.8	0.2	0.2	4.9	3.1	4.7	0.2	
Delay (s)	24.5	23.2		21.2	30.1	20.8	26.1	33.8	31.5	27.2	23.0	
Level of Service	C	C		C	C	C	C	C	C	C	C	
Approach Delay (s)		23.3			27.4			32.0			24.7	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	26.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	76.9	Sum of lost time (s)	33.3
Intersection Capacity Utilization	75.0%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	947	9	44	1343	2	23
Future Volume (Veh/h)	947	9	44	1343	2	23
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)	1029	10	48	1460	2	25
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)	352					
pX, platoon unblocked						
vC, conflicting volume			1039		1860	520
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1039		1860	520
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			93		97	95
cM capacity (veh/h)			677		62	507

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	686	353	535	973	27
Volume Left	0	0	48	0	2
Volume Right	0	10	0	0	25
cSH	1700	1700	677	1700	330
Volume to Capacity	0.40	0.21	0.07	0.57	0.08
Queue Length 95th (m)	0.0	0.0	1.7	0.0	2.0
Control Delay (s)	0.0	0.0	1.9	0.0	16.9
Lane LOS			A		C
Approach Delay (s)	0.0		0.7		16.9
Approach LOS					C

Intersection Summary			
Average Delay	0.6		
Intersection Capacity Utilization	89.9%	ICU Level of Service	E
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	803	541	0	195	847
Future Volume (Veh/h)	0	803	541	0	195	847
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	873	588	0	212	921
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	588				1024	294
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	588				1024	294
tC, single (s)	4.1				7.0	7.0
tC, 2 stage (s)						
tF (s)	2.2				3.6	3.3
p0 queue free %	100				2	0
cM capacity (veh/h)	997				216	696

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	436	436	294	294	212	921
Volume Left	0	0	0	0	212	0
Volume Right	0	0	0	0	0	921
cSH	1700	1700	1700	1700	216	696
Volume to Capacity	0.26	0.26	0.17	0.17	0.98	1.32
Queue Length 95th (m)	0.0	0.0	0.0	0.0	65.7	283.7
Control Delay (s)	0.0	0.0	0.0	0.0	102.8	174.0
Lane LOS					F	F
Approach Delay (s)	0.0		0.0		160.7	
Approach LOS					F	

Intersection Summary			
Average Delay	70.2		
Intersection Capacity Utilization	84.8%	ICU Level of Service	E
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	472	0	0	371	240	63
Future Volume (Veh/h)	472	0	0	371	240	63
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)	513	0	0	403	261	68
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			513		714	256
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			513		714	256
tC, single (s)			4.1		6.9	7.0
tC, 2 stage (s)						
tF (s)			2.2		3.6	3.3
p0 queue free %			100		27	91
cM capacity (veh/h)			1063		357	740

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	256	256	202	202	261	68
Volume Left	0	0	0	0	261	0
Volume Right	0	0	0	0	0	68
cSH	1700	1700	1700	1700	357	740
Volume to Capacity	0.15	0.15	0.12	0.12	0.73	0.09
Queue Length 95th (m)	0.0	0.0	0.0	0.0	42.3	2.3
Control Delay (s)	0.0	0.0	0.0	0.0	38.1	10.4
Lane LOS					E	B
Approach Delay (s)	0.0		0.0		32.4	
Approach LOS					D	

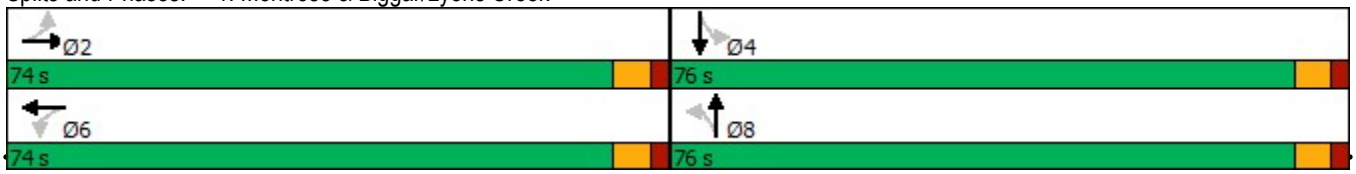
Intersection Summary			
Average Delay	8.5		
Intersection Capacity Utilization	84.8%	ICU Level of Service	E
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	149	388	623	416	27	266	601	454
Future Volume (vph)	149	388	623	416	27	266	601	454
Lane Group Flow (vph)	0	644	0	1451	0	796	0	1339
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		2		6		8		4
Permitted Phases	2		6		8		4	
Detector Phase	2	2	6	6	8	8	4	4
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	26.3	26.3	26.3	26.3	31.3	31.3	31.3	31.3
Total Split (s)	74.0	74.0	74.0	74.0	76.0	76.0	76.0	76.0
Total Split (%)	49.3%	49.3%	49.3%	49.3%	50.7%	50.7%	50.7%	50.7%
Yellow Time (s)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
All-Red Time (s)	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Lost Time Adjust (s)		3.0		3.0		3.0		3.0
Total Lost Time (s)		9.3		9.3		9.3		9.3
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	Max	Max	Max	Max	None	None	None	None
v/c Ratio		1.24		4.17		1.15		5.07
Control Delay		158.8		1446.4		119.5		1851.9
Queue Delay		0.0		0.0		0.0		0.0
Total Delay		158.8		1446.4		119.5		1851.9
Queue Length 50th (m)		~236.6		~692.5		~267.1		~674.6
Queue Length 95th (m)		#311.6		#774.4		#345.2		#757.1
Internal Link Dist (m)		279.7		233.5		313.4		208.5
Turn Bay Length (m)								
Base Capacity (vph)		521		348		691		264
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		1.24		4.17		1.15		5.07

Intersection Summary

Cycle Length: 150
Actuated Cycle Length: 150
Natural Cycle: 150
Control Type: Actuated-Uncoordinated
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Montrose & Biggar/Lyons Creek



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	149	388	55	623	416	296	27	266	440	601	454	178
Future Volume (vph)	149	388	55	623	416	296	27	266	440	601	454	178
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		9.3			9.3			9.3			9.3	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.99			0.97			0.92			0.98	
Flt Protected		0.99			0.98			1.00			0.98	
Satd. Flow (prot)		1659			1504			1557			1613	
Flt Permitted		0.72			0.51			0.95			0.35	
Satd. Flow (perm)		1204			792			1475			584	
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)	162	422	60	677	452	322	29	289	478	653	493	193
RTOR Reduction (vph)	0	2	0	0	7	0	0	36	0	0	4	0
Lane Group Flow (vph)	0	642	0	0	1444	0	0	760	0	0	1335	0
Heavy Vehicles (%)	0%	6%	1%	17%	5%	9%	0%	5%	4%	5%	7%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)		67.7			67.7			69.7			69.7	
Effective Green, g (s)		64.7			64.7			66.7			66.7	
Actuated g/C Ratio		0.43			0.43			0.44			0.44	
Clearance Time (s)		6.3			6.3			6.3			6.3	
Vehicle Extension (s)		6.0			6.0			6.0			6.0	
Lane Grp Cap (vph)		519			341			655			259	
v/s Ratio Prot												
v/s Ratio Perm		0.53			c1.82			0.52			c2.28	
v/c Ratio		1.24			4.24			1.16			5.15	
Uniform Delay, d1		42.6			42.6			41.6			41.6	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		122.2			1462.7			88.3			1878.3	
Delay (s)		164.9			1505.3			130.0			1919.9	
Level of Service		F			F			F			F	
Approach Delay (s)		164.9			1505.3			130.0			1919.9	
Approach LOS		F			F			F			F	

Intersection Summary			
HCM 2000 Control Delay	1173.7	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	4.69		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	18.6
Intersection Capacity Utilization	266.5%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	30	6	444	7	2	686
Future Volume (Veh/h)	30	6	444	7	2	686
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)	33	7	483	8	2	746
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)			69			185
pX, platoon unblocked	0.85	0.72			0.72	
vC, conflicting volume	1237	487			491	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	475	86			92	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	93	99			100	
cM capacity (veh/h)	469	701			1086	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	40	491	748
Volume Left	33	0	2
Volume Right	7	8	0
cSH	498	1700	1086
Volume to Capacity	0.08	0.29	0.00
Queue Length 95th (m)	2.0	0.0	0.0
Control Delay (s)	12.9	0.0	0.0
Lane LOS	B		A
Approach Delay (s)	12.9	0.0	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	55.9%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	219	19	13	507	699	211
Future Volume (Veh/h)	219	19	13	507	699	211
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)	238	21	14	551	760	229
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	1454	874	989			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1454	874	989			
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	94	98			
cM capacity (veh/h)	142	352	707			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	259	565	989
Volume Left	238	14	0
Volume Right	21	0	229
cSH	149	707	1700
Volume to Capacity	1.73	0.02	0.58
Queue Length 95th (m)	143.3	0.5	0.0
Control Delay (s)	409.1	0.5	0.0
Lane LOS	F	A	
Approach Delay (s)	409.1	0.5	0.0
Approach LOS	F		

Intersection Summary			
Average Delay	58.6		
Intersection Capacity Utilization	80.0%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	142	25	624	160	28	685
Future Volume (Veh/h)	142	25	624	160	28	685
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)	154	27	678	174	30	745
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	1570	765			852	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1570	765			852	
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	93			96	
cM capacity (veh/h)	118	406			795	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	181	852	775
Volume Left	154	0	30
Volume Right	27	174	0
cSH	132	1700	795
Volume to Capacity	1.37	0.50	0.04
Queue Length 95th (m)	89.8	0.0	0.9
Control Delay (s)	268.1	0.0	1.0
Lane LOS	F		A
Approach Delay (s)	268.1	0.0	1.0
Approach LOS	F		

Intersection Summary			
Average Delay	27.3		
Intersection Capacity Utilization	85.7%	ICU Level of Service	E
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	65	44	38	600	634	61
Future Volume (Veh/h)	65	44	38	600	634	61
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)	71	48	41	652	689	66
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	1423	689	755			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1423	689	755			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	51	89	95			
cM capacity (veh/h)	144	449	865			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	119	41	652	689	66
Volume Left	71	41	0	0	0
Volume Right	48	0	0	0	66
cSH	199	865	1700	1700	1700
Volume to Capacity	0.60	0.05	0.38	0.41	0.04
Queue Length 95th (m)	25.5	1.1	0.0	0.0	0.0
Control Delay (s)	47.1	9.4	0.0	0.0	0.0
Lane LOS	E	A			
Approach Delay (s)	47.1	0.6		0.0	
Approach LOS	E				

Intersection Summary			
Average Delay	3.8		
Intersection Capacity Utilization	54.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	155	53	54	610	605	223
Future Volume (Veh/h)	155	53	54	610	605	223
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)	168	58	59	663	658	242
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	1560	779	900			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1560	779	900			
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	85	92			
cM capacity (veh/h)	115	399	763			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	226	722	900
Volume Left	168	59	0
Volume Right	58	0	242
cSH	141	763	1700
Volume to Capacity	1.60	0.08	0.53
Queue Length 95th (m)	121.2	1.9	0.0
Control Delay (s)	358.6	2.0	0.0
Lane LOS	F	A	
Approach Delay (s)	358.6	2.0	0.0
Approach LOS	F		

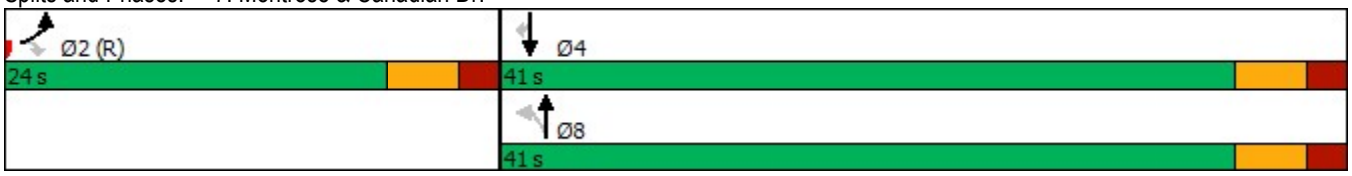
Intersection Summary			
Average Delay	44.6		
Intersection Capacity Utilization	107.9%	ICU Level of Service	G
Analysis Period (min)	15		

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	186	277	207	606	551	198
Future Volume (vph)	186	277	207	606	551	198
Lane Group Flow (vph)	202	301	225	659	599	215
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	2			8	4	
Permitted Phases		2	8			4
Minimum Split (s)	23.5	23.5	23.5	23.5	23.5	23.5
Total Split (s)	24.0	24.0	41.0	41.0	41.0	41.0
Total Split (%)	36.9%	36.9%	63.1%	63.1%	63.1%	63.1%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	3.0	3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	8.5	8.5	8.5	8.5	8.5	8.5
Lead/Lag						
Lead-Lag Optimize?						
v/c Ratio	0.53	0.58	0.79	0.78	0.70	0.25
Control Delay	27.5	11.5	37.7	21.9	17.9	2.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	27.5	11.5	37.7	21.9	17.9	2.3
Queue Length 50th (m)	21.2	7.1	20.9	60.6	51.4	0.0
Queue Length 95th (m)	39.4	27.3	#58.3	#117.2	85.7	8.7
Internal Link Dist (m)	249.7			540.4	157.6	
Turn Bay Length (m)	50.0		45.0			50.0
Base Capacity (vph)	381	518	284	842	859	859
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	0.53	0.58	0.79	0.78	0.70	0.25

Intersection Summary

Cycle Length: 65
Actuated Cycle Length: 65
Offset: 0 (0%), Referenced to phase 2:EBL and 6:, Start of Green
Natural Cycle: 65
Control Type: Pretimed
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 7: Montrose & Canadian Dr.



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	186	277	207	606	551	198
Future Volume (vph)	186	277	207	606	551	198
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	8.5	8.5	8.5	8.5	8.5	8.5
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)	1601	1446	1616	1685	1718	1504
Flt Permitted	0.95	1.00	0.33	1.00	1.00	1.00
Satd. Flow (perm)	1601	1446	569	1685	1718	1504
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	202	301	225	659	599	215
RTOR Reduction (vph)	0	174	0	0	0	108
Lane Group Flow (vph)	202	127	225	659	599	108
Heavy Vehicles (%)	5%	4%	4%	5%	3%	0%
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	2			8	4	
Permitted Phases		2	8			4
Actuated Green, G (s)	18.5	18.5	35.5	35.5	35.5	35.5
Effective Green, g (s)	15.5	15.5	32.5	32.5	32.5	32.5
Actuated g/C Ratio	0.24	0.24	0.50	0.50	0.50	0.50
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5
Lane Grp Cap (vph)	381	344	284	842	859	752
v/s Ratio Prot	c0.13			0.39	0.35	
v/s Ratio Perm		0.09	c0.40			0.07
v/c Ratio	0.53	0.37	0.79	0.78	0.70	0.14
Uniform Delay, d1	21.6	20.7	13.5	13.3	12.5	8.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	5.2	3.0	19.9	7.2	4.7	0.4
Delay (s)	26.8	23.7	33.4	20.5	17.1	9.1
Level of Service	C	C	C	C	B	A
Approach Delay (s)	24.9			23.8	15.0	
Approach LOS	C			C	B	

Intersection Summary			
HCM 2000 Control Delay	20.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	65.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	76.4%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	183	50	52	751	686	373
Future Volume (Veh/h)	183	50	52	751	686	373
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)	199	54	57	816	746	405
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)				182	222	
pX, platoon unblocked	0.69					
vC, conflicting volume	1878	576	1151			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2052	576	1151			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	0	88	91			
cM capacity (veh/h)	31	466	614			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	199	54	57	816	497	654
Volume Left	199	0	57	0	0	0
Volume Right	0	54	0	0	0	405
cSH	31	466	614	1700	1700	1700
Volume to Capacity	6.51	0.12	0.09	0.48	0.29	0.38
Queue Length 95th (m)	Err	3.0	2.3	0.0	0.0	0.0
Control Delay (s)	Err	13.7	11.5	0.0	0.0	0.0
Lane LOS	F	B	B			
Approach Delay (s)	7867.8		0.7		0.0	
Approach LOS	F					

Intersection Summary			
Average Delay	874.5		
Intersection Capacity Utilization	67.9%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBL	WBL	WBT	NBT	SBT
Lane Configurations					
Traffic Volume (vph)	56	630	0	927	425
Future Volume (vph)	56	630	0	927	425
Lane Group Flow (vph)	61	685	2	1008	462
Turn Type	Prot	Prot		NA	NA
Protected Phases	7	3		2	6
Permitted Phases					
Detector Phase	7	3		2	6
Switch Phase					
Minimum Initial (s)	8.0	8.0		8.0	8.0
Minimum Split (s)	13.2	13.2		13.5	13.5
Total Split (s)	25.0	25.0		30.0	30.0
Total Split (%)	45.5%	45.5%		54.5%	54.5%
Yellow Time (s)	3.2	3.2		3.5	3.5
All-Red Time (s)	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	3.0	3.0		3.0	3.0
Total Lost Time (s)	8.2	8.2		8.5	8.5
Lead/Lag					
Lead-Lag Optimize?					
Recall Mode	None	None		None	None
v/c Ratio	0.18	0.87	0.01	0.89	0.44
Control Delay	16.1	28.9	0.0	25.3	12.5
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	16.1	28.9	0.0	25.3	12.5
Queue Length 50th (m)	4.4	25.4	0.0	35.3	13.1
Queue Length 95th (m)	11.1	46.0	0.0	#67.5	26.4
Internal Link Dist (m)			271.6	198.2	233.7
Turn Bay Length (m)					
Base Capacity (vph)	680	1282	153	1675	1570
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	0.09	0.53	0.01	0.60	0.29

Intersection Summary

Cycle Length: 55
Actuated Cycle Length: 43.4
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 9: Montrose & Niagara Square Dr

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	56	0	0	630	0	2	0	927	0	0	425	0
Future Volume (vph)	56	0	0	630	0	2	0	927	0	0	425	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	8.2			8.2	7.0			8.5			8.5	
Lane Util. Factor	1.00			0.97	1.00			0.95			0.95	
Frt	1.00			1.00	0.85			1.00			1.00	
Flt Protected	0.95			0.95	1.00			1.00			1.00	
Satd. Flow (prot)	1681			3166	0			3233			3029	
Flt Permitted	0.95			0.95	1.00			1.00			1.00	
Satd. Flow (perm)	1681			3166	0			3233			3029	
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)	61	0	0	685	0	2	0	1008	0	0	462	0
RTOR Reduction (vph)	0	0	0	0	2	0	0	0	0	0	0	0
Lane Group Flow (vph)	61	0	0	685	0	0	0	1008	0	0	462	0
Heavy Vehicles (%)	0%	0%	0%	3%	0%	50%	0%	4%	0%	0%	11%	0%
Turn Type	Prot			Prot				NA			NA	
Protected Phases	7			3				2			6	
Permitted Phases												
Actuated Green, G (s)	13.9			13.9	0.0			18.3			18.3	
Effective Green, g (s)	10.9			10.9	0.0			15.3			15.3	
Actuated g/C Ratio	0.25			0.25	0.00			0.36			0.36	
Clearance Time (s)	5.2			5.2				5.5			5.5	
Vehicle Extension (s)	2.1			2.1				2.3			2.3	
Lane Grp Cap (vph)	427			804	0			1153			1080	
v/s Ratio Prot	0.04			c0.22				c0.31			0.15	
v/s Ratio Perm												
v/c Ratio	0.14			0.85	0.00			0.87			0.43	
Uniform Delay, d1	12.4			15.2	21.4			12.9			10.5	
Progression Factor	1.00			1.00	1.00			1.00			1.00	
Incremental Delay, d2	0.1			8.4	0.0			7.5			0.2	
Delay (s)	12.5			23.6	21.4			20.4			10.6	
Level of Service	B			C	C			C			B	
Approach Delay (s)		12.5			23.6			20.4			10.6	
Approach LOS		B			C			C			B	

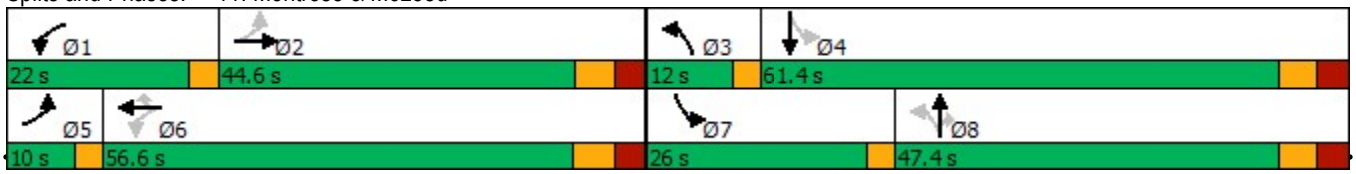
Intersection Summary			
HCM 2000 Control Delay	19.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	42.9	Sum of lost time (s)	16.7
Intersection Capacity Utilization	Err%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	91	957	210	911	328	99	289	559	405	299
Future Volume (vph)	91	957	210	911	328	99	289	559	405	299
Lane Group Flow (vph)	99	1080	228	990	357	108	314	608	440	421
Turn Type	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA
Protected Phases	5	2	1	6		3	8		7	4
Permitted Phases	2		6		6	8		8	4	
Detector Phase	5	2	1	6	6	3	8	8	7	4
Switch Phase										
Minimum Initial (s)	6.0	10.0	6.0	10.0	10.0	6.0	8.0	8.0	6.0	8.0
Minimum Split (s)	10.0	39.4	10.0	39.7	39.7	10.0	45.6	45.6	10.0	45.6
Total Split (s)	10.0	44.6	22.0	56.6	56.6	12.0	47.4	47.4	26.0	61.4
Total Split (%)	7.1%	31.9%	15.7%	40.4%	40.4%	8.6%	33.9%	33.9%	18.6%	43.9%
Yellow Time (s)	3.0	4.1	3.0	4.4	4.4	3.0	4.1	4.1	3.0	4.1
All-Red Time (s)	0.0	3.3	0.0	3.3	3.3	0.0	3.5	3.5	0.0	3.5
Lost Time Adjust (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	6.0	10.4	6.0	10.7	10.7	6.0	10.6	10.6	6.0	10.6
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	None	None	None
v/c Ratio	0.90	0.97	1.00	0.93	0.53	0.33	0.71	1.03	1.00	0.37
Control Delay	96.9	72.7	96.2	60.1	11.1	26.1	56.5	72.4	71.1	30.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	96.9	72.7	96.2	60.1	11.1	26.1	56.5	72.4	71.1	30.9
Queue Length 50th (m)	16.4	108.4	48.5	138.5	13.5	16.2	79.2	~120.3	84.1	41.5
Queue Length 95th (m)	#44.7	#137.5	#102.7	#177.3	42.7	27.6	113.3	#193.2	#163.0	55.8
Internal Link Dist (m)		257.8		244.2			112.3			232.4
Turn Bay Length (m)	45.0		140.0			90.0			140.0	
Base Capacity (vph)	110	1134	228	1085	674	338	444	590	442	1153
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.90	0.95	1.00	0.91	0.53	0.32	0.71	1.03	1.00	0.37

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 139.4
Natural Cycle: 140
Control Type: Actuated-Uncoordinated
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 11: Montrose & McLoed



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	91	957	37	210	911	328	99	289	559	405	299	88
Future Volume (vph)	91	957	37	210	911	328	99	289	559	405	299	88
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	10.4		6.0	10.7	10.7	6.0	10.6	10.6	6.0	10.6	
Lane Util. Factor	1.00	0.91		1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1514	4615		1542	3296	1460	1681	1685	1475	1664	3076	
Flt Permitted	0.15	1.00		0.10	1.00	1.00	0.51	1.00	1.00	0.34	1.00	
Satd. Flow (perm)	247	4615		165	3296	1460	895	1685	1475	600	3076	
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)	99	1040	40	228	990	357	108	314	608	440	325	96
RTOR Reduction (vph)	0	3	0	0	0	194	0	0	202	0	20	0
Lane Group Flow (vph)	99	1077	0	228	990	163	108	314	406	440	401	0
Confl. Peds. (#/hr)			7	7								
Heavy Vehicles (%)	11%	4%	4%	9%	2%	3%	0%	5%	2%	1%	6%	4%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2			6		6	8		8	4		
Actuated Green, G (s)	43.6	36.6		58.3	48.3	48.3	48.2	39.8	39.8	65.8	54.4	
Effective Green, g (s)	37.6	33.6		55.3	45.3	45.3	42.2	36.8	36.8	62.8	51.4	
Actuated g/C Ratio	0.27	0.24		0.40	0.32	0.32	0.30	0.26	0.26	0.45	0.37	
Clearance Time (s)	3.0	7.4		3.0	7.7	7.7	3.0	7.6	7.6	3.0	7.6	
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	102	1112		223	1071	474	301	444	389	422	1134	
v/s Ratio Prot	0.03	0.23		c0.12	0.30		0.01	0.19		c0.15	0.13	
v/s Ratio Perm	0.23			c0.29		0.11	0.09		0.28	c0.32		
v/c Ratio	0.97	0.97		1.02	0.92	0.34	0.36	0.71	1.04	1.04	0.35	
Uniform Delay, d1	48.7	52.4		41.0	45.4	35.7	36.3	46.4	51.3	34.2	31.9	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	79.3	19.6		66.2	13.0	0.3	0.5	4.7	57.7	55.4	0.1	
Delay (s)	128.0	71.9		107.2	58.4	36.1	36.8	51.2	109.0	89.6	32.1	
Level of Service	F	E		F	E	D	D	D	F	F	C	
Approach Delay (s)		76.7			60.4			83.8			61.5	
Approach LOS		E			E			F			E	

Intersection Summary			
HCM 2000 Control Delay	69.9	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	139.4	Sum of lost time (s)	33.3
Intersection Capacity Utilization	106.6%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	1417	11	35	1377	6	26
Future Volume (Veh/h)	1417	11	35	1377	6	26
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)	1540	12	38	1497	7	28
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)	352					
pX, platoon unblocked						
vC, conflicting volume			1552		2370	776
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1552		2370	776
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			91		74	92
cM capacity (veh/h)			433		27	345

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	1027	525	537	998	35
Volume Left	0	0	38	0	7
Volume Right	0	12	0	0	28
cSH	1700	1700	433	1700	104
Volume to Capacity	0.60	0.31	0.09	0.59	0.34
Queue Length 95th (m)	0.0	0.0	2.2	0.0	10.1
Control Delay (s)	0.0	0.0	2.6	0.0	56.5
Lane LOS			A		F
Approach Delay (s)	0.0		0.9		56.5
Approach LOS					F

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	83.6%	ICU Level of Service	E
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	1103	535	0	443	877
Future Volume (Veh/h)	0	1103	535	0	443	877
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	1199	582	0	482	953
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	582				1182	291
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	582				1182	291
tC, single (s)	4.1				6.9	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				0	0
cM capacity (veh/h)	1002				180	706

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	600	600	291	291	482	953
Volume Left	0	0	0	0	482	0
Volume Right	0	0	0	0	0	953
cSH	1700	1700	1700	1700	180	706
Volume to Capacity	0.35	0.35	0.17	0.17	2.68	1.35
Queue Length 95th (m)	0.0	0.0	0.0	0.0	319.7	303.2
Control Delay (s)	0.0	0.0	0.0	0.0	812.0	185.6
Lane LOS					F	F
Approach Delay (s)	0.0		0.0		396.0	
Approach LOS					F	

Intersection Summary			
Average Delay	176.7		
Intersection Capacity Utilization	86.7%	ICU Level of Service	E
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	946	0	0	480	112	101
Future Volume (Veh/h)	946	0	0	480	112	101
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)	1028	0	0	522	122	110
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			1028		1289	514
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1028		1289	514
tC, single (s)			4.1		7.2	7.0
tC, 2 stage (s)						
tF (s)			2.2		3.7	3.4
p0 queue free %			100		10	78
cM capacity (veh/h)			683		136	493

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	514	514	261	261	122	110
Volume Left	0	0	0	0	122	0
Volume Right	0	0	0	0	0	110
cSH	1700	1700	1700	1700	136	493
Volume to Capacity	0.30	0.30	0.15	0.15	0.90	0.22
Queue Length 95th (m)	0.0	0.0	0.0	0.0	45.4	6.4
Control Delay (s)	0.0	0.0	0.0	0.0	115.1	14.4
Lane LOS					F	B
Approach Delay (s)	0.0		0.0		67.4	
Approach LOS					F	

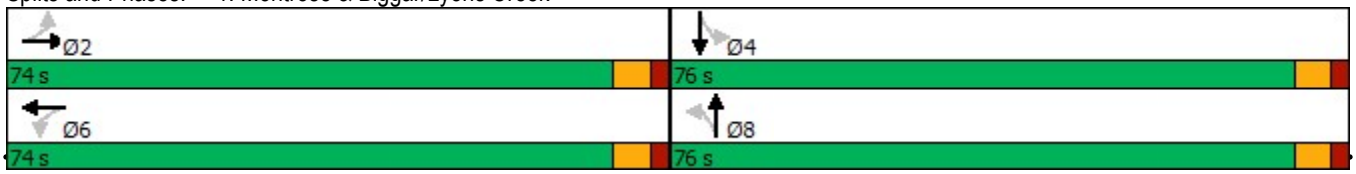
Intersection Summary			
Average Delay	8.8		
Intersection Capacity Utilization	86.7%	ICU Level of Service	E
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	264	339	343	540	60	351	267	179
Future Volume (vph)	264	339	343	540	60	351	267	179
Lane Group Flow (vph)	0	678	0	1715	0	1038	0	661
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		2		6		8		4
Permitted Phases	2		6		8		4	
Detector Phase	2	2	6	6	8	8	4	4
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	26.3	26.3	26.3	26.3	31.3	31.3	31.3	31.3
Total Split (s)	74.0	74.0	74.0	74.0	76.0	76.0	76.0	76.0
Total Split (%)	49.3%	49.3%	49.3%	49.3%	50.7%	50.7%	50.7%	50.7%
Yellow Time (s)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
All-Red Time (s)	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Lost Time Adjust (s)		3.0		3.0		3.0		3.0
Total Lost Time (s)		9.3		9.3		9.3		9.3
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	Max	Max	Max	Max	None	None	None	None
v/c Ratio		2.33		3.34		1.54		3.16
Control Delay		631.6		1072.6		278.2		1002.5
Queue Delay		0.0		0.0		0.0		0.0
Total Delay		631.6		1072.6		278.2		1002.5
Queue Length 50th (m)		~244.9		~903.0		~424.4		~284.3
Queue Length 95th (m)		#320.5		#983.7		#505.6		#359.2
Internal Link Dist (m)		279.7		233.5		313.4		208.5
Turn Bay Length (m)								
Base Capacity (vph)		291		514		676		209
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		2.33		3.34		1.54		3.16

Intersection Summary

Cycle Length: 150
Actuated Cycle Length: 150
Natural Cycle: 150
Control Type: Actuated-Uncoordinated
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Montrose & Biggar/Lyons Creek



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	264	339	21	343	540	695	60	351	544	267	179	162
Future Volume (vph)	264	339	21	343	540	695	60	351	544	267	179	162
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		9.3			9.3			9.3			9.3	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		1.00			1.00			1.00			0.99	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		1.00			0.94			0.92			0.96	
Flt Protected		0.98			0.99			1.00			0.98	
Satd. Flow (prot)		1697			1527			1578			1486	
Flt Permitted		0.39			0.74			0.92			0.30	
Satd. Flow (perm)		675			1148			1452			450	
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)	287	368	23	373	587	755	65	382	591	290	195	176
RTOR Reduction (vph)	0	1	0	0	19	0	0	32	0	0	9	0
Lane Group Flow (vph)	0	677	0	0	1696	0	0	1006	0	0	652	0
Confl. Bikes (#/hr)												1
Heavy Vehicles (%)	0%	3%	0%	7%	3%	12%	0%	4%	3%	18%	13%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)		67.7			67.7			69.7			69.7	
Effective Green, g (s)		64.7			64.7			66.7			66.7	
Actuated g/C Ratio		0.43			0.43			0.44			0.44	
Clearance Time (s)		6.3			6.3			6.3			6.3	
Vehicle Extension (s)		6.0			6.0			6.0			6.0	
Lane Grp Cap (vph)		291			495			645			200	
v/s Ratio Prot												
v/s Ratio Perm		1.00			c1.48			0.69			c1.45	
v/c Ratio		2.33			3.43			1.56			3.26	
Uniform Delay, d1		42.6			42.6			41.6			41.6	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		608.2			1097.1			259.6			1030.1	
Delay (s)		650.9			1139.8			301.3			1071.7	
Level of Service		F			F			F			F	
Approach Delay (s)		650.9			1139.8			301.3			1071.7	
Approach LOS		F			F			F			F	

Intersection Summary			
HCM 2000 Control Delay	835.1	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	3.34		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	18.6
Intersection Capacity Utilization	226.7%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	11	3	540	68	12	438
Future Volume (Veh/h)	11	3	540	68	12	438
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)	12	3	587	74	13	476
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)			69			185
pX, platoon unblocked	0.84	0.71			0.71	
vC, conflicting volume	1126	624			661	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	359	269			321	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	98	99			99	
cM capacity (veh/h)	534	551			890	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	15	661	489
Volume Left	12	0	13
Volume Right	3	74	0
cSH	537	1700	890
Volume to Capacity	0.03	0.39	0.01
Queue Length 95th (m)	0.7	0.0	0.3
Control Delay (s)	11.9	0.0	0.4
Lane LOS	B		A
Approach Delay (s)	11.9	0.0	0.4
Approach LOS	B		

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	50.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	386	18	45	500	471	337
Future Volume (Veh/h)	386	18	45	500	471	337
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)	420	20	49	543	512	366
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	1336	695	878			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1336	695	878			
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	96	94			
cM capacity (veh/h)	160	446	778			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	440	592	878
Volume Left	420	49	0
Volume Right	20	0	366
cSH	165	778	1700
Volume to Capacity	2.67	0.06	0.52
Queue Length 95th (m)	293.8	1.5	0.0
Control Delay (s)	810.9	1.7	0.0
Lane LOS	F	A	
Approach Delay (s)	810.9	1.7	0.0
Approach LOS	F		

Intersection Summary			
Average Delay	187.3		
Intersection Capacity Utilization	105.1%	ICU Level of Service	G
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	55	6	670	205	18	657
Future Volume (Veh/h)	55	6	670	205	18	657
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	7	728	223	20	714
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	1594	840			951	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1594	840			951	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	48	98			97	
cM capacity (veh/h)	116	368			730	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	67	951	734
Volume Left	60	0	20
Volume Right	7	223	0
cSH	125	1700	730
Volume to Capacity	0.54	0.56	0.03
Queue Length 95th (m)	19.5	0.0	0.6
Control Delay (s)	63.2	0.0	0.7
Lane LOS	F		A
Approach Delay (s)	63.2	0.0	0.7
Approach LOS	F		

Intersection Summary			
Average Delay	2.7		
Intersection Capacity Utilization	68.6%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	77	35	39	616	641	83
Future Volume (Veh/h)	77	35	39	616	641	83
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)	84	38	42	670	697	90
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	1451	697	787			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1451	697	787			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	39	91	95			
cM capacity (veh/h)	138	444	841			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	122	42	670	697	90
Volume Left	84	42	0	0	0
Volume Right	38	0	0	0	90
cSH	176	841	1700	1700	1700
Volume to Capacity	0.69	0.05	0.39	0.41	0.05
Queue Length 95th (m)	31.8	1.2	0.0	0.0	0.0
Control Delay (s)	62.0	9.5	0.0	0.0	0.0
Lane LOS	F	A			
Approach Delay (s)	62.0	0.6		0.0	
Approach LOS	F				

Intersection Summary			
Average Delay	4.9		
Intersection Capacity Utilization	55.2%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	198	50	35	659	675	85
Future Volume (Veh/h)	198	50	35	659	675	85
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)	215	54	38	716	734	92
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	1572	780	826			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1572	780	826			
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	86	95			
cM capacity (veh/h)	117	399	813			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	269	754	826
Volume Left	215	38	0
Volume Right	54	0	92
cSH	136	813	1700
Volume to Capacity	1.97	0.05	0.49
Queue Length 95th (m)	162.0	1.1	0.0
Control Delay (s)	517.6	1.2	0.0
Lane LOS	F	A	
Approach Delay (s)	517.6	1.2	0.0
Approach LOS	F		

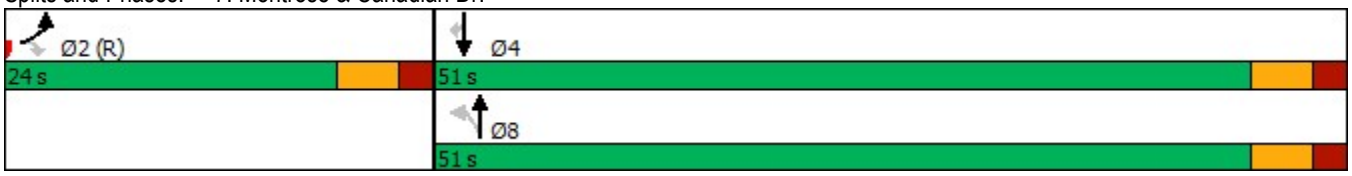
Intersection Summary			
Average Delay	75.8		
Intersection Capacity Utilization	95.5%	ICU Level of Service	F
Analysis Period (min)	15		

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	9	106	120	779	654	28
Future Volume (vph)	9	106	120	779	654	28
Lane Group Flow (vph)	10	115	130	847	711	30
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	2			8	4	
Permitted Phases		2	8			4
Minimum Split (s)	23.5	23.5	20.0	20.0	23.5	23.5
Total Split (s)	24.0	24.0	51.0	51.0	51.0	51.0
Total Split (%)	32.0%	32.0%	68.0%	68.0%	68.0%	68.0%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	3.0	3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	8.5	8.5	8.5	8.5	8.5	8.5
Lead/Lag						
Lead-Lag Optimize?						
v/c Ratio	0.04	0.30	0.49	0.91	0.76	0.04
Control Delay	24.4	7.8	17.6	31.4	19.0	3.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.4	7.8	17.6	31.4	19.0	3.1
Queue Length 50th (m)	1.2	0.0	10.1	98.4	69.9	0.0
Queue Length 95th (m)	4.8	11.9	26.1	#179.1	114.3	3.1
Internal Link Dist (m)	249.7			540.4	157.6	
Turn Bay Length (m)	50.0		45.0			50.0
Base Capacity (vph)	261	384	266	928	937	780
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	0.04	0.30	0.49	0.91	0.76	0.04

Intersection Summary

Cycle Length: 75
Actuated Cycle Length: 75
Offset: 0 (0%), Referenced to phase 2:EBL and 6:, Start of Green
Natural Cycle: 75
Control Type: Pretimed
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 7: Montrose & Canadian Dr.



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	9	106	120	779	654	28
Future Volume (vph)	9	106	120	779	654	28
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	8.5	8.5	8.5	8.5	8.5	8.5
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)	1264	1419	1616	1638	1654	1355
Flt Permitted	0.95	1.00	0.28	1.00	1.00	1.00
Satd. Flow (perm)	1264	1419	471	1638	1654	1355
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	10	115	130	847	711	30
RTOR Reduction (vph)	0	91	0	0	0	13
Lane Group Flow (vph)	10	24	130	847	711	17
Heavy Vehicles (%)	33%	6%	4%	8%	7%	11%
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	2			8	4	
Permitted Phases		2	8			4
Actuated Green, G (s)	18.5	18.5	45.5	45.5	45.5	45.5
Effective Green, g (s)	15.5	15.5	42.5	42.5	42.5	42.5
Actuated g/C Ratio	0.21	0.21	0.57	0.57	0.57	0.57
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5
Lane Grp Cap (vph)	261	293	266	928	937	767
v/s Ratio Prot	0.01			c0.52	0.43	
v/s Ratio Perm		c0.02	0.28			0.01
v/c Ratio	0.04	0.08	0.49	0.91	0.76	0.02
Uniform Delay, d1	23.8	24.0	9.7	14.6	12.4	7.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.3	0.5	6.3	14.7	5.7	0.1
Delay (s)	24.1	24.5	16.0	29.3	18.1	7.2
Level of Service	C	C	B	C	B	A
Approach Delay (s)	24.5			27.6	17.7	
Approach LOS	C			C	B	

Intersection Summary			
HCM 2000 Control Delay	23.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	72.5%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	12	4	21	768	676	67
Future Volume (Veh/h)	12	4	21	768	676	67
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)	13	4	23	835	735	73
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)				182	222	
pX, platoon unblocked	0.51					
vC, conflicting volume	1652	404	808			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1799	404	808			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	64	99	97			
cM capacity (veh/h)	36	602	826			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	13	4	23	835	490	318
Volume Left	13	0	23	0	0	0
Volume Right	0	4	0	0	0	73
cSH	36	602	826	1700	1700	1700
Volume to Capacity	0.36	0.01	0.03	0.49	0.29	0.19
Queue Length 95th (m)	9.1	0.2	0.7	0.0	0.0	0.0
Control Delay (s)	152.9	11.0	9.5	0.0	0.0	0.0
Lane LOS	F	B	A			
Approach Delay (s)	119.5		0.3		0.0	
Approach LOS	F					

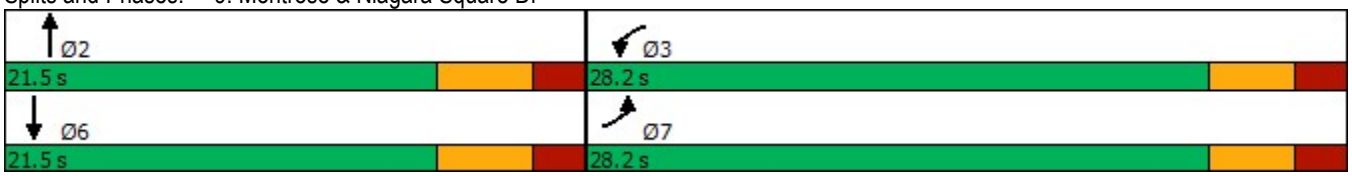
Intersection Summary			
Average Delay	1.3		
Intersection Capacity Utilization	60.6%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBL	WBL	NBT	SBT
Lane Configurations				
Traffic Volume (vph)	5	466	786	278
Future Volume (vph)	5	466	786	278
Lane Group Flow (vph)	5	507	854	302
Turn Type	Prot	Prot	NA	NA
Protected Phases	7	3	2	6
Permitted Phases				
Detector Phase	7	3	2	6
Switch Phase				
Minimum Initial (s)	8.0	8.0	8.0	8.0
Minimum Split (s)	13.2	13.2	13.5	13.5
Total Split (s)	28.2	28.2	21.5	21.5
Total Split (%)	56.7%	56.7%	43.3%	43.3%
Yellow Time (s)	3.2	3.2	3.5	3.5
All-Red Time (s)	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	3.0	3.0	3.0	3.0
Total Lost Time (s)	8.2	8.2	8.5	8.5
Lead/Lag				
Lead-Lag Optimize?				
Recall Mode	None	None	None	None
v/c Ratio	0.01	0.82	0.78	0.32
Control Delay	11.4	25.7	19.4	10.6
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	11.4	25.7	19.4	10.6
Queue Length 50th (m)	0.3	15.6	23.4	6.7
Queue Length 95th (m)	1.9	26.4	#55.2	15.1
Internal Link Dist (m)			198.2	233.7
Turn Bay Length (m)				
Base Capacity (vph)	905	1673	1089	957
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	0.01	0.30	0.78	0.32

Intersection Summary

Cycle Length: 49.7
Actuated Cycle Length: 37.2
Natural Cycle: 50
Control Type: Actuated-Uncoordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 9: Montrose & Niagara Square Dr



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	5	0	0	466	0	0	0	786	0	0	278	0
Future Volume (vph)	5	0	0	466	0	0	0	786	0	0	278	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	8.2			8.2				8.5			8.5	
Lane Util. Factor	1.00			0.97				0.95			0.95	
Frt	1.00			1.00				1.00			1.00	
Flt Protected	0.95			0.95				1.00			1.00	
Satd. Flow (prot)	1681			3106				3113			2733	
Flt Permitted	0.95			0.95				1.00			1.00	
Satd. Flow (perm)	1681			3106				3113			2733	
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	0	0	507	0	0	0	854	0	0	302	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	5	0	0	507	0	0	0	854	0	0	302	0
Heavy Vehicles (%)	0%	0%	0%	5%	0%	0%	0%	8%	0%	0%	23%	0%
Turn Type	Prot			Prot				NA			NA	
Protected Phases	7			3				2			6	
Permitted Phases												
Actuated Green, G (s)	10.5			10.5				16.0			16.0	
Effective Green, g (s)	7.5			7.5				13.0			13.0	
Actuated g/C Ratio	0.20			0.20				0.35			0.35	
Clearance Time (s)	5.2			5.2				5.5			5.5	
Vehicle Extension (s)	2.1			2.1				2.3			2.3	
Lane Grp Cap (vph)	338			626				1087			955	
v/s Ratio Prot	0.00			c0.16				c0.27			0.11	
v/s Ratio Perm												
v/c Ratio	0.01			0.81				0.79			0.32	
Uniform Delay, d1	11.9			14.2				10.9			8.8	
Progression Factor	1.00			1.00				1.00			1.00	
Incremental Delay, d2	0.0			7.3				3.6			0.1	
Delay (s)	11.9			21.4				14.5			9.0	
Level of Service	B			C				B			A	
Approach Delay (s)		11.9			21.4			14.5			9.0	
Approach LOS		B			C			B			A	

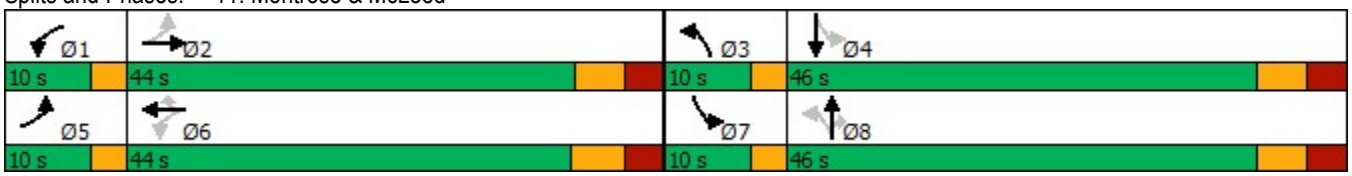
Intersection Summary			
HCM 2000 Control Delay	15.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	37.2	Sum of lost time (s)	16.7
Intersection Capacity Utilization	50.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	104	938	35	787	283	29	267	448	192	241
Future Volume (vph)	104	938	35	787	283	29	267	448	192	241
Lane Group Flow (vph)	113	1033	38	855	308	32	290	487	209	367
Turn Type	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA
Protected Phases	5	2	1	6		3	8		7	4
Permitted Phases	2		6		6	8		8	4	
Detector Phase	5	2	1	6	6	3	8	8	7	4
Switch Phase										
Minimum Initial (s)	6.0	10.0	6.0	10.0	10.0	6.0	8.0	8.0	6.0	8.0
Minimum Split (s)	10.0	39.4	10.0	39.7	39.7	10.0	45.6	45.6	10.0	45.6
Total Split (s)	10.0	44.0	10.0	44.0	44.0	10.0	46.0	46.0	10.0	46.0
Total Split (%)	9.1%	40.0%	9.1%	40.0%	40.0%	9.1%	41.8%	41.8%	9.1%	41.8%
Yellow Time (s)	3.0	4.1	3.0	4.4	4.4	3.0	4.1	4.1	3.0	4.1
All-Red Time (s)	0.0	3.3	0.0	3.3	3.3	0.0	3.5	3.5	0.0	3.5
Lost Time Adjust (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	6.0	10.4	6.0	10.7	10.7	6.0	10.6	10.6	6.0	10.6
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	None	None	None
v/c Ratio	0.72	0.65	0.26	0.90	0.49	0.09	0.67	0.96	0.63	0.41
Control Delay	50.0	31.3	22.4	47.5	6.3	17.6	39.6	52.8	32.7	24.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	50.0	31.3	22.4	47.5	6.3	17.6	39.6	52.8	32.7	24.0
Queue Length 50th (m)	13.4	67.7	4.3	85.3	0.0	3.7	50.7	60.5	27.1	26.1
Queue Length 95th (m)	#38.2	88.6	11.0	#123.2	19.7	9.2	78.7	#123.3	44.3	40.1
Internal Link Dist (m)		257.8		244.2			112.3			232.4
Turn Bay Length (m)	55.0		140.0			90.0			140.0	
Base Capacity (vph)	157	1653	154	1150	699	374	596	620	331	1035
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.72	0.62	0.25	0.74	0.44	0.09	0.49	0.79	0.63	0.35

Intersection Summary

Cycle Length: 110
Actuated Cycle Length: 97.1
Natural Cycle: 110
Control Type: Actuated-Uncoordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 11: Montrose & McLoed



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	104	938	12	35	787	283	29	267	448	192	241	97
Future Volume (vph)	104	938	12	35	787	283	29	267	448	192	241	97
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	10.4		6.0	10.7	10.7	6.0	10.6	10.6	6.0	10.6	
Lane Util. Factor	1.00	0.91		1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1437	4583		1227	3264	1419	1681	1594	1319	1556	2666	
Flt Permitted	0.17	1.00		0.23	1.00	1.00	0.53	1.00	1.00	0.46	1.00	
Satd. Flow (perm)	261	4583		300	3264	1419	943	1594	1319	751	2666	
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)	113	1020	13	38	855	308	32	290	487	209	262	105
RTOR Reduction (vph)	0	1	0	0	0	216	0	0	145	0	40	0
Lane Group Flow (vph)	113	1032	0	38	855	92	32	290	342	209	327	0
Confl. Peds. (#/hr)			2	2								
Heavy Vehicles (%)	17%	5%	20%	37%	3%	6%	0%	11%	14%	8%	23%	15%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2			6		6	8		8	4		
Actuated Green, G (s)	43.2	36.5		36.4	32.7	32.7	34.6	31.0	31.0	41.2	34.6	
Effective Green, g (s)	37.7	33.5		30.4	29.7	29.7	28.6	28.0	28.0	35.8	31.6	
Actuated g/C Ratio	0.38	0.34		0.31	0.30	0.30	0.29	0.28	0.28	0.36	0.32	
Clearance Time (s)	3.0	7.4		3.0	7.7	7.7	3.0	7.6	7.6	3.0	7.6	
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	148	1544		98	975	423	275	449	371	304	847	
v/s Ratio Prot	c0.03	0.23		0.00	c0.26		0.00	0.18		c0.03	0.12	
v/s Ratio Perm	c0.26			0.12		0.06	0.03		c0.26	0.22		
v/c Ratio	0.76	0.67		0.39	0.88	0.22	0.12	0.65	0.92	0.69	0.39	
Uniform Delay, d1	25.2	28.2		27.8	33.1	26.1	25.8	31.3	34.6	27.8	26.4	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	19.7	1.0		1.8	8.9	0.2	0.1	2.8	27.8	5.8	0.2	
Delay (s)	45.0	29.2		29.6	42.0	26.3	26.0	34.2	62.4	33.6	26.6	
Level of Service	D	C		C	D	C	C	C	E	C	C	
Approach Delay (s)		30.7			37.6			50.9			29.1	
Approach LOS		C			D			D			C	

Intersection Summary			
HCM 2000 Control Delay	37.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	99.4	Sum of lost time (s)	33.3
Intersection Capacity Utilization	84.6%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	1127	10	51	1587	3	27
Future Volume (Veh/h)	1127	10	51	1587	3	27
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)	1225	11	55	1725	3	29
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)	352					
pX, platoon unblocked						
vC, conflicting volume			1236		2203	618
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1236		2203	618
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			90		91	93
cM capacity (veh/h)			571		35	437

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	817	419	630	1150	32
Volume Left	0	0	55	0	3
Volume Right	0	11	0	0	29
cSH	1700	1700	571	1700	211
Volume to Capacity	0.48	0.25	0.10	0.68	0.15
Queue Length 95th (m)	0.0	0.0	2.4	0.0	4.0
Control Delay (s)	0.0	0.0	2.6	0.0	25.1
Lane LOS			A		D
Approach Delay (s)	0.0		0.9		25.1
Approach LOS					D

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	102.7%	ICU Level of Service	G
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	977	610	0	218	1029
Future Volume (Veh/h)	0	977	610	0	218	1029
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	1062	663	0	237	1118
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	663				1194	332
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	663				1194	332
tC, single (s)	4.1				7.0	7.0
tC, 2 stage (s)						
tF (s)	2.2				3.6	3.3
p0 queue free %	100				0	0
cM capacity (veh/h)	935				167	658

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	531	531	332	332	237	1118
Volume Left	0	0	0	0	237	0
Volume Right	0	0	0	0	0	1118
cSH	1700	1700	1700	1700	167	658
Volume to Capacity	0.31	0.31	0.20	0.20	1.42	1.70
Queue Length 95th (m)	0.0	0.0	0.0	0.0	112.4	486.4
Control Delay (s)	0.0	0.0	0.0	0.0	272.5	337.4
Lane LOS					F	F
Approach Delay (s)	0.0		0.0		326.0	
Approach LOS					F	

Intersection Summary			
Average Delay	143.4		
Intersection Capacity Utilization	99.2%	ICU Level of Service	F
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	539	0	0	424	261	69
Future Volume (Veh/h)	539	0	0	424	261	69
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)	586	0	0	461	284	75
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			586		816	293
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			586		816	293
tC, single (s)			4.1		6.9	7.0
tC, 2 stage (s)						
tF (s)			2.2		3.6	3.3
p0 queue free %			100		7	89
cM capacity (veh/h)			999		307	700

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	293	293	230	230	284	75
Volume Left	0	0	0	0	284	0
Volume Right	0	0	0	0	0	75
cSH	1700	1700	1700	1700	307	700
Volume to Capacity	0.17	0.17	0.14	0.14	0.93	0.11
Queue Length 95th (m)	0.0	0.0	0.0	0.0	68.4	2.7
Control Delay (s)	0.0	0.0	0.0	0.0	71.9	10.8
Lane LOS					F	B
Approach Delay (s)	0.0		0.0		59.1	
Approach LOS					F	

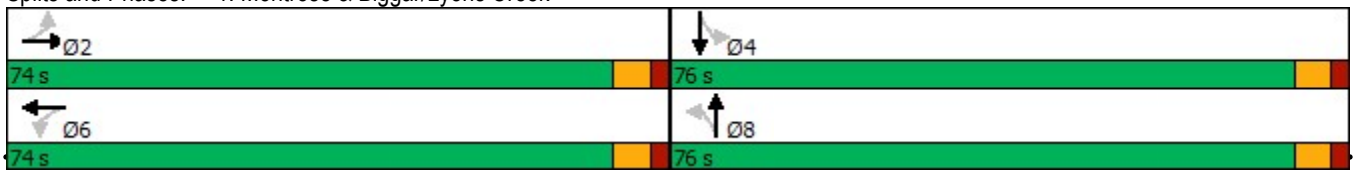
Intersection Summary			
Average Delay	15.1		
Intersection Capacity Utilization	99.2%	ICU Level of Service	F
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	210	490	706	516	31	289	694	499
Future Volume (vph)	210	490	706	516	31	289	694	499
Lane Group Flow (vph)	0	825	0	1702	0	884	0	1578
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		2		6		8		4
Permitted Phases	2		6		8		4	
Detector Phase	2	2	6	6	8	8	4	4
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	26.3	26.3	26.3	26.3	31.3	31.3	31.3	31.3
Total Split (s)	74.0	74.0	74.0	74.0	76.0	76.0	76.0	76.0
Total Split (%)	49.3%	49.3%	49.3%	49.3%	50.7%	50.7%	50.7%	50.7%
Yellow Time (s)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
All-Red Time (s)	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Lost Time Adjust (s)		3.0		3.0		3.0		3.0
Total Lost Time (s)		9.3		9.3		9.3		9.3
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	Max	Max	Max	Max	None	None	None	None
v/c Ratio		1.56		5.17		1.28		6.58
Control Delay		293.4		1895.6		169.1		2526.2
Queue Delay		0.0		0.0		0.0		0.0
Total Delay		293.4		1895.6		169.1		2526.2
Queue Length 50th (m)		~347.6		~861.3		~321.5		~838.5
Queue Length 95th (m)		#425.7		#942.0		#401.5		#919.8
Internal Link Dist (m)		279.7		233.5		313.4		208.5
Turn Bay Length (m)								
Base Capacity (vph)		528		329		692		240
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		1.56		5.17		1.28		6.58

Intersection Summary

Cycle Length: 150
Actuated Cycle Length: 150
Natural Cycle: 150
Control Type: Actuated-Uncoordinated
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Montrose & Biggar/Lyons Creek



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	210	490	59	706	516	344	31	289	493	694	499	259
Future Volume (vph)	210	490	59	706	516	344	31	289	493	694	499	259
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		9.3			9.3			9.3			9.3	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.99			0.97			0.92			0.98	
Flt Protected		0.99			0.98			1.00			0.98	
Satd. Flow (prot)		1661			1509			1556			1609	
Flt Permitted		0.72			0.49			0.95			0.32	
Satd. Flow (perm)		1219			748			1474			529	
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)	228	533	64	767	561	374	34	314	536	754	542	282
RTOR Reduction (vph)	0	2	0	0	7	0	0	37	0	0	5	0
Lane Group Flow (vph)	0	823	0	0	1695	0	0	847	0	0	1573	0
Heavy Vehicles (%)	0%	6%	1%	17%	5%	9%	0%	5%	4%	5%	7%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)		67.7			67.7			69.7			69.7	
Effective Green, g (s)		64.7			64.7			66.7			66.7	
Actuated g/C Ratio		0.43			0.43			0.44			0.44	
Clearance Time (s)		6.3			6.3			6.3			6.3	
Vehicle Extension (s)		6.0			6.0			6.0			6.0	
Lane Grp Cap (vph)		525			322			655			235	
v/s Ratio Prot												
v/s Ratio Perm		0.68			c2.26			0.57			c2.97	
v/c Ratio		1.57			5.26			1.29			6.69	
Uniform Delay, d1		42.6			42.6			41.6			41.6	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		264.3			1925.9			142.9			2571.1	
Delay (s)		307.0			1968.6			184.6			2612.8	
Level of Service		F			F			F			F	
Approach Delay (s)		307.0			1968.6			184.6			2612.8	
Approach LOS		F			F			F			F	

Intersection Summary			
HCM 2000 Control Delay	1581.5	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	5.98		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	18.6
Intersection Capacity Utilization	308.7%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	58	10	527	13	3	816
Future Volume (Veh/h)	58	10	527	13	3	816
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)	63	11	573	14	3	887
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)			69			185
pX, platoon unblocked	0.85	0.71			0.71	
vC, conflicting volume	1473	580			587	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	750	207			217	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	80	98			100	
cM capacity (veh/h)	322	597			971	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	74	587	890
Volume Left	63	0	3
Volume Right	11	14	0
cSH	346	1700	971
Volume to Capacity	0.21	0.35	0.00
Queue Length 95th (m)	6.1	0.0	0.1
Control Delay (s)	18.2	0.0	0.1
Lane LOS	C		A
Approach Delay (s)	18.2	0.0	0.1
Approach LOS	C		

Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	65.0%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	425	34	23	641	859	418
Future Volume (Veh/h)	425	34	23	641	859	418
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)	462	37	25	697	934	454
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	1908	1161	1388			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1908	1161	1388			
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	85	95			
cM capacity (veh/h)	72	240	500			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	499	722	1388
Volume Left	462	25	0
Volume Right	37	0	454
cSH	76	500	1700
Volume to Capacity	6.55	0.05	0.82
Queue Length 95th (m)	Err	1.2	0.0
Control Delay (s)	Err	1.5	0.0
Lane LOS	F	A	
Approach Delay (s)	Err	1.5	0.0
Approach LOS	F		

Intersection Summary			
Average Delay	1912.8		
Intersection Capacity Utilization	116.2%	ICU Level of Service	H
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	163	28	902	242	32	973
Future Volume (Veh/h)	163	28	902	242	32	973
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)	177	30	980	263	35	1058
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	2240	1112			1243	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2240	1112			1243	
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	88			94	
cM capacity (veh/h)	44	256			567	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	207	1243	1093
Volume Left	177	0	35
Volume Right	30	263	0
cSH	50	1700	567
Volume to Capacity	4.12	0.73	0.06
Queue Length 95th (m)	Err	0.0	1.5
Control Delay (s)	Err	0.0	2.2
Lane LOS	F		A
Approach Delay (s)	Err	0.0	2.2
Approach LOS	F		

Intersection Summary			
Average Delay	814.9		
Intersection Capacity Utilization	107.0%	ICU Level of Service	G
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	71	51	44	875	914	67
Future Volume (Veh/h)	71	51	44	875	914	67
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)	77	55	48	951	993	73
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	2040	993	1066			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2040	993	1066			
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	82	93			
cM capacity (veh/h)	58	300	661			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	132	48	951	993	73
Volume Left	77	48	0	0	0
Volume Right	55	0	0	0	73
cSH	88	661	1700	1700	1700
Volume to Capacity	1.50	0.07	0.56	0.58	0.04
Queue Length 95th (m)	78.4	1.8	0.0	0.0	0.0
Control Delay (s)	360.2	10.9	0.0	0.0	0.0
Lane LOS	F	B			
Approach Delay (s)	360.2	0.5		0.0	
Approach LOS	F				

Intersection Summary			
Average Delay	21.9		
Intersection Capacity Utilization	71.6%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	168	54	56	889	884	245
Future Volume (Veh/h)	168	54	56	889	884	245
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)	183	59	61	966	961	266
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	2182	1094	1227			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2182	1094	1227			
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	78	89			
cM capacity (veh/h)	46	263	575			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	242	1027	1227
Volume Left	183	61	0
Volume Right	59	0	266
cSH	57	575	1700
Volume to Capacity	4.22	0.11	0.72
Queue Length 95th (m)	Err	2.7	0.0
Control Delay (s)	Err	3.5	0.0
Lane LOS	F	A	
Approach Delay (s)	Err	3.5	0.0
Approach LOS	F		

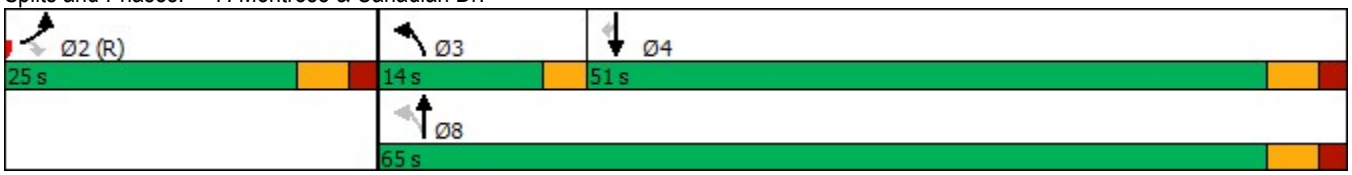
Intersection Summary			
Average Delay	970.9		
Intersection Capacity Utilization	126.0%	ICU Level of Service	H
Analysis Period (min)	15		

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	190	341	251	862	788	202
Future Volume (vph)	190	341	251	862	788	202
Lane Group Flow (vph)	207	371	273	937	857	220
Turn Type	Prot	Perm	pm+pt	NA	NA	Perm
Protected Phases	2		3	8	4	
Permitted Phases		2	8			4
Minimum Split (s)	23.5	23.5	8.0	20.0	23.5	23.5
Total Split (s)	25.0	25.0	14.0	65.0	51.0	51.0
Total Split (%)	27.8%	27.8%	15.6%	72.2%	56.7%	56.7%
Yellow Time (s)	3.5	3.5	3.0	3.5	3.5	3.5
All-Red Time (s)	2.0	2.0	0.0	2.0	2.0	2.0
Lost Time Adjust (s)	3.0	3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	8.5	8.5	6.0	8.5	8.5	8.5
Lead/Lag			Lead		Lag	Lag
Lead-Lag Optimize?			Yes		Yes	Yes
v/c Ratio	0.71	0.74	1.23	0.89	1.06	0.28
Control Delay	49.2	18.5	159.1	26.5	73.1	6.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	49.2	18.5	159.1	26.5	73.1	6.1
Queue Length 50th (m)	33.9	11.9	~44.0	122.5	~164.0	6.7
Queue Length 95th (m)	#63.3	#46.5	#91.6	#218.4	#232.7	19.1
Internal Link Dist (m)	249.7			540.4	157.6	
Turn Bay Length (m)	50.0		45.0			50.0
Base Capacity (vph)	293	503	222	1057	811	787
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	0.71	0.74	1.23	0.89	1.06	0.28

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2:EBL and 6:, Start of Green
Natural Cycle: 90
Control Type: Pretimed
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 7: Montrose & Canadian Dr.



