

City of Burlington

Downtown Burlington Traffic Overview

Final Report
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SUBMITTED BY CIMA CANADA INC.

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1. Introduction

CIMA+, as a subconsultant to SGL, was retained by the City of Burlington (the “City”) to expand on a previously completed traffic study to include 16 additional intersections, in order to capture the combined impact of five (5) approved developments at key intersections in the City’s downtown area. The objective of this report is to quantify the direct impacts of the new planned development on the traffic operations in the expanded study area. This effort is in support of the Scoped Re-Examination of the Adopted Official Plan for the Downtown Burlington.

1.1. Background

CIMA+ previously was retained by the City to prepare a traffic study, completed September 2018, with a smaller study area, covering seven (7) proposed developments, five (5) approved and two (2) in stream. The horizon years consisted of 2020 and 2025, on an area network consisting of six (6) signalized and eight (8) unsignalized intersections (i.e. a total of 14 intersections).

Since the submission of the September 2018 study report, the City decided to review a new planning horizon year (2031) and an expanded geographic study area, to include an additional 16 intersections. As part of this assessment, the operational impacts of the approved developments (shown in Figure 1) were reviewed at the study intersections. The analysis involved two distinct horizons (2019 existing traffic condition and 2031 future traffic condition), two peak periods (AM and PM peak hours) and three analysis scenarios (Existing, Future Background and Future Total – with developments). The details of these traffic analyses and other complementary reviews are discussed in the subsequent sections of the report.

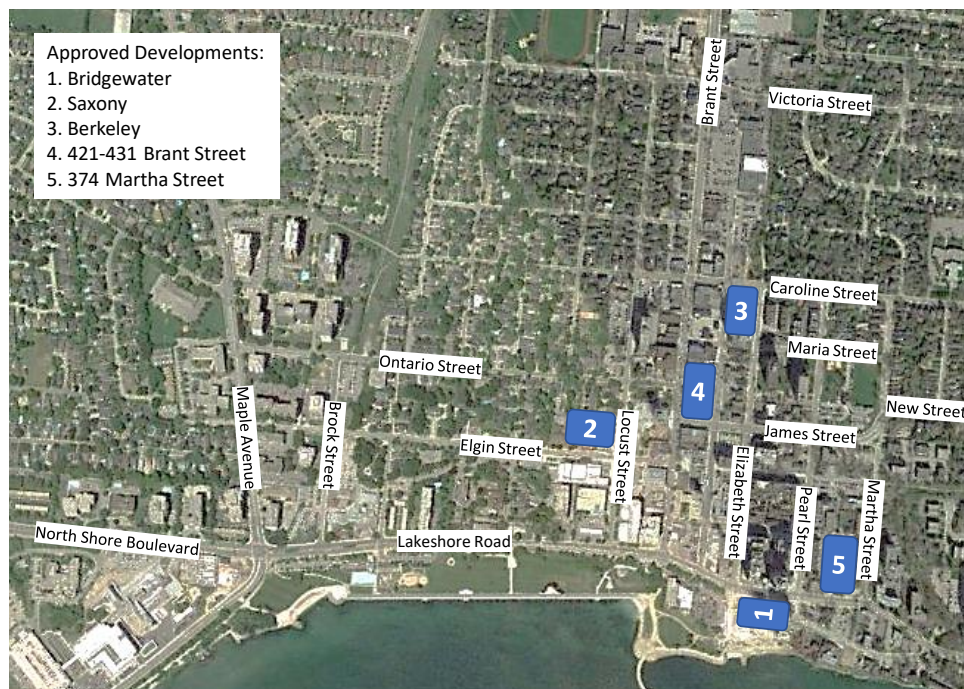


Figure 1: Approved Development Projects

1.2. Study Area

The study area is located within the downtown urban growth center and includes variety of land uses such as commercial employment, retail and services, residential, recreational, and tourism. Figure 2 showcases the expanded study area that is evaluated in this report.

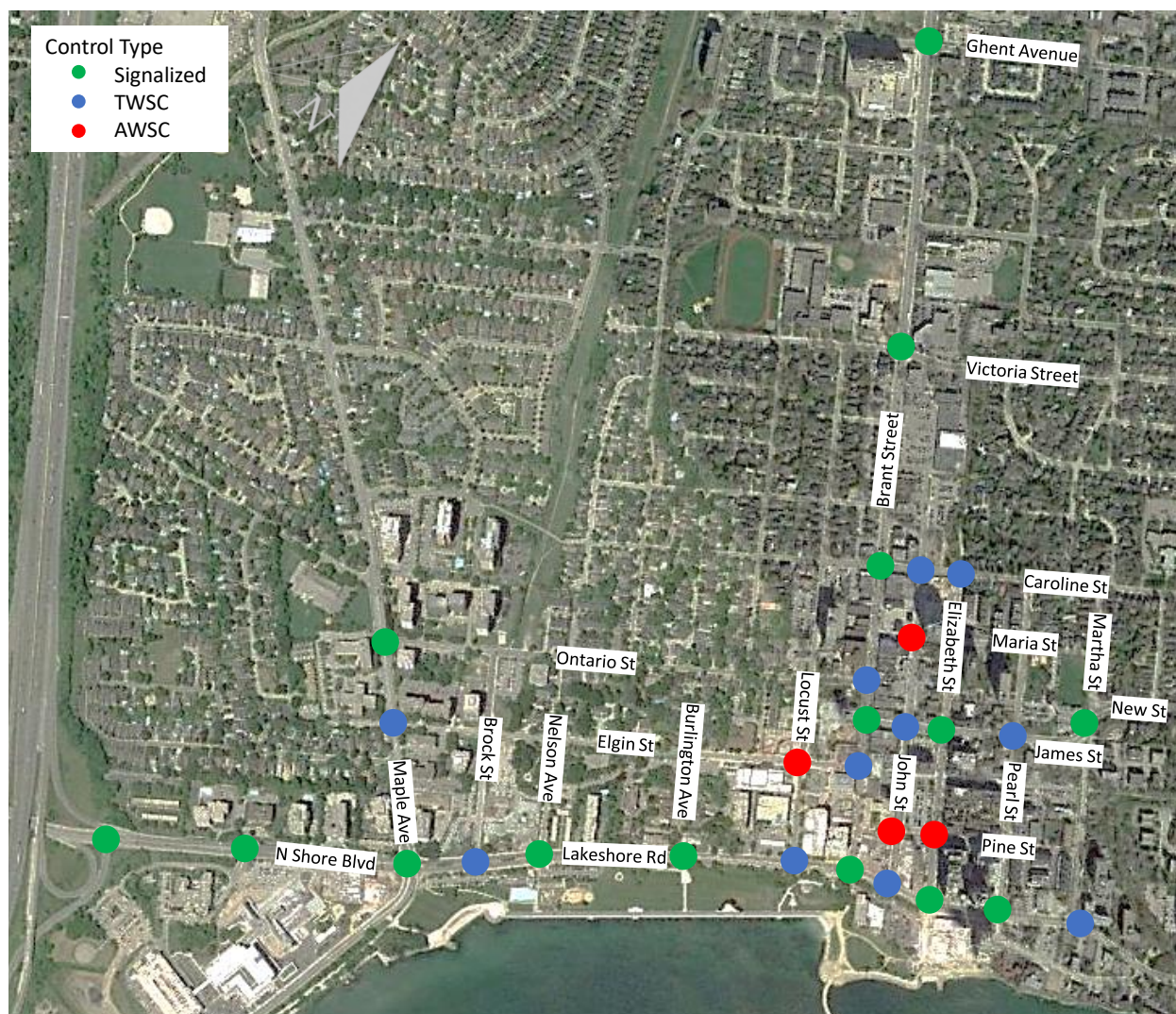


Figure 2: Expanded Study Area

The study area includes 15 signalized intersections, 11 two-way stop-controlled intersections, and 4 all-way stop controlled, as shown in Table 1. Turning movement counts (TMCs) at the study intersections were collected and provided by the City of Burlington on the dates shown in the table.

Table 1: Study Intersections

#	Intersection	Traffic Control	TMC Collection Date
1	Brant Street and Caroline Street	Signalized	June 27, 2017
2	Brant Street and James Street	Signalized	June 27, 2017
3	Brant Street and Lakeshore Road	Signalized	June 27, 2017

#	Intersection	Traffic Control	TMC Collection Date
4	Elizabeth Street and James Street	Signalized	June 27, 2017
5	Lakeshore Road and Elizabeth Street	Signalized	June 27, 2017
6	Lakeshore Road and Pearl Street	Signalized	June 27, 2017
7	Caroline Street and John Street	TWSC	June 19, 2018
8	Maria Street and John Street	AWSC	June 19, 2018
9	John Street and James Street	TWSC	June 25, 2015
10	Lakeshore Road and John Street	TWSC	June 19, 2018
11	Caroline Street and Elizabeth Street	TWSC	Oct. 20, 2015
12	James Street and Pearl Street	TWSC	June 27, 2017
13	Lakeshore Road and Martha Street	TWSC	June 27, 2017
14	Brant Street and Elgin Street	TWSC	June 27, 2017
15	Brant Street and Ontario Street	TWSC	June 27, 2017
16	Brant Street & Ghent Avenue	Signalized	Oct. 4, 2017
17	Brant Street & Victoria Avenue	Signalized	June 27, 2017
18	Martha Street & James Street/New Street	Signalized	Nov. 1, 2017
19	Lakeshore Road & Locust Street	TWSC	June 27, 2017
20	Lakeshore Road & Burlington Avenue	Signalized	June 19, 2019
21	Lakeshore Road & Nelson Avenue	Signalized	June 19, 2019
22	Lakeshore Road & Brock Avenue	TWSC	June 19, 2019
23	Lakeshore Road & Maple Avenue	Signalized	May 2, 2018
24	N Shore Blvd. E & Joseph Brant Hospital entrance	Signalized	May 9, 2018
25	N Shore Blvd. E & QEW East ramp terminal	Signalized	April 11, 2016
26	Maple Avenue & Elgin Street	TWSC	June 27, 2017
27	Maple Avenue & Ontario Street	Signalized	June 27, 2017
28	Pine Street & John Street	AWSC	June 27, 2017
29	Elgin Street & Locust Street	AWSC	June 27, 2017
30	Pine Street & Elizabeth Street	AWSC	June 27, 2017

The characteristic of the roadways in the study area are as following:

- Brant Street, within the context of this study south of Fairview Street, is a 2-lane north-south minor arterial road with sidewalk and on-street parking on both sides of the road. The speed limit is 50 km/h. It extends in the north-south direction and provides access between the downtown area and QEW / Highway 403.
- Lakeshore Road is a 4-lane east-west minor arterial road connecting the City of Burlington and Town of Oakville. The speed limit is 50 km/hr. Within the study area, there are 2 lanes in the westbound direction, 1 lane in the eastbound direction, and 1 shared centre lane for left turn maneuvers.
- Caroline Street is an east-west 2-lane collector road with a speed limit of 40 km/h. Within the study area, it has an urban cross-section, sidewalk on both sides, and on-street parking on the south side.
- James Street is an east-west 2-lane minor arterial road with a speed limit of 50 km/h. Within the study area, it has an urban cross-section, sidewalk on both sides of the roadway and on-street parking on the south side.

- John Street is a north-south 2-lane collector road with a speed limit of 50 km/h. Within the study area, it has an urban cross-section, sidewalks and on-street parking on both sides of the road.
- Elizabeth Street is a north-south 2-lane collector road with a speed limit of 50 km/h. Within the study area, it has an urban cross-section, sidewalks on both sides, on-street parking on the west side.
- Pearl Street is a north-south 2-lane collector road south of James Street and north of James Street is a local road with a posted speed limit of 40 km/h.
- Martha Street is a north-south collector road with a speed limit of 50 km/h. Within the study area, it has an urban cross-section, sidewalk on both sides, and a few parking spaces on the west side south of the Pine Street.
- Maria Street is an east-west 2-lane local road with a posted speed limit of 40 km/h. Within the study area, it has an urban cross-section with sidewalks and no parking restriction on either side of the roadway.
- Elgin Street is an east-west 2-lane (shared with bicycles) collector road with a posted speed limit of 40km/h. Within the study area, it has an urban cross-section with sidewalks on both sides of the roadway and no stopping restriction on either side of the roadway.
- Ontario Street is an east-west 2-lane collector road with a posted speed limit of 40 km/h. Within the study area, it has urban cross-section with sidewalks on both sides.
- Ghent Avenue is an east-west 4-lane collector road west of the intersection and 2-lane collector road east of the intersection, with a posted speed limit of 40 km/h. Within the study area, it has an urban cross-section with sidewalks on both sides of the roadway.
- Victoria Avenue is an east-west 2-lane collector road with a posted speed limit of 40 km/h. Within the study area, it has an urban cross-section with sidewalks on both sides of the roadway.
- Locust Street is a north-south 2-lane collector road with a speed limit of 50 km/h. Within the study area, it has urban cross-section with sidewalks on both sides with parking available on east end of the street.
- Burlington Avenue is a north-south 2-lane local road with a speed limit of 50 km/h. Within the study area, it has urban cross-section with sidewalks on both sides with no on-street parking available.
- Nelson Avenue is a north-south 2-lane local road with a speed limit of 50 km/h. Within the study area, it has urban cross-section with sidewalks on both sides with on-street parking available on the west end of the street.
- Brock Avenue is a north-south 2-lane local road with a speed limit of 50 km/h. Within the study area, it has urban cross-section with sidewalks on both sides with on-street parking available on the west end of the street.
- Maple Street is a 4-lane north-south minor arterial road with sidewalk on both sides of the road. The speed limit is 50 km/h. It extends in the north-south direction and provides access to the downtown area.
- Northshore Boulevard is a 4-lane east-west collector road with access to QEW and the Brant Hospital with sidewalks on both side of the street, within the study area. The posted speed limit is 60 km/h.

- Pine Street is an east-west 2-lane local road with a speed limit of 50 km/h. Within the study area, it has an urban cross-section, sidewalk on both sides of the roadway and on-street parking on the north side.
- New Street is an east-west 2-lane minor arterial road with a speed limit of 50 km/h. Within the study area, it has an urban cross-section, sidewalk on both sides of the roadway, no on-street parking and a bike lane on the north side and a sharrow on the south side.

2. Data Collecting and Processing

The City provided CIMA+ with the following information/data, all of which can be found in Appendix A:

- Turning Movement Counts (TMCs) for all study intersections (as per Table 1 above);
- Signal Timing Plans (STPs) for all signalized intersections within the study area;
- Trip generation for the Bridgewater, Saxony, and Berkeley development.
- *421-431 Brant Street Transportation Impact Study, Parking Study and TDM Options Report*, Paradigm Transportation Solutions Limited, December 2016;
- *374 Martha Street Traffic Impact Study*, Paradigm Transportation Solutions Limited, December 2016; and
- *The Road to Change – Halton Region Transportation Master Plan – 2031*, Halton Region, September 2011 (growth rates).

The provided information was used to estimate the AM and PM peak volumes and peak hour factors, in order to conduct the existing and future conditions assessment.

3. Traffic Operations Analysis

Capacity analysis of the study intersections was undertaken using the Synchro/SimTraffic software version 9. This software package follows the Highway Capacity Manual (HCM) approach to evaluate the operational performance of signalized and un-signalized intersections.

The following inputs were used for the analyses:

- Input traffic volumes were estimated for two different study horizons (i.e., 2019, and 2031);
- The intersection geometry (e.g., lane widths and storage lengths) was coded according to the existing lane configuration;
- Peak Hour Factors (PHF) were determined for each intersection based on the 15-minute TMCs provided by the City, as shown in Appendix A;
- A base saturation flow rate of 1900 vehicles per hour per lane which is a typical value for urban conditions was utilized; and
- The signal timing plans were coded for each intersection based on the existing timing plans provided by the City of Burlington.

