PLANMAC ENGINEERING INC.

SCHEDULE “C” MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT FOR LINE 8 AND 10 SIDEROAD IMPROVEMENTS STUDY PROJECT

Traffic Analysis Report – Existing and Future Conditions

JANUARY 19, 2024

SCHEDULE “C” MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT FOR LINE 8 AND 10 SIDEROAD IMPROVEMENTS STUDY PROJECT

TRAFFIC ANALYSIS REPORT- EXISTING AND FUTURE CONDITIONS

PLANMAC ENGINEERING INC.

TRAFFIC REPORT

PROJECT NO.: CA-WSP-221-12141-00
CLIENT REF:
DATE: JANUARY 19, 2024

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1 INTRODUCTION

1.1 INTRODUCTION

Planmac Engineering Inc. – Consultant for the Town of Bradford West Gwillimbury for the Schedule "C" Municipal Class Environment Assessment and Detailed Design for improvements to Line 8 and 10 Sideroad – has retained WSP to support Traffic Analysis pertaining to the assignment. Line 8 from Barrie Street to 10 Sideroad and 10 Sideroad from North of Line 8 to Reagens Industrial Parkway has been included in the study. As per Town's Official Plan, Line 8 and 10 Sideroad within the study area are identified as major arterial roads. The Town is fast growing in terms of residential and commercial development over the past several years. It is anticipated that the Town will experience considerable growth in future years and the operation and level of service on Line 8 and 10 Sideroad are anticipated for deterioration for future conditions and as a result roadway and intersection improvements would be required. It is expected that the Line 8 and 10 Sideroad study align with the Town's strategic plan of reducing congestion, promoting employment growth, improving community and traffic safety and upgrading existing facilities.

The focus on the evaluation of future (for 2031) alternatives will assume the completion of the Highway 400-404 connecting link (Bradford Bypass). The link would connect Provincial Highway 404 between Line 8 and Line 9 (located north of the Holland Street corridor in the Town of Bradford West Gwillimbury) to Provincial Highway 400 between Queensville Sideroad and Holborn Road (located in the Town of East Gwillimbury). The Highway 400-404 connecting link is expected to relieve congestion on arterial roads - Holland Street, Line 8, Line 9 and Dissette Street/ Bridge Street corridors by attracting the influx of traffic that travels to/from Highway 404 via Dissette Street/Marshview Boulevard intersection.

WSP has recently completed a Schedule C Municipal Class Environmental Assessment Study for the Holland Street East and Holland Street West Corridor Study. Another WSP Team has already undertaken a Transportation Master Plan (TMP) study for the Town of Bradford West Gwillimbury and has updated Existing and 2031 EMME based Sub-area models. The TMP project delivered a traffic simulation model to year 2031 using EMME. The current Line 8 and 10 Sideroad assignment have utilised the appropriate traversal matrices from the TMP model to develop existing and future microsimulation models of the study area corridor.