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	190	341	251	862	788	202
Future Volume (vph)	190	341	251	862	788	202
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	8.5	8.5	6.0	8.5	8.5	8.5
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)	1601	1446	1616	1685	1718	1504
Flt Permitted	0.95	1.00	0.08	1.00	1.00	1.00
Satd. Flow (perm)	1601	1446	140	1685	1718	1504
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	207	371	273	937	857	220
RTOR Reduction (vph)	0	238	0	0	0	78
Lane Group Flow (vph)	207	133	273	937	857	142
Heavy Vehicles (%)	5%	4%	4%	5%	3%	0%
Turn Type	Prot	Perm	pm+pt	NA	NA	Perm
Protected Phases	2		3	8	4	
Permitted Phases		2	8			4
Actuated Green, G (s)	19.5	19.5	59.5	59.5	45.5	45.5
Effective Green, g (s)	16.5	16.5	56.5	56.5	42.5	42.5
Actuated g/C Ratio	0.18	0.18	0.63	0.63	0.47	0.47
Clearance Time (s)	5.5	5.5	3.0	5.5	5.5	5.5
Lane Grp Cap (vph)	293	265	219	1057	811	710
v/s Ratio Prot	c0.13		c0.11	0.56	0.50	
v/s Ratio Perm		0.09	c0.67			0.09
v/c Ratio	0.71	0.50	1.25	0.89	1.06	0.20
Uniform Delay, d1	34.5	33.0	26.7	14.1	23.8	13.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	13.4	6.6	143.2	11.0	47.7	0.6
Delay (s)	47.9	39.6	169.9	25.0	71.4	14.5
Level of Service	D	D	F	C	E	B
Approach Delay (s)	42.6			57.7	59.8	
Approach LOS	D			E	E	

Intersection Summary			
HCM 2000 Control Delay	55.4	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.17		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	23.0
Intersection Capacity Utilization	90.7%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	195	56	61	1001	919	398
Future Volume (Veh/h)	195	56	61	1001	919	398
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)	212	61	66	1088	999	433
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)				182	222	
pX, platoon unblocked	0.53	0.94	0.94			
vC, conflicting volume	2436	716	1432			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2837	567	1330			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	0	86	87			
cM capacity (veh/h)	7	443	493			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	212	61	66	1088	666	766
Volume Left	212	0	66	0	0	0
Volume Right	0	61	0	0	0	433
cSH	7	443	493	1700	1700	1700
Volume to Capacity	32.49	0.14	0.13	0.64	0.39	0.45
Queue Length 95th (m)	Err	3.6	3.5	0.0	0.0	0.0
Control Delay (s)	Err	14.4	13.4	0.0	0.0	0.0
Lane LOS	F	B	B			
Approach Delay (s)	7768.0		0.8		0.0	
Approach LOS	F					

Intersection Summary			
Average Delay	742.1		
Intersection Capacity Utilization	82.3%	ICU Level of Service	E
Analysis Period (min)	15		

Lane Group	EBL	WBL	WBT	NBT	SBT
Lane Configurations					
Traffic Volume (vph)	59	800	0	1189	513
Future Volume (vph)	59	800	0	1189	513
Lane Group Flow (vph)	64	870	2	1292	558
Turn Type	Prot	Prot		NA	NA
Protected Phases	7	3		2	6
Permitted Phases					
Detector Phase	7	3		2	6
Switch Phase					
Minimum Initial (s)	8.0	8.0		8.0	8.0
Minimum Split (s)	13.2	13.2		13.5	13.5
Total Split (s)	27.0	27.0		33.0	33.0
Total Split (%)	45.0%	45.0%		55.0%	55.0%
Yellow Time (s)	3.2	3.2		3.5	3.5
All-Red Time (s)	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	3.0	3.0		3.0	3.0
Total Lost Time (s)	8.2	8.2		8.5	8.5
Lead/Lag					
Lead-Lag Optimize?					
Recall Mode	None	None		None	None
v/c Ratio	0.17	0.95	0.01	0.96	0.44
Control Delay	16.9	40.4	0.0	36.2	13.8
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	16.9	40.4	0.0	36.2	13.8
Queue Length 50th (m)	5.0	46.0	0.0	70.5	22.4
Queue Length 95th (m)	12.2	#76.2	0.0	#113.9	34.0
Internal Link Dist (m)			271.6	198.2	233.7
Turn Bay Length (m)					
Base Capacity (vph)	556	1047	140	1394	1306
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	0.12	0.83	0.01	0.93	0.43

Intersection Summary
Cycle Length: 60
Actuated Cycle Length: 57.2
Natural Cycle: 75
Control Type: Actuated-Uncoordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 9: Montrose & Niagara Square Dr

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	59	0	0	800	0	2	0	1189	0	0	513	0
Future Volume (vph)	59	0	0	800	0	2	0	1189	0	0	513	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	8.2			8.2	7.0			8.5			8.5	
Lane Util. Factor	1.00			0.97	1.00			0.95			0.95	
Frt	1.00			1.00	0.85			1.00			1.00	
Flt Protected	0.95			0.95	1.00			1.00			1.00	
Satd. Flow (prot)	1681			3166	0			3233			3029	
Flt Permitted	0.95			0.95	1.00			1.00			1.00	
Satd. Flow (perm)	1681			3166	0			3233			3029	
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)	64	0	0	870	0	2	0	1292	0	0	558	0
RTOR Reduction (vph)	0	0	0	0	2	0	0	0	0	0	0	0
Lane Group Flow (vph)	64	0	0	870	0	0	0	1292	0	0	558	0
Heavy Vehicles (%)	0%	0%	0%	3%	0%	50%	0%	4%	0%	0%	11%	0%
Turn Type	Prot			Prot				NA			NA	
Protected Phases	7			3				2			6	
Permitted Phases												
Actuated Green, G (s)	19.6			19.6	0.0			26.8			26.8	
Effective Green, g (s)	16.6			16.6	0.0			23.8			23.8	
Actuated g/C Ratio	0.29			0.29	0.00			0.42			0.42	
Clearance Time (s)	5.2			5.2				5.5			5.5	
Vehicle Extension (s)	2.1			2.1				2.3			2.3	
Lane Grp Cap (vph)	488			920	0			1347			1262	
v/s Ratio Prot	0.04			c0.27				c0.40			0.18	
v/s Ratio Perm												
v/c Ratio	0.13			0.95	0.00			0.96			0.44	
Uniform Delay, d1	14.9			19.8	28.6			16.2			11.9	
Progression Factor	1.00			1.00	1.00			1.00			1.00	
Incremental Delay, d2	0.1			17.7	0.0			15.6			0.1	
Delay (s)	15.0			37.5	28.6			31.7			12.0	
Level of Service	B			D	C			C			B	
Approach Delay (s)		15.0			37.5			31.7			12.0	
Approach LOS		B			D			C			B	

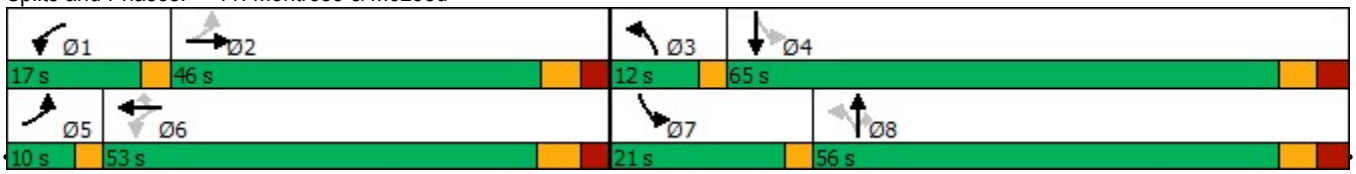
Intersection Summary			
HCM 2000 Control Delay	29.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	57.1	Sum of lost time (s)	16.7
Intersection Capacity Utilization	Err%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	104	1063	222	1034	366	103	380	723	454	384
Future Volume (vph)	104	1063	222	1034	366	103	380	723	454	384
Lane Group Flow (vph)	113	1201	241	1124	398	112	413	786	493	527
Turn Type	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA
Protected Phases	5	2	1	6		3	8		7	4
Permitted Phases	2		6		6	8		8	4	
Detector Phase	5	2	1	6	6	3	8	8	7	4
Switch Phase										
Minimum Initial (s)	6.0	10.0	6.0	10.0	10.0	6.0	8.0	8.0	6.0	8.0
Minimum Split (s)	10.0	39.4	10.0	39.7	39.7	10.0	45.6	45.6	10.0	45.6
Total Split (s)	10.0	46.0	17.0	53.0	53.0	12.0	56.0	56.0	21.0	65.0
Total Split (%)	7.1%	32.9%	12.1%	37.9%	37.9%	8.6%	40.0%	40.0%	15.0%	46.4%
Yellow Time (s)	3.0	4.1	3.0	4.4	4.4	3.0	4.1	4.1	3.0	4.1
All-Red Time (s)	0.0	3.3	0.0	3.3	3.3	0.0	3.5	3.5	0.0	3.5
Lost Time Adjust (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	6.0	10.4	6.0	10.7	10.7	6.0	10.6	10.6	6.0	10.6
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	None	None	None
v/c Ratio	1.20	1.02	1.40	1.13	0.63	0.32	0.76	1.28	1.31	0.43
Control Delay	190.1	82.5	240.0	115.5	17.7	22.8	52.6	167.9	184.9	30.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	190.1	82.5	240.0	115.5	17.7	22.8	52.6	167.9	184.9	30.7
Queue Length 50th (m)	~25.4	~128.7	~74.2	~189.2	28.8	16.0	102.4	~236.4	~138.2	53.0
Queue Length 95th (m)	#61.0	#158.6	#127.8	#231.6	64.9	26.8	142.7	#313.3	#228.0	68.8
Internal Link Dist (m)		257.8		244.2			112.3			232.4
Turn Bay Length (m)	55.0		140.0			90.0			140.0	
Base Capacity (vph)	94	1176	172	995	630	360	546	614	375	1226
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.20	1.02	1.40	1.13	0.63	0.31	0.76	1.28	1.31	0.43

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Natural Cycle: 140
Control Type: Actuated-Uncoordinated
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 11: Montrose & McLoed



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	104	1063	42	222	1034	366	103	380	723	454	384	101
Future Volume (vph)	104	1063	42	222	1034	366	103	380	723	454	384	101
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	10.4		6.0	10.7	10.7	6.0	10.6	10.6	6.0	10.6	
Lane Util. Factor	1.00	0.91		1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1514	4614		1542	3296	1460	1681	1685	1475	1664	3084	
Flt Permitted	0.11	1.00		0.10	1.00	1.00	0.46	1.00	1.00	0.28	1.00	
Satd. Flow (perm)	179	4614		157	3296	1460	808	1685	1475	493	3084	
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)	113	1155	46	241	1124	398	112	413	786	493	417	110
RTOR Reduction (vph)	0	3	0	0	0	190	0	0	136	0	17	0
Lane Group Flow (vph)	113	1198	0	241	1124	208	112	413	650	493	510	0
Confl. Peds. (#/hr)			7	7								
Heavy Vehicles (%)	11%	4%	4%	9%	2%	3%	0%	5%	2%	1%	6%	4%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2			6		6	8		8	4		
Actuated Green, G (s)	45.6	38.6		55.3	45.3	45.3	56.9	48.4	48.4	69.4	57.9	
Effective Green, g (s)	39.6	35.6		52.3	42.3	42.3	50.9	45.4	45.4	66.4	54.9	
Actuated g/C Ratio	0.28	0.25		0.37	0.30	0.30	0.36	0.32	0.32	0.47	0.39	
Clearance Time (s)	3.0	7.4		3.0	7.7	7.7	3.0	7.6	7.6	3.0	7.6	
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	88	1173		167	995	441	328	546	478	359	1209	
v/s Ratio Prot	0.04	0.26		c0.11	0.34		0.01	0.25		c0.15	0.17	
v/s Ratio Perm	0.32			c0.42		0.14	0.11		0.44	c0.50		
v/c Ratio	1.28	1.02		1.44	1.13	0.47	0.34	0.76	1.36	1.37	0.42	
Uniform Delay, d1	50.1	52.2		36.9	48.9	39.8	30.4	42.3	47.3	33.7	31.0	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	190.0	31.8		229.9	71.2	0.6	0.5	5.6	175.2	184.7	0.2	
Delay (s)	240.1	84.0		266.8	120.1	40.3	30.9	48.0	222.5	218.5	31.2	
Level of Service	F	F		F	F	D	C	D	F	F	C	
Approach Delay (s)		97.4			122.1			151.2			121.7	
Approach LOS		F			F			F			F	

Intersection Summary			
HCM 2000 Control Delay	123.1	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.49		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	33.3
Intersection Capacity Utilization	122.4%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	1663	13	41	1613	6	29
Future Volume (Veh/h)	1663	13	41	1613	6	29
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)	1808	14	45	1753	7	32
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)	352					
pX, platoon unblocked						
vC, conflicting volume			1822		2782	911
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1822		2782	911
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			87		48	89
cM capacity (veh/h)			341		14	281

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	1205	617	629	1169	39
Volume Left	0	0	45	0	7
Volume Right	0	14	0	0	32
cSH	1700	1700	341	1700	62
Volume to Capacity	0.71	0.36	0.13	0.69	0.63
Queue Length 95th (m)	0.0	0.0	3.4	0.0	20.2
Control Delay (s)	0.0	0.0	4.4	0.0	133.5
Lane LOS			A		F
Approach Delay (s)	0.0		1.6		133.5
Approach LOS					F

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	95.4%	ICU Level of Service	F
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	1346	605	0	494	1047
Future Volume (Veh/h)	0	1346	605	0	494	1047
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	1463	658	0	537	1138
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	658				1390	329
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	658				1390	329
tC, single (s)	4.1				6.9	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				0	0
cM capacity (veh/h)	939				131	667

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	732	732	329	329	537	1138
Volume Left	0	0	0	0	537	0
Volume Right	0	0	0	0	0	1138
cSH	1700	1700	1700	1700	131	667
Volume to Capacity	0.43	0.43	0.19	0.19	4.10	1.71
Queue Length 95th (m)	0.0	0.0	0.0	0.0	Err	497.3
Control Delay (s)	0.0	0.0	0.0	0.0	Err	341.0
Lane LOS					F	F
Approach Delay (s)	0.0		0.0		3437.4	
Approach LOS					F	

Intersection Summary			
Average Delay	1516.7		
Intersection Capacity Utilization	100.2%	ICU Level of Service	G
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	1066	0	0	538	126	108
Future Volume (Veh/h)	1066	0	0	538	126	108
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)	1159	0	0	585	137	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			1159		1452	580
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1159		1452	580
tC, single (s)			4.1		7.2	7.0
tC, 2 stage (s)						
tF (s)			2.2		3.7	3.4
p0 queue free %			100		0	74
cM capacity (veh/h)			610		105	446

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	580	580	292	292	137	117
Volume Left	0	0	0	0	137	0
Volume Right	0	0	0	0	0	117
cSH	1700	1700	1700	1700	105	446
Volume to Capacity	0.34	0.34	0.17	0.17	1.31	0.26
Queue Length 95th (m)	0.0	0.0	0.0	0.0	72.0	7.9
Control Delay (s)	0.0	0.0	0.0	0.0	267.4	15.9
Lane LOS					F	C
Approach Delay (s)	0.0		0.0		151.5	
Approach LOS					F	

Intersection Summary			
Average Delay	19.3		
Intersection Capacity Utilization	100.2%	ICU Level of Service	G
Analysis Period (min)	15		

APPENDIX F

SIGNAL WARRANTS ANALYSIS

PARSONS

Warrant Analysis - Justification 7, Projected Volumes

Horizon Year:	2026
Jurisdiction:	Niagara City/Region
Major Street:	Montrose Rd
Mionor Street:	Hospital North Access
Number of Approach lanes:	2
Tee Intersection:	Yes
Flow Conditions:	Restricted
Both Intersceting Roads Exist	No
Volume Expansion	150%

Justification 7 Results

Warrant	100% Satisfied	80% Satisfied	Justification 7 Satisfied
Warrant 1	NO	NO	NO
Warrant 2	NO	NO	

Time Period	Major Street						Minor Street						
	Montrose Rd						Hospital North Access						
	Northbound			Southbound			Eastbound			Westbound			Peds Crossing Main Road
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
AM Peak Hour	155	474	0	0	358	9	3	0	31	0	0	0	0
PM Peak Hour	61	498	0	0	733	3	8	0	85	0	0	0	0
Average Houly Volume (AHV)	54	243	0	0	273	3	3	0	29	0	0	0	0

Total Volumes

Warrant	AHV
1A -All Apchs	605
1B - Minor	32
2A - Major	573
2B - Cross	3

Major Approach Heavier Left Turn Volumes - Warrant 2B

Heavier Left Turn Volume (LTV)	54
Opposing Volume (OV)	273
LTV >120	No
Sum of LTV & OV > 720	No
Both Conditions Met	No
Add 50% of LTV to Crossing Volumes	0

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	All Approaches	Requirement	480	720	600	900		
		Volume Expansion	720	1080	900	1350	605	45%

1B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Minor Street	Requirement	180	255	180	255		
		Volume Expansion	270	383	270	383	32	8%

Warrant 2 - Delay to Cross Traffic

2A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Major Street	Requirement	480	720	600	900		
		Volume Expansion	720	1080	900	1350	573	42%

2B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Traffic Crossing Major Street	Requirement	50	75	120	170		
		Volume Expansion	75	113	180	255	3	1%

Warrant Analysis - Justification 7, Projected Volumes

Horizon Year:	2041
Jurisdiction:	Niagara City/Region
Major Street:	Montrose Rd
Mionor Street:	Hospital North Access
Number of Approach lanes:	2
Tee Intersection:	Yes
Flow Conditions:	Restricted
Both Intersceting Roads Exist	No
Volume Expansion	150%

Justification 7 Results

Warrant	100% Satisfied	80% Satisfied	Justification 7 Satisfied
Warrant 1	NO	NO	NO
Warrant 2	NO	NO	

Time Period	Major Street						Minor Street						
	Montrose Rd						Hospital North Access						
	Northbound			Southbound			Eastbound			Westbound			Peds Crossing Main Road
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
AM Peak Hour	155	610	0	0	481	9	3	0	31	0	0	0	0
PM Peak Hour	61	641	0	0	913	3	8	0	85	0	0	0	0
Average Houly Volume (AHV)	54	313	0	0	349	3	3	0	29	0	0	0	0

Total Volumes

Warrant	AHV
1A -All Apchs	751
1B - Minor	32
2A - Major	719
2B - Cross	3

Major Approach Heavier Left Turn Volumes - Warrant 2B

Heavier Left Turn Volume (LTV)	54
Opposing Volume (OV)	349
LTV >120	No
Sum of LTV & OV > 720	No
Both Conditions Met	No
Add 50% of LTV to Crossing Volumes	0

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	All Approaches	Requirement	480	720	600	900		
		Volume Expansion	720	1080	900	1350	751	56%

1B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Minor Street	Requirement	180	255	180	255		
		Volume Expansion	270	383	270	383	32	8%

Warrant 2 - Delay to Cross Traffic

2A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Major Street	Requirement	480	720	600	900		
		Volume Expansion	720	1080	900	1350	719	53%

2B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Traffic Crossing Major Street	Requirement	50	75	120	170		
		Volume Expansion	75	113	180	255	3	1%

Warrant Analysis - Justification 7, Projected Volumes

Horizon Year:	2026
Jurisdiction:	Niagara City/Region
Major Street:	Montrose Rd
Mionor Street:	Street B
Number of Approach lanes:	2
Tee Intersection:	Yes
Flow Conditions:	Restricted
Both Intersceting Roads Exist	No
Volume Expansion	150%

Justification 7 Results

Warrant	100% Satisfied	80% Satisfied	Justification 7 Satisfied
Warrant 1	NO	NO	NO
Warrant 2	NO	NO	

Time Period	Major Street						Minor Street						
	Montrose Rd						Street B						
	Northbound			Southbound			Eastbound			Westbound			Peds Crossing Main Road
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
AM Peak Hour	18	427	0	0	349	10	17	0	21	0	0	0	0
PM Peak Hour	19	486	0	0	690	21	14	0	20	0	0	0	0
Average Houly Volume (AHV)	9	228	0	0	260	8	8	0	10	0	0	0	0

Total Volumes

Warrant	AHV
1A -All Apchs	523
1B - Minor	18
2A - Major	505
2B - Cross	8

Major Approach Heavier Left Turn Volumes - Warrant 2B

Heavier Left Turn Volume (LTV)	9
Opposing Volume (OV)	260
LTV >120	No
Sum of LTV & OV > 720	No
Both Conditions Met	No
Add 50% of LTV to Crossing Volumes	0

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	All Approaches	Requirement	480	720	600	900		
		Volume Expansion	720	1080	900	1350	523	39%

1B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Minor Street	Requirement	180	255	180	255		
		Volume Expansion	270	383	270	383	18	5%

Warrant 2 - Delay to Cross Traffic

2A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Major Street	Requirement	480	720	600	900		
		Volume Expansion	720	1080	900	1350	505	37%

2B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Traffic Crossing Major Street	Requirement	50	75	120	170		
		Volume Expansion	75	113	180	255	8	3%

Warrant Analysis - Justification 7, Projected Volumes

Horizon Year:	2041
Jurisdiction:	Niagara City/Region
Major Street:	Montrose Rd
Mionor Street:	Street B
Number of Approach lanes:	2
Tee Intersection:	Yes
Flow Conditions:	Restricted
Both Intersceting Roads Exist	No
Volume Expansion	150%

Justification 7 Results

Warrant	100% Satisfied	80% Satisfied	Justification 7 Satisfied
Warrant 1	NO	NO	NO
Warrant 2	NO	NO	

Time Period	Major Street						Minor Street						
	Montrose Rd						Street B						
	Northbound			Southbound			Eastbound			Westbound			Peds Crossing Main Road
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
AM Peak Hour	35	513	0	0	452	20	34	0	41	0	0	0	0
PM Peak Hour	38	609	0	0	823	41	28	0	39	0	0	0	0
Average Houly Volume (AHV)	18	281	0	0	319	15	16	0	20	0	0	0	0

Total Volumes

Warrant	AHV
1A -All Apchs	669
1B - Minor	36
2A - Major	633
2B - Cross	16

Major Approach Heavier Left Turn Volumes - Warrant 2B

Heavier Left Turn Volume (LTV)	18
Opposing Volume (OV)	319
LTV >120	No
Sum of LTV & OV > 720	No
Both Conditions Met	No
Add 50% of LTV to Crossing Volumes	0

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	All Approaches	Requirement	480	720	600	900		
		Volume Expansion	720	1080	900	1350	669	50%

1B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Minor Street	Requirement	180	255	180	255		
		Volume Expansion	270	383	270	383	36	9%

Warrant 2 - Delay to Cross Traffic

2A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Major Street	Requirement	480	720	600	900		
		Volume Expansion	720	1080	900	1350	633	47%

2B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Traffic Crossing Major Street	Requirement	50	75	120	170		
		Volume Expansion	75	113	180	255	16	6%

Warrant Analysis - Justification 7, Projected Volumes

Horizon Year:	2026
Jurisdiction:	Niagara City/Region
Major Street:	Montrose Rd
Mionor Street:	Grassy Brook Rd
Number of Approach lanes:	2
Tee Intersection:	Yes
Flow Conditions:	Restricted
Both Intersceting Roads Exist	Yes
Volume Expansion	120%

Justification 7 Results

Warrant	100% Satisfied	80% Satisfied	Justification 7 Satisfied
Warrant 1	NO	NO	NO
Warrant 2	NO	NO	

Time Period	Major Street						Minor Street						
	Montrose Rd						Grassy Brook Rd						
	Northbound			Southbound			Eastbound			Westbound			Peds Crossing Main Road
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
AM Peak Hour	29	401	0	0	365	170	193	0	9	0	0	0	0
PM Peak Hour	13	507	0	0	699	211	219	0	19	0	0	0	0
Average Houly Volume (AHV)	11	227	0	0	266	95	103	0	7	0	0	0	0

Total Volumes

Warrant	AHV
1A -All Apchs	709
1B - Minor	110
2A - Major	599
2B - Cross	103

Major Approach Heavier Left Turn Volumes - Warrant 2B

Heavier Left Turn Volume (LTV)	11
Opposing Volume (OV)	266
LTV >120	No
Sum of LTV & OV > 720	No
Both Conditions Met	No
Add 50% of LTV to Crossing Volumes	0

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	All Approaches	Requirement	480	720	600	900		
		Volume Expansion	576	864	720	1080	709	66%

1B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Minor Street	Requirement	180	255	180	255		
		Volume Expansion	216	306	216	306	110	36%

Warrant 2 - Delay to Cross Traffic

2A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Major Street	Requirement	480	720	600	900		
		Volume Expansion	576	864	720	1080	599	55%

2B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Traffic Crossing Major Street	Requirement	50	75	120	170		
		Volume Expansion	60	90	144	204	103	50%

Warrant Analysis - Justification 7, Projected Volumes

Horizon Year:	2041
Jurisdiction:	Niagara City/Region
Major Street:	Montrose Rd
Mionor Street:	Grassy Brook Rd
Number of Approach lanes:	2
Tee Intersection:	Yes
Flow Conditions:	Restricted
Both Intersceting Roads Exist	Yes
Volume Expansion	120%

Justification 7 Results

Warrant	100% Satisfied	80% Satisfied	Justification 7 Satisfied
Warrant 1	NO	NO	NO
Warrant 2	NO	NO	

Time Period	Major Street						Minor Street						
	Montrose Rd						Grassy Brook Rd						
	Northbound			Southbound			Eastbound			Westbound			Peds Crossing Main Road
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
AM Peak Hour	45	500	0	0	471	337	386	0	18	0	0	0	0
PM Peak Hour	23	641	0	0	859	418	425	0	34	0	0	0	0
Average Houly Volume (AHV)	17	285	0	0	333	189	203	0	13	0	0	0	0

Total Volumes

Warrant	AHV
1A -All Apchs	1040
1B - Minor	216
2A - Major	824
2B - Cross	203

Major Approach Heavier Left Turn Volumes - Warrant 2B

Heavier Left Turn Volume (LTV)	17
Opposing Volume (OV)	333
LTV >120	No
Sum of LTV & OV > 720	No
Both Conditions Met	No
Add 50% of LTV to Crossing Volumes	0

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	All Approaches	Requirement	480	720	600	900		
		Volume Expansion	576	864	720	1080	1040	96%

1B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Minor Street	Requirement	180	255	180	255		
		Volume Expansion	216	306	216	306	216	71%

Warrant 2 - Delay to Cross Traffic

2A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Major Street	Requirement	480	720	600	900		
		Volume Expansion	576	864	720	1080	824	76%

2B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Traffic Crossing Major Street	Requirement	50	75	120	170		
		Volume Expansion	60	90	144	204	203	100%

Warrant Analysis - Justification 7, Projected Volumes

Horizon Year:	2026
Jurisdiction:	Niagara City/Region
Major Street:	Montrose Rd
Mionor Street:	Oakwood Dr
Number of Approach lanes:	2
Tee Intersection:	Yes
Flow Conditions:	Restricted
Both Intersceting Roads Exist	Yes
Volume Expansion	120%

Justification 7 Results

Warrant	100% Satisfied	80% Satisfied	Justification 7 Satisfied
Warrant 1	NO	NO	NO
Warrant 2	NO	NO	

Time Period	Major Street						Minor Street						
	Montrose Rd						Oakwood Dr						
	Northbound			Southbound			Eastbound			Westbound			Peds Crossing Main Road
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
AM Peak Hour	0	445	139	16	447	0	0	0	0	48	0	5	0
PM Peak Hour	0	624	160	28	685	0	0	0	0	142	0	25	0
Average Houly Volume (AHV)	0	267	75	11	283	0	0	0	0	48	0	8	0

Total Volumes

Warrant	AHV
1A -All Apchs	692
1B - Minor	56
2A - Major	636
2B - Cross	48

Major Approach Heavier Left Turn Volumes - Warrant 2B

Heavier Left Turn Volume (LTV)	11
Opposing Volume (OV)	267
LTV >120	No
Sum of LTV & OV > 720	No
Both Conditions Met	No
Add 50% of LTV to Crossing Volumes	0

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	All Approaches	Requirement	480	720	600	900		
		Volume Expansion	576	864	720	1080	692	64%

1B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Minor Street	Requirement	180	255	180	255		
		Volume Expansion	216	306	216	306	56	18%

Warrant 2 - Delay to Cross Traffic

2A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Major Street	Requirement	480	720	600	900		
		Volume Expansion	576	864	720	1080	636	59%

2B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Traffic Crossing Major Street	Requirement	50	75	120	170		
		Volume Expansion	60	90	144	204	48	24%

Warrant Analysis - Justification 7, Projected Volumes

Horizon Year:	2041
Jurisdiction:	Niagara City/Region
Major Street:	Montrose Rd
Mionor Street:	Oakwood Dr
Number of Approach lanes:	2
Tee Intersection:	Yes
Flow Conditions:	Restricted
Both Intersceting Roads Exist	Yes
Volume Expansion	120%

Justification 7 Results

Warrant	100% Satisfied	80% Satisfied	Justification 7 Satisfied
Warrant 1	NO	NO	NO
Warrant 2	NO	NO	

Time Period	Major Street						Minor Street						
	Montrose Rd						Oakwood Dr						
	Northbound			Southbound			Eastbound			Westbound			Peds Crossing Main Road
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
AM Peak Hour	0	670	205	18	657	0	0	0	0	55	0	6	0
PM Peak Hour	0	902	242	32	973	0	0	0	0	163	0	28	0
Average Houly Volume (AHV)	0	393	112	13	408	0	0	0	0	55	0	9	0

Total Volumes

Warrant	AHV
1A -All Apchs	990
1B - Minor	64
2A - Major	926
2B - Cross	55

Major Approach Heavier Left Turn Volumes - Warrant 2B

Heavier Left Turn Volume (LTV)	13
Opposing Volume (OV)	393
LTV >120	No
Sum of LTV & OV > 720	No
Both Conditions Met	No
Add 50% of LTV to Crossing Volumes	0

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	All Approaches	Requirement	480	720	600	900		
		Volume Expansion	576	864	720	1080	990	92%

1B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Minor Street	Requirement	180	255	180	255		
		Volume Expansion	216	306	216	306	64	21%

Warrant 2 - Delay to Cross Traffic

2A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Major Street	Requirement	480	720	600	900		
		Volume Expansion	576	864	720	1080	926	86%

2B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Traffic Crossing Major Street	Requirement	50	75	120	170		
		Volume Expansion	60	90	144	204	55	27%

Warrant Analysis - Justification 7, Projected Volumes

Horizon Year:	2041
Jurisdiction:	Niagara City/Region
Major Street:	Montrose Rd
Mionor Street:	Chippawa Creek Rd
Number of Approach lanes:	2
Tee Intersection:	Yes
Flow Conditions:	Restricted
Both Intersceting Roads Exist	Yes
Volume Expansion	120%

Justification 7 Results

Warrant	100% Satisfied	80% Satisfied	Justification 7 Satisfied
Warrant 1	NO	NO	NO
Warrant 2	NO	NO	

Time Period	Major Street						Minor Street						
	Montrose Rd						Chippawa Creek Rd						
	Northbound			Southbound			Eastbound			Westbound			Peds Crossing Main Road
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
AM Peak Hour	39	616	0	0	641	83	77	0	35	0	0	0	0
PM Peak Hour	44	875	0	0	914	67	71	0	51	0	0	0	0
Average Houly Volume (AHV)	21	373	0	0	389	38	37	0	22	0	0	0	0

Total Volumes

Warrant	AHV
1A -All Apchs	880
1B - Minor	59
2A - Major	821
2B - Cross	37

Major Approach Heavier Left Turn Volumes - Warrant 2B

Heavier Left Turn Volume (LTV)	21
Opposing Volume (OV)	389
LTV >120	No
Sum of LTV & OV > 720	No
Both Conditions Met	No
Add 50% of LTV to Crossing Volumes	0

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	All Approaches	Requirement	480	720	600	900		
		Volume Expansion	576	864	720	1080	880	81%

1B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Minor Street	Requirement	180	255	180	255		
		Volume Expansion	216	306	216	306	59	19%

Warrant 2 - Delay to Cross Traffic

2A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Major Street	Requirement	480	720	600	900		
		Volume Expansion	576	864	720	1080	821	76%

2B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Traffic Crossing Major Street	Requirement	50	75	120	170		
		Volume Expansion	60	90	144	204	37	18%

Warrant Analysis - Justification 7, Projected Volumes

Horizon Year:	2026
Jurisdiction:	Niagara City/Region
Major Street:	Montrose Rd
Mionor Street:	Chippawa Creek Rd
Number of Approach lanes:	2
Tee Intersection:	Yes
Flow Conditions:	Restricted
Both Intersceting Roads Exist	Yes
Volume Expansion	120%

Justification 7 Results

Warrant	100% Satisfied	80% Satisfied	Justification 7 Satisfied
Warrant 1	NO	NO	NO
Warrant 2	NO	NO	

Time Period	Major Street						Minor Street						
	Montrose Rd						Chippawa Creek Rd						
	Northbound			Southbound			Eastbound			Westbound			Peds Crossing Main Road
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
AM Peak Hour	34	398	0	0	433	74	68	0	30	0	0	0	0
PM Peak Hour	38	600	0	0	634	61	65	0	44	0	0	0	0
Average Houly Volume (AHV)	18	250	0	0	267	34	33	0	19	0	0	0	0

Total Volumes

Warrant	AHV
1A -All Apchs	621
1B - Minor	52
2A - Major	569
2B - Cross	33

Major Approach Heavier Left Turn Volumes - Warrant 2B

Heavier Left Turn Volume (LTV)	18
Opposing Volume (OV)	267
LTV >120	No
Sum of LTV & OV > 720	No
Both Conditions Met	No
Add 50% of LTV to Crossing Volumes	0

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	All Approaches	Requirement	480	720	600	900		
		Volume Expansion	576	864	720	1080	621	58%

1B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Minor Street	Requirement	180	255	180	255		
		Volume Expansion	216	306	216	306	52	17%

Warrant 2 - Delay to Cross Traffic

2A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Major Street	Requirement	480	720	600	900		
		Volume Expansion	576	864	720	1080	569	53%

2B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Traffic Crossing Major Street	Requirement	50	75	120	170		
		Volume Expansion	60	90	144	204	33	16%

Warrant Analysis - Justification 7, Projected Volumes

Horizon Year:	2026
Jurisdiction:	Niagara City/Region
Major Street:	Montrose Rd
Mionor Street:	Brown Rd
Number of Approach lanes:	2
Tee Intersection:	Yes
Flow Conditions:	Restricted
Both Intersceting Roads Exist	Yes
Volume Expansion	120%

Justification 7 Results

Warrant	100% Satisfied	80% Satisfied	Justification 7 Satisfied
Warrant 1	NO	NO	NO
Warrant 2	NO	NO	

Time Period	Major Street						Minor Street						
	Montrose Rd						Brown Rd						
	Northbound			Southbound			Eastbound			Westbound			Peds Crossing Main Road
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
AM Peak Hour	34	433	0	0	460	78	178	0	48	0	0	0	0
PM Peak Hour	54	610	0	0	605	223	155	0	53	0	0	0	0
Average Houly Volume (AHV)	22	261	0	0	266	75	83	0	25	0	0	0	0

Total Volumes

Warrant	AHV
1A -All Apchs	732
1B - Minor	108
2A - Major	624
2B - Cross	83

Major Approach Heavier Left Turn Volumes - Warrant 2B

Heavier Left Turn Volume (LTV)	22
Opposing Volume (OV)	266
LTV >120	No
Sum of LTV & OV > 720	No
Both Conditions Met	No
Add 50% of LTV to Crossing Volumes	0

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	All Approaches	Requirement	480	720	600	900		
		Volume Expansion	576	864	720	1080	732	68%

1B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Minor Street	Requirement	180	255	180	255		
		Volume Expansion	216	306	216	306	108	35%

Warrant 2 - Delay to Cross Traffic

2A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Major Street	Requirement	480	720	600	900		
		Volume Expansion	576	864	720	1080	624	58%

2B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Traffic Crossing Major Street	Requirement	50	75	120	170		
		Volume Expansion	60	90	144	204	83	41%

Warrant Analysis - Justification 7, Projected Volumes

Horizon Year:	2041
Jurisdiction:	Niagara City/Region
Major Street:	Montrose Rd
Mionor Street:	Brown Rd
Number of Approach lanes:	2
Tee Intersection:	Yes
Flow Conditions:	Restricted
Both Intersceting Roads Exist	Yes
Volume Expansion	120%

Justification 7 Results

Warrant	100% Satisfied	80% Satisfied	Justification 7 Satisfied
Warrant 1	NO	NO	NO
Warrant 2	NO	NO	

Time Period	Major Street						Minor Street						
	Montrose Rd						Brown Rd						
	Northbound			Southbound			Eastbound			Westbound			Peds Crossing Main Road
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
AM Peak Hour	35	659	0	0	675	85	198	0	50	0	0	0	0
PM Peak Hour	56	889	0	0	884	245	168	0	54	0	0	0	0
Average Houly Volume (AHV)	23	387	0	0	390	83	92	0	26	0	0	0	0

Total Volumes

Warrant	AHV
1A -All Apchs	1001
1B - Minor	118
2A - Major	883
2B - Cross	92

Major Approach Heavier Left Turn Volumes - Warrant 2B

Heavier Left Turn Volume (LTV)	23
Opposing Volume (OV)	390
LTV >120	No
Sum of LTV & OV > 720	No
Both Conditions Met	No
Add 50% of LTV to Crossing Volumes	0

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	All Approaches	Requirement	480	720	600	900		
		Volume Expansion	576	864	720	1080	1001	93%

1B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Minor Street	Requirement	180	255	180	255		
		Volume Expansion	216	306	216	306	118	39%

Warrant 2 - Delay to Cross Traffic

2A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Major Street	Requirement	480	720	600	900		
		Volume Expansion	576	864	720	1080	883	82%

2B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Traffic Crossing Major Street	Requirement	50	75	120	170		
		Volume Expansion	60	90	144	204	92	45%

Warrant Analysis - Justification 7, Projected Volumes

Horizon Year:	2026
Jurisdiction:	Niagara City/Region
Major Street:	Biggar Rd
Mionor Street:	Hospital West Acces
Number of Approach lanes:	2
Tee Intersection:	Yes
Flow Conditions:	Restricted
Both Intersceting Roads Exist	No
Volume Expansion	150%

Justification 7 Results

Warrant	100% Satisfied	80% Satisfied	Justification 7 Satisfied
Warrant 1	NO	NO	NO
Warrant 2	NO	NO	

Time Period	Major Street						Minor Street						
	Biggar Rd						Hospital West Acces						
	Eastbound			Westbound			Northbound			Southbound			Peds Crossing Main Road
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
AM Peak Hour	19	433	0	0	367	48	0	0	0	0	0	15	0
PM Peak Hour	7	380	0	0	554	19	0	0	0	42	0	43	0
Average Houly Volume (AHV)	7	203	0	0	230	17	0	0	0	11	0	15	0

Total Volumes

Warrant	AHV
1A -All Apchs	483
1B - Minor	26
2A - Major	457
2B - Cross	11

Major Approach Heavier Left Turn Volumes - Warrant 2B

Heavier Left Turn Volume (LTV)	7
Opposing Volume (OV)	230
LTV >120	No
Sum of LTV & OV > 720	No
Both Conditions Met	No
Add 50% of LTV to Crossing Volumes	0

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	All Approaches	Requirement	480	720	600	900		
		Volume Expansion	720	1080	900	1350	483	36%

1B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Minor Street	Requirement	180	255	180	255		
		Volume Expansion	270	383	270	383	26	7%

Warrant 2 - Delay to Cross Traffic

2A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Major Street	Requirement	480	720	600	900		
		Volume Expansion	720	1080	900	1350	457	34%

2B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Traffic Crossing Major Street	Requirement	50	75	120	170		
		Volume Expansion	75	113	180	255	11	4%

Warrant Analysis - Justification 7, Projected Volumes

Horizon Year:	2041
Jurisdiction:	Niagara City/Region
Major Street:	Biggar Rd
Mionor Street:	Hospital West Acces
Number of Approach lanes:	2
Tee Intersection:	Yes
Flow Conditions:	Restricted
Both Intersceting Roads Exist	No
Volume Expansion	150%

Justification 7 Results

Warrant	100% Satisfied	80% Satisfied	Justification 7 Satisfied
Warrant 1	NO	NO	NO
Warrant 2	NO	NO	

Time Period	Major Street						Minor Street						
	Biggar Rd						Hospital West Acces						
	Eastbound			Westbound			Northbound			Southbound			Peds Crossing Main Road
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
AM Peak Hour	19	551	0	0	542	48	0	0	0	0	0	15	0
PM Peak Hour	7	572	0	0	715	19	0	0	0	43	0	42	0
Average Houly Volume (AHV)	7	281	0	0	314	17	0	0	0	11	0	14	0

Total Volumes

Warrant	AHV
1A -All Apchs	644
1B - Minor	25
2A - Major	619
2B - Cross	11

Major Approach Heavier Left Turn Volumes - Warrant 2B

Heavier Left Turn Volume (LTV)	7
Opposing Volume (OV)	314
LTV >120	No
Sum of LTV & OV > 720	No
Both Conditions Met	No
Add 50% of LTV to Crossing Volumes	0

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	All Approaches	Requirement	480	720	600	900		
		Volume Expansion	720	1080	900	1350	644	48%

1B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Minor Street	Requirement	180	255	180	255		
		Volume Expansion	270	383	270	383	25	7%

Warrant 2 - Delay to Cross Traffic

2A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Major Street	Requirement	480	720	600	900		
		Volume Expansion	720	1080	900	1350	619	46%

2B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Traffic Crossing Major Street	Requirement	50	75	120	170		
		Volume Expansion	75	113	180	255	11	4%

Warrant Analysis - Justification 7, Projected Volumes

Horizon Year:	2026
Jurisdiction:	Niagara City/Region
Major Street:	Lyons Creek Rd
Mionor Street:	Wilodell Rd
Number of Approach lanes:	2
Tee Intersection:	Yes
Flow Conditions:	Restricted
Both Intersceting Roads Exist	Yes
Volume Expansion	120%

Justification 7 Results

Warrant	100% Satisfied	80% Satisfied	Justification 7 Satisfied
Warrant 1	NO	NO	NO
Warrant 2	NO	NO	

Time Period	Major Street						Minor Street						
	Lyons Creek Rd						Wilodell Rd						
	Eastbound			Westbound			Northbound			Southbound			Peds Crossing Main Road
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
AM Peak Hour	0	947	9	44	1343	0	2	0	23	0	0	0	0
PM Peak Hour	0	1417	11	35	1377	0	6	0	26	0	0	0	0
Average Houly Volume (AHV)	0	591	5	20	680	0	2	0	12	0	0	0	0

Total Volumes

Warrant	AHV
1A -All Apchs	1310
1B - Minor	14
2A - Major	1296
2B - Cross	2

Major Approach Heavier Left Turn Volumes - Warrant 2B

Heavier Left Turn Volume (LTV)	20
Opposing Volume (OV)	591
LTV >120	No
Sum of LTV & OV > 720	No
Both Conditions Met	No
Add 50% of LTV to Crossing Volumes	0

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	All Approaches	Requirement	480	720	600	900		
		Volume Expansion	576	864	720	1080	1310	100%

1B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Minor Street	Requirement	180	255	180	255		
		Volume Expansion	216	306	216	306	14	5%

Warrant 2 - Delay to Cross Traffic

2A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Major Street	Requirement	480	720	600	900		
		Volume Expansion	576	864	720	1080	1296	100%

2B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Traffic Crossing Major Street	Requirement	50	75	120	170		
		Volume Expansion	60	90	144	204	2	1%

Warrant Analysis - Justification 7, Projected Volumes

Horizon Year:	2041
Jurisdiction:	Niagara City/Region
Major Street:	Lyons Creek Rd
Mionor Street:	Wilodell Rd
Number of Approach lanes:	2
Tee Intersection:	Yes
Flow Conditions:	Restricted
Both Intersceting Roads Exist	Yes
Volume Expansion	120%

Justification 7 Results

Warrant	100% Satisfied	80% Satisfied	Justification 7 Satisfied
Warrant 1	NO	NO	NO
Warrant 2	NO	NO	

Time Period	Major Street						Minor Street						
	Lyons Creek Rd						Wilodell Rd						
	Eastbound			Westbound			Northbound			Southbound			Peds Crossing Main Road
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
AM Peak Hour	0	1127	10	51	1587	0	3	0	27	0	0	0	0
PM Peak Hour	0	1663	13	41	1613	0	6	0	29	0	0	0	0
Average Houly Volume (AHV)	0	698	6	23	800	0	2	0	14	0	0	0	0

Total Volumes

Warrant	AHV
1A -All Apchs	1543
1B - Minor	16
2A - Major	1527
2B - Cross	2

Major Approach Heavier Left Turn Volumes - Warrant 2B

Heavier Left Turn Volume (LTV)	23
Opposing Volume (OV)	698
LTV >120	No
Sum of LTV & OV > 720	Yes
Both Conditions Met	No
Add 50% of LTV to Crossing Volumes	0

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	All Approaches	Requirement	480	720	600	900		
		Volume Expansion	576	864	720	1080	1543	100%

1B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Minor Street	Requirement	180	255	180	255		
		Volume Expansion	216	306	216	306	16	5%

Warrant 2 - Delay to Cross Traffic

2A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Major Street	Requirement	480	720	600	900		
		Volume Expansion	576	864	720	1080	1527	100%

2B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Traffic Crossing Major Street	Requirement	50	75	120	170		
		Volume Expansion	60	90	144	204	2	1%

Warrant Analysis - Justification 7, Projected Volumes

Horizon Year:	2026
Jurisdiction:	Niagara City/Region
Major Street:	Lyons Creek Rd
Mionor Street:	QEW FEB Off-ramp
Number of Approach lanes:	2
Tee Intersection:	Yes
Flow Conditions:	Restricted
Both Intersceting Roads Exist	Yes
Volume Expansion	120%

Justification 7 Results

Warrant	100% Satisfied	80% Satisfied	Justification 7 Satisfied
Warrant 1	YES	YES	YES
Warrant 2	NO	NO	

Time Period	Major Street						Minor Street						
	Lyons Creek Rd						QEW FEB Off-ramp						
	Eastbound			Westbound			Northbound			Southbound			Peds Crossing Main Road
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
AM Peak Hour	0	803	0	0	541	0	0	0	0	195	0	847	0
PM Peak Hour	0	1103	0	0	535	0	0	0	0	443	0	877	0
Average Houly Volume (AHV)	0	477	0	0	269	0	0	0	0	160	0	431	0

Total Volumes

Warrant	AHV
1A -All Apchs	1337
1B - Minor	591
2A - Major	746
2B - Cross	160

Major Approach Heavier Left Turn Volumes - Warrant 2B

Heavier Left Turn Volume (LTV)	0
Opposing Volume (OV)	477
LTV >120	No
Sum of LTV & OV > 720	No
Both Conditions Met	No
Add 50% of LTV to Crossing Volumes	0

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	All Approaches	Requirement	480	720	600	900		
		Volume Expansion	576	864	720	1080	1337	100%

1B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Minor Street	Requirement	180	255	180	255		
		Volume Expansion	216	306	216	306	591	100%

Warrant 2 - Delay to Cross Traffic

2A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Major Street	Requirement	480	720	600	900		
		Volume Expansion	576	864	720	1080	746	69%

2B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Traffic Crossing Major Street	Requirement	50	75	120	170		
		Volume Expansion	60	90	144	204	160	78%

Warrant Analysis - Justification 7, Projected Volumes

Horizon Year:	2026
Jurisdiction:	Niagara City/Region
Major Street:	Lyons Creek Rd
Mionor Street:	QEW TB Off-ramp
Number of Approach lanes:	2
Tee Intersection:	Yes
Flow Conditions:	Restricted
Both Intersceting Roads Exist	Yes
Volume Expansion	120%

Justification 7 Results

Warrant	100% Satisfied	80% Satisfied	Justification 7 Satisfied
Warrant 1	NO	NO	NO
Warrant 2	NO	NO	

Time Period	Major Street						Minor Street						
	Lyons Creek Rd						QEW TB Off-ramp						
	Eastbound			Westbound			Northbound			Southbound			Peds Crossing Main Road
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
AM Peak Hour	0	472	0	0	371	0	240	0	63	0	0	0	0
PM Peak Hour	0	946	0	0	480	0	112	0	101	0	0	0	0
Average Houly Volume (AHV)	0	355	0	0	213	0	88	0	41	0	0	0	0

Total Volumes

Warrant	AHV
1A -All Apchs	697
1B - Minor	129
2A - Major	568
2B - Cross	88

Major Approach Heavier Left Turn Volumes - Warrant 2B

Heavier Left Turn Volume (LTV)	0
Opposing Volume (OV)	355
LTV >120	No
Sum of LTV & OV > 720	No
Both Conditions Met	No
Add 50% of LTV to Crossing Volumes	0

Warrant 1 - Minimum Vehicular Volume

	Approach Lanes		1		2 or more		AHV	Compliance
1A	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	All Approaches	Requirement	480	720	600	900		
		Volume Expansion	576	864	720	1080	697	65%

	Approach Lanes		1		2 or more		AHV	Compliance
1B	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Minor Street	Requirement	180	255	180	255		
		Volume Expansion	216	306	216	306	129	42%

Warrant 2 - Delay to Cross Traffic

	Approach Lanes		1		2 or more		AHV	Compliance
2A	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Major Street	Requirement	480	720	600	900		
		Volume Expansion	576	864	720	1080	568	53%

	Approach Lanes		1		2 or more		AHV	Compliance
2B	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Traffic Crossing Major Street	Requirement	50	75	120	170		
		Volume Expansion	60	90	144	204	88	43%

Warrant Analysis - Justification 7, Projected Volumes

Horizon Year:	2041
Jurisdiction:	Niagara City/Region
Major Street:	Lyons Creek Rd
Mionor Street:	QEW FEB Off-ramp
Number of Approach lanes:	2
Tee Intersection:	Yes
Flow Conditions:	Restricted
Both Intersceting Roads Exist	Yes
Volume Expansion	120%

Justification 7 Results

Warrant	100% Satisfied	80% Satisfied	Justification 7 Satisfied
Warrant 1	YES	YES	YES
Warrant 2	NO	YES	

Time Period	Major Street						Minor Street						
	Lyons Creek Rd						QEW FEB Off-ramp						
	Eastbound			Westbound			Northbound			Southbound			Peds Crossing Main Road
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
AM Peak Hour	0	977	0	0	610	0	0	0	0	218	0	1029	0
PM Peak Hour	0	1346	0	0	605	0	0	0	0	494	0	1047	0
Average Houly Volume (AHV)	0	581	0	0	304	0	0	0	0	178	0	519	0

Total Volumes

Warrant	AHV
1A -All Apchs	1582
1B - Minor	697
2A - Major	885
2B - Cross	178

Major Approach Heavier Left Turn Volumes - Warrant 2B

Heavier Left Turn Volume (LTV)	0
Opposing Volume (OV)	581
LTV >120	No
Sum of LTV & OV > 720	No
Both Conditions Met	No
Add 50% of LTV to Crossing Volumes	0

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	All Approaches	Requirement	480	720	600	900		
		Volume Expansion	576	864	720	1080	1582	100%

1B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Minor Street	Requirement	180	255	180	255		
		Volume Expansion	216	306	216	306	697	100%

Warrant 2 - Delay to Cross Traffic

2A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Major Street	Requirement	480	720	600	900		
		Volume Expansion	576	864	720	1080	885	82%

2B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Traffic Crossing Major Street	Requirement	50	75	120	170		
		Volume Expansion	60	90	144	204	178	87%

Warrant Analysis - Justification 7, Projected Volumes

Horizon Year:	2041
Jurisdiction:	Niagara City/Region
Major Street:	Lyons Creek Rd
Mionor Street:	QEW TB Off-ramp
Number of Approach lanes:	2
Tee Intersection:	Yes
Flow Conditions:	Restricted
Both Intersceting Roads Exist	Yes
Volume Expansion	120%

Justification 7 Results

Warrant	100% Satisfied	80% Satisfied	Justification 7 Satisfied
Warrant 1	NO	NO	NO
Warrant 2	NO	NO	

Time Period	Major Street						Minor Street						
	Lyons Creek Rd						QEW TB Off-ramp						
	Eastbound			Westbound			Northbound			Southbound			Peds Crossing Main Road
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
AM Peak Hour	0	539	0	0	424	0	261	0	69	0	0	0	0
PM Peak Hour	0	1066	0	0	538	0	126	0	108	0	0	0	0
Average Houly Volume (AHV)	0	401	0	0	241	0	97	0	44	0	0	0	0

Total Volumes

Warrant	AHV
1A -All Apchs	783
1B - Minor	141
2A - Major	642
2B - Cross	97

Major Approach Heavier Left Turn Volumes - Warrant 2B

Heavier Left Turn Volume (LTV)	0
Opposing Volume (OV)	401
LTV >120	No
Sum of LTV & OV > 720	No
Both Conditions Met	No
Add 50% of LTV to Crossing Volumes	0

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	All Approaches	Requirement	480	720	600	900		
		Volume Expansion	576	864	720	1080	783	73%

1B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Minor Street	Requirement	180	255	180	255		
		Volume Expansion	216	306	216	306	141	46%

Warrant 2 - Delay to Cross Traffic

2A	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Major Street	Requirement	480	720	600	900		
		Volume Expansion	576	864	720	1080	642	59%

2B	Approach Lanes		1		2 or more		AHV	Compliance
	Flow Conditions		Free	Restricted	Free	Restricted		
						Yes		
	Traffic Crossing Major Street	Requirement	50	75	120	170		
		Volume Expansion	60	90	144	204	97	48%

APPENDIX G

ROUNDABOUT FEASIBILITY, SIDRA LOS, LANE USE PERFORMANCE REPORTS

PARSONS

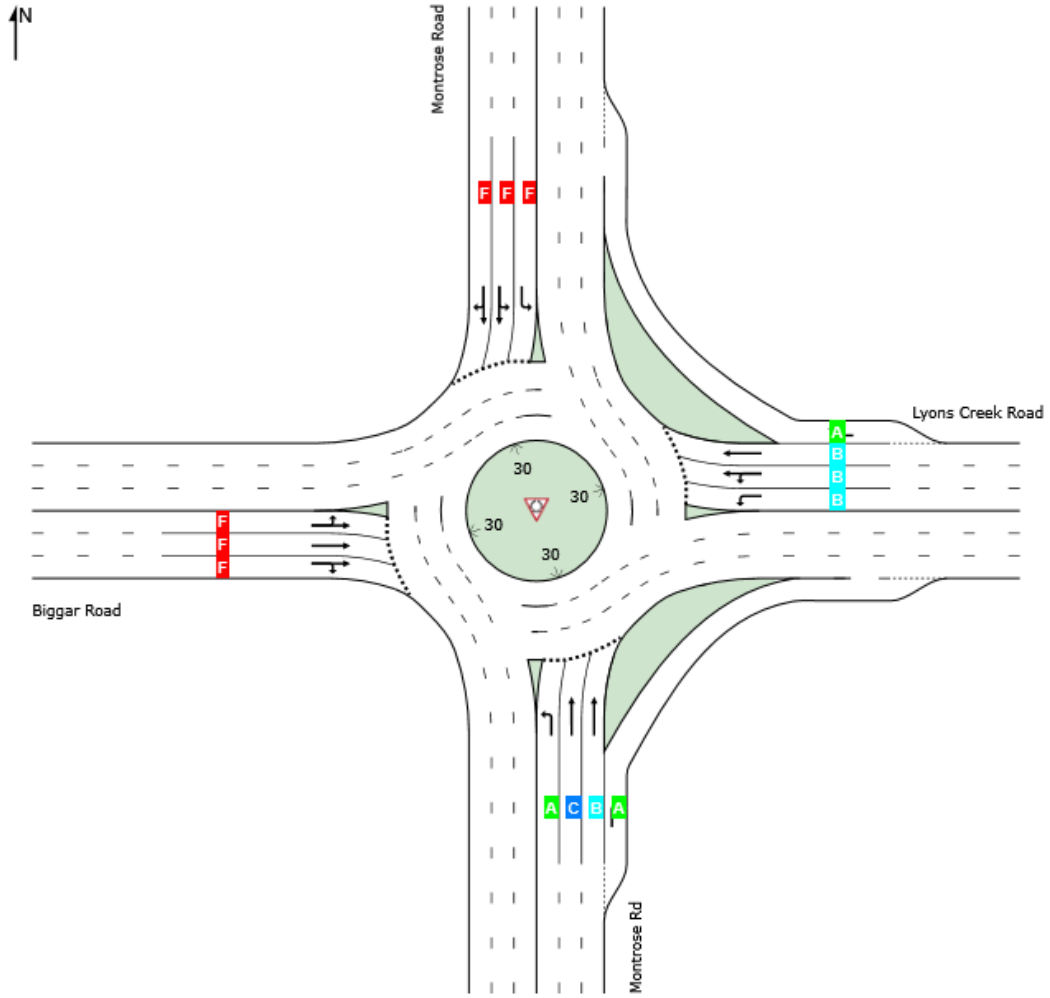
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101 [2041 PM Montrose Rd & Lyons Creek Rd-3 en & 3 ex - (Rev Dec 2020)]

New Site
Site Category: (None)
Roundabout

	Approaches				Intersection
	South	East	North	West	
LOS	A	B	F	F	F



Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.

\Roundabout Analysis\QEW SB Off Ramp & Lyons Creek.sip8

LANE SUMMARY

Site: 101 [2041 PM Montrose Rd & Lyons Creek Rd-3 en & 3 ex - (Rev Dec 2020)]

New Site
Site Category: (None)
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Montrose Rd													
Lane 1	34	0.0	420	0.080	100	9.8	LOS A	0.3	2.0	Full	500	0.0	0.0
Lane 2	153	0.0	420	0.364	100	15.3	LOS C	1.5	11.3	Full	500	0.0	0.0
Lane 3[d]	176	0.0	482	0.364	100	13.5	LOS B	1.5	11.4	Full	500	0.0	0.0
Lane 4	557	0.0	1675	0.332	100	0.0	LOS A	0.0	0.0	Short	60	0.0	NA
Approach	918	0.0		0.364		5.5	LOS A	1.5	11.4				
East: Lyons Creek Road													
Lane 1	480	0.0	791	0.608	100	14.4	LOS B	5.2	39.6	Full	375	0.0	0.0
Lane 2	480	0.0	791	0.608	100	14.4	LOS B	5.2	39.6	Full	375	0.0	0.0
Lane 3[d]	526	0.0	866	0.608	100	13.4	LOS B	5.3	40.3	Full	375	0.0	0.0
Lane 4	408	0.0	1675	0.243	100	0.0	LOS A	0.0	0.0	Short	60	0.0	NA
Approach	1895	0.0		0.608		11.0	LOS B	5.3	40.3				
North: Montrose Road													
Lane 1	522	0.0	333	1.566	100	297.6	LOS F	67.5	513.3	Full	230	0.0	39.8
Lane 2	522	0.0	333	1.566	100	297.6	LOS F	67.5	513.3	Full	230	0.0	39.8
Lane 3[d]	611	0.0	390	1.566	100	292.4	LOS F	77.9	592.4	Full	230	0.0	54.6
Approach	1654	0.0		1.566		295.6	LOS F	77.9	592.4				
West: Biggar Road													
Lane 1	269	0.0	263	1.021	100	102.9	LOS F	11.7	88.8	Full	300	0.0	0.0
Lane 2	269	0.0	263	1.021	100	102.9	LOS F	11.7	88.8	Full	300	0.0	0.0
Lane 3[d]	320	0.0	313	1.021	100	94.1	LOS F	13.0	98.5	Full	300	0.0	0.0
Approach	858	0.0		1.021		99.6	LOS F	13.0	98.5				
Intersection	5325	0.0		1.566		112.8	LOS F	77.9	592.4				

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

SIDRA INTERSECTION 8.0 | Copyright © 2000-2018 Akcelik and Associates Pty Ltd | sidrasolutions.com

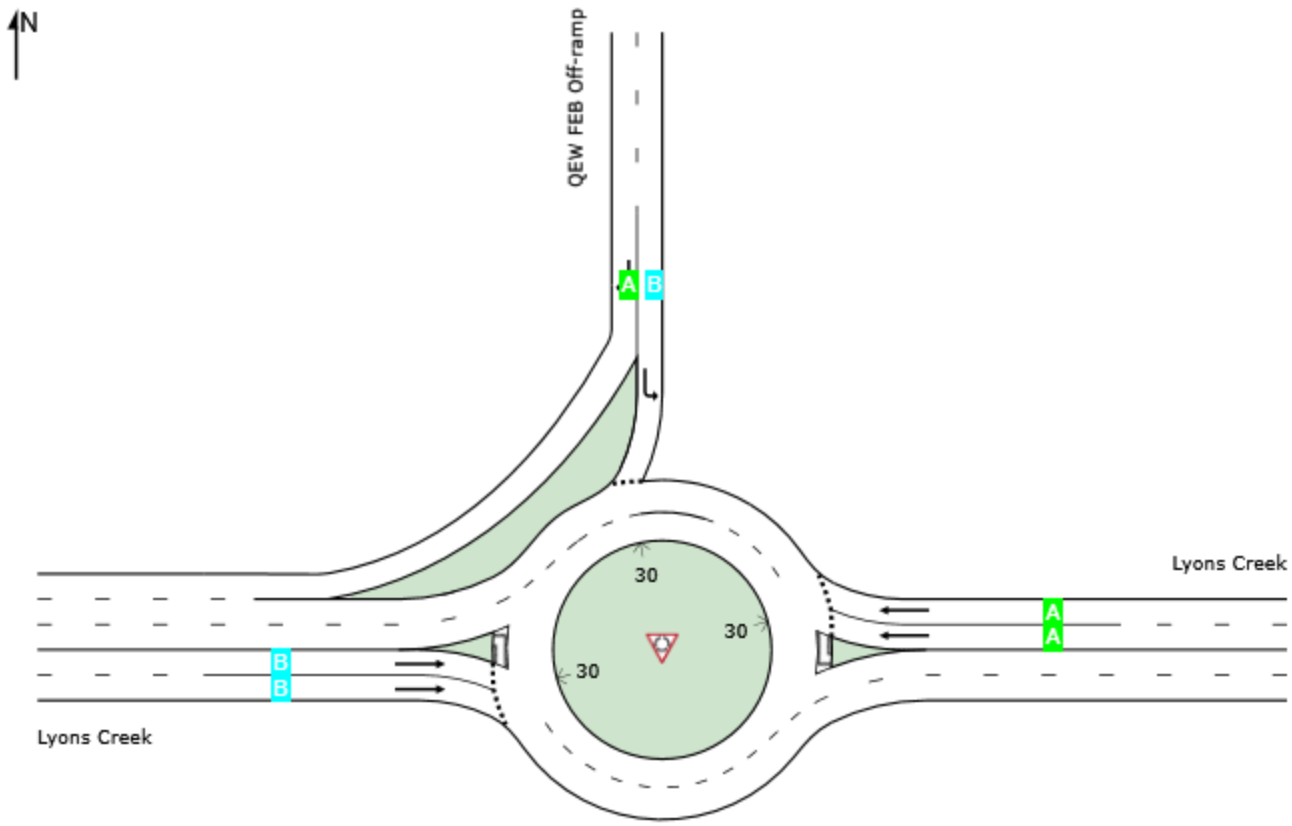
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101 [QEW Fort Erie bound Off-ramp & Lyons Creek Road (Rev Dec 2020)-2041 PM]

New Site
Site Category: (None)
Roundabout

	Approaches			Intersection
	East	North	West	
LOS	A	A	B	A



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

SIDRA INTERSECTION 8.0 | Copyright © 2000-2018 Akcelik and Associates Pty Ltd | sidrasolutions.com

LANE SUMMARY

Site: 101 [QEW Fort Erie bound Off-ramp & Lyons Creek Road (Rev Dec 2020)-2041 PM]

New Site
Site Category: (None)
Roundabout

Lane Use and Performance													
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: Lyons Creek													
Lane 1	343	0.0	1420	0.241	100	3.4	LOS A	0.0	0.0	Full	500	0.0	0.0
Lane 2[d]	343	0.0	1420	0.241	100	3.4	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	685	0.0		0.241		3.4	LOS A	0.0	0.0				
North: QEW FEB Off-ramp													
Lane 1[d]	540	0.0	793	0.681	100	15.7	LOS B	5.0	35.2	Full	500	0.0	0.0
Lane 2	1129	0.0	1876	0.602	100	3.2	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	1669	0.0		0.681		7.2	LOS A	5.0	35.2				
West: Lyons Creek													
Lane 1	731	0.0	869	0.841	100	13.7	LOS B	10.7	74.8	Full	500	0.0	0.0
Lane 2[d]	731	0.0	869	0.841	100	13.7	LOS B	10.7	74.8	Full	500	0.0	0.0
Approach	1461	0.0		0.841		13.7	LOS B	10.7	74.8				
Intersection	3816	0.0		0.841		9.0	LOS A	10.7	74.8				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: US HCM 6.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

SIDRA INTERSECTION 8.0 | Copyright © 2000-2018 Akcelik and Associates Pty Ltd | sidrasolutions.com

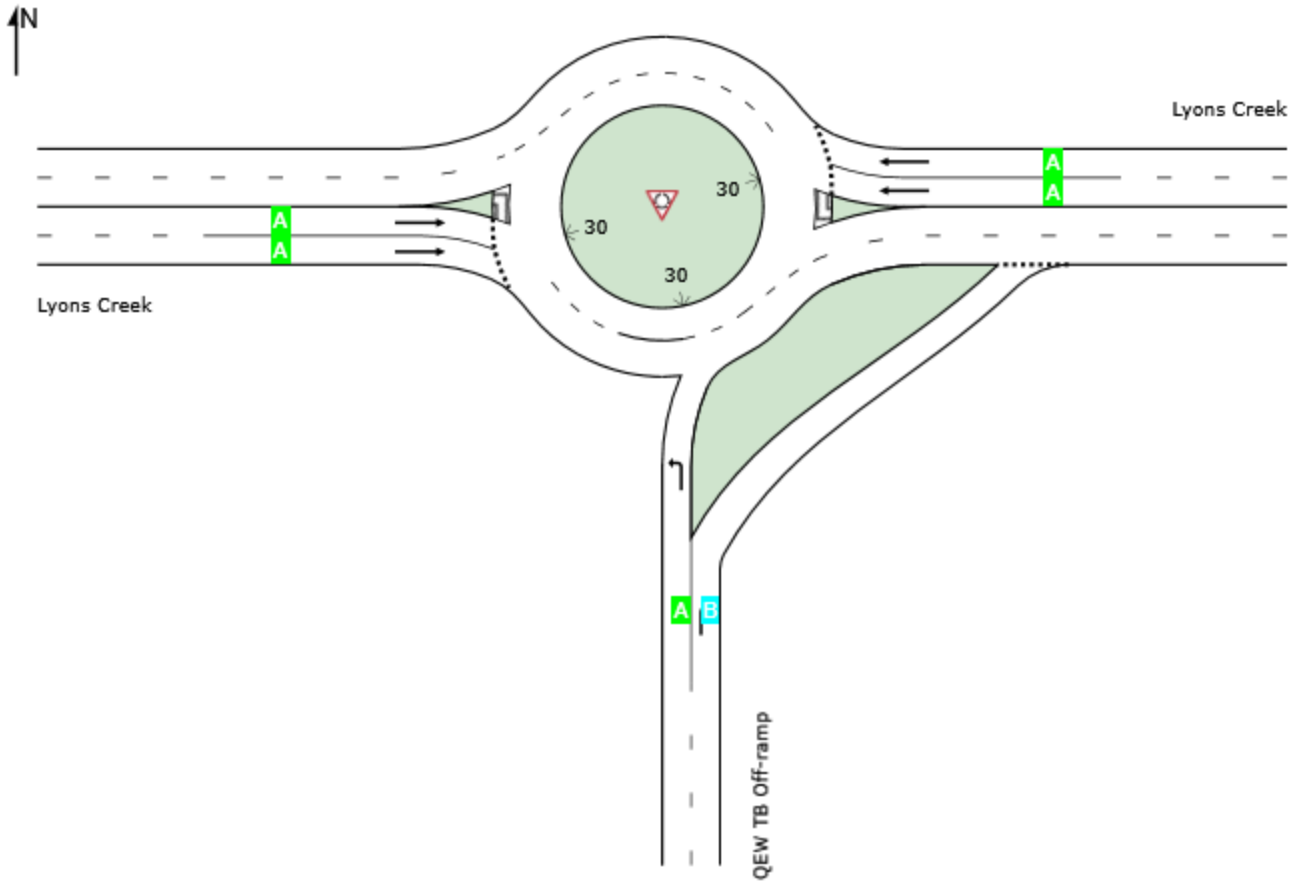
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101 [QEW Toronto bound Off Ramp and Lyons Creek Road -2041 PM (Rev Dec 2020)]

New Site
Site Category: (None)
Roundabout

	Approaches			Intersection
	South	East	West	
LOS	A	A	A	A



Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.

LANE SUMMARY

Site: 101 [QEW Toronto bound Off Ramp and Lyons Creek Road -2041 PM (Rev Dec 2020)]

New Site
Site Category: (None)
Roundabout

Lane Use and Performance													
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: QEW TB Off-ramp													
Lane 1[d]	161	0.0	1882	0.085	100	0.0	LOS A	0.0	0.0	Full	500	0.0	0.0
Lane 2	126	0.0	504	0.250	100	10.8	LOS B	0.9	6.7	Full	500	0.0	0.0
Approach	287	0.0		0.250		4.7	LOS A	0.9	6.7				
East: Lyons Creek													
Lane 1	307	0.0	1227	0.250	100	5.2	LOS A	1.2	9.2	Full	500	0.0	0.0
Lane 2[d]	307	0.0	1227	0.250	100	5.2	LOS A	1.2	9.2	Full	500	0.0	0.0
Approach	613	0.0		0.250		5.2	LOS A	1.2	9.2				
West: Lyons Creek													
Lane 1	610	0.0	1420	0.429	100	6.6	LOS A	0.0	0.0	Full	500	0.0	0.0
Lane 2[d]	610	0.0	1420	0.429	100	6.6	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	1220	0.0		0.429		6.6	LOS A	0.0	0.0				
Intersection	2120	0.0		0.429		5.9	LOS A	1.2	9.2				

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

SIDRA INTERSECTION 8.0 | Copyright © 2000-2018 Akcelik and Associates Pty Ltd | sidrasolutions.com

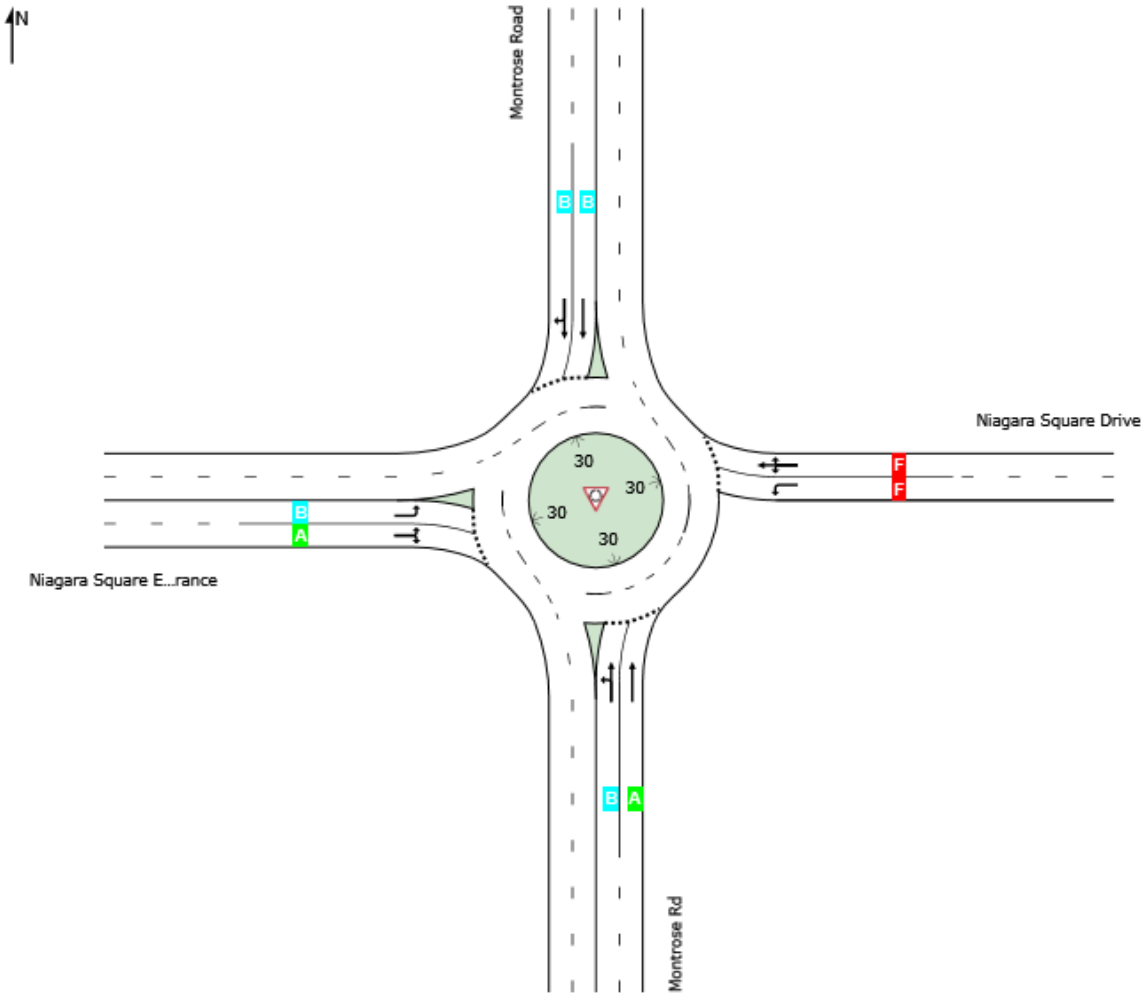
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101 [2041 PM Montrose Rd & Niagara Square Drive (Rev Dec 2040)]

New Site
Site Category: (None)
Roundabout

	Approaches				Intersection
	South	East	North	West	
LOS	B	F	B	A	E



Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.