To determine the performance of signalized intersections, five performance measures were identified: (1) control delay, (2) average queue, (3) 95th percentile queue lengths, (3) volume to capacity (v/c), and (5) level of service (LOS). Intersection LOS is an indication of the acceptability of delay levels to motorists. Theoretically, a V/C ratio above 1.0 indicates that the examined

intersection or turning movement is over saturated. The 95th percentile queue is the queue length that has only a 5% probability of being exceeded during the analysis period. It is industry practice and accepted methodology to use the 95th percentile queue length for design and operational analysis purposes. In this study, consistent with the Halton Region TIS Guidelines, more congested turning movements were identified considering the following criteria:

- A volume to capacity (v/c) ratio of 0.85 or higher for signalized intersections;
- Excessive delays, indicated by LOS “E” or worse for both signalized and un-signalized intersections; and
- 95th percentile queue lengths for individual movements that exceed available lane storage or queues that reach upstream intersections for both signalized and un-signalized intersections.

It is noteworthy that constrained turning movements are typical of urban areas such as the downtown Burlington and road users in such environment generally have an increased tolerance for higher levels of traffic congestion.

The HCM definition of LOS for signalized and unsignalized intersections is detailed below in Table 2.

Table 2: HCM Level of Service

LOS	Delay (s)	
	Signalized Intersection	Unsignalized Intersection
A	≤10 sec	≤10 sec
B	10–20 sec	10–15 sec
C	20–35 sec	15–25 sec
D	35–55 sec	25–35 sec
E	55–80 sec	35–50 sec
F	>80 sec	>50 sec

The results of the capacity analysis for the study intersections are presented in the following subsections. To better address the study objectives, these results are provided separately for the two horizons of interest.

3.1. Existing Traffic Conditions

The existing traffic conditions at study intersections were reviewed using the observed traffic volumes and current signal timing plans. The resulted outcomes of this analysis were considered as a benchmark to further quantify the traffic impacts of the new developments.

3.1.1. Existing Lane Configurations

The existing lane configurations for study intersections are illustrated in Figure 3.

3.1.2. Existing Traffic Volumes

As previously mentioned, the available traffic volume data were collected on different dates (2015 to 2018) resulting in some volume imbalances across the study area. Therefore, the AM and PM peak hour volumes at different intersections were converted into 2019 numbers by utilizing a

growth factor of 0.5% per annum based on the City's historical traffic volume trends. The estimated peak traffic volumes for 2019 existing conditions are presented in Figure Figure 4.



Figure 3: Existing Lane Configuration

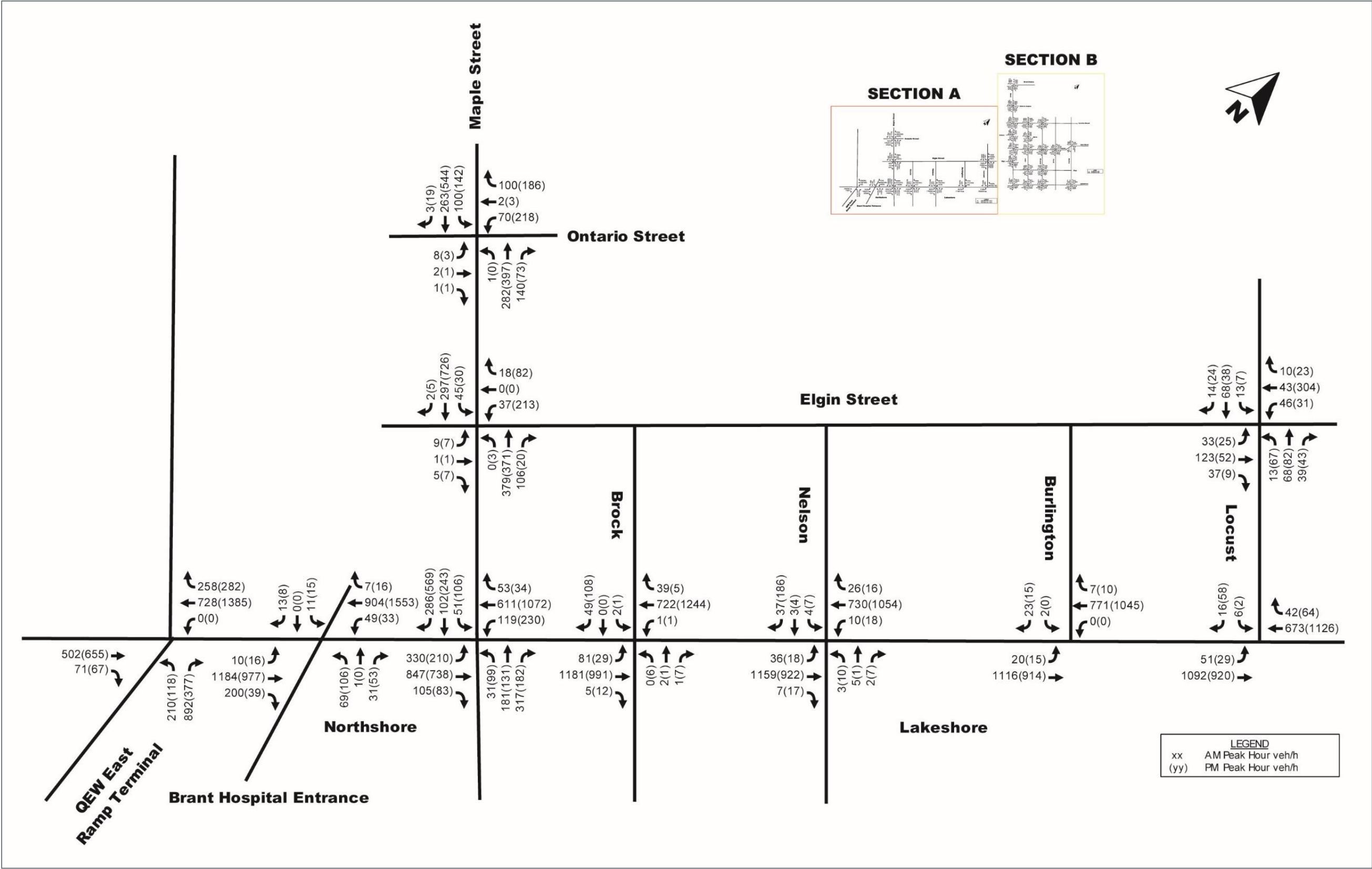


Figure 4-a: Existing Traffic Volume (Section A)

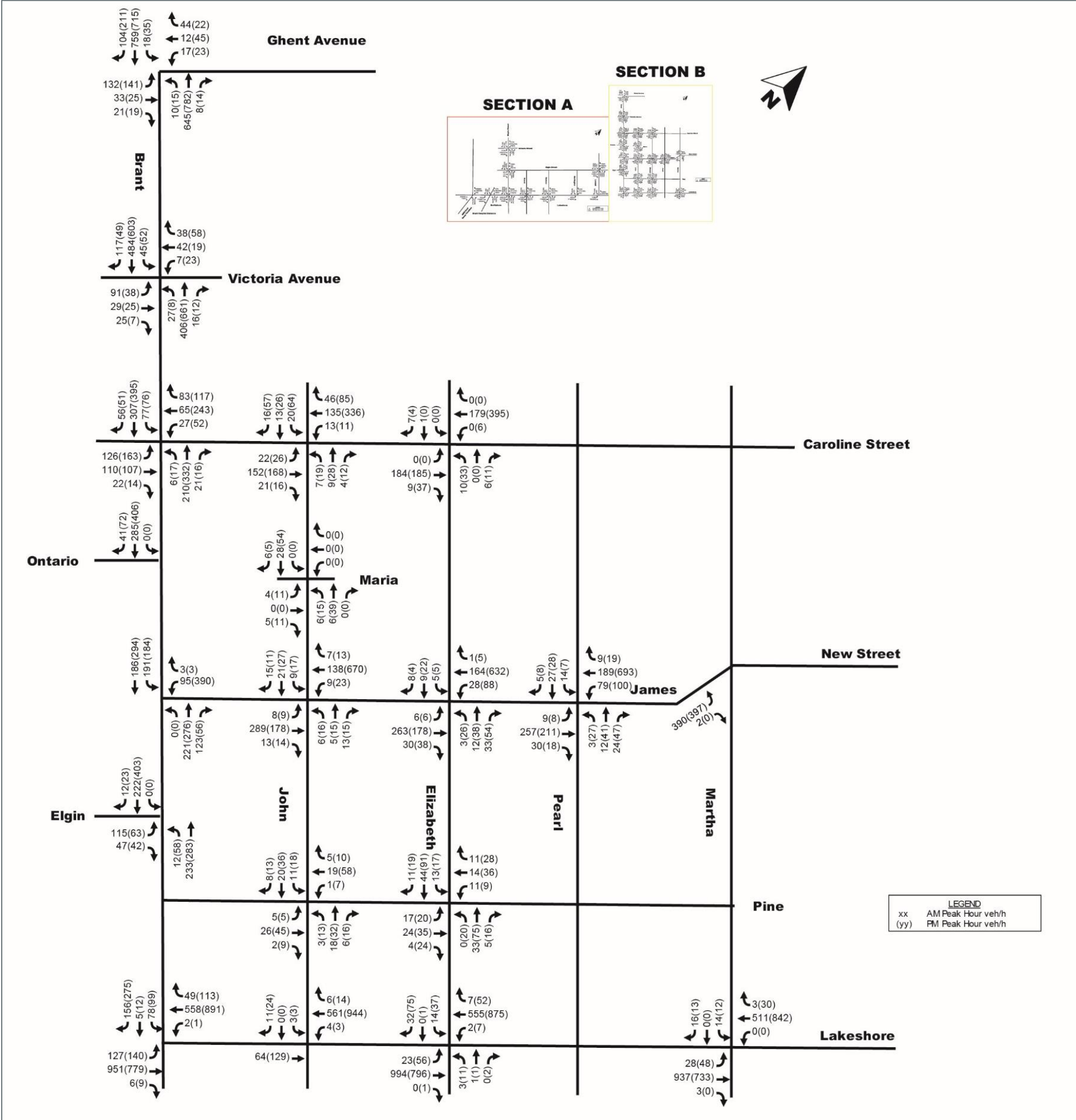


Figure 4b: Existing Traffic Volume (Section B)

3.1.3. 2019 Results

Table 3 and Table 4 summarize the 2019 existing traffic operations for signalized and unsignalized intersections, respectively. Full Synchro and SimTraffic reports are provided in Appendix B for future reference.

The following observations can be made from Table 3:

- **The traffic operations at almost all signalized intersections are within the acceptable range (LOS D or better) under the existing conditions, with the majority having an overall LOS of A or B.** The exceptions are the intersections of QEW East Ramp Entrance & North Shore Road and Lakeshore Road & Maple Avenue.
 - North Shore Boulevard & QEW East Ramp Terminal operates at an overall LOS of F and V/C ratio of 0.86 during the AM peak hour. The constrained movement in both AM and PM peak hours is the northbound right-turn movement (LOS F in both AM and PM peaks and V/C Ratio of 1.84 in the AM and 0.87 in the PM). During the AM peak, the 95th percentile queue is relatively long for the Northbound right-turn and northbound left-turn movements. However, during the PM peak, the 95th percentile queue is only notable for the eastbound through/right-turn movement. These queues were verified by Google Traffic, as shown in Figure 5.

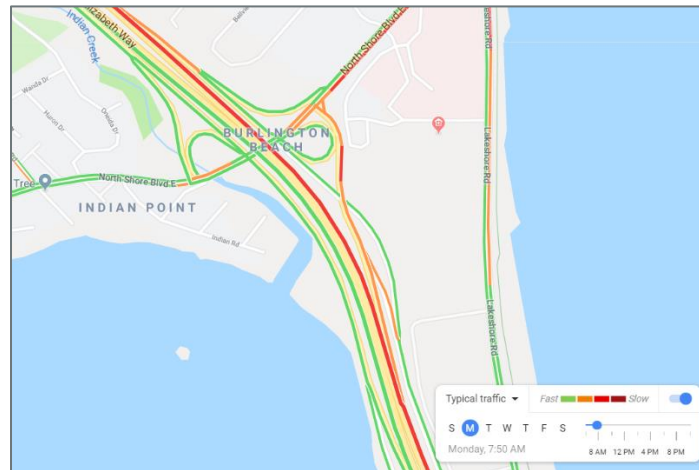


Figure 5: Google Traffic Snapshot at the North Shore Blvd and QEW East Ramp Terminal (AM Peak Hour)

- Lakeshore Road & Maple Avenue Intersection operates at an overall LOS of D and a V/C ratio of 1.10 and 0.92 in the AM and PM peaks, respectively. The constrained movements in the AM peak hour are the eastbound left-turn (LOS F & V/C Ratio 1.28), the eastbound through/right-turn (LOS C & V/C 0.85), and the northbound through/right-turn movements (LOS E & V/C 0.98). On the other hand, in the PM peak hour the eastbound left-turn (LOS F & V/C 0.95), the eastbound through/right-turn (LOS D & V/C 0.89), the westbound left-turn (LOS F & V/C ratio 1.02), the westbound through (LOS D & V/C 0.94) and the southbound right-turn movement (LOS E & V/C 0.90) and are operating close to the capacity. During the AM peak, the long queues are mainly reported in the eastbound and

northbound approaches; however, during the PM peak, the queues are reported in the eastbound and westbound approaches. These queues were verified by Google Traffic, as shown in Figure 6.

- In a number of cases, the 95th percentile queues along the Lakeshore Road extend to the upstream intersection. This is due to the heavy eastbound and westbound volumes along this corridor during the AM and PM peak period as highlighted in Figure 6.

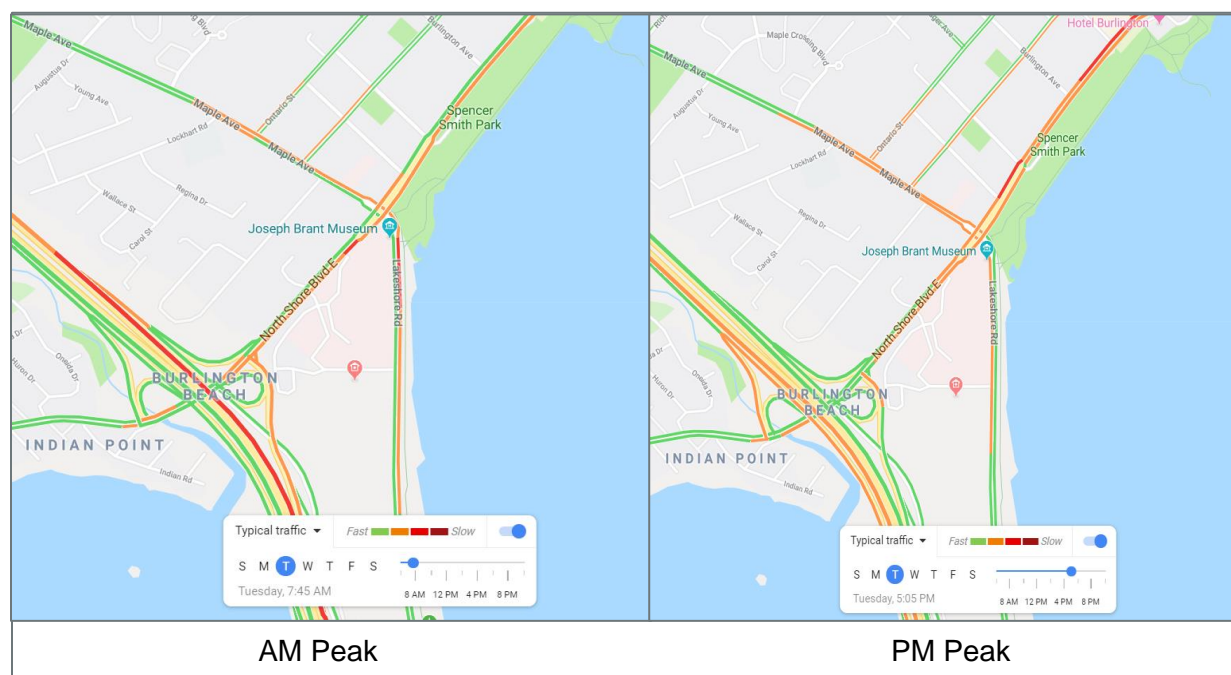


Figure 6: Google Traffic Snapshots at the Lakeshore Rd. and Maple Ave. Intersection (AM and PM Peak Hours)