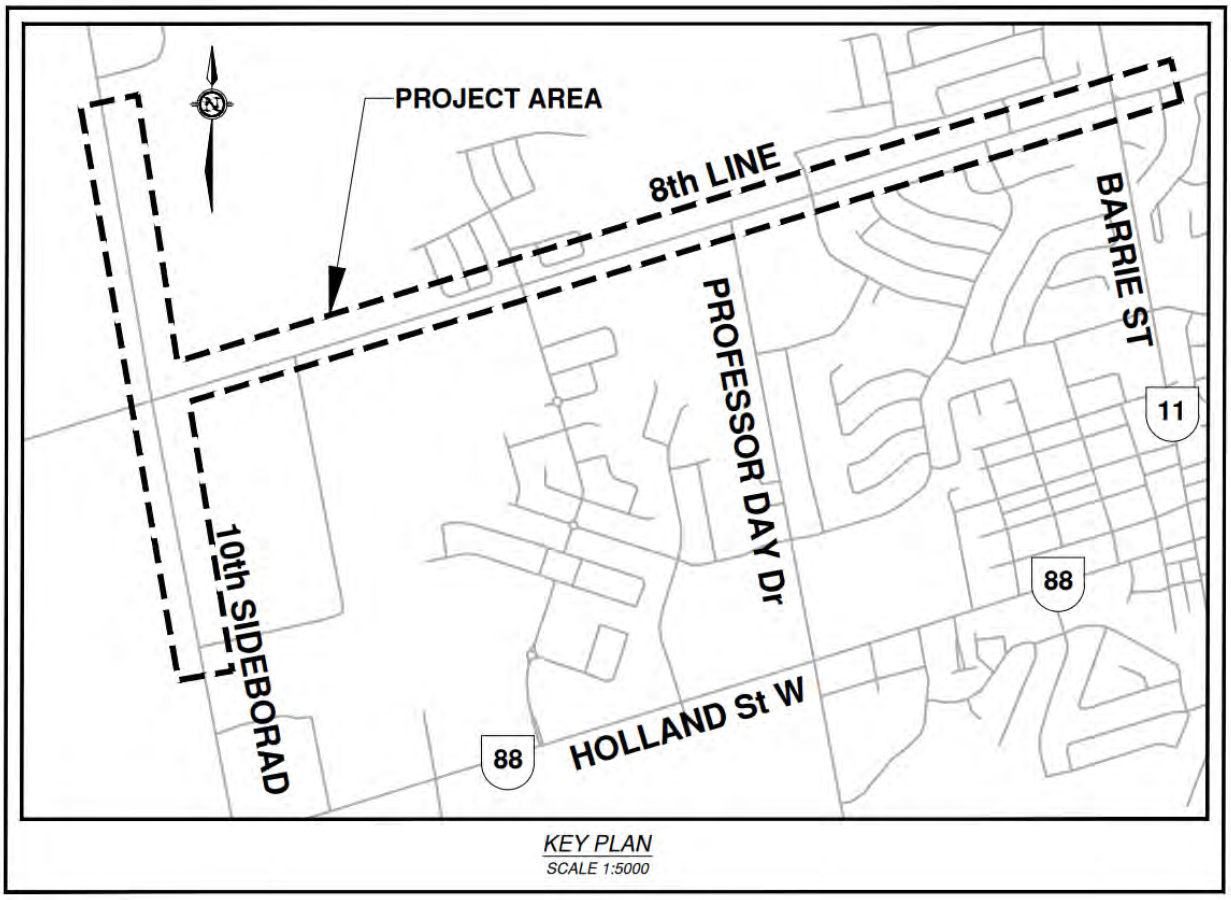
The following Traffic analysis tasks are envisaged:

- Collect and summarise existing traffic volumes for all the intersections within the study corridor and establish the base year for Existing Conditions Analysis.
- Gather information on Existing Signal Timing Plans of all signalised intersections within the study area.
- Conduct Synchro analysis of intersections for the base existing conditions to evaluate intersection performance based on indicators such as Level of Service (LOS), delay, and volume-to-capacity ratio (v/c Ratio), queue length etc. of intersection turning movements.
- Develop a microsimulation model of the study corridors using Aimsun software for the existing condition, supply demand matrices (cars, trucks etc.) based on the traversal matrices from TMP model and the real data set comprising of all existing turning movement counts at the intersections along the corridors.
- Obtain existing travel time data along Line 8 corridor.
- Calibrate and validate existing microsimulation model and conduct evaluation of existing conditions.
- Develop microsimulation models for future Do-Nothing and other alternate scenarios for 2031 conditions based on traffic demand from future updated TMP models.
- Conduct detailed traffic analysis within the study area to confirm needs and justification of problems, and appropriate configuration of Line 8 corridor and 10 Sideroad intersections for future conditions. Specifically, to consider the following:
    - Potential widening of Line 8.
    - Alternative improvement scenarios evaluations for the intersection of Line 8 and Barrie Street for the future 2031 conditions.
    - Alternatives for intersections on Line 8 at Northgate and Lowes Gate to account for the short spacing between them.
    - Evaluation of Roundabout Alternatives for the following intersections:
        - 10 Sideroad
        - Langford Boulevard
        - Rogers Trail/Summerlynn Trail
        - Professor Day Drive

1.2 STUDY AREA

Based on discussion with Planmac Engineering Inc, the project limits are Line 8 from Barrie Street to 10 Sideroad and 10 Sideroad from North of Line 8 to Reagens Industrial Parkway as shown in Figure 1-1.

Figure 1-1: Study Area – Line 8 and 10 Sideroad



The project includes all intersecting roadways with Line 8 and 10 Sideroad and the following intersections within the study area:

- Line 8 and 10 Sideroad,
- Line 8 and Reagens Industrial Parkway,
- Line 8 and Langford Boulevard,
- Line 8 and Rogers Trail/Summerlin Trail,
- Line 8 and Professor Day Drive,
- Line 8 and Taucar Gate,

- Line 8 and Noble Drive,
- Line 8 and Lowes Gate,
- Line 8 and Barrie Street, and
- 10 Sideroad and Reagens Industrial Parkway.