\Roundabout Analysis\QEW SB Off Ramp & Lyons Creek.sip8

LANE SUMMARY

Site: 101 [2041 PM Montrose Rd & Niagara Square Drive (Rev Dec 2040)]

New Site
Site Category: (None)
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Montrose Rd													
Lane 1	576	0.0	1047	0.550	100	10.3	LOS B	4.4	33.3	Full	400	0.0	0.0
Lane 2[d]	618	0.0	1123	0.550	100	9.8	LOS A	4.2	31.8	Full	400	0.0	0.0
Approach	1195	0.0		0.550		10.1	LOS B	4.4	33.3				
East: Niagara Square Drive													
Lane 1	411	0.0	349	1.177	100	138.9	LOS F	28.5	216.8	Full	260	0.0	0.0
Lane 2[d]	479	0.0	407	1.177	100	132.7	LOS F	32.3	245.5	Full	260	0.0	3.3
Approach	889	0.0		1.177		135.6	LOS F	32.3	245.5				
North: Montrose Road													
Lane 1	284	0.0	631	0.450	100	12.5	LOS B	2.4	18.1	Full	420	0.0	0.0
Lane 2[d]	316	0.0	703	0.450	100	11.5	LOS B	2.4	18.2	Full	420	0.0	0.0
Approach	600	0.0		0.450		11.9	LOS B	2.4	18.2				
West: Niagara Square Entrance													
Lane 1	159	0.0	555	0.285	100	10.4	LOS B	1.1	8.4	Full	100	0.0	0.0
Lane 2[d]	178	0.0	625	0.285	100	9.4	LOS A	1.1	8.3	Full	100	0.0	0.0
Approach	337	0.0		0.285		9.9	LOS A	1.1	8.4				
Intersection	3021	0.0		1.177		47.4	LOS E	32.3	245.5				

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

SIDRA INTERSECTION 8.0 | Copyright © 2000-2018 Akcelik and Associates Pty Ltd | sidrasolutions.com

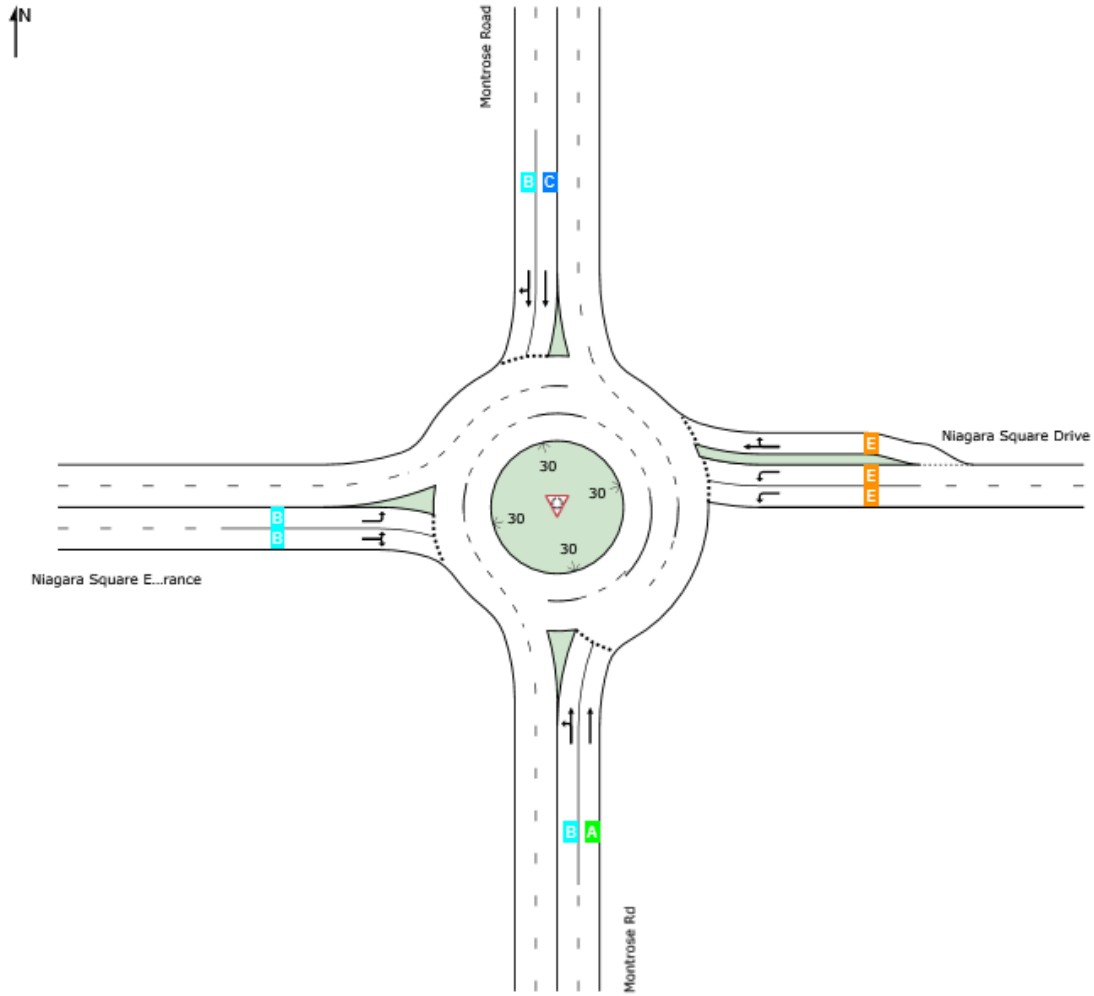
LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101 [2041 PM Montrose Rd & Niagara Square Drive Spiral (Rev Dec 2020)]

New Site
Site Category: (None)
Roundabout

	Approaches				Intersection
	South	East	North	West	
LOS	B	E	B	B	C



Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.

\Roundabout Analysis\QEW SB Off Ramp & Lyons Creek.sip8

LANE SUMMARY

Site: 101 [2041 PM Montrose Rd & Niagara Square Drive Spiral (Rev Dec 2020)]

New Site
Site Category: (None)
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Montrose Rd													
Lane 1	576	0.0	1047	0.550	100	10.3	LOS B	4.4	33.3	Full	400	0.0	0.0
Lane 2[d]	618	0.0	1123	0.550	100	9.8	LOS A	4.2	31.8	Full	400	0.0	0.0
Approach	1195	0.0		0.550		10.1	LOS B	4.4	33.3				
East: Niagara Square Drive													
Lane 1	287	0.0	349	0.823	100	48.1	LOS E	5.9	44.7	Full	260	0.0	0.0
Lane 2[d]	335	0.0	407	0.823	100	42.8	LOS E	6.2	47.1	Full	260	0.0	0.0
Lane 3	267	0.0	349	0.766	100	41.1	LOS E	4.8	36.8	Short	60	0.0	NA
Approach	889	0.0		0.823		44.0	LOS E	6.2	47.1				
North: Montrose Road													
Lane 1	282	0.0	562	0.502	100	15.2	LOS C	2.7	20.9	Full	420	0.0	0.0
Lane 2[d]	318	0.0	632	0.502	100	13.8	LOS B	2.8	21.2	Full	420	0.0	0.0
Approach	600	0.0		0.502		14.5	LOS B	2.8	21.2				
West: Niagara Square Entrance													
Lane 1	158	0.0	512	0.308	100	11.7	LOS B	1.2	9.3	Full	100	0.0	0.0
Lane 2[d]	179	0.0	580	0.308	100	10.5	LOS B	1.2	9.3	Full	100	0.0	0.0
Approach	337	0.0		0.308		11.0	LOS B	1.2	9.3				
Intersection	3021	0.0		0.823		21.0	LOS C	6.2	47.1				

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

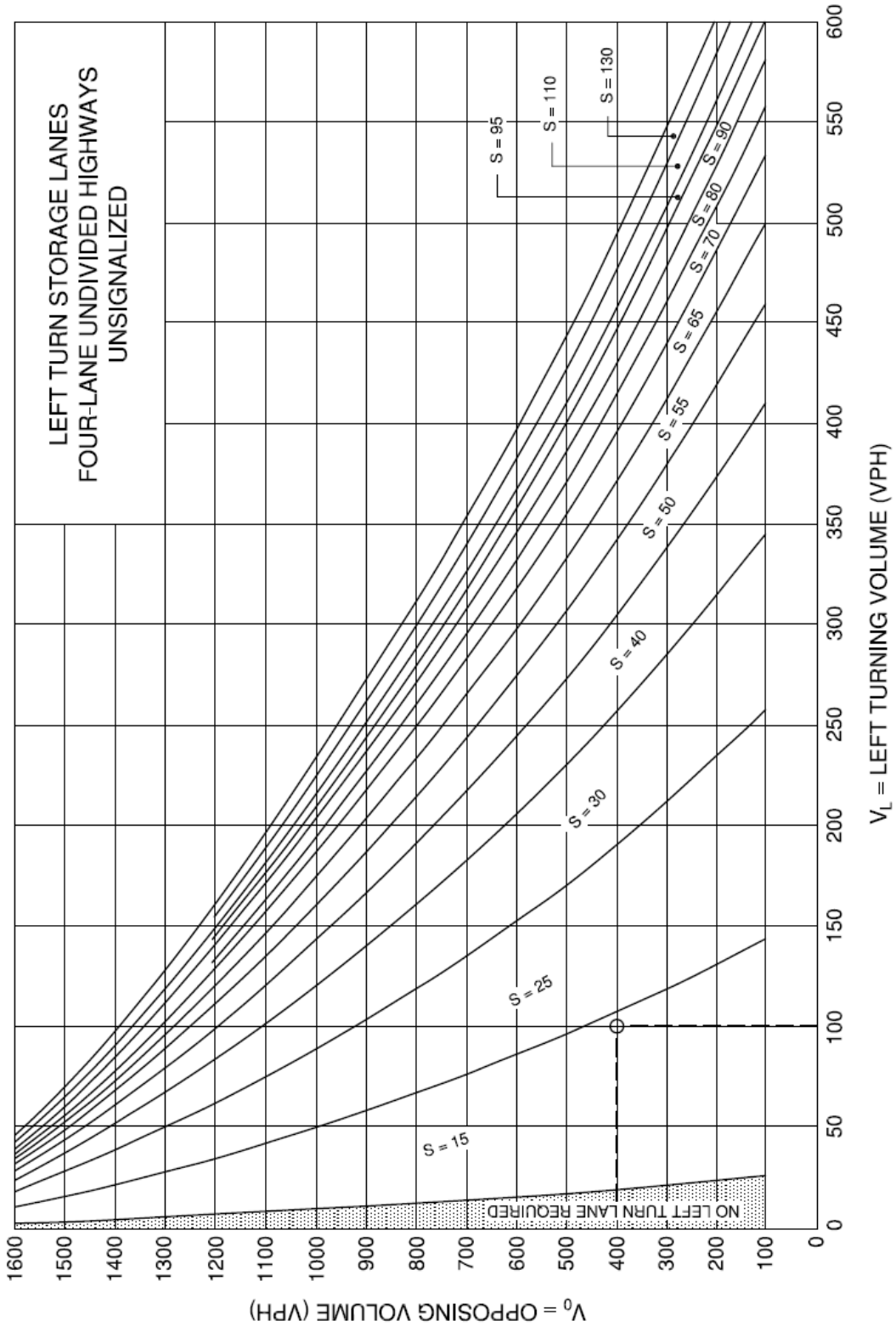
d Dominant lane on roundabout approach

APPENDIX H

LEFT TURNS LANE WARRANTS

PARSONS

Exhibit 9A-30



Interscetion	Montrose Rd & Hospital North Access			
Direction	Northbound Left			
Analysis Year	2026		2041	
Peak Hour	AM	PM	AM	PM
Design speed	80	80	80	80
Left Turning Volume VL	155	61	155	61
Opposing Volume Vo	367	736	490	916
Left Turn Lane Warranted	Yes	Yes	Yes	Yes
Storage Length (m)	25	15	25	15

Interscetion	Montrose Rd & Street B			
Direction	Northbound Left			
Analysis Year	2026		2041	
Peak Hour	AM	PM	AM	PM
Design speed	80	80	80	80
Left Turning Volume VL	18	19	35	38
Opposing Volume Vo	359	711	472	864
Left Turn Lane Warranted	No	No	Yes	Yes
Storage Length (m)	NA	NA	15	15

Interscetion	Montrose Rd & Grassy Brook Rd			
Direction	Northbound Left			
Analysis Year	2026		2041	
Peak Hour	AM	PM	AM	PM
Design speed	80	80	80	80
Left Turning Volume VL	29	13	45	23
Opposing Volume Vo	535	910	808	1277
Left Turn Lane Warranted	Yes	Yes	Yes	Yes
Storage Length (m)	15	15	15	15

Interscetion	Montrose Rd & Oakwood Rd			
Direction	Southbound Left			
Analysis Year	2026		2041	
Peak Hour	AM	PM	AM	PM
Design speed	80	80	80	80
Left Turning Volume VL	16	28	18	32
Opposing Volume Vo	501	798	670	902
Left Turn Lane Warranted	No	Yes	No	Yes
Storage Length (m)	NA	15	NA	15

Interscetion	Montrose Rd & Brown Rd			
Direction	Northbound Left			
Analysis Year	2026		2041	
Peak Hour	AM	PM	AM	PM
Design speed	80	80	80	80
Left Turning Volume VL	34	54	35	56
Opposing Volume Vo	538	828	760	1129
Left Turn Lane Warranted	Yes	Yes	Yes	Yes
Storage Length (m)	15	15	15	25

Interscetion	Montrose Rd & Chippawa Creek			
Direction	Northbound Left			
Analysis Year	2026		2041	
Peak Hour	AM	PM	AM	PM
Design speed	80	80	80	80
Left Turning Volume VL	34	38	39	44
Opposing Volume Vo	507	695	724	981
Left Turn Lane Warranted	Yes	Yes	Yes	Yes
Storage Length (m)	15	15	15	15

Interscetion	Biggar Rd & Hospital West Access			
Direction	Eastbound Left			
Analysis Year	2026		2041	
Peak Hour	AM	PM	AM	PM
Design speed	80	80	80	80
Left Turning Volume VL	19	7	19	7
Opposing Volume Vo	415	573	590	734
Left Turn Lane Warranted	Yes	Yes	Yes	Yes
Storage Length (m)	15	NA	15	NA

Interscetion	Lyons Creek Rd & Wilodell Road			
Direction	Westbound Left			
Analysis Year	2026		2041	
Peak Hour	AM	PM	AM	PM
Design speed	80	80	80	80
Left Turning Volume VL	44	35	51	41
Opposing Volume Vo	956	1428	1137	1676
Left Turn Lane Warranted	Yes	Yes	Yes	Yes
Storage Length (m)	15	25	25	25

APPENDIX I

SYNCHRO REPORTS, FUTURE 2026 & 2041 CONDITIONS WITH IMPROVEMENTS

PARSONS

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	213	261	304	435	596	56	317	478	228	163
Future Volume (vph)	213	261	304	435	596	56	317	478	228	163
Lane Group Flow (vph)	232	305	330	473	648	61	345	520	248	295
Turn Type	Perm	NA	Prot	NA	Perm	Perm	NA	Perm	Prot	NA
Protected Phases		2	1	6			8		7	4
Permitted Phases	2				6	8		8		
Detector Phase	2	2	1	6	6	8	8	8	7	4
Switch Phase										
Minimum Initial (s)	10.0	10.0	4.0	10.0	10.0	10.0	10.0	10.0	4.0	10.0
Minimum Split (s)	26.3	26.3	9.5	26.3	26.3	31.3	31.3	31.3	9.5	31.3
Total Split (s)	39.1	39.1	20.8	59.9	59.9	31.3	31.3	31.3	18.8	50.1
Total Split (%)	35.5%	35.5%	18.9%	54.5%	54.5%	28.5%	28.5%	28.5%	17.1%	45.5%
Yellow Time (s)	4.1	4.1	3.5	4.1	4.1	4.1	4.1	4.1	3.5	4.1
All-Red Time (s)	2.2	2.2	2.0	2.2	2.2	2.0	2.0	2.0	2.0	2.2
Lost Time Adjust (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	9.3	9.3	8.5	9.3	9.3	9.1	9.1	9.1	8.5	9.3
Lead/Lag	Lag	Lag	Lead			Lag	Lag	Lag	Lead	
Lead-Lag Optimize?	Yes	Yes	Yes			Yes	Yes	Yes	Yes	
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max	Max	Max
v/c Ratio	1.01	0.35	0.97	0.32	0.75	0.30	0.53	0.82	0.96	0.26
Control Delay	103.1	32.8	91.3	19.5	13.2	42.0	42.6	20.3	97.4	14.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	103.1	32.8	91.3	19.5	13.2	42.0	42.6	20.3	97.4	14.7
Queue Length 50th (m)	~50.5	27.1	36.9	32.8	31.5	11.2	35.1	17.2	27.7	13.2
Queue Length 95th (m)	#99.7	39.3	#64.7	44.5	82.3	23.8	49.7	#75.2	#52.3	23.0
Internal Link Dist (m)		279.7		233.5			313.4			98.6
Turn Bay Length (m)	30.0		30.0		30.0	30.0		30.0	30.0	
Base Capacity (vph)	230	882	340	1501	862	204	652	635	258	1156
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.01	0.35	0.97	0.32	0.75	0.30	0.53	0.82	0.96	0.26

Intersection Summary

Cycle Length: 110
Actuated Cycle Length: 110
Natural Cycle: 110
Control Type: Semi Act-Uncoord
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Montrose & Biggar/Lyons Creek

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	213	261	19	304	435	596	56	317	478	228	163	109
Future Volume (vph)	213	261	19	304	435	596	56	317	478	228	163	109
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	9.3	9.3		8.5	9.3	9.3	9.1	9.1	9.1	8.5	9.3	
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.94	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1681	3237		3048	3264	1343	1681	3233	1460	2764	2917	
Flt Permitted	0.48	1.00		0.95	1.00	1.00	0.57	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	851	3237		3048	3264	1343	1011	3233	1460	2764	2917	
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)	232	284	21	330	473	648	61	345	520	248	177	118
RTOR Reduction (vph)	0	5	0	0	0	245	0	0	341	0	74	0
Lane Group Flow (vph)	232	300	0	330	473	403	61	345	179	248	221	0
Confl. Bikes (#/hr)												1
Heavy Vehicles (%)	0%	3%	0%	7%	3%	12%	0%	4%	3%	18%	13%	0%
Turn Type	Perm	NA		Prot	NA	Perm	Perm	NA	Perm	Prot	NA	
Protected Phases		2		1	6			8		7	4	
Permitted Phases	2					6	8		8			
Actuated Green, G (s)	32.8	32.8		15.3	53.6	53.6	25.2	25.2	25.2	13.3	43.8	
Effective Green, g (s)	29.8	29.8		12.3	50.6	50.6	22.2	22.2	22.2	10.3	40.8	
Actuated g/C Ratio	0.27	0.27		0.11	0.46	0.46	0.20	0.20	0.20	0.09	0.37	
Clearance Time (s)	6.3	6.3		5.5	6.3	6.3	6.1	6.1	6.1	5.5	6.3	
Vehicle Extension (s)	6.0	6.0		3.0	6.0	6.0	6.0	6.0	6.0	3.0	6.0	
Lane Grp Cap (vph)	230	876		340	1501	617	204	652	294	258	1081	
v/s Ratio Prot		0.09		0.11	0.14			0.11		c0.09	0.08	
v/s Ratio Perm	c0.27					c0.30	0.06		c0.12			
v/c Ratio	1.01	0.34		0.97	0.32	0.65	0.30	0.53	0.61	0.96	0.20	
Uniform Delay, d1	40.1	32.2		48.7	18.8	22.9	37.3	39.2	40.0	49.7	23.6	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	61.6	1.1		41.9	0.6	5.3	3.7	3.1	9.1	46.9	0.4	
Delay (s)	101.7	33.3		90.6	19.3	28.3	41.0	42.3	49.0	96.6	24.0	
Level of Service	F	C		F	B	C	D	D	D	F	C	
Approach Delay (s)		62.8			39.5			46.0			57.1	
Approach LOS		E			D			D			E	

Intersection Summary			
HCM 2000 Control Delay	47.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	35.4
Intersection Capacity Utilization	85.5%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	6	2	440	35	7	341
Future Volume (Veh/h)	6	2	440	35	7	341
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)	7	2	478	38	8	371
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			TWLTL			TWLTL
Median storage veh)			2			2
Upstream signal (m)			329			
pX, platoon unblocked						
vC, conflicting volume	698	258			516	
vC1, stage 1 conf vol	497					
vC2, stage 2 conf vol	202					
vCu, unblocked vol	698	258			516	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3			2.2	
p0 queue free %	99	100			99	
cM capacity (veh/h)	542	747			1060	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	9	319	197	8	186	186
Volume Left	7	0	0	8	0	0
Volume Right	2	0	38	0	0	0
cSH	577	1700	1700	1060	1700	1700
Volume to Capacity	0.02	0.19	0.12	0.01	0.11	0.11
Queue Length 95th (m)	0.4	0.0	0.0	0.2	0.0	0.0
Control Delay (s)	11.3	0.0	0.0	8.4	0.0	0.0
Lane LOS	B			A		
Approach Delay (s)	11.3	0.0		0.2		
Approach LOS	B					

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	29.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	193	9	29	401	365	170
Future Volume (Veh/h)	193	9	29	401	365	170
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)	210	10	32	436	397	185
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				TWLTL	None	
Median storage veh)				2		
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	772	291	582			
vC1, stage 1 conf vol	490					
vC2, stage 2 conf vol	282					
vCu, unblocked vol	772	291	582			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3	2.2			
p0 queue free %	60	99	97			
cM capacity (veh/h)	522	712	1002			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	220	32	218	218	265	317
Volume Left	210	32	0	0	0	0
Volume Right	10	0	0	0	0	185
cSH	528	1002	1700	1700	1700	1700
Volume to Capacity	0.42	0.03	0.13	0.13	0.16	0.19
Queue Length 95th (m)	15.5	0.8	0.0	0.0	0.0	0.0
Control Delay (s)	16.6	8.7	0.0	0.0	0.0	0.0
Lane LOS	C	A				
Approach Delay (s)	16.6	0.6			0.0	
Approach LOS	C					

Intersection Summary			
Average Delay	3.1		
Intersection Capacity Utilization	49.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	48	5	445	139	16	447
Future Volume (Veh/h)	48	5	445	139	16	447
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)	52	5	484	151	17	486
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	836	318			635	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	836	318			635	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	83	99			98	
cM capacity (veh/h)	304	684			958	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	57	323	312	17	243	243
Volume Left	52	0	0	17	0	0
Volume Right	5	0	151	0	0	0
cSH	320	1700	1700	958	1700	1700
Volume to Capacity	0.18	0.19	0.18	0.02	0.14	0.14
Queue Length 95th (m)	4.9	0.0	0.0	0.4	0.0	0.0
Control Delay (s)	18.7	0.0	0.0	8.8	0.0	0.0
Lane LOS	C			A		
Approach Delay (s)	18.7	0.0		0.3		
Approach LOS	C					

Intersection Summary			
Average Delay	1.0		
Intersection Capacity Utilization	33.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	68	30	34	398	433	74
Future Volume (Veh/h)	68	30	34	398	433	74
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)	74	33	37	433	471	80
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	762	236	551			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	762	236	551			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	78	96	96			
cM capacity (veh/h)	333	772	1029			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	107	37	216	216	236	236	80
Volume Left	74	37	0	0	0	0	0
Volume Right	33	0	0	0	0	0	80
cSH	404	1029	1700	1700	1700	1700	1700
Volume to Capacity	0.26	0.04	0.13	0.13	0.14	0.14	0.05
Queue Length 95th (m)	8.0	0.8	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	17.1	8.6	0.0	0.0	0.0	0.0	0.0
Lane LOS	C	A					
Approach Delay (s)	17.1	0.7			0.0		
Approach LOS	C						

Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	39.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	178	48	34	433	460	78
Future Volume (Veh/h)	178	48	34	433	460	78
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)	193	52	37	471	500	85
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	852	292	585			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	852	292	585			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	34	93	96			
cM capacity (veh/h)	291	710	1000			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	245	37	236	236	333	252
Volume Left	193	37	0	0	0	0
Volume Right	52	0	0	0	0	85
cSH	333	1000	1700	1700	1700	1700
Volume to Capacity	0.74	0.04	0.14	0.14	0.20	0.15
Queue Length 95th (m)	42.2	0.9	0.0	0.0	0.0	0.0
Control Delay (s)	40.7	8.7	0.0	0.0	0.0	0.0
Lane LOS	E	A				
Approach Delay (s)	40.7	0.6			0.0	
Approach LOS	E					

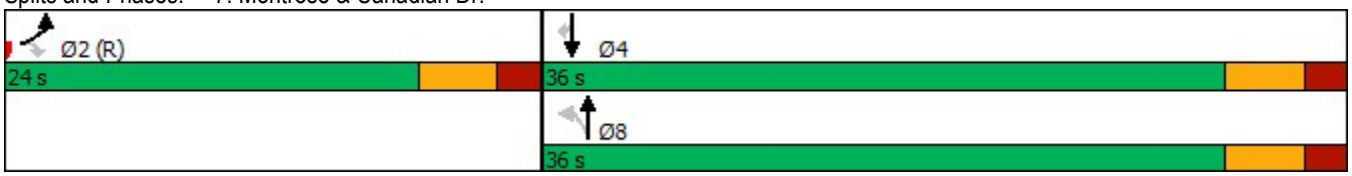
Intersection Summary			
Average Delay	7.7		
Intersection Capacity Utilization	51.2%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	8	95	108	540	443	25
Future Volume (vph)	8	95	108	540	443	25
Lane Group Flow (vph)	9	103	117	587	482	27
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	2			8	4	
Permitted Phases		2	8			4
Minimum Split (s)	23.5	23.5	23.5	23.5	23.5	23.5
Total Split (s)	24.0	24.0	36.0	36.0	36.0	36.0
Total Split (%)	40.0%	40.0%	60.0%	60.0%	60.0%	60.0%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	2.0	2.0	2.0	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)	5.5	5.5	5.5	5.5	5.5	5.5
Lead/Lag						
Lead-Lag Optimize?						
v/c Ratio	0.02	0.20	0.28	0.37	0.30	0.04
Control Delay	14.8	5.1	10.8	9.8	9.2	3.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.8	5.1	10.8	9.8	9.2	3.5
Queue Length 50th (m)	0.7	0.0	6.8	18.8	14.8	0.0
Queue Length 95th (m)	3.3	8.6	16.0	28.4	23.0	3.0
Internal Link Dist (m)	249.7			540.4	157.6	
Turn Bay Length (m)	50.0		45.0			50.0
Base Capacity (vph)	389	508	412	1582	1597	702
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	0.02	0.20	0.28	0.37	0.30	0.04

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 60
Offset: 0 (0%), Referenced to phase 2:EBL and 6:, Start of Green
Natural Cycle: 50
Control Type: Pretimed

Splits and Phases: 7: Montrose & Canadian Dr.



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	8	95	108	540	443	25
Future Volume (vph)	8	95	108	540	443	25
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5	5.5
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	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)	1264	1419	1616	3113	3142	1355
Flt Permitted	0.95	1.00	0.48	1.00	1.00	1.00
Satd. Flow (perm)	1264	1419	811	3113	3142	1355
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	9	103	117	587	482	27
RTOR Reduction (vph)	0	71	0	0	0	13
Lane Group Flow (vph)	9	32	117	587	482	14
Heavy Vehicles (%)	33%	6%	4%	8%	7%	11%
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	2			8	4	
Permitted Phases		2	8			4
Actuated Green, G (s)	18.5	18.5	30.5	30.5	30.5	30.5
Effective Green, g (s)	18.5	18.5	30.5	30.5	30.5	30.5
Actuated g/C Ratio	0.31	0.31	0.51	0.51	0.51	0.51
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5
Lane Grp Cap (vph)	389	437	412	1582	1597	688
v/s Ratio Prot	0.01			c0.19	0.15	
v/s Ratio Perm		c0.02	0.14			0.01
v/c Ratio	0.02	0.07	0.28	0.37	0.30	0.02
Uniform Delay, d1	14.5	14.7	8.5	8.9	8.6	7.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	0.3	1.7	0.7	0.5	0.1
Delay (s)	14.6	15.0	10.2	9.6	9.1	7.4
Level of Service	B	B	B	A	A	A
Approach Delay (s)	15.0			9.7	9.0	
Approach LOS	B			A	A	

Intersection Summary			
HCM 2000 Control Delay	9.9	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.26		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	40.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	11	3	19	530	463	60
Future Volume (Veh/h)	11	3	19	530	463	60
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)	12	3	21	576	503	65
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)				182	222	
pX, platoon unblocked	0.94					
vC, conflicting volume	833	252	568			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	695	252	568			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	97	100	98			
cM capacity (veh/h)	350	754	1014			

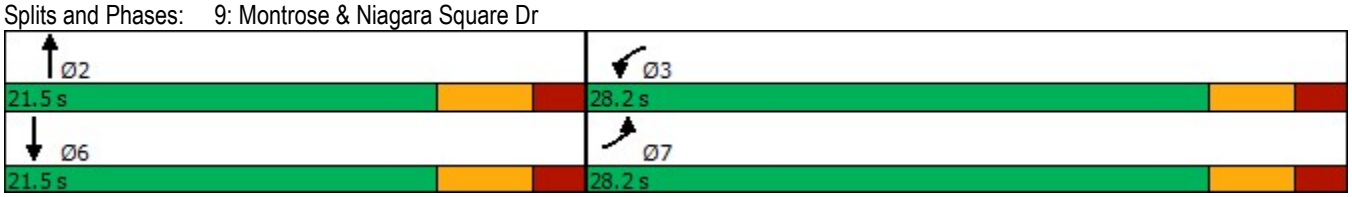
Direction, Lane #	EB 1	EB 2	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	12	3	21	288	288	252	252	65
Volume Left	12	0	21	0	0	0	0	0
Volume Right	0	3	0	0	0	0	0	65
cSH	350	754	1014	1700	1700	1700	1700	1700
Volume to Capacity	0.03	0.00	0.02	0.17	0.17	0.15	0.15	0.04
Queue Length 95th (m)	0.8	0.1	0.5	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	15.6	9.8	8.6	0.0	0.0	0.0	0.0	0.0
Lane LOS	C	A	A					
Approach Delay (s)	14.5		0.3			0.0		
Approach LOS	B							

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	32.1%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	WBL	NBT	SBT
Lane Configurations				
Traffic Volume (vph)	4	328	546	195
Future Volume (vph)	4	328	546	195
Lane Group Flow (vph)	4	357	593	212
Turn Type	Prot	Prot	NA	NA
Protected Phases	7	3	2	6
Permitted Phases				
Detector Phase	7	3	2	6
Switch Phase				
Minimum Initial (s)	8.0	8.0	8.0	8.0
Minimum Split (s)	13.2	13.2	13.5	13.5
Total Split (s)	28.2	28.2	21.5	21.5
Total Split (%)	56.7%	56.7%	43.3%	43.3%
Yellow Time (s)	3.2	3.2	3.5	3.5
All-Red Time (s)	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	3.0	3.0	3.0	3.0
Total Lost Time (s)	8.2	8.2	8.5	8.5
Lead/Lag				
Lead-Lag Optimize?				
Recall Mode	None	None	None	None
v/c Ratio	0.01	0.60	0.77	0.31
Control Delay	11.0	16.3	17.8	10.5
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	11.0	16.3	17.8	10.5
Queue Length 50th (m)	0.2	7.7	12.8	4.0
Queue Length 95th (m)	1.6	17.8	25.3	9.5
Internal Link Dist (m)			198.2	233.7
Turn Bay Length (m)				
Base Capacity (vph)	1125	2079	1355	1189
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	0.00	0.17	0.44	0.18

Intersection Summary
Cycle Length: 49.7
Actuated Cycle Length: 30.3
Natural Cycle: 40
Control Type: Actuated-Uncoordinated

Splits and Phases: 9: Montrose & Niagara Square Dr



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	4	0	0	328	0	0	0	546	0	0	195	0
Future Volume (vph)	4	0	0	328	0	0	0	546	0	0	195	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	8.2			8.2				8.5			8.5	
Lane Util. Factor	1.00			0.97				0.95			0.95	
Frt	1.00			1.00				1.00			1.00	
Flt Protected	0.95			0.95				1.00			1.00	
Satd. Flow (prot)	1681			3106				3113			2733	
Flt Permitted	0.95			0.95				1.00			1.00	
Satd. Flow (perm)	1681			3106				3113			2733	
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)	4	0	0	357	0	0	0	593	0	0	212	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	4	0	0	357	0	0	0	593	0	0	212	0
Heavy Vehicles (%)	0%	0%	0%	5%	0%	0%	0%	8%	0%	0%	23%	0%
Turn Type	Prot			Prot				NA			NA	
Protected Phases	7			3				2			6	
Permitted Phases												
Actuated Green, G (s)	8.8			8.8				10.6			10.6	
Effective Green, g (s)	5.8			5.8				7.6			7.6	
Actuated g/C Ratio	0.19			0.19				0.25			0.25	
Clearance Time (s)	5.2			5.2				5.5			5.5	
Vehicle Extension (s)	2.1			2.1				2.3			2.3	
Lane Grp Cap (vph)	323			598				786			690	
v/s Ratio Prot	0.00			c0.11				c0.19			0.08	
v/s Ratio Perm												
v/c Ratio	0.01			0.60				0.75			0.31	
Uniform Delay, d1	9.8			11.1				10.4			9.1	
Progression Factor	1.00			1.00				1.00			1.00	
Incremental Delay, d2	0.0			1.1				3.8			0.1	
Delay (s)	9.8			12.2				14.2			9.3	
Level of Service	A			B				B			A	
Approach Delay (s)		9.8			12.2			14.2			9.3	
Approach LOS		A			B			B			A	

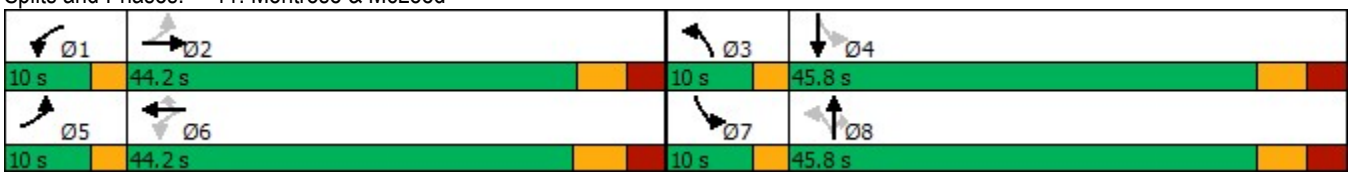
Intersection Summary			
HCM 2000 Control Delay	12.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	30.1	Sum of lost time (s)	16.7
Intersection Capacity Utilization	39.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	91	824	31	694	252	26	187	297	171	162
Future Volume (vph)	91	824	31	694	252	26	187	297	171	162
Lane Group Flow (vph)	99	908	34	754	274	28	203	323	186	268
Turn Type	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA
Protected Phases	5	2	1	6		3	8		7	4
Permitted Phases	2		6		6	8		8	4	
Detector Phase	5	2	1	6	6	3	8	8	7	4
Switch Phase										
Minimum Initial (s)	6.0	10.0	6.0	10.0	10.0	6.0	8.0	8.0	6.0	8.0
Minimum Split (s)	10.0	39.4	10.0	39.7	39.7	10.0	45.6	45.6	10.0	45.6
Total Split (s)	10.0	44.2	10.0	44.2	44.2	10.0	45.8	45.8	10.0	45.8
Total Split (%)	9.1%	40.2%	9.1%	40.2%	40.2%	9.1%	41.6%	41.6%	9.1%	41.6%
Yellow Time (s)	3.0	4.1	3.0	4.4	4.4	3.0	4.1	4.1	3.0	4.1
All-Red Time (s)	0.0	3.3	0.0	3.3	3.3	0.0	3.5	3.5	0.0	3.5
Lost Time Adjust (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	6.0	10.4	6.0	10.7	10.7	6.0	10.6	10.6	6.0	10.6
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	None	None	None
v/c Ratio	0.45	0.61	0.18	0.80	0.45	0.09	0.76	0.81	0.60	0.35
Control Delay	20.5	24.0	14.3	32.5	5.7	18.4	49.7	28.0	31.5	18.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.5	24.0	14.3	32.5	5.7	18.4	49.7	28.0	31.5	18.7
Queue Length 50th (m)	7.3	40.2	2.4	51.5	0.0	2.5	27.7	14.0	18.6	9.8
Queue Length 95th (m)	18.6	63.3	8.1	83.0	16.3	8.7	55.9	48.3	#43.8	25.9
Internal Link Dist (m)		257.8		244.2			112.3			232.4
Turn Bay Length (m)	55.0		140.0			90.0			140.0	
Base Capacity (vph)	226	2192	201	1546	816	337	793	764	311	1366
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.44	0.41	0.17	0.49	0.34	0.08	0.26	0.42	0.60	0.20

Intersection Summary

Cycle Length: 110
Actuated Cycle Length: 74.3
Natural Cycle: 110
Control Type: Actuated-Uncoordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 11: Montrose & McLoed



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	91	824	11	31	694	252	26	187	297	171	162	85
Future Volume (vph)	91	824	11	31	694	252	26	187	297	171	162	85
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	10.4		6.0	10.7	10.7	6.0	10.6	10.6	6.0	10.6	
Lane Util. Factor	1.00	0.91		1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1437	4582		1227	3264	1419	1681	1594	1319	1556	2652	
Flt Permitted	0.27	1.00		0.30	1.00	1.00	0.59	1.00	1.00	0.47	1.00	
Satd. Flow (perm)	403	4582		390	3264	1419	1038	1594	1319	763	2652	
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)	99	896	12	34	754	274	28	203	323	186	176	92
RTOR Reduction (vph)	0	1	0	0	0	195	0	0	174	0	67	0
Lane Group Flow (vph)	99	907	0	34	754	79	28	203	149	186	201	0
Confl. Peds. (#/hr)			2	2								
Heavy Vehicles (%)	17%	5%	20%	37%	3%	6%	0%	11%	14%	8%	23%	15%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2			6		6	8		8	4		
Actuated Green, G (s)	32.6	27.3		28.7	25.2	25.2	19.9	17.7	17.7	28.1	22.9	
Effective Green, g (s)	26.6	24.3		22.7	22.2	22.2	14.7	14.7	14.7	24.3	19.9	
Actuated g/C Ratio	0.35	0.32		0.30	0.29	0.29	0.19	0.19	0.19	0.32	0.26	
Clearance Time (s)	3.0	7.4		3.0	7.7	7.7	3.0	7.6	7.6	3.0	7.6	
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	170	1447		120	942	409	198	304	252	286	686	
v/s Ratio Prot	c0.02	0.20		0.00	c0.23			0.13		c0.04	0.08	
v/s Ratio Perm	0.18			0.08		0.06	0.03		0.11	c0.17		
v/c Ratio	0.58	0.63		0.28	0.80	0.19	0.14	0.67	0.59	0.65	0.29	
Uniform Delay, d1	20.4	22.4		20.2	25.3	20.6	25.9	28.8	28.4	22.5	22.9	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	4.2	0.7		0.9	4.8	0.2	0.2	4.9	3.1	4.7	0.2	
Delay (s)	24.5	23.2		21.2	30.1	20.8	26.1	33.8	31.5	27.2	23.0	
Level of Service	C	C		C	C	C	C	C	C	C	C	
Approach Delay (s)		23.3			27.4			32.0			24.7	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	26.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	76.9	Sum of lost time (s)	33.3
Intersection Capacity Utilization	75.0%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	947	9	44	1343	2	23
Future Volume (Veh/h)	947	9	44	1343	2	23
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)	1029	10	48	1460	2	25
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)	352			183		
pX, platoon unblocked			0.99		0.99	0.99
vC, conflicting volume			1039		1617	520
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1012		1598	486
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			93		98	95
cM capacity (veh/h)			684		91	526

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	WB 4	NB 1
Volume Total	686	353	48	487	487	487	27
Volume Left	0	0	48	0	0	0	2
Volume Right	0	10	0	0	0	0	25
cSH	1700	1700	684	1700	1700	1700	388
Volume to Capacity	0.40	0.21	0.07	0.29	0.29	0.29	0.07
Queue Length 95th (m)	0.0	0.0	1.7	0.0	0.0	0.0	1.7
Control Delay (s)	0.0	0.0	10.7	0.0	0.0	0.0	15.0
Lane LOS			B				B
Approach Delay (s)	0.0		0.3				15.0
Approach LOS							B

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	52.9%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBT	WBT	SBL	SBR
Lane Configurations				
Traffic Volume (vph)	803	541	195	847
Future Volume (vph)	803	541	195	847
Lane Group Flow (vph)	873	588	212	921
Turn Type	NA	NA	Prot	Free
Protected Phases	2	6	4	
Permitted Phases				Free
Minimum Split (s)	21.5	21.5	21.5	
Total Split (s)	28.0	28.0	22.0	
Total Split (%)	56.0%	56.0%	44.0%	
Yellow Time (s)	3.5	3.5	3.5	
All-Red Time (s)	2.0	2.0	2.0	
Lost Time Adjust (s)	3.0	3.0	3.0	
Total Lost Time (s)	8.5	8.5	8.5	
Lead/Lag				
Lead-Lag Optimize?				
v/c Ratio	0.69	0.50	0.52	0.64
Control Delay	16.3	13.4	20.9	2.2
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	16.3	13.4	20.9	2.2
Queue Length 50th (m)	32.5	19.8	15.9	0.0
Queue Length 95th (m)	49.0	31.3	32.0	0.0
Internal Link Dist (m)	158.9	496.9	180.1	
Turn Bay Length (m)			70.0	
Base Capacity (vph)	1260	1181	408	1446
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	0.69	0.50	0.52	0.64

Intersection Summary

Cycle Length: 50
Actuated Cycle Length: 50
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Green
Natural Cycle: 50
Control Type: Pretimed

Splits and Phases: 14: Lyons Creek & QEW FEB Off-Ramp

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	0	803	541	0	195	847
Future Volume (vph)	0	803	541	0	195	847
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)		8.5	8.5		8.5	7.0
Lane Util. Factor		0.95	0.95		1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00	1.00
Flpb, ped/bikes		1.00	1.00		1.00	1.00
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		3233	3029		1514	1446
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		3233	3029		1514	1446
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	873	588	0	212	921
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	873	588	0	212	921
Confl. Bikes (#/hr)				2		
Heavy Vehicles (%)	0%	4%	11%	0%	11%	4%
Turn Type		NA	NA		Prot	Free
Protected Phases		2	6		4	
Permitted Phases						Free
Actuated Green, G (s)		22.5	22.5		16.5	50.0
Effective Green, g (s)		19.5	19.5		13.5	50.0
Actuated g/C Ratio		0.39	0.39		0.27	1.00
Clearance Time (s)		5.5	5.5		5.5	
Lane Grp Cap (vph)		1260	1181		408	1446
v/s Ratio Prot		0.27	0.19		0.14	
v/s Ratio Perm						c0.64
v/c Ratio		0.69	0.50		0.52	0.64
Uniform Delay, d1		12.7	11.5		15.5	0.0
Progression Factor		1.00	1.00		1.00	1.00
Incremental Delay, d2		3.2	1.5		4.7	2.2
Delay (s)		15.9	13.0		20.2	2.2
Level of Service		B	B		C	A
Approach Delay (s)		15.9	13.0		5.5	
Approach LOS		B	B		A	

Intersection Summary			
HCM 2000 Control Delay	10.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	50.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	50.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	472	0	0	371	240	63
Future Volume (Veh/h)	472	0	0	371	240	63
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)	513	0	0	403	261	68
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			513		714	256
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			513		714	256
tC, single (s)			4.1		6.9	7.0
tC, 2 stage (s)						
tF (s)			2.2		3.6	3.3
p0 queue free %			100		27	91
cM capacity (veh/h)			1063		357	740

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	256	256	202	202	261	68
Volume Left	0	0	0	0	261	0
Volume Right	0	0	0	0	0	68
cSH	1700	1700	1700	1700	357	740
Volume to Capacity	0.15	0.15	0.12	0.12	0.73	0.09
Queue Length 95th (m)	0.0	0.0	0.0	0.0	42.3	2.3
Control Delay (s)	0.0	0.0	0.0	0.0	38.1	10.4
Lane LOS					E	B
Approach Delay (s)	0.0		0.0		32.4	
Approach LOS					D	

Intersection Summary			
Average Delay	8.5		
Intersection Capacity Utilization	50.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	17	21	18	427	349	10
Future Volume (Veh/h)	17	21	18	427	349	10
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)	18	23	20	464	379	11
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				TWLTL	TWLTL	
Median storage veh)				2	2	
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	656	195	390			
vC1, stage 1 conf vol	384					
vC2, stage 2 conf vol	272					
vCu, unblocked vol	656	195	390			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3	2.2			
p0 queue free %	97	97	98			
cM capacity (veh/h)	577	814	1165			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	41	20	232	232	253	137
Volume Left	18	20	0	0	0	0
Volume Right	23	0	0	0	0	11
cSH	689	1165	1700	1700	1700	1700
Volume to Capacity	0.06	0.02	0.14	0.14	0.15	0.08
Queue Length 95th (m)	1.4	0.4	0.0	0.0	0.0	0.0
Control Delay (s)	10.6	8.1	0.0	0.0	0.0	0.0
Lane LOS	B	A				
Approach Delay (s)	10.6	0.3			0.0	
Approach LOS	B					

Intersection Summary			
Average Delay	0.7		
Intersection Capacity Utilization	32.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	3	31	155	474	358	9
Future Volume (Veh/h)	3	31	155	474	358	9
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)	3	34	168	515	389	10
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	TWLTL	
Median storage veh)					2	
Upstream signal (m)				260		
pX, platoon unblocked	1.00					
vC, conflicting volume	988	200	399			
vC1, stage 1 conf vol	394					
vC2, stage 2 conf vol	594					
vCu, unblocked vol	980	200	399			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3	2.2			
p0 queue free %	99	96	85			
cM capacity (veh/h)	397	808	1156			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	37	168	258	258	259	140
Volume Left	3	168	0	0	0	0
Volume Right	34	0	0	0	0	10
cSH	746	1156	1700	1700	1700	1700
Volume to Capacity	0.05	0.15	0.15	0.15	0.15	0.08
Queue Length 95th (m)	1.2	3.9	0.0	0.0	0.0	0.0
Control Delay (s)	10.1	8.6	0.0	0.0	0.0	0.0
Lane LOS	B	A				
Approach Delay (s)	10.1	2.1			0.0	
Approach LOS	B					

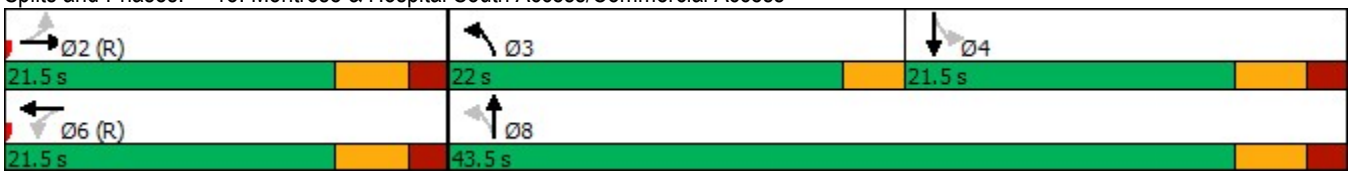
Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	43.7%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	6	0	7	0	455	620	22	349
Future Volume (vph)	6	0	7	0	455	620	22	349
Lane Group Flow (vph)	7	153	0	11	495	729	24	400
Turn Type	Perm	NA	Perm	NA	pm+pt	NA	Perm	NA
Protected Phases		2		6	3	8		4
Permitted Phases	2		6		8		4	
Minimum Split (s)	21.5	21.5	21.5	21.5	9.5	21.5	21.5	21.5
Total Split (s)	21.5	21.5	21.5	21.5	22.0	43.5	21.5	21.5
Total Split (%)	33.1%	33.1%	33.1%	33.1%	33.8%	66.9%	33.1%	33.1%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.0	3.5	3.5	3.5
All-Red Time (s)	2.0	2.0	2.0	2.0	0.0	2.0	2.0	2.0
Lost Time Adjust (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	8.5	8.5		8.5	6.0	8.5	8.5	8.5
Lead/Lag					Lead		Lag	Lag
Lead-Lag Optimize?					Yes		Yes	Yes
v/c Ratio	0.03	0.19		0.03	0.81	0.41	0.18	0.61
Control Delay	21.3	0.5		0.2	21.9	9.5	25.7	27.7
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Total Delay	21.3	0.5		0.2	21.9	9.5	25.7	27.7
Queue Length 50th (m)	0.7	0.0		0.0	32.2	24.2	2.4	22.7
Queue Length 95th (m)	3.5	0.0		0.0	#72.4	35.1	8.4	35.5
Internal Link Dist (m)		64.2		77.5		85.9		236.0
Turn Bay Length (m)					30.0		30.0	
Base Capacity (vph)	260	800		335	608	1764	130	660
Starvation Cap Reductn	0	0		0	0	0	0	0
Spillback Cap Reductn	0	0		0	0	0	0	0
Storage Cap Reductn	0	0		0	0	0	0	0
Reduced v/c Ratio	0.03	0.19		0.03	0.81	0.41	0.18	0.61

Intersection Summary

Cycle Length: 65
Actuated Cycle Length: 65
Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green
Natural Cycle: 65
Control Type: Pretimed
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 18: Montrose & Hospital South Access/Commercial Access



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	6	0	141	7	0	3	455	620	51	22	349	19
Future Volume (vph)	6	0	141	7	0	3	455	620	51	22	349	19
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	8.5	8.5			8.5		6.0	8.5		8.5	8.5	
Lane Util. Factor	1.00	1.00			1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.85			0.96		1.00	0.99		1.00	0.99	
Flt Protected	0.95	1.00			0.96		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1648	1475			1612		1648	3259		1648	3270	
Flt Permitted	0.75	1.00			0.78		0.35	1.00		0.37	1.00	
Satd. Flow (perm)	1302	1475			1309		613	3259		650	3270	
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	0	153	8	0	3	495	674	55	24	379	21
RTOR Reduction (vph)	0	122	0	0	9	0	0	9	0	0	6	0
Lane Group Flow (vph)	7	31	0	0	2	0	495	720	0	24	394	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		2			6		3	8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	16.0	16.0			16.0		38.0	38.0		16.0	16.0	
Effective Green, g (s)	13.0	13.0			13.0		35.0	35.0		13.0	13.0	
Actuated g/C Ratio	0.20	0.20			0.20		0.54	0.54		0.20	0.20	
Clearance Time (s)	5.5	5.5			5.5		3.0	5.5		5.5	5.5	
Lane Grp Cap (vph)	260	295			261		584	1754		130	654	
v/s Ratio Prot		c0.02					c0.21	0.22			0.12	
v/s Ratio Perm	0.01				0.00		c0.25			0.04		
v/c Ratio	0.03	0.10			0.01		0.85	0.41		0.18	0.60	
Uniform Delay, d1	20.9	21.2			20.8		10.5	8.9		21.6	23.6	
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.2	0.7			0.1		14.2	0.7		3.1	4.1	
Delay (s)	21.1	21.9			20.9		24.7	9.6		24.7	27.7	
Level of Service	C	C			C		C	A		C	C	
Approach Delay (s)		21.9			20.9			15.7			27.5	
Approach LOS		C			C			B			C	

Intersection Summary			
HCM 2000 Control Delay	19.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	65.0	Sum of lost time (s)	23.0
Intersection Capacity Utilization	67.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Configurations					
Traffic Volume (vph)	48	385	384	85	31
Future Volume (vph)	48	385	384	85	31
Lane Group Flow (vph)	52	418	649	92	34
Turn Type	Perm	NA	NA	Prot	Perm
Protected Phases		2	6	4	
Permitted Phases	2				4
Minimum Split (s)	21.5	21.5	21.5	21.5	21.5
Total Split (s)	38.5	38.5	38.5	21.5	21.5
Total Split (%)	64.2%	64.2%	64.2%	35.8%	35.8%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	8.5	8.5	8.5	8.5	8.5
Lead/Lag					
Lead-Lag Optimize?					
v/c Ratio	0.15	0.25	0.39	0.26	0.10
Control Delay	9.5	9.1	6.5	21.8	8.6
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	9.5	9.1	6.5	21.8	8.6
Queue Length 50th (m)	2.8	12.7	12.8	8.4	0.0
Queue Length 95th (m)	8.1	20.0	21.8	18.9	5.7
Internal Link Dist (m)		466.8	279.7	146.1	
Turn Bay Length (m)	30.0				
Base Capacity (vph)	351	1648	1675	357	346
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	0.25	0.39	0.26	0.10

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 60
Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBT, Start of Green
Natural Cycle: 45
Control Type: Pretimed

Splits and Phases: 19: Biggar & Hospital East Access

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	48	385	384	213	85	31
Future Volume (vph)	48	385	384	213	85	31
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	8.5	8.5	8.5		8.5	8.5
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Frt	1.00	1.00	0.95		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1648	3296	3119		1648	1475
Flt Permitted	0.41	1.00	1.00		0.95	1.00
Satd. Flow (perm)	703	3296	3119		1648	1475
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	52	418	417	232	92	34
RTOR Reduction (vph)	0	0	116	0	0	27
Lane Group Flow (vph)	52	418	533	0	92	7
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		2	6		4	
Permitted Phases	2					4
Actuated Green, G (s)	33.0	33.0	33.0		16.0	16.0
Effective Green, g (s)	30.0	30.0	30.0		13.0	13.0
Actuated g/C Ratio	0.50	0.50	0.50		0.22	0.22
Clearance Time (s)	5.5	5.5	5.5		5.5	5.5
Lane Grp Cap (vph)	351	1648	1559		357	319
v/s Ratio Prot		0.13	c0.17		c0.06	
v/s Ratio Perm	0.07					0.00
v/c Ratio	0.15	0.25	0.34		0.26	0.02
Uniform Delay, d1	8.1	8.6	9.0		19.5	18.5
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.9	0.4	0.6		1.7	0.1
Delay (s)	9.0	9.0	9.6		21.2	18.6
Level of Service	A	A	A		C	B
Approach Delay (s)		9.0	9.6		20.5	
Approach LOS		A	A		C	

Intersection Summary			
HCM 2000 Control Delay	10.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.32		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	53.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	19	433	367	48	0	15
Future Volume (Veh/h)	19	433	367	48	0	15
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)	21	471	399	52	0	16
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	451				702	226
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	451				702	226
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	98				100	98
cM capacity (veh/h)	1106				365	778

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1
Volume Total	21	236	236	266	185	16
Volume Left	21	0	0	0	0	0
Volume Right	0	0	0	0	52	16
cSH	1106	1700	1700	1700	1700	778
Volume to Capacity	0.02	0.14	0.14	0.16	0.11	0.02
Queue Length 95th (m)	0.4	0.0	0.0	0.0	0.0	0.5
Control Delay (s)	8.3	0.0	0.0	0.0	0.0	9.7
Lane LOS	A					A
Approach Delay (s)	0.4			0.0		9.7
Approach LOS						A

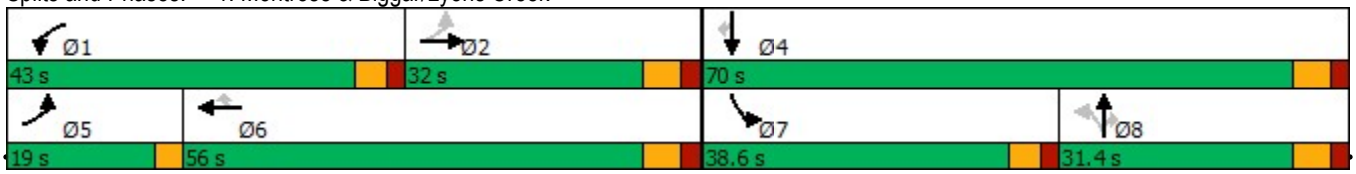
Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	33.8%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											
Traffic Volume (vph)	149	388	623	416	296	27	266	440	601	454	178
Future Volume (vph)	149	388	623	416	296	27	266	440	601	454	178
Lane Group Flow (vph)	162	482	677	452	322	29	289	478	653	493	193
Turn Type	pm+pt	NA	Prot	NA	Perm	Perm	NA	Perm	Prot	NA	Perm
Protected Phases	5	2	1	6			8		7	4	
Permitted Phases	2				6	8		8			4
Detector Phase	5	2	1	6	6	8	8	8	7	4	4
Switch Phase											
Minimum Initial (s)	4.0	10.0	8.0	10.0	10.0	10.0	10.0	10.0	8.0	10.0	10.0
Minimum Split (s)	8.0	26.3	13.5	26.3	26.3	31.3	31.3	31.3	13.5	31.3	31.3
Total Split (s)	19.0	32.0	43.0	56.0	56.0	31.4	31.4	31.4	38.6	70.0	70.0
Total Split (%)	13.1%	22.1%	29.7%	38.6%	38.6%	21.7%	21.7%	21.7%	26.6%	48.3%	48.3%
Yellow Time (s)	3.0	4.1	3.5	4.1	4.1	4.1	4.1	4.1	3.5	4.1	4.1
All-Red Time (s)	0.0	2.2	2.0	2.2	2.2	2.2	2.2	2.2	2.0	2.2	2.2
Lost Time Adjust (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	6.0	9.3	8.5	9.3	9.3	9.3	9.3	9.3	8.5	9.3	9.3
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lag	Lag	Lag	Lead		
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Recall Mode	None	Max	Max	Max	Max	Max	Max	Max	Max	Max	Max
v/c Ratio	0.59	0.97	1.02	0.41	0.51	0.23	0.59	0.84	1.01	0.39	0.27
Control Delay	35.9	92.6	94.1	38.5	12.8	59.3	62.8	23.2	95.1	30.5	7.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	35.9	92.6	94.1	38.5	12.8	59.3	62.8	23.2	95.1	30.5	7.3
Queue Length 50th (m)	26.5	72.1	~106.0	52.5	15.5	7.4	41.2	16.0	~99.6	51.3	6.1
Queue Length 95th (m)	41.1	#108.0	#144.1	70.0	45.3	17.7	56.8	#73.6	#139.2	66.4	21.7
Internal Link Dist (m)		279.7		233.5			313.4			90.5	
Turn Bay Length (m)	30.0		30.0		30.0	30.0		30.0	30.0		30.0
Base Capacity (vph)	306	497	663	1092	632	127	488	572	644	1249	720
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.53	0.97	1.02	0.41	0.51	0.23	0.59	0.84	1.01	0.39	0.27

Intersection Summary

Cycle Length: 145
Actuated Cycle Length: 145
Natural Cycle: 145
Control Type: Semi Act-Uncoord
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Montrose & Biggar/Lyons Creek



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	149	388	55	623	416	296	27	266	440	601	454	178
Future Volume (vph)	149	388	55	623	416	296	27	266	440	601	454	178
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	9.3		8.5	9.3	9.3	9.3	9.3	9.3	8.5	9.3	9.3
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1681	3131		2787	3202	1380	1681	3202	1446	3106	2985	1504
Flt Permitted	0.49	1.00		0.95	1.00	1.00	0.47	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	869	3131		2787	3202	1380	835	3202	1446	3106	2985	1504
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)	162	422	60	677	452	322	29	289	478	653	493	193
RTOR Reduction (vph)	0	8	0	0	0	161	0	0	353	0	0	91
Lane Group Flow (vph)	162	474	0	677	452	161	29	289	125	653	493	102
Heavy Vehicles (%)	0%	6%	1%	17%	5%	9%	0%	5%	4%	5%	7%	0%
Parking (#/hr)											0	
Turn Type	pm+pt	NA		Prot	NA	Perm	Perm	NA	Perm	Prot	NA	Perm
Protected Phases	5	2		1	6			8		7	4	
Permitted Phases	2					6	8		8			4
Actuated Green, G (s)	38.9	25.7		37.5	52.5	52.5	25.1	25.1	25.1	33.1	63.7	63.7
Effective Green, g (s)	32.9	22.7		34.5	49.5	49.5	22.1	22.1	22.1	30.1	60.7	60.7
Actuated g/C Ratio	0.23	0.16		0.24	0.34	0.34	0.15	0.15	0.15	0.21	0.42	0.42
Clearance Time (s)	3.0	6.3		5.5	6.3	6.3	6.3	6.3	6.3	5.5	6.3	6.3
Vehicle Extension (s)	3.0	6.0		3.0	6.0	6.0	6.0	6.0	6.0	3.0	6.0	6.0
Lane Grp Cap (vph)	254	490		663	1093	471	127	488	220	644	1249	629
v/s Ratio Prot	0.04	c0.15		c0.24	0.14			c0.09		c0.21	0.17	
v/s Ratio Perm	0.10					0.12	0.03		0.09			0.07
v/c Ratio	0.64	0.97		1.02	0.41	0.34	0.23	0.59	0.57	1.01	0.39	0.16
Uniform Delay, d1	48.1	60.8		55.2	36.6	35.6	54.0	57.3	57.0	57.5	29.4	26.3
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	5.2	33.5		40.4	1.2	2.0	4.1	5.2	10.3	39.0	0.9	0.6
Delay (s)	53.2	94.3		95.6	37.8	37.6	58.1	62.5	67.3	96.4	30.3	26.8
Level of Service	D	F		F	D	D	E	E	E	F	C	C
Approach Delay (s)		84.0			64.7			65.2			62.1	
Approach LOS		F			E			E			E	

Intersection Summary			
HCM 2000 Control Delay	66.9	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	145.0	Sum of lost time (s)	35.6
Intersection Capacity Utilization	89.5%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	30	6	444	7	2	686
Future Volume (Veh/h)	30	6	444	7	2	686
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)	33	7	483	8	2	746
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			TWLTL			TWLTL
Median storage veh)			2			2
Upstream signal (m)			329			
pX, platoon unblocked						
vC, conflicting volume	864	246			491	
vC1, stage 1 conf vol	487					
vC2, stage 2 conf vol	377					
vCu, unblocked vol	864	246			491	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3			2.2	
p0 queue free %	93	99			100	
cM capacity (veh/h)	502	761			1083	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	40	322	169	2	373	373
Volume Left	33	0	0	2	0	0
Volume Right	7	0	8	0	0	0
cSH	533	1700	1700	1083	1700	1700
Volume to Capacity	0.07	0.19	0.10	0.00	0.22	0.22
Queue Length 95th (m)	1.8	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	12.3	0.0	0.0	8.3	0.0	0.0
Lane LOS	B			A		
Approach Delay (s)	12.3	0.0		0.0		
Approach LOS	B					

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	35.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	219	19	13	507	699	211
Future Volume (Veh/h)	219	19	13	507	699	211
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)	238	21	14	551	760	229
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				TWLTL	None	
Median storage veh)				2		
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1178	494	989			
vC1, stage 1 conf vol	874					
vC2, stage 2 conf vol	304					
vCu, unblocked vol	1178	494	989			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3	2.2			
p0 queue free %	32	96	98			
cM capacity (veh/h)	348	526	707			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	259	14	276	276	507	482
Volume Left	238	14	0	0	0	0
Volume Right	21	0	0	0	0	229
cSH	358	707	1700	1700	1700	1700
Volume to Capacity	0.72	0.02	0.16	0.16	0.30	0.28
Queue Length 95th (m)	41.4	0.5	0.0	0.0	0.0	0.0
Control Delay (s)	37.3	10.2	0.0	0.0	0.0	0.0
Lane LOS	E	B				
Approach Delay (s)	37.3	0.3			0.0	
Approach LOS	E					

Intersection Summary			
Average Delay	5.4		
Intersection Capacity Utilization	54.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	142	25	624	160	28	685
Future Volume (Veh/h)	142	25	624	160	28	685
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)	154	27	678	174	30	745
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	1198	426			852	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1198	426			852	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	12	95			96	
cM capacity (veh/h)	174	582			795	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	181	452	400	30	372	372
Volume Left	154	0	0	30	0	0
Volume Right	27	0	174	0	0	0
cSH	195	1700	1700	795	1700	1700
Volume to Capacity	0.93	0.27	0.24	0.04	0.22	0.22
Queue Length 95th (m)	56.4	0.0	0.0	0.9	0.0	0.0
Control Delay (s)	96.8	0.0	0.0	9.7	0.0	0.0
Lane LOS	F			A		
Approach Delay (s)	96.8	0.0		0.4		
Approach LOS	F					

Intersection Summary			
Average Delay	9.9		
Intersection Capacity Utilization	47.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	65	44	38	600	634	61
Future Volume (Veh/h)	65	44	38	600	634	61
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)	71	48	41	652	689	66
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	1097	344	755			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1097	344	755			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	65	93	95			
cM capacity (veh/h)	201	657	865			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	119	41	326	326	344	344	66
Volume Left	71	41	0	0	0	0	0
Volume Right	48	0	0	0	0	0	66
cSH	279	865	1700	1700	1700	1700	1700
Volume to Capacity	0.43	0.05	0.19	0.19	0.20	0.20	0.04
Queue Length 95th (m)	15.4	1.1	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	27.2	9.4	0.0	0.0	0.0	0.0	0.0
Lane LOS	D	A					
Approach Delay (s)	27.2	0.6			0.0		
Approach LOS	D						

Intersection Summary			
Average Delay	2.3		
Intersection Capacity Utilization	46.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	155	53	54	610	605	223
Future Volume (Veh/h)	155	53	54	610	605	223
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)	168	58	59	663	658	242
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	1228	450	900			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1228	450	900			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	0	90	92			
cM capacity (veh/h)	160	562	763			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	226	59	332	332	439	461
Volume Left	168	59	0	0	0	0
Volume Right	58	0	0	0	0	242
cSH	196	763	1700	1700	1700	1700
Volume to Capacity	1.16	0.08	0.20	0.20	0.26	0.27
Queue Length 95th (m)	85.8	1.9	0.0	0.0	0.0	0.0
Control Delay (s)	162.1	10.1	0.0	0.0	0.0	0.0
Lane LOS	F	B				
Approach Delay (s)	162.1	0.8			0.0	
Approach LOS	F					

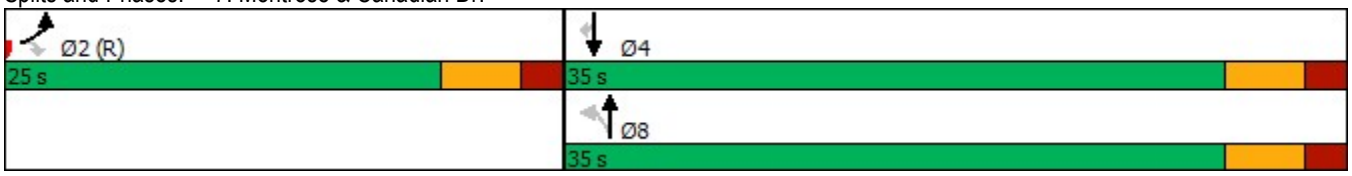
Intersection Summary			
Average Delay	20.1		
Intersection Capacity Utilization	59.6%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	186	277	207	606	551	198
Future Volume (vph)	186	277	207	606	551	198
Lane Group Flow (vph)	202	301	225	659	599	215
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	2			8	4	
Permitted Phases		2	8			4
Minimum Split (s)	23.5	23.5	23.5	23.5	23.5	23.5
Total Split (s)	25.0	25.0	35.0	35.0	35.0	35.0
Total Split (%)	41.7%	41.7%	58.3%	58.3%	58.3%	58.3%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	3.0	3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	8.5	8.5	8.5	8.5	8.5	8.5
Lead/Lag						
Lead-Lag Optimize?						
v/c Ratio	0.46	0.57	0.70	0.47	0.42	0.27
Control Delay	22.1	12.4	28.9	13.1	12.6	2.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	22.1	12.4	28.9	13.1	12.6	2.8
Queue Length 50th (m)	18.3	10.1	18.9	25.3	22.4	0.0
Queue Length 95th (m)	34.9	30.1	#50.6	37.5	33.4	9.5
Internal Link Dist (m)	249.7			540.4	157.6	
Turn Bay Length (m)	50.0		45.0			50.0
Base Capacity (vph)	440	531	320	1414	1441	784
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	0.46	0.57	0.70	0.47	0.42	0.27

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 60
Offset: 0 (0%), Referenced to phase 2:EBL and 6:, Start of Green
Natural Cycle: 60
Control Type: Pretimed
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 7: Montrose & Canadian Dr.