Table 3: Existing 2019 AM & PM Intersection Performance Summary (Signalized)

Movement	AM Peak						PM Peak						
	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Storage (m)
Brant Street and Caroline Street													
EBL	126	25	C	0.55	18	30	163	22	C	0.63	22	35	45
EBT	110	20	B	0.25	18	31	107	13	B	0.13	13	27	75
EBR	22	18	B	0.02	6	17	14	12	B	0.02	3	10	15
WBL	27	28	C	0.21	8	21	52	19	B	0.15	12	28	20
WBT/R	148	31	C	0.42	22	39	360	29	C	0.66	38	57	200
NBL	6	19	B	0.04	1	4	17	22	C	0.10	5	20	30
NBT/R	231	24	C	0.34	24	45	348	32	C	0.65	43	76	240
SBL	77	10	B	0.20	11	21	76	20	C	0.34	14	25	340

Movement	AM Peak						PM Peak						
	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Storage (m)
SBT/R	363	11	B	0.38	32	64	446	21	C	0.67	56	105	340
TOTAL	1110	20	B	0.46	-	-	1583	25	C	0.70	-	-	-
Brant Street and James Street													
WBL	95	31	C	0.45	17	30	390	31	C	0.78	42	53	45
WBR	89	28	C	0.08	12	23	295	20	B	0.24	27	43	100
NBT	221	8	A	0.26	17	40	276	17	B	0.43	35	62	220
NBR	123	7	A	0.13	12	23	56	13	B	0.08	9	22	10
SBL	191	9	A	0.34	17	28	184	20	C	0.54	20	29	25
SBT	186	8	A	0.21	16	41	294	16	B	0.39	33	53	230
TOTAL	905	13	B	0.35	-	-	1495	21	C	0.61	-	-	-
Brant Street and Lakeshore Road													
EBL	127	7	A	0.29	24	58	140	18	B	0.52	30	65	50
EBT/R	957	15	B	0.84	68	107	788	14	B	0.67	68	104	65
WBL	2	6	A	0.05	0	3	1	6	A	0.02	0	69	25
WBT/R	607	6	A	0.30	22	43	1004	9	A	0.51	49	75	110
NBL/T/R	19	40	D	0.10	5	14	13	43	D	0.15	3	12	80
SBL	78	45	D	0.50	20	43	99	48	D	0.54	46	83	220
SBT/R	161	41	D	0.17	19	28	287	49	D	0.59	22	28	15
TOTAL	1951	15	B	0.75	-	-	2332	18	B	0.65	-	-	-
Elizabeth Street and James Street													
EBL	6	3	A	0.03	1	6	6	4	A	0.02	2	10	15
EBT/R	293	4	A	0.27	20	43	216	4	A	0.19	13	35	105
WBL	28	2	A	0.06	4	13	88	4	A	0.12	12	40	40
WBT/R	165	3	A	0.15	10	25	637	6	A	0.56	45	84	260
NBL/T/R	48	26	C	0.15	8	16	118	36	D	0.57	20	36	155
SBL/T/R	22	26	C	0.13	5	14	31	34	C	0.11	7	19	240
TOTAL	562	7	A	0.25	-	-	1096	11	B	0.56	-	-	-
Lakeshore Road and Elizabeth Street													
EBL	23	1	A	0.09	3	13	56	3	A	0.17	7	17	80
EBT/R	995	3	A	0.70	25	41	797	4	A	0.56	22	37	100
WBL	2	1	A	0.01	0	3	7	2	A	0.06	4	20	30
WBT/R	562	2	A	0.22	18	41	927	2	A	0.36	41	99	90
NBL/T/R	4	46	D	0.06	1	8	14	48	D	0.16	4	16	15
SBL	14	47	D	0.22	4	13	37	50	D	0.37	9	21	25
SBT/R	32	46	D	0.03	8	18	76	47	D	0.09	12	62	80
TOTAL	1632	4	A	0.65	-	-	1914	7	A	0.54	-	-	-

Movement	AM Peak						PM Peak						
	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Storage (m)
Lakeshore Road and Pearl Street													
EBL	29	0	A	0.09	4	18	42	1	A	0.13	6	14	50
EBT/R	984	2	A	0.70	34	88	791	2	A	0.57	13	28	90
WBL	1	1	A	0.01	0	2	3	2	A	0.02	0	6	20
WBT/R	534	2	A	0.20	9	25	867	3	A	0.32	29	74	285
NBL/T	3	47	D	0.05	1	5	49	56	E	0.58	13	34	270
NBR	1	47	D	0.00	1	4	6	47	D	0.01	2	11	15
SBL	9	48	D	0.16	3	11	27	49	D	0.22	7	16	15
SBT/R	29	47	D	0.06	6	13	81	48	D	0.15	16	48	95
TOTAL	1590	4	A	0.65	-	-	1866	8	A	0.57	-	-	-
Brant Street & Ghent Avenue													
EBL/T	165	37	D	0.65	29	51	166	38	D	0.69	30	51	300
EBR	21	28	C	0.02	8	24	19	27	C	0.02	5	21	25
WBL/T/R	73	29	C	0.20	11	22	90	29	C	0.26	16	30	500
NBL	10	7	A	0.06	3	14	15	5	A	0.10	4	14	45
NBT/R	653	9	A	0.37	32	54	796	7	A	0.41	21	42	285
SBL	18	7	A	0.06	4	16	35	8	A	0.13	62	27	30
SBT/R	863	10	A	0.45	81	134	926	11	B	0.51	20	120	125
TOTAL	1803	13	B	0.50	-	-	2047	13	B	0.56	-	-	-
Brant Street & Victoria Avenue													
EBL	91	37	D	0.52	14	26	38	38	D	0.33	9	19	20
EBT/R	54	33	C	0.17	10	24	32	37	D	0.21	7	15	180
WBL	7	33	C	0.08	2	9	23	36	D	0.18	4	14	30
WBT/R	80	35	D	0.40	12	25	77	37	D	0.24	12	23	340
NBL	27	4	A	0.07	6	19	8	5	A	0.03	2	11	15
NBT/R	422	6	A	0.35	34	67	563	11	B	0.58	56	98	340
SBL	45	4	A	0.09	10	32	52	2	A	0.15	7	15	50
SBT	484	5	A	0.41	46	79	603	2	A	0.49	17	40	185
SBR	117	3	A	0.10	17	46	49	0	A	0.04	3	13	60
TOTAL	1327	11	B	0.43	-	-	1445	10	B	0.55	-	-	-
Lakeshore Road & Burlington Avenue													
EBL	20	2	A	0.06	3	11	15	4	A	0.13	5	18	75
EBT	1116	14	B	0.84	25	96	914	8	A	0.67	26	88	205
WBT/R	778	4	A	0.58	12	45	1055	9	A	0.79	53	129	265
SBL/R	25	48	D	0.07	6	18	15	52	D	0.01	4	13	150
TOTAL	1939	11	B	0.78	-	-	1999	9	A	0.73	-	-	-

Movement	AM Peak						PM Peak						
	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Storage (m)
Lakeshore Road & Nelson Avenue													
EBL	36	2	A	0.09	5	17	18	4	A	0.07	2	19	30
EBT	1159	14	B	0.82	44	99	922	12	B	0.71	60	89	200
EBR	7	2	A	0.01	0	3	17	2	A	0.02	1	6	200
WBL	10	4	A	0.07	1	7	18	2	A	0.10	7	28	25
WBT/R	756	5	A	0.31	17	43	1070	3	A	0.45	63	88	205
NBL/T/R	10	50	D	0.20	2	6	18	44	D	0.10	3	12	10
SBL/T/R	44	50	D	0.17	8	18	197	62	E	0.76	37	64	170
TOTAL	2022	11	B	0.77	-	-	2260	13	B	0.72	-	-	-
Lakeshore Road & Maple Avenue													
EBL	330	165	F	1.28	157	161	210	97	F	0.95	152	204	170
EBT/R	952	26	C	0.85	244	251	821	39	D	0.89	246	254	240
WBL	119	43	D	0.77	29	45	230	95	F	1.02	36	42	30
WBT	664	32	C	0.57	57	83	1106	45	D	0.94	119	129	190
NBL	31	22	C	0.10	51	146	99	26	C	0.35	20	39	120
NBT/R	498	70	E	0.98	280	478	313	40	D	0.66	48	87	500
SBL	51	26	C	0.39	12	26	106	27	C	0.43	17	33	60
SBT	102	26	C	0.19	17	33	243	35	C	0.46	138	210	345
SBR	286	26	C	0.20	26	43	569	61	E	0.90	125	212	345
TOTAL	3033	50	D	1.10	-	-	3697	50	D	0.92	-	-	-
North Shore Blvd. E & Brant Hospital Entrance													
EBL	10	8	A	0.06	11	63	16	10	A	0.19	28	97	55
EBT/R	1384	15	B	0.71	118	128	1016	10	A	0.47	113	142	210
WBL	49	22	C	0.27	9	25	33	5	A	0.11	4	15	70
WBT/R	911	9	A	0.39	42	75	1569	7	A	0.67	34	60	240
NBL	69	48	D	0.60	16	31	106	57	E	0.71	22	43	100
NBT	1	39	D	0.01	-	3	0	42	D	0.00	10	0	100
NBR	31	39	D	0.03	7	17	53	43	D	0.06	10	25	20
SBL/T	11	40	D	0.09	2	9	15	42	D	0.09	3	13	20
SBR	13	39	D	0.01	3	9	8	12	B	0.01	2	9	111
TOTAL	2479	15	B	0.68	-	-	2816	12	B	0.70	-	-	-
North Shore Blvd. E & QEW East Ramp Entrance													
EBT/R	573	9	A	0.29	39	98	722	5	A	0.32	226	409	280
WBT/R	986	11	B	0.48	22	56	1667	4	A	0.73	20	36	320
NBL	210	34	C	0.60	549	796	118	54	D	0.62	33	64	680
NBR	892	425	F	1.84	583	732	377	80	F	0.87	107	227	680
TOTAL	2661	150	F	0.86	-	-	2884	16	B	0.75	-	-	-

Movement	AM Peak						PM Peak						
	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Storage (m)
Maple Avenue & Ontario Street													
EBL/T/R	11	11	B	0.05	2	7	5	24	C	0.04	1	6	10
WBL	70	12	B	0.28	10	20	218	40	D	0.72	31	49	45
WBT/R	102	11	B	0.09	8	16	189	44	D	0.14	15	38	390
NBL	1	7	A	0.01	10	0	0	0	A	0.00	13	0	30
NBT/R	422	8	A	0.32	17	24	470	8	A	0.26	16	34	345
SBL	100	9	A	0.37	14	24	142	11	B	0.36	16	30	30
SBT/R	266	8	A	0.25	14	29	563	9	A	0.29	25	42	470
TOTAL	972	9	A	0.33	-	-	1587	17	B	0.46	-	-	-
Martha Street & New Street													
WBL	285	2	A	0.24	6	22	809	5	A	0.63	34	86	550
WBR	46	2	A	0.04	0	5	79	1	A	0.08	3	19	30
NBR	390	3	A	0.28	6	18	397	2	A	0.31	6	15	260
SBL	10	33	C	0.20	3	9	12	44	D	0.25	4	11	20
SBT	5	33	C	0.09	2	8	5	43	D	0.14	2	11	190
TOTAL	736	3	A	0.28	-	-	1302	4	A	0.49	-	-	-

The following observations can be made from Table 4:

- **The traffic operation at all unsignalized intersections is within the acceptable range (LOS D or better) under the 2019 existing conditions.** Intersections with constrained movements are Lakeshore Road & John Street, James Street & Pearl Street, Lakeshore Road & Martha Street, Lakeshore Road & Locust Street, Lakeshore Road & Brock Avenue, and Maple Avenue & Elgin Street, all of which are two way stop-controlled intersections. At these intersections some movements from the minor streets operate at a poor level of service (E or F) during the AM and/or PM peak hours. **It is noteworthy that these movements have relatively low traffic volumes compared to the adjacent main street and therefore their operation is of lower priority;**
- The reported 95th percentile queue lengths for only 2 turning movements slightly exceed their available storage lengths.

Table 4: Existing 2019 AM & PM Intersection Performance Summary (Unsignalized)

Movement	AM Peak						PM Peak						
	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Storage (m)
Caroline Street and John Street													
EBL	22	8	A	0.03	1	7	26	8	A	0.04	2	8	20
WBL	13	8	A	0.01	0	3	11	8	A	0.02	1	5	35

Movement	AM Peak						PM Peak						
	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Storage (m)
NBL/T/R	20	13	B	0.07	3	11	59	22	C	0.32	9	22	90
SBL/T	33	12	B	0.11	7	15	64	21	C	0.42	13	31	145
SBR	16	0	A	0.00	4	12	83	0	A	0.00	10	21	40
TOTAL	458	2	A	0.11	-	-	848	3	A	0.23	-	-	-
Maria Street and John Street													
EBL/T/R	10	7	A	-	3	10	22	7	A	-	5	13	50
WBL/T/R	0	7	A	-	0	0	0	7	A	-	0	0	40
NBL/T/R	12	8	A	-	4	13	54	8	A	-	8	15	130
SBL/T/R	34	7	A	-	8	16	59	8	A	-	9	17	90
TOTAL	56	7	A	-	-	-	135	7	A	-	-	-	-
John Street and James Street													
WBL	9	9	A	0.02	1	6	23	8	A	0.02	3	15	20
NBL/T/R	24	15	B	0.07	5	17	46	40	E	0.45	7	18	100
SBL/T/R	45	13	B	0.13	5	12	55	35	D	0.38	7	15	130
TOTAL	533	2	A	0.05	-	-	1008	4	A	0.35	-	-	-
Lakeshore Road and John Street													
EBL	10	10	A	0.02	1	7	14	14	B	0.06	2	8	10
NBL/T/R	14	115	F	0.48	4	11	3	325	F	0.45	1	5	15
SBL/T/R	14	426	F	0.94	3	11	27	617	F	1.73	6	15	60
TOTAL	1629	7	A	0.43	-	-	1871	14	B	0.57	-	-	-
Caroline Street and Elizabeth Street													
NBL/T/R	16	12	B	0.05	4	12	44	15	B	0.15	8	16	240
SBT/R	8	10	A	0.03	2	8	4	11	B	0.01	1	4	200
TOTAL	396	1	A	0.13	-	-	671	1	A	0.21	-	-	-
James Street and Pearl Street													
EBL	9	8	A	0.01	1	4	8	10	A	0.01	1	6	45
WBL	79	8	A	0.08	5	13	100	8	A	0.10	5	13	50
NBL/T/R	39	15	B	0.14	7	15	115	92	F	0.88	15	28	155
SBL/T/R	46	21	C	0.24	7	14	43	57	F	0.49	8	16	245
TOTAL	658	3	A	0.16	-	-	1207	12	B	0.43	-	-	-
Lakeshore Road and Martha Street													
EBL	28	9	A	0.03	3	11	48	10	B	0.08	6	15	20
SBL/R	30	61	F	0.39	6	17	25	61	F	0.39	6	13	280
TOTAL	1509	2	A	0.50	-	-	1678	2	A	0.49	-	-	-
Brant Street and Elgin Street													
EBL/R	162	16	B	0.38	11	20	105	20	C	0.35	11	21	75
TOTAL	722	4	A	0.15	-	-	1142	3	A	0.21	-	-	-