However, a broader study area as shown in Figure 1-2 developed in consultation with the Town has been included for the microsimulation analysis. The subarea shown below includes the following:

- Line 8 Corridor including approximately 1km east and 1km west of the study limit,
- All the crossing roads and intersections within the study corridor, and
- 10 Sideroad from north of Line 8 to south of Reagens Industrial Parkway.

Within the project limit, Line 8 has a 2-lane cross section from 10 Sideroad to Barrie Street and 4-lane cross section east of Barrie Street with a posted speed of 50 km/h. Additional left-turn and right-turn lanes are also present at some of the intersections. The existing lane configurations and control types for the study area intersections are presented in Figure 1-3.

Figure 1-2: Broader Study Area – Line 8 and 10 Sideroad

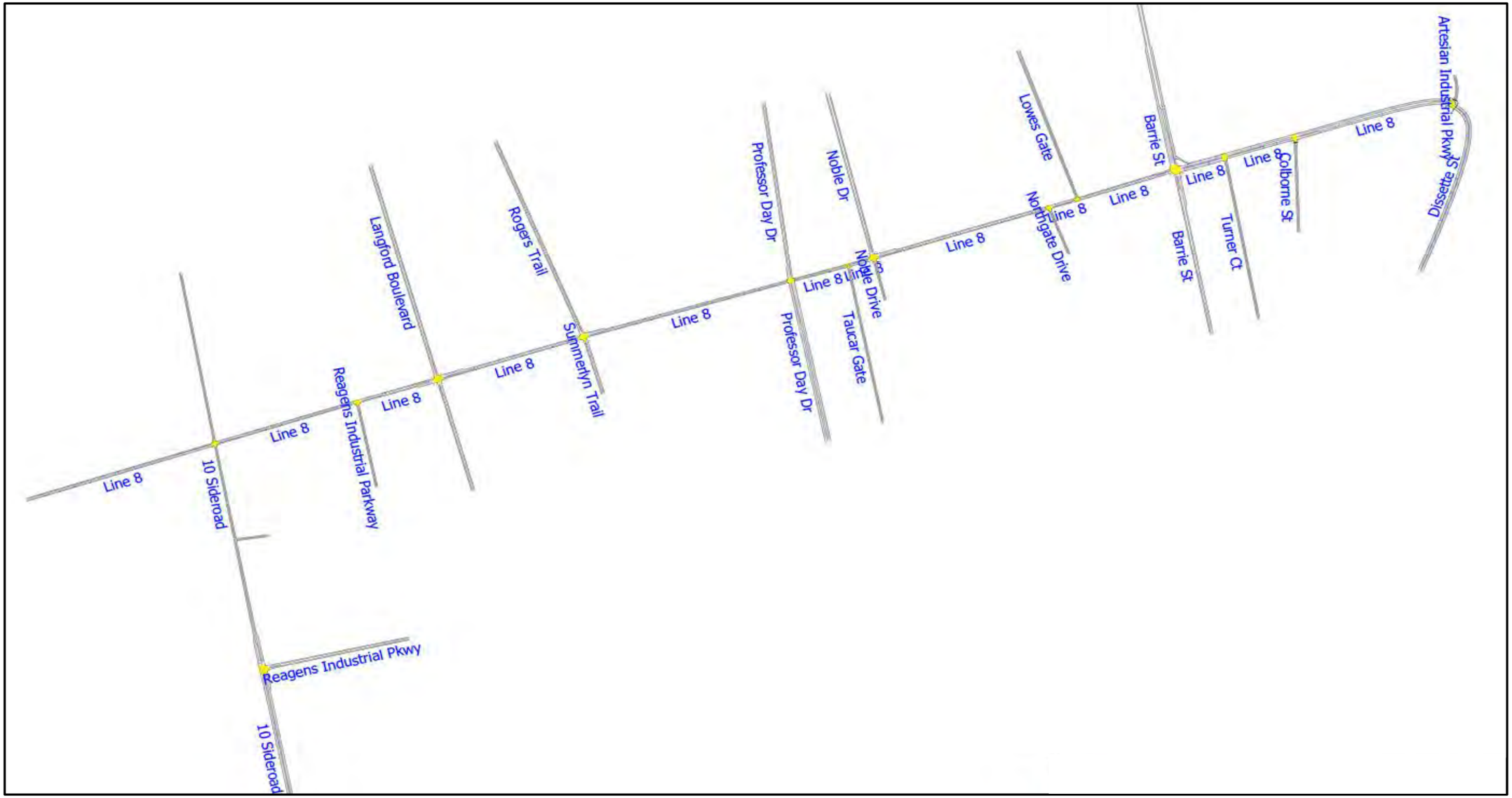
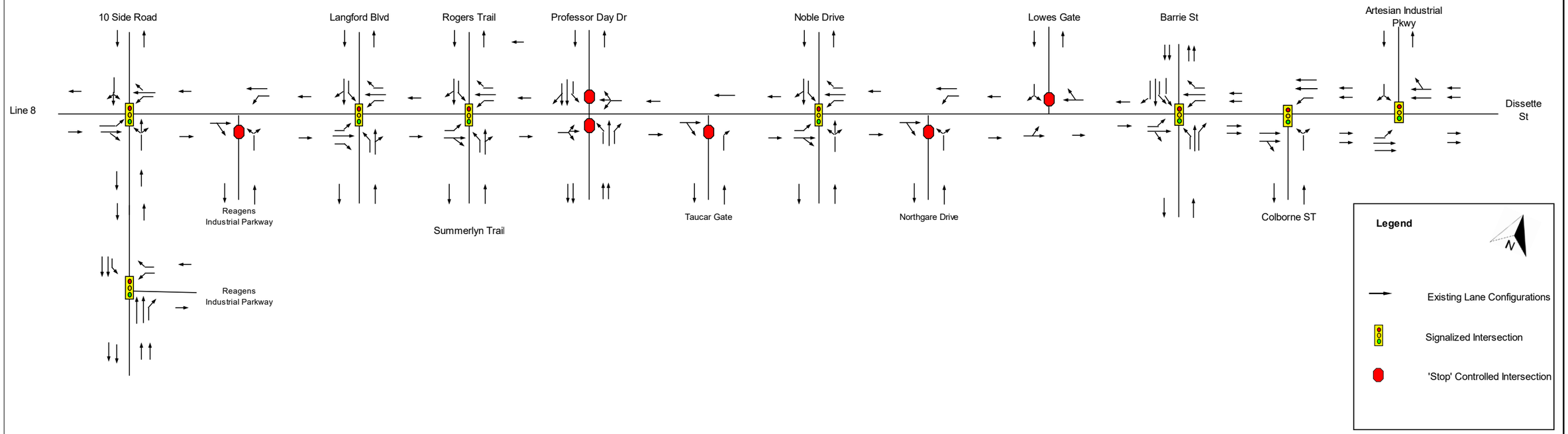