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	186	277	207	606	551	198
Future Volume (vph)	186	277	207	606	551	198
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	8.5	8.5	8.5	8.5	8.5	8.5
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	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)	1601	1446	1616	3202	3264	1504
Flt Permitted	0.95	1.00	0.43	1.00	1.00	1.00
Satd. Flow (perm)	1601	1446	724	3202	3264	1504
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	202	301	225	659	599	215
RTOR Reduction (vph)	0	133	0	0	0	120
Lane Group Flow (vph)	202	168	225	659	599	95
Heavy Vehicles (%)	5%	4%	4%	5%	3%	0%
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	2			8	4	
Permitted Phases		2	8			4
Actuated Green, G (s)	19.5	19.5	29.5	29.5	29.5	29.5
Effective Green, g (s)	16.5	16.5	26.5	26.5	26.5	26.5
Actuated g/C Ratio	0.28	0.28	0.44	0.44	0.44	0.44
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5
Lane Grp Cap (vph)	440	397	319	1414	1441	664
v/s Ratio Prot	c0.13			0.21	0.18	
v/s Ratio Perm		0.12	c0.31			0.06
v/c Ratio	0.46	0.42	0.71	0.47	0.42	0.14
Uniform Delay, d1	18.0	17.8	13.6	11.8	11.5	10.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	3.4	3.3	12.4	1.1	0.9	0.5
Delay (s)	21.5	21.1	25.9	12.9	12.3	10.4
Level of Service	C	C	C	B	B	B
Approach Delay (s)	21.3			16.2	11.8	
Approach LOS	C			B	B	

Intersection Summary			
HCM 2000 Control Delay	15.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	61.4%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	183	50	52	751	686	373
Future Volume (Veh/h)	183	50	52	751	686	373
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)	199	54	57	816	746	405
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)				182	222	
pX, platoon unblocked	0.90					
vC, conflicting volume	1268	373	1151			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1082	373	1151			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	0	91	91			
cM capacity (veh/h)	176	630	614			

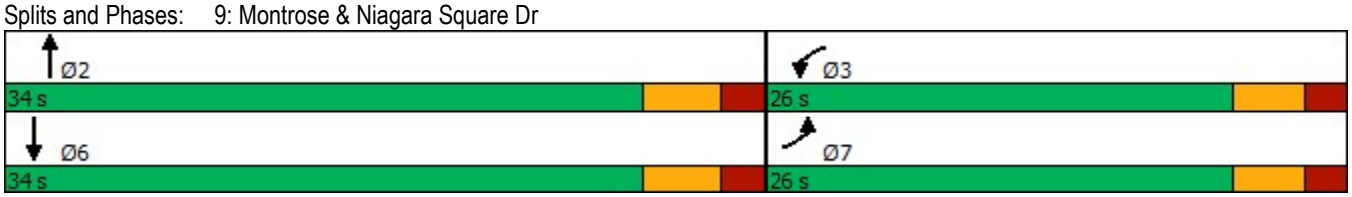
Direction, Lane #	EB 1	EB 2	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	199	54	57	408	408	373	373	405
Volume Left	199	0	57	0	0	0	0	0
Volume Right	0	54	0	0	0	0	0	405
cSH	176	630	614	1700	1700	1700	1700	1700
Volume to Capacity	1.13	0.09	0.09	0.24	0.24	0.22	0.22	0.24
Queue Length 95th (m)	77.3	2.1	2.3	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	160.1	11.2	11.5	0.0	0.0	0.0	0.0	0.0
Lane LOS	F	B	B					
Approach Delay (s)	128.3		0.7			0.0		
Approach LOS	F							

Intersection Summary			
Average Delay	14.5		
Intersection Capacity Utilization	52.4%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	WBL	WBT	NBT	SBT
Lane Configurations					
Traffic Volume (vph)	56	630	0	927	425
Future Volume (vph)	56	630	0	927	425
Lane Group Flow (vph)	61	685	2	1008	462
Turn Type	Prot	Prot		NA	NA
Protected Phases	7	3		2	6
Permitted Phases					
Detector Phase	7	3		2	6
Switch Phase					
Minimum Initial (s)	8.0	8.0		8.0	8.0
Minimum Split (s)	13.2	13.2		13.5	13.5
Total Split (s)	26.0	26.0		34.0	34.0
Total Split (%)	43.3%	43.3%		56.7%	56.7%
Yellow Time (s)	3.2	3.2		3.5	3.5
All-Red Time (s)	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	3.0	3.0		3.0	3.0
Total Lost Time (s)	8.2	8.2		8.5	8.5
Lead/Lag					
Lead-Lag Optimize?					
Recall Mode	None	None		None	None
v/c Ratio	0.16	0.87	0.01	0.88	0.43
Control Delay	15.6	29.7	0.0	23.3	12.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	15.6	29.7	0.0	23.3	12.3
Queue Length 50th (m)	3.6	25.4	0.0	35.4	13.2
Queue Length 95th (m)	12.1	50.7	0.0	66.4	26.8
Internal Link Dist (m)			271.6	198.2	233.7
Turn Bay Length (m)					
Base Capacity (vph)	710	1337	140	1956	1832
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	0.09	0.51	0.01	0.52	0.25

Intersection Summary
Cycle Length: 60
Actuated Cycle Length: 44.5
Natural Cycle: 60
Control Type: Actuated-Uncoordinated

Splits and Phases: 9: Montrose & Niagara Square Dr



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	56	0	0	630	0	2	0	927	0	0	425	0
Future Volume (vph)	56	0	0	630	0	2	0	927	0	0	425	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	8.2			8.2	7.0			8.5			8.5	
Lane Util. Factor	1.00			0.97	1.00			0.95			0.95	
Frt	1.00			1.00	0.85			1.00			1.00	
Flt Protected	0.95			0.95	1.00			1.00			1.00	
Satd. Flow (prot)	1681			3166	0			3233			3029	
Flt Permitted	0.95			0.95	1.00			1.00			1.00	
Satd. Flow (perm)	1681			3166	0			3233			3029	
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)	61	0	0	685	0	2	0	1008	0	0	462	0
RTOR Reduction (vph)	0	0	0	0	2	0	0	0	0	0	0	0
Lane Group Flow (vph)	61	0	0	685	0	0	0	1008	0	0	462	0
Heavy Vehicles (%)	0%	0%	0%	3%	0%	50%	0%	4%	0%	0%	11%	0%
Turn Type	Prot			Prot				NA			NA	
Protected Phases	7			3				2			6	
Permitted Phases												
Actuated Green, G (s)	14.2			14.2	0.0			19.0			19.0	
Effective Green, g (s)	11.2			11.2	0.0			16.0			16.0	
Actuated g/C Ratio	0.26			0.26	0.00			0.36			0.36	
Clearance Time (s)	5.2			5.2				5.5			5.5	
Vehicle Extension (s)	2.1			2.1				2.3			2.3	
Lane Grp Cap (vph)	428			807	0			1178			1103	
v/s Ratio Prot	0.04			c0.22				c0.31			0.15	
v/s Ratio Perm												
v/c Ratio	0.14			0.85	0.00			0.86			0.42	
Uniform Delay, d1	12.6			15.5	21.9			12.9			10.5	
Progression Factor	1.00			1.00	1.00			1.00			1.00	
Incremental Delay, d2	0.1			8.0	0.0			6.1			0.2	
Delay (s)	12.7			23.6	21.9			19.0			10.6	
Level of Service	B			C	C			B			B	
Approach Delay (s)		12.7			23.6			19.0			10.6	
Approach LOS		B			C			B			B	

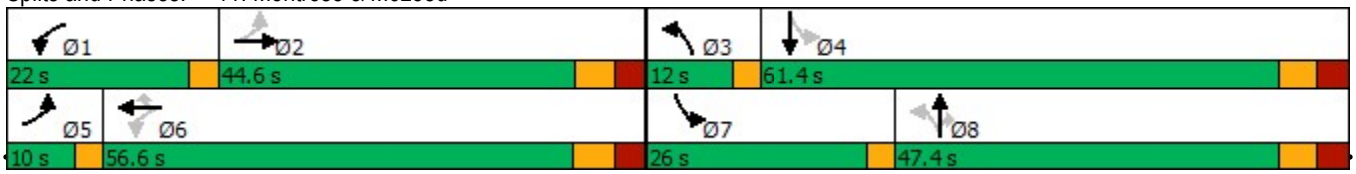
Intersection Summary			
HCM 2000 Control Delay	18.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	43.9	Sum of lost time (s)	16.7
Intersection Capacity Utilization	Err%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	91	957	210	911	328	99	289	559	405	299
Future Volume (vph)	91	957	210	911	328	99	289	559	405	299
Lane Group Flow (vph)	99	1080	228	990	357	108	314	608	440	421
Turn Type	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA
Protected Phases	5	2	1	6		3	8		7	4
Permitted Phases	2		6		6	8		8	4	
Detector Phase	5	2	1	6	6	3	8	8	7	4
Switch Phase										
Minimum Initial (s)	6.0	10.0	6.0	10.0	10.0	6.0	8.0	8.0	6.0	8.0
Minimum Split (s)	10.0	39.4	10.0	39.7	39.7	10.0	45.6	45.6	10.0	45.6
Total Split (s)	10.0	44.6	22.0	56.6	56.6	12.0	47.4	47.4	26.0	61.4
Total Split (%)	7.1%	31.9%	15.7%	40.4%	40.4%	8.6%	33.9%	33.9%	18.6%	43.9%
Yellow Time (s)	3.0	4.1	3.0	4.4	4.4	3.0	4.1	4.1	3.0	4.1
All-Red Time (s)	0.0	3.3	0.0	3.3	3.3	0.0	3.5	3.5	0.0	3.5
Lost Time Adjust (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	6.0	10.4	6.0	10.7	10.7	6.0	10.6	10.6	6.0	10.6
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	None	None	None
v/c Ratio	0.90	0.97	1.00	0.93	0.53	0.33	0.71	1.03	1.00	0.37
Control Delay	96.9	72.7	96.2	60.1	11.1	26.1	56.5	72.4	71.1	30.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	96.9	72.7	96.2	60.1	11.1	26.1	56.5	72.4	71.1	30.9
Queue Length 50th (m)	16.4	108.4	48.5	138.5	13.5	16.2	79.2	~120.3	84.1	41.5
Queue Length 95th (m)	#44.7	#137.5	#102.7	#177.3	42.7	27.6	113.3	#193.2	#163.0	55.8
Internal Link Dist (m)		257.8		244.2			112.3			232.4
Turn Bay Length (m)	45.0		140.0			90.0			140.0	
Base Capacity (vph)	110	1134	228	1085	674	338	444	590	442	1153
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.90	0.95	1.00	0.91	0.53	0.32	0.71	1.03	1.00	0.37

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 139.4
Natural Cycle: 140
Control Type: Actuated-Uncoordinated
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 11: Montrose & McLoed



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	91	957	37	210	911	328	99	289	559	405	299	88
Future Volume (vph)	91	957	37	210	911	328	99	289	559	405	299	88
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	10.4		6.0	10.7	10.7	6.0	10.6	10.6	6.0	10.6	
Lane Util. Factor	1.00	0.91		1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1514	4615		1542	3296	1460	1681	1685	1475	1664	3076	
Flt Permitted	0.15	1.00		0.10	1.00	1.00	0.51	1.00	1.00	0.34	1.00	
Satd. Flow (perm)	247	4615		165	3296	1460	895	1685	1475	600	3076	
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)	99	1040	40	228	990	357	108	314	608	440	325	96
RTOR Reduction (vph)	0	3	0	0	0	194	0	0	202	0	20	0
Lane Group Flow (vph)	99	1077	0	228	990	163	108	314	406	440	401	0
Confl. Peds. (#/hr)			7	7								
Heavy Vehicles (%)	11%	4%	4%	9%	2%	3%	0%	5%	2%	1%	6%	4%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2			6		6	8		8	4		
Actuated Green, G (s)	43.6	36.6		58.3	48.3	48.3	48.2	39.8	39.8	65.8	54.4	
Effective Green, g (s)	37.6	33.6		55.3	45.3	45.3	42.2	36.8	36.8	62.8	51.4	
Actuated g/C Ratio	0.27	0.24		0.40	0.32	0.32	0.30	0.26	0.26	0.45	0.37	
Clearance Time (s)	3.0	7.4		3.0	7.7	7.7	3.0	7.6	7.6	3.0	7.6	
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	102	1112		223	1071	474	301	444	389	422	1134	
v/s Ratio Prot	0.03	0.23		c0.12	0.30		0.01	0.19		c0.15	0.13	
v/s Ratio Perm	0.23			c0.29		0.11	0.09		0.28	c0.32		
v/c Ratio	0.97	0.97		1.02	0.92	0.34	0.36	0.71	1.04	1.04	0.35	
Uniform Delay, d1	48.7	52.4		41.0	45.4	35.7	36.3	46.4	51.3	34.2	31.9	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	79.3	19.6		66.2	13.0	0.3	0.5	4.7	57.7	55.4	0.1	
Delay (s)	128.0	71.9		107.2	58.4	36.1	36.8	51.2	109.0	89.6	32.1	
Level of Service	F	E		F	E	D	D	D	F	F	C	
Approach Delay (s)		76.7			60.4			83.8			61.5	
Approach LOS		E			E			F			E	

Intersection Summary			
HCM 2000 Control Delay	69.9	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	139.4	Sum of lost time (s)	33.3
Intersection Capacity Utilization	106.6%	ICU Level of Service	G
Analysis Period (min)	15		

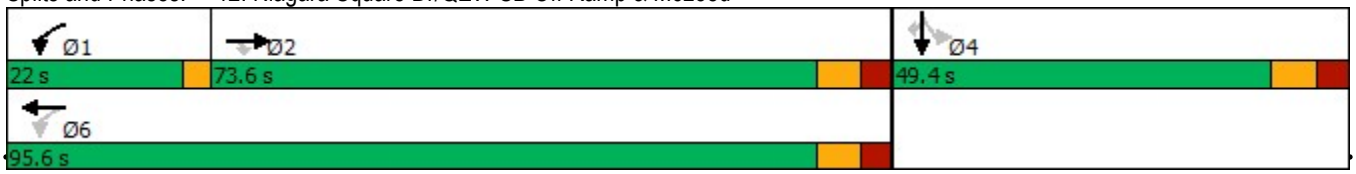
c Critical Lane Group

Lane Group	EBT	EBR	WBL	WBT	SBL	SBT	SBR
Lane Configurations							
Traffic Volume (vph)	1892	3	247	1084	447	383	382
Future Volume (vph)	1892	3	247	1084	447	383	382
Lane Group Flow (vph)	2057	3	268	1178	486	458	373
Turn Type	NA	Perm	pm+pt	NA	Perm	NA	Perm
Protected Phases	2		1	6		4	
Permitted Phases		2	6		4		4
Detector Phase	2	2	1	6	4	4	4
Switch Phase							
Minimum Initial (s)	20.0	20.0	6.0	20.0	10.0	10.0	10.0
Minimum Split (s)	34.3	34.3	10.0	34.3	47.7	47.7	47.7
Total Split (s)	73.6	73.6	22.0	95.6	49.4	49.4	49.4
Total Split (%)	50.8%	50.8%	15.2%	65.9%	34.1%	34.1%	34.1%
Yellow Time (s)	4.8	4.8	3.0	4.8	5.0	5.0	5.0
All-Red Time (s)	3.5	3.5	0.0	3.5	3.7	3.7	3.7
Lost Time Adjust (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	11.3	11.3	6.0	11.3	11.7	11.7	11.7
Lead/Lag	Lag	Lag	Lead				
Lead-Lag Optimize?	Yes	Yes	Yes				
Recall Mode	None	None	None	None	None	None	None
v/c Ratio	1.02	0.00	1.15	0.43	0.59	1.08	0.93
Control Delay	66.1	23.7	143.7	17.6	50.4	117.1	71.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	66.1	23.7	143.7	17.6	50.4	117.1	71.6
Queue Length 50th (m)	~228.9	0.5	~74.5	66.5	63.2	~154.1	92.4
Queue Length 95th (m)	#257.0	2.5	#131.3	77.2	81.5	#225.2	#156.6
Internal Link Dist (m)	244.2			227.3		107.7	
Turn Bay Length (m)		110.0	40.0				45.0
Base Capacity (vph)	2015	633	233	2726	823	423	403
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	1.02	0.00	1.15	0.43	0.59	1.08	0.93

Intersection Summary

Cycle Length: 145
Actuated Cycle Length: 145
Natural Cycle: 145
Control Type: Actuated-Uncoordinated
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 12: Niagara Square Dr/QEW SB Off Ramp & McLoed



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1892	3	247	1084	0	0	0	0	447	383	382
Future Volume (vph)	0	1892	3	247	1084	0	0	0	0	447	383	382
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		11.3	11.3	6.0	11.3					11.7	11.7	11.7
Lane Util. Factor		0.91	1.00	1.00	0.91					0.97	0.95	0.95
Frpb, ped/bikes		1.00	1.00	1.00	1.00					1.00	1.00	1.00
Flpb, ped/bikes		1.00	1.00	1.00	1.00					1.00	1.00	1.00
Frt		1.00	0.85	1.00	1.00					1.00	0.99	0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (prot)		4690	1475	1648	4690					3166	1620	1348
Flt Permitted		1.00	1.00	0.06	1.00					0.95	1.00	1.00
Satd. Flow (perm)		4690	1475	102	4690					3166	1620	1348
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	2057	3	268	1178	0	0	0	0	486	416	415
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	2	53
Lane Group Flow (vph)	0	2057	3	268	1178	0	0	0	0	486	456	320
Confl. Peds. (#/hr)	3					3						
Heavy Vehicles (%)	0%	3%	2%	2%	3%	0%	0%	0%	0%	3%	2%	6%
Turn Type		NA	Perm	pm+pt	NA					Perm	NA	Perm
Protected Phases		2		1	6						4	
Permitted Phases			2	6						4		4
Actuated Green, G (s)		65.3	65.3	87.3	87.3					40.7	40.7	40.7
Effective Green, g (s)		62.3	62.3	84.3	84.3					37.7	37.7	37.7
Actuated g/C Ratio		0.43	0.43	0.58	0.58					0.26	0.26	0.26
Clearance Time (s)		8.3	8.3	3.0	8.3					8.7	8.7	8.7
Vehicle Extension (s)		2.5	2.5	2.5	2.5					2.5	2.5	2.5
Lane Grp Cap (vph)		2015	633	229	2726					823	421	350
v/s Ratio Prot		0.44		c0.13	0.25						c0.28	
v/s Ratio Perm			0.00	c0.55						0.15		0.24
v/c Ratio		1.02	0.00	1.17	0.43					0.59	1.08	0.91
Uniform Delay, d1		41.4	23.6	48.7	17.0					46.9	53.6	52.1
Progression Factor		1.00	1.00	1.00	1.00					1.00	1.00	1.00
Incremental Delay, d2		25.5	0.0	113.2	0.1					1.0	67.9	27.3
Delay (s)		66.8	23.6	161.9	17.0					47.9	121.5	79.4
Level of Service		E	C	F	B					D	F	E
Approach Delay (s)		66.8			43.9			0.0			82.4	
Approach LOS		E			D			A			F	

Intersection Summary			
HCM 2000 Control Delay	64.2	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.17		
Actuated Cycle Length (s)	145.0	Sum of lost time (s)	29.0
Intersection Capacity Utilization	109.0%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	1417	11	35	1377	6	26
Future Volume (Veh/h)	1417	11	35	1377	6	26
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)	1540	12	38	1497	7	28
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)	352			183		
pX, platoon unblocked			0.89		0.89	0.89
vC, conflicting volume			1552		2121	776
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1378		2016	509
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			92		84	94
cM capacity (veh/h)			450		43	459

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	WB 4	NB 1
Volume Total	1027	525	38	499	499	499	35
Volume Left	0	0	38	0	0	0	7
Volume Right	0	12	0	0	0	0	28
cSH	1700	1700	450	1700	1700	1700	155
Volume to Capacity	0.60	0.31	0.08	0.29	0.29	0.29	0.23
Queue Length 95th (m)	0.0	0.0	2.1	0.0	0.0	0.0	6.3
Control Delay (s)	0.0	0.0	13.7	0.0	0.0	0.0	34.8
Lane LOS			B				D
Approach Delay (s)	0.0		0.3				34.8
Approach LOS							D

Intersection Summary			
Average Delay	0.6		
Intersection Capacity Utilization	57.9%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBT	WBT	SBL	SBR
Lane Configurations				
Traffic Volume (vph)	1103	535	443	877
Future Volume (vph)	1103	535	443	877
Lane Group Flow (vph)	1199	582	482	953
Turn Type	NA	NA	Prot	Free
Protected Phases	2	6	4	
Permitted Phases				Free
Minimum Split (s)	21.5	21.5	21.5	
Total Split (s)	38.0	38.0	22.0	
Total Split (%)	63.3%	63.3%	36.7%	
Yellow Time (s)	3.5	3.5	3.5	
All-Red Time (s)	2.0	2.0	2.0	
Lost Time Adjust (s)	3.0	3.0	3.0	
Total Lost Time (s)	8.5	8.5	8.5	
Lead/Lag				
Lead-Lag Optimize?				
v/c Ratio	0.75	0.38	0.68	0.65
Control Delay	15.9	10.5	27.0	2.2
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	15.9	10.5	27.0	2.2
Queue Length 50th (m)	51.7	19.5	25.1	0.0
Queue Length 95th (m)	73.3	29.3	38.7	0.0
Internal Link Dist (m)	158.9	496.9	180.1	
Turn Bay Length (m)			70.0	
Base Capacity (vph)	1604	1530	705	1475
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	0.75	0.38	0.68	0.65

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 60
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Green
Natural Cycle: 60
Control Type: Pretimed

Splits and Phases: 14: Lyons Creek & QEW FEB Off-Ramp

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	0	1103	535	0	443	877
Future Volume (vph)	0	1103	535	0	443	877
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)		8.5	8.5		8.5	7.0
Lane Util. Factor		0.95	0.95		0.97	1.00
Frpb, ped/bikes		1.00	1.00		1.00	1.00
Flpb, ped/bikes		1.00	1.00		1.00	1.00
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		3264	3113		3136	1475
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		3264	3113		3136	1475
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	1199	582	0	482	953
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1199	582	0	482	953
Confl. Bikes (#/hr)				1		
Heavy Vehicles (%)	0%	3%	8%	0%	4%	2%
Turn Type		NA	NA		Prot	Free
Protected Phases		2	6		4	
Permitted Phases						Free
Actuated Green, G (s)		32.5	32.5		16.5	60.0
Effective Green, g (s)		29.5	29.5		13.5	60.0
Actuated g/C Ratio		0.49	0.49		0.22	1.00
Clearance Time (s)		5.5	5.5		5.5	
Lane Grp Cap (vph)		1604	1530		705	1475
v/s Ratio Prot		0.37	0.19		0.15	
v/s Ratio Perm						c0.65
v/c Ratio		0.75	0.38		0.68	0.65
Uniform Delay, d1		12.3	9.5		21.3	0.0
Progression Factor		1.00	1.00		1.00	1.00
Incremental Delay, d2		3.2	0.7		5.3	2.2
Delay (s)		15.5	10.3		26.6	2.2
Level of Service		B	B		C	A
Approach Delay (s)		15.5	10.3		10.4	
Approach LOS		B	B		B	

Intersection Summary			
HCM 2000 Control Delay	12.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	61.0%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	946	0	0	480	112	101
Future Volume (Veh/h)	946	0	0	480	112	101
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)	1028	0	0	522	122	110
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			1028		1289	514
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1028		1289	514
tC, single (s)			4.1		7.2	7.0
tC, 2 stage (s)						
tF (s)			2.2		3.7	3.4
p0 queue free %			100		10	78
cM capacity (veh/h)			683		136	493

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	514	514	261	261	122	110
Volume Left	0	0	0	0	122	0
Volume Right	0	0	0	0	0	110
cSH	1700	1700	1700	1700	136	493
Volume to Capacity	0.30	0.30	0.15	0.15	0.90	0.22
Queue Length 95th (m)	0.0	0.0	0.0	0.0	45.4	6.4
Control Delay (s)	0.0	0.0	0.0	0.0	115.1	14.4
Lane LOS					F	B
Approach Delay (s)	0.0		0.0		67.4	
Approach LOS					F	

Intersection Summary			
Average Delay	8.8		
Intersection Capacity Utilization	61.0%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	14	20	19	486	690	21
Future Volume (Veh/h)	14	20	19	486	690	21
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)	15	22	21	528	750	23
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				TWLTL	TWLTL	
Median storage veh)				2	2	
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1068	386	773			
vC1, stage 1 conf vol	762					
vC2, stage 2 conf vol	306					
vCu, unblocked vol	1068	386	773			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3	2.2			
p0 queue free %	96	96	97			
cM capacity (veh/h)	388	612	838			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	37	21	264	264	500	273
Volume Left	15	21	0	0	0	0
Volume Right	22	0	0	0	0	23
cSH	496	838	1700	1700	1700	1700
Volume to Capacity	0.07	0.03	0.16	0.16	0.29	0.16
Queue Length 95th (m)	1.8	0.6	0.0	0.0	0.0	0.0
Control Delay (s)	12.8	9.4	0.0	0.0	0.0	0.0
Lane LOS	B	A				
Approach Delay (s)	12.8	0.4			0.0	
Approach LOS	B					

Intersection Summary			
Average Delay	0.5		
Intersection Capacity Utilization	36.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	8	85	61	498	733	3
Future Volume (Veh/h)	8	85	61	498	733	3
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)	9	92	66	541	797	3
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	TWLTL	
Median storage veh)					2	
Upstream signal (m)				260		
pX, platoon unblocked	0.95					
vC, conflicting volume	1201	400	800			
vC1, stage 1 conf vol	798					
vC2, stage 2 conf vol	402					
vCu, unblocked vol	1102	400	800			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	85	92			
cM capacity (veh/h)	366	600	819			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	101	66	270	270	531	269
Volume Left	9	66	0	0	0	0
Volume Right	92	0	0	0	0	3
cSH	567	819	1700	1700	1700	1700
Volume to Capacity	0.18	0.08	0.16	0.16	0.31	0.16
Queue Length 95th (m)	4.9	2.0	0.0	0.0	0.0	0.0
Control Delay (s)	12.7	9.8	0.0	0.0	0.0	0.0
Lane LOS	B	A				
Approach Delay (s)	12.7	1.1			0.0	
Approach LOS	B					

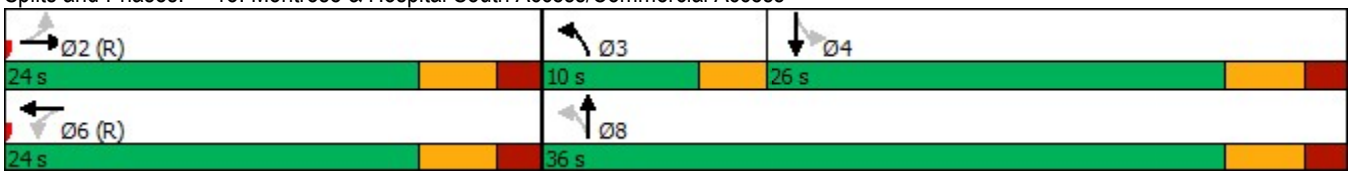
Intersection Summary			
Average Delay	1.3		
Intersection Capacity Utilization	49.5%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	17	0	46	0	180	522	4	806
Future Volume (vph)	17	0	46	0	180	522	4	806
Lane Group Flow (vph)	18	415	0	72	196	578	4	884
Turn Type	Perm	NA	Perm	NA	pm+pt	NA	Perm	NA
Protected Phases		2		6	3	8		4
Permitted Phases	2		6		8		4	
Minimum Split (s)	21.5	21.5	21.5	21.5	8.0	21.5	21.5	21.5
Total Split (s)	24.0	24.0	24.0	24.0	10.0	36.0	26.0	26.0
Total Split (%)	40.0%	40.0%	40.0%	40.0%	16.7%	60.0%	43.3%	43.3%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.0	3.5	3.5	3.5
All-Red Time (s)	2.0	2.0	2.0	2.0	0.0	2.0	2.0	2.0
Lost Time Adjust (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	8.5	8.5		8.5	6.0	8.5	8.5	8.5
Lead/Lag					Lead		Lag	Lag
Lead-Lag Optimize?					Yes		Yes	Yes
v/c Ratio	0.06	0.70		0.30	0.83	0.38	0.02	0.92
Control Delay	17.5	13.9		6.2	42.1	11.5	15.5	37.8
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Total Delay	17.5	13.9		6.2	42.1	11.5	15.5	37.8
Queue Length 50th (m)	1.5	11.0		0.0	11.3	20.5	0.3	48.9
Queue Length 95th (m)	5.6	#40.1		5.6	#34.2	30.7	2.1	#82.4
Internal Link Dist (m)		64.2		77.5		94.1		236.0
Turn Bay Length (m)					30.0		30.0	
Base Capacity (vph)	318	596		243	237	1508	219	961
Starvation Cap Reductn	0	0		0	0	0	0	0
Spillback Cap Reductn	0	0		0	0	0	0	0
Storage Cap Reductn	0	0		0	0	0	0	0
Reduced v/c Ratio	0.06	0.70		0.30	0.83	0.38	0.02	0.92

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 60
Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green
Natural Cycle: 60
Control Type: Pretimed
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 18: Montrose & Hospital South Access/Commercial Access



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	17	0	382	46	0	20	180	522	10	4	806	7
Future Volume (vph)	17	0	382	46	0	20	180	522	10	4	806	7
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	8.5	8.5			8.5		6.0	8.5		8.5	8.5	
Lane Util. Factor	1.00	1.00			1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.85			0.96		1.00	1.00		1.00	1.00	
Flt Protected	0.95	1.00			0.97		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1648	1475			1607		1648	3287		1648	3292	
Flt Permitted	0.71	1.00			0.39		0.17	1.00		0.43	1.00	
Satd. Flow (perm)	1232	1475			656		295	3287		753	3292	
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)	18	0	415	50	0	22	196	567	11	4	876	8
RTOR Reduction (vph)	0	216	0	0	53	0	0	2	0	0	1	0
Lane Group Flow (vph)	18	199	0	0	19	0	196	576	0	4	883	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		2			6		3	8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	18.5	18.5			18.5		30.5	30.5		20.5	20.5	
Effective Green, g (s)	15.5	15.5			15.5		27.5	27.5		17.5	17.5	
Actuated g/C Ratio	0.26	0.26			0.26		0.46	0.46		0.29	0.29	
Clearance Time (s)	5.5	5.5			5.5		3.0	5.5		5.5	5.5	
Lane Grp Cap (vph)	318	381			169		225	1506		219	960	
v/s Ratio Prot		c0.14					c0.06	0.18			0.27	
v/s Ratio Perm	0.01				0.03		c0.34			0.01		
v/c Ratio	0.06	0.52			0.11		0.87	0.38		0.02	0.92	
Uniform Delay, d1	16.7	19.1			17.0		12.7	10.7		15.1	20.6	
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.3	5.1			1.3		34.1	0.7		0.2	15.2	
Delay (s)	17.1	24.1			18.3		46.8	11.4		15.3	35.8	
Level of Service	B	C			B		D	B		B	D	
Approach Delay (s)		23.8			18.3			20.4			35.7	
Approach LOS		C			B			C			D	

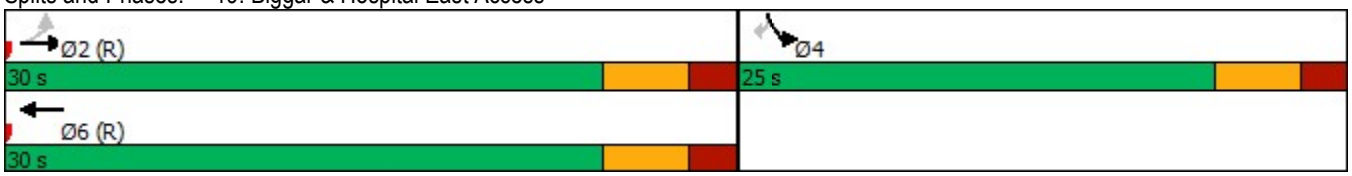
Intersection Summary			
HCM 2000 Control Delay	27.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	23.0
Intersection Capacity Utilization	93.9%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Configurations					
Traffic Volume (vph)	19	404	488	187	85
Future Volume (vph)	19	404	488	187	85
Lane Group Flow (vph)	21	439	621	203	92
Turn Type	Perm	NA	NA	Prot	Perm
Protected Phases		2	6	4	
Permitted Phases	2				4
Minimum Split (s)	21.5	21.5	21.5	21.5	21.5
Total Split (s)	30.0	30.0	30.0	25.0	25.0
Total Split (%)	54.5%	54.5%	54.5%	45.5%	45.5%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	8.5	8.5	8.5	8.5	8.5
Lead/Lag					
Lead-Lag Optimize?					
v/c Ratio	0.07	0.34	0.48	0.41	0.18
Control Delay	11.5	12.7	13.2	18.5	5.1
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	11.5	12.7	13.2	18.5	5.1
Queue Length 50th (m)	1.3	15.4	21.6	15.9	0.0
Queue Length 95th (m)	4.8	24.5	33.6	31.0	7.9
Internal Link Dist (m)		466.8	279.7	146.1	
Turn Bay Length (m)	30.0				
Base Capacity (vph)	282	1288	1285	494	506
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	0.07	0.34	0.48	0.41	0.18

Intersection Summary

Cycle Length: 55
Actuated Cycle Length: 55
Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBT, Start of Green
Natural Cycle: 45
Control Type: Pretimed

Splits and Phases: 19: Biggar & Hospital East Access



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	19	404	488	84	187	85
Future Volume (vph)	19	404	488	84	187	85
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	8.5	8.5	8.5		8.5	8.5
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Frt	1.00	1.00	0.98		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1648	3296	3224		1648	1475
Flt Permitted	0.42	1.00	1.00		0.95	1.00
Satd. Flow (perm)	722	3296	3224		1648	1475
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	21	439	530	91	203	92
RTOR Reduction (vph)	0	0	25	0	0	64
Lane Group Flow (vph)	21	439	596	0	203	28
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		2	6		4	
Permitted Phases	2					4
Actuated Green, G (s)	24.5	24.5	24.5		19.5	19.5
Effective Green, g (s)	21.5	21.5	21.5		16.5	16.5
Actuated g/C Ratio	0.39	0.39	0.39		0.30	0.30
Clearance Time (s)	5.5	5.5	5.5		5.5	5.5
Lane Grp Cap (vph)	282	1288	1260		494	442
v/s Ratio Prot		0.13	c0.18		c0.12	
v/s Ratio Perm	0.03					0.02
v/c Ratio	0.07	0.34	0.47		0.41	0.06
Uniform Delay, d1	10.5	11.8	12.5		15.4	13.7
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.5	0.7	1.3		2.5	0.3
Delay (s)	11.0	12.5	13.8		17.9	14.0
Level of Service	B	B	B		B	B
Approach Delay (s)		12.4	13.8		16.7	
Approach LOS		B	B		B	

Intersection Summary			
HCM 2000 Control Delay	14.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	55.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	43.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	7	380	554	19	43	42
Future Volume (Veh/h)	7	380	554	19	43	42
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	8	413	602	21	47	46
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	623				835	312
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	623				835	312
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				85	93
cM capacity (veh/h)	954				304	684

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1
Volume Total	8	206	206	401	222	93
Volume Left	8	0	0	0	0	47
Volume Right	0	0	0	0	21	46
cSH	954	1700	1700	1700	1700	419
Volume to Capacity	0.01	0.12	0.12	0.24	0.13	0.22
Queue Length 95th (m)	0.2	0.0	0.0	0.0	0.0	6.4
Control Delay (s)	8.8	0.0	0.0	0.0	0.0	16.0
Lane LOS	A					C
Approach Delay (s)	0.2			0.0		16.0
Approach LOS						C

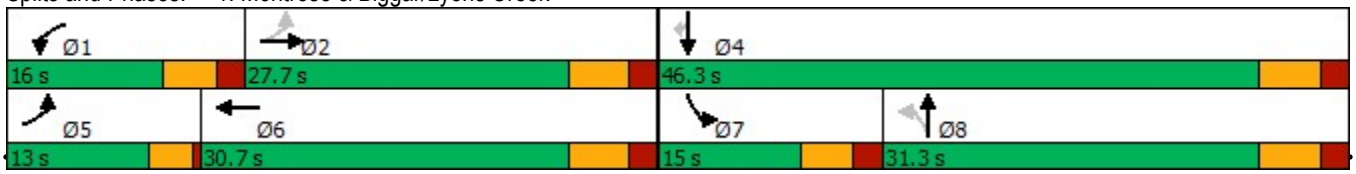
Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	34.3%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											
Traffic Volume (vph)	264	339	343	540	695	60	351	544	267	179	162
Future Volume (vph)	264	339	343	540	695	60	351	544	267	179	162
Lane Group Flow (vph)	287	391	373	587	755	65	382	591	290	195	176
Turn Type	pm+pt	NA	Prot	NA	Free	Perm	NA	Free	Prot	NA	Perm
Protected Phases	5	2	1	6			8		7	4	
Permitted Phases	2				Free	8		Free			4
Detector Phase	5	2	1	6		8	8		7	4	4
Switch Phase											
Minimum Initial (s)	4.0	10.0	4.0	10.0		10.0	10.0		4.0	10.0	10.0
Minimum Split (s)	8.0	26.3	9.5	26.3		31.3	31.3		9.5	31.3	31.3
Total Split (s)	13.0	27.7	16.0	30.7		31.3	31.3		15.0	46.3	46.3
Total Split (%)	14.4%	30.8%	17.8%	34.1%		34.8%	34.8%		16.7%	51.4%	51.4%
Yellow Time (s)	3.0	4.1	3.5	4.1		4.1	4.1		3.5	4.1	4.1
All-Red Time (s)	0.5	2.0	2.0	2.0		2.0	2.0		2.0	2.0	2.0
Lost Time Adjust (s)	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Total Lost Time (s)	6.5	9.1	8.5	9.1		9.1	9.1		8.5	9.1	9.1
Lead/Lag	Lead	Lag	Lead	Lag		Lag	Lag		Lead		
Lead-Lag Optimize?	Yes	Yes	Yes	Yes		Yes	Yes		Yes		
Recall Mode	None	Max	Max	Max		Max	Max		Max	Max	Max
v/c Ratio	1.02	0.58	1.47	0.75	0.56	0.24	0.48	0.40	1.46	0.16	0.25
Control Delay	87.0	35.6	263.5	38.6	1.7	30.0	31.3	0.8	264.3	17.0	3.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	87.0	35.6	263.5	38.6	1.7	30.0	31.3	0.8	264.3	17.0	3.7
Queue Length 50th (m)	~35.4	31.7	~46.0	49.6	0.0	9.0	29.7	0.0	~35.6	10.8	0.0
Queue Length 95th (m)	#85.3	46.2	#73.0	68.0	0.0	19.9	43.2	0.0	#60.0	17.7	11.4
Internal Link Dist (m)		279.7		233.5			313.4			98.6	
Turn Bay Length (m)	30.0		30.0		30.0	30.0		30.0	30.0		30.0
Base Capacity (vph)	281	674	254	783	1343	274	797	1460	199	1229	717
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.02	0.58	1.47	0.75	0.56	0.24	0.48	0.40	1.46	0.16	0.25

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 90
Natural Cycle: 90
Control Type: Semi Act-Uncoord
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Montrose & Biggar/Lyons Creek



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	264	339	21	343	540	695	60	351	544	267	179	162
Future Volume (vph)	264	339	21	343	540	695	60	351	544	267	179	162
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.5	9.1		8.5	9.1	7.0	9.1	9.1	7.0	8.5	9.1	9.1
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1681	3241		3048	3264	1343	1681	3233	1460	2764	2975	1485
Flt Permitted	0.38	1.00		0.95	1.00	1.00	0.63	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	677	3241		3048	3264	1343	1113	3233	1460	2764	2975	1485
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)	287	368	23	373	587	755	65	382	591	290	195	176
RTOR Reduction (vph)	0	5	0	0	0	0	0	0	0	0	0	103
Lane Group Flow (vph)	287	386	0	373	587	755	65	382	591	290	195	73
Confl. Bikes (#/hr)												1
Heavy Vehicles (%)	0%	3%	0%	7%	3%	12%	0%	4%	3%	18%	13%	0%
Turn Type	pm+pt	NA		Prot	NA	Free	Perm	NA	Free	Prot	NA	Perm
Protected Phases	5	2		1	6			8		7	4	
Permitted Phases	2					Free	8		Free			4
Actuated Green, G (s)	31.1	21.6		10.5	24.6	90.0	25.2	25.2	90.0	9.5	40.2	40.2
Effective Green, g (s)	25.1	18.6		7.5	21.6	90.0	22.2	22.2	90.0	6.5	37.2	37.2
Actuated g/C Ratio	0.28	0.21		0.08	0.24	1.00	0.25	0.25	1.00	0.07	0.41	0.41
Clearance Time (s)	3.5	6.1		5.5	6.1		6.1	6.1		5.5	6.1	6.1
Vehicle Extension (s)	3.0	6.0		3.0	6.0		6.0	6.0		3.0	6.0	6.0
Lane Grp Cap (vph)	261	669		254	783	1343	274	797	1460	199	1229	613
v/s Ratio Prot	0.08	0.12		c0.12	0.18			0.12		c0.10	0.07	
v/s Ratio Perm	c0.23					c0.56	0.06		0.40			0.05
v/c Ratio	1.10	0.58		1.47	0.75	0.56	0.24	0.48	0.40	1.46	0.16	0.12
Uniform Delay, d1	30.4	32.2		41.2	31.7	0.0	27.1	29.0	0.0	41.8	16.6	16.3
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	85.0	3.6		231.1	6.5	1.7	2.0	2.1	0.8	231.4	0.3	0.4
Delay (s)	115.4	35.8		272.3	38.2	1.7	29.2	31.0	0.8	273.2	16.9	16.7
Level of Service	F	D		F	D	A	C	C	A	F	B	B
Approach Delay (s)		69.5			73.1			13.7			129.3	
Approach LOS		E			E			B			F	

Intersection Summary			
HCM 2000 Control Delay	66.5	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	35.2
Intersection Capacity Utilization	78.6%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	11	3	540	68	12	438
Future Volume (Veh/h)	11	3	540	68	12	438
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)	12	3	587	74	13	476
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			TWLTL			TWLTL
Median storage veh)			2			2
Upstream signal (m)			329			
pX, platoon unblocked	0.92	0.92			0.92	
vC, conflicting volume	888	330			661	
vC1, stage 1 conf vol	624					
vC2, stage 2 conf vol	264					
vCu, unblocked vol	705	99			459	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3			2.2	
p0 queue free %	98	100			99	
cM capacity (veh/h)	529	868			1024	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	15	391	270	13	238	238
Volume Left	12	0	0	13	0	0
Volume Right	3	0	74	0	0	0
cSH	574	1700	1700	1024	1700	1700
Volume to Capacity	0.03	0.23	0.16	0.01	0.14	0.14
Queue Length 95th (m)	0.6	0.0	0.0	0.3	0.0	0.0
Control Delay (s)	11.4	0.0	0.0	8.6	0.0	0.0
Lane LOS	B			A		
Approach Delay (s)	11.4	0.0		0.2		
Approach LOS	B					

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	33.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	386	18	45	500	471	337
Future Volume (Veh/h)	386	18	45	500	471	337
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)	420	20	49	543	512	366
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				TWLTL	None	
Median storage veh)				2		
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1064	439	878			
vC1, stage 1 conf vol	695					
vC2, stage 2 conf vol	370					
vCu, unblocked vol	1064	439	878			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3	2.2			
p0 queue free %	0	96	94			
cM capacity (veh/h)	405	571	778			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	440	49	272	272	341	537
Volume Left	420	49	0	0	0	0
Volume Right	20	0	0	0	0	366
cSH	411	778	1700	1700	1700	1700
Volume to Capacity	1.07	0.06	0.16	0.16	0.20	0.32
Queue Length 95th (m)	112.5	1.5	0.0	0.0	0.0	0.0
Control Delay (s)	96.8	9.9	0.0	0.0	0.0	0.0
Lane LOS	F	A				
Approach Delay (s)	96.8	0.8			0.0	
Approach LOS	F					

Intersection Summary			
Average Delay	22.5		
Intersection Capacity Utilization	71.1%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	55	6	670	205	18	657
Future Volume (Veh/h)	55	6	670	205	18	657
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	7	728	223	20	714
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	1236	476			951	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1236	476			951	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	64	99			97	
cM capacity (veh/h)	166	541			730	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	67	485	466	20	357	357
Volume Left	60	0	0	20	0	0
Volume Right	7	0	223	0	0	0
cSH	179	1700	1700	730	1700	1700
Volume to Capacity	0.37	0.29	0.27	0.03	0.21	0.21
Queue Length 95th (m)	12.2	0.0	0.0	0.6	0.0	0.0
Control Delay (s)	36.6	0.0	0.0	10.1	0.0	0.0
Lane LOS	E			B		
Approach Delay (s)	36.6	0.0		0.3		
Approach LOS	E					

Intersection Summary			
Average Delay	1.5		
Intersection Capacity Utilization	42.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	77	35	39	616	641	83
Future Volume (Veh/h)	77	35	39	616	641	83
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)	84	38	42	670	697	90
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	1161	394	787			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1161	394	787			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	54	94	95			
cM capacity (veh/h)	182	611	841			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	122	42	335	335	465	322
Volume Left	84	42	0	0	0	0
Volume Right	38	0	0	0	0	90
cSH	233	841	1700	1700	1700	1700
Volume to Capacity	0.52	0.05	0.20	0.20	0.27	0.19
Queue Length 95th (m)	20.9	1.2	0.0	0.0	0.0	0.0
Control Delay (s)	36.3	9.5	0.0	0.0	0.0	0.0
Lane LOS	E	A				
Approach Delay (s)	36.3	0.6			0.0	
Approach LOS	E					

Intersection Summary			
Average Delay	3.0		
Intersection Capacity Utilization	49.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	198	50	35	659	675	85
Future Volume (Veh/h)	198	50	35	659	675	85
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)	215	54	38	716	734	92
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	1214	413	826			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1214	413	826			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	0	91	95			
cM capacity (veh/h)	169	594	813			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	269	38	358	358	489	337
Volume Left	215	38	0	0	0	0
Volume Right	54	0	0	0	0	92
cSH	197	813	1700	1700	1700	1700
Volume to Capacity	1.37	0.05	0.21	0.21	0.29	0.20
Queue Length 95th (m)	117.9	1.1	0.0	0.0	0.0	0.0
Control Delay (s)	239.8	9.6	0.0	0.0	0.0	0.0
Lane LOS	F	A				
Approach Delay (s)	239.8	0.5			0.0	
Approach LOS	F					

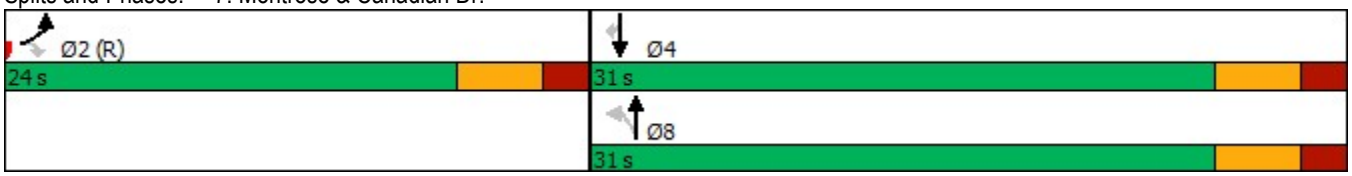
Intersection Summary			
Average Delay	35.1		
Intersection Capacity Utilization	58.5%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	9	106	120	779	654	28
Future Volume (vph)	9	106	120	779	654	28
Lane Group Flow (vph)	10	115	130	847	711	30
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	2			8	4	
Permitted Phases		2	8			4
Minimum Split (s)	23.5	23.5	23.5	23.5	23.5	23.5
Total Split (s)	24.0	24.0	31.0	31.0	31.0	31.0
Total Split (%)	43.6%	43.6%	56.4%	56.4%	56.4%	56.4%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	2.0	2.0	2.0	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)	5.5	5.5	5.5	5.5	5.5	5.5
Lead/Lag						
Lead-Lag Optimize?						
v/c Ratio	0.02	0.21	0.47	0.59	0.49	0.05
Control Delay	12.6	4.4	17.4	12.9	11.7	3.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.6	4.4	17.4	12.9	11.7	3.9
Queue Length 50th (m)	0.7	0.0	8.3	30.4	24.0	0.0
Queue Length 95th (m)	3.2	8.2	22.1	45.1	36.0	3.3
Internal Link Dist (m)	249.7			540.4	157.6	
Turn Bay Length (m)	50.0		45.0			50.0
Base Capacity (vph)	425	553	274	1443	1456	644
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	0.02	0.21	0.47	0.59	0.49	0.05

Intersection Summary

Cycle Length: 55
Actuated Cycle Length: 55
Offset: 0 (0%), Referenced to phase 2:EBL and 6:, Start of Green
Natural Cycle: 55
Control Type: Pretimed

Splits and Phases: 7: Montrose & Canadian Dr.



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	9	106	120	779	654	28
Future Volume (vph)	9	106	120	779	654	28
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5	5.5
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	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)	1264	1419	1616	3113	3142	1355
Flt Permitted	0.95	1.00	0.35	1.00	1.00	1.00
Satd. Flow (perm)	1264	1419	592	3113	3142	1355
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	10	115	130	847	711	30
RTOR Reduction (vph)	0	76	0	0	0	16
Lane Group Flow (vph)	10	39	130	847	711	14
Heavy Vehicles (%)	33%	6%	4%	8%	7%	11%
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	2			8	4	
Permitted Phases		2	8			4
Actuated Green, G (s)	18.5	18.5	25.5	25.5	25.5	25.5
Effective Green, g (s)	18.5	18.5	25.5	25.5	25.5	25.5
Actuated g/C Ratio	0.34	0.34	0.46	0.46	0.46	0.46
Clearance Time (s)	5.5	5.5	5.5	5.5	5.5	5.5
Lane Grp Cap (vph)	425	477	274	1443	1456	628
v/s Ratio Prot	0.01			c0.27	0.23	
v/s Ratio Perm		c0.03	0.22			0.01
v/c Ratio	0.02	0.08	0.47	0.59	0.49	0.02
Uniform Delay, d1	12.2	12.5	10.1	10.9	10.2	8.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	0.3	5.8	1.8	1.2	0.1
Delay (s)	12.3	12.8	15.9	12.6	11.4	8.1
Level of Service	B	B	B	B	B	A
Approach Delay (s)	12.7			13.1	11.3	
Approach LOS	B			B	B	

Intersection Summary			
HCM 2000 Control Delay	12.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.37		
Actuated Cycle Length (s)	55.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	47.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	12	4	21	768	676	67
Future Volume (Veh/h)	12	4	21	768	676	67
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)	13	4	23	835	735	73
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)				182	222	
pX, platoon unblocked	0.84					
vC, conflicting volume	1198	368	808			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	853	368	808			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	95	99	97			
cM capacity (veh/h)	247	635	826			

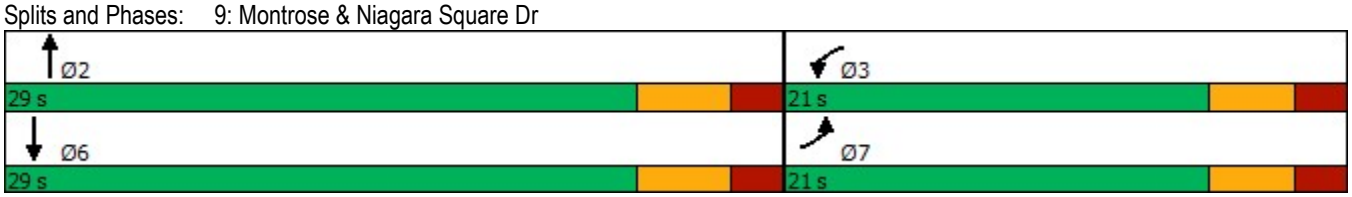
Direction, Lane #	EB 1	EB 2	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	13	4	23	418	418	368	368	73
Volume Left	13	0	23	0	0	0	0	0
Volume Right	0	4	0	0	0	0	0	73
cSH	247	635	826	1700	1700	1700	1700	1700
Volume to Capacity	0.05	0.01	0.03	0.25	0.25	0.22	0.22	0.04
Queue Length 95th (m)	1.3	0.1	0.7	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	20.4	10.7	9.5	0.0	0.0	0.0	0.0	0.0
Lane LOS	C	B	A					
Approach Delay (s)	18.1		0.3			0.0		
Approach LOS	C							

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	38.0%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	WBL	NBT	SBT
Lane Configurations				
Traffic Volume (vph)	5	466	786	278
Future Volume (vph)	5	466	786	278
Lane Group Flow (vph)	5	507	854	302
Turn Type	Prot	Prot	NA	NA
Protected Phases	7	3	2	6
Permitted Phases				
Detector Phase	7	3	2	6
Switch Phase				
Minimum Initial (s)	8.0	8.0	8.0	8.0
Minimum Split (s)	13.2	13.2	13.5	13.5
Total Split (s)	21.0	21.0	29.0	29.0
Total Split (%)	42.0%	42.0%	58.0%	58.0%
Yellow Time (s)	3.2	3.2	3.5	3.5
All-Red Time (s)	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	3.0	3.0	3.0	3.0
Total Lost Time (s)	8.2	8.2	8.5	8.5
Lead/Lag				
Lead-Lag Optimize?				
Recall Mode	None	None	None	None
v/c Ratio	0.01	0.78	0.86	0.35
Control Delay	13.2	23.6	21.5	10.7
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	13.2	23.6	21.5	10.7
Queue Length 50th (m)	0.3	14.4	23.4	6.7
Queue Length 95th (m)	2.1	32.7	46.7	15.6
Internal Link Dist (m)			198.2	233.7
Turn Bay Length (m)				
Base Capacity (vph)	606	1119	1797	1578
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	0.01	0.45	0.48	0.19

Intersection Summary
Cycle Length: 50
Actuated Cycle Length: 37
Natural Cycle: 50
Control Type: Actuated-Uncoordinated

Splits and Phases: 9: Montrose & Niagara Square Dr



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	5	0	0	466	0	0	0	786	0	0	278	0
Future Volume (vph)	5	0	0	466	0	0	0	786	0	0	278	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	8.2			8.2				8.5			8.5	
Lane Util. Factor	1.00			0.97				0.95			0.95	
Frt	1.00			1.00				1.00			1.00	
Flt Protected	0.95			0.95				1.00			1.00	
Satd. Flow (prot)	1681			3106				3113			2733	
Flt Permitted	0.95			0.95				1.00			1.00	
Satd. Flow (perm)	1681			3106				3113			2733	
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	0	0	507	0	0	0	854	0	0	302	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	5	0	0	507	0	0	0	854	0	0	302	0
Heavy Vehicles (%)	0%	0%	0%	5%	0%	0%	0%	8%	0%	0%	23%	0%
Turn Type	Prot			Prot				NA			NA	
Protected Phases	7			3				2			6	
Permitted Phases												
Actuated Green, G (s)	10.9			10.9				15.0			15.0	
Effective Green, g (s)	7.9			7.9				12.0			12.0	
Actuated g/C Ratio	0.22			0.22				0.33			0.33	
Clearance Time (s)	5.2			5.2				5.5			5.5	
Vehicle Extension (s)	2.1			2.1				2.3			2.3	
Lane Grp Cap (vph)	362			670				1020			896	
v/s Ratio Prot	0.00			c0.16				c0.27			0.11	
v/s Ratio Perm												
v/c Ratio	0.01			0.76				0.84			0.34	
Uniform Delay, d1	11.3			13.4				11.4			9.3	
Progression Factor	1.00			1.00				1.00			1.00	
Incremental Delay, d2	0.0			4.4				5.9			0.1	
Delay (s)	11.3			17.9				17.3			9.4	
Level of Service	B			B				B			A	
Approach Delay (s)		11.3			17.9			17.3			9.4	
Approach LOS		B			B			B			A	

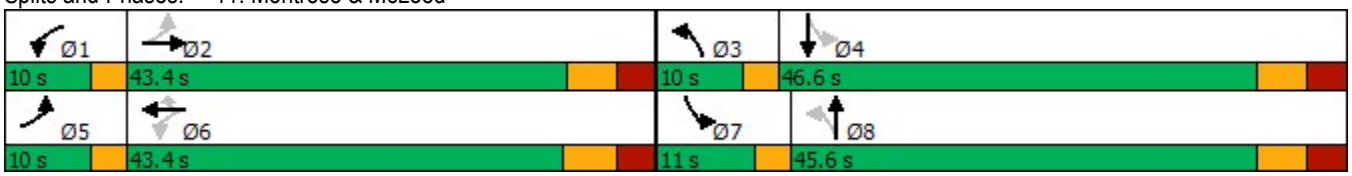
Intersection Summary			
HCM 2000 Control Delay	16.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	36.6	Sum of lost time (s)	16.7
Intersection Capacity Utilization	50.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	104	938	35	787	283	29	267	448	192	241
Future Volume (vph)	104	938	35	787	283	29	267	448	192	241
Lane Group Flow (vph)	113	1033	38	855	308	32	290	487	209	367
Turn Type	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA	Free	pm+pt	NA
Protected Phases	5	2	1	6		3	8		7	4
Permitted Phases	2		6		6	8		Free	4	
Detector Phase	5	2	1	6	6	3	8		7	4
Switch Phase										
Minimum Initial (s)	6.0	10.0	6.0	10.0	10.0	6.0	8.0		6.0	8.0
Minimum Split (s)	10.0	39.4	10.0	39.7	39.7	10.0	45.6		11.0	45.6
Total Split (s)	10.0	43.4	10.0	43.4	43.4	10.0	45.6		11.0	46.6
Total Split (%)	9.1%	39.5%	9.1%	39.5%	39.5%	9.1%	41.5%		10.0%	42.4%
Yellow Time (s)	3.0	4.1	3.0	4.4	4.4	3.0	4.1		3.0	4.1
All-Red Time (s)	0.0	3.3	0.0	3.3	3.3	0.0	3.5		0.0	3.5
Lost Time Adjust (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0
Total Lost Time (s)	6.0	10.4	6.0	10.7	10.7	6.0	10.6		6.0	10.6
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes
Recall Mode	None	None	None	None	None	None	None		None	None
v/c Ratio	0.54	0.59	0.21	0.82	0.46	0.13	0.73	0.37	0.80	0.62
Control Delay	23.4	21.8	13.2	31.9	5.1	20.8	44.9	0.8	49.8	30.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.4	21.8	13.2	31.9	5.1	20.8	44.9	0.8	49.8	30.9
Queue Length 50th (m)	8.1	46.2	2.6	59.3	0.0	3.2	22.0	0.0	23.5	23.3
Queue Length 95th (m)	#19.8	67.6	7.9	89.1	16.1	9.6	37.2	0.0	#62.1	41.6
Internal Link Dist (m)		257.8		244.2			112.3			232.4
Turn Bay Length (m)	55.0		140.0			90.0			140.0	
Base Capacity (vph)	209	1966	194	1387	780	266	1377	1319	261	1277
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.54	0.53	0.20	0.62	0.39	0.12	0.21	0.37	0.80	0.29

Intersection Summary

Cycle Length: 110
Actuated Cycle Length: 78.1
Natural Cycle: 110
Control Type: Actuated-Uncoordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 11: Montrose & McLoed



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	104	938	12	35	787	283	29	267	448	192	241	97
Future Volume (vph)	104	938	12	35	787	283	29	267	448	192	241	97
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	10.4		6.0	10.7	10.7	6.0	10.6	7.0	6.0	10.6	
Lane Util. Factor	1.00	0.91		1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1437	4583		1227	3264	1419	1681	3029	1319	1556	2666	
Flt Permitted	0.21	1.00		0.27	1.00	1.00	0.53	1.00	1.00	0.41	1.00	
Satd. Flow (perm)	322	4583		342	3264	1419	943	3029	1319	678	2666	
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)	113	1020	13	38	855	308	32	290	487	209	262	105
RTOR Reduction (vph)	0	1	0	0	0	207	0	0	0	0	46	0
Lane Group Flow (vph)	113	1032	0	38	855	101	32	290	487	209	321	0
Confl. Peds. (#/hr)			2	2								
Heavy Vehicles (%)	17%	5%	20%	37%	3%	6%	0%	11%	14%	8%	23%	15%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Free	pm+pt	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2			6		6	8		Free	4		
Actuated Green, G (s)	39.8	33.1		33.1	29.4	29.4	18.2	14.6	80.5	25.7	19.1	
Effective Green, g (s)	34.2	30.1		27.1	26.4	26.4	12.2	11.6	80.5	21.2	16.1	
Actuated g/C Ratio	0.42	0.37		0.34	0.33	0.33	0.15	0.14	1.00	0.26	0.20	
Clearance Time (s)	3.0	7.4		3.0	7.7	7.7	3.0	7.6		3.0	7.6	
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5	2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)	193	1713		122	1070	465	148	436	1319	234	533	
v/s Ratio Prot	0.03	0.23		0.00	c0.26		0.00	0.10		c0.06	0.12	
v/s Ratio Perm	0.22			0.10		0.07	0.03		c0.37	c0.18		
v/c Ratio	0.59	0.60		0.31	0.80	0.22	0.22	0.67	0.37	0.89	0.60	
Uniform Delay, d1	15.4	20.4		18.9	24.6	19.6	29.7	32.6	0.0	27.9	29.3	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	3.7	0.5		1.1	4.1	0.2	0.5	3.4	0.8	31.8	1.6	
Delay (s)	19.1	20.9		19.9	28.8	19.7	30.2	36.0	0.8	59.7	30.9	
Level of Service	B	C		B	C	B	C	D	A	E	C	
Approach Delay (s)		20.7			26.2			14.6			41.3	
Approach LOS		C			C			B			D	

Intersection Summary			
HCM 2000 Control Delay	24.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	80.5	Sum of lost time (s)	33.3
Intersection Capacity Utilization	77.2%	ICU Level of Service	D
Analysis Period (min)	15		

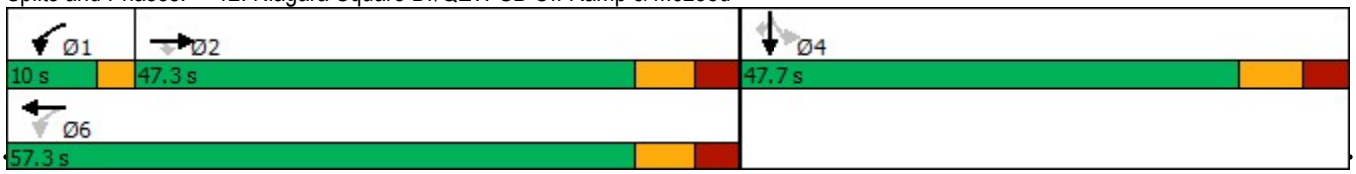
c Critical Lane Group

Lane Group	EBT	EBR	WBL	WBT	SBL	SBT	SBR
Lane Configurations							
Traffic Volume (vph)	1531	1	122	744	334	393	355
Future Volume (vph)	1531	1	122	744	334	393	355
Lane Group Flow (vph)	1664	1	133	809	363	466	347
Turn Type	NA	Perm	pm+pt	NA	Perm	NA	Perm
Protected Phases	2		1	6		4	
Permitted Phases		2	6		4		4
Detector Phase	2	2	1	6	4	4	4
Switch Phase							
Minimum Initial (s)	20.0	20.0	6.0	20.0	10.0	10.0	10.0
Minimum Split (s)	34.3	34.3	10.0	34.3	47.7	47.7	47.7
Total Split (s)	47.3	47.3	10.0	57.3	47.7	47.7	47.7
Total Split (%)	45.0%	45.0%	9.5%	54.6%	45.4%	45.4%	45.4%
Yellow Time (s)	4.8	4.8	3.0	4.8	5.0	5.0	5.0
All-Red Time (s)	3.5	3.5	0.0	3.5	3.7	3.7	3.7
Lost Time Adjust (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	11.3	11.3	6.0	11.3	11.7	11.7	11.7
Lead/Lag	Lag	Lag	Lead				
Lead-Lag Optimize?	Yes	Yes	Yes				
Recall Mode	None	None	None	None	None	None	None
v/c Ratio	1.03	0.00	1.03	0.40	0.37	0.95	0.68
Control Delay	64.1	23.0	111.5	19.8	27.5	64.9	29.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	64.1	23.0	111.5	19.8	27.5	64.9	29.0
Queue Length 50th (m)	~137.9	0.1	~16.3	40.4	28.1	93.1	45.5
Queue Length 95th (m)	#167.1	1.4	#47.7	50.9	40.1	#155.1	78.6
Internal Link Dist (m)	244.2			227.3		107.7	
Turn Bay Length (m)			40.0				45.0
Base Capacity (vph)	1616	459	129	2046	1101	541	552
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	1.03	0.00	1.03	0.40	0.33	0.86	0.63

Intersection Summary

Cycle Length: 105
Actuated Cycle Length: 101.8
Natural Cycle: 105
Control Type: Actuated-Uncoordinated
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 12: Niagara Square Dr/QEW SB Off Ramp & McLoed



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1531	1	122	744	0	0	0	0	334	393	355
Future Volume (vph)	0	1531	1	122	744	0	0	0	0	334	393	355
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		11.3	11.3	6.0	11.3					11.7	11.7	11.7
Lane Util. Factor		0.91	1.00	1.00	0.91					0.97	0.95	0.95
Frpb, ped/bikes		1.00	1.00	1.00	1.00					1.00	1.00	1.00
Flpb, ped/bikes		1.00	1.00	1.00	1.00					1.00	1.00	1.00
Frt		1.00	0.85	1.00	1.00					1.00	0.99	0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (prot)		4557	1297	1514	4515					3106	1517	1387
Flt Permitted		1.00	1.00	0.10	1.00					0.95	1.00	1.00
Satd. Flow (perm)		4557	1297	151	4515					3106	1517	1387
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	1664	1	133	809	0	0	0	0	363	427	386
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	3	64
Lane Group Flow (vph)	0	1664	1	133	809	0	0	0	0	363	463	283
Confl. Peds. (#/hr)	1					1						
Heavy Vehicles (%)	0%	6%	16%	11%	7%	0%	0%	0%	0%	5%	10%	3%
Turn Type		NA	Perm	pm+pt	NA					Perm	NA	Perm
Protected Phases		2		1	6						4	
Permitted Phases			2	6						4		4
Actuated Green, G (s)		39.1	39.1	49.1	49.1					35.6	35.6	35.6
Effective Green, g (s)		36.1	36.1	46.1	46.1					32.6	32.6	32.6
Actuated g/C Ratio		0.35	0.35	0.45	0.45					0.32	0.32	0.32
Clearance Time (s)		8.3	8.3	3.0	8.3					8.7	8.7	8.7
Vehicle Extension (s)		2.5	2.5	2.5	2.5					2.5	2.5	2.5
Lane Grp Cap (vph)		1617	460	122	2046					995	486	444
v/s Ratio Prot		0.37		c0.04	0.18						c0.30	
v/s Ratio Perm			0.00	c0.45						0.12		0.20
v/c Ratio		1.03	0.00	1.09	0.40					0.36	0.95	0.64
Uniform Delay, d1		32.8	21.2	25.8	18.5					26.6	33.8	29.5
Progression Factor		1.00	1.00	1.00	1.00					1.00	1.00	1.00
Incremental Delay, d2		30.2	0.0	107.7	0.1					0.2	28.9	2.6
Delay (s)		63.0	21.2	133.5	18.6					26.7	62.7	32.1
Level of Service		E	C	F	B					C	E	C
Approach Delay (s)		62.9			34.8			0.0			42.6	
Approach LOS		E			C			A			D	

Intersection Summary			
HCM 2000 Control Delay	49.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.07		
Actuated Cycle Length (s)	101.7	Sum of lost time (s)	29.0
Intersection Capacity Utilization	93.9%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	1127	10	51	1587	3	27
Future Volume (Veh/h)	1127	10	51	1587	3	27
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)	1225	11	55	1725	3	29
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)	352			183		
pX, platoon unblocked			0.96		0.96	0.96
vC, conflicting volume			1236		1916	618
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1157		1867	512
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			91		95	94
cM capacity (veh/h)			585		57	491

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	WB 4	NB 1
Volume Total	817	419	55	575	575	575	32
Volume Left	0	0	55	0	0	0	3
Volume Right	0	11	0	0	0	0	29
cSH	1700	1700	585	1700	1700	1700	286
Volume to Capacity	0.48	0.25	0.09	0.34	0.34	0.34	0.11
Queue Length 95th (m)	0.0	0.0	2.4	0.0	0.0	0.0	2.8
Control Delay (s)	0.0	0.0	11.8	0.0	0.0	0.0	19.2
Lane LOS			B				C
Approach Delay (s)	0.0		0.4				19.2
Approach LOS							C

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	58.3%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBT	WBT	SBL	SBR
Lane Configurations				
Traffic Volume (vph)	977	610	218	1029
Future Volume (vph)	977	610	218	1029
Lane Group Flow (vph)	1062	663	237	1118
Turn Type	NA	NA	Prot	Free
Protected Phases	2	6	4	
Permitted Phases				Free
Minimum Split (s)	21.5	21.5	21.5	
Total Split (s)	33.5	33.5	21.5	
Total Split (%)	60.9%	60.9%	39.1%	
Yellow Time (s)	3.5	3.5	3.5	
All-Red Time (s)	2.0	2.0	2.0	
Lost Time Adjust (s)	3.0	3.0	3.0	
Total Lost Time (s)	8.5	8.5	8.5	
Lead/Lag				
Lead-Lag Optimize?				
v/c Ratio	0.72	0.48	0.34	0.77
Control Delay	15.7	12.0	19.1	4.3
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	15.7	12.0	19.1	4.3
Queue Length 50th (m)	42.2	22.6	10.1	0.0
Queue Length 95th (m)	61.5	34.4	18.0	0.0
Internal Link Dist (m)	158.9	496.9	180.1	
Turn Bay Length (m)				
Base Capacity (vph)	1469	1376	694	1446
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	0.48	0.34	0.77