Movement	AM Peak						PM Peak						
	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Storage (m)
Brant Street and Ontario Street													
EBL/R	96	12	B	0.19	12	20	77	13	B	0.16	13	25	75
TOTAL	691	2	A	0.15	-	-	1070	3	A	0.26	-	-	-
Lakeshore Road & Locust Street													
EBL	51	10	A	0.09	8	29	29	11	B	0.06	6	15	170
SBL/R	22	NR	F	5.16	6	15	60	19	C	0.22	9	16	140
TOTAL	1880	NR	C	0.57	-	-	2199	1	A	0.50	-	-	-
Lakeshore Road & Brock Avenue													
EBL	81	11	B	0.14	6	14	29	14	B	0.08	5	15	25
WBL	1	14	B	0.01	0	2	1	12	B	0.01	93	6	30
NBL/T/R	3	325	F	0.59	1	4	14	146	F	0.60	10	35	20
SBL/T/R	51	198	F	0.94	10	19	109	58	F	0.67	23	42	185
TOTAL	2083	7	A	0.57	-	-	2405	5	A	0.59	-	-	-
Maple Avenue & Elgin Street													
EBL/T/R	15	17	B	0.10	1	5	15	28	D	0.16	2	8	10
WBL	37	24	C	0.20	6	13	213	155	F	1.17	26	45	40
WBT/R	18	10	B	0.03	3	9	82	10	B	0.14	19	85	135
SBL	45	9	A	0.08	4	11	30	8	A	0.05	2	8	100
TOTAL	899	2	A	0.15	-	-	1465	24	C	0.36	-	-	-
Pine Street & John Street													
EBL/T/R	33	8	A	-	6	14	59	8	A	-	9	16	50
WBL/T/R	25	8	A	-	6	15	75	8	A	-	8	14	40
NBL/T/R	27	8	A	-	8	20	61	8	A	-	10	19	50
SBL/T/R	39	8	A	-	9	18	67	9	A	-	10	17	50
TOTAL	124	8	A	-	-	-	262	8	A	-	-	-	-
Elgin Street & Locust Street													
EBL/T/R	193	10	B	-	13	20	86	10	B	-	10	16	170
WBL/T/R	99	9	A	-	10	15	359	18	C	-	17	28	75
NBL/T/R	120	9	A	-	10	17	192	13	B	-	13	21	145
SBL/T/R	95	9	A	-	10	18	69	10	B	-	9	14	120
TOTAL	507	10	A	-	-	-	706	15	B	-	-	-	-
Pine Street & Elizabeth Street													
EBL/T/R	45	8	A	-	8	16	79	9	A	-	9	12	40
WBL/T/R	36	8	A	-	6	13	73	9	A	-	9	16	100
NBL/T/R	38	8	A	-	7	14	111	9	A	-	11	18	85
SBL/T/R	68	8	A	-	9	16	127	9	A	-	10	15	155
TOTAL	187	8	A	-	-	-	390	9	A	-	-	-	-

Overall, the traffic operations at the study intersections for the existing 2019 conditions (during both AM and PM peak hours) are typical of urban areas such as the downtown Burlington where road users generally have an increased tolerance for higher levels of traffic congestion.

3.2. 2031 Traffic Conditions – Background

A 2031 background traffic scenario was prepared for future downtown conditions without considering the traffic generating from the approved developments. In this scenario, a background growth rate was applied to all movements (0.5% per annum), signal timing plans were optimized, and the signal coordination along the Lakeshore Road corridor was optimally maintained. The results of this scenario were used as the baseline to quantify the impacts of the approved developments under the 2031 traffic conditions (Section 3.4). The results of this scenario are not provided in the body of the report but can be found in Appendix C.

3.3. 2031 Traffic Conditions – Approved Developments

In this study a new planning horizon year of 2031 was used to evaluate the expanded geographic study area with the five (5) approved developments, which are anticipated to be completed by 2020. The two (2) developments that have not yet been approved by the City of Burlington were not included in the analysis as per the instructions received by the City. The analysis of signalized intersections was completed considering the current signal timing plans optimized to account for the increased traffic volume (as the result of background traffic growth and new developments). Moreover, the planned network improvements found in the Halton Region Transportation Master Plan 2031 were made to the study network as well as the following changes as per the intersection specific recommendations in the TIS's provided by the City:

- Lakeshore Road/Martha Street – provide extension to the existing EB LT lane to accommodate 50 m of storage length (374 Martha Street TIS);
- Brant/Ontario – NB LT lane with 90 m of storage length (409 Brant TIS);
- Brant/Elgin – NB LT lane with 40 m of storage length (409 Brant TIS);
- John/James – EB LT with 15 m of storage length (409 Brant TIS).

The results of this scenario are presented in the following subsections.

3.3.1. 2031 Traffic Volumes

For this scenario, the AM and PM 2031 traffic volumes were estimated in two steps. First the background traffic flows were calculated assuming an organic growth in the existing 2019 balanced volumes, grown at 0.5% per annum. Then, the generated volumes from the approved developments and their distribution across the study area were determined based on the information provided in relevant traffic impact studies. The summation of these two components formed the total 2031 traffic volumes.

The generated traffic volumes from the approved developments were determined as follows:

- **Location 1 (Bridgewater)** is a mixed-used development at the southeast corner of the intersection of Elizabeth Street and Lakeshore Road (Figure 1). The development includes three buildings, a condominium building with 22-storeys with 100 residential units and 1170

square metres of commercial space, a 7-storey building with 50 residential units and 750 square metres of commercial space, and a 8-storey hotel with 130 rooms and 855 square metres of commercial space.

- **Location 2 (Saxony)** is a development of 7-storey mixed-use residential building with ground floor commercial at the northwest corner of the intersection of Elgin Street and Locust Street (Figure 1).
- **Location 3 (Berkeley)** is a mixed-use development with three connected buildings (an 80-storey office space building, a 17-storey residential building and a 6-storey parking garage) occupying the block bounded by Caroline Street, Maria Street, John Street and Elizabeth Street (Figure 1).
- **Location 4 (421-431 Brant St.)** is a 27-storey mixed-use building with 177 residential units, 1327 square metres of office space and 967 square metres of commercial retail space at the northeast corner of intersection of Brant Street and James Street (Figure 1). This development will have a driveway access on John Street, north of James Street. The trip generation for this development was taken from the TIS report entitled '421 - 431 Brant Street Transportation Impact Study, Parking Study and TDM Options Report', dated December 2016.
- **Location 5 (374 Martha Street)** is a 26-storey condominium building with 240 units and 423 square metres commercial space at the northwest corner of the intersection of Martha Street and Lakeshore Road (Figure 1). This development will have a driveway access on Martha Street. The trip generation for this development was taken from the TIS report entitled '374 Martha Street Traffic Impact Study' dated August 2014.

The total trip generation numbers are summarized in Table 5. Furthermore, the estimated peak traffic volumes for 2031 future horizon are illustrated in Figure 7. These volumes consist of future background traffic as well as the traffic generated from the approved developments.

Table 5: Trip Generation - Approved Developments

Development	Weekday AM Peak Hour			Weekday PM Peak Hour		
	In	Out	Total	In	Out	Total
<i>Bridgewater</i>	56	90	104	104	67	171
<i>Saxony</i>	10	24	34	26	18	44
<i>Berkeley</i>	249	162	411	244	319	563
<i>421-431 Brant</i>	42	73	115	71	68	139
<i>374 Martha</i>	17	63	80	60	40	100

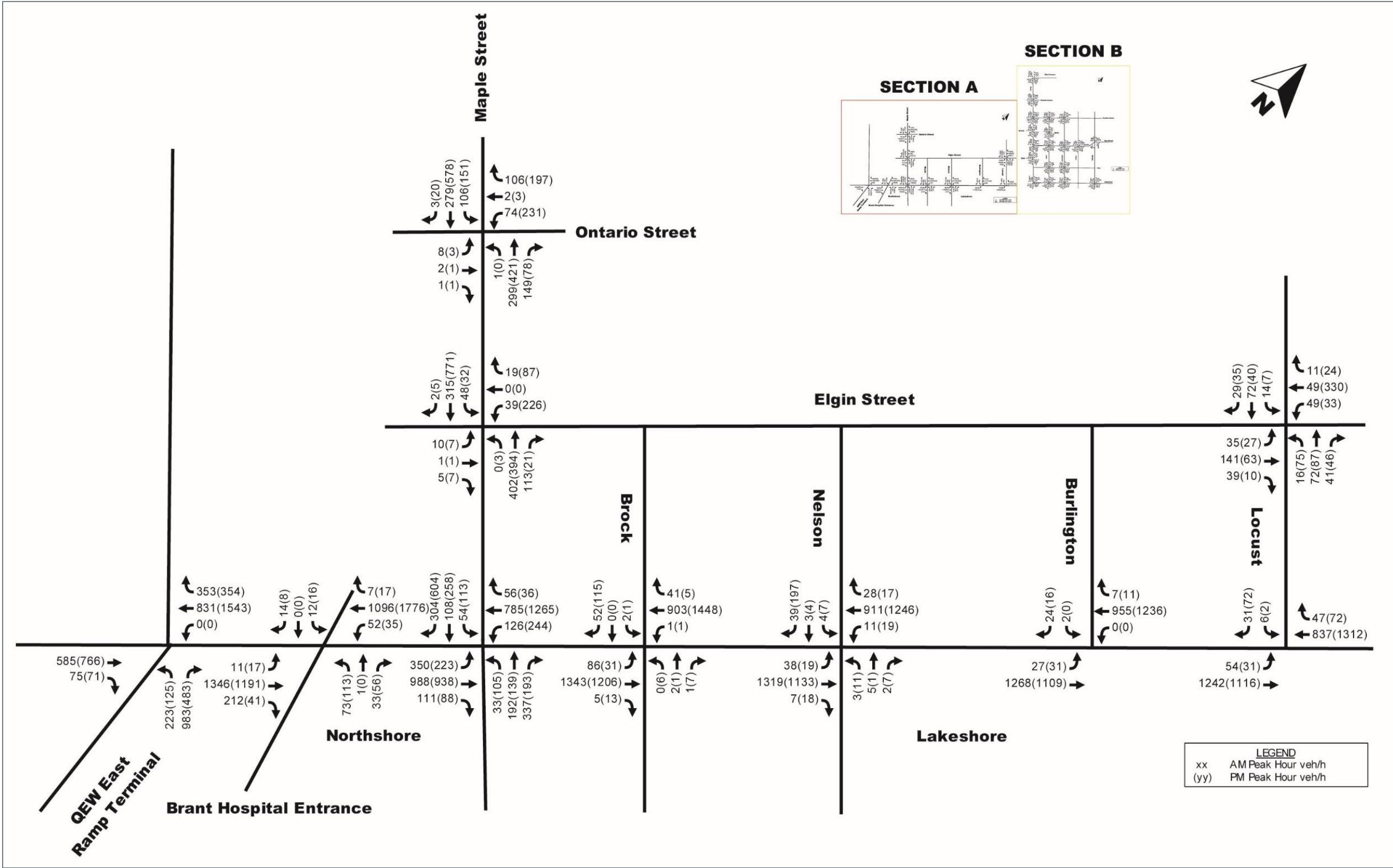


Figure 7-a: 2031 Projected Traffic Volumes (Section A)

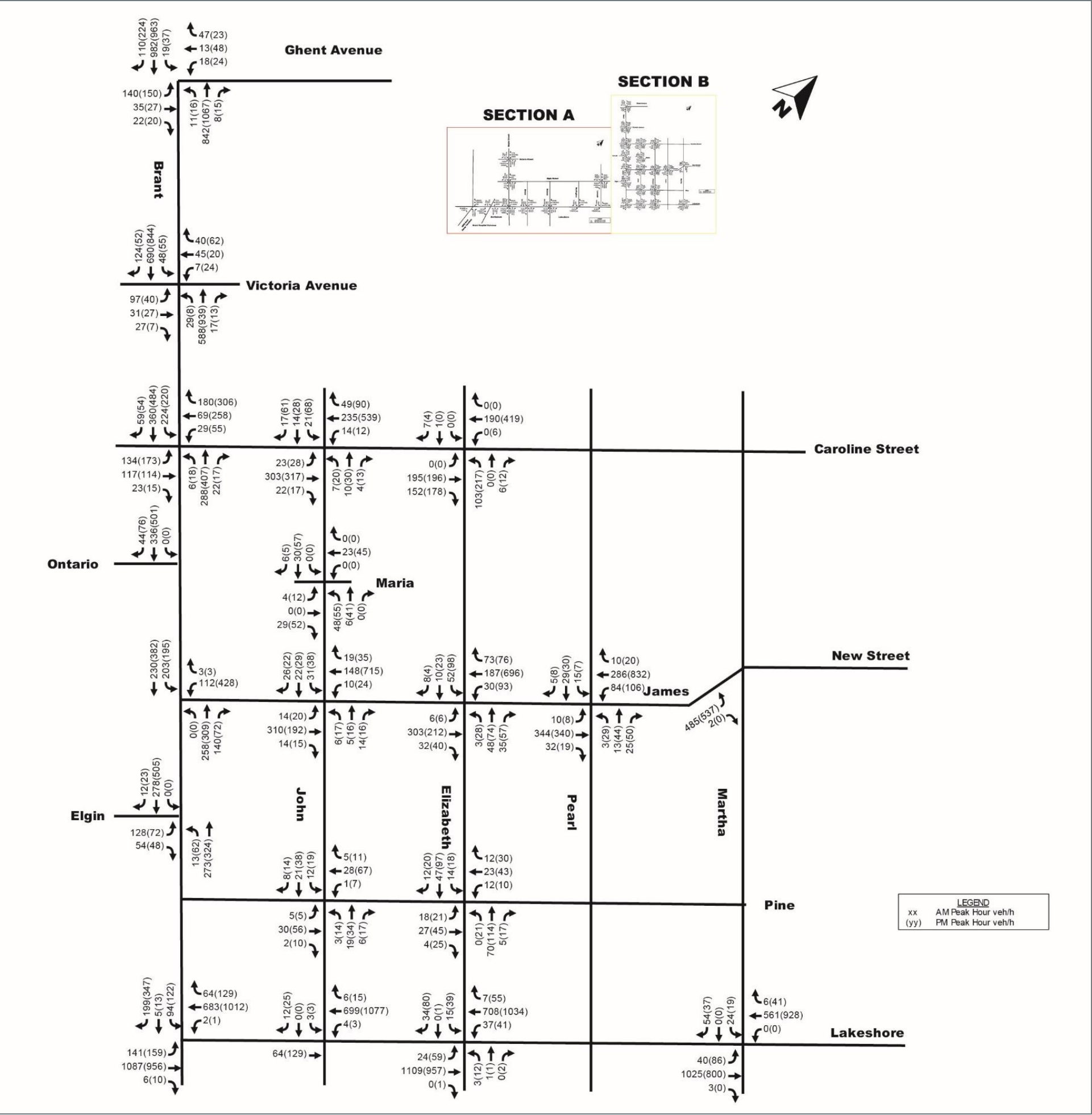


Figure 7-b: 2031 Projected Traffic Volumes (Section B)

The trips for each development were distributed using the methodology detailed in their associated TIS reports. The resulted Trip Distribution is summarized in Table 6. Moreover, the variations in trip distribution for each development is summarized in Figure 8. Each development is colour coded. Purple indicates 421 Brant Street and Berkeley developments as they share the same trip distribution pattern. Green indicates Saxony and 374 Martha Street developments as they share the same trip distribution pattern. Blue indicates the Bridgewater development as this development has a unique trip distribution.