Figure 1-3: Existing Intersection Lane Configurations – Line 8 and 10 Sideroad



2 EXISTING TRAFFIC CONDITIONS

2.1 TRAFFIC DATA

This section provides a summary of traffic data received from the Town through Planmac Engineering Inc. which includes intersection Turning Movement Count (TMC) data and mid-block Automatic Traffic Recorder (ATR) counts for various years ranging from 2016-2023. Table 2-1 provides a list of TMC data received from the Town and Table 2-2 provides a list of available ATR data.

Table 2-1: List of available Turning Movement data

Intersections	Type of control	Data set 1	Data set 2	Data set 4	Data set 5
Line 8 & 10th Sideroad	Signalised	06-Jul-16	18-Jun-20	12-Oct-22	13-Oct-22
Line 8 & Reagents Industrial Pkwy	Stop-controlled			12-Oct-22	13-Oct-22
Line 8 & Langford Blvd	Signalised			12-Oct-22	13-Oct-22
Line 8 & Summerlyn Trail/ Rogers Trail	Signalised			12-Oct-22	13-Oct-22
Line 8 & Professor Day Dr	Stop-controlled			12-Oct-22	13-Oct-22
Line 8 & Taucar Gate	Stop-controlled			12-Oct-22	13-Oct-22
Line 8 & Noble Dr	Signalised			12-Oct-22	13-Oct-22
Line 8 & Northgate Dr	Stop-controlled			12-Oct-22	13-Oct-22
Line 8 & Lowes Gate	Stop-controlled			12-Oct-22	13-Oct-22
Line 8 & Barrie Street	Signalised	03-May-16	16-Nov-17	12-Oct-22	13-Oct-22
Line 8 & Colborne Street	Signalised				07-Feb-23
Line 8 & Artesian Industrial Pkwy	Signalised				07-Feb-23
Sideroad 10 & Reagens Industrial Pkwy	Signalised			12-Oct-22	13-Oct-22