Intersection Summary
Cycle Length: 55
Actuated Cycle Length: 55
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Green
Natural Cycle: 55
Control Type: Pretimed

Splits and Phases: 14: Lyons Creek & QEW FEB Off-Ramp

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	0	977	610	0	218	1029
Future Volume (vph)	0	977	610	0	218	1029
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)		8.5	8.5		8.5	7.0
Lane Util. Factor		0.95	0.95		0.97	1.00
Frpb, ped/bikes		1.00	1.00		1.00	1.00
Flpb, ped/bikes		1.00	1.00		1.00	1.00
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		3233	3029		2938	1446
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		3233	3029		2938	1446
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	1062	663	0	237	1118
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1062	663	0	237	1118
Confl. Bikes (#/hr)				2		
Heavy Vehicles (%)	0%	4%	11%	0%	11%	4%
Turn Type		NA	NA		Prot	Free
Protected Phases		2	6		4	
Permitted Phases						Free
Actuated Green, G (s)		28.0	28.0		16.0	55.0
Effective Green, g (s)		25.0	25.0		13.0	55.0
Actuated g/C Ratio		0.45	0.45		0.24	1.00
Clearance Time (s)		5.5	5.5		5.5	
Lane Grp Cap (vph)		1469	1376		694	1446
v/s Ratio Prot		0.33	0.22		0.08	
v/s Ratio Perm						c0.77
v/c Ratio		0.72	0.48		0.34	0.77
Uniform Delay, d1		12.2	10.5		17.4	0.0
Progression Factor		1.00	1.00		1.00	1.00
Incremental Delay, d2		3.1	1.2		1.3	4.1
Delay (s)		15.3	11.7		18.8	4.1
Level of Service		B	B		B	A
Approach Delay (s)		15.3	11.7		6.7	
Approach LOS		B	B		A	

Intersection Summary			
HCM 2000 Control Delay	10.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	1.12		
Actuated Cycle Length (s)	55.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	50.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	539	0	0	424	261	69
Future Volume (Veh/h)	539	0	0	424	261	69
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)	586	0	0	461	284	75
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			586		816	293
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			586		816	293
tC, single (s)			4.1		6.9	7.0
tC, 2 stage (s)						
tF (s)			2.2		3.6	3.3
p0 queue free %			100		7	89
cM capacity (veh/h)			999		307	700

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	293	293	230	230	284	75
Volume Left	0	0	0	0	284	0
Volume Right	0	0	0	0	0	75
cSH	1700	1700	1700	1700	307	700
Volume to Capacity	0.17	0.17	0.14	0.14	0.93	0.11
Queue Length 95th (m)	0.0	0.0	0.0	0.0	68.4	2.7
Control Delay (s)	0.0	0.0	0.0	0.0	71.9	10.8
Lane LOS					F	B
Approach Delay (s)	0.0		0.0		59.1	
Approach LOS					F	

Intersection Summary			
Average Delay	15.1		
Intersection Capacity Utilization	50.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	34	41	35	513	452	20
Future Volume (Veh/h)	34	41	35	513	452	20
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)	37	45	38	558	491	22
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				TWLTL	TWLTL	
Median storage veh)				2	2	
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	857	256	513			
vC1, stage 1 conf vol	502					
vC2, stage 2 conf vol	355					
vCu, unblocked vol	857	256	513			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3	2.2			
p0 queue free %	92	94	96			
cM capacity (veh/h)	488	743	1049			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	82	38	279	279	327	186
Volume Left	37	38	0	0	0	0
Volume Right	45	0	0	0	0	22
cSH	601	1049	1700	1700	1700	1700
Volume to Capacity	0.14	0.04	0.16	0.16	0.19	0.11
Queue Length 95th (m)	3.6	0.9	0.0	0.0	0.0	0.0
Control Delay (s)	11.9	8.6	0.0	0.0	0.0	0.0
Lane LOS	B	A				
Approach Delay (s)	11.9	0.5			0.0	
Approach LOS	B					

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	42.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	3	31	155	610	481	9
Future Volume (Veh/h)	3	31	155	610	481	9
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)	3	34	168	663	523	10
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	TWLTL	
Median storage veh)					2	
Upstream signal (m)				260		
pX, platoon unblocked	0.88					
vC, conflicting volume	1196	266	533			
vC1, stage 1 conf vol	528					
vC2, stage 2 conf vol	668					
vCu, unblocked vol	960	266	533			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3	2.2			
p0 queue free %	99	95	84			
cM capacity (veh/h)	403	732	1031			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	37	168	332	332	349	184
Volume Left	3	168	0	0	0	0
Volume Right	34	0	0	0	0	10
cSH	686	1031	1700	1700	1700	1700
Volume to Capacity	0.05	0.16	0.20	0.20	0.21	0.11
Queue Length 95th (m)	1.3	4.4	0.0	0.0	0.0	0.0
Control Delay (s)	10.5	9.2	0.0	0.0	0.0	0.0
Lane LOS	B	A				
Approach Delay (s)	10.5	1.9			0.0	
Approach LOS	B					

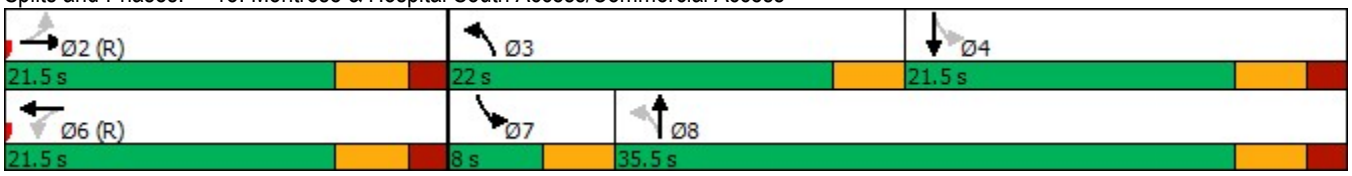
Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	47.4%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	6	0	14	0	455	753	43	450
Future Volume (vph)	6	0	14	0	455	753	43	450
Lane Group Flow (vph)	7	153	15	7	495	928	47	510
Turn Type	Perm	NA	Perm	NA	pm+pt	NA	pm+pt	NA
Protected Phases		2		6	3	8	7	4
Permitted Phases	2		6		8		4	
Minimum Split (s)	21.5	21.5	21.5	21.5	8.0	21.5	8.0	21.5
Total Split (s)	21.5	21.5	21.5	21.5	22.0	35.5	8.0	21.5
Total Split (%)	33.1%	33.1%	33.1%	33.1%	33.8%	54.6%	12.3%	33.1%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	2.0	2.0	2.0	2.0	0.0	2.0	0.0	2.0
Lost Time Adjust (s)	3.0	3.0	4.0	3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	8.5	8.5	9.5	8.5	6.5	8.5	6.5	8.5
Lead/Lag					Lead	Lag	Lead	Lag
Lead-Lag Optimize?					Yes	Yes	Yes	Yes
v/c Ratio	0.03	0.21	0.07	0.01	0.88	0.68	0.29	0.77
Control Delay	21.3	0.6	23.0	0.0	30.5	18.2	16.1	34.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	21.3	0.6	23.0	0.0	30.5	18.2	16.1	34.0
Queue Length 50th (m)	0.7	0.0	1.5	0.0	33.0	44.6	2.3	30.4
Queue Length 95th (m)	3.5	0.0	5.9	0.0	#83.2	63.5	5.9	#51.0
Internal Link Dist (m)		64.2		77.5		85.9		236.0
Turn Bay Length (m)					30.0		30.0	
Base Capacity (vph)	261	734	211	475	562	1360	161	660
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.03	0.21	0.07	0.01	0.88	0.68	0.29	0.77

Intersection Summary

Cycle Length: 65
Actuated Cycle Length: 65
Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green
Natural Cycle: 65
Control Type: Pretimed
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 18: Montrose & Hospital South Access/Commercial Access



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	6	0	141	14	0	6	455	753	101	43	450	19
Future Volume (vph)	6	0	141	14	0	6	455	753	101	43	450	19
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	8.5	8.5		9.5	8.5		6.5	8.5		6.5	8.5	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.85		1.00	0.85		1.00	0.98		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1648	1475		1648	1475		1648	3237		1648	3276	
Flt Permitted	0.75	1.00		0.66	1.00		0.29	1.00		0.31	1.00	
Satd. Flow (perm)	1306	1475		1145	1475		511	3237		534	3276	
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	0	153	15	0	7	495	818	110	47	489	21
RTOR Reduction (vph)	0	122	0	0	6	0	0	16	0	0	5	0
Lane Group Flow (vph)	7	31	0	15	1	0	495	912	0	47	505	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		2			6		3	8		7	4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	16.0	16.0		16.0	16.0		38.0	30.0		20.5	16.0	
Effective Green, g (s)	13.0	13.0		12.0	13.0		35.0	27.0		14.5	13.0	
Actuated g/C Ratio	0.20	0.20		0.18	0.20		0.54	0.42		0.22	0.20	
Clearance Time (s)	5.5	5.5		5.5	5.5		3.5	5.5		3.5	5.5	
Lane Grp Cap (vph)	261	295		211	295		546	1344		144	655	
v/s Ratio Prot		c0.02			0.00		c0.22	0.28		0.01	0.15	
v/s Ratio Perm	0.01			0.01			c0.27			0.06		
v/c Ratio	0.03	0.10		0.07	0.00		0.91	0.68		0.33	0.77	
Uniform Delay, d1	20.9	21.2		21.9	20.8		10.9	15.5		20.2	24.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.2	0.7		0.7	0.0		21.3	2.8		5.9	8.6	
Delay (s)	21.1	21.9		22.5	20.8		32.2	18.2		26.1	33.2	
Level of Service	C	C		C	C		C	B		C	C	
Approach Delay (s)		21.9			22.0			23.1			32.6	
Approach LOS		C			C			C			C	

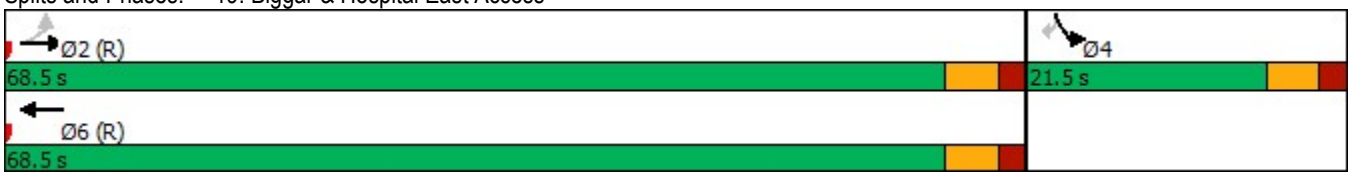
Intersection Summary			
HCM 2000 Control Delay	25.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	65.0	Sum of lost time (s)	23.5
Intersection Capacity Utilization	73.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Configurations					
Traffic Volume (vph)	48	503	559	85	31
Future Volume (vph)	48	503	559	85	31
Lane Group Flow (vph)	52	547	840	92	34
Turn Type	Perm	NA	NA	Prot	Perm
Protected Phases		2	6	4	
Permitted Phases	2				4
Minimum Split (s)	21.5	21.5	21.5	21.5	21.5
Total Split (s)	68.5	68.5	68.5	21.5	21.5
Total Split (%)	76.1%	76.1%	76.1%	23.9%	23.9%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	8.5	8.5	8.5	8.5	8.5
Lead/Lag					
Lead-Lag Optimize?					
v/c Ratio	0.14	0.25	0.39	0.39	0.14
Control Delay	6.6	6.3	6.1	40.3	13.4
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	6.6	6.3	6.1	40.3	13.4
Queue Length 50th (m)	2.9	17.4	24.5	14.6	0.0
Queue Length 95th (m)	7.2	24.2	34.1	29.0	8.1
Internal Link Dist (m)		466.8	279.7	146.1	
Turn Bay Length (m)	30.0				
Base Capacity (vph)	380	2197	2151	238	242
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	0.14	0.25	0.39	0.39	0.14

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBT, Start of Green
Natural Cycle: 45
Control Type: Pretimed

Splits and Phases: 19: Biggar & Hospital East Access



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	48	503	559	213	85	31
Future Volume (vph)	48	503	559	213	85	31
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	8.5	8.5	8.5		8.5	8.5
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Frt	1.00	1.00	0.96		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1648	3296	3159		1648	1475
Flt Permitted	0.33	1.00	1.00		0.95	1.00
Satd. Flow (perm)	570	3296	3159		1648	1475
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	52	547	608	232	92	34
RTOR Reduction (vph)	0	0	44	0	0	29
Lane Group Flow (vph)	52	547	796	0	92	5
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		2	6		4	
Permitted Phases	2					4
Actuated Green, G (s)	63.0	63.0	63.0		16.0	16.0
Effective Green, g (s)	60.0	60.0	60.0		13.0	13.0
Actuated g/C Ratio	0.67	0.67	0.67		0.14	0.14
Clearance Time (s)	5.5	5.5	5.5		5.5	5.5
Lane Grp Cap (vph)	380	2197	2106		238	213
v/s Ratio Prot		0.17	c0.25		c0.06	
v/s Ratio Perm	0.09					0.00
v/c Ratio	0.14	0.25	0.38		0.39	0.02
Uniform Delay, d1	5.5	6.0	6.7		34.9	33.0
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.7	0.3	0.5		4.7	0.2
Delay (s)	6.3	6.3	7.2		39.6	33.2
Level of Service	A	A	A		D	C
Approach Delay (s)		6.3	7.2		37.9	
Approach LOS		A	A		D	

Intersection Summary			
HCM 2000 Control Delay	9.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.38		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	58.8%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	19	551	542	48	0	15
Future Volume (Veh/h)	19	551	542	48	0	15
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)	21	599	589	52	0	16
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				956	320
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	641				956	320
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	98				100	98
cM capacity (veh/h)	939				250	675

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1
Volume Total	21	300	300	393	248	16
Volume Left	21	0	0	0	0	0
Volume Right	0	0	0	0	52	16
cSH	939	1700	1700	1700	1700	675
Volume to Capacity	0.02	0.18	0.18	0.23	0.15	0.02
Queue Length 95th (m)	0.5	0.0	0.0	0.0	0.0	0.6
Control Delay (s)	8.9	0.0	0.0	0.0	0.0	10.5
Lane LOS	A					B
Approach Delay (s)	0.3			0.0		10.5
Approach LOS						B

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	34.6%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											
Traffic Volume (vph)	210	490	706	516	344	31	289	493	694	499	259
Future Volume (vph)	210	490	706	516	344	31	289	493	694	499	259
Lane Group Flow (vph)	228	597	767	561	374	34	314	536	754	542	282
Turn Type	pm+pt	NA	Prot	NA	Free	Perm	NA	Free	Prot	NA	Perm
Protected Phases	5	2	1	6			8		7	4	
Permitted Phases	2				Free	8		Free			4
Detector Phase	5	2	1	6		8	8		7	4	4
Switch Phase											
Minimum Initial (s)	4.0	10.0	8.0	10.0		10.0	10.0		8.0	10.0	10.0
Minimum Split (s)	8.0	26.3	13.5	26.3		31.3	31.3		13.5	31.3	31.3
Total Split (s)	27.0	34.7	41.0	48.7		31.3	31.3		38.0	69.3	69.3
Total Split (%)	18.6%	23.9%	28.3%	33.6%		21.6%	21.6%		26.2%	47.8%	47.8%
Yellow Time (s)	3.0	4.1	3.5	4.1		4.1	4.1		3.5	4.1	4.1
All-Red Time (s)	0.5	2.2	2.0	2.2		2.2	2.2		2.0	2.2	2.2
Lost Time Adjust (s)	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Total Lost Time (s)	6.5	9.3	8.5	9.3		9.3	9.3		8.5	9.3	9.3
Lead/Lag	Lead	Lag	Lead	Lag		Lag	Lag		Lead		
Lead-Lag Optimize?	Yes	Yes	Yes	Yes		Yes	Yes		Yes		
Recall Mode	None	Max	Max	Max		Max	Max		Max	Max	Max
v/c Ratio	0.71	1.07	1.23	0.56	0.27	0.28	0.65	0.37	1.19	0.44	0.38
Control Delay	39.2	114.0	163.0	44.9	0.5	61.6	64.8	0.7	151.1	31.9	9.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	39.2	114.0	163.0	44.9	0.5	61.6	64.8	0.7	151.1	31.9	9.5
Queue Length 50th (m)	38.9	~99.1	~139.5	70.5	0.0	8.8	45.2	0.0	~134.4	58.1	13.2
Queue Length 95th (m)	57.6	#137.2	#178.8	95.5	0.0	20.2	61.6	0.0	#173.4	74.4	34.6
Internal Link Dist (m)		279.7		233.5			313.4			90.5	
Turn Bay Length (m)	30.0		30.0		30.0	30.0		30.0	30.0		30.0
Base Capacity (vph)	389	556	624	1002	1380	120	485	1446	631	1235	743
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.59	1.07	1.23	0.56	0.27	0.28	0.65	0.37	1.19	0.44	0.38

Intersection Summary

Cycle Length: 145
Actuated Cycle Length: 145
Natural Cycle: 145
Control Type: Semi Act-Uncoord
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Montrose & Biggar/Lyons Creek

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	210	490	59	706	516	344	31	289	493	694	499	259
Future Volume (vph)	210	490	59	706	516	344	31	289	493	694	499	259
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.5	9.3		8.5	9.3	7.0	9.3	9.3	7.0	8.5	9.3	9.3
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1681	3137		2787	3202	1380	1681	3202	1446	3106	2985	1504
Flt Permitted	0.44	1.00		0.95	1.00	1.00	0.45	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	781	3137		2787	3202	1380	796	3202	1446	3106	2985	1504
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)	228	533	64	767	561	374	34	314	536	754	542	282
RTOR Reduction (vph)	0	7	0	0	0	0	0	0	0	0	0	121
Lane Group Flow (vph)	228	590	0	767	561	374	34	314	536	754	542	161
Heavy Vehicles (%)	0%	6%	1%	17%	5%	9%	0%	5%	4%	5%	7%	0%
Parking (#/hr)											0	
Turn Type	pm+pt	NA		Prot	NA	Free	Perm	NA	Free	Prot	NA	Perm
Protected Phases	5	2		1	6			8		7	4	
Permitted Phases	2					Free	8		Free			4
Actuated Green, G (s)	45.9	28.4		35.5	48.4	145.0	25.0	25.0	145.0	32.5	63.0	63.0
Effective Green, g (s)	39.9	25.4		32.5	45.4	145.0	22.0	22.0	145.0	29.5	60.0	60.0
Actuated g/C Ratio	0.28	0.18		0.22	0.31	1.00	0.15	0.15	1.00	0.20	0.41	0.41
Clearance Time (s)	3.5	6.3		5.5	6.3		6.3	6.3		5.5	6.3	6.3
Vehicle Extension (s)	3.0	6.0		3.0	6.0		6.0	6.0		3.0	6.0	6.0
Lane Grp Cap (vph)	304	549		624	1002	1380	120	485	1446	631	1235	622
v/s Ratio Prot	0.07	c0.19		c0.28	0.18			c0.10		c0.24	0.18	
v/s Ratio Perm	0.13					0.27	0.04		0.37			0.11
v/c Ratio	0.75	1.08		1.23	0.56	0.27	0.28	0.65	0.37	1.19	0.44	0.26
Uniform Delay, d1	44.2	59.8		56.2	41.5	0.0	54.5	57.9	0.0	57.8	30.4	27.9
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	10.0	60.3		116.8	2.3	0.5	5.8	6.5	0.7	102.7	1.1	1.0
Delay (s)	54.2	120.1		173.0	43.7	0.5	60.3	64.4	0.7	160.4	31.6	28.9
Level of Service	D	F		F	D	A	E	E	A	F	C	C
Approach Delay (s)		101.9			92.5			25.6			92.7	
Approach LOS		F			F			C			F	

Intersection Summary			
HCM 2000 Control Delay	82.2	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.07		
Actuated Cycle Length (s)	145.0	Sum of lost time (s)	35.6
Intersection Capacity Utilization	98.4%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	58	10	527	13	3	816
Future Volume (Veh/h)	58	10	527	13	3	816
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)	63	11	573	14	3	887
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			TWLTL			TWLTL
Median storage veh)			2			2
Upstream signal (m)			329			
pX, platoon unblocked	0.98	0.98			0.98	
vC, conflicting volume	1030	294			587	
vC1, stage 1 conf vol	580					
vC2, stage 2 conf vol	450					
vCu, unblocked vol	989	238			537	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3			2.2	
p0 queue free %	86	99			100	
cM capacity (veh/h)	454	754			1020	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	74	382	205	3	444	444
Volume Left	63	0	0	3	0	0
Volume Right	11	0	14	0	0	0
cSH	483	1700	1700	1020	1700	1700
Volume to Capacity	0.15	0.22	0.12	0.00	0.26	0.26
Queue Length 95th (m)	4.1	0.0	0.0	0.1	0.0	0.0
Control Delay (s)	13.8	0.0	0.0	8.5	0.0	0.0
Lane LOS	B			A		
Approach Delay (s)	13.8	0.0		0.0		
Approach LOS	B					

Intersection Summary			
Average Delay	0.7		
Intersection Capacity Utilization	40.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	425	34	23	641	859	418
Future Volume (Veh/h)	425	34	23	641	859	418
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)	462	37	25	697	934	454
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				TWLTL	None	
Median storage veh)				2		
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1560	694	1388			
vC1, stage 1 conf vol	1161					
vC2, stage 2 conf vol	398					
vCu, unblocked vol	1560	694	1388			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3	2.2			
p0 queue free %	0	91	95			
cM capacity (veh/h)	247	390	500			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	462	37	25	348	348	623	765
Volume Left	462	0	25	0	0	0	0
Volume Right	0	37	0	0	0	0	454
cSH	247	390	500	1700	1700	1700	1700
Volume to Capacity	1.87	0.09	0.05	0.20	0.20	0.37	0.45
Queue Length 95th (m)	245.3	2.4	1.2	0.0	0.0	0.0	0.0
Control Delay (s)	441.4	15.2	12.6	0.0	0.0	0.0	0.0
Lane LOS	F	C	B				
Approach Delay (s)	409.8		0.4			0.0	
Approach LOS	F						

Intersection Summary			
Average Delay	78.5		
Intersection Capacity Utilization	77.5%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	163	28	902	242	32	973
Future Volume (Veh/h)	163	28	902	242	32	973
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)	177	30	980	263	35	1058
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	1710	622			1243	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1710	622			1243	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	0	93			94	
cM capacity (veh/h)	78	435			567	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	177	30	653	590	35	529	529
Volume Left	177	0	0	0	35	0	0
Volume Right	0	30	0	263	0	0	0
cSH	78	435	1700	1700	567	1700	1700
Volume to Capacity	2.26	0.07	0.38	0.35	0.06	0.31	0.31
Queue Length 95th (m)	124.6	1.7	0.0	0.0	1.5	0.0	0.0
Control Delay (s)	691.8	13.9	0.0	0.0	11.8	0.0	0.0
Lane LOS	F	B			B		
Approach Delay (s)	593.5		0.0		0.4		
Approach LOS	F						

Intersection Summary			
Average Delay	48.5		
Intersection Capacity Utilization	56.9%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	71	51	44	875	914	67
Future Volume (Veh/h)	71	51	44	875	914	67
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)	77	55	48	951	993	73
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	1601	533	1066			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1601	533	1066			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	16	89	93			
cM capacity (veh/h)	91	496	661			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	77	55	48	476	476	662	404
Volume Left	77	0	48	0	0	0	0
Volume Right	0	55	0	0	0	0	73
cSH	91	496	661	1700	1700	1700	1700
Volume to Capacity	0.84	0.11	0.07	0.28	0.28	0.39	0.24
Queue Length 95th (m)	34.5	2.8	1.8	0.0	0.0	0.0	0.0
Control Delay (s)	136.0	13.2	10.9	0.0	0.0	0.0	0.0
Lane LOS	F	B	B				
Approach Delay (s)	84.8		0.5			0.0	
Approach LOS	F						

Intersection Summary			
Average Delay	5.3		
Intersection Capacity Utilization	54.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	168	54	56	889	884	245
Future Volume (Veh/h)	168	54	56	889	884	245
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)	183	59	61	966	961	266
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	1699	614	1227			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1699	614	1227			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	0	87	89			
cM capacity (veh/h)	76	440	575			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	183	59	61	483	483	641	586
Volume Left	183	0	61	0	0	0	0
Volume Right	0	59	0	0	0	0	266
cSH	76	440	575	1700	1700	1700	1700
Volume to Capacity	2.41	0.13	0.11	0.28	0.28	0.38	0.34
Queue Length 95th (m)	131.8	3.5	2.7	0.0	0.0	0.0	0.0
Control Delay (s)	760.3	14.4	12.0	0.0	0.0	0.0	0.0
Lane LOS	F	B	B				
Approach Delay (s)	578.5		0.7			0.0	
Approach LOS	F						

Intersection Summary			
Average Delay	56.4		
Intersection Capacity Utilization	66.0%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	190	341	251	862	788	202
Future Volume (vph)	190	341	251	862	788	202
Lane Group Flow (vph)	207	371	273	937	857	220
Turn Type	Prot	Perm	pm+pt	NA	NA	Perm
Protected Phases	2		3	8	4	
Permitted Phases		2	8			4
Minimum Split (s)	23.5	23.5	8.0	23.5	23.5	23.5
Total Split (s)	25.0	25.0	15.0	45.0	30.0	30.0
Total Split (%)	35.7%	35.7%	21.4%	64.3%	42.9%	42.9%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	2.0	2.0	0.0	2.0	2.0	2.0
Lost Time Adjust (s)	3.0	3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	8.5	8.5	6.5	8.5	8.5	8.5
Lead/Lag			Lead		Lag	Lag
Lead-Lag Optimize?			Yes		Yes	Yes
v/c Ratio	0.55	0.60	0.87	0.56	0.86	0.36
Control Delay	29.9	7.7	41.1	13.0	33.2	4.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.9	7.7	41.1	13.0	33.2	4.8
Queue Length 50th (m)	23.9	0.6	17.7	40.5	54.8	0.0
Queue Length 95th (m)	43.1	20.3	#56.8	56.2	#85.2	13.4
Internal Link Dist (m)	249.7			540.4	157.6	
Turn Bay Length (m)	50.0		45.0			50.0
Base Capacity (vph)	377	619	314	1669	1002	614
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	0.55	0.60	0.87	0.56	0.86	0.36

Intersection Summary

Cycle Length: 70
Actuated Cycle Length: 70
Offset: 0 (0%), Referenced to phase 2:EBL and 6:, Start of Green
Natural Cycle: 70
Control Type: Pretimed
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 7: Montrose & Canadian Dr.

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	190	341	251	862	788	202
Future Volume (vph)	190	341	251	862	788	202
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	8.5	8.5	6.5	8.5	8.5	8.5
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	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)	1601	1446	1616	3202	3264	1504
Flt Permitted	0.95	1.00	0.16	1.00	1.00	1.00
Satd. Flow (perm)	1601	1446	277	3202	3264	1504
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	207	371	273	937	857	220
RTOR Reduction (vph)	0	279	0	0	0	152
Lane Group Flow (vph)	207	92	273	937	857	68
Heavy Vehicles (%)	5%	4%	4%	5%	3%	0%
Turn Type	Prot	Perm	pm+pt	NA	NA	Perm
Protected Phases	2		3	8	4	
Permitted Phases		2	8			4
Actuated Green, G (s)	19.5	19.5	39.5	39.5	24.5	24.5
Effective Green, g (s)	16.5	16.5	36.5	36.5	21.5	21.5
Actuated g/C Ratio	0.24	0.24	0.52	0.52	0.31	0.31
Clearance Time (s)	5.5	5.5	3.5	5.5	5.5	5.5
Lane Grp Cap (vph)	377	340	307	1669	1002	461
v/s Ratio Prot	c0.13		c0.11	0.29	0.26	
v/s Ratio Perm		0.06	c0.36			0.04
v/c Ratio	0.55	0.27	0.89	0.56	0.86	0.15
Uniform Delay, d1	23.5	21.8	12.5	11.3	22.8	17.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	5.7	2.0	29.6	1.4	9.3	0.7
Delay (s)	29.1	23.8	42.0	12.7	32.1	18.3
Level of Service	C	C	D	B	C	B
Approach Delay (s)	25.7			19.3	29.3	
Approach LOS	C			B	C	

Intersection Summary			
HCM 2000 Control Delay	24.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	23.5
Intersection Capacity Utilization	69.8%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	195	56	61	1001	919	398
Future Volume (Veh/h)	195	56	61	1001	919	398
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)	212	61	66	1088	999	433
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)				182	222	
pX, platoon unblocked	0.83					
vC, conflicting volume	1675	500	1432			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1403	500	1432			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	0	88	86			
cM capacity (veh/h)	95	522	481			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	212	61	66	544	544	500	500	433
Volume Left	212	0	66	0	0	0	0	0
Volume Right	0	61	0	0	0	0	0	433
cSH	95	522	481	1700	1700	1700	1700	1700
Volume to Capacity	2.22	0.12	0.14	0.32	0.32	0.29	0.29	0.25
Queue Length 95th (m)	143.0	3.0	3.6	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	655.5	12.8	13.7	0.0	0.0	0.0	0.0	0.0
Lane LOS	F	B	B					
Approach Delay (s)	511.9		0.8			0.0		
Approach LOS	F							

Intersection Summary			
Average Delay	49.2		
Intersection Capacity Utilization	60.5%	ICU Level of Service	B
Analysis Period (min)	15		

Lane Group	EBL	WBL	WBT	NBT	SBT
Lane Configurations					
Traffic Volume (vph)	59	800	0	1189	513
Future Volume (vph)	59	800	0	1189	513
Lane Group Flow (vph)	64	870	2	1292	558
Turn Type	Prot	Prot		NA	NA
Protected Phases	7	3		2	6
Permitted Phases					
Detector Phase	7	3		2	6
Switch Phase					
Minimum Initial (s)	8.0	8.0		8.0	8.0
Minimum Split (s)	13.2	13.2		13.5	13.5
Total Split (s)	32.0	32.0		43.0	43.0
Total Split (%)	42.7%	42.7%		57.3%	57.3%
Yellow Time (s)	3.2	3.2		3.5	3.5
All-Red Time (s)	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	3.0	3.0		3.0	3.0
Total Lost Time (s)	8.2	8.2		8.5	8.5
Lead/Lag					
Lead-Lag Optimize?					
Recall Mode	None	None		None	None
v/c Ratio	0.17	0.92	0.02	0.93	0.43
Control Delay	19.8	39.3	0.0	30.1	14.1
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	19.8	39.3	0.0	30.1	14.1
Queue Length 50th (m)	5.9	54.4	0.0	77.7	24.7
Queue Length 95th (m)	14.6	#90.1	0.0	#124.4	37.8
Internal Link Dist (m)			271.6	198.2	233.7
Turn Bay Length (m)					
Base Capacity (vph)	648	1220	112	1807	1693
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	0.71	0.02	0.71	0.33

Intersection Summary
Cycle Length: 75
Actuated Cycle Length: 64.2
Natural Cycle: 75
Control Type: Actuated-Uncoordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 9: Montrose & Niagara Square Dr

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	59	0	0	800	0	2	0	1189	0	0	513	0
Future Volume (vph)	59	0	0	800	0	2	0	1189	0	0	513	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	8.2			8.2	7.0			8.5			8.5	
Lane Util. Factor	1.00			0.97	1.00			0.95			0.95	
Frt	1.00			1.00	0.85			1.00			1.00	
Flt Protected	0.95			0.95	1.00			1.00			1.00	
Satd. Flow (prot)	1681			3166	0			3233			3029	
Flt Permitted	0.95			0.95	1.00			1.00			1.00	
Satd. Flow (perm)	1681			3166	0			3233			3029	
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)	64	0	0	870	0	2	0	1292	0	0	558	0
RTOR Reduction (vph)	0	0	0	0	2	0	0	0	0	0	0	0
Lane Group Flow (vph)	64	0	0	870	0	0	0	1292	0	0	558	0
Heavy Vehicles (%)	0%	0%	0%	3%	0%	50%	0%	4%	0%	0%	11%	0%
Turn Type	Prot			Prot				NA			NA	
Protected Phases	7			3				2			6	
Permitted Phases												
Actuated Green, G (s)	22.2			22.2	0.0			30.8			30.8	
Effective Green, g (s)	19.2			19.2	0.0			27.8			27.8	
Actuated g/C Ratio	0.30			0.30	0.00			0.44			0.44	
Clearance Time (s)	5.2			5.2				5.5			5.5	
Vehicle Extension (s)	2.1			2.1				2.3			2.3	
Lane Grp Cap (vph)	506			954	0			1410			1321	
v/s Ratio Prot	0.04			c0.27				c0.40			0.18	
v/s Ratio Perm												
v/c Ratio	0.13			0.91	0.00			0.92			0.42	
Uniform Delay, d1	16.2			21.4	31.9			16.9			12.4	
Progression Factor	1.00			1.00	1.00			1.00			1.00	
Incremental Delay, d2	0.0			12.5	0.0			9.5			0.1	
Delay (s)	16.2			33.9	31.9			26.3			12.5	
Level of Service	B			C	C			C			B	
Approach Delay (s)		16.2			33.9			26.3			12.5	
Approach LOS		B			C			C			B	

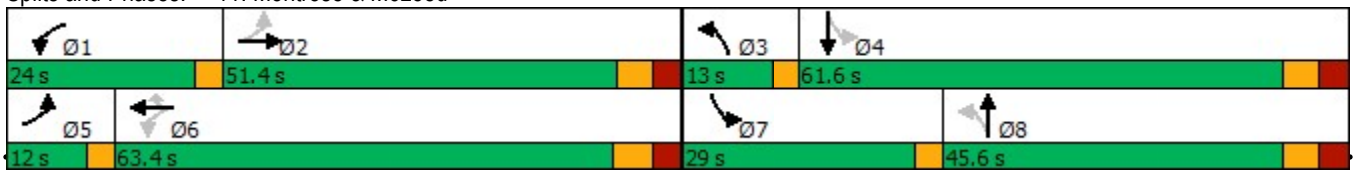
Intersection Summary			
HCM 2000 Control Delay	25.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	63.7	Sum of lost time (s)	16.7
Intersection Capacity Utilization	Err%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations										
Traffic Volume (vph)	104	1063	222	1034	366	103	380	723	454	384
Future Volume (vph)	104	1063	222	1034	366	103	380	723	454	384
Lane Group Flow (vph)	113	1201	241	1124	398	112	413	786	493	527
Turn Type	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA	Free	pm+pt	NA
Protected Phases	5	2	1	6		3	8		7	4
Permitted Phases	2		6		6	8		Free	4	
Detector Phase	5	2	1	6	6	3	8		7	4
Switch Phase										
Minimum Initial (s)	6.0	10.0	6.0	10.0	10.0	6.0	8.0		6.0	8.0
Minimum Split (s)	10.0	39.4	10.0	39.7	39.7	10.0	45.6		11.0	45.6
Total Split (s)	12.0	51.4	24.0	63.4	63.4	13.0	45.6		29.0	61.6
Total Split (%)	8.0%	34.3%	16.0%	42.3%	42.3%	8.7%	30.4%		19.3%	41.1%
Yellow Time (s)	3.0	4.1	3.0	4.4	4.4	3.0	4.1		3.0	4.1
All-Red Time (s)	0.0	3.3	0.0	3.3	3.3	0.0	3.5		0.0	3.5
Lost Time Adjust (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0
Total Lost Time (s)	6.0	10.4	6.0	10.7	10.7	6.0	10.6		6.0	10.6
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes
Recall Mode	None	None	None	None	None	None	None		None	None
v/c Ratio	0.80	0.89	0.90	0.89	0.55	0.50	0.90	0.53	1.22	0.62
Control Delay	60.8	53.7	68.9	48.7	12.8	38.1	79.7	1.4	150.2	43.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	60.8	53.7	68.9	48.7	12.8	38.1	79.7	1.4	150.2	43.8
Queue Length 50th (m)	15.1	108.7	46.9	142.5	22.3	19.1	57.4	0.0	~130.2	62.5
Queue Length 95th (m)	#42.0	135.8	#103.0	#194.8	56.6	32.1	75.8	0.0	#199.2	81.1
Internal Link Dist (m)		257.8		244.2			112.3			232.4
Turn Bay Length (m)	55.0		140.0			90.0		70.0	140.0	
Base Capacity (vph)	142	1446	268	1326	751	233	855	1475	404	1215
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.80	0.83	0.90	0.85	0.53	0.48	0.48	0.53	1.22	0.43

Intersection Summary

Cycle Length: 150
Actuated Cycle Length: 131.5
Natural Cycle: 150
Control Type: Actuated-Uncoordinated
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 11: Montrose & McLoed



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	104	1063	42	222	1034	366	103	380	723	454	384	101
Future Volume (vph)	104	1063	42	222	1034	366	103	380	723	454	384	101
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	6.0	10.4		6.0	10.7	10.7	6.0	10.6	7.0	6.0	10.6	
Lane Util. Factor	1.00	0.91		1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1514	4614		1542	3296	1460	1681	3202	1475	1664	3084	
Flt Permitted	0.14	1.00		0.09	1.00	1.00	0.46	1.00	1.00	0.29	1.00	
Satd. Flow (perm)	226	4614		151	3296	1460	808	3202	1475	502	3084	
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)	113	1155	46	241	1124	398	112	413	786	493	417	110
RTOR Reduction (vph)	0	3	0	0	0	169	0	0	0	0	17	0
Lane Group Flow (vph)	113	1198	0	241	1124	229	112	413	786	493	510	0
Confl. Peds. (#/hr)			7	7								
Heavy Vehicles (%)	11%	4%	4%	9%	2%	3%	0%	5%	2%	1%	6%	4%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Free	pm+pt	NA	
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2			6		6	8		Free	4		
Actuated Green, G (s)	50.4	41.4		65.2	53.2	53.2	31.0	21.8	131.4	50.9	38.7	
Effective Green, g (s)	44.4	38.4		62.2	50.2	50.2	25.0	18.8	131.4	47.9	35.7	
Actuated g/C Ratio	0.34	0.29		0.47	0.38	0.38	0.19	0.14	1.00	0.36	0.27	
Clearance Time (s)	3.0	7.4		3.0	7.7	7.7	3.0	7.6		3.0	7.6	
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5	2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)	135	1348		263	1259	557	194	458	1475	387	837	
v/s Ratio Prot	0.04	0.26		c0.13	c0.34		0.03	0.13		c0.22	0.17	
v/s Ratio Perm	0.24			c0.31		0.16	0.08		0.53	c0.24		
v/c Ratio	0.84	0.89		0.92	0.89	0.41	0.58	0.90	0.53	1.27	0.61	
Uniform Delay, d1	35.1	44.5		37.6	38.1	29.8	46.3	55.4	0.0	36.5	41.8	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	33.5	7.5		33.8	8.3	0.4	3.4	20.7	1.4	142.0	1.1	
Delay (s)	68.6	51.9		71.4	46.4	30.1	49.7	76.0	1.4	178.5	42.8	
Level of Service	E	D		E	D	C	D	E	A	F	D	
Approach Delay (s)		53.4			46.1			29.0			108.4	
Approach LOS		D			D			C			F	

Intersection Summary			
HCM 2000 Control Delay	55.5	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.15		
Actuated Cycle Length (s)	131.4	Sum of lost time (s)	33.3
Intersection Capacity Utilization	103.8%	ICU Level of Service	G
Analysis Period (min)	15		

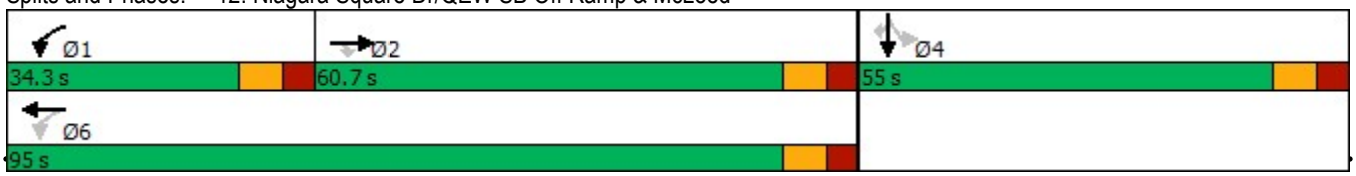
c Critical Lane Group

Lane Group	EBT	EBR	WBL	WBT	SBL	SBT	SBR
Lane Configurations							
Traffic Volume (vph)	2207	4	270	1205	514	529	430
Future Volume (vph)	2207	4	270	1205	514	529	430
Lane Group Flow (vph)	2399	4	293	1310	559	622	420
Turn Type	NA	Perm	pm+pt	NA	Perm	NA	Perm
Protected Phases	2		1	6		4	
Permitted Phases		2	6		4		4
Detector Phase	2	2	1	6	4	4	4
Switch Phase							
Minimum Initial (s)	20.0	20.0	20.0	20.0	10.0	10.0	10.0
Minimum Split (s)	34.3	34.3	34.3	34.3	47.7	47.7	47.7
Total Split (s)	60.7	60.7	34.3	95.0	55.0	55.0	55.0
Total Split (%)	40.5%	40.5%	22.9%	63.3%	36.7%	36.7%	36.7%
Yellow Time (s)	4.8	4.8	4.8	4.8	5.0	5.0	5.0
All-Red Time (s)	3.5	3.5	3.5	3.5	3.7	3.7	3.7
Lost Time Adjust (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	11.3	11.3	11.3	11.3	11.7	11.7	11.7
Lead/Lag	Lag	Lag	Lead				
Lead-Lag Optimize?	Yes	Yes	Yes				
Recall Mode	None	None	None	None	None	None	None
v/c Ratio	1.55	0.01	0.99	0.50	0.61	1.32	0.92
Control Delay	286.4	34.0	94.5	21.2	49.5	199.5	64.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	286.4	34.0	94.5	21.2	49.5	199.5	64.5
Queue Length 50th (m)	~367.4	0.8	73.3	84.7	74.3	~251.4	102.5
Queue Length 95th (m)	#393.6	3.7	#133.3	97.1	94.0	#329.6	#170.1
Internal Link Dist (m)	244.2			227.3		107.7	
Turn Bay Length (m)			40.0				45.0
Base Capacity (vph)	1545	486	298	2619	914	471	459
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	1.55	0.01	0.98	0.50	0.61	1.32	0.92

Intersection Summary

Cycle Length: 150
Actuated Cycle Length: 149.9
Natural Cycle: 150
Control Type: Actuated-Uncoordinated
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 12: Niagara Square Dr/QEW SB Off Ramp & McLoed



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	2207	4	270	1205	0	0	0	0	514	529	430
Future Volume (vph)	0	2207	4	270	1205	0	0	0	0	514	529	430
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		11.3	11.3	11.3	11.3					11.7	11.7	11.7
Lane Util. Factor		0.91	1.00	1.00	0.91					0.97	0.95	0.95
Frpb, ped/bikes		1.00	1.00	1.00	1.00					1.00	1.00	1.00
Flpb, ped/bikes		1.00	1.00	1.00	1.00					1.00	1.00	1.00
Frt		1.00	0.85	1.00	1.00					1.00	0.99	0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (prot)		4690	1475	1648	4690					3166	1625	1348
Flt Permitted		1.00	1.00	0.07	1.00					0.95	1.00	1.00
Satd. Flow (perm)		4690	1475	114	4690					3166	1625	1348
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	2399	4	293	1310	0	0	0	0	559	575	467
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	2	70
Lane Group Flow (vph)	0	2399	4	293	1310	0	0	0	0	559	620	350
Confl. Peds. (#/hr)	3					3						
Heavy Vehicles (%)	0%	3%	2%	2%	3%	0%	0%	0%	0%	3%	2%	6%
Turn Type		NA	Perm	pm+pt	NA					Perm	NA	Perm
Protected Phases		2		1	6						4	
Permitted Phases			2	6						4		4
Actuated Green, G (s)		52.4	52.4	86.6	86.6					46.3	46.3	46.3
Effective Green, g (s)		49.4	49.4	83.6	83.6					43.3	43.3	43.3
Actuated g/C Ratio		0.33	0.33	0.56	0.56					0.29	0.29	0.29
Clearance Time (s)		8.3	8.3	8.3	8.3					8.7	8.7	8.7
Vehicle Extension (s)		2.5	2.5	2.5	2.5					2.5	2.5	2.5
Lane Grp Cap (vph)		1545	486	297	2615					914	469	389
v/s Ratio Prot		c0.51		c0.15	0.28						c0.38	
v/s Ratio Perm			0.00	0.40						0.18		0.26
v/c Ratio		1.55	0.01	0.99	0.50					0.61	1.32	0.90
Uniform Delay, d1		50.3	33.8	50.7	20.3					46.0	53.3	51.2
Progression Factor		1.00	1.00	1.00	1.00					1.00	1.00	1.00
Incremental Delay, d2		252.0	0.0	48.1	0.1					1.0	159.1	22.6
Delay (s)		302.2	33.8	98.8	20.5					47.1	212.4	73.8
Level of Service		F	C	F	C					D	F	E
Approach Delay (s)		301.8			34.8			0.0			118.3	
Approach LOS		F			C			A			F	

Intersection Summary			
HCM 2000 Control Delay	173.1	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.36		
Actuated Cycle Length (s)	149.9	Sum of lost time (s)	34.3
Intersection Capacity Utilization	131.2%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	1663	13	41	1613	6	29
Future Volume (Veh/h)	1663	13	41	1613	6	29
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)	1808	14	45	1753	7	32
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)	352			183		
pX, platoon unblocked			0.86		0.86	0.86
vC, conflicting volume			1822		2489	911
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1623		2403	558
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			87		67	92
cM capacity (veh/h)			348		21	409

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	WB 4	NB 1
Volume Total	1205	617	45	584	584	584	39
Volume Left	0	0	45	0	0	0	7
Volume Right	0	14	0	0	0	0	32
cSH	1700	1700	348	1700	1700	1700	95
Volume to Capacity	0.71	0.36	0.13	0.34	0.34	0.34	0.41
Queue Length 95th (m)	0.0	0.0	3.4	0.0	0.0	0.0	12.7
Control Delay (s)	0.0	0.0	16.9	0.0	0.0	0.0	66.7
Lane LOS			C				F
Approach Delay (s)	0.0		0.4				66.7
Approach LOS							F

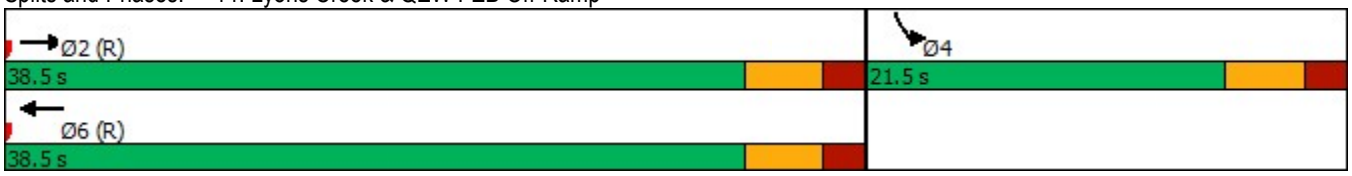
Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	65.4%	ICU Level of Service	C
Analysis Period (min)	15		

Lane Group	EBT	WBT	SBL	SBR
Lane Configurations				
Traffic Volume (vph)	1346	605	494	1047
Future Volume (vph)	1346	605	494	1047
Lane Group Flow (vph)	1463	658	537	1138
Turn Type	NA	NA	Prot	Free
Protected Phases	2	6	4	
Permitted Phases				Free
Minimum Split (s)	21.5	21.5	21.5	
Total Split (s)	38.5	38.5	21.5	
Total Split (%)	64.2%	64.2%	35.8%	
Yellow Time (s)	3.5	3.5	3.5	
All-Red Time (s)	2.0	2.0	2.0	
Lost Time Adjust (s)	3.0	3.0	3.0	
Total Lost Time (s)	8.5	8.5	8.5	
Lead/Lag				
Lead-Lag Optimize?				
v/c Ratio	0.90	0.42	0.79	0.77
Control Delay	23.1	10.6	32.8	4.0
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	23.1	10.6	32.8	4.0
Queue Length 50th (m)	70.7	22.2	28.9	0.0
Queue Length 95th (m)	#116.9	33.0	#49.9	0.0
Internal Link Dist (m)	158.9	496.9	180.1	
Turn Bay Length (m)			70.0	
Base Capacity (vph)	1632	1556	679	1475
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	0.90	0.42	0.79	0.77

Intersection Summary
Cycle Length: 60
Actuated Cycle Length: 60
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Green
Natural Cycle: 60
Control Type: Pretimed
95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 14: Lyons Creek & QEW FEB Off-Ramp



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	0	1346	605	0	494	1047
Future Volume (vph)	0	1346	605	0	494	1047
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)		8.5	8.5		8.5	7.0
Lane Util. Factor		0.95	0.95		0.97	1.00
Frpb, ped/bikes		1.00	1.00		1.00	1.00
Flpb, ped/bikes		1.00	1.00		1.00	1.00
Frt		1.00	1.00		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		3264	3113		3136	1475
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		3264	3113		3136	1475
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	1463	658	0	537	1138
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1463	658	0	537	1138
Confl. Bikes (#/hr)				1		
Heavy Vehicles (%)	0%	3%	8%	0%	4%	2%
Turn Type		NA	NA		Prot	Free
Protected Phases		2	6		4	
Permitted Phases						Free
Actuated Green, G (s)		33.0	33.0		16.0	60.0
Effective Green, g (s)		30.0	30.0		13.0	60.0
Actuated g/C Ratio		0.50	0.50		0.22	1.00
Clearance Time (s)		5.5	5.5		5.5	
Lane Grp Cap (vph)		1632	1556		679	1475
v/s Ratio Prot		0.45	0.21		0.17	
v/s Ratio Perm						c0.77
v/c Ratio		0.90	0.42		0.79	0.77
Uniform Delay, d1		13.6	9.5		22.2	0.0
Progression Factor		1.00	1.00		1.00	1.00
Incremental Delay, d2		8.1	0.8		9.1	4.0
Delay (s)		21.7	10.4		31.4	4.0
Level of Service		C	B		C	A
Approach Delay (s)		21.7	10.4		12.7	
Approach LOS		C	B		B	

Intersection Summary			
HCM 2000 Control Delay	15.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	1.08		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	69.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	1066	0	0	538	126	108
Future Volume (Veh/h)	1066	0	0	538	126	108
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)	1159	0	0	585	137	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			1159		1452	580
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1159		1452	580
tC, single (s)			4.1		7.2	7.0
tC, 2 stage (s)						
tF (s)			2.2		3.7	3.4
p0 queue free %			100		0	74
cM capacity (veh/h)			610		105	446

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	580	580	292	292	137	117
Volume Left	0	0	0	0	137	0
Volume Right	0	0	0	0	0	117
cSH	1700	1700	1700	1700	105	446
Volume to Capacity	0.34	0.34	0.17	0.17	1.31	0.26
Queue Length 95th (m)	0.0	0.0	0.0	0.0	72.0	7.9
Control Delay (s)	0.0	0.0	0.0	0.0	267.4	15.9
Lane LOS					F	C
Approach Delay (s)	0.0		0.0		151.5	
Approach LOS					F	

Intersection Summary			
Average Delay	19.3		
Intersection Capacity Utilization	69.9%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	28	39	38	609	823	41
Future Volume (Veh/h)	28	39	38	609	823	41
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)	30	42	41	662	895	45
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				TWLTL	TWLTL	
Median storage veh)				2	2	
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1330	470	940			
vC1, stage 1 conf vol	918					
vC2, stage 2 conf vol	413					
vCu, unblocked vol	1330	470	940			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3	2.2			
p0 queue free %	90	92	94			
cM capacity (veh/h)	315	540	725			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	72	41	331	331	597	343
Volume Left	30	41	0	0	0	0
Volume Right	42	0	0	0	0	45
cSH	416	725	1700	1700	1700	1700
Volume to Capacity	0.17	0.06	0.19	0.19	0.35	0.20
Queue Length 95th (m)	4.7	1.4	0.0	0.0	0.0	0.0
Control Delay (s)	15.4	10.3	0.0	0.0	0.0	0.0
Lane LOS	C	B				
Approach Delay (s)	15.4	0.6			0.0	
Approach LOS	C					

Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	50.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	8	85	61	641	913	3
Future Volume (Veh/h)	8	85	61	641	913	3
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)	9	92	66	697	992	3
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	TWLTL	
Median storage veh)					2	
Upstream signal (m)				260		
pX, platoon unblocked	0.90					
vC, conflicting volume	1474	498	995			
vC1, stage 1 conf vol	994					
vC2, stage 2 conf vol	480					
vCu, unblocked vol	1313	498	995			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3	2.2			
p0 queue free %	97	82	90			
cM capacity (veh/h)	294	518	691			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	101	66	348	348	661	334
Volume Left	9	66	0	0	0	0
Volume Right	92	0	0	0	0	3
cSH	485	691	1700	1700	1700	1700
Volume to Capacity	0.21	0.10	0.20	0.20	0.39	0.20
Queue Length 95th (m)	5.9	2.4	0.0	0.0	0.0	0.0
Control Delay (s)	14.4	10.8	0.0	0.0	0.0	0.0
Lane LOS	B	B				
Approach Delay (s)	14.4	0.9			0.0	
Approach LOS	B					

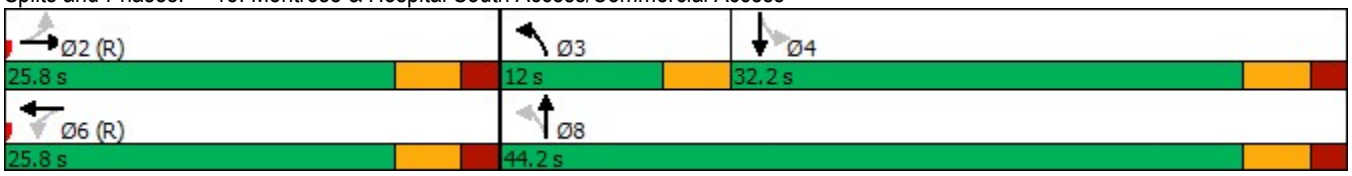
Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	54.9%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	17	0	91	0	180	646	8	982
Future Volume (vph)	17	0	91	0	180	646	8	982
Lane Group Flow (vph)	18	415	99	42	196	723	9	1075
Turn Type	Perm	NA	Perm	NA	pm+pt	NA	Perm	NA
Protected Phases		2		6	3	8		4
Permitted Phases	2		6		8		4	
Minimum Split (s)	21.5	21.5	21.5	21.5	8.0	21.5	21.5	21.5
Total Split (s)	25.8	25.8	25.8	25.8	12.0	44.2	32.2	32.2
Total Split (%)	36.9%	36.9%	36.9%	36.9%	17.1%	63.1%	46.0%	46.0%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	2.0	2.0	2.0	2.0	0.0	2.0	2.0	2.0
Lost Time Adjust (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	8.5	8.5	8.5	8.5	6.5	8.5	8.5	8.5
Lead/Lag					Lead		Lag	Lag
Lead-Lag Optimize?					Yes		Yes	Yes
v/c Ratio	0.06	0.73	0.77	0.08	0.84	0.43	0.04	0.96
Control Delay	20.9	17.2	65.7	0.3	42.8	11.7	16.4	44.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.9	17.2	65.7	0.3	42.8	11.7	16.4	44.2
Queue Length 50th (m)	1.8	15.3	12.1	0.0	12.4	28.8	0.8	71.4
Queue Length 95th (m)	6.3	#54.4	#36.2	0.0	#43.1	40.7	3.6	#112.1
Internal Link Dist (m)		64.2		77.5		94.1		236.0
Turn Bay Length (m)			60.0		30.0		30.0	
Base Capacity (vph)	312	571	128	499	234	1677	221	1115
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.06	0.73	0.77	0.08	0.84	0.43	0.04	0.96

Intersection Summary

Cycle Length: 70
Actuated Cycle Length: 70
Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green
Natural Cycle: 70
Control Type: Pretimed
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 18: Montrose & Hospital South Access/Commercial Access



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	17	0	382	91	0	39	180	646	19	8	982	7
Future Volume (vph)	17	0	382	91	0	39	180	646	19	8	982	7
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	8.5	8.5		8.5	8.5		6.5	8.5		8.5	8.5	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.85		1.00	0.85		1.00	1.00		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1648	1475		1648	1475		1648	3282		1648	3292	
Flt Permitted	0.73	1.00		0.30	1.00		0.13	1.00		0.38	1.00	
Satd. Flow (perm)	1266	1475		521	1475		230	3282		654	3292	
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)	18	0	415	99	0	42	196	702	21	9	1067	8
RTOR Reduction (vph)	0	207	0	0	32	0	0	3	0	0	1	0
Lane Group Flow (vph)	18	208	0	99	10	0	196	720	0	9	1074	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		2			6		3	8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	20.3	20.3		20.3	20.3		38.7	38.7		26.7	26.7	
Effective Green, g (s)	17.3	17.3		17.3	17.3		35.7	35.7		23.7	23.7	
Actuated g/C Ratio	0.25	0.25		0.25	0.25		0.51	0.51		0.34	0.34	
Clearance Time (s)	5.5	5.5		5.5	5.5		3.5	5.5		5.5	5.5	
Lane Grp Cap (vph)	312	364		128	364		228	1673		221	1114	
v/s Ratio Prot		0.14			0.01		c0.07	0.22			c0.33	
v/s Ratio Perm	0.01			c0.19			0.37			0.01		
v/c Ratio	0.06	0.57		0.77	0.03		0.86	0.43		0.04	0.96	
Uniform Delay, d1	20.1	23.1		24.5	20.0		13.4	10.8		15.5	22.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.4	6.4		35.6	0.1		32.1	0.8		0.3	19.7	
Delay (s)	20.5	29.5		60.1	20.1		45.4	11.6		15.9	42.4	
Level of Service	C	C		E	C		D	B		B	D	
Approach Delay (s)		29.1			48.2			18.8			42.2	
Approach LOS		C			D			B			D	

Intersection Summary			
HCM 2000 Control Delay	32.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	23.5
Intersection Capacity Utilization	99.6%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Configurations					
Traffic Volume (vph)	19	596	649	187	85
Future Volume (vph)	19	596	649	187	85
Lane Group Flow (vph)	21	648	796	203	92
Turn Type	Perm	NA	NA	Prot	Perm
Protected Phases		2	6	4	
Permitted Phases	2				4
Minimum Split (s)	21.5	21.5	21.5	21.5	21.5
Total Split (s)	23.5	23.5	23.5	21.5	21.5
Total Split (%)	52.2%	52.2%	52.2%	47.8%	47.8%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	3.0	3.0	3.0	3.0	3.0
Total Lost Time (s)	8.5	8.5	8.5	8.5	8.5
Lead/Lag					
Lead-Lag Optimize?					
v/c Ratio	0.11	0.59	0.72	0.43	0.19
Control Delay	12.2	15.1	17.3	16.4	7.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	12.2	15.1	17.3	16.4	7.0
Queue Length 50th (m)	1.1	21.5	26.7	12.7	1.5
Queue Length 95th (m)	4.6	34.1	42.2	26.4	8.8
Internal Link Dist (m)		466.8	279.7	146.1	
Turn Bay Length (m)	30.0				
Base Capacity (vph)	195	1098	1102	476	472
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	0.59	0.72	0.43	0.19

Intersection Summary

Cycle Length: 45
Actuated Cycle Length: 45
Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBT, Start of Green
Natural Cycle: 45
Control Type: Pretimed

Splits and Phases: 19: Biggar & Hospital East Access

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	19	596	649	84	187	85
Future Volume (vph)	19	596	649	84	187	85
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	8.5	8.5	8.5		8.5	8.5
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Frt	1.00	1.00	0.98		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1648	3296	3240		1648	1475
Flt Permitted	0.34	1.00	1.00		0.95	1.00
Satd. Flow (perm)	584	3296	3240		1648	1475
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	21	648	705	91	203	92
RTOR Reduction (vph)	0	0	22	0	0	46
Lane Group Flow (vph)	21	648	774	0	203	46
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		2	6		4	
Permitted Phases	2					4
Actuated Green, G (s)	18.0	18.0	18.0		16.0	16.0
Effective Green, g (s)	15.0	15.0	15.0		13.0	13.0
Actuated g/C Ratio	0.33	0.33	0.33		0.29	0.29
Clearance Time (s)	5.5	5.5	5.5		5.5	5.5
Lane Grp Cap (vph)	194	1098	1080		476	426
v/s Ratio Prot		0.20	c0.24		c0.12	
v/s Ratio Perm	0.04					0.03
v/c Ratio	0.11	0.59	0.72		0.43	0.11
Uniform Delay, d1	10.4	12.4	13.1		13.0	11.7
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	1.1	2.3	4.1		2.8	0.5
Delay (s)	11.5	14.8	17.2		15.8	12.3
Level of Service	B	B	B		B	B
Approach Delay (s)		14.7	17.2		14.7	
Approach LOS		B	B		B	

Intersection Summary			
HCM 2000 Control Delay	15.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	45.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	47.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	7	572	715	19	43	42
Future Volume (Veh/h)	7	572	715	19	43	42
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	8	622	777	21	47	46
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	798				1114	399
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	798				1114	399
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				77	92
cM capacity (veh/h)	820				200	601

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1	SB 2
Volume Total	8	311	311	518	280	47	46
Volume Left	8	0	0	0	0	47	0
Volume Right	0	0	0	0	21	0	46
cSH	820	1700	1700	1700	1700	200	601
Volume to Capacity	0.01	0.18	0.18	0.30	0.16	0.23	0.08
Queue Length 95th (m)	0.2	0.0	0.0	0.0	0.0	6.7	1.9
Control Delay (s)	9.4	0.0	0.0	0.0	0.0	28.4	11.5
Lane LOS	A					D	B
Approach Delay (s)	0.1			0.0		20.1	
Approach LOS						C	

Intersection Summary			
Average Delay	1.3		
Intersection Capacity Utilization	37.1%	ICU Level of Service	A
Analysis Period (min)	15		

APPENDIX J

TECHNICAL MEMORANDUM ARCADY ANALYSIS OF ROUNDABOUTS AT QEW TERMINALS

PARSONS

1393 North Service Road East, Suite 103, Oakville, ON, L6H 1A7
Direct: +1 905.569.4122 / www.parsons.com

Technical Memo

Date: March 11, 2021 Our Reference # 4773511

To: Carolyn Ryall – Region of Niagara

From: Altaf Hussain – Parsons

Imran Salam - Parsons

Copy: Richard Goertz – Parsons

Noris Bot - Parsons

Subject: **Montrose Road, Lyons Creek Road/Biggar Road Municipal Class Environmental Assessment & Detail Design –ARCADY Analysis of Proposed Roundabouts at QEW Terminals at Lyons Creek Road**

The Municipality of Niagara Region has retained Parsons to conduct a Municipal Class Environmental Assessment (EA) & Detailed Design for the reconstruction of Montrose Road from Lyons Creek Road to McLeod Road and for reconstruction of Lyons Creek Road from the QEW interchange to the western limits of proposed South Niagara Hospital. A Detailed Transportation Assessment (DTA) has been conducted under existing (2019) and future (2026 and 2041) traffic conditions to determine the roadway functional design components and traffic control facilities to meet the future traffic needs. The draft DTA is currently under review by various agencies including Ministry of Transportation Ontario (MTO).

The DTA contains preliminary sizing and feasibility assessment of roundabout intersection control at the both QEW terminals at Lyons Creek Road. The preliminary assessment was conducted using SIDRA software. Following the submission of the draft DTA, preliminary draft design of the roundabouts at both the QEW terminals was developed. Accordingly, a detailed operational assessment of the roundabouts has been conducted using MTO's approved ARCADY software which depends on the geometric parameters of a roundabout for capacity calculations.

This memorandum reports the ARCADY analysis results for the future traffic conditions and provides conclusions about the feasibility of roundabout intersection control at both the QEW terminals at Lyons Creek Road.

Analysis Parameters

Following parameters were adhered to for the analysis:

- MTO roundabout traffic analysis guidelines provided in the *Highway Design Bulletin 2012-003 dated April 23,2012* and Appendix B of *MTO Traffic Impact Study Guidelines (September 2014)* were followed.
- ARCADY version 9.5 was used.
- Future 2026 and 2041 traffic forecasts provided in the DTA were used. Input to ARCADY was in the form of Passenger Car Equivalent (PCE). The entering, circulating, and departing traffic volumes are provided in Attachment 1.
- Geometric inputs to the software were measured off the preliminary draft design using the ARCADY's measuring tool. Preliminary draft design of the roundabouts referenced for the analysis is included as Attachment 2.
- Capacity analysis was conducted for 85% and 90% y-intercept for 2026 and 2041, respectively, as required by the relevant MTO guidelines identified above.

Analysis Results

Table 1 below summarizes the intersections' as well as respective approaches' delay and level of service (LOS). Volume to Capacity (V/C) ratios, Mean and 95th percentile queues in terms of PCE are also reported for each approach. ARCADY reports are provided in Attachment 3.

TABLE 1: ARCADY ANALYSIS – SUMMARY RESULTS

AM Peak Hour								PM Peak Hour							
Overall		Approach						Overall		Approach					
Delay (s)	LOS	Direction	V/C	Delay (s)	LOS	Queue (PCE)*		Delay (s)	LOS	Direction	V/C	Delay (s)	LOS	Queue (PCE)*	
						Mean	95th							Mean	95th
2026 Traffic Conditions															
Lyons Creek Road and QEW Fort Erie Bound Off-ramp Intersection															
4.16	A	Eastbound	0.54	3.93	A	1.2 (9m)	1.5 (11m)	10.66	B	Eastbound	0.89	17.22	C	7.5 (56m)	38.1 (286m)
		Westbound	0.36	3.02	A	0.6 (5m)	2.9 (22m)			Westbound	0.37	3.21	A	0.6 (5m)	2.9 (22m)
		Southbound	0.23	5.07	A	0.3 (2m)	1.5 (11m)			Southbound	0.49	7.0	A	1.0 (8m)	2.6 (20m)
Lyons Creek Road and QEW Toronto Bound Off-ramp Intersection															
3.77	A	Eastbound	0.60	4.83	A	1.5 (11m)	2.0 (15m)	10.06	B	Eastbound	0.87	14.77	B	6.6 (50m)	34.2 (257m)
		Westbound	0.35	2.97	A	0.6 (5m)	2.7 (20m)			Westbound	0.38	2.77	A	0.6 (5m)	2.7 (20m)
		Northbound	0.15	1.94	A	0.2 (1.5m)	0.5 (4m)			Northbound	0.14	2.48	A	0.2 (1.5m)	0.5 (4m)
2041 Traffic Conditions															
Lyons Creek Road and QEW Fort Erie Bound Off-ramp Intersection															
4.82	A	Eastbound	0.65	5.19	A	0.9 (8m)	3.1 (23m)	57.61	F	Eastbound	1.07	124.45	F	74.5 (560m)	152.1 (1140m)
		Westbound	0.38	2.95	A	0.7 (8m)	3.0 (23m)			Westbound	0.38	3.06	A	0.7 (8m)	3 (23m)
		Southbound	0.27	5.57	A	0.4 (8m)	1.3 (10m)			Southbound	0.57	8.63	A	1.3 (8m)	2.4 (18m)
Lyons Creek Road and QEW Toronto Bound Off-ramp Intersection															
4.40	A	Eastbound	0.68	5.73	A	2.1 (15m)	4.0 (30m)	33.23	D	Eastbound	0.99	51.46	F	28.2 (212m)	110.8 (830m)
		Westbound	0.41	3.28	A	0.7 (8m)	2.8 (23m)			Westbound	0.44	3.05	A	0.8 (8m)	2.1 (15m)
		Northbound	0.17	2.04	A	0.2 (8m)	0.5 (8m)			Northbound	0.16	2.67	A	0.2 (8m)	0.5 (8m)

*Queue (PCE) converted into metres assuming a queued passenger car occupies 7.5m length

Both the roundabouts are predicted to operate well during the AM peak hour under the both 2026 and 2041 traffic conditions. During the PM peak hour, the roundabouts operate well under 2026 traffic conditions only. During the PM peak hour conditions, the eastbound approach experiences capacity constraints at both the intersections under the both 2026 and 2041 traffic conditions.

2026 TRAFFIC CONDITIONS

The maximum mean eastbound queue for the roundabouts ranges between 50 – 60 m. The maximum 95th percentile eastbound queue at the QEW Fort Erie Bound (FEB) Off-ramp intersection is 286 m while the spacing to the upstream Lyons Creek and Montrose Road intersection is approximately *540 m*. At the QEW Toronto Bound (TB) Off-ramp intersection, the maximum 95th percentile queue is forecast to be 257 m while the spacing to the upstream

FEB Off-ramp intersection is approximately *500 m*. The eastbound queues are not predicted to interfere with the upstream intersections' operations.

2041 TRAFFIC CONDITIONS

The QEW FEB Off-ramp roundabout is shown to be over-capacity with overall LOS F during the PM peak hour. The eastbound approach is overcapacity during PM peak hour with average delay of 125 s. The maximum mean queue is forecast to be 560 m which exceeds the *540 m* (approximately) spacing between the FEB Off-ramp and the Lyons Creek Road and Montrose Road intersection.