Table 6: Trip Distribution Methodology

Travel Origin/Destination	Route	Direction Summary
GTA	West via Lakeshore Road 29%	North via Brant Street 13%
	East via New Street 2%	
Halton Region	West via Lakeshore Road 8%	East via Lakeshore Road 15%
	East via New Street 2%	
	East via Lakeshore Road 6%	
Burlington	West via Lakeshore Road 13%	West via Lakeshore Road 58%
	East via Lakeshore Road 9%	
	North via Brant Street 13%	
	West via Lakeshore Road 8%	
Hamilton Area	West via Lakeshore Road 11%	East via New Street 14%
Niagara Region	West via Lakeshore Road 1%	
Waterloo Region	West via Lakeshore Road 1%	
Brantford	West via Lakeshore Road 1%	

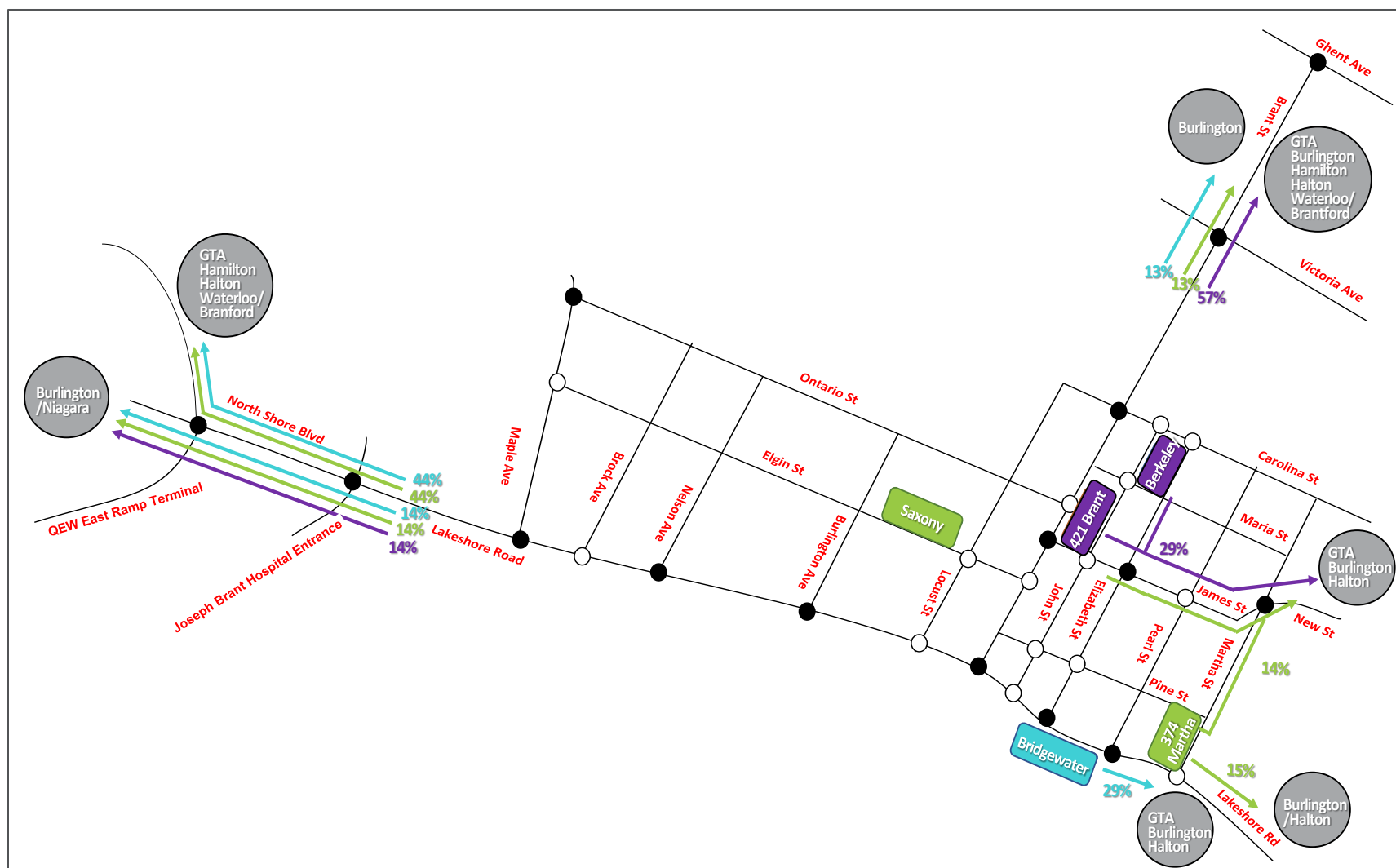


Figure 8: Trip Distribution Pattern for New Developments

3.3.2. 2031 Future Total Results

Table 7 and Table 8 summarize 2031 traffic operations for signalized and unsignalized intersections, respectively. The complete Synchro/SimTraffic reports are provided in Appendix D for future reference.

The following observations can be made from Table 7:

- **The traffic operations at majority of the signalized intersections are within the acceptable range (LOS of D or better).** Exceptions are the intersections of Brant Street & Caroline Street, Brant Street & Lakeshore Road, Lakeshore Street & Burlington Avenue, Lakeshore Street & Nelson Avenue, Lakeshore Street & Maple Avenue, and QEW East Ramp Entrance & North Shore Road.
 - Brant Street & Caroline Street Intersection operates at an overall LOS of E and V/C Ratio of 1.02 during the PM peak hour. The constrained movements during this peak period are the eastbound left-turn (LOS F & V/C 0.99), westbound through/right-turn (LOS E & V/C 1.04), northbound through/right-turn (LOS D & V/C 0.89), and southbound through/right-turn (LOS F & V/C 1.01) movements.
 - Brant Street & Lakeshore Road Intersection operates at an overall LOS of C and V/C Ratios of 0.87 and 0.85 during the AM and PM peak hours, respectively. The constrained movement during both peak periods is the eastbound through/right-turn movement (LOS C & V/C 0.98 during AM and LOS C & V/C 0.90 during PM). The 95th percentile queues reported for this movement, during both AM and PM peak periods, are expected to spill back to the upstream intersection.
 - Lakeshore Road & Burlington Avenue Intersection operates at an overall LOS of B and V/C Ratios of 0.88 and 0.86 during the AM and PM peak hours, respectively. The constrained movement during the AM peak period is the eastbound through movement (LOS C & V/C 0.97) and during the PM peak period is the westbound through/right-turn movement (LOS B & V/C 0.93).
 - Lakeshore Road & Nelson Avenue Intersection operates at an overall LOS of B and V/C Ratio of 0.88 during both AM and PM peak hours. The constrained movement during both peak periods is the eastbound through movement (LOS B & V/C 0.93 during AM and LOS B & V/C 0.88 during PM).
 - Lakeshore Road & Maple Avenue Intersection operates at an overall LOS of D and E, and a V/C ratio of 1.04 and 1.02 in the AM and PM peaks, respectively. The constrained movements in the AM peak hour are the eastbound left-turn (LOS F & V/C Ratio 1.09), the eastbound through/right-turn (LOS D & V/C 0.98), westbound left-turn (LOS E & V/C 0.90), westbound through (LOS E & V/C 0.98), and northbound through/right-turn (LOS F & V/C Ratio 1.04) movements. Similarly, in the PM peak hour the eastbound left-turn (LOS E & V/C Ratio 0.94), the eastbound through/right-turn (LOS D & V/C 1.01), westbound left-turn (LOS F & V/C 0.99), westbound through (LOS D & V/C 1.00), and southbound right-turn (LOS F & V/C Ratio 1.11) movements operate close or over the capacity. During the AM peak, the long queues are mainly reported in the eastbound and northbound

approaches; however, during the PM peak, the long queues are reported in the eastbound and westbound approaches.

- North Shore Boulevard & QEW East Ramp Terminal operates at an overall LOS of F and V/C ratio of 1.14 during the AM peak hour and LOS D and V/C 1.01 during the PM peak hour. The constrained movements in the AM peak hour are westbound through/right-turn (LOS D & V/C 0.89) and the northbound right-turn movement (LOS F & V/C Ratio of 1.36). Similarly, during the PM peak hour, the westbound through/right-turn (LOS C & V/C 1.02) and northbound right-turn (LOS F & V/C 0.99) movements are operating over the capacity. During the AM peak, the 95th percentile queue is only notable for the eastbound through/right-turn movement. However, during the PM peak, the 95th percentile queue is relatively long for the eastbound through/right-turn, northbound left-turn and northbound right-turn movements.

Table 7: Future 2031 AM & PM Intersection Performance Summary (Signalized)

Movement	AM Peak						PM Peak						
	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Storage (m)
Brant Street and Caroline Street													
EBL	134	31	C	0.69	21	37	173	85	F	0.99	26	45	45
EBT	117	19	B	0.26	17	34	114	13	B	0.14	16	37	75
EBR	23	17	B	0.02	6	17	15	12	B	0.02	3	11	15
WBL	29	27	C	0.21	9	24	55	19	B	0.16	15	36	20
WBT/R	247	34	C	0.63	30	48	564	77	E	1.04	57	65	200
NBL	6	24	C	0.05	1	6	18	27	C	0.16	5	17	30
NBT/R	310	32	C	0.55	38	66	424	50	D	0.89	66	107	240
SBL	224	16	B	0.66	25	45	220	95	F	1.01	41	79	340
SBT/R	419	12	B	0.44	39	76	538	29	C	0.8	83	141	340
TOTAL	1509	24	C	0.67	-	-	2121	56	E	1.02	-	-	-
Brant Street and James Street													
WBL	112	31	C	0.50	17	31	428	34	C	0.82	43	53	45
WBR	94	27	C	0.09	11	21	313	19	B	0.26	24	45	100
NBT	258	9	A	0.31	20	46	309	19	B	0.51	37	61	220
NBR	140	8	A	0.16	13	23	72	14	B	0.12	10	23	10
SBL	203	10	B	0.39	17	28	195	26	C	0.64	22	30	25
SBT	230	8	A	0.27	16	41	382	20	B	0.54	42	56	230
TOTAL	1037	13	B	0.39	-	-	1699	23	C	0.68	-	-	-
Brant Street and Lakeshore Road													
EBL	141	9	A	0.39	27	63	159	42	D	0.73	37	72	50
EBT/R	1093	27	C	0.98	70	112	966	27	C	0.90	82	99	65
WBL	2	8	A	0.12	1	59	1	9	A	0.05	0	1	25
WBT/R	747	7	A	0.37	32	49	1141	13	B	0.63	58	71	110

Movement	AM Peak						PM Peak						
	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Storage (m)
NBL/T/R	20	39	D	0.11	5	14	13	38	D	0.11	3	12	80
SBL	94	45	D	0.55	29	62	122	44	D	0.53	76	135	220
SBT/R	204	40	D	0.19	20	28	360	53	D	0.75	23	25	15
TOTAL	2301	21	C	0.87	-	-	2762	26	C	0.85	-	-	-
Elizabeth Street and James Street													
EBL	6	4	A	0.05	2	9	6	7	A	0.06	2	8	15
EBT/R	335	6	A	0.34	21	41	252	7	A	0.25	17	35	105
WBL	30	4	A	0.07	5	17	93	7	A	0.16	21	55	40
WBT/R	260	6	A	0.42	16	33	772	19	B	0.85	71	117	260
NBL/T/R	86	23	C	0.27	14	26	159	31	C	0.6	23	46	155
SBL/T/R	70	28	C	0.59	13	25	125	44	D	0.81	22	40	240
TOTAL	787	11	B	0.46	-	-	1407	21	C	0.84	-	-	-
Lakeshore Road and Elizabeth Street													
EBL	24	1	A	0.11	3	13	59	3	A	0.22	6	15	80
EBT/R	1109	4	A	0.79	25	42	958	5	A	0.68	23	40	100
WBL	37	4	A	0.28	7	20	41	7	A	0.44	25	66	30
WBT/R	715	2	A	0.28	24	51	1089	3	A	0.42	100	132	90
NBL/T/R	4	46	D	0.06	2	10	15	48	D	0.18	27	65	15
SBL	15	47	D	0.24	3	11	39	50	D	0.38	11	23	25
SBT/R	34	46	D	0.04	7	18	81	47	D	0.10	17	41	80
TOTAL	1938	5	A	0.73	-	-	2282	7	A	0.64	-	-	-
Lakeshore Road and Pearl Street													
EBL	31	1	A	0.11	3	11	45	1	A	0.16	6	15	50
EBT/R	1085	3	A	0.77	31	74	897	2	A	0.65	20	45	90
WBL	1	1	A	0.01	0	3	3	2	A	0.02	1	8	20
WBT/R	622	2	A	0.23	13	32	978	3	A	0.36	89	135	285
NBL/T	3	47	D	0.05	2	8	52	58	E	0.62	33	91	270
NBR	1	47	D	0.00	1	5	6	46	D	0.01	2	10	15
SBL	10	48	D	0.18	3	10	29	49	D	0.24	7	18	15
SBT/R	31	47	D	0.06	6	14	86	47	D	0.16	51	129	95
TOTAL	1784	4	A	0.72	-	-	2096	8	A	0.65	-	-	-
Brant Street & Ghent Avenue													
EBL/T	175	39	D	0.69	30	50	177	38	D	0.71	31	55	300
EBR	22	27	C	0.02	8	25	20	26	C	0.02	5	18	25
WBL/T/R	78	29	C	0.21	12	23	95	28	C	0.27	17	33	500
NBL	11	7	A	0.09	4	15	16	6	A	0.18	5	14	45
NBT/R	850	10	B	0.48	34	60	1082	8	A	0.56	25	47	285
SBL	19	7	A	0.09	6	23	37	10	B	0.22	9	26	30

Movement	AM Peak						PM Peak						
	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Storage (m)
SBT/R	1092	11	B	0.57	218	343	1187	14	B	0.67	156	281	125
TOTAL	2247	14	B	0.60	-	-	2614	14	B	0.68	-	-	-
Brant Street & Victoria Avenue													
EBL	97	39	D	0.56	16	27	40	38	D	0.35	9	20	20
EBT/R	58	33	C	0.18	11	27	34	37	D	0.23	6	16	180
WBL	7	32	C	0.08	2	7	24	37	D	0.19	5	14	30
WBT/R	85	35	D	0.43	12	23	82	37	D	0.31	12	24	340
NBL	29	5	A	0.11	7	19	8	5	A	0.05	3	13	15
NBT/R	605	8	A	0.51	49	86	952	16	B	0.82	77	120	340
SBL	48	6	A	0.13	14	41	55	5	A	0.36	12	30	50
SBT	690	9	A	0.59	69	96	844	5	A	0.68	34	62	185
SBR	124	8	A	0.11	22	58	52	0	A	0.05	3	10	60
TOTAL	1743	13	B	0.58	-	-	2091	13	B	0.76	-	-	-
Lakeshore Street & Burlington Avenue													
EBL	27	2	A	0.12	10	43	31	10	A	0.5	8	30	75
EBT	1268	23	C	0.97	48	151	1109	10	A	0.81	39	125	205
WBT/R	962	7	A	0.72	20	64	1247	19	B	0.93	83	122	265
SBL/R	26	46	D	0.06	7	19	16	52	D	0.01	5	13	150
TOTAL	2283	16	B	0.88	-	-	2403	15	B	0.86	-	-	-
Lakeshore Street & Nelson Avenue													
EBL	38	1	A	0.12	5	18	19	2	A	0.10	4	10	30
EBT	1319	20	B	0.93	41	90	1133	17	B	0.88	46	93	200
EBR	7	2	A	0.01	0	2	18	1	A	0.02	1	5	200
WBL	11	7	A	0.17	3	13	19	6	A	0.27	8	25	25
WBT/R	939	5	A	0.38	28	61	1263	5	A	0.53	68	102	205
NBL/T/R	10	50	D	0.19	2	7	19	43	D	0.1	3	36	10
SBL/T/R	46	50	D	0.17	9	24	208	77	E	0.87	56	114	170
TOTAL	2370	14	B	0.88	-	-	2679	17	B	0.88	-	-	-
Lakeshore Street & Maple Avenue													
EBL	350	93	F	1.09	153	190	223	71	E	0.94	125	229	170
EBT/R	1099	36	D	0.98	244	252	1026	53	D	1.01	247	254	240
WBL	126	69	E	0.90	34	44	244	89	F	0.99	33	48	30
WBT	841	56	E	0.98	95	135	1301	51	D	1.00	108	158	190
NBL	33	22	C	0.11	49	144	105	32	C	0.47	22	63	120
NBT/R	529	88	F	1.04	394	605	332	51	D	0.80	81	145	500
SBL	54	28	C	0.47	11	24	113	37	D	0.63	27	62	60
SBT	108	26	C	0.20	18	36	258	39	D	0.55	193	299	345
SBR	304	26	C	0.21	29	51	604	124	F	1.11	190	327	345