Table 2-2: List of available ATR data

Location	Date
Line 8 between Reagans Industrial Pkwy & Summerlyn Trail/Rogers Trail	Oct, 2017
Line 8 between Summerlyn Trail/Rogers Trail & Professor Day Drive	Oct, 2017
Summerlyn Trail between Line 8 & Scarlet Way/Tigertail Crescent	Oct 2021 & April 2022
Professor Day Dr between Line 8 & Breeze Drive/West Park Avenue	Dec, 2021

2.2 EXISTING TRAFFIC VOLUMES AT INTERSECTIONS

Traffic volume counts for the study area intersections were used for the development of existing baseline turning movement volumes. The latest available data from October 2022 and February 2023 were used to establish Existing Baseline conditions. Between

data from October 12th and 13th from 2022, the peak hour volumes from October 12 were found to be marginally greater than that from October 13, 2022, and therefore, data from October 12, 2022, was used for developing turning movement volumes for the intersections. The existing (2022) raw traffic volumes for the weekday morning and afternoon peak hours are presented in Figure 2-1. These volumes represent the maximum volumes for AM and PM peak hours. For the evaluation of intersections independently using Synchro software these highest peak hour raw volumes were used. However, for the networkwide evaluation using the microsimulation model, balanced volumes representing the same peak hour duration presented in Figure 2-2 were used. There is only marginal difference between raw turning movement volumes and balanced volumes.

Figure 2-1: Existing weekday AM and PM peak hour Turning Movement Volumes (Raw) – Line 8 and 10 Sideroad