The queues variation chart at 5 minutes intervals produced in ARCADY for the eastbound approach at the FEB Off-ramp intersection is shown in **Figure 1**. The 95th percentile queue exceeds the 540 m length (72 PCE) for 35-40 minutes during the peak hour. Therefore, it is predicted to interfere with the operation of the upstream Lyons Creak Road Montrose Road intersection. The maximum 95th percentile queue is predicted to be 1140 m (152 PCE).

At the QEW TB Off-ramp intersection, the eastbound approach is at capacity during the PM peak hour with average delay of 51.46 s. The maximum mean queue is 212 m (28.2 PCE). The maximum 95th percentile queue is forecast to be 830 m (110.8 PCE) which exceeds the approximate *500 m* spacing between the FEB Off-ramp and TB Off-ramp intersections. Queue variations chart is shown in **Figure 2**. The 95th percentile queue exceeds 500 m length (67 PCE) for 25-30 minutes during the PM peak hour and therefore is anticipated to interfere with the operation of the upstream FEB Off-ramp roundabout intersection.

Based on the ARCADY traffic analysis, it is inferred that the roundabouts as proposed in the preliminary draft design, are not operationally feasible. The sensitivity analysis with slightly modified roundabout configuration was conducted and found to be operationally acceptable. Details are presented further below.

FIGURE 1: QUEUES VARIATIONS – EASTBOUND APPROACH, LYONS CREEK ROAD AND QEW FEB OFF-RAMP

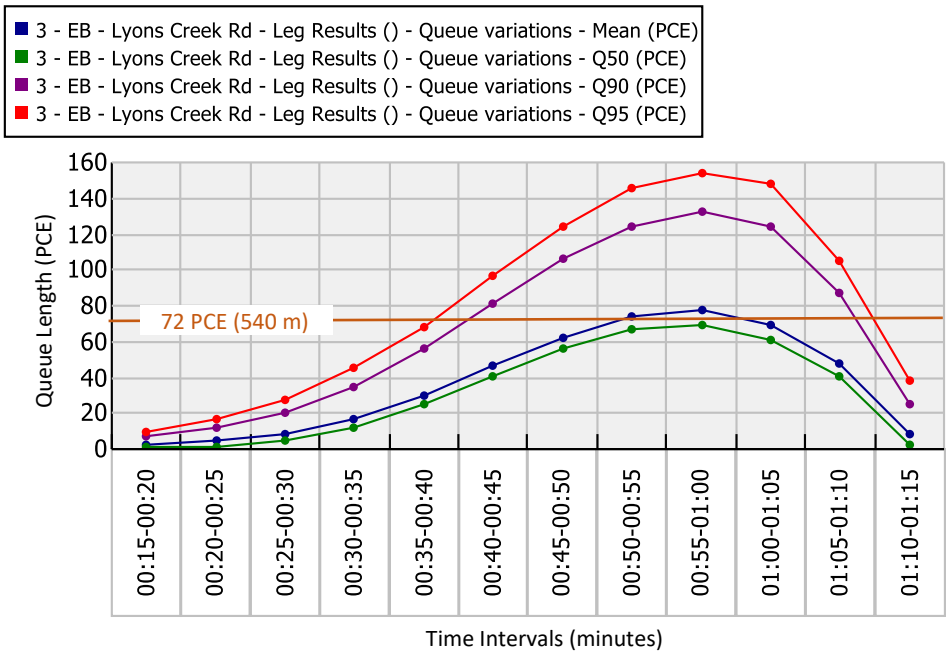
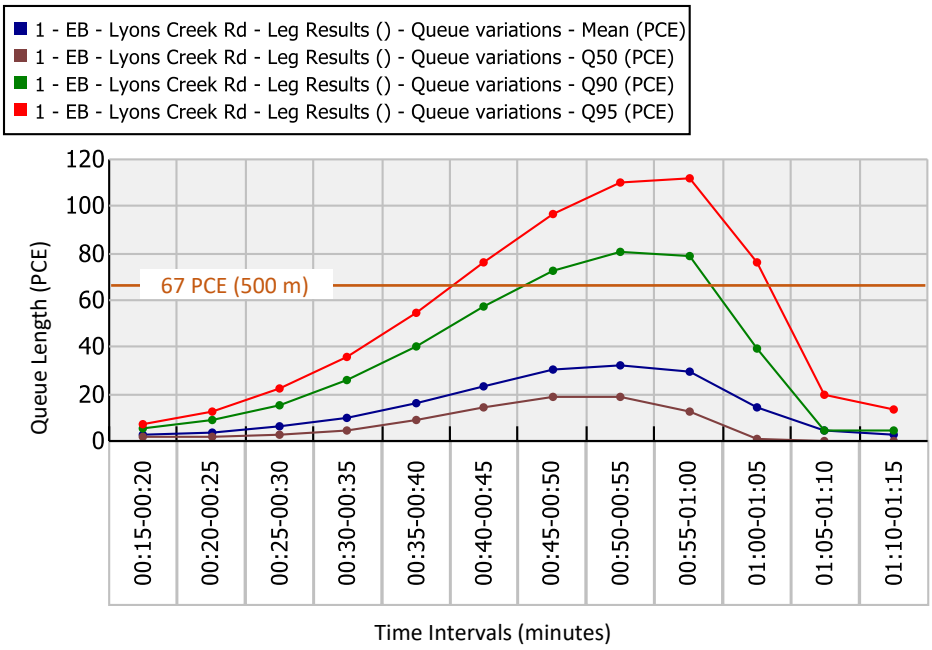


FIGURE 2: QUEUES VARIATIONS – EASTBOUND APPROACH, LYONS CREEK ROAD AND QEW TB OFF-RAMP



Sensitivity Analysis - Modified Roundabout Configurations

Following modifications to the roundabouts' preliminary draft design were analyzed.

- **QEW FEB Off-ramp Roundabout**: The preliminary draft design (**Attachment 2**) deletes the existing West to FEB On-ramp (EBR movement) thus causing this movement to use the existing East to FEB On-ramp, consequently turning left (EBL) through the roundabout. It is proposed to maintain the existing West-FEB On-ramp thus eliminating the EBL turning movement through the roundabout.
- **QEW TB Off-ramp Roundabout**: In the preliminary draft design the West to TB On-ramp (EBR) movement passes through the roundabout. It is proposed to provide a channelized right turn for EBR turning movement bypassing the roundabout.

ARCADY analysis results for the modified roundabouts under 2041 traffic conditions are summarized in **Table 2**. ARCADY reports are provided in **Attachment 3.** The roundabouts' operation with the modified configuration is significantly improved and the eastbound queueing issues are resolved.

TABLE 2: SENSITIVITY ANALYSIS SUMMARY – MODIFIED ROUNDABOUT CONFIGURATIONS

AM Peak Hour								PM Peak Hour							
Overall		Approach						Overall		Approach					
Delay (s)	LOS	Direction	V/C	Delay (s)	LOS	Queue (PCE)*		Delay (s)	LOS	Direction	V/C	Delay (s)	LOS	Queue (PCE)*	
						Mean	95th							Mean	95th
Lyons Creek Road and QEW Fort Erie Bound Off-ramp Intersection															
4.38	A	Eastbound	0.55	4.13	A	1.3 (10m)	1.5 (11m)	9.28	A	Eastbound	0.85	13.51	B	5.5 (41m)	27.9 (209m)
		Westbound	0.36	2.66	A	0.6 (5m)	2.9 (22m)			Westbound	0.34	2.50	A	0.5 (4m)	2.5 (19m)
		Southbound	0.27	4.13	A	0.4 (3m)	1.3 (10m)			Southbound	0.57	8.63	A	1.3 (10m)	2.4 (18m)

AM Peak Hour								PM Peak Hour							
Overall		Approach						Overall		Approach					
Delay (s)	LOS	Direction	V/C	Delay (s)	LOS	Queue (PCE)*		Delay (s)	LOS	Direction	V/C	Delay (s)	LOS	Queue (PCE)*	
						Mean	95th							Mean	95th
Lyons Creek Road and QEW Toronto Bound Off-ramp Intersection															
2.86	A	Eastbound	0.32	2.84	A	0.5 (4m)	2.1 (16m)	4.15	A	Eastbound	0.61	4.86	A	1.7 (13m)	2.5 (19m)
		Westbound	0.41	3.28	A	0.7 (5m)	2.8 (21m)			Westbound	0.44	3.05	A	0.8 (6m)	2.1 (16m)
		Northbound	0.17	2.04	A	0.2 (1.5m)	0.5 (4m)			Northbound	0.16	2.70	A	0.2 (1.5m)	0.5 (4m)

*Queue (PCE) converted into metres assuming a queued passenger car occupies 7.5m length

Conclusions

Based on the ARCADY traffic analysis of the roundabouts' design proposed in the preliminary draft design, it is inferred that the roundabouts are likely to operate acceptably and within capacity under 2026 traffic conditions. The eastbound queues are not predicted to interfere with the upstream intersection' operations.

Under the 2041 conditions, the QEW FEB Off-ramp roundabout is forecast to be overcapacity. The eastbound approach at both the FEB Off-ramp and TB Off-ramp roundabout intersections will be constrained. The eastbound queues at both the intersections are predicted to interfere with the operations of the upstream intersections for significant duration (30-45 minutes) during the PM peak hour.

The roundabout configurations in the preliminary draft design are operationally feasible with slight modifications. Maintaining the existing West-FEB On-ramp at Lyons Creek Road and QEW FEB Off-ramp roundabout as well as providing a channelized bypass lane at Lyons Creek Road and QEW TB Off-ramp roundabout for EBR turning movement resolve the capacity and queueing issues under 2041 traffic conditions.

Attachment(s)/Enclosure

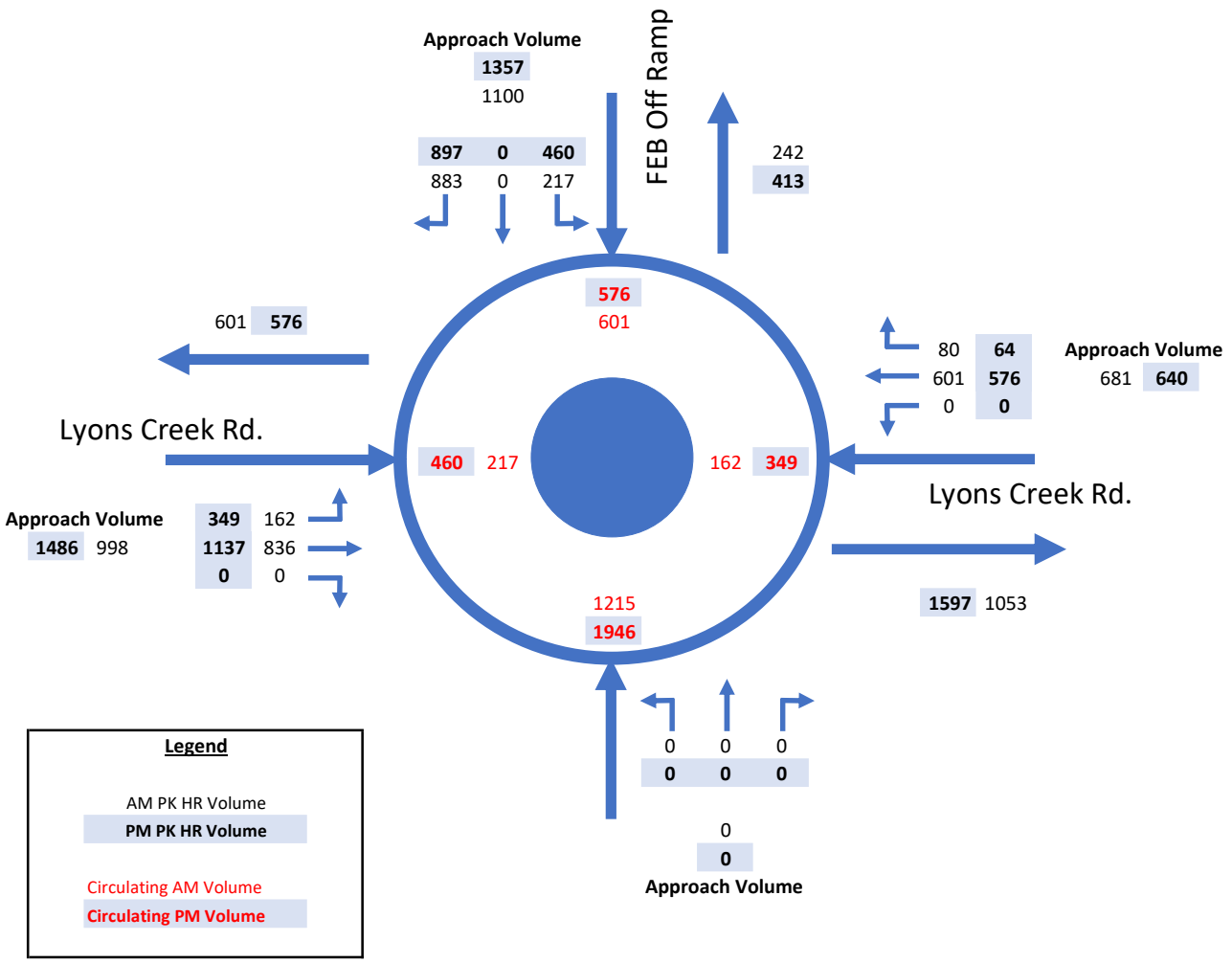
Attachment 1 – Roundabout Traffic Volumes
Attachment 2 – Preliminary Draft Design of Roundabouts
Attachment 3 – ARCADY Reports

ATTACHMENT 1

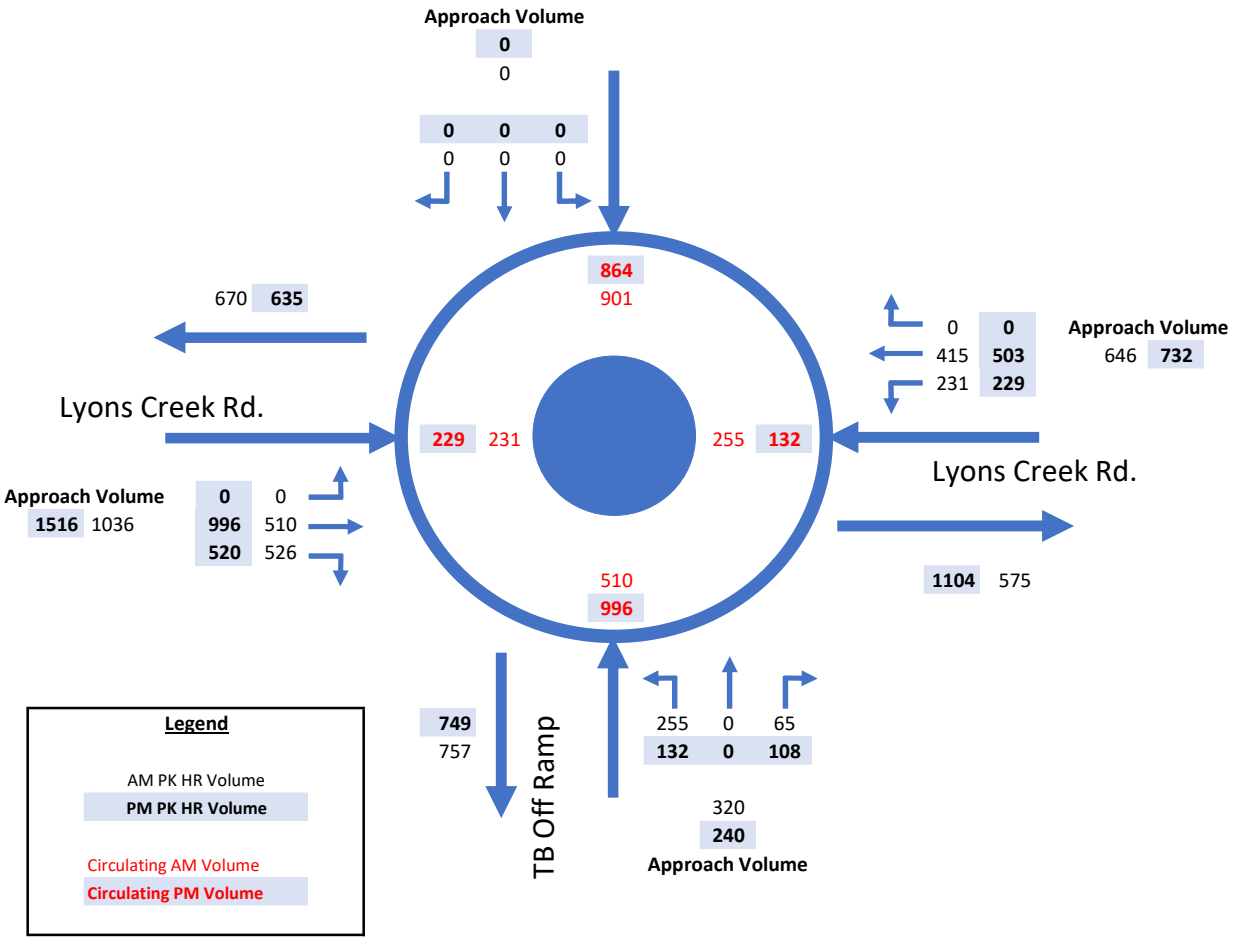
ROUNDABOUT TRAFFIC VOLUMES

PARSONS

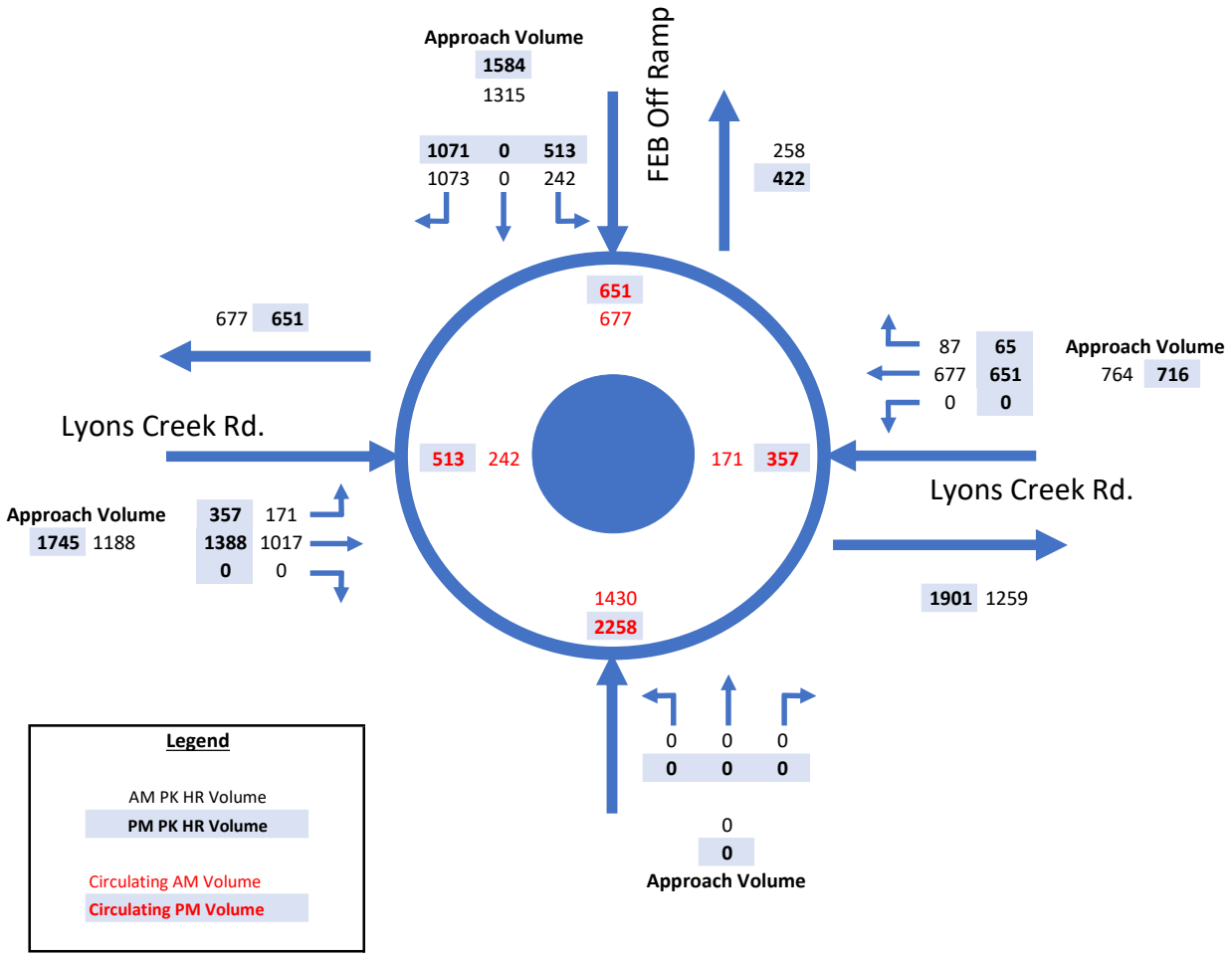
QEW Fort Erie Bound Off-ramp Roundabout (2026) Total Volumes (PCEs), AM and PM Peak Hour



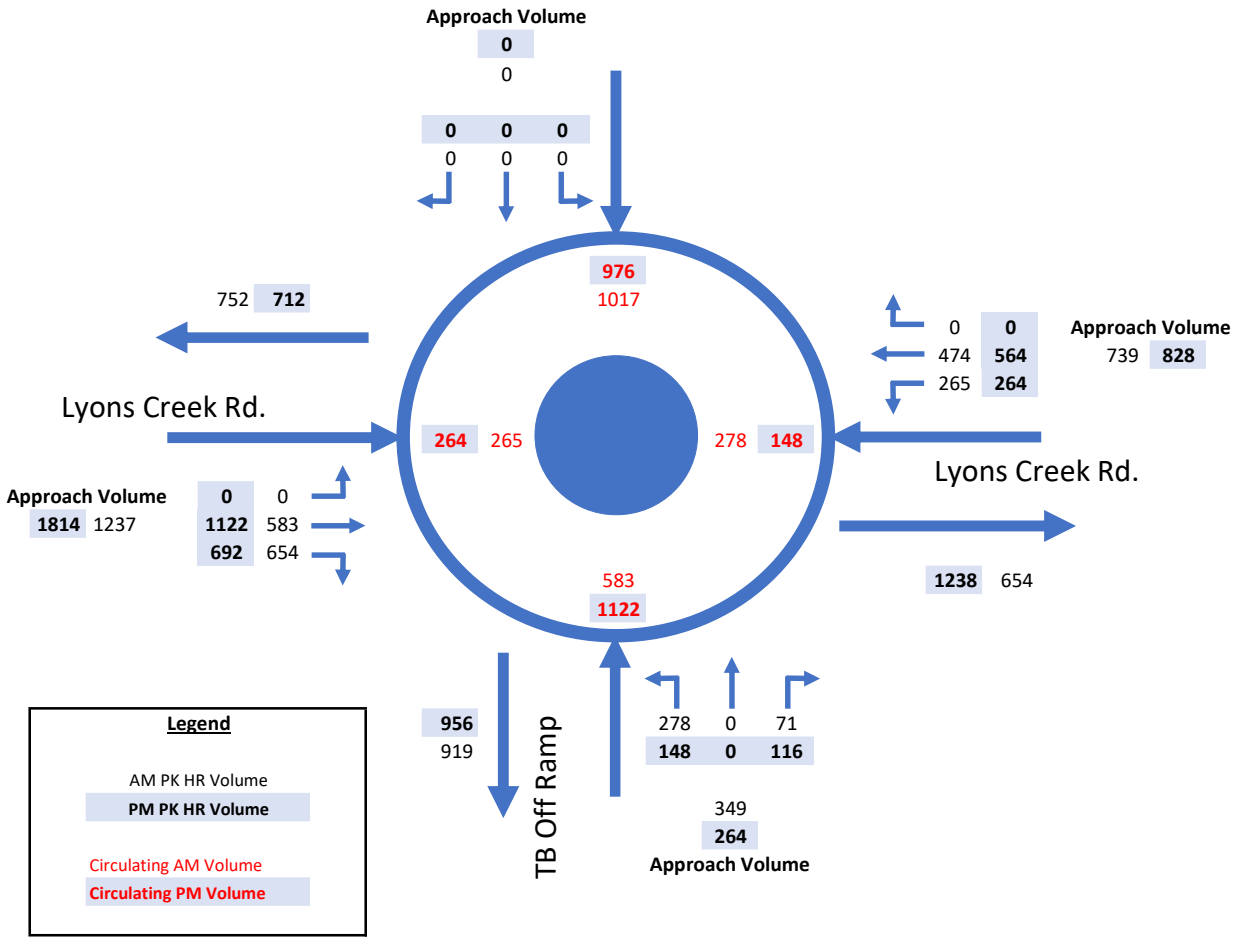
QEW Toronto Bound Off-ramp Roundabout (2026) Total Volumes (PCEs), AM and PM Peak Hour



QEW Fort Erie Bound Off-ramp Roundabout (2041) Total Volumes (PCEs), AM and PM Peak Hour



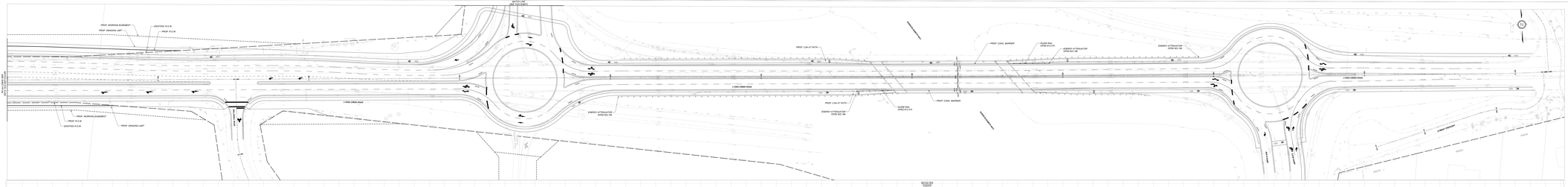
QEW Toronto Bound Off-ramp Roundabout (2041) Total Volumes (PCEs), AM and PM Peak Hour

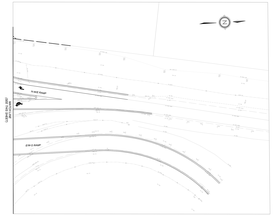


ATTACHMENT 2

PRELIMINARY DRAFT DESIGN OF ROUNDABOUTS

PARSONS





REGIONAL ROAD 47 @ LYONS CREEK ROAD
CLASS ENVIRONMENTAL ASSESSMENT AND PRELIMINARY DESIGN STUDY
FROM 350M EAST OF REGIONAL ROAD 98 (MONTROSE ROAD) TO 3147 OF G.E.W
PLAN AND PROFILE - Page 20
Project No. 17-2-1
Feb 19, 2021

ATTACHMENT 3

ARCADY REPORTS

PARSONS

Junctions 9

ARCADY 9 - Roundabout Module

Version: 9.5.1.7462
© Copyright TRL Limited, 2019

For sales and distribution information, program advice and maintenance, contact TRL:
+44 (0)1344 379777 software@trl.co.uk www.trlsoftware.co.uk

The users of this computer program for the solution of an engineering problem are in no way relieved of their responsibility for the correctness of the solution

Filename: Future 2026 QEW RA Pre_Des FEB Terminals.j9
Path: \\XCCAN56FS01\Projects\DATA\477511 (Montrose Road & Lyons Creek EA & DD)\MF#6A - Deliverables\Traffic\Traffic Analysis\ARCADY
Report generation date: 3/5/2021 1:39:06 PM

»Preliminary Design - 2026 Conditions, AM
»Preliminary Design - 2026 Conditions, PM

Summary of intersection performance

	AM							PM						
	Queue (PCE)	95% Queue (PCE)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Queue (PCE)	95% Queue (PCE)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS
	Preliminary Design - 2026 Conditions													
1 - WB - Lyons Creek Rd	0.6	2.9	3.02	0.36	A	4.16	A	0.6	2.9	3.21	0.37	A	10.66	B
2 - SB - QEW FEB Off-ramp	0.3	1.5	5.07	0.23	A			1.0	2.6	7.00	0.49	A		
3 - EB - Lyons Creek Rd	1.2	1.5	3.93	0.54	A			7.5	38.1	17.22	0.89	C		

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle. Intersection LOS and Intersection Delay are demand-weighted averages.

File summary

File Description

Title	Montrose Rd & Lyons Creek Rd EA
Location	Lyons Creek Rd & QEW Fort Erie Bound Off-ramp
Site number	
Date	2/25/2021
Version	2026 Conditions
Status	
Identifier	
Client	Niagara Region
Jobnumber	
Analyst	Imran Salam
Description	Preliminary Draft Design - Roundabout Traffic Analysis

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCE	PCE	perHour	s	-Min	perMin

Analysis Options

Vehicle length (m)	Calculate Queue Percentiles	Calculate detailed queueing delay	Calculate residual capacity	V/C Ratio Threshold	Average Delay threshold (s)	Queue threshold (PCE)
5.75	✓			0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Results for central hour only	Run automatically
D1	2026 Conditions	AM	ONE HOUR	00:00	01:30	15	✓	✓
D2	2026 Conditions	PM	ONE HOUR	00:00	01:30	15	✓	✓

Analysis Set Details

ID	Name	Include in report	Network flow scaling factor (%)	Network capacity scaling factor (%)
A1	Preliminary Design	✓	100.000	100.000

Preliminary Design - 2026 Conditions, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Demand Sets	D1 - 2026 Conditions, AM	Time results are shown for central hour only. (Model is run for a 90 minute period.)
Warning	Queue variations	Analysis Options	Queue percentiles may be unreliable if the mean queue in any time segment is very low or very high.

Results

Results Summary for whole modelled period

Leg	Max V/C Ratio	Max Delay (s)	Max Queue (PCE)	Max 95th percentile Queue (PCE)	Max LOS	Average Demand (PCE/hr)	Total Intersection Arrivals (PCE)
1 - WB - Lyons Creek Rd	0.36	3.02	0.6	2.9	A	681	681
2 - SB - QEW FEB Off-ramp	0.23	5.07	0.3	1.5	A	1100	217
3 - EB - Lyons Creek Rd	0.54	3.93	1.2	1.5	A	998	998

Main Results for each time segment

00:15 - 00:30

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)
1 - WB - Lyons Creek Rd	612	612	153	0	0	145	2101	0.291	612	946	0.4	0.5
2 - SB - QEW FEB Off-ramp	989	195	49	794	0	540	1091	0.179	195	217	0.2	0.2
3 - EB - Lyons Creek Rd	897	897	224	0	794	195	2080	0.431	896	540	0.6	0.8

00:30 - 00:45

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)
1 - WB - Lyons Creek Rd	750	750	187	0	0	178	2076	0.361	749	1158	0.5	0.6
2 - SB - QEW FEB Off-ramp	1211	239	60	972	0	661	1027	0.233	239	266	0.2	0.3
3 - EB - Lyons Creek Rd	1099	1099	275	0	972	239	2046	0.537	1097	661	0.8	1.2

00:45 - 01:00

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)
1 - WB - Lyons Creek Rd	750	750	187	0	0	178	2076	0.361	750	1159	0.6	0.6
2 - SB - QEW FEB Off-ramp	1211	239	60	972	0	662	1027	0.233	239	266	0.3	0.3
3 - EB - Lyons Creek Rd	1099	1099	275	0	972	239	2046	0.537	1099	662	1.2	1.2

01:00 - 01:15

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)
1 - WB - Lyons Creek Rd	612	612	153	0	0	146	2101	0.291	613	948	0.6	0.5
2 - SB - QEW FEB Off-ramp	989	195	49	794	0	541	1090	0.179	195	218	0.3	0.2
3 - EB - Lyons Creek Rd	897	897	224	0	794	195	2079	0.432	899	541	1.2	0.8

Queue Variation Results for each time segment

00:15 - 00:30

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - WB - Lyons Creek Rd	0.46	0.00	0.00	0.46	0.46			N/A	N/A
2 - SB - QEW FEB Off-ramp	0.24	0.00	0.00	0.24	0.24			N/A	N/A
3 - EB - Lyons Creek Rd	0.78	0.08	0.83	1.20	1.20			N/A	N/A

00:30 - 00:45

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - WB - Lyons Creek Rd	0.63	0.03	0.28	0.63	0.63			N/A	N/A
2 - SB - QEW FEB Off-ramp	0.33	0.03	0.28	0.51	0.54			N/A	N/A
3 - EB - Lyons Creek Rd	1.19	0.03	0.26	1.19	1.19			N/A	N/A

00:45 - 01:00

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - WB - Lyons Creek Rd	0.63	0.03	0.33	1.46	2.93			N/A	N/A
2 - SB - QEW FEB Off-ramp	0.34	0.03	0.35	1.15	1.45			N/A	N/A
3 - EB - Lyons Creek Rd	1.19	0.03	0.27	1.19	1.19			N/A	N/A

01:00 - 01:15

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - WB - Lyons Creek Rd	0.46	0.00	0.00	0.46	0.46			N/A	N/A
2 - SB - QEW FEB Off-ramp	0.24	0.00	0.00	0.24	0.24			N/A	N/A
3 - EB - Lyons Creek Rd	0.79	0.55	1.02	1.45	1.50			N/A	N/A

Preliminary Design - 2026 Conditions, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Demand Sets	D2 - 2026 Conditions, PM	Time results are shown for central hour only. (Model is run for a 90 minute period.)
Warning	Queue variations	Analysis Options	Queue percentiles may be unreliable if the mean queue in any time segment is very low or very high.

Results

Results Summary for whole modelled period

Leg	Max V/C Ratio	Max Delay (s)	Max Queue (PCE)	Max 95th percentile Queue (PCE)	Max LOS	Average Demand (PCE/hr)	Total Intersection Arrivals (PCE)
1 - WB - Lyons Creek Rd	0.37	3.21	0.6	2.9	A	640	640
2 - SB - QEW FEB Off-ramp	0.49	7.00	1.0	2.6	A	1357	460
3 - EB - Lyons Creek Rd	0.89	17.22	7.5	38.1	C	1486	1486

Main Results for each time segment

00:15 - 00:30

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)
1 - WB - Lyons Creek Rd	575	575	144	0	0	313	1972	0.292	575	1432	0.3	0.4
2 - SB - QEW FEB Off-ramp	1220	414	103	806	0	517	1102	0.375	413	370	0.4	0.6
3 - EB - Lyons Creek Rd	1336	1336	334	0	806	413	1914	0.698	1332	517	1.3	2.3

00:30 - 00:45

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)
1 - WB - Lyons Creek Rd	705	705	176	0	0	380	1921	0.367	704	1743	0.4	0.6
2 - SB - QEW FEB Off-ramp	1494	506	127	988	0	634	1042	0.486	505	450	0.6	1.0
3 - EB - Lyons Creek Rd	1636	1636	409	0	988	505	1844	0.887	1617	634	2.3	7.0

00:45 - 01:00

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)
1 - WB - Lyons Creek Rd	705	705	176	0	0	384	1917	0.367	705	1757	0.6	0.6
2 - SB - QEW FEB Off-ramp	1494	506	127	988	0	634	1041	0.486	506	454	1.0	1.0
3 - EB - Lyons Creek Rd	1636	1636	409	0	988	506	1843	0.888	1634	634	7.0	7.5

01:00 - 01:15

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)
1 - WB - Lyons Creek Rd	575	575	144	0	0	318	1968	0.292	576	1452	0.6	0.4
2 - SB - QEW FEB Off-ramp	1220	414	103	806	0	518	1102	0.375	415	376	1.0	0.6
3 - EB - Lyons Creek Rd	1336	1336	334	0	806	415	1913	0.698	1356	518	7.5	2.4

Queue Variation Results for each time segment

00:15 - 00:30

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - WB - Lyons Creek Rd	0.44	0.00	0.00	0.44	0.44			N/A	N/A
2 - SB - QEW FEB Off-ramp	0.62	0.10	0.87	1.42	1.49			N/A	N/A
3 - EB - Lyons Creek Rd	2.31	0.04	0.45	6.33	10.89			N/A	N/A

00:30 - 00:45

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - WB - Lyons Creek Rd	0.62	0.03	0.27	0.62	0.62			N/A	N/A
2 - SB - QEW FEB Off-ramp	0.97	0.03	0.27	0.97	0.97			N/A	N/A
3 - EB - Lyons Creek Rd	6.98	0.04	0.39	17.23	38.11			N/A	N/A

00:45 - 01:00

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - WB - Lyons Creek Rd	0.63	0.03	0.32	1.42	2.92			N/A	N/A
2 - SB - QEW FEB Off-ramp	0.98	0.03	0.29	0.98	2.62			N/A	N/A
3 - EB - Lyons Creek Rd	7.46	0.03	0.32	8.64	35.21			N/A	N/A

01:00 - 01:15

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - WB - Lyons Creek Rd	0.45	0.00	0.00	0.45	0.45			N/A	N/A
2 - SB - QEW FEB Off-ramp	0.63	0.12	0.90	1.43	1.49			N/A	N/A
3 - EB - Lyons Creek Rd	2.42	0.05	0.46	6.69	11.30			N/A	N/A

Junctions 9

ARCADY 9 - Roundabout Module

Version: 9.5.1.7462
© Copyright TRL Limited, 2019

For sales and distribution information, program advice and maintenance, contact TRL:
+44 (0)1344 379777 software@trl.co.uk www.trlsoftware.co.uk

The users of this computer program for the solution of an engineering problem are in no way relieved of their responsibility for the correctness of the solution

Filename: Future 2041 QEW RA Pre_Des FEB Terminals.j9
Path: \\XCCAN56FS01\Projects\DATA\477511 (Montrose Road & Lyons Creek EA & DD)\MF#6A - Deliverables\Traffic\Traffic Analysis\ARCADY
Report generation date: 3/2/2021 11:05:59 PM

»Preliminary Design - 2041 Conditions, AM
»Preliminary Design - 2041 Conditions, PM

Summary of intersection performance

	AM							PM						
	Queue (PCE)	95% Queue (PCE)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Queue (PCE)	95% Queue (PCE)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS
	Preliminary Design - 2041 Conditions													
1 - WB - Lyons Creek Rd	0.7	3.0	2.95	0.38	A	4.82	A	0.7	3.0	3.06	0.38	A	57.61	F
2 - SB - QEW FEB Off-ramp	0.4	1.3	5.57	0.27	A			1.3	2.4	8.63	0.57	A		
3 - EB - Lyons Creek Rd	1.9	3.1	5.19	0.65	A			74.5	152.1	124.45	1.07	F		

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle. Intersection LOS and Intersection Delay are demand-weighted averages.

File summary

File Description

Title	Montrose Rd & Lyons Creek Rd EA
Location	Lyons Creek Rd & QEW Fort Erie Bound Off-ramp
Site number	
Date	2/25/2021
Version	1
Status	
Identifier	
Client	Niagara Region
Jobnumber	
Analyst	Imran Salam
Description	Preliminary Draft Design - Roundabout Traffic Analysis

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCE	PCE	perHour	s	-Min	perMin

Analysis Options

Vehicle length (m)	Calculate Queue Percentiles	Calculate detailed queueing delay	Calculate residual capacity	V/C Ratio Threshold	Average Delay threshold (s)	Queue threshold (PCE)
5.75	✓			0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Results for central hour only	Locked	Run automatically
D1	2041 Conditions	AM	ONE HOUR	00:00	01:30	15	✓	✓	✓
D2	2041 Conditions	PM	ONE HOUR	00:00	01:30	15	✓	✓	✓

Analysis Set Details

ID	Name	Include in report	Network flow scaling factor (%)	Network capacity scaling factor (%)
A1	Preliminary Design	✓	100.000	100.000

Preliminary Design - 2041 Conditions, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Demand Sets	D1 - 2041 Conditions, AM [Locked]	Time results are shown for central hour only. (Model is run for a 90 minute period.)
Warning	Queue variations	Analysis Options	Queue percentiles may be unreliable if the mean queue in any time segment is very low or very high.

Results

Results Summary for whole modelled period

Leg	Max V/C Ratio	Max Delay (s)	Max Queue (PCE)	Max 95th percentile Queue (PCE)	Max LOS	Average Demand (PCE/hr)	Total Intersection Arrivals (PCE)
1 - WB - Lyons Creek Rd	0.38	2.95	0.7	3.0	A	764	764
2 - SB - QEW FEB Off-ramp	0.27	5.57	0.4	1.3	A	1315	242
3 - EB - Lyons Creek Rd	0.65	5.19	1.9	3.1	A	1188	1188

Main Results for each time segment

00:15 - 00:30

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)
1 - WB - Lyons Creek Rd	687	687	172	0	0	154	2225	0.309	686	1130	0.4	0.5
2 - SB - QEW FEB Off-ramp	1182	218	54	965	0	608	1055	0.206	217	232	0.2	0.3
3 - EB - Lyons Creek Rd	1068	1068	267	0	965	217	2063	0.518	1067	608	0.8	1.1

00:30 - 00:45

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)
1 - WB - Lyons Creek Rd	841	841	210	0	0	188	2199	0.383	840	1383	0.5	0.7
2 - SB - QEW FEB Off-ramp	1448	266	67	1181	0	745	984	0.271	266	284	0.3	0.4
3 - EB - Lyons Creek Rd	1308	1308	327	0	1181	266	2026	0.646	1305	745	1.1	1.9

00:45 - 01:00

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)
1 - WB - Lyons Creek Rd	841	841	210	0	0	188	2199	0.383	841	1386	0.7	0.7
2 - SB - QEW FEB Off-ramp	1448	266	67	1181	0	745	984	0.271	266	284	0.4	0.4
3 - EB - Lyons Creek Rd	1308	1308	327	0	1181	266	2025	0.646	1308	745	1.9	1.9

01:00 - 01:15

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)
1 - WB - Lyons Creek Rd	687	687	172	0	0	154	2225	0.309	688	1135	0.7	0.5
2 - SB - QEW FEB Off-ramp	1182	218	54	965	0	609	1054	0.206	218	232	0.4	0.3
3 - EB - Lyons Creek Rd	1068	1068	267	0	965	218	2062	0.518	1071	609	1.9	1.1

Queue Variation Results for each time segment

00:15 - 00:30

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - WB - Lyons Creek Rd	0.49	0.00	0.00	0.49	0.49			N/A	N/A
2 - SB - QEW FEB Off-ramp	0.29	0.00	0.00	0.29	0.29			N/A	N/A
3 - EB - Lyons Creek Rd	1.10	0.06	0.75	2.24	3.12			N/A	N/A

00:30 - 00:45

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - WB - Lyons Creek Rd	0.69	0.03	0.28	0.69	0.69			N/A	N/A
2 - SB - QEW FEB Off-ramp	0.41	0.03	0.28	0.51	0.54			N/A	N/A
3 - EB - Lyons Creek Rd	1.86	0.03	0.27	1.86	1.86			N/A	N/A

00:45 - 01:00

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - WB - Lyons Creek Rd	0.69	0.03	0.32	1.26	3.02			N/A	N/A
2 - SB - QEW FEB Off-ramp	0.41	0.04	0.36	1.31	1.31			N/A	N/A
3 - EB - Lyons Creek Rd	1.87	0.03	0.27	1.87	1.87			N/A	N/A

01:00 - 01:15

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - WB - Lyons Creek Rd	0.50	0.00	0.00	0.50	0.50			N/A	N/A
2 - SB - QEW FEB Off-ramp	0.29	0.00	0.00	0.29	0.29			N/A	N/A
3 - EB - Lyons Creek Rd	1.12	0.20	1.09	1.62	1.91			N/A	N/A

Preliminary Design - 2041 Conditions, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Demand Sets	D2 - 2041 Conditions, PM [Locked]	Time results are shown for central hour only. (Model is run for a 90 minute period.)
Warning	Queue variations	Analysis Options	Queue percentiles may be unreliable if the mean queue in any time segment is very low or very high.

Results

Results Summary for whole modelled period

Leg	Max V/C Ratio	Max Delay (s)	Max Queue (PCE)	Max 95th percentile Queue (PCE)	Max LOS	Average Demand (PCE/hr)	Total Intersection Arrivals (PCE)
1 - WB - Lyons Creek Rd	0.38	3.06	0.7	3.0	A	716	716
2 - SB - QEW FEB Off-ramp	0.57	8.63	1.3	2.4	A	1584	513
3 - EB - Lyons Creek Rd	1.07	124.45	74.5	152.1	F	1745	1745

Main Results for each time segment

00:15 - 00:30

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)
1 - WB - Lyons Creek Rd	644	644	161	0	0	319	2098	0.307	643	1699	0.4	0.5
2 - SB - QEW FEB Off-ramp	1424	461	115	963	0	585	1067	0.432	460	377	0.5	0.8
3 - EB - Lyons Creek Rd	1569	1569	392	0	963	460	1878	0.835	1558	585	2.1	4.8

00:30 - 00:45

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)
1 - WB - Lyons Creek Rd	788	788	197	0	0	362	2064	0.382	788	1971	0.5	0.7
2 - SB - QEW FEB Off-ramp	1744	565	141	1179	0	716	999	0.566	563	434	0.8	1.3
3 - EB - Lyons Creek Rd	1921	1921	480	0	1179	563	1801	1.067	1771	716	4.8	42.5

00:45 - 01:00

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)
1 - WB - Lyons Creek Rd	788	788	197	0	0	367	2061	0.383	788	1991	0.7	0.7
2 - SB - QEW FEB Off-ramp	1744	565	141	1179	0	717	998	0.566	565	438	1.3	1.3
3 - EB - Lyons Creek Rd	1921	1921	480	0	1179	565	1799	1.068	1793	717	42.5	74.5

01:00 - 01:15

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)
1 - WB - Lyons Creek Rd	644	644	161	0	0	376	2054	0.313	644	1925	0.7	0.5
2 - SB - QEW FEB Off-ramp	1424	461	115	963	0	586	1067	0.432	463	434	1.3	0.8
3 - EB - Lyons Creek Rd	1569	1569	392	0	963	463	1876	0.836	1838	586	74.5	7.2

Queue Variation Results for each time segment

00:15 - 00:30

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - WB - Lyons Creek Rd	0.48	0.00	0.00	0.48	0.48			N/A	N/A
2 - SB - QEW FEB Off-ramp	0.78	0.11	0.88	1.46	1.53			N/A	N/A
3 - EB - Lyons Creek Rd	4.83	0.06	0.91	13.77	22.40			N/A	N/A

00:30 - 00:45

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - WB - Lyons Creek Rd	0.66	0.03	0.27	0.66	0.66			N/A	N/A
2 - SB - QEW FEB Off-ramp	1.33	0.03	0.27	1.33	1.33			N/A	N/A
3 - EB - Lyons Creek Rd	42.50	9.29	36.52	77.94	93.51			N/A	N/A

00:45 - 01:00

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - WB - Lyons Creek Rd	0.67	0.03	0.31	1.25	2.96			N/A	N/A
2 - SB - QEW FEB Off-ramp	1.34	0.03	0.28	1.34	2.42			N/A	N/A
3 - EB - Lyons Creek Rd	74.47	21.38	66.56	129.22	152.11			N/A	N/A

01:00 - 01:15

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - WB - Lyons Creek Rd	0.50	0.00	0.00	0.50	0.50			N/A	N/A
2 - SB - QEW FEB Off-ramp	0.80	0.11	0.90	1.47	1.54			N/A	N/A
3 - EB - Lyons Creek Rd	7.20	0.06	1.02	20.90	34.96			N/A	N/A

Junctions 9

ARCADY 9 - Roundabout Module

Version: 9.5.1.7462
© Copyright TRL Limited, 2019

For sales and distribution information, program advice and maintenance, contact TRL:
+44 (0)1344 379777 software@trl.co.uk www.trlsoftware.co.uk

The users of this computer program for the solution of an engineering problem are in no way relieved of their responsibility for the correctness of the solution

Filename: Future 2026 QEW RA Pre_Des TB Terminals.j9
Path: \\XCCAN56FS01\Projects\DATA\477511 (Montrose Road & Lyons Creek EA & DD)\MF#6A - Deliverables\Traffic\Traffic Analysis\ARCADY
Report generation date: 3/5/2021 1:51:02 PM

»Preliminary Design - 2026 Conditions, AM
»Preliminary Design - 2026 Conditions, PM

Summary of intersection performance

	AM							PM						
	Queue (PCE)	95% Queue (PCE)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Queue (PCE)	95% Queue (PCE)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS
	Preliminary Design - 2026 Conditions													
1 - EB - Lyons Creek Rd	1.5	2.0	4.83	0.60	A	3.77	A	6.6	34.2	14.77	0.87	B	10.06	B
2 - NB - QEW TB Off-ramp	0.2	0.5	1.94	0.15	A			0.2	0.5	2.48	0.14	A		
3 - WB - Lyons Creek Rd	0.6	2.7	2.97	0.35	A			0.6	2.7	2.77	0.38	A		

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle. Intersection LOS and Intersection Delay are demand-weighted averages.

File summary

File Description

Title	Montrose Rd & Lyons Creek Rd EA
Location	Lyons Creek Rd & Toronto Bound Off-ramp
Site number	
Date	2/25/2021
Version	2026 Conditions
Status	
Identifier	
Client	Niagara Region
Jobnumber	
Analyst	Imran Salam
Description	Preliminary Draft Design - Roundabout Traffic Analysis

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCE	PCE	perHour	s	-Min	perMin

Analysis Options

Vehicle length (m)	Calculate Queue Percentiles	Calculate detailed queueing delay	Calculate residual capacity	V/C Ratio Threshold	Average Delay threshold (s)	Queue threshold (PCE)
5.75	✓			0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Results for central hour only	Run automatically
D1	2026 Conditions	AM	ONE HOUR	00:00	01:30	15	✓	✓
D2	2026 Conditions	PM	ONE HOUR	00:00	01:30	15	✓	✓

Analysis Set Details

ID	Name	Include in report	Network flow scaling factor (%)	Network capacity scaling factor (%)
A1	Preliminary Design	✓	100.000	100.000

Preliminary Design - 2026 Conditions, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Demand Sets	D1 - 2026 Conditions, AM	Time results are shown for central hour only. (Model is run for a 90 minute period.)
Warning	Queue variations	Analysis Options	Queue percentiles may be unreliable if the mean queue in any time segment is very low or very high.

Results

Results Summary for whole modelled period

Leg	Max V/C Ratio	Max Delay (s)	Max Queue (PCE)	Max 95th percentile Queue (PCE)	Max LOS	Average Demand (PCE/hr)	Total Intersection Arrivals (PCE)
1 - EB - Lyons Creek Rd	0.60	4.83	1.5	2.0	A	1036	1036
2 - NB - QEW TB Off-ramp	0.15	1.94	0.2	0.5	A	320	320
3 - WB - Lyons Creek Rd	0.35	2.97	0.6	2.7	A	646	646

Main Results for each time segment

00:15 - 00:30

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	Delay (s)	Unsignalised level of service
1 - EB - Lyons Creek Rd	931	233	208	1946	0.479	930	602	0.7	0.9	3.674	A
2 - NB - QEW TB Off-ramp	288	72	458	2380	0.121	288	680	0.1	0.1	1.811	A
3 - WB - Lyons Creek Rd	581	145	229	2046	0.284	580	516	0.3	0.4	2.637	A

00:30 - 00:45

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	Delay (s)	Unsignalised level of service
1 - EB - Lyons Creek Rd	1141	285	254	1915	0.596	1138	737	0.9	1.5	4.799	A
2 - NB - QEW TB Off-ramp	352	88	560	2303	0.153	352	832	0.1	0.2	1.944	A
3 - WB - Lyons Creek Rd	711	178	281	2011	0.354	711	632	0.4	0.6	2.971	A

00:45 - 01:00

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	Delay (s)	Unsignalised level of service
1 - EB - Lyons Creek Rd	1141	285	254	1915	0.596	1141	738	1.5	1.5	4.826	A
2 - NB - QEW TB Off-ramp	352	88	562	2302	0.153	352	833	0.2	0.2	1.945	A
3 - WB - Lyons Creek Rd	711	178	281	2011	0.354	711	633	0.6	0.6	2.974	A

01:00 - 01:15

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	Delay (s)	Unsignalised level of service
1 - EB - Lyons Creek Rd	931	233	208	1946	0.479	934	603	1.5	1.0	3.699	A
2 - NB - QEW TB Off-ramp	288	72	460	2379	0.121	288	682	0.2	0.1	1.813	A
3 - WB - Lyons Creek Rd	581	145	229	2046	0.284	581	518	0.6	0.4	2.640	A

Queue Variation Results for each time segment

00:15 - 00:30

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - EB - Lyons Creek Rd	0.95	0.07	0.84	1.64	2.02			N/A	N/A
2 - NB - QEW TB Off-ramp	0.14	0.00	0.00	0.14	0.14			N/A	N/A
3 - WB - Lyons Creek Rd	0.42	0.00	0.00	0.42	0.42			N/A	N/A

00:30 - 00:45

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - EB - Lyons Creek Rd	1.51	0.03	0.27	1.51	1.51			N/A	N/A
2 - NB - QEW TB Off-ramp	0.19	0.03	0.27	0.48	0.51			N/A	N/A
3 - WB - Lyons Creek Rd	0.58	0.03	0.27	0.58	0.58			N/A	N/A

00:45 - 01:00

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - EB - Lyons Creek Rd	1.52	0.03	0.27	1.52	1.52			N/A	N/A
2 - NB - QEW TB Off-ramp	0.19	0.00	0.00	0.19	0.19			N/A	N/A
3 - WB - Lyons Creek Rd	0.59	0.03	0.32	1.47	2.75			N/A	N/A

01:00 - 01:15

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - EB - Lyons Creek Rd	0.96	0.34	1.03	1.16	1.16			N/A	N/A
2 - NB - QEW TB Off-ramp	0.15	0.00	0.00	0.15	0.15			N/A	N/A
3 - WB - Lyons Creek Rd	0.43	0.00	0.00	0.43	0.43			N/A	N/A

Preliminary Design - 2026 Conditions, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Demand Sets	D2 - 2026 Conditions, PM	Time results are shown for central hour only. (Model is run for a 90 minute period.)
Warning	Queue variations	Analysis Options	Queue percentiles may be unreliable if the mean queue in any time segment is very low or very high.

Results

Results Summary for whole modelled period

Leg	Max V/C Ratio	Max Delay (s)	Max Queue (PCE)	Max 95th percentile Queue (PCE)	Max LOS	Average Demand (PCE/hr)	Total Intersection Arrivals (PCE)
1 - EB - Lyons Creek Rd	0.87	14.77	6.6	34.2	B	1516	1516
2 - NB - QEW TB Off-ramp	0.14	2.48	0.2	0.5	A	240	240
3 - WB - Lyons Creek Rd	0.38	2.77	0.6	2.7	A	732	732

Main Results for each time segment

00:15 - 00:30

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	Delay (s)	Unsignalised level of service
1 - EB - Lyons Creek Rd	1363	341	206	1948	0.700	1359	571	1.4	2.4	6.272	A
2 - NB - QEW TB Off-ramp	216	54	893	2054	0.105	216	672	0.1	0.1	2.208	A
3 - WB - Lyons Creek Rd	658	165	119	2122	0.310	658	990	0.3	0.4	2.458	A

00:30 - 00:45

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	Delay (s)	Unsignalised level of service
1 - EB - Lyons Creek Rd	1669	417	252	1916	0.871	1654	699	2.4	6.3	13.409	B
2 - NB - QEW TB Off-ramp	264	66	1086	1909	0.138	264	819	0.1	0.2	2.468	A
3 - WB - Lyons Creek Rd	806	201	145	2104	0.383	805	1205	0.4	0.6	2.771	A

00:45 - 01:00

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	Delay (s)	Unsignalised level of service
1 - EB - Lyons Creek Rd	1669	417	252	1916	0.871	1668	699	6.3	6.6	14.772	B
2 - NB - QEW TB Off-ramp	264	66	1096	1901	0.139	264	824	0.2	0.2	2.479	A
3 - WB - Lyons Creek Rd	806	201	145	2104	0.383	806	1215	0.6	0.6	2.773	A

01:00 - 01:15

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	Delay (s)	Unsignalised level of service
1 - EB - Lyons Creek Rd	1363	341	206	1947	0.700	1379	571	6.6	2.5	6.725	A
2 - NB - QEW TB Off-ramp	216	54	906	2044	0.106	216	679	0.2	0.1	2.221	A
3 - WB - Lyons Creek Rd	658	165	119	2122	0.310	659	1003	0.6	0.5	2.461	A

Queue Variation Results for each time segment

00:15 - 00:30

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - EB - Lyons Creek Rd	2.35	0.05	0.46	6.46	10.93			N/A	N/A
2 - NB - QEW TB Off-ramp	0.13	0.00	0.00	0.13	0.13			N/A	N/A
3 - WB - Lyons Creek Rd	0.45	0.00	0.00	0.45	0.45			N/A	N/A

00:30 - 00:45

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - EB - Lyons Creek Rd	6.25	0.04	0.37	13.42	34.15			N/A	N/A
2 - NB - QEW TB Off-ramp	0.18	0.03	0.29	0.52	0.55			N/A	N/A
3 - WB - Lyons Creek Rd	0.62	0.03	0.25	0.62	0.62			N/A	N/A

00:45 - 01:00

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - EB - Lyons Creek Rd	6.58	0.03	0.31	6.58	26.40			N/A	N/A
2 - NB - QEW TB Off-ramp	0.18	0.00	0.00	0.18	0.18			N/A	N/A
3 - WB - Lyons Creek Rd	0.62	0.03	0.29	1.12	2.71			N/A	N/A

01:00 - 01:15

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - EB - Lyons Creek Rd	2.46	0.05	0.49	6.77	11.15			N/A	N/A
2 - NB - QEW TB Off-ramp	0.13	0.00	0.00	0.13	0.13			N/A	N/A
3 - WB - Lyons Creek Rd	0.45	0.00	0.00	0.45	0.45			N/A	N/A

Junctions 9

ARCADY 9 - Roundabout Module

Version: 9.5.1.7462
© Copyright TRL Limited, 2019

For sales and distribution information, program advice and maintenance, contact TRL:
+44 (0)1344 379777 software@trl.co.uk www.trlsoftware.co.uk

The users of this computer program for the solution of an engineering problem are in no way relieved of their responsibility for the correctness of the solution

Filename: Future 2041 QEW RA Pre_Des TB Terminals.j9
Path: \\XCCAN56FS01\Projects\DATA\477511 (Montrose Road & Lyons Creek EA & DD)\MF#6A - Deliverables\Traffic\Traffic Analysis\ARCADY
Report generation date: 3/2/2021 10:57:23 PM

»Preliminary Design - 2041 Conditions, AM
»Preliminary Design - 2041 Conditions, PM

Summary of intersection performance

	AM							PM						
	Queue (PCE)	95% Queue (PCE)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Queue (PCE)	95% Queue (PCE)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS
	Preliminary Design - 2041 Conditions													
1 - EB - Lyons Creek Rd	2.1	4.0	5.73	0.68	A	4.40	A	28.2	110.8	51.46	0.99	F	33.23	D
2 - NB - QEW TB Off-ramp	0.2	0.5	2.04	0.17	A			0.2	0.5	2.67	0.16	A		
3 - WB - Lyons Creek Rd	0.7	2.8	3.28	0.41	A			0.8	2.1	3.05	0.44	A		

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle. Intersection LOS and Intersection Delay are demand-weighted averages.

File summary

File Description

Title	Montrose Rd & Lyons Creek Rd EA
Location	Lyons Creek Rd & Toronto Bound Off-ramp
Site number	
Date	2/25/2021
Version	1
Status	
Identifier	
Client	Niagara Region
Jobnumber	
Analyst	Imran Salam
Description	Preliminary Draft Design - Roundabout Traffic Analysis

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCE	PCE	perHour	s	-Min	perMin

Analysis Options

Vehicle length (m)	Calculate Queue Percentiles	Calculate detailed queueing delay	Calculate residual capacity	V/C Ratio Threshold	Average Delay threshold (s)	Queue threshold (PCE)
5.75	✓			0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Results for central hour only	Locked	Run automatically
D1	2041 Conditions	AM	ONE HOUR	00:00	01:30	15	✓	✓	✓
D2	2041 Conditions	PM	ONE HOUR	00:00	01:30	15	✓	✓	✓

Analysis Set Details

ID	Name	Include in report	Network flow scaling factor (%)	Network capacity scaling factor (%)
A1	Preliminary Design	✓	100.000	100.000

Preliminary Design - 2041 Conditions, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Demand Sets	D1 - 2041 Conditions, AM [Locked]	Time results are shown for central hour only. (Model is run for a 90 minute period.)
Warning	Queue variations	Analysis Options	Queue percentiles may be unreliable if the mean queue in any time segment is very low or very high.

Results

Results Summary for whole modelled period

Leg	Max V/C Ratio	Max Delay (s)	Max Queue (PCE)	Max 95th percentile Queue (PCE)	Max LOS	Average Demand (PCE/hr)	Total Intersection Arrivals (PCE)
1 - EB - Lyons Creek Rd	0.68	5.73	2.1	4.0	A	1237	1237
2 - NB - QEW TB Off-ramp	0.17	2.04	0.2	0.5	A	349	349
3 - WB - Lyons Creek Rd	0.41	3.28	0.7	2.8	A	739	739

Main Results for each time segment

00:15 - 00:30

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	Delay (s)	Unsignalised level of service
1 - EB - Lyons Creek Rd	1112	278	238	2048	0.543	1111	676	0.8	1.2	3.970	A
2 - NB - QEW TB Off-ramp	314	78	523	2331	0.135	314	825	0.1	0.2	1.879	A
3 - WB - Lyons Creek Rd	664	166	250	2032	0.327	664	587	0.4	0.5	2.825	A

00:30 - 00:45

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	Delay (s)	Unsignalised level of service
1 - EB - Lyons Creek Rd	1362	340	291	2012	0.677	1358	827	1.2	2.1	5.673	A
2 - NB - QEW TB Off-ramp	384	96	640	2243	0.171	384	1010	0.2	0.2	2.040	A
3 - WB - Lyons Creek Rd	814	203	306	1994	0.408	813	718	0.5	0.7	3.272	A

00:45 - 01:00

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	Delay (s)	Unsignalised level of service
1 - EB - Lyons Creek Rd	1362	340	292	2012	0.677	1362	828	2.1	2.1	5.735	A
2 - NB - QEW TB Off-ramp	384	96	642	2242	0.171	384	1012	0.2	0.2	2.041	A
3 - WB - Lyons Creek Rd	814	203	306	1993	0.408	814	720	0.7	0.7	3.275	A

01:00 - 01:15

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	Delay (s)	Unsignalised level of service
1 - EB - Lyons Creek Rd	1112	278	239	2048	0.543	1116	677	2.1	1.2	4.017	A
2 - NB - QEW TB Off-ramp	314	78	526	2329	0.135	314	828	0.2	0.2	1.881	A
3 - WB - Lyons Creek Rd	664	166	250	2032	0.327	665	590	0.7	0.5	2.829	A

Queue Variation Results for each time segment

00:15 - 00:30

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - EB - Lyons Creek Rd	1.22	0.06	0.67	2.76	3.98			N/A	N/A
2 - NB - QEW TB Off-ramp	0.16	0.00	0.00	0.16	0.16			N/A	N/A
3 - WB - Lyons Creek Rd	0.52	0.00	0.00	0.52	0.52			N/A	N/A

00:30 - 00:45

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - EB - Lyons Creek Rd	2.13	0.03	0.28	2.13	2.13			N/A	N/A
2 - NB - QEW TB Off-ramp	0.22	0.03	0.27	0.48	0.51			N/A	N/A
3 - WB - Lyons Creek Rd	0.74	0.03	0.27	0.74	0.74			N/A	N/A

00:45 - 01:00

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - EB - Lyons Creek Rd	2.15	0.03	0.27	2.15	2.15			N/A	N/A
2 - NB - QEW TB Off-ramp	0.22	0.03	0.26	0.47	0.50			N/A	N/A
3 - WB - Lyons Creek Rd	0.74	0.03	0.30	0.86	2.83			N/A	N/A

01:00 - 01:15

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - EB - Lyons Creek Rd	1.24	0.14	1.13	1.94	2.50			N/A	N/A
2 - NB - QEW TB Off-ramp	0.16	0.00	0.00	0.16	0.16			N/A	N/A
3 - WB - Lyons Creek Rd	0.52	0.00	0.00	0.52	0.52			N/A	N/A

Preliminary Design - 2041 Conditions, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Demand Sets	D2 - 2041 Conditions, PM [Locked]	Time results are shown for central hour only. (Model is run for a 90 minute period.)
Warning	Queue variations	Analysis Options	Queue percentiles may be unreliable if the mean queue in any time segment is very low or very high.

Results

Results Summary for whole modelled period

Leg	Max V/C Ratio	Max Delay (s)	Max Queue (PCE)	Max 95th percentile Queue (PCE)	Max LOS	Average Demand (PCE/hr)	Total Intersection Arrivals (PCE)
1 - EB - Lyons Creek Rd	0.99	51.46	28.2	110.8	F	1814	1814
2 - NB - QEW TB Off-ramp	0.16	2.67	0.2	0.5	A	264	264
3 - WB - Lyons Creek Rd	0.44	3.05	0.8	2.1	A	828	828

Main Results for each time segment

00:15 - 00:30

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	Delay (s)	Unsignalised level of service
1 - EB - Lyons Creek Rd	1631	408	237	2049	0.796	1623	640	1.9	3.8	8.558	A
2 - NB - QEW TB Off-ramp	237	59	1004	1970	0.120	237	856	0.1	0.2	2.344	A
3 - WB - Lyons Creek Rd	744	186	133	2112	0.352	744	1108	0.4	0.5	2.631	A

00:30 - 00:45

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	Delay (s)	Unsignalised level of service
1 - EB - Lyons Creek Rd	1997	499	290	2013	0.992	1930	783	3.8	20.7	31.515	D
2 - NB - QEW TB Off-ramp	291	73	1194	1828	0.159	290	1027	0.2	0.2	2.643	A
3 - WB - Lyons Creek Rd	912	228	163	2092	0.436	911	1321	0.5	0.8	3.047	A

00:45 - 01:00

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	Delay (s)	Unsignalised level of service
1 - EB - Lyons Creek Rd	1997	499	291	2013	0.992	1967	784	20.7	28.2	51.458	F
2 - NB - QEW TB Off-ramp	291	73	1217	1811	0.161	291	1041	0.2	0.2	2.673	A
3 - WB - Lyons Creek Rd	912	228	163	2092	0.436	912	1344	0.8	0.8	3.050	A

01:00 - 01:15

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	Delay (s)	Unsignalised level of service
1 - EB - Lyons Creek Rd	1631	408	238	2049	0.796	1727	641	28.2	4.2	14.756	B
2 - NB - QEW TB Off-ramp	237	59	1068	1922	0.123	238	896	0.2	0.2	2.412	A
3 - WB - Lyons Creek Rd	744	186	133	2112	0.352	745	1172	0.8	0.5	2.635	A

Queue Variation Results for each time segment

00:15 - 00:30

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - EB - Lyons Creek Rd	3.84	0.05	0.50	10.89	18.43			N/A	N/A
2 - NB - QEW TB Off-ramp	0.15	0.00	0.00	0.15	0.15			N/A	N/A
3 - WB - Lyons Creek Rd	0.54	0.07	0.71	1.34	1.42			N/A	N/A

00:30 - 00:45

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - EB - Lyons Creek Rd	20.69	0.30	10.51	53.11	73.52			N/A	N/A
2 - NB - QEW TB Off-ramp	0.21	0.03	0.29	0.52	0.55			N/A	N/A
3 - WB - Lyons Creek Rd	0.77	0.03	0.25	0.77	0.77			N/A	N/A

00:45 - 01:00

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - EB - Lyons Creek Rd	28.20	0.21	11.39	76.98	110.83			N/A	N/A
2 - NB - QEW TB Off-ramp	0.22	0.03	0.28	0.51	0.54			N/A	N/A
3 - WB - Lyons Creek Rd	0.77	0.03	0.27	0.77	2.11			N/A	N/A

01:00 - 01:15

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - EB - Lyons Creek Rd	4.25	0.04	0.43	11.66	22.05			N/A	N/A
2 - NB - QEW TB Off-ramp	0.16	0.00	0.00	0.16	0.16			N/A	N/A
3 - WB - Lyons Creek Rd	0.55	0.55	1.00	1.40	1.45			N/A	N/A

Junctions 9

ARCADY 9 - Roundabout Module

Version: 9.5.1.7462
© Copyright TRL Limited, 2019

For sales and distribution information, program advice and maintenance, contact TRL:
+44 (0)1344 379777 software@trl.co.uk www.trlsoftware.co.uk

The users of this computer program for the solution of an engineering problem are in no way relieved of their responsibility for the correctness of the solution

Filename: Future 2041 QEW RA Pre_Des FEB wo W-S Vol Terminals.j9
Path: \\XCCAN56FS01\Projects\DATA\477511 (Montrose Road & Lyons Creek EA & DD)\MF#6A - Deliverables\Traffic\Traffic Analysis\ARCADY
Report generation date: 3/11/2021 5:56:49 PM

»Preliminary Design with Modifications - 2041 Conditions, AM
»Preliminary Design with Modifications - 2041 Conditions, PM

Summary of intersection performance

	AM							PM						
	Queue (PCE)	95% Queue (PCE)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Queue (PCE)	95% Queue (PCE)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS
	Preliminary Design with Modifications - 2041 Conditions													
1 - WB - Lyons Creek Rd	0.6	2.9	2.66	0.36	A	4.38	A	0.5	2.5	2.50	0.34	A	9.28	A
2 - SB - QEW FEB Off-ramp	0.4	1.3	5.57	0.27	A			1.3	2.4	8.63	0.57	A		
3 - EB - Lyons Creek Rd	1.3	1.5	4.13	0.55	A			5.5	27.9	13.51	0.85	B		

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle. Intersection LOS and Intersection Delay are demand-weighted averages.