Movement	AM Peak						PM Peak						
	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Storage (m)
TOTAL	3444	55	D	1.04	-	-	4206	63	E	1.02	-	-	-
North Shore Blvd. E & Brant Hospital Entrance													
EBL	11	9	A	0.09	8	48	17	22	C	0.41	30	88	55
EBT/R	1558	18	B	0.80	117	125	1232	9	A	0.57	119	127	210
WBL	52	9	A	0.33	8	19	35	3	A	0.15	4	15	70
WBT/R	1103	4	A	0.47	34	60	1793	3	A	0.77	32	59	240
NBL	73	48	D	0.62	16	30	113	58	E	0.73	24	106	100
NBR	33	39	D	0.03	18	71	56	42	D	0.06	12	117	100
SBL/T	12	40	D	0.10	5	16	16	42	D	0.10	4	32	20
SBR	14	39	D	0.01	3	8	8	41	D	0.01	2	7	20
TOTAL	2856	15	B	0.75	-	-	3270	9	A	0.79	-	-	-
North Shore Blvd. E & QEW East Ramp Terminal													
EBT/R	660	23	C	0.52	273	560	837	13	B	0.46	802	1300	280
WBT/R	1184	36	D	0.89	17	42	1897	35	C	1.02	37	67	320
NBL	223	16	B	0.33	627	633	125	35	C	0.31	374	727	680
NBR	983	196	F	1.36	627	632	483	84	F	0.99	514	755	680
TOTAL	3050	83	F	1.14	-	-	3342	36	D	1.01	-	-	-
Maple Avenue & Ontario Street													
EBL/T/R	11	11	B	0.05	2	6	15	23	C	0.04	2	111	10
WBL	74	12	B	0.30	8	13	226	40	D	0.74	44	56	45
WBT/R	108	11	B	0.10	9	8	87	45	D	0.15	148	203	390
NBL	1	7	A	0.01	0	0	3	0	A	0	16	0	30
NBT/R	448	8	A	0.34	16	3	415	9	A	0.28	21	19	345
SBL	106	9	A	0.40	14	11	32	12	B	0.4	27	17	30
SBT/R	282	8	A	0.26	14	0	776	9	A	0.31	112	141	470
TOTAL	1030	9	A	0.36	-	-	1554	18	B	0.5	-	-	-
Martha Street & New Street													
WBL	388	3	A	0.32	9	31	955	7	A	0.75	86	272	550
WBR	49	2	A	0.04	0	5	84	1	A	0.09	6	24	30
NBR	485	3	A	0.35	6	19	537	3	A	0.41	6	18	260
SBL	11	34	C	0.22	3	10	13	45	D	0.29	4	12	20
SBT	5	33	C	0.09	1	6	5	43	D	0.14	2	10	190
TOTAL	938	3	A	0.35	-	-	1594	6	A	0.73	-	-	-

The following observations can be made from Table 8:

- The traffic operation at almost all unsignalized intersections is within the acceptable range (LOS D or better) under the 2031-With Developments conditions. The only exception is:

- James Street and Pearl Street intersection which its total delay is slightly more than the threshold for the LOS F.
- Other intersections with constrained movements are Caroline Street & John Street, John Street & James Street, Caroline Street & Elizabeth Street, Lakeshore Road & Brock Avenue, Lakeshore Road & John Street, Lakeshore Road & Martha Street, Lakeshore Road & Locust Street, and Maple Avenue & Elgin Street, all of which are two way stop-controlled intersections. At these intersections some movements from the minor streets operate at a poor level of service (E or F) during the AM and/or PM peak hours. It is noteworthy that these movements have relatively low traffic volumes compared to the adjacent main street and therefore their operations are of lower priority;
- The reported 95th percentile queue lengths for only 4 turning movements slightly exceed their available storage lengths.

The traffic operations at the study intersections for the future 2031 traffic condition are reflective of an urban environment such as the downtown area. Moreover, the projected traffic congestion for some of the turning movements are mainly due to the background traffic growth rather than the additional traffic generated from the new developments. It should also be noted that reported traffic conditions are only reflective of the peak hours.

Finally, Traffic warrants were conducted for all unsignalized intersections to confirm whether signalization is appropriate. The results of the warrant analysis are presented in Section 4.

Table 8: Future 2031 AM & PM Intersection Performance Summary (Unsignalized)

Movement	AM Peak						PM Peak						
	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Storage (m)
Caroline Street and John Street													
EBL	23	8	A	0.03	2	8	28	9	A	0.05	3	10	20
WBL	14	8	A	0.02	1	5	12	8	A	0.02	6	30	35
NBL/T/R	21	17	C	0.11	4	11	63	75	F	0.74	13	28	90
SBL/T	35	17	C	0.19	7	16	96	182	F	1.19	19	35	145
SBR	17	0	A	0.00	4	12	61	0	A	0.00	11	24	40
TOTAL	718	2	A	0.19	-	-	1223	18	C	0.42	-	-	-
Maria Street and John Street													
EBL/T/R	33	7	A	-	6	14	64	8	A	-	11	20	50
WBL/T/R	23	8	A	-	4	12	45	8	A	-	7	14	40
NBL/T/R	54	9	A	-	11	21	96	8	A	-	10	17	130
SBL/T/R	36	8	A	-	7	16	62	8	A	-	9	17	90
TOTAL	146	8	A	-	-	-	267	8	A	-	-	-	-
John Street and James Street													
WBL	10	9	A	0.02	1	4	24	8	A	0.03	3	14	20
NBL/T/R	25	16	C	0.08	4	16	49	148	F	0.92	8	21	100
SBL/T/R	79	16	C	0.27	7	14	89	191	F	1.11	10	20	130
TOTAL	340	7	A	0.18	-	-	1139	24	C	0.48	-	-	-

Movement	AM Peak						PM Peak						
	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Storage (m)
Lakeshore Road and John Street													
EBL	11	11	B	0.03	1	6	15	16	C	0.08	2	8	10
NBL/T/R	15	735	F	1.61	4	12	3	NR	F	7.16	1	6	15
SBL/T/R	15	NR	F	5.59	3	11	28	NR	F	NR	7	18	60
TOTAL	1922	NR	C	0.72	-	-	2206	NR	C	0.66	-	-	-
Caroline Street and Elizabeth Street													
NBL/T/R	109	24	C	0.55	11	17	229	99	F	1.02	161	193	240
SBT/R	8	11	B	0.03	2	8	4	11	B	0.01	1	6	200
TOTAL	658	4	A	0.29	-	-	1032	22	C	0.44	-	-	-
James Street and Pearl Street													
EBL	10	8	A	0.01	1	5	8	10	B	0.02	1	5	45
WBL	84	9	A	0.09	6	14	106	9	A	0.12	8	19	50
NBL/T/R	41	20	C	0.21	6	14	123	524	F	1.90	21	47	155
SBL/T/R	49	32	D	0.37	8	14	45	259	F	1.10	11	23	245
TOTAL	856	4	A	0.23	-	-	1493	52	F	0.59	-	-	-
Lakeshore Road and Martha Street													
EBL	40	9	A	0.05	4	12	86	12	B	0.16	10	23	50
SBL/R	78	NR	F	NR	11	24	56	288	F	1.25	17	48	280
TOTAL	1710	NR	C	0.65	-	-	1911	13	C	0.69	-	-	-
Brant Street and Elgin Street													
EBL/R	182	19	C	0.49	13	23	120	30	D	0.50	15	32	75
TOTAL	848	7	A	0.24	-	-	1329	6	A	0.27	-	-	-
Brant Street and Ontario Street													
EBL/R	102	12	B	0.21	13	24	82	16	C	0.22	13	26	75
TOTAL	790	5	A	0.17	-	-	1221	6	A	0.32	-	-	-
Lakeshore Road & Locust Street													
EBL	54	10	B	0.11	11	42	31	12	B	0.08	9	33	170
SBL/R	37	500	F	NR	7	14	74	313	F	1.30	26	85	140
TOTAL	2217	NR	D	0.75	-	-	2605	10	C	0.70	-	-	-
Lakeshore Road & Brock Avenue													
EBL	86	13	B	0.18	7	18	31	17	C	0.11	5	14	25
WBL	1	17	C	0.01	0	1	1	15	B	0.01	92	5	30
NBL/T/R	3	NR	F	1.41	1	4	14	495	F	1.26	11	36	20
SBL/T/R	54	NR	F	NR	11	23	116	637	F	2.08	25	43	185
TOTAL	2436	28	D	0.63	-	-	2834	30	D	0.75	-	-	-
Maple Avenue & Elgin Street													
EBL/T/R	16	18	C	0.11	1	6	15	31	D	0.18	53	111	10
WBL	39	26	D	0.23	6	13	226	225	F	1.34	39	56	40

Movement	AM Peak						PM Peak						
	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Volume (veh/hr)	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Storage (m)
WBT/R	19	11	B	0.04	3	8	87	11	B	0.15	87	203	135
NBL	0	0	A	0.00	-	-	3	9	A	0.00	-	3	120
SBL	48	9	A	0.13	4	11	32	9	A	0.33	3	17	100
TOTAL	954	2	A	0.14	-	-	1554	34	D	0.34	-	-	-
Pine Street & John Street													
EBL/T/R	37	8	A	-	7	15	71	8	A	-	9	16	50
WBL/T/R	34	8	A	-	7	16	85	8	A	-	9	16	40
NBL/T/R	28	8	A	-	7	19	65	8	A	-	10	19	50
SBL/T/R	41	8	A	-	8	18	71	8	A	-	10	18	50
TOTAL	140	8	A	-	-	-	292	8	A	-	-	-	-
Elgin Street & Locust Street													
EBL/T/R	215	12	B	-	13	20	100	11	B	-	11	18	170
WBL/T/R	109	10	A	-	10	15	387	23	C	-	19	33	75
NBL/T/R	129	10	A	-	10	16	208	14	B	-	13	21	145
SBL/T/R	115	10	A	-	11	17	82	11	B	-	10	18	120
TOTAL	568	11	B	-	-	-	777	18	C	-	-	-	-
Pine Street & Elizabeth Street													
EBL/T/R	49	8	A	-	8	15	91	9	A	-	9	13	40
WBL/T/R	47	8	A	-	7	13	83	9	A	-	9	16	100
NBL/T/R	75	8	A	-	10	17	152	10	A	-	11	17	85
SBL/T/R	73	8	A	-	10	16	135	9	A	-	11	17	155
TOTAL	244	8	A	-	-	-	461	9	A	-	-	-	-

3.4. Comparison of Results

The impacts of the new developments on the traffic operation of the study intersections are outlined below in Figure 9-a and Figure 9-b. In these figures, the traffic operations at study intersections are compared for 2 scenarios (2031-without developments Vs. 2031-with developments). The boxes in blue represent the performance measures associated with the 2031-Without Developments Scenario and the boxes in red represent the performance measures associated with the 2031-With Developments Scenario. For each intersection and during each peak period, 2 measures are provided. The numbers in the top boxes indicate the intersection delay and the letters in the bottom boxes indicate the LOS categories (LOS E and LOS F are highlighted in red).

The following observation can be made from Figure 9-a and Figure 9-b:

- **The increase in delay and LOS for majority of study intersections is relatively minimal.** Exceptions are:
 - Brant Street & Caroline Street Intersection: Increase in the overall delay during the PM peak hour (change from LOS C to LOS E) due to the increase in the traffic volume for through and left turn movements generating from the approved developments. Under this

condition, less capacity will be available to the left-turning movements (i.e., SBL and EBL) which are the constrained movements at this intersection.

- James and Pearl Street Intersection: Increase in the overall delay during the PM peak hour (change from LOS C to LOS F) due to the increase in the through movement volumes on the main street. Under this scenario, there will be less gaps available in traffic for the side streets, which are the constrained movements at this intersection. **It is noteworthy that side street (i.e., Pearl Street) turning movement counts have relatively low traffic volumes compared to the main street (i.e., James Street) and therefore their operations are of lower priority.**
- Lakeshore Road and Brock Avenue Intersection: Increase in the overall delay during the PM peak hour (change from LOS A to LOS D) due to the increase in through movement volumes on the main street. Under this traffic condition, there will be less gaps available in traffic for the side streets, which are the constrained movements at this intersection. **It is noteworthy that side street (i.e., Brock Street) turning movement counts have relatively low traffic volumes compared to the main street (i.e., Lakeshore Road) and therefore their operations are of lower priority.**
- North Shore Blvd. E & QEW East Ramp Terminal: Increase in the overall delay for both peak hours (AM: change from LOS E to F and PM: change from LOS B to D) due to the additional traffic volume at the intersection. The increase in traffic volumes causes the westbound through movement to reach capacity which in turn results in an increase in the overall intersection delay.