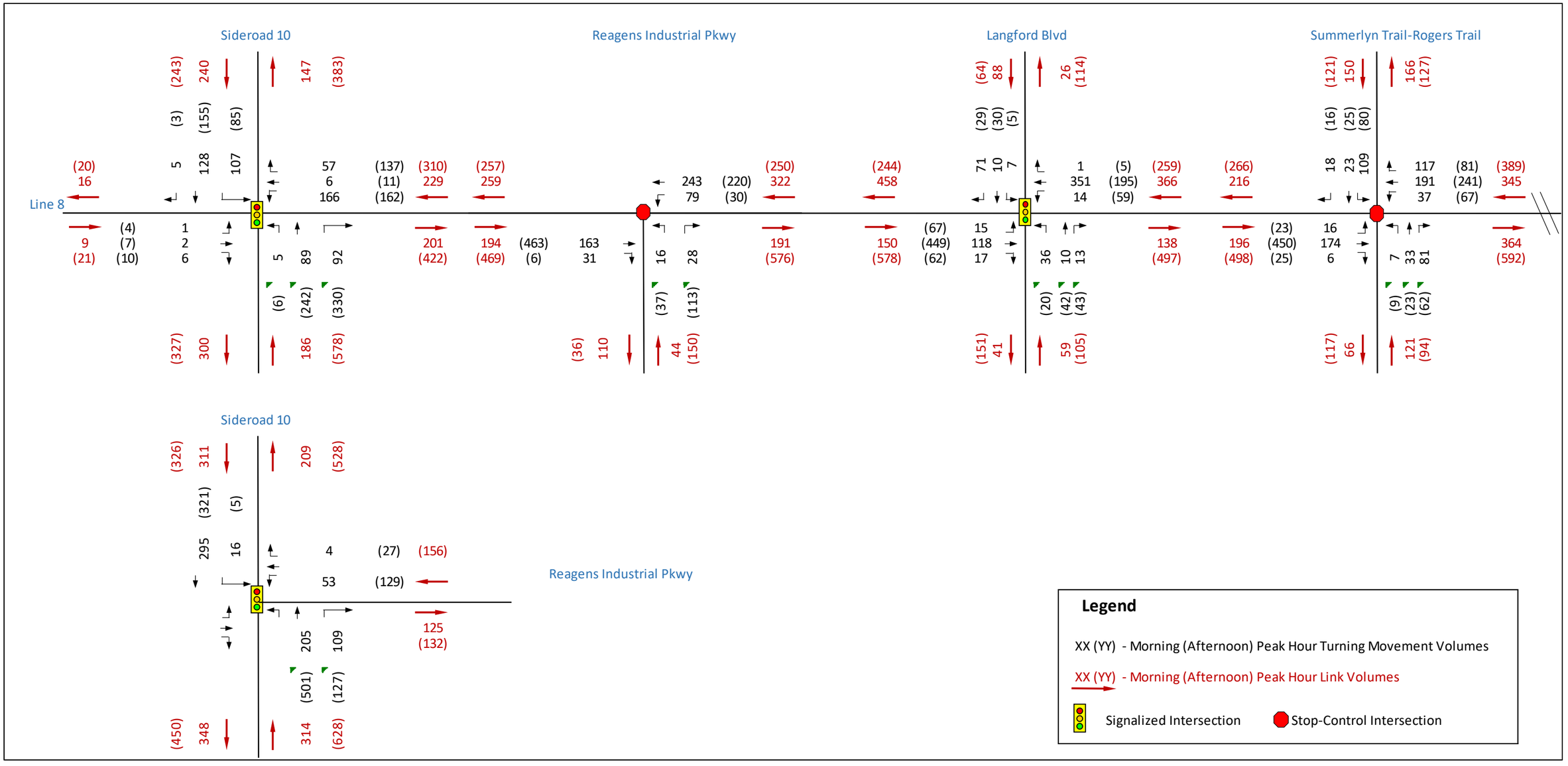


Figure 2-1: Existing weekday AM and PM peak hour Turning Movement Volumes (Raw) - Line 8 and 10 Sideroad (continued)