File summary

File Description

Title	Montrose Rd & Lyons Creek Rd EA
Location	Lyons Creek Rd & QEW Fort Erie Bound Off-ramp
Site number	
Date	2/25/2021
Version	1
Status	
Identifier	
Client	Niagara Region
Jobnumber	
Analyst	Imran Salam
Description	Preliminary Draft Design - Roundabout Traffic Analysis W-FEB On-ramp maintained

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCE	PCE	perHour	s	-Min	perMin

Analysis Options

Vehicle length (m)	Calculate Queue Percentiles	Calculate detailed queueing delay	Calculate residual capacity	V/C Ratio Threshold	Average Delay threshold (s)	Queue threshold (PCE)
5.75	✓			0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Results for central hour only	Locked	Run automatically
D1	2041 Conditions	AM	ONE HOUR	00:00	01:30	15	✓	✓	✓
D2	2041 Conditions	PM	ONE HOUR	00:00	01:30	15	✓	✓	✓

Analysis Set Details

ID	Name	Include in report	Network flow scaling factor (%)	Network capacity scaling factor (%)
A1	Preliminary Design with Modifications	✓	100.000	100.000

Preliminary Design with Modifications - 2041 Conditions, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Demand Sets	D1 - 2041 Conditions, AM [Locked]	Time results are shown for central hour only. (Model is run for a 90 minute period.)
Warning	Queue variations	Analysis Options	Queue percentiles may be unreliable if the mean queue in any time segment is very low or very high.

Results

Results Summary for whole modelled period

Leg	Max V/C Ratio	Max Delay (s)	Max Queue (PCE)	Max 95th percentile Queue (PCE)	Max LOS	Average Demand (PCE/hr)	Total Intersection Arrivals (PCE)
1 - WB - Lyons Creek Rd	0.36	2.66	0.6	2.9	A	764	764
2 - SB - QEW FEB Off-ramp	0.27	5.57	0.4	1.3	A	1315	242
3 - EB - Lyons Creek Rd	0.55	4.13	1.3	1.5	A	1017	1017

Main Results for each time segment

00:15 - 00:30

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)
1 - WB - Lyons Creek Rd	687	687	172	0	0	0	2344	0.293	686	1131	0.4	0.5
2 - SB - QEW FEB Off-ramp	1182	218	54	965	0	608	1055	0.206	217	78	0.2	0.3
3 - EB - Lyons Creek Rd	914	914	229	0	965	217	2063	0.443	913	608	0.6	0.8

00:30 - 00:45

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)
1 - WB - Lyons Creek Rd	841	841	210	0	0	0	2344	0.359	841	1384	0.5	0.6
2 - SB - QEW FEB Off-ramp	1448	266	67	1181	0	745	984	0.271	266	96	0.3	0.4
3 - EB - Lyons Creek Rd	1120	1120	280	0	1181	266	2026	0.553	1118	745	0.8	1.3

00:45 - 01:00

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)
1 - WB - Lyons Creek Rd	841	841	210	0	0	0	2344	0.359	841	1386	0.6	0.6
2 - SB - QEW FEB Off-ramp	1448	266	67	1181	0	745	984	0.271	266	96	0.4	0.4
3 - EB - Lyons Creek Rd	1120	1120	280	0	1181	266	2025	0.553	1120	745	1.3	1.3

01:00 - 01:15

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)
1 - WB - Lyons Creek Rd	687	687	172	0	0	0	2344	0.293	687	1134	0.6	0.5
2 - SB - QEW FEB Off-ramp	1182	218	54	965	0	609	1054	0.206	218	78	0.4	0.3
3 - EB - Lyons Creek Rd	914	914	229	0	965	218	2062	0.443	916	609	1.3	0.8

Queue Variation Results for each time segment

00:15 - 00:30

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - WB - Lyons Creek Rd	0.46	0.00	0.00	0.46	0.46			N/A	N/A
2 - SB - QEW FEB Off-ramp	0.29	0.00	0.00	0.29	0.29			N/A	N/A
3 - EB - Lyons Creek Rd	0.82	0.08	0.83	1.54	1.55			N/A	N/A

00:30 - 00:45

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - WB - Lyons Creek Rd	0.62	0.03	0.28	0.62	0.62			N/A	N/A
2 - SB - QEW FEB Off-ramp	0.41	0.03	0.28	0.51	0.54			N/A	N/A
3 - EB - Lyons Creek Rd	1.27	0.03	0.27	1.27	1.27			N/A	N/A

00:45 - 01:00

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - WB - Lyons Creek Rd	0.62	0.03	0.33	1.47	2.91			N/A	N/A
2 - SB - QEW FEB Off-ramp	0.41	0.04	0.36	1.31	1.31			N/A	N/A
3 - EB - Lyons Creek Rd	1.28	0.03	0.27	1.28	1.28			N/A	N/A

01:00 - 01:15

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - WB - Lyons Creek Rd	0.46	0.00	0.00	0.46	0.46			N/A	N/A
2 - SB - QEW FEB Off-ramp	0.29	0.00	0.00	0.29	0.29			N/A	N/A
3 - EB - Lyons Creek Rd	0.83	0.54	1.03	1.45	1.51			N/A	N/A

Preliminary Design with Modifications - 2041 Conditions, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Demand Sets	D2 - 2041 Conditions, PM [Locked]	Time results are shown for central hour only. (Model is run for a 90 minute period.)
Warning	Queue variations	Analysis Options	Queue percentiles may be unreliable if the mean queue in any time segment is very low or very high.

Results

Results Summary for whole modelled period

Leg	Max V/C Ratio	Max Delay (s)	Max Queue (PCE)	Max 95th percentile Queue (PCE)	Max LOS	Average Demand (PCE/hr)	Total Intersection Arrivals (PCE)
1 - WB - Lyons Creek Rd	0.34	2.50	0.5	2.5	A	716	716
2 - SB - QEW FEB Off-ramp	0.57	8.63	1.3	2.4	A	1584	513
3 - EB - Lyons Creek Rd	0.85	13.51	5.5	27.9	B	1388	1388

Main Results for each time segment

00:15 - 00:30

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)
1 - WB - Lyons Creek Rd	644	644	161	0	0	0	2344	0.275	643	1705	0.3	0.4
2 - SB - QEW FEB Off-ramp	1424	461	115	963	0	585	1067	0.432	460	58	0.5	0.8
3 - EB - Lyons Creek Rd	1248	1248	312	0	963	460	1878	0.664	1245	585	1.2	2.0

00:30 - 00:45

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)
1 - WB - Lyons Creek Rd	788	788	197	0	0	0	2344	0.336	788	2078	0.4	0.5
2 - SB - QEW FEB Off-ramp	1744	565	141	1179	0	716	999	0.566	563	72	0.8	1.3
3 - EB - Lyons Creek Rd	1528	1528	382	0	1179	563	1801	0.849	1515	716	2.0	5.3

00:45 - 01:00

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)
1 - WB - Lyons Creek Rd	788	788	197	0	0	0	2344	0.336	788	2092	0.5	0.5
2 - SB - QEW FEB Off-ramp	1744	565	141	1179	0	717	998	0.566	565	72	1.3	1.3
3 - EB - Lyons Creek Rd	1528	1528	382	0	1179	565	1799	0.849	1527	717	5.3	5.5

01:00 - 01:15

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)
1 - WB - Lyons Creek Rd	644	644	161	0	0	0	2344	0.275	644	1725	0.5	0.4
2 - SB - QEW FEB Off-ramp	1424	461	115	963	0	586	1067	0.432	463	58	1.3	0.8
3 - EB - Lyons Creek Rd	1248	1248	312	0	963	463	1876	0.665	1262	586	5.5	2.1

Queue Variation Results for each time segment

00:15 - 00:30

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - WB - Lyons Creek Rd	0.41	0.00	0.00	0.41	0.41			N/A	N/A
2 - SB - QEW FEB Off-ramp	0.78	0.11	0.88	1.46	1.53			N/A	N/A
3 - EB - Lyons Creek Rd	2.00	0.05	0.46	5.41	9.10			N/A	N/A

00:30 - 00:45

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - WB - Lyons Creek Rd	0.55	0.03	0.27	0.55	0.55			N/A	N/A
2 - SB - QEW FEB Off-ramp	1.33	0.03	0.27	1.33	1.33			N/A	N/A
3 - EB - Lyons Creek Rd	5.29	0.03	0.34	9.44	27.94			N/A	N/A

00:45 - 01:00

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - WB - Lyons Creek Rd	0.55	0.03	0.33	1.53	2.48			N/A	N/A
2 - SB - QEW FEB Off-ramp	1.34	0.03	0.28	1.34	2.42			N/A	N/A
3 - EB - Lyons Creek Rd	5.53	0.03	0.30	5.53	18.73			N/A	N/A

01:00 - 01:15

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - WB - Lyons Creek Rd	0.41	0.00	0.00	0.41	0.41			N/A	N/A
2 - SB - QEW FEB Off-ramp	0.80	0.11	0.90	1.47	1.54			N/A	N/A
3 - EB - Lyons Creek Rd	2.08	0.05	0.50	5.59	8.93			N/A	N/A

Junctions 9

ARCADY 9 - Roundabout Module

Version: 9.5.1.7462
© Copyright TRL Limited, 2019

For sales and distribution information, program advice and maintenance, contact TRL:
+44 (0)1344 379777 software@trl.co.uk www.trlsoftware.co.uk

The users of this computer program for the solution of an engineering problem are in no way relieved of their responsibility for the correctness of the solution

Filename: Future 2041 QEW RA Pre_Des TB wo E-s Vol Terminals.j9
Path: \\XCCAN56FS01\Projects\DATA\477511 (Montrose Road & Lyons Creek EA & DD)\MF#6A - Deliverables\Traffic\Traffic Analysis\ARCADY
Report generation date: 3/11/2021 6:00:31 PM

»Preliminary Design with Modifications - 2041 Conditions, AM
»Preliminary Design with Modifications - 2041 Conditions, PM

Summary of intersection performance

	AM							PM						
	Queue (PCE)	95% Queue (PCE)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Queue (PCE)	95% Queue (PCE)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS
	Preliminary Design with Modifications - 2041 Conditions													
1 - EB - Lyons Creek Rd	0.5	2.1	2.84	0.32	A	2.86	A	1.7	2.5	4.86	0.61	A	4.15	A
2 - NB - QEW TB Off-ramp	0.2	0.5	2.04	0.17	A			0.2	0.5	2.70	0.16	A		
3 - WB - Lyons Creek Rd	0.7	2.8	3.28	0.41	A			0.8	2.1	3.05	0.44	A		

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle. Intersection LOS and Intersection Delay are demand-weighted averages.

File summary

File Description

Title	Montrose Rd & Lyons Creek Rd EA
Location	Lyons Creek Rd & Toronto Bound Off-ramp
Site number	
Date	2/25/2021
Version	1
Status	
Identifier	
Client	Niagara Region
Jobnumber	
Analyst	Imran Salam
Description	Preliminary Draft Design - Roundabout Traffic Analysis

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCE	PCE	perHour	s	-Min	perMin

Analysis Options

Vehicle length (m)	Calculate Queue Percentiles	Calculate detailed queueing delay	Calculate residual capacity	V/C Ratio Threshold	Average Delay threshold (s)	Queue threshold (PCE)
5.75	✓			0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Results for central hour only	Locked	Run automatically
D1	2041 Conditions	AM	ONE HOUR	00:00	01:30	15	✓	✓	✓
D2	2041 Conditions	PM	ONE HOUR	00:00	01:30	15	✓	✓	✓

Analysis Set Details

ID	Name	Include in report	Network flow scaling factor (%)	Network capacity scaling factor (%)
A1	Preliminary Design with Modifications	✓	100.000	100.000

Preliminary Design with Modifications - 2041 Conditions, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Demand Sets	D1 - 2041 Conditions, AM [Locked]	Time results are shown for central hour only. (Model is run for a 90 minute period.)
Warning	Queue variations	Analysis Options	Queue percentiles may be unreliable if the mean queue in any time segment is very low or very high.

Results

Results Summary for whole modelled period

Leg	Max V/C Ratio	Max Delay (s)	Max Queue (PCE)	Max 95th percentile Queue (PCE)	Max LOS	Average Demand (PCE/hr)	Total Intersection Arrivals (PCE)
1 - EB - Lyons Creek Rd	0.32	2.84	0.5	2.1	A	1237	583
2 - NB - QEW TB Off-ramp	0.17	2.04	0.2	0.5	A	349	349
3 - WB - Lyons Creek Rd	0.41	3.28	0.7	2.8	A	739	739

Main Results for each time segment

00:15 - 00:30

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	D
1 - EB - Lyons Creek Rd	1112	524	131	588	0	238	2048	0.256	524	676	0.3	0.4	2
2 - NB - QEW TB Off-ramp	314	314	78	0	588	524	2331	0.135	314	238	0.1	0.2	1
3 - WB - Lyons Creek Rd	664	664	166	0	0	250	2032	0.327	664	588	0.4	0.5	2

00:30 - 00:45

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	D
1 - EB - Lyons Creek Rd	1362	642	160	720	0	291	2012	0.319	641	827	0.4	0.5	2
2 - NB - QEW TB Off-ramp	384	384	96	0	720	641	2243	0.171	384	291	0.2	0.2	2
3 - WB - Lyons Creek Rd	814	814	203	0	0	306	1994	0.408	813	719	0.5	0.7	3

00:45 - 01:00

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	D
1 - EB - Lyons Creek Rd	1362	642	160	720	0	292	2012	0.319	642	828	0.5	0.5	2
2 - NB - QEW TB Off-ramp	384	384	96	0	720	642	2242	0.171	384	292	0.2	0.2	2
3 - WB - Lyons Creek Rd	814	814	203	0	0	306	1993	0.408	814	720	0.7	0.7	3

01:00 - 01:15

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	D
1 - EB - Lyons Creek Rd	1112	524	131	588	0	239	2048	0.256	525	677	0.5	0.4	2
2 - NB - QEW TB Off-ramp	314	314	78	0	588	525	2330	0.135	314	239	0.2	0.2	1
3 - WB - Lyons Creek Rd	664	664	166	0	0	250	2032	0.327	665	589	0.7	0.5	2

Queue Variation Results for each time segment

00:15 - 00:30

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - EB - Lyons Creek Rd	0.37	0.00	0.00	0.37	0.37			N/A	N/A
2 - NB - QEW TB Off-ramp	0.16	0.00	0.00	0.16	0.16			N/A	N/A
3 - WB - Lyons Creek Rd	0.52	0.00	0.00	0.52	0.52			N/A	N/A

00:30 - 00:45

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - EB - Lyons Creek Rd	0.50	0.03	0.27	0.50	0.52			N/A	N/A
2 - NB - QEW TB Off-ramp	0.22	0.03	0.27	0.48	0.51			N/A	N/A
3 - WB - Lyons Creek Rd	0.74	0.03	0.27	0.74	0.74			N/A	N/A

00:45 - 01:00

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - EB - Lyons Creek Rd	0.50	0.03	0.34	1.52	2.09			N/A	N/A
2 - NB - QEW TB Off-ramp	0.22	0.03	0.26	0.47	0.50			N/A	N/A
3 - WB - Lyons Creek Rd	0.74	0.03	0.30	0.86	2.83			N/A	N/A

01:00 - 01:15

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - EB - Lyons Creek Rd	0.37	0.00	0.00	0.37	0.37			N/A	N/A
2 - NB - QEW TB Off-ramp	0.16	0.00	0.00	0.16	0.16			N/A	N/A
3 - WB - Lyons Creek Rd	0.52	0.00	0.00	0.52	0.52			N/A	N/A

Preliminary Design with Modifications - 2041 Conditions, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Demand Sets	D2 - 2041 Conditions, PM [Locked]	Time results are shown for central hour only. (Model is run for a 90 minute period.)
Warning	Queue variations	Analysis Options	Queue percentiles may be unreliable if the mean queue in any time segment is very low or very high.

Results

Results Summary for whole modelled period

Leg	Max V/C Ratio	Max Delay (s)	Max Queue (PCE)	Max 95th percentile Queue (PCE)	Max LOS	Average Demand (PCE/hr)	Total Intersection Arrivals (PCE)
1 - EB - Lyons Creek Rd	0.61	4.86	1.7	2.5	A	1814	1122
2 - NB - QEW TB Off-ramp	0.16	2.70	0.2	0.5	A	264	264
3 - WB - Lyons Creek Rd	0.44	3.05	0.8	2.1	A	828	828

Main Results for each time segment

00:15 - 00:30

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	D
1 - EB - Lyons Creek Rd	1631	1009	252	622	0	237	2049	0.492	1007	640	0.7	1.0	3
2 - NB - QEW TB Off-ramp	237	237	59	0	622	1007	1968	0.121	237	237	0.1	0.2	2
3 - WB - Lyons Creek Rd	744	744	186	0	0	133	2112	0.352	744	1112	0.4	0.5	2

00:30 - 00:45

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	D
1 - EB - Lyons Creek Rd	1997	1235	309	762	0	290	2013	0.614	1233	783	1.0	1.6	4
2 - NB - QEW TB Off-ramp	291	291	73	0	762	1233	1799	0.162	290	290	0.2	0.2	2
3 - WB - Lyons Creek Rd	912	912	228	0	0	163	2092	0.436	911	1360	0.5	0.8	3

00:45 - 01:00

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	D
1 - EB - Lyons Creek Rd	1997	1235	309	762	0	291	2013	0.614	1235	784	1.6	1.7	4
2 - NB - QEW TB Off-ramp	291	291	73	0	762	1235	1797	0.162	291	291	0.2	0.2	2
3 - WB - Lyons Creek Rd	912	912	228	0	0	163	2092	0.436	912	1363	0.8	0.8	3

01:00 - 01:15

Leg	Total Demand (PCE/hr)	Intersection demand (PCE/hr)	Intersection Arrivals (PCE)	Bypass demand (PCE/hr)	Bypass exit flow (PCE/hr)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	D
1 - EB - Lyons Creek Rd	1631	1009	252	622	0	238	2049	0.492	1011	641	1.7	1.0	3
2 - NB - QEW TB Off-ramp	237	237	59	0	622	1011	1965	0.121	238	238	0.2	0.2	2
3 - WB - Lyons Creek Rd	744	744	186	0	0	133	2112	0.352	745	1116	0.8	0.5	2

Queue Variation Results for each time segment

00:15 - 00:30

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - EB - Lyons Creek Rd	1.01	0.07	0.82	1.86	2.52			N/A	N/A
2 - NB - QEW TB Off-ramp	0.15	0.00	0.00	0.15	0.15			N/A	N/A
3 - WB - Lyons Creek Rd	0.54	0.07	0.71	1.34	1.42			N/A	N/A

00:30 - 00:45

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - EB - Lyons Creek Rd	1.65	0.03	0.27	1.65	1.65			N/A	N/A
2 - NB - QEW TB Off-ramp	0.22	0.03	0.29	0.52	0.55			N/A	N/A
3 - WB - Lyons Creek Rd	0.77	0.03	0.25	0.77	0.77			N/A	N/A

00:45 - 01:00

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - EB - Lyons Creek Rd	1.66	0.03	0.28	1.66	1.66			N/A	N/A
2 - NB - QEW TB Off-ramp	0.22	0.03	0.28	0.51	0.54			N/A	N/A
3 - WB - Lyons Creek Rd	0.77	0.03	0.27	0.77	2.11			N/A	N/A

01:00 - 01:15

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - EB - Lyons Creek Rd	1.03	0.30	1.06	1.07	1.60			N/A	N/A
2 - NB - QEW TB Off-ramp	0.16	0.00	0.00	0.16	0.16			N/A	N/A
3 - WB - Lyons Creek Rd	0.55	0.55	1.00	1.40	1.45			N/A	N/A

APPENDIX K

RESPONSE TO MTO COMMENTS ON DRAFT DTA VERSION 3

PARSONS

1393 North Service Road East, Suite 103, Oakville, ON, L6H 1A7
Direct: +1 905.569.4122 / www.parsons.com

Technical Memo

Date: April 14, 2021 Our Reference # 477511

To: Kashif Hussain– Ministry of Transportation Ontario (MTO)

From: Altaf Hussain – Parsons

Imran Salam - Parsons

Copy: Carolyn Ryall – Region of Niagara

Maged Elmadhoon - Region of Niagara

Richard Goertz – Parsons

Noris Bot - Parsons

Subject: **Montrose Road, Lyons Creek Road/Biggar Road Municipal Class Environmental Assessment & Detail Design –Response to MTO Comments on Final Draft Detailed Transportation Assessment (DTA)**

This memorandum is in response to MTO's comments on the draft Detailed Transportation Assessment (DTA) Report (Version 3) submitted to MTO on Feb 3, 2021 in support of the subject EA. The MTO subsequently provided an email dated April 07, 2021 containing additional comments. The April 7th email also contains comments from the earlier MTO email dated March 05, 2021.

MTO Comments – March 05, 2021

Comment - 1: The report indicates the overall totals for QEW ramps rather than individual movements. The totals indicate higher v/c ratios and lower delays. For example; page 33, Lyons Creek Rd & QEW FEB Off-ramp (AM PEAK) has an overall delay of 11s, LOS B and has a v/c ratio of 0.97. Comparatively, during the PM Peak, the delay is 12s with an LOS B but has a lower v/c ratio of 0.90. How can you have a v/c near 1 but still have lower LOS and delay?

Response - 1: The results were summarized in the table for only those movements which had LOS D or worse and a V/C ratio 0.85 or worse. The detailed Synchro reports showing results for all the individual movements were included in the appendices. The reported results used HCM 2000 which accounted for the traffic volume of the free southbound right movement in calculating the overall V/C ratio, however no delay for a free movement is calculated in Synchro. Thus the overall V/C ratio includes the total volume on all approaches of the intersection, but the overall delay is calculated from the delay experienced by only those movements passing through the traffic control. SimTraffic results are provided in response to a comment below which do not have this anomaly.

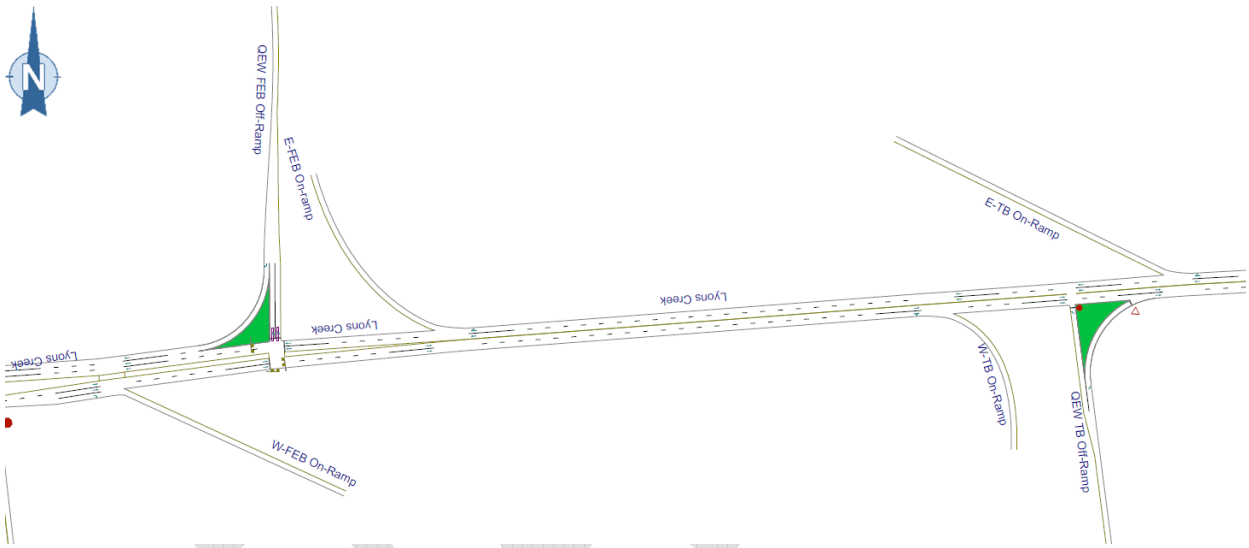
Comment - 2: MTO would like a SIM Traffic review of the following intersections to see how they impact each other. Both Hospital entrance Signals; Montrose Rd/Lyons Creek Rd; Willodell Rd as a Right In/ Right Out & Both QEW Ramp Terminals

Response - 2: SimTraffic results are summarized in **Table 1** on page 3. Detailed SimTraffic reports are provided in **Attachment 2**. The table presents the overall LOS as well as the LOS of all individual movements at the respective intersections. Average, maximum and 95th queues are presented along with the link/storage length available. **Table 1** also presents the analysis of the ramp terminal with a classic T-intersection configuration. The analysis was requested by MTO as part of their review of the proposed preliminary design of the ramp terminals.

The following three scenarios were modelled in SimTraffic:

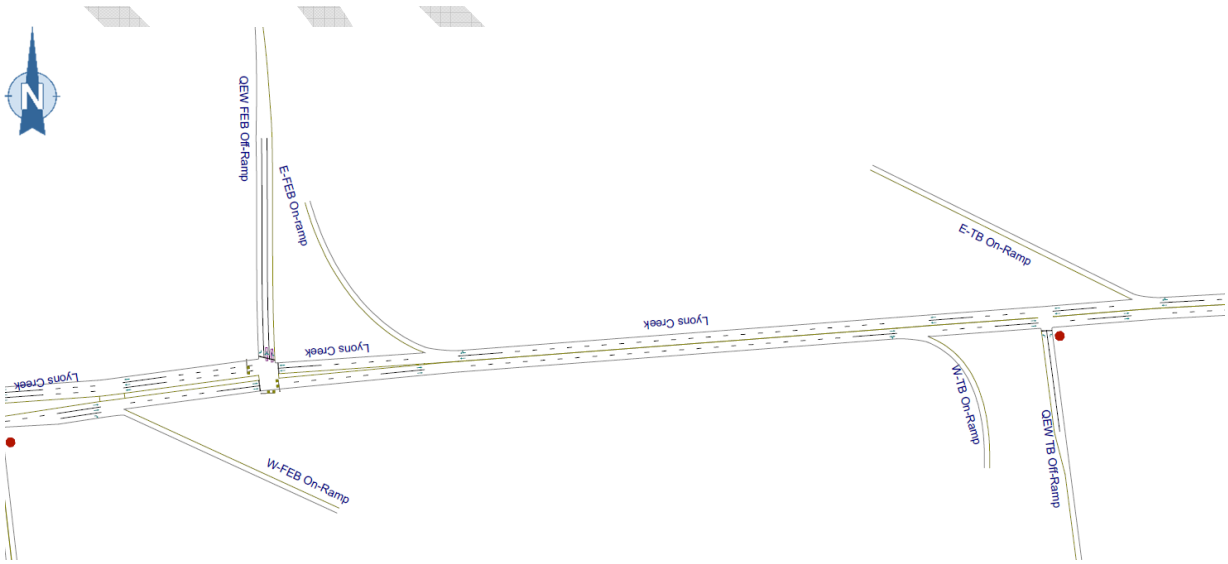
- **Scenario 1**: Channelized QEW Ramp terminals, shown in **Figure 1**, with an auxiliary westbound lane along the Lyons Creek Road segment between Montrose Road and QEW Fort Erie Bound (FEB) off-ramp. The Synchro analysis presented in DTA pertain to this scenario. Considering the Complete Street Design guidelines of Niagara Region, the lane configuration of Montrose Road and Lyons Creek Road intersection was modified from that presented in the DTA. The east to north as well as the south to east channelized right turns were converted to permitted right turns passing through the intersection. Additionally, Willodell Road was modelled as Right-in/Right-out only in response to the Comment 4.

FIGURE 1: SCENARIO – 1; CHANNELIZED QEW RAMP WITH AUXILIARY WESTBOUND LANE (FOR FEB) ALONG LYONS CREEK ROAD



- **Scenario 2**: Same as Scenario 1 but QEW both the ramp terminals modelled as T-intersections. Centre lane for QEW FEB off-ramp was modelled as a shared right-left turn lane. Lane configuration is shown in **Figure 2**.

FIGURE 2: SCENARIO – 2; T-INTERSECTION QEW RAMPS WITH AUXILIARY WESTBOUND LANE (FOR FEB) ALONG LYONS CREEK ROAD



- **Scenario 3**: Same as Scenario 2 but without the auxiliary westbound lane along the Lyons Creek Road segment between Montrose Road and QEW FEB off-ramp. Lane configuration is shown **Figure 3**.

FIGURE 3: SCENARIO – 3; T-INTERSECTION QEW RAMPS WITHOUT AUXILIARY WESTBOUND LANE (FOR FEB) ALONG LYONS CREEK ROAD

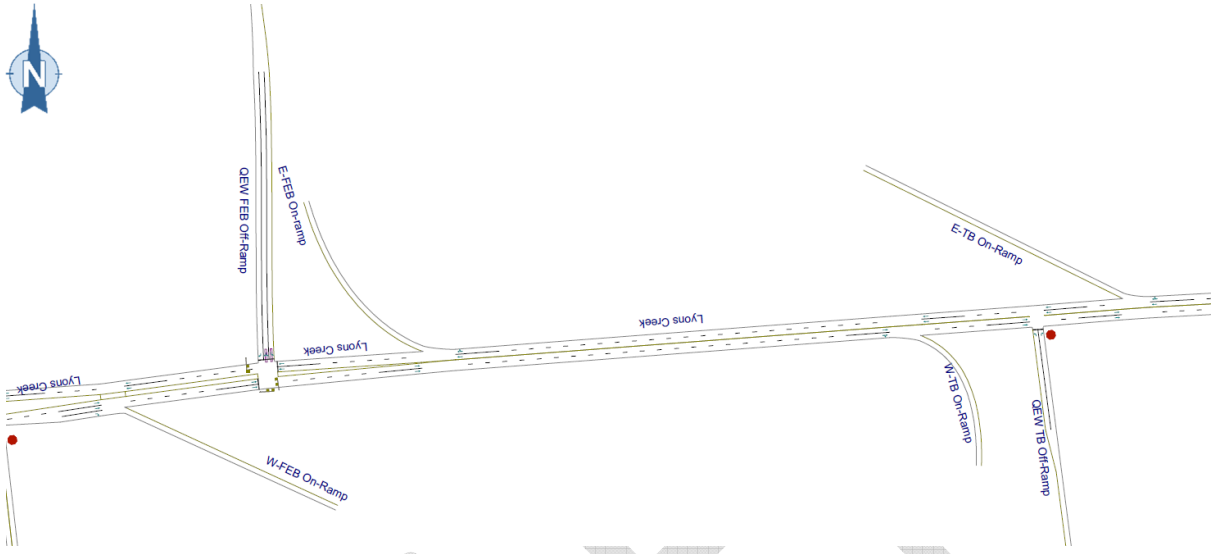


TABLE 1: SUMMARY OF SIMTRAFFIC ANALYSIS

Intersection	AM Peak Hour									PM Peak Hour								
	Overall		Turning Movements							Overall		Turning Movements						
	Delay (s)	LOS	Dir	Delay (s)	LOS	Queue (m) Ave-rage	Queue (m) Max	Queue (m) 95th	Link Length (m)	Delay (s)	LOS	Dir	Delay (s)	LOS	Queue (m) Ave-rage	Queue (m) Max	Queue (m) 95th	Link Length (m)
Scenario 1 – Channelized QEW Ramp Terminals with auxiliary westbound lane along Lyons Creek Road																		
Montrose Rd & Lyons Creek Rd/Biggar Rd	48	D	EBL	123	F	83	129	164	180	80	E	EBL	53	D	44	82	77	180
			EBT	42	D	63	110	164				EBT	60	E	65	104	94	
			EBR	8	A	2	6	6				EBR	15	B	6	21	14	
			WBL	48	D	45	78	66	311			WBL	165	F	181	232	265	311
			WBT	26	C	78	181	172				WBT	27	C	81	196	185	
			WBR	63	E	169	242	277				WBR	8	A	23	52	44	
			NBL	49	D	13	33	28	320			NBL	65	E	7	22	18	320
			NBT	54	D	57	108	87				NBT	57	E	45	95	73	
			NBR	27	C	67	142	119				NBR	38	D	80	145	132	
			SBL	87	F	51	94	84	264			SBL	223	F	206	230	276	264
			SBT	23	C	15	44	33				SBT	29	C	197	270	365	
			SBR	11	B	10	29	22				SBR	16	B	20	49	39	
Montrose Road and Hospital South Access	17	B	EBL	23	C	1.4	9	6	Access	53	D	EBL	28	C	42	96	130	Access
			EBR	6	A	12	29	22				EBR	85	F	83	122	140	
			WBL	23	C	3	15	11				WBL	53	D	22	54	45	
			WBR	5	A	1	9	6				WBR	6	A	6	29	18	

Intersection	AM Peak Hour									PM Peak Hour								
	Overall		Turning Movements							Overall		Turning Movements						
	Delay (s)	LOS	Dir	Delay (s)	LOS	Queue (m) Ave-rage	Queue (m) Max	Queue (m) 95th	Link Length (m)	Delay (s)	LOS	Dir	Delay (s)	LOS	Queue (m) Ave-rage	Queue (m) Max	Queue (m) 95th	Link Length (m)
			NBL	24	C	47	87	78	264			NBL	33	C	30	59	51	264
			NBT	12	B	27	58	47				NBT	13	B	26	57	45	
			NBTR	9	A	31	56	49				NBTR	10	A	31	60	50	
			SBL	15	B	8	19	16	198			SBL	58	E	7	106	52	198
			SBT	24	C	36	65	58				SBT	76	E	149	191	243	
			SBR	6	A	3	11	9				SBR	17	B	2	36	16	
Montrose Road and Hospital East Access	14	B	EBL	24	C	10	47	30	184	11	B	EBL	24	C	4	18	14	184
			EBT	16	B	28	70	63				EBT	10	A	23	38	25	
			WBT	15	B	27	56	46	181			WBT	14	B	29	56	28	181
			WBR	8	A	16	36	29				WBR	7	A	9	23	50	
			SBL	11	B	10	24	20	Access			SBL	10	A	18	35	18	Access
			SBR	5	A	4	14	11				SBR	5	A	7	21	7	
QEW Fort Erie Bound Off-Ramp & Lyons Creek Rd (Channelized Ramps)	19	B	EBT	8	A	29	60	49	97	20	B	EBT	12	B	49	76	69	97
			WBT	7	A	20	48	39	100			WBT	7	A	25	16	39	100
			SBL	37	D	21	41	35	450			SBL	40	D	32	47	45	450
			SBR	31	C	Free						SBR	28	C	Free			
QEW Toronto Bound Off-Ramp & Lyons Creek Rd (Channelized Ramps)	10	B	EBT	2	A	0	0	0	75	48	E	EBT	2	A	1	14	5	75
			WBT	1	A	0	5	3	57			WBT	1	A	0	2	1	57
			NBL	44	E	44	91	84	340			NBL	504	F	93	100	123	340
			NBR	5	A	6	73	47				NBR	219	F	217	273	394	
Scenario 2 –QEW Ramp Terminals as T-Intersections with auxiliary westbound lane along Lyons Creek Road																		
Montrose Rd & Lyons Creek Rd/Biggar Rd	**Same as shown in Scenario - 1**																	
QEW Fort Erie Bound Off-Ramp & Lyons Creek Rd (T-Intersection Ramps)	20	B	EBT	21	C	60	90	82	97	33	C	EBT	22	C	75	103	103	97
			WBT	17	B	42	69	64	100			WBT	13	B	34	65	54	100
			SBL	23	C	35	76	71				SBL	54	D	159	172	159	
			SBLR	-	-	66	100	89	450			SBLR	-	-	129	186	180	450
			SBR	19	B	51	84	80				SBR	51	C	103	169	159	
QEW Toronto Bound Off-Ramp & Lyons Creek Rd (T-Intersection Ramps)	11	B	EBT	2	A	0	0	0	75	37	E	EBT	2	A	0	5	5	75
			WBT	1	A	0	0	0	57			WBT	1	A	0	0	0	57
			NBL	49	E	49	103	103	340			NBL	401	F	92	100	118	340
			NBR	3	A	9	31	23				NBR	119	F	158	263	313	
Scenario 3 –QEW Ramp Terminals as T-Intersections without auxiliary westbound lane along Lyons Creek Road																		
Montrose Rd & Lyons Creek Rd/Biggar Rd	56	E	EBL	88	E	72	134	132	180	81	F	EBL	54	D	43	88	75	180
			EBT	41	D	40	119	89				EBT	57	E	64	108	93	
			EBR	9	A	2	10	6				EBR	17	B	8	57	29	
			WBL	48	D	45	76	67	311			WBL	174	F	188	240	265	311
			WBT	25	C	99	227	207				WBT	27	C	102	212	228	
			WBR	71	E	179	271	283				WBR	8	A	23	53	44	
			NBL	48	D	13	34	29	320			NBL	65	E	8	25	19	320
			NBT	52	D	54	83	75				NBT	57	E	45	162	110	

Intersection	AM Peak Hour									PM Peak Hour								
	Overall		Turning Movements							Overall		Turning Movements						
	Delay (s)	LOS	Dir	Delay (s)	LOS	Queue (m) Ave-rage	Queue (m) Max	Queue (m) 95th	Link Length (m)	Delay (s)	LOS	Dir	Delay (s)	LOS	Queue (m) Ave-rage	Queue (m) Max	Queue (m) 95th	Link Length (m)
			NBR	23	C	60	118	105				NBR	47	D	98	159	150	
			SBL	74	E	45	76	75				SBL	220	F	209	230	276	
			SBT	24	C	14	36	29	264			SBT	30	C	201	270	368	264
			SBR	13	B	12	34	25				SBR	15	B	20	50	38	
QEW Fort Erie Bound Off-Ramp & Lyons Creek Rd (T-Intersection Ramps)	27	C	EBT	29	C	75	98	102	97	52	D	EBT	30	C	94	108	105	97
			WBT	18	B	41	70	62	100			WBT	16	B	45	68	68	100
			SBL	32	C	73	144	130				SBL	68	E	150	205	208	
			SBLR	-	-	94	158	140	450			SBLR	-	-	170	224	224	450
			SBR	38	D	88	139	131				SBR	96	F	156	208	212	
QEW Toronto Bound Off-Ramp & Lyons Creek Rd (T-Intersection Ramps)	14	B	EBT	2	A	0	4	2	75	46	E	EBT	2	A	0	0	0	75
			WBT	1	A	0	7	4	57			WBT	1	A	0	0	0	57
			NBL	63	F	57	113	123	340			NBL	470	F	93	100	117	340
			NBR	4	A	14	47	57				NBR	182	F	206	277	374	

Following is inferred from the SimTraffic analysis.

- The operations of the QEW ramp terminals will not be impacted by the queues from Montrose Road and Lyons Creek Road intersection. Of all the scenarios, the longest maximum westbound queue predicted is 271 m (Scenario 3) for the westbound right turn movement during the AM peak hour. The approximate length of the Lyons Creek Road segment between Willodell Road and Montrose Road is 300 m, therefore the longest maximum predicted queue would not extend easterly beyond Willodell Road.
- Channelized Fort Erie Bound (FEB) off-ramp is shown to operate better than the T-intersection off-ramp in Scenario 2 and 3.
- T-intersection at Toronto Bound (TB) off-ramp is shown to perform better than the channelized off-ramp (Scenario -1). The better performance perhaps could be attributed to a higher delay to the eastbound vehicles at FEB Off-ramp in Scenario 2 & 3 than in Scenario 1, thus allowing increased number of gaps to the northbound vehicles at TB off-ramp.
- The predicted queues on both of the off-ramps are not anticipated to extend back to the QEW main line. The predicted queues during the PM peak hour being critical are summarized in **Table 2**. Storage length modelled in SimTraffic along with the approximate ramp length up to the respective bullnose is also given.

TABLE 2: PREDICTED QUEUES AND MODELLED STORAGE LENGTHS AT QEW OFF-RAMPS

Intersection	Dir	Scenario 1			Scenario 2			Scenario 3			Ramp Length up to Bullnose (m)
		Queue (m) Ave-rage	Queue (m) Max	Storage Length (m)	Queue (m) Ave-rage	Queue (m) Max	Storage Length (m)	Queue (m) Ave-rage	Queue (m) Max	Storage Length (m)	
QEW Fort Erie Bound Off-Ramp & Lyons Creek Rd	SBL	32	47	50	159	172	150	150	205	200	450
	SBLR	-			129	186		170	224		
	SBR	Free			103	169	150	156	208	200	
QEW Toronto Bound Off-Ramp & Lyons Creek Rd	NBL	93	100	70	92	100	100	93	100	100	340
	NBR	217	273	-	158	263		206	277		

DRAFT

Comment - 3: Although Montrose Rd/Lyons Creek Rd intersection is not under MTO's jurisdiction we are enquiring if any further lane arrangements were looked at that could enhance the LOS considering the proximity of MTO ramp terminals and the potential impact on them. Under signalized intersection analysis, it appears that Montrose Rd/Lyons Creek Rd will perform at a LOS E and LOS F.

Response - 3: Multiple combinations of lane configurations and signal phasing/timings were explored, including channelized right turns for the westbound right and northbound right movements. The proposed lane configuration is optimal considering the Complete Street Design guidelines and, as discussed above, the resulting queues are not anticipated to impact the operation of the QEW ramp terminals.

Comment - 4: Additionally, MTO recommends that Willodell Rd be a Right In / Right Out only. MTO does not recommend traffic signals at this intersection as our policy is to not allow a signalized intersection within 400 metres of a ramp terminal.

Response - 4: The SimTraffic analysis presented above included Willodell Road as Right-in/Right-out only. We agree that the Willodell Road intersection is too close to the west ramp terminal such that there is insufficient distance for right turning vehicles from the FEB off-ramp to safely maneuver to a left turn lane for Willodell Road.

Comment - 5: It appears that traffic signals for the TB off-ramp under the assessment report are not warranted, but the hospital report indicates traffic signals are warranted. MTO recommends reviewing traffic volumes and warrants again. MTO will also perform traffic signal warrants to ensure there is no discrepancy.

Response - 5: The hospital report recommends the traffic signals for the TB Off-ramp however does not include a warrant analysis. It appears that the report recommended traffic signals at this location for operational considerations. The warrant analysis included in the final draft DTA report suggests that traffic signals are not warranted by volume under 2041 traffic conditions. However, due to the excessive delays predicted to the northbound left turn movement, the final draft DTA report recommends monitoring of the intersection operation beyond 2026. Traffic signals should be installed at the TB off-ramp when warranted based on the actual volumes or if needed to address the operational concerns.

Comment - 6: Lastly, the analysis indicates significant delay for the TB off-ramp particularly the NBL movement (115.1 seconds - AM PEAK, 267.4 seconds - PM PEAK), with a LOS F. What improvements are required to mitigate delays?

Response - 6: Please refer to the response for Comment - 5 above.

Additional MTO Comments – April 07, 2021

Comment - 7: Traffic volumes that were submitted in the report do not match the volumes that were recently submitted with the site traffic volumes on March 26th. The report needs to be updated with the correct sheets.

Response - 7: We understand this comment pertains to the detailed traffic forecasts that were submitted on March 26, 2021 in response to MTO's request to facilitate the review of the final draft DTA. These detailed forecasts for the Lyons Creek Road Segment between Montrose Road and QEW TB off-ramp are based on the revised traffic forecasts described in Section 2.8 of the final draft DTA Report (Version 3) submitted on Feb 3, 2021. Turning movement diagrams for these revised traffic forecasts were included in Appendix D to the report on page 68-71 of the pdf. There is no difference in the intersection volumes presented in the report and the detailed forecasts submitted on March 26th.

The analyses presented in the final draft DTA were Synchro intersection capacity analyses and therefore did not include free movements to the on-ramps. As part of the on-going review of the DTA, MTO requested a SimTraffic analysis which requires simulation of all the movements as opposed to the Synchro analysis which requires volumes at intersection approaches only. The detailed forecasts were prepared for the requested SimTraffic analysis and therefore included detailed balancing for on-ramps' volumes as well. The exercise resulted in a slight increase of 55

and 85 vehicles for the 2041 AM and PM peak, respectively, on East-Toronto bound on-ramp. An increase of 80 vehicles occurred on West-Toronto bound on-ramp for 2041 PM peak hour only. There is no change in on-ramps volumes as well other than the instances mentioned, between the volumes presented in the report and the detailed forecasts submitted on March 26th.

Please note that these slight variations in the on-ramp volumes do not impact the Synchro analysis presented in the DTA. We will update the final report with the detailed traffic forecasts sheets submitted on March 26th, however, due to no control on the on-ramps, discrepancy in volumes at ramps will not affect operations of the other intersections.

Comment - 8: The recent roll out plan submitted on 23rd March indicates dual WB left-turn lane that extends till QEW FEB off-ramp. Has a detail weaving analysis been done to determine if the SB right-turn volumes would be of concern?

Response - 8: No methodology or guidelines exist for the weaving analysis of the urban streets having interrupted flow such as Lyons Creek Road. The weaving analysis methodology specified in HCM applies to a freeway facility only where upstream and downstream traffic is not interrupted by traffic controls. We believe SB right-turn volumes would pose no concern due to the following facts:

- At Montrose Road and Lyons Creek intersection, the longest average and maximum westbound left turn queues of the three scenarios discussed under Comment 2, are 188 m and 240 m respectively, for Scenario 3 PM peak hour. Similarly, the longest average and maximum westbound through queues of the three scenarios, are 102 m (PM peak hour) and 227 m (AM Peak hour) respectively for Scenario 3. The approximate length of Lyons Creek Segment between Montrose Road and FEB off-ramp is 475 m. Therefore, under maximum queue conditions approximately 235 m (475 – 240) length will still be available for a potential lane change.
- During the SB green interval at FEB off-ramp, the SB right-turning vehicles would be able to change lanes freely without having to compete for gaps with the westbound through traffic at FEB Off-ramp intersection. Based on the 60 s cycle length programmed for Scenario-1 (channelized ramps) PM peak hour, 36% of the time the SB right-turn traffic would be able to change lanes freely. At other times sufficient gaps are anticipated to be available due to the random arrival of vehicles because the westbound movement at this intersection is not constrained or saturated. The maximum westbound queue at this intersection under Scenario-1 is 48 m that would dissipate within one cycle length.
- No blockage or stopping of vehicles was observed during SimTraffic simulations because of the vehicles not finding gaps to change the lanes in the segment.

Please note that the WB left turn lane has been redesigned (shortened) and it no longer extends as far as the QEW FEB off-ramp.

Comment - 9: The ministry strongly suggests that any planned MUP be temporarily terminated at Montrose Rd. Niagara Region can introduce the MUP in phases when development expands along Lyons Creek Rd on the north side.

Response - 9: The MUP, as designed, is now shown to end at Willodell Road. Niagara Region has indicated that they would like to include all planned infrastructure within their ROW during the next phase of implementation. We will further discuss this issue with Niagara Region and advise you accordingly.

Comment - 10: Confirm that the road infrastructure east of the TB off-ramp is sufficient to support future traffic volumes (e.g. 1 lane per direction)?

Response - 10: **Table 3** presents the corridor Volume to Capacity (V/C) ratio for the Lyons Creek Segment east of the TB off-ramp. The analysis is based on the relevant future travel demand information available currently, detailed in the Section 2.8 of the final draft DTA report.

For the analysis, capacity of a lane has been assumed to be 850 vehicles per lane per hour consistent with the DTA. The Lyons Creek segment east of the TB off-ramp is expected to exceed the capacity, however the V/C ratio

calculation is deterministic assuming whole demand on the respective segment instantaneously, while the traffic demand would be distributed over time. These conditions are similar to the conditions west of the TB off-ramp where no additional widening was proposed and SimTraffic analysis presented under Comment 2 supports the sufficiency of four-lane cross section to absorb the future traffic volumes. The capacity analysis for the Lyons Creek segment to the west of the TB off-ramp is provided in Section 3.1.2 of the DTA report.

TABLE 3: CORRIDOR CAPACITY - LYONS CREEK ROAD SEGMENT EAST OF QEW TB OFF-RAMP

Horizon	No of Lanes	Capacity	AM Peak Hour				PM Peak Hour			
			Traffic Volume		V/C		Traffic Volume		V/C	
			EB	WB	EB	WB	EB	WB	EB	WB
2026	1	850	535	657	0.63	0.77	1047	794	1.23	0.94
2041	1	850	608	744	0.72	0.88	1174	887	1.38	1.04

Comment - 11: The 4 lane structure over the QEW is sufficient to support future traffic volumes?

Response - 11: Yes, the four-lane cross section over the QEW is sufficient to support the future traffic volumes. Please refer to Section 3.1.2 of the final draft DTA report and response the Comment 9 for further details.

Comment - 12: What is triggering the dual SB left at the FB off-ramp, if Lyons Creek Rd east of the TB ramp terminal is to remain at 1 lane per direction?

Response - 12: The nodal capacity of the QEW FEB off-ramp is a function of SB left turn volumes in addition to the eastbound and westbound traffic along Lyons Creek Road. The eastbound traffic at this intersection includes approximately 800 vehicles exiting to the W-N (TB) onramp past the QEW overpass. A single lane left-turn not only impacted the capacity of SB left-turn but also the capacity and queue length of eastbound movement as presented in **Table 4** below. The 50th percentile eastbound queue is 124 m backing up past the upstream Willodell intersection. Introduction of second left turn lane is similar to the concept of "widening through the intersection" which is implemented to increase the nodal capacity while maximizing the use of available corridor capacity. Dual left turn significantly improves the operation and reduces the queue lengths including the SB left queue.

TABLE 4: COMPARIOSN OF SINGLE VS DUAL SB LEFT TURN AT QEW FB OFF RAMP INTERSECTION– 2041 PM PEAK HOUR

Single SB Left Turn								Dual SB Left urn							
Overall		Turning Movements						Overall		Turning Movements					
Delay (s)	LOS	Dir	V/C	Delay (s)	LOS	Queue (m)		Delay (s)	LOS	Dir	V/C	Delay (s)	LOS	Queue (m)	
						50th	95th							50th	95th
27	C	EBT	0.96	38	D	124	174	15	B	EBT	0.89	21	C	71	117
		WBT	0.45	17	B	39	53			WBT	0.42	10	B	22	33
		SBL	0.97	61	E	90	154			SBL	0.82	32	C	29	50
		SBR	0.77	4	A	Free				SBR	0.77	4	C	Free	

Comment - 13: Has sight distance been reviewed? Can Parsons confirm there will be no issues due to the SBGR.?

Response - 13: Yes, the sight distance at the ramp terminals has been reviewed. At the FEB off-ramp (west ramp terminal), the sight distance available looking east is approximately 220m. At the TB off-ramp (east ramp terminal), the sight distance available looking west is approximately 200m. The required Stopping Sight Distance, based on the MTO Design Supplement, April 2020, is 185m for a 100 km/h Design Speed and 160m for a 80 km/h Design Speed. These values are achieved as noted. We do not foresee any sight distance issues being caused by SBGR.

Enclosed:

1. SimTraffic Results
2. MTO's email dated April 7, 2021

Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	6:45	6:45	6:45	6:45	6:45	6:45
End Time	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	75	75	75	75	75	75
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	5832	5845	5884	5880	5845	5857
Vehs Exited	5864	5910	5876	5804	5845	5857
Starting Vehs	224	243	209	182	218	212
Ending Vehs	192	178	217	258	218	210
Denied Entry Before	3	3	21	1	2	6
Denied Entry After	2	2	0	36	1	7
Travel Distance (km)	6265	6395	6240	6258	6247	6281
Travel Time (hr)	229.8	226.0	228.6	220.2	234.4	227.8
Total Delay (hr)	119.3	114.1	118.9	110.3	124.0	117.3
Total Stops	7197	7326	7332	7056	7347	7247
Fuel Used (l)	660.9	669.0	661.1	660.0	656.7	661.5

Interval #0 Information Seeding

Start Time	6:45
End Time	7:00
Total Time (min)	15

Volumes adjusted by PHF, Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	7:00
End Time	8:00
Total Time (min)	60

Volumes adjusted by PHF, Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	5832	5845	5884	5880	5845	5857
Vehs Exited	5864	5910	5876	5804	5845	5857
Starting Vehs	224	243	209	182	218	212
Ending Vehs	192	178	217	258	218	210
Denied Entry Before	3	3	21	1	2	6
Denied Entry After	2	2	0	36	1	7
Travel Distance (km)	6265	6395	6240	6258	6247	6281
Travel Time (hr)	229.8	226.0	228.6	220.2	234.4	227.8
Total Delay (hr)	119.3	114.1	118.9	110.3	124.0	117.3
Total Stops	7197	7326	7332	7056	7347	7247
Fuel Used (l)	660.9	669.0	661.1	660.0	656.7	661.5

1: Montrose & Biggar/Lyons Creek Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.0	0.0	0.0	0.5	0.3	1.8	0.1	0.1	0.5	0.0	0.0	0.0
Denied Del/Veh (s)	0.2	0.0	0.3	5.0	1.6	8.6	2.8	0.7	3.0	0.0	0.0	0.0
Total Delay (hr)	9.7	4.3	0.0	5.2	5.8	13.1	0.9	5.7	4.4	7.4	1.7	0.5
Total Del/Veh (s)	122.7	42.3	7.7	48.2	25.5	62.6	48.9	53.5	26.7	87.4	23.1	11.4
Vehicles Entered	274	357	23	376	806	736	64	382	594	299	259	163
Vehicles Exited	275	361	23	378	813	746	62	370	587	299	259	163
Hourly Exit Rate	275	361	23	378	813	746	62	370	587	299	259	163
Input Volume	287	370	23	373	787	755	65	382	591	290	255	176
% of Volume	96	98	100	101	103	99	95	97	99	103	102	93
Denied Entry Before	0	0	0	0	0	0	0	0	1	0	0	0
Denied Entry After	0	0	0	0	0	0	0	0	1	0	0	0

1: Montrose & Biggar/Lyons Creek Performance by movement

Movement	All
Denied Delay (hr)	3.3
Denied Del/Veh (s)	2.7
Total Delay (hr)	58.8
Total Del/Veh (s)	48.0
Vehicles Entered	4333
Vehicles Exited	4336
Hourly Exit Rate	4336
Input Volume	4354
% of Volume	100
Denied Entry Before	1
Denied Entry After	1

3: Montrose & Hospital South Access/Commercial Access Performance by movement

Movement	EBL	EBR	WBL	WBR	NBL	NBT	NBR	SBL	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Denied Del/Veh (s)	0.1	0.2	4.1	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.1
Total Delay (hr)	0.0	0.3	0.1	0.0	3.1	3.0	0.3	0.2	3.2	0.0	10.2
Total Del/Veh (s)	23.0	6.2	23.0	4.7	23.6	11.9	8.8	14.5	23.7	6.2	16.6
Vehicles Entered	6	149	14	6	472	894	104	46	491	18	2200
Vehicles Exited	6	148	14	6	474	892	104	46	490	18	2198
Hourly Exit Rate	6	148	14	6	474	892	104	46	490	18	2198
Input Volume	7	153	15	7	495	896	110	47	489	21	2240
% of Volume	86	97	93	86	96	100	95	98	100	86	98
Denied Entry Before	0	0	0	0	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0	0	0	0	0

4: Biggar & Hospital East Access Performance by movement

Movement	EBL	EBT	WBT	WBR	SBL	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.1	0.2	0.1	0.0
Total Delay (hr)	0.3	2.4	2.6	0.5	0.3	0.0	6.1
Total Del/Veh (s)	23.5	15.9	14.8	8.3	11.2	4.5	14.1
Vehicles Entered	49	529	622	222	91	37	1550
Vehicles Exited	49	525	620	223	91	37	1545
Hourly Exit Rate	49	525	620	223	91	37	1545
Input Volume	52	547	609	232	92	34	1566
% of Volume	94	96	102	96	99	109	99
Denied Entry Before	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0

13: Willodell Rd & Lyons Creek Performance by movement

Movement	EBT	EBR	WBT	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.1	0.0	0.1	0.0
Total Delay (hr)	1.4	0.0	0.8	0.1	2.2
Total Del/Veh (s)	3.8	2.6	1.5	9.0	2.5
Vehicles Entered	1296	12	1815	32	3155
Vehicles Exited	1291	12	1814	32	3149
Hourly Exit Rate	1291	12	1814	32	3149
Input Volume	1306	11	1816	33	3166
% of Volume	99	109	100	97	99
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

14: W-FEB On-Ramp & Lyons Creek Performance by movement

Movement	EBT	EBR	WBT	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.1	0.1	0.0
Total Delay (hr)	0.4	0.0	5.7	6.1
Total Del/Veh (s)	1.2	0.3	10.9	7.0
Vehicles Entered	1091	173	1863	3127
Vehicles Exited	1093	173	1866	3132
Hourly Exit Rate	1093	173	1866	3132
Input Volume	1097	186	1864	3147
% of Volume	100	93	100	100
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

15: Lyons Creek & QEW FEB Off-Ramp Performance by movement

Movement	EBT	WBT	SBL	SBR	All
Denied Delay (hr)	0.0	0.0	0.5	2.2	2.8
Denied Del/Veh (s)	0.0	0.0	8.0	7.1	3.2
Total Delay (hr)	2.3	1.3	2.4	9.8	15.8
Total Del/Veh (s)	7.6	6.7	36.7	30.6	17.9
Vehicles Entered	1081	708	233	1127	3149
Vehicles Exited	1083	708	234	1135	3160
Hourly Exit Rate	1083	708	234	1135	3160
Input Volume	1083	722	237	1118	3160
% of Volume	100	98	99	102	100
Denied Entry Before	0	0	1	4	5
Denied Entry After	0	0	1	5	6

16: Lyons Creek & E-FEB On-ramp Performance by movement

Movement	EBT	WBT	WBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.0
Total Delay (hr)	1.1	0.3	0.0	1.4
Total Del/Veh (s)	3.0	1.5	0.7	2.5
Vehicles Entered	1334	651	84	2069
Vehicles Exited	1338	649	84	2071
Hourly Exit Rate	1338	649	84	2071
Input Volume	1341	662	84	2087
% of Volume	100	98	100	99
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

17: W-TB On-Ramp & Lyons Creek Performance by movement

Movement	EBT	EBR	WBT	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.0
Total Delay (hr)	0.7	1.3	0.2	2.2
Total Del/Veh (s)	4.0	6.8	0.9	3.8
Vehicles Entered	593	699	793	2085
Vehicles Exited	590	695	794	2079
Hourly Exit Rate	590	695	794	2079
Input Volume	588	711	802	2101
% of Volume	100	98	99	99
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

18: QEW TB Off-Ramp Performance by movement

Movement	EBT	WBT	NBL	NBR	All
Denied Delay (hr)	0.0	0.0	0.3	0.0	0.3
Denied Del/Veh (s)	0.0	0.0	3.7	0.8	0.7
Total Delay (hr)	0.3	0.2	3.5	0.1	4.1
Total Del/Veh (s)	1.9	1.3	43.7	4.6	9.9
Vehicles Entered	623	496	278	71	1468
Vehicles Exited	623	496	280	72	1471
Hourly Exit Rate	623	496	280	72	1471
Input Volume	621	507	284	75	1487
% of Volume	100	98	99	96	99
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

Total Zone Performance

Denied Delay (hr)	6.5
Denied Del/Veh (s)	6.0
Total Delay (hr)	107.0
Total Del/Veh (s)	225.8
Vehicles Entered	3890
Vehicles Exited	1521
Hourly Exit Rate	1521
Input Volume	23974
% of Volume	6
Denied Entry Before	6
Denied Entry After	7

Intersection: 1: Montrose & Biggar/Lyons Creek

Movement	EB	EB	EB	EB	WB	WB	WB	WB	WB	NB	NB	NB
Directions Served	L	T	T	R	L	L	T	T	R	L	T	T
Maximum Queue (m)	129.4	109.8	104.9	6.0	77.9	76.5	136.0	180.5	241.9	32.5	91.8	107.5
Average Queue (m)	82.8	62.9	44.8	2.0	44.5	44.8	47.7	78.3	168.5	13.0	56.5	37.6
95th Queue (m)	163.5	164.1	114.7	5.7	66.4	65.0	93.2	172.1	276.8	27.5	87.3	76.8
Link Distance (m)		180.8	180.8				310.8	310.8	310.8		320.8	320.8
Upstream Blk Time (%)		6	0									
Queuing Penalty (veh)		20	0									
Storage Bay Dist (m)	120.0			22.0	210.0	210.0				120.0		
Storage Blk Time (%)	22	0	24									0
Queuing Penalty (veh)	40	0	6									0

Intersection: 1: Montrose & Biggar/Lyons Creek

Movement	NB	SB	SB	SB	SB	SB
Directions Served	R	L	L	T	T	R
Maximum Queue (m)	142.4	94.2	89.1	43.8	38.6	29.2
Average Queue (m)	67.4	51.0	46.7	15.2	13.4	9.9
95th Queue (m)	118.7	83.7	78.6	32.7	29.5	21.7
Link Distance (m)				263.5	263.5	
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (m)	105.0	135.0	135.0			40.0
Storage Blk Time (%)	3				0	0
Queuing Penalty (veh)	5				0	0

Intersection: 3: Montrose & Hospital South Access/Commercial Access

Movement	EB	EB	WB	WB	NB	NB	NB	SB	SB	SB	SB
Directions Served	L	TR	L	TR	L	T	TR	L	T	T	R
Maximum Queue (m)	9.2	28.5	15.0	8.5	87.2	58.0	55.5	19.2	65.4	51.8	11.2
Average Queue (m)	1.4	12.3	3.3	1.0	46.7	27.3	31.4	7.5	36.1	25.1	2.9
95th Queue (m)	6.4	22.1	11.0	5.5	77.6	46.7	49.3	15.7	57.7	44.8	9.3
Link Distance (m)	111.7	111.7		119.4		263.5	263.5		198.0	198.0	
Upstream Blk Time (%)											
Queuing Penalty (veh)											
Storage Bay Dist (m)			60.0		80.0			45.0			30.0
Storage Blk Time (%)					1	0			4	2	
Queuing Penalty (veh)					5	0			2	1	

Intersection: 4: Biggar & Hospital East Access

Movement	EB	EB	EB	WB	WB	WB	SB	SB
Directions Served	L	T	T	T	T	R	L	R
Maximum Queue (m)	46.7	70.4	56.4	54.8	53.5	35.7	24.3	14.4
Average Queue (m)	9.9	28.4	16.7	25.0	27.2	16.2	9.7	3.9
95th Queue (m)	30.1	63.1	47.1	46.2	45.2	28.8	20.2	11.0
Link Distance (m)		183.7	183.7	180.8	180.8		155.4	155.4
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (m)	60.0					15.0		
Storage Blk Time (%)		4			15	5		
Queuing Penalty (veh)		2			36	14		

Intersection: 13: Willodell Rd & Lyons Creek

Movement	NB
Directions Served	R
Maximum Queue (m)	11.9
Average Queue (m)	6.3
95th Queue (m)	13.5
Link Distance (m)	103.6
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 14: W-FEB On-Ramp & Lyons Creek

Movement	EB	WB	WB
Directions Served	R	T	T
Maximum Queue (m)	1.0	4.0	39.3
Average Queue (m)	0.0	0.1	1.4
95th Queue (m)	0.7	2.2	16.5
Link Distance (m)		97.3	97.3
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (m)	30.0		
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 15: Lyons Creek & QEW FEB Off-Ramp

Movement	EB	EB	WB	WB	SB	SB
Directions Served	T	T	T	T	L	L
Maximum Queue (m)	45.2	59.8	48.2	47.3	30.0	40.5
Average Queue (m)	22.8	29.2	20.4	20.0	11.6	21.1
95th Queue (m)	39.6	48.8	39.2	37.5	24.0	34.8
Link Distance (m)	97.3	97.3	99.7	99.7		
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (m)					50.0	50.0
Storage Blk Time (%)						0
Queuing Penalty (veh)						0

Intersection: 16: Lyons Creek & E-FEB On-ramp

Movement	WB
Directions Served	TR
Maximum Queue (m)	1.7
Average Queue (m)	0.1
95th Queue (m)	1.2
Link Distance (m)	301.9
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 17: W-TB On-Ramp & Lyons Creek

Movement	EB	EB
Directions Served	T	TR
Maximum Queue (m)	3.3	11.5
Average Queue (m)	0.1	0.5
95th Queue (m)	2.4	5.1
Link Distance (m)	301.9	301.9
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 18: QEW TB Off-Ramp

Movement	WB	NB	NB
Directions Served	T	L	R
Maximum Queue (m)	4.8	91.4	73.4
Average Queue (m)	0.2	44.3	5.9
95th Queue (m)	3.4	83.9	47.4
Link Distance (m)	57.3		283.2
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (m)		70.0	
Storage Blk Time (%)		7	0
Queuing Penalty (veh)		6	0

Zone Summary

Zone wide Queuing Penalty: 137

Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	3:45	3:45	3:45	3:45	3:45	3:45
End Time	5:00	5:00	5:00	5:00	5:00	5:00
Total Time (min)	75	75	75	75	75	75
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	6817	6876	6862	6804	6789	6833
Vehs Exited	6715	6796	6745	6674	6633	6714
Starting Vehs	290	277	305	303	327	299
Ending Vehs	392	357	422	433	483	416
Denied Entry Before	43	50	9	20	39	32
Denied Entry After	238	228	94	187	246	198
Travel Distance (km)	7602	7674	7541	7526	7565	7582
Travel Time (hr)	472.6	456.5	409.7	457.5	529.9	465.3
Total Delay (hr)	339.6	322.2	278.1	325.8	397.7	332.7
Total Stops	9553	9370	9975	9945	10418	9852
Fuel Used (l)	967.0	952.4	905.9	948.0	1000.1	954.7

Interval #0 Information Seeding

Start Time	3:45
End Time	4:00
Total Time (min)	15

Volumes adjusted by PHF, Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	4:00
End Time	5:00
Total Time (min)	60

Volumes adjusted by PHF, Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	6817	6876	6862	6804	6789	6833
Vehs Exited	6715	6796	6745	6674	6633	6714
Starting Vehs	290	277	305	303	327	299
Ending Vehs	392	357	422	433	483	416
Denied Entry Before	43	50	9	20	39	32
Denied Entry After	238	228	94	187	246	198
Travel Distance (km)	7602	7674	7541	7526	7565	7582
Travel Time (hr)	472.6	456.5	409.7	457.5	529.9	465.3
Total Delay (hr)	339.6	322.2	278.1	325.8	397.7	332.7
Total Stops	9553	9370	9975	9945	10418	9852
Fuel Used (l)	967.0	952.4	905.9	948.0	1000.1	954.7

1: Montrose & Biggar/Lyons Creek Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.0	0.0	0.0	5.5	1.1	1.2	0.0	0.0	0.5	0.1	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	27.1	5.0	11.6	2.9	0.6	3.1	0.3	0.1	0.0
Total Delay (hr)	3.4	9.9	0.3	33.5	5.9	0.8	0.6	4.9	5.5	44.6	4.7	1.2
Total Del/Veh (s)	52.6	59.8	15.4	164.8	26.5	7.7	65.1	56.9	37.7	222.5	29.3	16.2
Vehicles Entered	232	580	61	715	798	355	32	306	524	687	570	257
Vehicles Exited	231	581	61	688	785	355	32	307	523	666	574	260
Hourly Exit Rate	231	581	61	688	785	355	32	307	523	666	574	260
Input Volume	228	575	64	767	813	374	34	314	536	754	590	282
% of Volume	101	101	95	90	97	95	94	98	98	88	97	92
Denied Entry Before	0	0	0	0	0	0	0	0	1	0	0	0
Denied Entry After	0	0	0	14	4	4	0	0	1	0	0	0

1: Montrose & Biggar/Lyons Creek Performance by movement

Movement	All
Denied Delay (hr)	8.4
Denied Del/Veh (s)	5.9
Total Delay (hr)	115.2
Total Del/Veh (s)	79.5
Vehicles Entered	5117
Vehicles Exited	5063
Hourly Exit Rate	5063
Input Volume	5331
% of Volume	95
Denied Entry Before	1
Denied Entry After	23

3: Montrose & Hospital South Access/Commercial Access Performance by movement

Movement	EBL	EBR	WBL	WBR	NBL	NBT	NBR	SBL	SBT	SBR	All
Denied Delay (hr)	0.3	9.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.5
Denied Del/Veh (s)	69.8	81.1	4.0	0.3	0.2	0.0	0.0	0.0	0.0	0.0	13.6
Total Delay (hr)	0.1	9.0	1.4	0.1	1.7	2.6	0.1	0.1	21.8	0.0	36.9
Total Del/Veh (s)	28.2	84.9	52.8	5.5	33.1	12.7	10.2	58.3	75.6	16.9	52.7
Vehicles Entered	15	377	95	37	185	729	19	7	1031	6	2501
Vehicles Exited	15	367	92	37	186	728	19	6	1010	6	2466
Hourly Exit Rate	15	367	92	37	186	728	19	6	1010	6	2466
Input Volume	18	415	99	42	196	734	21	9	1068	8	2610
% of Volume	83	88	93	88	95	99	90	67	95	75	94
Denied Entry Before	0	0	0	0	0	0	0	0	0	0	0
Denied Entry After	1	28	0	0	0	0	0	0	0	0	29