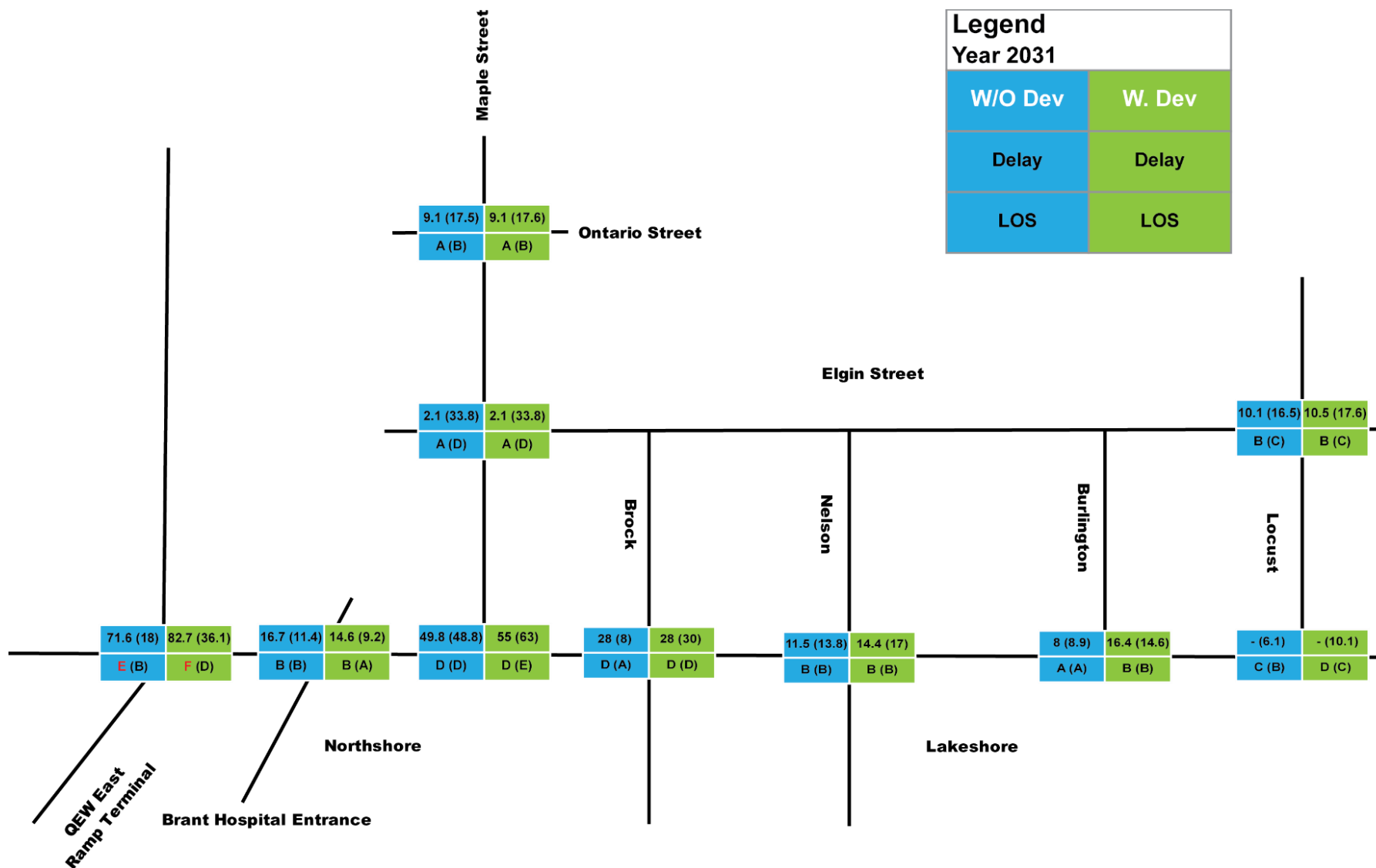
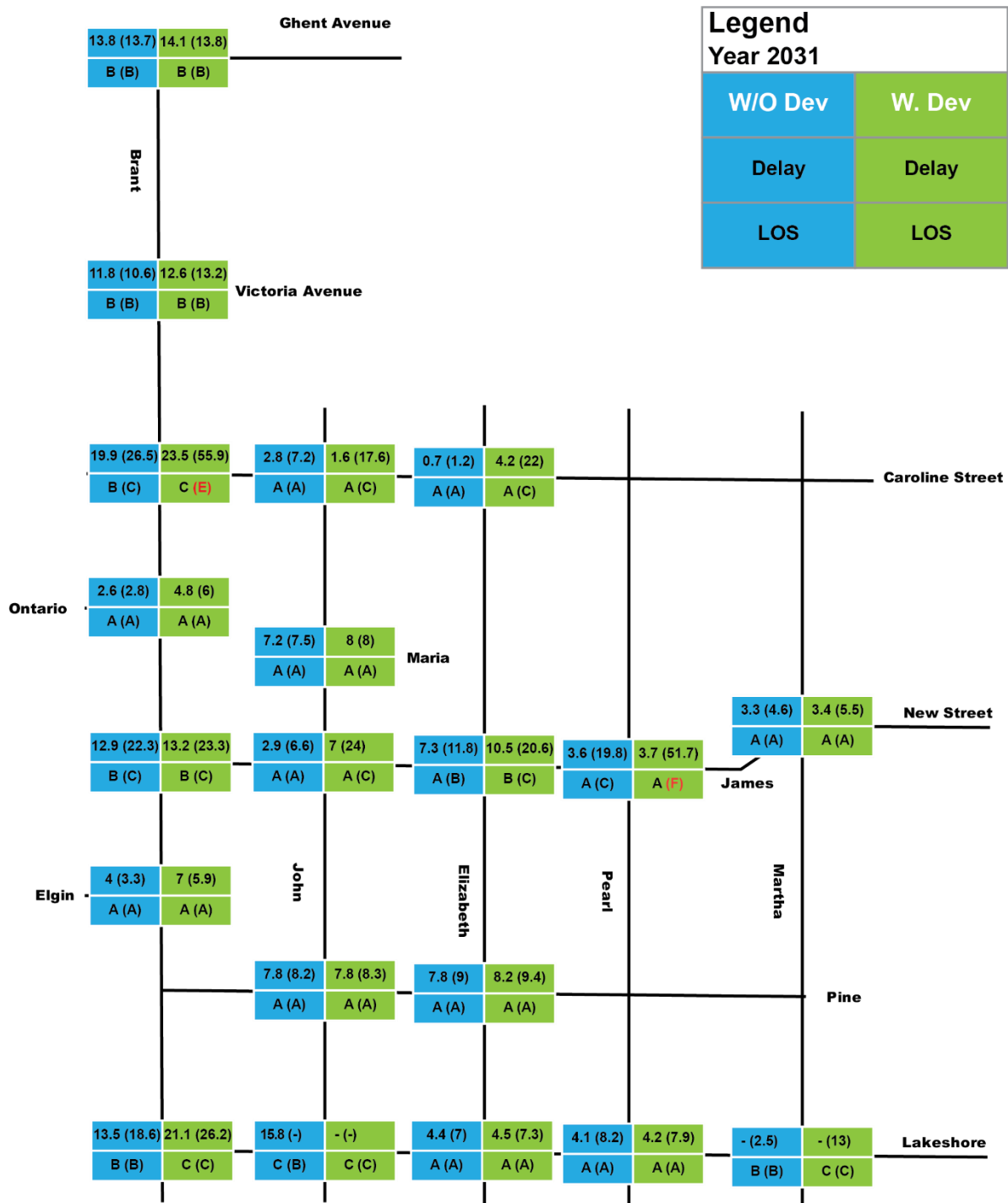


Figure 9-a: Change in Traffic Operation across the Study Network (Section A)
(2031-With Developments Vs. 2031-Without Developments)



4. Traffic Signal Warrants for Unsignalized Intersections

The need for the installation of traffic signal at the un-signalized intersections was reviewed following the OTM Book 12 methodology for Projected Volumes. According to the provided guidelines in this manual, the signal justification for future conditions is based on the use of Justification 7 which considers an analysis using average hour volumes rather than eight-hour volumes. Due to the increased uncertainty generated by the use of average values, the OTM Book 12 methodology increases the required thresholds for traffic signals by 20% (i.e., 120%) when both intersecting roads already exist.

The calculated compliance rates for the study intersections are presented in Figure 10 and indicate that signalization is not yet warranted at the intersections within the study area. It should be noted that in a recent study conducted by CIMA+ the signalization of John Street & James Street Intersection is recommended for safety reasons.

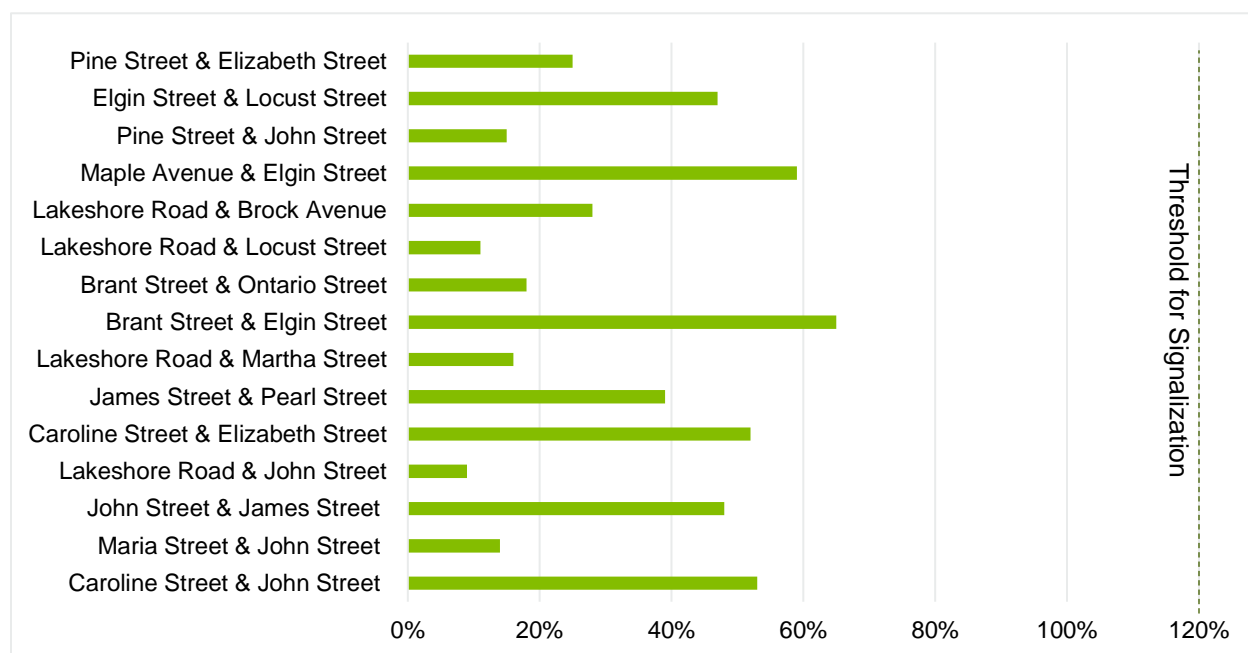


Figure 10: Traffic Signal Justification for the Un-Signalized Intersections (2031-With Developments Scenario)

4.1.1. Recommendations

Based on the operational performance of the study intersections under the 2031-With Developments Scenario, the following network improvements are recommended:

- Consider extending the storage lane at the following locations:
 - Brant St. & James St. Intersection: The left turn storage lane for the SB approach can be extended up to the upstream intersection providing 40 meters of storage length,
 - Elizabeth St. & James St. Intersection: The left turn storage lane for the WB approach can be extended to provide 60 meters of storage length,

- Elizabeth St. & Lakeshore Rd. Intersection: The left turn storage lane for the SB approach can be extended to provide 30 meters of storage length,
 - J. Brant Hospital Driveway & Lakeshore Rd Intersection: The left turn storage lane for the EB approach can be extended to provide 50 meters of storage length,
 - Maple Ave & Lakeshore Rd/North Shore Blvd Intersection: The left turn storage lane for the NB approach can be extended to provide 150 meters of storage length;
- Consider providing signal coordinating along North Shore Boulevard and Lakeshore Road (by setting equal cycle lengths and optimised offsets for signalized intersections along this corridor (Specifically the Cycle length for the Northshore Boulevard & QEW East Ramp Terminal during the AM peak period should be increased to 110 seconds to accommodate coordination along this corridor); and

5. Conclusions

A traffic operational analysis of the downtown area was conducted to investigate traffic operations for the expanded study area in 2019 existing conditions and a future 2031 horizon year to consider the additional volumes generated by the approved developments.

The following observations were made:

- Under the 2019 existing conditions, the traffic operations at almost all signalized intersections are within the acceptable range (LOS D or better) under the existing conditions, with the majority having an overall LOS of A or B. The exceptions are the intersections of QEW East Ramp Entrance & North Shore Road and Lakeshore Road & Maple Avenue;
- Under the 2019 existing conditions, 95th percentile queues along the Lakeshore Road are relatively long and, in some cases, extend to the upstream intersection. This is due to the heavy eastbound and westbound volumes along this corridor during the AM and PM peak period;
- Under the 2019 existing conditions, the traffic operation at all unsignalized intersections is within the acceptable range (LOS D or better). Intersections with Constrained movements are Lakeshore Road & John Street, James Street & Pearl Street, Lakeshore Road & Martha Street, Lakeshore Road & Locust Street, Lakeshore Road & Brock Avenue, and Maple Avenue & Elgin Street, all of which are two way stop-controlled intersections. At these intersections some movements from the minor streets operate at a poor level of service (E or F) during the AM and/or PM peak hours. It is noteworthy that these movements have relatively low traffic volumes compared to the adjacent main street and therefore their operation is of lower priority;
- Under the 2031-With Developments conditions, the traffic operations at majority of the signalized intersections are within the acceptable range (LOS of D or better). The exceptions are the intersections of Brant Street & Caroline Street, Brant Street & Lakeshore Road, Lakeshore Street & Burlington Avenue, Lakeshore Street & Nelson Avenue, Lakeshore Street & Maple Avenue, and QEW East Ramp Entrance & North Shore Road;
- Under the 2031-With Developments conditions, the traffic operation at almost all unsignalized intersections is within the acceptable range (LOS D or better). The only exception is James Street & Pearl Street. Other intersections with Constrained movements are Caroline Street & John Street, John Street & James Street, Caroline Street & Elizabeth Street, James Street &

Pearl Street, Lakeshore Road & Brock Avenue, Lakeshore Road & Locust Street, Lakeshore Road & Martha Street, and Lakeshore Road & John Street, and Maple Avenue & Elgin Street, all of which are two way stop-controlled intersections. At these intersections some movements from the minor streets operate at a poor level of service (E or F) during the AM and/or PM peak hours. It is noteworthy that these movements have relatively low traffic volumes compared to the adjacent main street and therefore their operation is of lower priority;

- Considering the geometric limitations at the downtown area, the extension of the storage lane at the following locations is recommended:
 - Brant St. & James St. Intersection: The left turn storage lane for the SB approach can be extended up to the upstream intersection providing 40 meters of storage length,
 - Elizabeth St. & James St. Intersection: The left turn storage lane for the WB approach can be extended to provide 60 meters of storage length,
 - Elizabeth St. & Lakeshore Rd. Intersection: The left turn storage lane for the SB approach can be extended to provide 30 meters of storage length,
 - J. Brant Hospital Driveway & Lakeshore Rd Intersection: The left turn storage lane for the EB approach can be extended to provide 50 meters of storage length,
 - Maple Ave & Lakeshore Rd/North Shore Blvd Intersection: The left turn storage lane for the NB approach can be extended to provide 150 meters of storage length; and
- Based on the operational performance of the intersections along the Lakeshore Road, the extension of signal coordinating along North Shore Boulevard and Lakeshore Road is recommended (specifically the cycle length for the Northshore Boulevard & QEW East Ramp Terminal during the AM peak period should be increased to 110 seconds to accommodate coordination along this corridor).

Overall, the increase in traffic, as a result of the approved developments, can be accommodated within the existing road network, much of the congestion that may appear in the network is due to regular background growth (rather than the additional traffic generated from the approved developments). There are physical limitations of the downtown (short blocks) that prevent extended storage lengths from being implemented. Further monitoring is recommended to ensure that the traffic operation across the downtown area remains within the acceptable range and also identify if additional corrective measures are required.

A

Appendix A



B

Appendix B





Appendix C



Background 2031 AM & PM Intersection Performance Summary (Signalized)

Movement	AM Peak						PM Peak						
	Volume	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Volume	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Storage (m)
Brant Street and Caroline Street													
EBL	134	24.5	C	0.58	23	38	173	26.8	C	0.71	21	37	45
EBT	117	19.2	B	0.26	19	33	114	13	B	0.14	12	28	75
EBR	23	17.3	B	0.02	4	16	15	11.9	B	0.02	3	12	15
WBL	29	27.9	C	0.22	9	20	55	19.4	B	0.16	13	31	20
WBT/R	249	30.2	C	0.44	22	40	382	30.3	C	0.71	40	57	200
NBL	6	19.2	B	0.04	1	9	18	22.9	C	0.12	3	12	30
NBT/R	245	24.3	C	0.36	27	49	369	33.4	C	0.7	40	73	240
SBL	82	10.7	B	0.23	11	24	81	22.3	C	0.39	25	82	340
SBT/R	385	11.5	B	0.41	33	62	473	23.6	C	0.71	80	213	340
TOTAL	1270	19.9	B	0.49	-	-	1680	26.5	C	0.75	-	-	-
Brant Street and James Street													
WBL	101	30.8	C	0.47	17	33	414	33	C	0.81	42	55	45
WBR	94	27.7	C	0.09	12	21	313	19.8	B	0.26	24	50	100
NBT	235	8.1	A	0.28	15	36	293	17.7	B	0.47	33	73	220
NBR	131	7.1	A	0.14	12	25	59	13.2	B	0.09	8	20	10
SBL	203	9.4	A	0.37	18	26	195	23.3	C	0.61	19	32	25
SBT	197	7.5	A	0.23	13	33	312	17	B	0.42	40	54	230
TOTAL	961	12.9	B	0.37	-	-	1586	22.3	C	0.66	-	-	-
Brant Street and Lakeshore Road													
EBL	135	2.6	A	0.32	16	42	149	17.9	B	0.58	47	75	50
EBT/R	1016	11.8	B	0.89	60	104	837	15	B	0.73	81	106	65
WBL	2	5.4	A	0.07	0	2	1	6.1	A	0.02	0	2	25
WBT/R	644	5.6	A	0.32	25	48	1066	9.6	A	0.55	55	77	110
NBL/T/R	20	40	D	0.11	6	15	13	42.1	D	0.15	11	36	80
SBL	83	44.7	D	0.52	18	35	105	47.8	D	0.56	38	95	220
SBT/R	171	40.5	D	0.17	18	28	305	48.9	D	0.6	19	31	15
TOTAL	2071	13.5	B	0.80	-	-	2476	18.6	B	0.7	-	-	-
Elizabeth Road and James Street													
EBL	6	2.7	A	0.03	1	7	6	3.7	A	0.02	2	7	15
EBT/R	311	3.8	A	0.29	17	38	229	4.5	A	0.21	13	29	105
WBL	30	2.8	A	0.06	4	12	93	4.3	A	0.13	10	34	40
WBT/R	175	3.1	A	0.16	7	19	676	8.1	A	0.6	62	116	260
NBL/T/R	51	26	C	0.16	7	15	125	36.6	D	0.59	26	58	155
SBL/T/R	23	25.8	C	0.14	5	13	32	33.2	C	0.11	10	23	240
TOTAL	596	7.3	A	0.26	-	-	1161	11.8	B	0.59	-	-	-