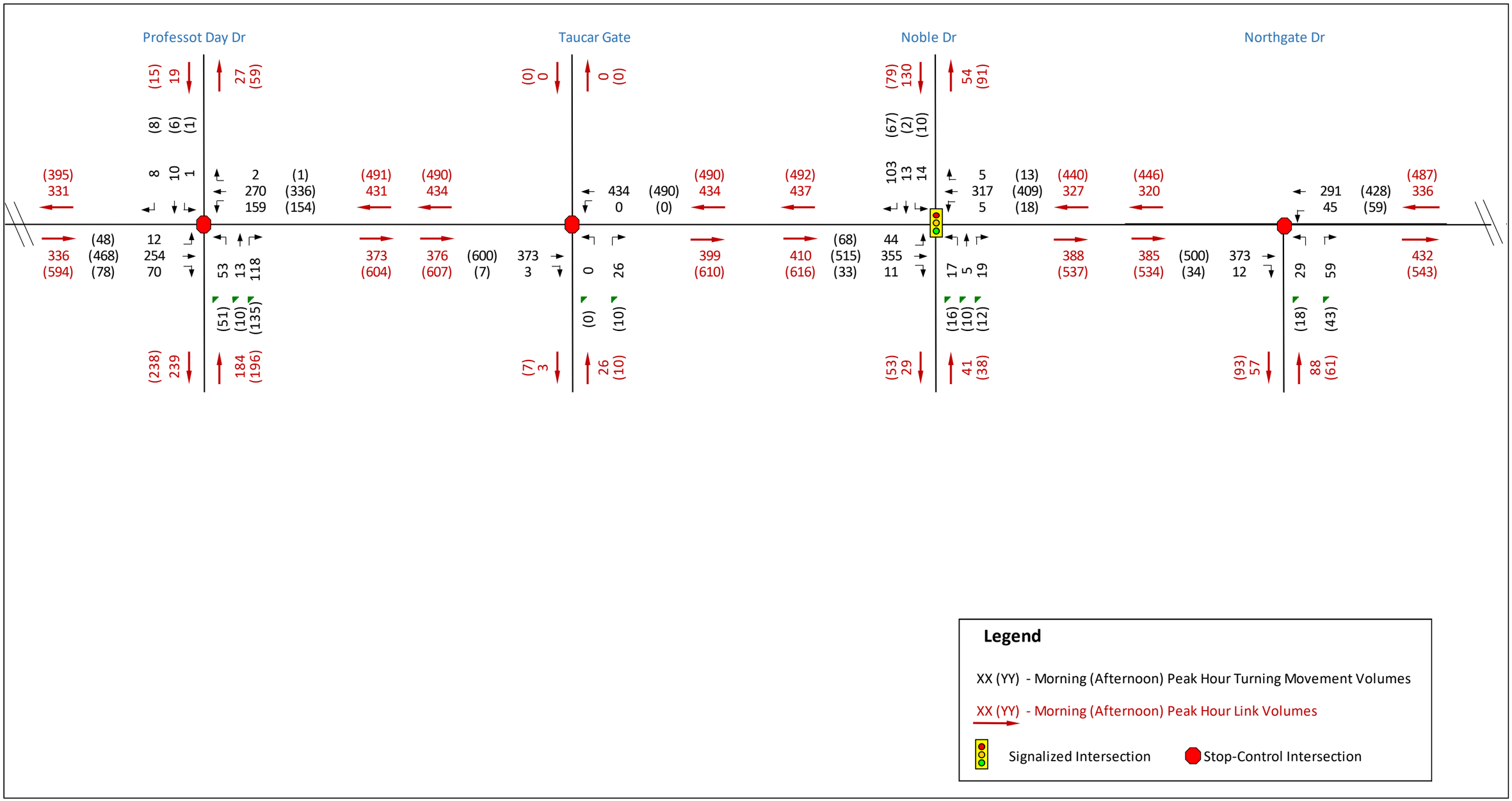


Figure 2-1: Existing weekday AM and PM peak hour Turning Movement Volumes (Raw) – Line 8 and 10 Sideroad (continued)

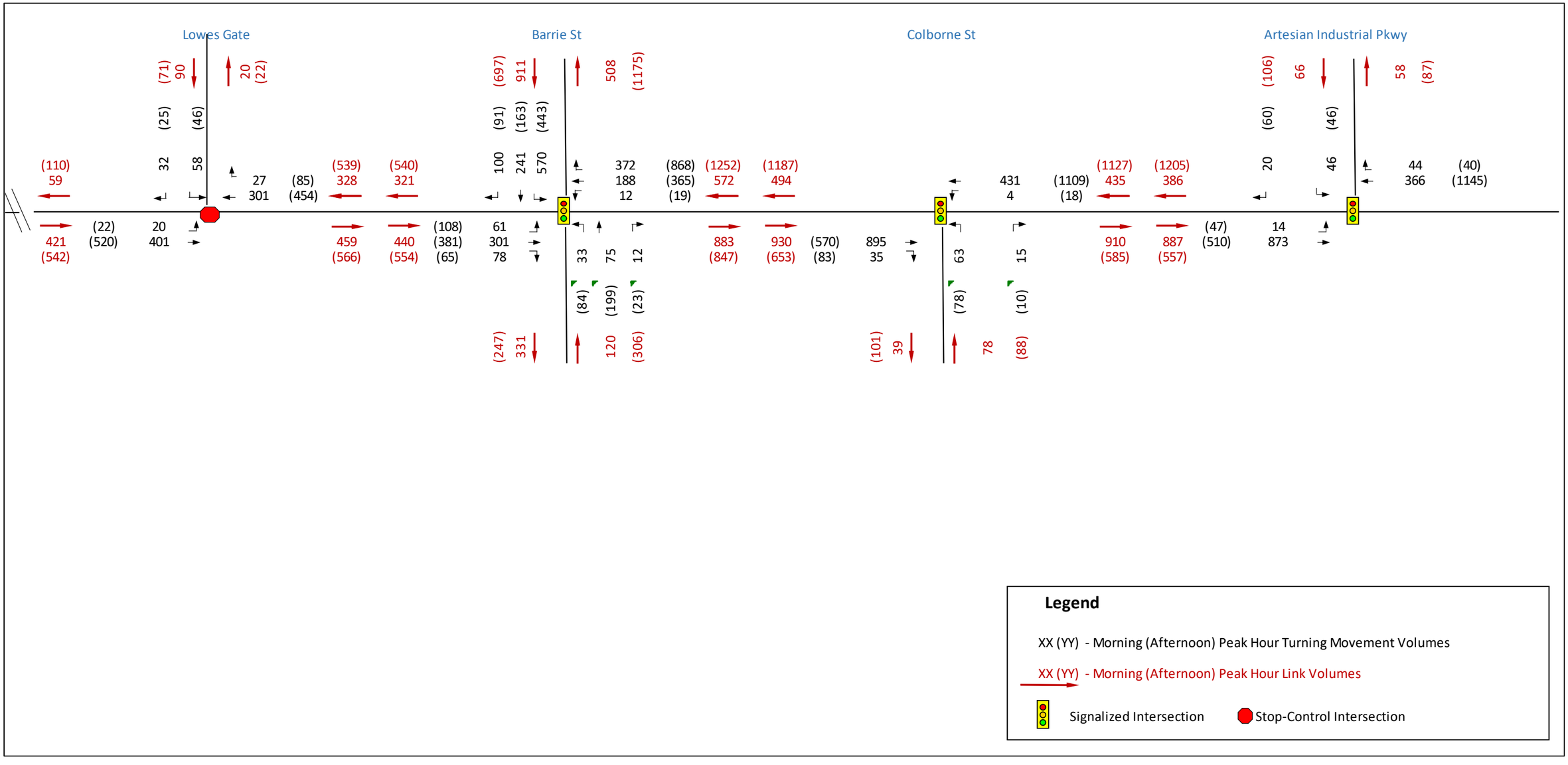


Figure 2-2: Existing Balanced weekday AM and PM peak hour Turning Movement Volumes – Line 8 and 10 Sideroad