4: Biggar & Hospital East Access Performance by movement

Movement	EBL	EBT	WBT	WBR	SBL	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.2	0.2	0.0
Total Delay (hr)	0.1	1.8	2.9	0.2	0.6	0.1	5.7
Total Del/Veh (s)	24.4	10.0	13.7	7.0	10.3	5.0	11.4
Vehicles Entered	20	645	741	86	210	89	1791
Vehicles Exited	20	646	750	87	210	89	1802
Hourly Exit Rate	20	646	750	87	210	89	1802
Input Volume	21	648	786	91	203	92	1841
% of Volume	95	100	95	96	103	97	98
Denied Entry Before	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0

9: Montrose & Hospital North Access Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Delay (hr)	0.2	2.6	0.0	0.0	4.6	0.0	7.4
Denied Del/Veh (s)	87.0	98.1	0.0	0.0	16.5	6.0	14.2
Total Delay (hr)	0.5	4.8	0.2	0.5	7.5	0.0	13.5
Total Del/Veh (s)	248.8	207.1	11.5	2.6	27.2	9.3	26.4
Vehicles Entered	7	82	68	682	989	3	1831
Vehicles Exited	7	71	67	681	972	3	1801
Hourly Exit Rate	7	71	67	681	972	3	1801
Input Volume	9	92	66	697	992	3	1859
% of Volume	78	77	102	98	98	100	97
Denied Entry Before	0	0	0	0	0	0	0
Denied Entry After	1	12	0	0	19	0	32

10: Biggar & Hospital West Access Performance by movement

Movement	EBL	EBT	WBT	WBR	SBL	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	2.7	0.2	0.0	0.0	0.1	0.1	0.1
Total Delay (hr)	0.0	0.1	1.1	0.0	0.2	0.1	1.5
Total Del/Veh (s)	4.5	0.8	5.2	3.5	14.2	5.9	3.7
Vehicles Entered	8	615	746	16	51	48	1484
Vehicles Exited	7	614	745	16	50	48	1480
Hourly Exit Rate	7	614	745	16	50	48	1480
Input Volume	8	622	777	21	47	46	1521
% of Volume	88	99	96	76	106	104	97
Denied Entry Before	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0

13: Willodell Rd & Lyons Creek Performance by movement

Movement	EBT	EBR	WBT	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.1	0.0
Total Delay (hr)	3.7	0.0	0.7	0.3	4.6
Total Del/Veh (s)	7.4	6.5	1.4	26.4	4.7
Vehicles Entered	1772	12	1741	36	3561
Vehicles Exited	1768	12	1742	37	3559
Hourly Exit Rate	1768	12	1742	37	3559
Input Volume	1863	14	1798	38	3713
% of Volume	95	86	97	97	96
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

14: W-FEB On-Ramp & Lyons Creek Performance by movement

Movement	EBT	EBR	WBT	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.0
Total Delay (hr)	0.8	0.1	5.3	6.3
Total Del/Veh (s)	2.1	1.1	10.8	6.4
Vehicles Entered	1392	369	1781	3542
Vehicles Exited	1392	369	1780	3541
Hourly Exit Rate	1392	369	1780	3541
Input Volume	1463	388	1836	3687
% of Volume	95	95	97	96
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

15: Lyons Creek & QEW FEB Off-Ramp Performance by movement

Movement	EBT	WBT	SBL	SBR	All
Denied Delay (hr)	0.0	0.0	20.1	43.9	64.0
Denied Del/Veh (s)	0.0	0.0	136.6	136.0	60.9
Total Delay (hr)	4.9	1.4	5.6	8.6	20.5
Total Del/Veh (s)	12.4	7.3	40.1	27.9	19.8
Vehicles Entered	1408	684	495	1094	3681
Vehicles Exited	1407	683	494	1094	3678
Hourly Exit Rate	1407	683	494	1094	3678
Input Volume	1478	698	537	1138	3851
% of Volume	95	98	92	96	96
Denied Entry Before	0	0	7	24	31
Denied Entry After	0	0	34	68	102

16: Lyons Creek & E-FEB On-ramp Performance by movement

Movement	EBT	WBT	WBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.0
Total Delay (hr)	2.3	0.2	0.0	2.5
Total Del/Veh (s)	4.3	1.3	0.4	3.5
Vehicles Entered	1912	646	60	2618
Vehicles Exited	1912	644	59	2615
Hourly Exit Rate	1912	644	59	2615
Input Volume	2025	658	64	2747
% of Volume	94	98	92	95
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

17: W-TB On-Ramp & Lyons Creek Performance by movement

Movement	EBT	EBR	WBT	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.0
Total Delay (hr)	1.8	2.3	0.1	4.3
Total Del/Veh (s)	6.1	10.1	0.7	5.8
Vehicles Entered	1082	806	744	2632
Vehicles Exited	1084	806	744	2634
Hourly Exit Rate	1084	806	744	2634
Input Volume	1161	839	762	2762
% of Volume	93	96	98	95
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

18: QEW TB Off-Ramp Performance by movement

Movement	EBT	WBT	NBL	NBR	All
Denied Delay (hr)	0.0	0.0	1.8	1.7	3.5
Denied Del/Veh (s)	0.0	0.0	52.6	49.4	6.4
Total Delay (hr)	0.7	0.2	18.2	7.1	26.2
Total Del/Veh (s)	2.3	1.1	504.1	218.8	47.8
Vehicles Entered	1121	603	120	116	1960
Vehicles Exited	1120	604	108	109	1941
Hourly Exit Rate	1120	604	108	109	1941
Input Volume	1194	602	137	117	2050
% of Volume	94	100	79	93	95
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	6	6	12

Total Zone Performance

Denied Delay (hr)	92.9
Denied Del/Veh (s)	55.1
Total Delay (hr)	237.3
Total Del/Veh (s)	480.7
Vehicles Entered	5871
Vehicles Exited	1393
Hourly Exit Rate	1393
Input Volume	32678
% of Volume	4
Denied Entry Before	32
Denied Entry After	198

Intersection: 1: Montrose & Biggar/Lyons Creek

Movement	EB	EB	EB	EB	WB	WB	WB	WB	WB	NB	NB	NB
Directions Served	L	T	T	R	L	L	T	T	R	L	T	T
Maximum Queue (m)	82.0	104.3	102.1	21.3	232.3	228.2	195.8	176.4	52.4	21.7	74.8	94.7
Average Queue (m)	43.9	63.0	65.2	5.8	180.5	177.9	80.6	65.8	23.0	7.4	45.3	33.4
95th Queue (m)	77.4	94.2	95.9	14.3	261.3	265.1	185.3	136.0	43.5	18.1	68.5	73.0
Link Distance (m)		180.8	180.8				310.8	310.8	310.8		320.8	320.8
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (m)	120.0			22.0	210.0	210.0				120.0		
Storage Blk Time (%)		0	56	0	8	13	0					
Queuing Penalty (veh)		0	36	1	23	35	2					

Intersection: 1: Montrose & Biggar/Lyons Creek

Movement	NB	SB	SB	SB	SB	SB
Directions Served	R	L	L	T	T	R
Maximum Queue (m)	145.3	182.5	230.0	269.0	262.3	48.8
Average Queue (m)	80.3	170.4	206.6	196.9	64.0	20.3
95th Queue (m)	131.8	214.8	276.4	365.1	164.4	39.3
Link Distance (m)				263.5	263.5	
Upstream Blk Time (%)				21	0	
Queuing Penalty (veh)				164	0	
Storage Bay Dist (m)	105.0	135.0	135.0			40.0
Storage Blk Time (%)	5	60	71	2	8	1
Queuing Penalty (veh)	7	164	192	12	24	3

Intersection: 3: Montrose & Hospital South Access/Commercial Access

Movement	EB	EB	WB	WB	NB	NB	NB	SB	SB	SB	SB
Directions Served	L	TR	L	TR	L	T	TR	L	T	T	R
Maximum Queue (m)	95.8	121.5	54.4	29.3	59.1	57.2	59.6	105.5	188.6	190.9	38.5
Average Queue (m)	41.6	82.8	22.3	6.4	29.5	25.9	31.1	7.4	148.6	128.1	1.9
95th Queue (m)	129.6	140.4	44.7	18.1	50.9	45.2	50.3	52.3	242.8	233.4	15.9
Link Distance (m)	111.7	111.7		119.4		263.5	263.5		198.0	198.0	
Upstream Blk Time (%)	18	42							24	7	
Queuing Penalty (veh)	0	0							132	36	
Storage Bay Dist (m)			60.0		80.0			45.0			30.0
Storage Blk Time (%)			0	0	0				61	29	
Queuing Penalty (veh)			0	0	0				6	2	

Intersection: 4: Biggar & Hospital East Access

Movement	EB	EB	EB	WB	WB	WB	SB	SB
Directions Served	L	T	T	T	T	R	L	R
Maximum Queue (m)	18.1	37.9	33.4	55.8	56.4	23.3	35.0	20.7
Average Queue (m)	4.4	23.4	16.2	25.6	28.7	8.8	18.0	7.3
95th Queue (m)	13.6	34.6	27.7	47.4	50.0	18.3	31.2	15.5
Link Distance (m)		183.7	183.7	180.8	180.8		155.4	155.4
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (m)	60.0					15.0		
Storage Blk Time (%)					17	1		
Queuing Penalty (veh)					15	3		

Intersection: 9: Montrose & Hospital North Access

Movement	EB	NB	SB	SB
Directions Served	LR	L	T	TR
Maximum Queue (m)	109.8	20.6	116.2	109.4
Average Queue (m)	44.9	7.8	50.3	44.1
95th Queue (m)	128.3	17.4	152.0	141.8
Link Distance (m)	139.1		128.9	128.9
Upstream Blk Time (%)	18		23	7
Queuing Penalty (veh)	0		0	0
Storage Bay Dist (m)		40.0		
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 10: Biggar & Hospital West Access

Movement	EB	SB	SB
Directions Served	L	L	R
Maximum Queue (m)	7.7	19.0	18.1
Average Queue (m)	0.9	9.3	8.4
95th Queue (m)	4.9	16.8	16.0
Link Distance (m)		172.6	172.6
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (m)	70.0		
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 13: Willodell Rd & Lyons Creek

Movement	EB	NB
Directions Served	TR	R
Maximum Queue (m)	2.2	22.9
Average Queue (m)	0.1	8.6
95th Queue (m)	1.6	19.4
Link Distance (m)	310.8	103.6
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 14: W-FEB On-Ramp & Lyons Creek

Movement	WB	WB	WB
Directions Served	T	T	T
Maximum Queue (m)	12.6	56.2	84.9
Average Queue (m)	0.4	3.4	4.4
95th Queue (m)	5.6	27.7	38.6
Link Distance (m)	97.7	97.7	97.7
Upstream Blk Time (%)			0
Queuing Penalty (veh)			1
Storage Bay Dist (m)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 15: Lyons Creek & QEW FEB Off-Ramp

Movement	EB	EB	WB	WB	SB	SB
Directions Served	T	T	T	T	L	L
Maximum Queue (m)	72.1	75.6	45.7	33.4	45.4	48.6
Average Queue (m)	42.0	48.7	25.2	17.7	24.2	32.1
95th Queue (m)	65.1	69.3	39.4	29.6	40.2	45.2
Link Distance (m)	97.7	97.7	99.1	99.1		
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (m)					50.0	50.0
Storage Blk Time (%)					0	0
Queuing Penalty (veh)					1	2

Intersection: 16: Lyons Creek & E-FEB On-ramp

Movement
Directions Served
Maximum Queue (m)
Average Queue (m)
95th Queue (m)
Link Distance (m)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (m)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 17: W-TB On-Ramp & Lyons Creek

Movement	EB	EB
Directions Served	T	TR
Maximum Queue (m)	4.8	15.2
Average Queue (m)	0.2	1.2
95th Queue (m)	2.6	8.5
Link Distance (m)	301.9	301.9
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 18: QEW TB Off-Ramp

Movement	EB	EB	WB	NB	NB
Directions Served	T	T	T	L	R
Maximum Queue (m)	13.6	1.4	1.8	100.0	273.0
Average Queue (m)	0.5	0.1	0.1	92.7	217.2
95th Queue (m)	5.3	1.3	1.3	123.3	394.3
Link Distance (m)	75.0	75.0	57.3		283.2
Upstream Blk Time (%)					40
Queuing Penalty (veh)					0
Storage Bay Dist (m)				70.0	
Storage Blk Time (%)				88	
Queuing Penalty (veh)				102	

Zone Summary

Zone wide Queuing Penalty: 964

Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	6:45	6:45	6:45	6:45	6:45	6:45
End Time	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	75	75	75	75	75	75
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	5840	5907	5956	5833	5814	5868
Vehs Exited	5804	5937	5923	5852	5807	5862
Starting Vehs	210	231	223	243	226	224
Ending Vehs	246	201	256	224	233	234
Denied Entry Before	1	5	1	1	3	2
Denied Entry After	40	48	6	2	1	18
Travel Distance (km)	6358	6428	6364	6211	6290	6330
Travel Time (hr)	237.1	257.1	253.2	206.0	212.8	233.2
Total Delay (hr)	125.1	144.3	141.0	96.0	101.9	121.6
Total Stops	7999	8229	8329	7393	7627	7912
Fuel Used (l)	680.1	697.0	690.8	645.3	650.3	672.7

Interval #0 Information Seeding

Start Time	6:45
End Time	7:00
Total Time (min)	15

Volumes adjusted by PHF, Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	7:00
End Time	8:00
Total Time (min)	60

Volumes adjusted by PHF, Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	5840	5907	5956	5833	5814	5868
Vehs Exited	5804	5937	5923	5852	5807	5862
Starting Vehs	210	231	223	243	226	224
Ending Vehs	246	201	256	224	233	234
Denied Entry Before	1	5	1	1	3	2
Denied Entry After	40	48	6	2	1	18
Travel Distance (km)	6358	6428	6364	6211	6290	6330
Travel Time (hr)	237.1	257.1	253.2	206.0	212.8	233.2
Total Delay (hr)	125.1	144.3	141.0	96.0	101.9	121.6
Total Stops	7999	8229	8329	7393	7627	7912
Fuel Used (l)	680.1	697.0	690.8	645.3	650.3	672.7

15: Lyons Creek & QEW FEB Off-Ramp Performance by movement

Movement	EBT	WBT	SBL	SBR	All
Denied Delay (hr)	0.0	0.0	0.2	1.1	1.3
Denied Del/Veh (s)	0.0	0.0	3.3	3.6	1.5
Total Delay (hr)	6.3	3.6	1.5	5.9	17.3
Total Del/Veh (s)	21.1	17.1	23.1	18.8	19.5
Vehicles Entered	1056	752	228	1121	3157
Vehicles Exited	1055	750	229	1122	3156
Hourly Exit Rate	1055	750	229	1122	3156
Input Volume	1083	722	237	1118	3160
% of Volume	97	104	97	100	100
Denied Entry Before	0	0	0	1	1
Denied Entry After	0	0	0	1	1

18: QEW TB Off-Ramp Performance by movement

Movement	EBT	WBT	NBL	NBR	All
Denied Delay (hr)	0.0	0.0	0.3	0.0	0.3
Denied Del/Veh (s)	0.0	0.0	3.6	0.9	0.7
Total Delay (hr)	0.3	0.2	4.0	0.1	4.5
Total Del/Veh (s)	1.8	1.3	48.6	3.3	10.8
Vehicles Entered	598	537	288	77	1500
Vehicles Exited	598	538	290	77	1503
Hourly Exit Rate	598	538	290	77	1503
Input Volume	621	507	284	75	1487
% of Volume	96	106	102	103	101
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

Total Zone Performance

Denied Delay (hr)	1.7
Denied Del/Veh (s)	3.2
Total Delay (hr)	21.8
Total Del/Veh (s)	376.3
Vehicles Entered	1881
Vehicles Exited	161
Hourly Exit Rate	161
Input Volume	4647
% of Volume	3
Denied Entry Before	1
Denied Entry After	1

Intersection: 15: Lyons Creek & QEW FEB Off-Ramp

Movement	EB	EB	WB	WB	SB	SB	SB
Directions Served	T	T	T	T	L	LR	R
Maximum Queue (m)	81.0	90.3	68.8	68.9	76.2	99.7	83.5
Average Queue (m)	49.9	59.7	42.0	41.5	35.0	66.3	51.4
95th Queue (m)	73.0	82.1	64.3	62.4	71.3	88.6	79.7
Link Distance (m)	93.6	93.6	100.2	100.2		454.5	
Upstream Blk Time (%)	0	0					
Queuing Penalty (veh)	0	1					
Storage Bay Dist (m)					150.0		150.0
Storage Blk Time (%)							
Queuing Penalty (veh)							

Intersection: 18: QEW TB Off-Ramp

Movement	NB	NB
Directions Served	L	R
Maximum Queue (m)	103.4	31.3
Average Queue (m)	48.6	9.3
95th Queue (m)	102.7	23.3
Link Distance (m)		282.8
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)	100.0	
Storage Blk Time (%)	8	
Queuing Penalty (veh)	6	

Zone Summary

Zone wide Queuing Penalty: 7

Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	3:45	3:45	3:45	3:45	3:45	3:45
End Time	5:00	5:00	5:00	5:00	5:00	5:00
Total Time (min)	75	75	75	75	75	75
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	6884	6760	6809	6898	6801	6830
Vehs Exited	6775	6630	6678	6766	6721	6715
Starting Vehs	332	289	306	304	324	307
Ending Vehs	441	419	437	436	404	424
Denied Entry Before	16	40	7	12	4	15
Denied Entry After	133	218	129	153	138	156
Travel Distance (km)	7626	7486	7577	7703	7602	7599
Travel Time (hr)	443.4	507.1	442.6	465.3	445.9	460.9
Total Delay (hr)	309.0	376.1	309.4	330.5	312.0	327.4
Total Stops	11286	10630	10963	11201	10964	11005
Fuel Used (l)	947.9	992.7	941.0	954.8	941.8	955.6

Interval #0 Information Seeding

Start Time	3:45
End Time	4:00
Total Time (min)	15

Volumes adjusted by PHF, Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	4:00
End Time	5:00
Total Time (min)	60

Volumes adjusted by PHF, Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	6884	6760	6809	6898	6801	6830
Vehs Exited	6775	6630	6678	6766	6721	6715
Starting Vehs	332	289	306	304	324	307
Ending Vehs	441	419	437	436	404	424
Denied Entry Before	16	40	7	12	4	15
Denied Entry After	133	218	129	153	138	156
Travel Distance (km)	7626	7486	7577	7703	7602	7599
Travel Time (hr)	443.4	507.1	442.6	465.3	445.9	460.9
Total Delay (hr)	309.0	376.1	309.4	330.5	312.0	327.4
Total Stops	11286	10630	10963	11201	10964	11005
Fuel Used (l)	947.9	992.7	941.0	954.8	941.8	955.6

15: Lyons Creek & QEW FEB Off-Ramp Performance by movement

Movement	EBT	WBT	SBL	SBR	All
Denied Delay (hr)	0.0	0.0	15.4	33.0	48.5
Denied Del/Veh (s)	0.1	0.0	104.1	105.5	46.9
Total Delay (hr)	8.5	2.4	7.8	15.7	34.3
Total Del/Veh (s)	21.7	12.6	53.6	51.1	33.2
Vehicles Entered	1394	666	512	1081	3653
Vehicles Exited	1394	666	513	1083	3656
Hourly Exit Rate	1394	666	513	1083	3656
Input Volume	1478	698	537	1138	3851
% of Volume	94	95	96	95	95
Denied Entry Before	0	0	8	6	14
Denied Entry After	0	0	21	46	67

18: QEW TB Off-Ramp Performance by movement

Movement	EBT	WBT	NBL	NBR	All
Denied Delay (hr)	0.0	0.0	1.8	1.3	3.1
Denied Del/Veh (s)	0.0	0.0	46.0	39.7	5.6
Total Delay (hr)	0.7	0.2	15.9	3.7	20.5
Total Del/Veh (s)	2.2	1.1	400.5	119.1	37.2
Vehicles Entered	1134	593	136	113	1976
Vehicles Exited	1135	592	120	105	1952
Hourly Exit Rate	1135	592	120	105	1952
Input Volume	1194	602	137	117	2050
% of Volume	95	98	88	90	95
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	4	3	7

Total Zone Performance

Denied Delay (hr)	51.6
Denied Del/Veh (s)	91.8
Total Delay (hr)	54.8
Total Del/Veh (s)	997.2
Vehicles Entered	1947
Vehicles Exited	101
Hourly Exit Rate	101
Input Volume	5901
% of Volume	2
Denied Entry Before	14
Denied Entry After	74

Intersection: 15: Lyons Creek & QEW FEB Off-Ramp

Movement	EB	EB	WB	WB	SB	SB	SB
Directions Served	T	T	T	T	L	LR	R
Maximum Queue (m)	97.0	103.3	64.6	52.9	172.4	186.3	168.9
Average Queue (m)	68.4	75.2	33.5	27.4	106.8	128.9	103.3
95th Queue (m)	99.2	103.2	54.4	45.3	159.0	179.8	159.6
Link Distance (m)	93.5	93.5	100.4	100.4		451.2	
Upstream Blk Time (%)	1	1					
Queuing Penalty (veh)	4	11					
Storage Bay Dist (m)					150.0		150.0
Storage Blk Time (%)					0	7	0
Queuing Penalty (veh)					1	56	3

Intersection: 18: QEW TB Off-Ramp

Movement	EB	EB	NB	NB
Directions Served	T	T	L	R
Maximum Queue (m)	4.7	1.3	100.0	262.7
Average Queue (m)	0.4	0.0	92.1	158.0
95th Queue (m)	5.4	0.9	117.9	312.7
Link Distance (m)	75.0	75.0		282.8
Upstream Blk Time (%)				14
Queuing Penalty (veh)				0
Storage Bay Dist (m)			100.0	
Storage Blk Time (%)			82	0
Queuing Penalty (veh)			97	0

Zone Summary

Zone wide Queuing Penalty: 171

Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	6:45	6:45	6:45	6:45	6:45	6:45
End Time	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	75	75	75	75	75	75
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	5849	5886	5870	5925	5795	5865
Vehs Exited	5888	5940	5826	5899	5796	5871
Starting Vehs	249	242	214	213	209	223
Ending Vehs	210	188	258	239	208	222
Denied Entry Before	5	0	2	2	3	1
Denied Entry After	10	4	1	3	3	3
Travel Distance (km)	6247	6330	6299	6277	6245	6280
Travel Time (hr)	240.7	244.4	248.3	232.2	226.9	238.5
Total Delay (hr)	130.3	132.8	137.4	121.0	116.6	127.6
Total Stops	8322	8707	8906	8235	8115	8455
Fuel Used (l)	676.7	685.6	688.8	676.0	662.6	677.9

Interval #0 Information Seeding

Start Time	6:45
End Time	7:00
Total Time (min)	15

Volumes adjusted by PHF, Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	7:00
End Time	8:00
Total Time (min)	60

Volumes adjusted by PHF, Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	5849	5886	5870	5925	5795	5865
Vehs Exited	5888	5940	5826	5899	5796	5871
Starting Vehs	249	242	214	213	209	223
Ending Vehs	210	188	258	239	208	222
Denied Entry Before	5	0	2	2	3	1
Denied Entry After	10	4	1	3	3	3
Travel Distance (km)	6247	6330	6299	6277	6245	6280
Travel Time (hr)	240.7	244.4	248.3	232.2	226.9	238.5
Total Delay (hr)	130.3	132.8	137.4	121.0	116.6	127.6
Total Stops	8322	8707	8906	8235	8115	8455
Fuel Used (l)	676.7	685.6	688.8	676.0	662.6	677.9

1: Montrose & Biggar/Lyons Creek Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.5	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.0	0.2	0.1	0.1	0.8	2.5	0.7	2.9	0.0	0.0	0.0
Total Delay (hr)	6.4	4.2	0.0	4.7	6.5	22.7	0.9	5.8	4.2	6.6	1.8	0.7
Total Del/Veh (s)	80.2	41.3	6.9	47.2	29.0	107.3	49.4	53.5	24.9	81.0	24.6	13.4
Vehicles Entered	275	363	25	347	796	740	65	387	599	286	257	176
Vehicles Exited	285	367	25	350	800	742	64	379	593	290	257	175
Hourly Exit Rate	285	367	25	350	800	742	64	379	593	290	257	175
Input Volume	287	370	23	373	787	755	65	382	591	290	255	176
% of Volume	99	99	109	94	102	98	98	99	100	100	101	99
Denied Entry Before	0	0	0	0	0	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0	0	0	0	0	0

1: Montrose & Biggar/Lyons Creek Performance by movement

Movement	All
Denied Delay (hr)	0.8
Denied Del/Veh (s)	0.7
Total Delay (hr)	64.5
Total Del/Veh (s)	52.8
Vehicles Entered	4316
Vehicles Exited	4327
Hourly Exit Rate	4327
Input Volume	4354
% of Volume	99
Denied Entry Before	0
Denied Entry After	0

15: Lyons Creek & QEW FEB Off-Ramp Performance by movement

Movement	EBT	WBT	SBL	SBR	All
Denied Delay (hr)	0.0	0.0	0.2	1.1	1.3
Denied Del/Veh (s)	0.1	0.0	3.3	3.6	1.5
Total Delay (hr)	8.2	3.6	2.1	12.3	26.2
Total Del/Veh (s)	27.0	18.2	32.2	40.1	30.0
Vehicles Entered	1067	708	231	1083	3089
Vehicles Exited	1067	707	232	1089	3095
Hourly Exit Rate	1067	707	232	1089	3095
Input Volume	1083	722	237	1118	3160
% of Volume	99	98	98	97	98
Denied Entry Before	0	0	0	1	1
Denied Entry After	0	0	1	2	3

18: QEW TB Off-Ramp Performance by movement

Movement	EBT	WBT	NBL	NBR	All
Denied Delay (hr)	0.0	0.0	0.3	0.0	0.3
Denied Del/Veh (s)	0.0	0.0	3.6	0.8	0.7
Total Delay (hr)	0.3	0.2	3.1	0.1	3.7
Total Del/Veh (s)	1.8	1.2	40.6	3.0	9.0
Vehicles Entered	614	507	273	79	1473
Vehicles Exited	614	508	272	79	1473
Hourly Exit Rate	614	508	272	79	1473
Input Volume	621	507	284	75	1487
% of Volume	99	100	96	105	99
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

Total Zone Performance

Denied Delay (hr)	2.4
Denied Del/Veh (s)	2.8
Total Delay (hr)	94.4
Total Del/Veh (s)	610.2
Vehicles Entered	3118
Vehicles Exited	428
Hourly Exit Rate	428
Input Volume	9001
% of Volume	5
Denied Entry Before	1
Denied Entry After	3

Intersection: 1: Montrose & Biggar/Lyons Creek

Movement	EB	EB	EB	EB	WB	WB	WB	WB	WB	NB	NB	NB
Directions Served	L	T	T	R	L	L	T	T	R	L	T	T
Maximum Queue (m)	123.0	105.6	59.1	8.7	70.3	67.6	286.0	322.6	310.7	38.9	88.4	67.7
Average Queue (m)	65.8	34.5	32.4	1.9	39.8	40.8	82.0	195.3	235.1	13.9	55.4	36.6
95th Queue (m)	121.1	71.4	51.6	6.3	63.1	61.3	211.9	369.0	359.5	31.0	79.7	65.9
Link Distance (m)		180.8	180.8				310.8	310.8			320.8	320.8
Upstream Blk Time (%)							0	8	5			
Queuing Penalty (veh)							0	75	0			
Storage Bay Dist (m)	120.0			22.0	210.0	210.0			250.0	120.0		
Storage Blk Time (%)	2	0	24				0	2	36			
Queuing Penalty (veh)	3	0	6				0	15	104			

Intersection: 1: Montrose & Biggar/Lyons Creek

Movement	NB	SB	SB	SB	SB	SB
Directions Served	R	L	L	T	T	R
Maximum Queue (m)	131.4	85.6	72.7	39.8	35.3	33.0
Average Queue (m)	63.8	47.6	42.8	14.0	13.7	12.2
95th Queue (m)	108.8	80.6	70.8	30.0	29.5	26.5
Link Distance (m)				263.5	263.5	
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (m)	105.0	135.0	135.0			40.0
Storage Blk Time (%)	1				0	0
Queuing Penalty (veh)	3				0	0

Intersection: 15: Lyons Creek & QEW FEB Off-Ramp

Movement	EB	EB	WB	WB	SB	SB	SB
Directions Served	T	T	T	T	L	LR	R
Maximum Queue (m)	90.5	99.0	69.5	71.2	159.3	170.6	159.1
Average Queue (m)	60.8	70.2	38.4	40.0	73.5	94.6	87.6
95th Queue (m)	88.4	96.9	60.6	62.8	139.2	151.4	141.1
Link Distance (m)	93.2	93.2	100.2	100.2		457.6	
Upstream Blk Time (%)	0	1					
Queuing Penalty (veh)	1	6					
Storage Bay Dist (m)					200.0		200.0
Storage Blk Time (%)						0	
Queuing Penalty (veh)						0	

Intersection: 18: QEW TB Off-Ramp

Movement	WB	WB	NB	NB
Directions Served	T	T	L	R
Maximum Queue (m)	3.2	1.9	89.3	17.0
Average Queue (m)	0.1	0.1	41.9	8.7
95th Queue (m)	2.3	1.4	78.9	14.7
Link Distance (m)	53.5	53.5		282.8
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (m)			100.0	
Storage Blk Time (%)			1	
Queuing Penalty (veh)			0	

Zone Summary

Zone wide Queuing Penalty: 213

Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	3:45	3:45	3:45	3:45	3:45	3:45
End Time	5:00	5:00	5:00	5:00	5:00	5:00
Total Time (min)	75	75	75	75	75	75
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	6808	6842	6907	6942	6901	6877
Vehs Exited	6705	6737	6816	6737	6759	6752
Starting Vehs	340	339	301	288	366	327
Ending Vehs	443	444	392	493	508	455
Denied Entry Before	40	16	10	19	10	19
Denied Entry After	132	195	86	170	165	149
Travel Distance (km)	7587	7682	7665	7656	7684	7655
Travel Time (hr)	498.1	475.0	396.9	458.0	508.3	467.3
Total Delay (hr)	365.2	340.1	261.9	323.7	373.7	332.9
Total Stops	11153	11848	10399	11884	12316	11518
Fuel Used (l)	981.0	967.9	904.2	952.4	1001.0	961.3

Interval #0 Information Seeding

Start Time	3:45
End Time	4:00
Total Time (min)	15

Volumes adjusted by PHF, Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	4:00
End Time	5:00
Total Time (min)	60

Volumes adjusted by PHF, Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	6808	6842	6907	6942	6901	6877
Vehs Exited	6705	6737	6816	6737	6759	6752
Starting Vehs	340	339	301	288	366	327
Ending Vehs	443	444	392	493	508	455
Denied Entry Before	40	16	10	19	10	19
Denied Entry After	132	195	86	170	165	149
Travel Distance (km)	7587	7682	7665	7656	7684	7655
Travel Time (hr)	498.1	475.0	396.9	458.0	508.3	467.3
Total Delay (hr)	365.2	340.1	261.9	323.7	373.7	332.9
Total Stops	11153	11848	10399	11884	12316	11518
Fuel Used (l)	981.0	967.9	904.2	952.4	1001.0	961.3

1: Montrose & Biggar/Lyons Creek Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.0	0.0	0.0	4.6	0.5	0.8	0.0	0.0	0.5	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.1	22.6	2.4	7.9	2.9	0.6	3.1	0.2	0.0	0.0
Total Delay (hr)	3.4	9.3	0.3	35.5	6.0	0.8	0.6	4.8	7.1	44.8	5.0	1.2
Total Del/Veh (s)	54.3	56.5	16.7	173.7	27.1	7.7	64.7	56.8	47.0	219.9	30.4	15.1
Vehicles Entered	221	575	60	713	789	357	32	302	539	699	579	276
Vehicles Exited	221	576	60	688	781	355	32	304	536	677	582	278
Hourly Exit Rate	221	576	60	688	781	355	32	304	536	677	582	278
Input Volume	228	575	64	767	813	374	34	314	536	754	590	282
% of Volume	97	100	94	90	96	95	94	97	100	90	99	99
Denied Entry Before	0	0	0	1	0	0	0	0	1	0	0	0
Denied Entry After	0	0	0	13	1	2	0	0	0	0	0	0

1: Montrose & Biggar/Lyons Creek Performance by movement

Movement	All
Denied Delay (hr)	6.5
Denied Del/Veh (s)	4.5
Total Delay (hr)	118.8
Total Del/Veh (s)	81.3
Vehicles Entered	5142
Vehicles Exited	5090
Hourly Exit Rate	5090
Input Volume	5331
% of Volume	95
Denied Entry Before	2
Denied Entry After	16

15: Lyons Creek & QEW FEB Off-Ramp Performance by movement

Movement	EBT	WBT	SBL	SBR	All
Denied Delay (hr)	0.1	0.0	14.3	30.4	44.8
Denied Del/Veh (s)	0.2	0.0	96.1	96.2	42.7
Total Delay (hr)	11.8	3.1	9.9	29.6	54.3
Total Del/Veh (s)	29.6	15.9	68.2	96.4	52.0
Vehicles Entered	1414	686	511	1085	3696
Vehicles Exited	1414	685	510	1070	3679
Hourly Exit Rate	1414	685	510	1070	3679
Input Volume	1478	698	537	1138	3851
% of Volume	96	98	95	94	96
Denied Entry Before	0	0	6	11	17
Denied Entry After	0	0	24	54	78

18: QEW TB Off-Ramp Performance by movement

Movement	EBT	WBT	NBL	NBR	All
Denied Delay (hr)	0.0	0.0	4.8	4.4	9.2
Denied Del/Veh (s)	0.0	0.0	118.5	123.3	16.4
Total Delay (hr)	0.7	0.2	18.7	6.0	25.5
Total Del/Veh (s)	2.3	1.0	470.0	181.6	45.9
Vehicles Entered	1136	604	132	116	1988
Vehicles Exited	1135	604	120	109	1968
Hourly Exit Rate	1135	604	120	109	1968
Input Volume	1194	602	137	117	2050
% of Volume	95	100	88	93	96
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	13	12	25

Total Zone Performance

Denied Delay (hr)	60.4
Denied Del/Veh (s)	69.1
Total Delay (hr)	198.6
Total Del/Veh (s)	991.8
Vehicles Entered	3028
Vehicles Exited	432
Hourly Exit Rate	432
Input Volume	11232
% of Volume	4
Denied Entry Before	19
Denied Entry After	119

Intersection: 1: Montrose & Biggar/Lyons Creek

Movement	EB	EB	EB	EB	WB	WB	WB	WB	WB	NB	NB	NB
Directions Served	L	T	T	R	L	L	T	T	R	L	T	T
Maximum Queue (m)	87.5	103.4	107.9	56.5	228.9	239.8	212.1	175.4	53.2	24.9	93.9	161.7
Average Queue (m)	42.5	60.8	63.6	7.7	188.0	187.4	101.6	62.2	22.6	7.7	44.8	42.6
95th Queue (m)	75.3	89.2	92.9	29.2	258.2	265.7	228.1	132.3	43.9	19.1	71.7	109.6
Link Distance (m)		180.8	180.8				310.8	310.8			320.8	320.8
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (m)	120.0			22.0	210.0	210.0			280.0	120.0		
Storage Blk Time (%)			53	0	11	15	1					
Queuing Penalty (veh)			34	0	30	42	9					

Intersection: 1: Montrose & Biggar/Lyons Creek

Movement	NB	SB	SB	SB	SB	SB
Directions Served	R	L	L	T	T	R
Maximum Queue (m)	158.8	182.5	230.0	269.5	265.9	50.4
Average Queue (m)	97.9	170.7	208.7	200.6	76.4	19.7
95th Queue (m)	150.4	215.3	275.8	367.6	196.7	38.3
Link Distance (m)				263.5	263.5	
Upstream Blk Time (%)				19	0	
Queuing Penalty (veh)				152	1	
Storage Bay Dist (m)	105.0	135.0	135.0			40.0
Storage Blk Time (%)	10	60	71	3	9	1
Queuing Penalty (veh)	16	162	192	20	27	3

Intersection: 15: Lyons Creek & QEW FEB Off-Ramp

Movement	EB	EB	WB	WB	SB	SB	SB
Directions Served	T	T	T	T	L	LR	R
Maximum Queue (m)	102.2	107.6	67.5	60.8	208.3	223.5	212.2
Average Queue (m)	88.4	93.6	45.4	37.6	149.7	169.8	156.2
95th Queue (m)	105.9	108.7	64.0	56.0	204.9	222.1	207.7
Link Distance (m)	93.2	93.2	100.4	100.4		454.5	
Upstream Blk Time (%)	5	10					
Queuing Penalty (veh)	38	72					
Storage Bay Dist (m)					200.0		200.0
Storage Blk Time (%)					0	3	0
Queuing Penalty (veh)					1	27	2

Intersection: 18: QEW TB Off-Ramp

Movement	NB	NB
Directions Served	L	R
Maximum Queue (m)	100.0	277.4
Average Queue (m)	93.9	205.6
95th Queue (m)	117.4	374.3
Link Distance (m)		282.8
Upstream Blk Time (%)		41
Queuing Penalty (veh)		0
Storage Bay Dist (m)	100.0	
Storage Blk Time (%)	87	0
Queuing Penalty (veh)	102	0

Zone Summary

Zone wide Queuing Penalty: 929

Salam, Imran

From: Hussain, Kashif (MTO) <Kashif.Hussain@ontario.ca>
Sent: Wednesday, April 7, 2021 6:12 PM
To: Hussain, Altaf; Bot, Noris
Cc: Goertz, Richard; Ryall, Carolyn; Jawed, Bushra (MTO); Hakomaki, Eric (MTO); Dutchak, Lance (MTO); Weng, Xin (MTO); Salam, Imran; Sneep, Martin (MTO)
Subject: [EXTERNAL] RE: Discussion of MTO Comments on Lyons Creek Road/Montrose
Attachments: RE: [EXTERNAL] Kevin stewart has shared the folder 'Montrose EA - Final Draft DTA Report' with you.

Hi Noris and Altaf,

Please see following comments from our traffic office and provide your response. We are also waiting for response on the previous comments.

- Traffic volumes that were submitted in the report do not match the volumes that were recently submitted with the site traffic volumes on March 26th. The report needs to be updated with the correct sheets.

- The recent roll out plan submitted on 23rd March indicates dual WB left-turn lane that extends till QEW FEB off-ramp. Has a detail weaving analysis been done to determine if the SB right-turn volumes would be of concern?

- The ministry strongly suggests that any planned MUP be temporarily terminated at Montrose Rd. Niagara Region can introduce the MUP in phases when development expands along Lyons Creek Rd on the north side.

- Confirm that the road infrastructure east of the TB off-ramp is sufficient to support future traffic volumes (e.g. 1 lane per direction)?

- The 4 lane structure over the QEW is sufficient to support future traffic volumes?

- What is triggering the dual SB left at the FB off-ramp, if Lyons Creek Rd east of the TB ramp terminal is to remain at 1 lane per direction?

- Has sight distance been reviewed? Can Parsons confirm there will be no issues due to the SBGR.

Also, please see below as the following comments still need to be addressed. These were sent on March 5th (see attached).

- The report indicates the overall totals for QEW ramps rather than individual movements. The totals indicate higher v/c ratios and lower delays. For example; page 33, Lyons Creek Rd & QEW FEB Off-ramp (AM PEAK) has an overall delay of 11s, LOS B and has a v/c ratio of 0.97. Comparatively, during the PM Peak, the delay is 12s with an LOS B but has a lower v/c ratio of 0.90. How can you have a v/c near 1 but still have lower LOS and delay?

- MTO would need a SIM Traffic review of the following intersections to see how they impact each other.
    - Both Hospital entrance Signals; Montrose Rd/Lyons Cr Rd; Willodell Rd as a Right In/ Right Out & Both QEW Ramp Terminals. We need to see how the study area will perform as a whole, as each intersection impacts the other.
- Although Montrose Rd/Lyons Creek Rd intersection is not under MTO's jurisdiction we are enquiring if any further lane arrangements were looked at, as that could enhance the LOS considering the proximity of MTO ramp terminals and the potential impact on them. Under signalized intersection analysis, it appears that Montrose Rd/Lyons Creek Rd will perform at a LOS E and LOS F. The ministry is concerned given these anticipated LOS results, that may result in vehicle queues extending upstream to impact the QEW off-ramp terminal.
- The analysis indicates significant delay for the TB off-ramp particularly the NBL movement (115.1 seconds - AM PEAK, 267.4 seconds - PM PEAK), with a LOS F. Delays of almost 2 minutes are not acceptable as motorists will start to take chances and accept shorter gaps leading to safety concerns due to potential collisions. Has Parsons looked at the improvements / mitigation measures to reduce the delays?

Regards

Kashif

From: Hussain, Altaf <Altaf.Hussain@parsons.com>
Sent: March 24, 2021 1:56 PM
To: Hussain, Kashif (MTO) <Kashif.Hussain@ontario.ca>
Cc: Bot, Noris <Noris.Bot@parsons.com>; Goertz, Richard <Richard.Goertz@parsons.com>; Ryall, Carolyn <Carolyn.Ryall@niagararegion.ca>; Jawed, Bushra (MTO) <Bushra.Jawed@ontario.ca>; Hakomaki, Eric (MTO) <Eric.Hakomaki@ontario.ca>; Dutchak, Lance (MTO) <Lance.Dutchak@ontario.ca>; Weng, Xin (MTO) <Xin.Weng@ontario.ca>; Salam, Imran <Imran.Salam@parsons.com>
Subject: RE: Discussion of MTO Comments on Lyons Creek Road/Montrose

CAUTION -- EXTERNAL E-MAIL - Do not click links or open attachments unless you recognize the sender.

Hi Kashif,

We are preparing our responses to the MTO review comments on the Draft traffic report Feb 2021 in addition to comments/clarifications requested in the meetings on Friday and yesterday in the Exec review meeting. We will submit the package by tomorrow. Thanks

Altaf Hussain, M.A.Sc., P. Eng.
Principal Transportation Engineer
altaf.hussain@parsons.com - T: Cell: 647-649-5023

PARSONS - Envision More
Parsons [can01.safelinks.protection.outlook.com] | LinkedIn [can01.safelinks.protection.outlook.com] | Twitter [can01.safelinks.protection.outlook.com] | Facebook [can01.safelinks.protection.outlook.com]

APPENDIX L

ARCADY ANALYSIS OF NIAGARA SQ ROUNDABOUT & CANADIAN DRIVE

PARSONS

Junctions 9

ARCADY 9 - Roundabout Module

Version: 9.5.1.7462
© Copyright TRL Limited, 2019

For sales and distribution information, program advice and maintenance, contact TRL:
+44 (0)1344 379777 software@trl.co.uk www.trlsoftware.co.uk

The users of this computer program for the solution of an engineering problem are in no way relieved of their responsibility for the correctness of the solution

Filename: Future 2041 Niagara Sq Dr_UTurn Vol.j9
Path: \\XCCAN56FS01\Projects\DATA\477511 (Montrose Road & Lyons Creek EA & DD)\MF#6A - Deliverables\Traffic\Traffic Analysis\Comments_Preferred Scen Checks\Niagara Square Roundabouts
Report generation date: 3/30/2021 6:36:22 PM

»Preliminary Design - 2041 Conditions, AM
»Preliminary Design - 2041 Conditions, PM

Summary of intersection performance

	AM							PM						
	Queue (PCE)	95% Queue (PCE)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Queue (PCE)	95% Queue (PCE)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS
	Preliminary Design - 2041 Conditions													
1 - NB - Montrose Rd	0.8	2.5	3.13	0.42	A	3.43	A	2.1	4.2	5.41	0.68	A	9.83	A
2 - WB - Niagara Square Dr	0.6	2.8	4.22	0.36	A			4.8	24.8	20.65	0.83	C		
3 - SB - Montrose Rd	0.3	0.6	2.99	0.17	A			0.7	3.1	4.20	0.37	A		

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle. Intersection LOS and Intersection Delay are demand-weighted averages.

File summary

File Description

Title	Montrose Rd & Lyons Creek Rd EA
Location	Montrose Road & Niagara Square Dr
Site number	
Date	2/25/2021
Version	3 Leg Roundabout
Status	
Identifier	
Client	Niagara Region
Jobnumber	
Analyst	Imran Salam
Description	Sensitivity Analysis of Three Leg Rounabout. West Leg Deleted.

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCE	PCE	perHour	s	-Min	perMin

Analysis Options

Vehicle length (m)	Calculate Queue Percentiles	Calculate detailed queueing delay	Calculate residual capacity	V/C Ratio Threshold	Average Delay threshold (s)	Queue threshold (PCE)
5.75	✓			0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Results for central hour only	Run automatically
D1	2041 Conditions	AM	ONE HOUR	00:00	01:30	15	✓	✓
D2	2041 Conditions	PM	ONE HOUR	00:00	01:30	15	✓	✓

Analysis Set Details

ID	Name	Include in report	Network flow scaling factor (%)	Network capacity scaling factor (%)
A1	Preliminary Design	✓	100.000	100.000

Preliminary Design - 2041 Conditions, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Demand Sets	D1 - 2041 Conditions, AM	Time results are shown for central hour only. (Model is run for a 90 minute period.)
Warning	Queue variations	Analysis Options	Queue percentiles may be unreliable if the mean queue in any time segment is very low or very high.

Results

Results Summary for whole modelled period

Leg	Max V/C Ratio	Max Delay (s)	Max Queue (PCE)	Max 95th percentile Queue (PCE)	Max LOS	Average Demand (PCE/hr)	Total Intersection Arrivals (PCE)
1 - NB - Montrose Rd	0.42	3.13	0.8	2.5	A	812	812
2 - WB - Niagara Square Dr	0.36	4.22	0.6	2.8	A	466	466
3 - SB - Montrose Rd	0.17	2.99	0.3	0.6	A	278	278

Main Results for each time segment

00:15 - 00:30

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	Delay (s)	Unsignalised level of service
1 - NB - Montrose Rd	730	182	0	2132	0.342	729	687	0.4	0.6	2.766	A
2 - WB - Niagara Square Dr	419	105	729	1514	0.277	419	0	0.3	0.4	3.452	A
3 - SB - Montrose Rd	250	62	437	1850	0.135	250	711	0.2	0.2	2.766	A

00:30 - 00:45

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	Delay (s)	Unsignalised level of service
1 - NB - Montrose Rd	894	224	0	2132	0.419	893	841	0.6	0.8	3.130	A
2 - WB - Niagara Square Dr	513	128	893	1409	0.364	512	0	0.4	0.6	4.212	A
3 - SB - Montrose Rd	306	77	535	1786	0.171	306	870	0.2	0.3	2.992	A

00:45 - 01:00

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	Delay (s)	Unsignalised level of service
1 - NB - Montrose Rd	894	224	0	2132	0.419	894	842	0.8	0.8	3.133	A
2 - WB - Niagara Square Dr	513	128	894	1408	0.364	513	0	0.6	0.6	4.221	A
3 - SB - Montrose Rd	306	77	536	1785	0.171	306	871	0.3	0.3	2.993	A

01:00 - 01:15

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	Delay (s)	Unsignalised level of service
1 - NB - Montrose Rd	730	182	0	2132	0.342	731	689	0.8	0.6	2.770	A
2 - WB - Niagara Square Dr	419	105	731	1513	0.277	420	0	0.6	0.4	3.462	A
3 - SB - Montrose Rd	250	62	439	1849	0.135	250	712	0.3	0.2	2.771	A

Queue Variation Results for each time segment

00:15 - 00:30

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - NB - Montrose Rd	0.56	0.56	1.08	1.51	1.56			N/A	N/A
2 - WB - Niagara Square Dr	0.40	0.00	0.00	0.40	0.40			N/A	N/A
3 - SB - Montrose Rd	0.19	0.00	0.00	0.19	0.19			N/A	N/A

00:30 - 00:45

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - NB - Montrose Rd	0.77	0.03	0.27	0.77	0.77			N/A	N/A
2 - WB - Niagara Square Dr	0.60	0.03	0.27	0.60	0.60			N/A	N/A
3 - SB - Montrose Rd	0.25	0.03	0.31	0.56	0.59			N/A	N/A

00:45 - 01:00

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - NB - Montrose Rd	0.78	0.03	0.30	0.78	2.53			N/A	N/A
2 - WB - Niagara Square Dr	0.60	0.03	0.31	1.46	2.82			N/A	N/A
3 - SB - Montrose Rd	0.25	0.03	0.31	0.55	0.59			N/A	N/A

01:00 - 01:15

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - NB - Montrose Rd	0.56	0.56	1.08	1.51	1.56			N/A	N/A
2 - WB - Niagara Square Dr	0.40	0.00	0.00	0.40	0.40			N/A	N/A
3 - SB - Montrose Rd	0.19	0.00	0.00	0.19	0.19			N/A	N/A

Preliminary Design - 2041 Conditions, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Demand Sets	D2 - 2041 Conditions, PM	Time results are shown for central hour only. (Model is run for a 90 minute period.)
Warning	Queue variations	Analysis Options	Queue percentiles may be unreliable if the mean queue in any time segment is very low or very high.

Results

Results Summary for whole modelled period

Leg	Max V/C Ratio	Max Delay (s)	Max Queue (PCE)	Max 95th percentile Queue (PCE)	Max LOS	Average Demand (PCE/hr)	Total Intersection Arrivals (PCE)
1 - NB - Montrose Rd	0.68	5.41	2.1	4.2	A	1309	1309
2 - WB - Niagara Square Dr	0.83	20.65	4.8	24.8	C	802	802
3 - SB - Montrose Rd	0.37	4.20	0.7	3.1	A	513	513

Main Results for each time segment

00:15 - 00:30

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	Delay (s)	Unsignalised level of service
1 - NB - Montrose Rd	1177	294	0	2132	0.552	1175	1232	0.9	1.3	3.899	A
2 - WB - Niagara Square Dr	721	180	1175	1229	0.587	719	0	0.8	1.4	7.238	A
3 - SB - Montrose Rd	461	115	772	1631	0.283	461	1122	0.3	0.4	3.413	A

00:30 - 00:45

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	Delay (s)	Unsignalised level of service
1 - NB - Montrose Rd	1441	360	0	2132	0.676	1438	1499	1.3	2.1	5.355	A
2 - WB - Niagara Square Dr	883	221	1438	1061	0.832	871	0	1.4	4.6	18.409	C
3 - SB - Montrose Rd	565	141	935	1523	0.371	564	1373	0.4	0.6	4.162	A

00:45 - 01:00

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	Delay (s)	Unsignalised level of service
1 - NB - Montrose Rd	1441	360	0	2132	0.676	1441	1512	2.1	2.1	5.406	A
2 - WB - Niagara Square Dr	883	221	1441	1059	0.834	882	0	4.6	4.8	20.655	C
3 - SB - Montrose Rd	565	141	947	1516	0.373	565	1376	0.6	0.7	4.201	A

01:00 - 01:15

Leg	Total Demand (PCE/hr)	Intersection Arrivals (PCE)	Circulating flow (PCE/hr)	Capacity (PCE/hr)	V/C Ratio	Throughput (PCE/hr)	Throughput (exit side) (PCE/hr)	Start queue (PCE)	End queue (PCE)	Delay (s)	Unsignalised level of service
1 - NB - Montrose Rd	1177	294	0	2132	0.552	1180	1250	2.1	1.3	3.939	A
2 - WB - Niagara Square Dr	721	180	1180	1226	0.588	734	0	4.8	1.5	7.751	A
3 - SB - Montrose Rd	461	115	788	1620	0.285	462	1127	0.7	0.4	3.454	A

Queue Variation Results for each time segment

00:15 - 00:30

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - NB - Montrose Rd	1.27	0.06	0.67	2.89	4.18			N/A	N/A
2 - WB - Niagara Square Dr	1.44	0.05	0.49	3.62	5.63			N/A	N/A
3 - SB - Montrose Rd	0.44	0.00	0.00	0.44	0.44			N/A	N/A

00:30 - 00:45

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - NB - Montrose Rd	2.13	0.03	0.28	2.13	2.13			N/A	N/A
2 - WB - Niagara Square Dr	4.56	0.04	0.37	10.50	24.78			N/A	N/A
3 - SB - Montrose Rd	0.65	0.03	0.28	0.65	0.65			N/A	N/A

00:45 - 01:00

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - NB - Montrose Rd	2.15	0.03	0.27	2.15	2.15			N/A	N/A
2 - WB - Niagara Square Dr	4.84	0.03	0.32	5.45	22.68			N/A	N/A
3 - SB - Montrose Rd	0.66	0.03	0.33	1.52	3.08			N/A	N/A

01:00 - 01:15

Leg	Mean (PCE)	Q05 (PCE)	Q50 (PCE)	Q90 (PCE)	Q95 (PCE)	Percentile message	Marker message	Probability of reaching or exceeding marker	Probability of exactly reaching marker
1 - NB - Montrose Rd	1.29	0.15	1.17	1.99	2.60			N/A	N/A
2 - WB - Niagara Square Dr	1.50	0.05	0.45	3.91	6.37			N/A	N/A
3 - SB - Montrose Rd	0.44	0.00	0.00	0.44	0.44			N/A	N/A

1393 North Service Road East, Suite 103, Oakville, ON, L6H 1A7
Direct: +1 905.569.4122 / www.parsons.com

Technical Memo

Date: April 19, 2021 Our Reference # 477511

To: Carolyn Ryall – Region of Niagara

From: Altaf Hussain – Parsons

Imran Salam - Parsons

Copy: Maged Elmadhoon - Region of Niagara

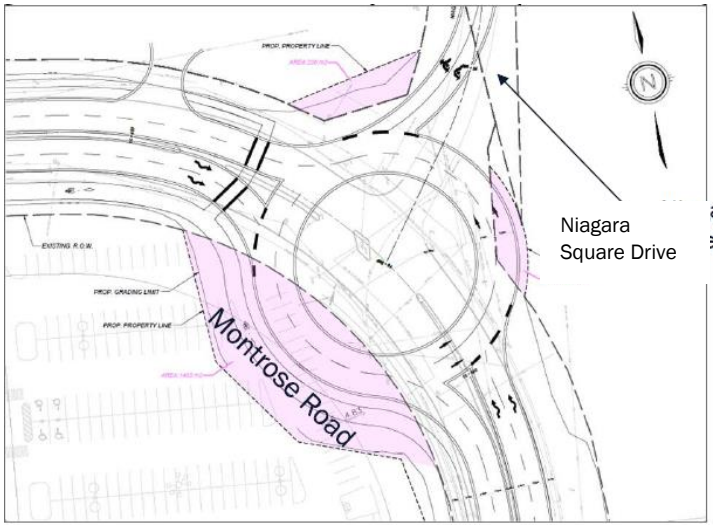
Richard Goertz – Parsons

Noris Bot - Parsons

Subject: **Montrose Road and Lyons Creek Road/Biggar Road Municipal Class Environmental Assessment & Detail Design –Revised Analysis of Montrose Road and Canadian Drive Intersection**

This memorandum is in response to Bayfield's (Niagara Square) request during the Stakeholders' meeting held on April 16, 2021, to provide the revised intersection capacity analysis of the Montrose Road and Canadian Drive Intersection. The revision resulted due to the proposed roundabout at Montrose Road and Niagara Square Drive intersection is shown in **Figure 1**.

FIGURE 1: MONTROSE ROAD AND NIAGARA SQUARE DRIVE ROUNDABOUT



Currently the Montrose Road and Niagara Square Drive intersection is a four-leg signalized intersection. Niagara Square Drive (the east approach) is a one-way westbound street. The existing west approach serves as a one-way exit from Niagara Square Mall with only left turns allowed onto Montrose Road. The proposed roundabout design does not include the existing west approach. Also, with the implementation of the roundabout, the existing full move Niagara Square Entrance to the south of the roundabout will be converted to right-in/right-out access only.

The potential redistribution of the 2041 traffic due to the proposed design is illustrated in **Figure 2**.

The northbound left turning traffic at Niagara Square Entrance is anticipated to switch to Montrose Road and Canadian Drive intersection subsequently accessing Niagara Square off the driveways connecting to Canadian Drive. The traffic may also make a U-turn at the proposed roundabout to become the southbound right at Niagara Square Entrance. However, as a worst case for the Canadian Drive intersection all the traffic has been assigned to northbound left movement at the Canadian Drive intersection. Westbound left exiting traffic from Niagara Square Mall is expected to exit through Canadian Drive to the south and eventually become eastbound left traffic at Canadian Drive and Montrose Road intersection.

FIGURE 2: TRAFFIC RE-DISTRIBUTION DUE TO ROUNDABOUT IMPLEMENTATION

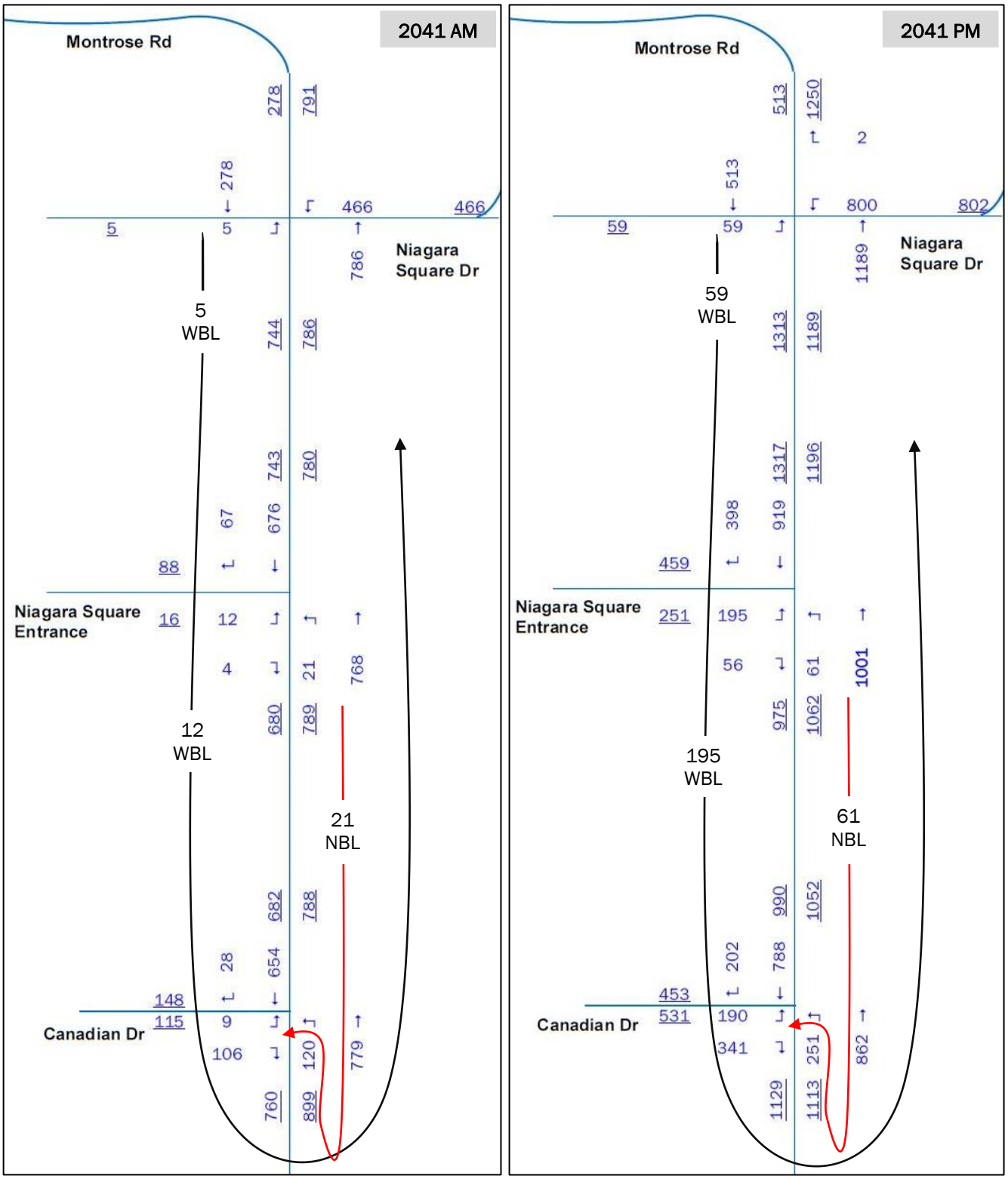


Table 1 below summarizes the SimTraffic analysis for the Canadian Drive intersection. Detailed reports are enclosed

TABLE 1: SIMTRAFFIC ANALYSIS – SUMMARY RESULTS

AM Peak Hour									PM Peak Hour								
Overall		Turning Movements							Overall		Turning Movements						
Delay (s)	LOS	Dir	Delay (s)	LOS	Queue (m)			Storage Length Coded (m)	Delay (s)	LOS	Dir	Delay (s)	LOS	Queue (m)			Storage Length Coded (m))
					Ave-rage	Max	95th							Ave-rage	Max	95th	
12	B	EBL	11	B	3	16	11	70	22	B	EBL	33	C	68	116	107	100
		EBR	6	A	11	24	20	-			EBR	13	B	34	105	78	-
		NBL	14	B	16	30	28	65			NBL	30	C	40	79	65	80
		NBT	10	B	25	53	40	-			NBT	13	B	36	65	56	-
		SBT	16	B	36	56	50	-			SBT	29	C	57	93	82	-
		SBR	3	A	4	10	11	45			SBR	8	A	17	47	33	45

The intersection is predicted to operate well during both the AM and PM peak hours under 2041 traffic conditions. The required storage length for the EBL lane is 100 m while the existing storage length is 50 m. Similarly, the NBL storage will need to be increased to 80 m from the existing 45 m storage length. The existing 50 m SBR storage length is predicted to be sufficient under future traffic conditions.

Enclosed:

SimTraffic Reports – Montrose Road and Canadian Drive intersection

Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	3:45	3:45	3:45	3:45	3:45	3:45
End Time	5:00	5:00	5:00	5:00	5:00	5:00
Total Time (min)	75	75	75	75	75	75
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	1801	1840	1888	1768	1806	1820
Vehs Exited	1808	1848	1890	1762	1808	1822
Starting Vehs	34	40	34	28	40	36
Ending Vehs	27	32	32	34	38	32
Travel Distance (km)	1619	1638	1688	1572	1625	1629
Travel Time (hr)	36.7	37.4	38.9	36.0	37.5	37.3
Total Delay (hr)	7.1	7.3	7.9	7.2	7.7	7.4
Total Stops	866	882	968	869	935	904
Fuel Used (l)	130.4	132.1	136.3	126.3	130.4	131.1

Interval #0 Information Seeding

Start Time	3:45
End Time	4:00
Total Time (min)	15

Volumes adjusted by Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	4:00
End Time	5:00
Total Time (min)	60

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	1801	1840	1888	1768	1806	1820
Vehs Exited	1808	1848	1890	1762	1808	1822
Starting Vehs	34	40	34	28	40	36
Ending Vehs	27	32	32	34	38	32
Travel Distance (km)	1619	1638	1688	1572	1625	1629
Travel Time (hr)	36.7	37.4	38.9	36.0	37.5	37.3
Total Delay (hr)	7.1	7.3	7.9	7.2	7.7	7.4
Total Stops	866	882	968	869	935	904
Fuel Used (l)	130.4	132.1	136.3	126.3	130.4	131.1

7: Montrose & Canadian Dr. Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.1	0.0	0.0	0.0	0.1
Denied Del/Veh (s)	3.6	0.2	1.6	0.2	0.0	0.0	0.3
Total Delay (hr)	0.1	0.2	0.5	2.1	3.0	0.0	5.8
Total Del/Veh (s)	10.9	6.0	13.8	9.5	15.6	3.3	11.9

8: Montrose & Niagara Sq Entrance Performance by movement

Movement	EBR	NBT	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.2	0.0	0.2	0.2	0.1
Total Delay (hr)	0.0	0.4	0.1	0.0	0.5
Total Del/Veh (s)	2.5	1.8	0.4	0.5	1.1

Total Zone Performance

Denied Delay (hr)	0.2
Denied Del/Veh (s)	0.3
Total Delay (hr)	6.3
Total Del/Veh (s)	270.1

Intersection: 7: Montrose & Canadian Dr.

Movement	EB	EB	NB	NB	NB	SB	SB	SB
Directions Served	L	R	L	T	T	T	T	R
Maximum Queue (m)	15.7	23.8	30.4	44.5	53.1	55.8	51.3	10.2
Average Queue (m)	3.4	10.6	15.9	25.1	23.7	35.7	30.5	3.7
95th Queue (m)	11.1	19.8	27.6	38.4	40.1	49.9	46.4	10.7
Link Distance (m)		261.5		557.2	557.2	171.6	171.6	
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (m)	70.0		65.0					45.0
Storage Blk Time (%)							1	
Queuing Penalty (veh)							0	

Intersection: 8: Montrose & Niagara Sq Entrance

Movement	EB
Directions Served	R
Maximum Queue (m)	8.8
Average Queue (m)	0.9
95th Queue (m)	5.2
Link Distance (m)	90.9
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Zone Summary

Zone wide Queuing Penalty: 0

Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	3:45	3:45	3:45	3:45	3:45	3:45
End Time	5:00	5:00	5:00	5:00	5:00	5:00
Total Time (min)	75	75	75	75	75	75
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	3360	3401	3340	3370	3318	3359
Vehs Exited	3340	3417	3338	3357	3321	3354
Starting Vehs	66	85	76	74	74	75
Ending Vehs	86	69	78	87	71	78
Travel Distance (km)	2653	2676	2682	2665	2642	2664
Travel Time (hr)	72.7	77.0	74.5	74.4	72.7	74.3
Total Delay (hr)	20.8	24.4	22.5	22.2	21.0	22.2
Total Stops	1919	2149	2014	2017	1927	2004
Fuel Used (l)	230.3	237.9	234.4	231.1	228.9	232.5

Interval #0 Information Seeding

Start Time	3:45
End Time	4:00
Total Time (min)	15

Volumes adjusted by Growth Factors.

No data recorded this interval.

Interval #1 Information Recording

Start Time	4:00
End Time	5:00
Total Time (min)	60

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	3360	3401	3340	3370	3318	3359
Vehs Exited	3340	3417	3338	3357	3321	3354
Starting Vehs	66	85	76	74	74	75
Ending Vehs	86	69	78	87	71	78
Travel Distance (km)	2653	2676	2682	2665	2642	2664
Travel Time (hr)	72.7	77.0	74.5	74.4	72.7	74.3
Total Delay (hr)	20.8	24.4	22.5	22.2	21.0	22.2
Total Stops	1919	2149	2014	2017	1927	2004
Fuel Used (l)	230.3	237.9	234.4	231.1	228.9	232.5

7: Montrose & Canadian Dr. Performance by movement

Movement	EBL	EBR	NBL	NBT	SBT	SBR	All
Denied Delay (hr)	0.4	0.1	0.2	0.1	0.0	0.0	0.8
Denied Del/Veh (s)	3.2	1.6	1.8	0.3	0.0	0.0	0.9
Total Delay (hr)	4.2	1.2	2.5	3.1	6.5	0.5	18.0
Total Del/Veh (s)	33.1	12.9	29.7	13.2	28.5	8.4	21.8

8: Montrose & Niagara Sq Entrance Performance by movement

Movement	EBR	NBT	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.1	0.1	0.2
Denied Del/Veh (s)	0.1	0.0	0.3	0.5	0.2
Total Delay (hr)	0.1	0.6	0.5	0.3	1.5
Total Del/Veh (s)	4.0	1.6	2.1	3.0	2.0

Total Zone Performance

Denied Delay (hr)	0.9
Denied Del/Veh (s)	1.0
Total Delay (hr)	19.6
Total Del/Veh (s)	582.5

Intersection: 7: Montrose & Canadian Dr.

Movement	EB	EB	NB	NB	NB	SB	SB	SB
Directions Served	L	R	L	T	T	T	T	R
Maximum Queue (m)	115.5	105.1	79.4	64.8	63.7	92.5	92.8	46.7
Average Queue (m)	68.4	34.4	39.4	35.9	34.7	56.6	53.2	17.0
95th Queue (m)	106.5	77.9	64.9	56.2	55.2	81.5	78.8	32.7
Link Distance (m)		261.5		557.2	557.2	171.6	171.6	
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (m)	100.0		80.0					45.0
Storage Blk Time (%)	2		1				11	
Queuing Penalty (veh)	8		2				22	

Intersection: 8: Montrose & Niagara Sq Entrance

Movement	EB	SB	SB
Directions Served	R	T	TR
Maximum Queue (m)	14.8	44.1	2.8
Average Queue (m)	7.8	1.5	0.2
95th Queue (m)	14.6	31.0	2.8
Link Distance (m)	90.9	216.7	216.7
Upstream Blk Time (%)		0	
Queuing Penalty (veh)		0	
Storage Bay Dist (m)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Zone Summary

Zone wide Queuing Penalty: 33