Movement	AM Peak						PM Peak						
	Volume	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Volume	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Storage (m)
Lakeshore Road and Elizabeth Street													
EBL	24	0.5	A	0.03	2	9	59	3.1	A	0.6	5	15	80
EBT/R	1055	3.2	A	0.29	20	39	846	2.2	A	0	23	44	100
WBL	2	1.6	A	0.06	0	3	7	2.2	A	0.06	1	6	30
WBT/R	596	1.9	A	0.16	17	38	984	2.8	A	0.38	63	115	90
NBL/T/R	4	45.7	D	0.16	1	6	15	47.5	D	0.18	6	18	15
SBL	15	47.3	D	0.14	4	11	39	49.9	D	0.38	7	19	25
SBT/R	34	45.5	D	0.26	6	16	81	46.7	D	0.1	29	73	80
TOTAL	1730	4.4	A	0.7	-	-	2031	7	A	0.57	-	-	-
Lakeshore Road and Pearl Street													
EBL	31	0.5	A	0.1	5	25	45	1.5	A	0.15	4	12	50
EBT/R	1045	2.7	A	0.74	30	74	840	2.7	A	0.61	18	46	90
WBL	1	1.4	A	0.01	6	18	3	2.3	A	0.02	41	88	20
WBT/R	567	1.7	A	0.21	1	6	921	3.4	A	0.34	33	84	285
NBL/T	3	47	D	0.05	0	3	52	57.6	E	0.61	9	24	270
NBR	1	46.6	D	0	2	7	6	46.1	D	0.01	0	3	15
SBL	10	48.2	D	0.18	2	7	29	48.4	D	0.24	4	13	15
SBT/R	31	47	D	0.06	5	12	86	47.3	D	0.16	18	42	95
TOTAL	1689	4.1	A	0.69	-	-	1982	8.2	A	0.61	-	-	-
Brant Street & Ghent Avenue													
EBL/T	175	38	D	0.68	31	54	177	38.6	D	0.71	30	46	300
EBR	22	27.1	C	0.02	8	23	20	26.2	C	0.02	7	23	25
WBL/T/R	78	28.6	C	0.21	11	20	95	28.2	C	0.27	15	32	500
NBL	11	7.4	A	0.07	4	14	16	5.8	A	0.12	3	12	45
NBT/R	693	9.6	A	0.39	34	50	845	7.8	A	0.44	23	41	285
SBL	19	7.2	A	0.07	4	20	37	8.8	A	0.15	11	31	30
SBT/R	916	10.2	B	0.48	103	172	983	11.7	B	0.55	78	129	125
TOTAL	1914	13.8	B	0.54	-	-	2173	13.7	B	0.6	-	-	-
Brant Street & Victoria Avenue													
EBL	97	38.5	D	0.56	17	28	40	38.1	D	0.35	12	21	20
EBT/R	58	32.9	C	0.18	11	26	34	36.6	D	0.23	7	15	180
WBL	7	32.2	C	0.08	1	5	24	36.5	D	0.19	4	12	30
WBT/R	85	35.1	D	0.42	12	24	82	36.8	D	0.24	11	25	340
NBL	29	4.5	A	0.08	8	21	8	5	A	0.03	1	6	15
NBT/R	448	6.2	A	0.38	38	71	715	11.3	B	0.62	47	96	340
SBL	48	4.4	A	0.1	12	36	55	1.7	A	0.17	8	24	50
SBT	514	5.9	A	0.44	48	72	640	2.5	A	0.52	28	85	185

Movement	AM Peak						PM Peak						
	Volume	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Volume	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Storage (m)
SBR	124	4.7	A	0.11	17	44	52	0.1	A	0.05	2	7	60
TOTAL	1410	11.8	B	0.46	-	-	1650	10.6	B	0.58	-	-	-
Lakeshore Road & Burlington Avenue													
EBL	21	0.5	A	0.08	4	11	16	4	A	0.16	5	17	75
EBT	1185	7.5	A	0.91	13	61	970	7.5	A	0.71	52	163	205
WBT/R	826	7	A	0.62	15	58	1120	9.5	A	0.83	55	120	265
SBL/R	26	46.3	D	0.06	7	18	16	52.4	D	0.01	4	14	150
TOTAL	2058	8	A	0.82	-	-	2122	8.9	A	0.77	-	-	-
Lakeshore Road & Nelson Avenue													
EBL	38	1	A	0.1	6	17	19	3.1	A	0.08	2	9	30
EBT	1230	14.2	B	0.87	33	82	979	13.9	B	0.77	64	99	200
EBR	7	1.9	A	0.01	0	3	18	0.7	A	0.02	1	4	200
WBL	11	4.1	A	0.1	2	12	19	1.7	A	0.13	10	31	25
WBT/R	803	4.9	A	0.33	19	40	1136	1.8	A	0.48	58	99	205
NBL/T/R	10	49.6	D	0.19	2	8	19	43.1	D	0.1	8	26	10
SBL/T/R	46	49.6	D	0.17	7	16	208	67.3	E	0.82	60	112	170
TOTAL	2145	11.5	B	0.82	-	-	2398	13.8	B	0.77	-	-	-
Lakeshore Road & Maple Avenue													
EBL	350	91	F	1.10	155	180	223	85	F	0.92	138	222	170
EBT/R	1010	33	C	0.90	244	253	872	42	D	0.93	246	254	240
WBL	126	67	E	0.89	30	45	244	71	E	0.92	35	47	30
WBT	649	39	D	0.80	66	103	1138	47	D	0.95	114	147	190
NBL	33	22	C	0.11	47	141	105	30	E	0.44	36	99	120
NBT/R	529	88	F	1.04	373	609	332	48	D	0.77	87	160	500
SBL	54	28	C	0.47	12	25	113	33	D	0.57	27	58	60
SBT	108	26	C	0.20	17	33	258	38	E	0.53	144	270	345
SBR	304	26	C	0.21	29	50	604	94	F	1.03	210	252	-
TOTAL	3163	50	D	1.07	-	-	3889	55	D	0.92	-	-	-
North Shore Blvd. E & Brant Hospital Entrance													
EBL	11	8	A	0.07	19	78	17	11.4	B	0.25	22	84	55
EBT/R	1469	16.5	B	0.75	119	125	1078	8.8	A	0.5	119	119	210
WBL	52	15.1	B	0.33	9	20	35	4.1	A	0.13	4	12	70
WBT/R	967	11	B	0.41	54	91	1666	6.3	A	0.71	37	53	240
NBL	73	48	D	0.62	17	35	113	58.2	E	0.73	23	42	100
NBR	33	39	D	0.03	9	24	56	41.7	D	0.06	15	37	100
SBL/T	12	39.5	D	0.1	3	11	16	42	D	0.1	4	13	20
SBR	14	38.8	D	0.01	2	9	8	41.3	D	0.01	0	2	20

Movement	AM Peak						PM Peak						
	Volume	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Volume	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Storage (m)
TOTAL	2631	16.7	B	0.72	-	-	2989	11.4	B	0.74	-	-	-
North Shore Blvd. E & QEW East Ramp Entrance													
EBT/R	608	22.3	C	0.48	60	138	766	8.8	A	0.38	284	663	280
WBT/R	1047	29.7	C	0.79	27	66	1769	9.5	A	0.86	28	55	320
NBL	223	16.4	B	0.33	605	718	125	41.4	D	0.41	131	422	680
NBR	947	163.8	F	1.28	617	664	400	67.1	E	0.87	251	556	680
TOTAL	2825	71.6	E	1.05	-	-	3060	18	B	0.87	-	-	-
Maple Avenue & Ontario Street													
EBL/T/R	11	10.7	B	0.05	2	8	5	23	C	0.04	1	6	10
WBL	74	12.2	B	0.3	9	20	231	39.9	D	0.74	28	45	45
WBT/R	108	10.9	B	0.1	9	20	200	44.3	D	0.15	13	24	809
NBL	1	7.3	A	0.01	11	23	0		A		13	27	30
NBT/R	448	8.4	A	0.34	16	28	499	8.8	A	0.28	15	33	102
SBL	106	9.3	A	0.4	13	25	151	11.7	B	0.4	17	31	30
SBT/R	282	8.1	A	0.26	16	24	598	9	A	0.31	24	46	470
TOTAL	1030	9.1	A	0.36	-	-	1684	17.5	B	0.5	-	-	-
Martha Street & New Street													
WBL	303	2.3	A	0.25	11	27	859	5.2	A	0.67	25	84	550
WBR	49	1.6	A	0.04	1	7	84	1.3	A	0.09	5	21	30
NBR	414	2.5	A	0.3	7	19	421	2.2	A	0.32	3	12	260
SBL	11	33.5	C	0.22	5	13	13	44.8	D	0.29	2	9	20
SBT	5	32.5	C	0.09	2	8	5	43.2	D	0.14	2	9	190
TOTAL	782	3.3	A	0.3	-	-	1382	4.6	A	0.66	-	-	-

Background 2031 AM & PM Intersection Performance Summary (Un-Signalized)

Movement	AM Peak						PM Peak							
	Volume	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Volume	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Storage (m)	Greater
Caroline Street and John Street														
EBL	23	7.9	A	0.03	2	9	28	8.5	A	0.04	3	10	20	No
WBL	14	7.7	A	0.02	1	5	12	7.9	A	0.02	1	4	35	No
NBL/T/R	35	13.1	B	0.08	4	12	106	24.9	C	0.37	10	20	90	No
SBL	21	12.8	B	0.12	6	14	68	24.7	C	0.50	15	34	145	No
SBT/R	31	12.8	B	0.12	5	14	89	24.7	C	0.50	12	25	40	No
TOTAL	499	2.8	A	0.12	-	-	945	7.2	A	0.30	-	-	-	No
Maria Street and John Street														
EBL/T/R	9	6.9	A	-	3	9	24	7.4	A	-	4	12	50	No
WBL/T/R	0	7.1	A	-	-	-	-	7.3	A	-	-	-	40	No
NBL/T/R	12	7.5	A	-	4	12	57	7.6	A	-	9	15	130	No
SBL/T/R	36	7.2	A	-	7	14	62	7.5	A	-	10	16	90	No
TOTAL	57	7.2	A	-	-	-	143	7.5	A	-	-	-	-	No
John Street and James Street														
WBL	10	8.6	A	0.02	2	10	24	8.1	A	0.03	3	16	20	No
NBL/T/R	39	15.4	C	0.07	3	12	65	55.7	F	0.58	13	31	100	No
SBL/T/R	64	14.0	B	0.14	6	12	71	44.3	E	0.47	7	13	130	No
TOTAL	596	2.9	A	0.06	-	-	1099	6.6	A	0.37	-	-	-	No
Lakeshore Road and John Street														
EBL	11	10.2	B	0.03	1	8	15	14.5	B	0.07	1	6	10	No
NBL/T/R	15	275.2	F	0.85	3	9	3	630.0	F	0.75	27	4	15	No
SBL/T/R	15	1028.7	F	1.84	3	11	28	NR	F	4.13	1	23	60	No
TOTAL	1730	16	C	0.54	-	-	1985	NR	B	0.58	-	-	-	No
Caroline Street and Elizabeth Street														
NBL/T/R	17	12.2	B	0.06	4	13	47	15.5	C	0.17	7	15	240	No
SBT/R	8	10.1	B	0.03	2	9	4	11	B	0.01	1	6	200	No
TOTAL	420	0.7	A	0.14	-	-	711	1.2	A	0.23	-	-	-	No
James Street and Pearl Street														
EBL	10	7.8	A	0.01	0	0	8	10	A	0.02	0	0	45	No
WBL	84	8.3	A	0.09	4	12	106	8	A	0.10	5	19	50	No
NBL/T/R	41	15.9	C	0.16	6	13	123	169	F	1.12	19	42	155	No
SBL/T/R	49	23.0	C	0.28	8	14	45	81	F	0.62	8	16	245	No
TOTAL	700	3.6	A	0.18	-	-	1281	20	C	0.48	-	-	-	No
Lakeshore Road and Martha Street														
EBL	30	9	A	0.04	3	10	51	11	B	0.09	5	13	20	No
SBL/R	32	NR	F	8.58	8	15	27	93	F	0.54	5	12	280	No

Movement	AM Peak						PM Peak							
	Volume	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Volume	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Storage (m)	Greater
TOTAL	1603	NR	B	0.62	-	-	1782	2.5	B	0.59	-	-	-	No
Brant Street and Elgin Street														
EBL/R	172	17	C	0.42	10	16	112	23	C	0.40	16	45	75	No
TOTAL	767	4	A	0.16	-	-	1213	3	A	0.23	-	-	-	No
Brant Street and Ontario Street														
EBL/R	102	12	B	0.2	13	21	82	13	B	0.17	36	103	75	Yes
TOTAL	487	3	A	0.22	-	-	784	3	A	0.30	-	-	-	No
Lakeshore Street & Locust Street														
EBL	54	9.7	A	0.10	5	13	31	11.3	B	0.07	7	19	170	No
SBL/R	23	NR	F	7.99	4	12	64	190.8	F	0.99	7	13	140	No
TOTAL	1996	NR	C	0.71	-	-	2335	6	B	0.62	-	-	-	No
Lakeshore Street & Brock Avenue														
EBL	86	11.6	B	0.16	7	20	31	14.8	B	0.09	5	17	25	No
WBL	1	14.9	B	0.01	1	5	1	12.5	B	0.01	86	126	30	Yes
NBL/T/R	3	550.1	F	0.86	1	5	14	212.2	F	0.75	4	12	20	No
SBL/T/R	54	955.5	F	2.43	9	18	116	109.4	F	0.90	26	45	185	No
TOTAL	2211	28	D	0.64	-	-	2553	8	A	0.63	-	-	-	No
Maple Avenue & Elgin Street														
EBL/T/R	16	18	C	0.11	2	6	15	31.0	D	0.18	3	11	10	Yes
WBL	39	26	D	0.23	6	14	226	225.0	F	1.34	45	48	40	Yes
WBT/R	19	11	B	0.04	2	7	87	10.5	B	0.15	537	856	135	Yes
NBL	0	0	A	0.00	-	-	3	9.2	A	0.00	0	3	120	No
SBL	48	9	A	0.08	5	13	32	8.5	A	0.05	14	7	100	No
TOTAL	954	2	A	0.16	-	-	1554	33.8	D	0.42	-	64	-	No
Pine Street & John Street														
EBL/T/R	35	7.6	A	-	8	16	63	8	A	-	11	20	50	No
WBL/T/R	26	7.6	A	-	6	14	80	8.3	A	-	9	17	40	No
NBL/T/R	28	7.9	A	-	8	22	65	8.3	A	-	11	19	50	No
SBL/T/R	41	7.9	A	-	8	19	71	8.3	A	-	10	20	50	No
TOTAL	130	8	A	-	-	-	279	8	A	-	-	-	-	No
Elgin Street & Locust Street														
EBL/T/R	205	10.9	B	-	13	19	92	10.9	B	-	9	15	170	No
WBL/T/R	106	9.7	A	-	10	14	380	20.7	C	-	29	54	75	No
NBL/T/R	127	9.7	A	-	11	17	204	13.5	B	-	26	62	145	No
SBL/T/R	101	9.6	A	-	9	15	72	10.5	B	-	12	28	120	No
TOTAL	539	10	B	-	-	-	748	17	C	-	-	-	-	No

Movement	AM Peak						PM Peak							
	Volume	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Volume	Delay (s)	LOS	V/C	Ave Queue (m)	95th % Queue (m)	Storage (m)	Greater
Pine Street & Elizabeth Street														
EBL/T/R	47	7.9	A	-	9	16	83	9	A	-	11	28	40	No
WBL/T/R	39	7.6	A	-	6	13	78	8.7	A	-	16	46	100	No
NBL/T/R	40	7.7	A	-	5	14	118	9.1	A	-	8	15	85	No
SBL/T/R	73	8	A	-	10	16	135	9	A	-	11	18	155	No
TOTAL	199	8	A	-	-	-	414	9	A	-	-	-	-	No

D

Appendix D



SUBMITTED BY CIMA CANADA INC.

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