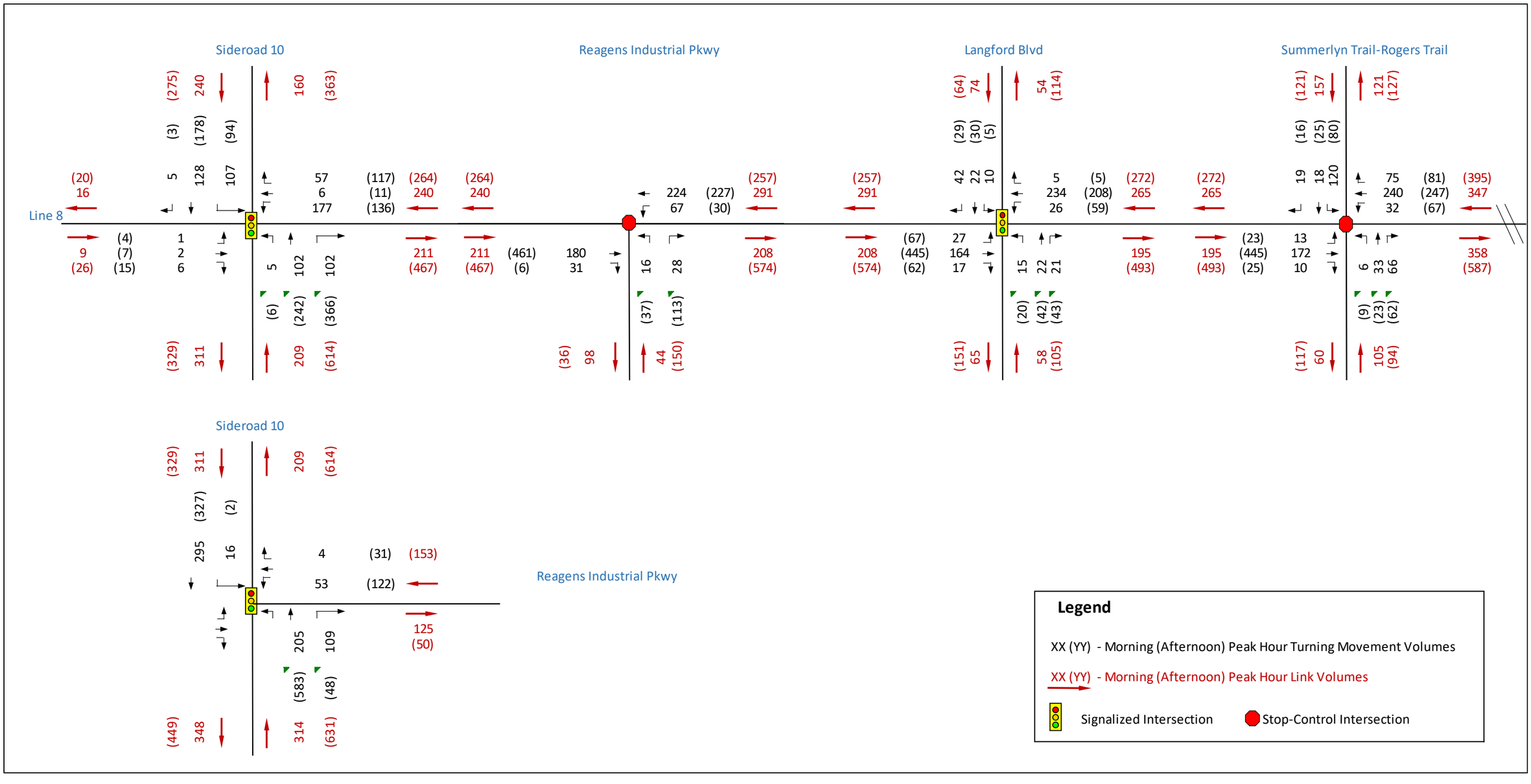


Figure 2-2: Existing Balanced weekday AM and PM peak hour Turning Movement Volumes - Line 8 and 10 Sideroad (continued)

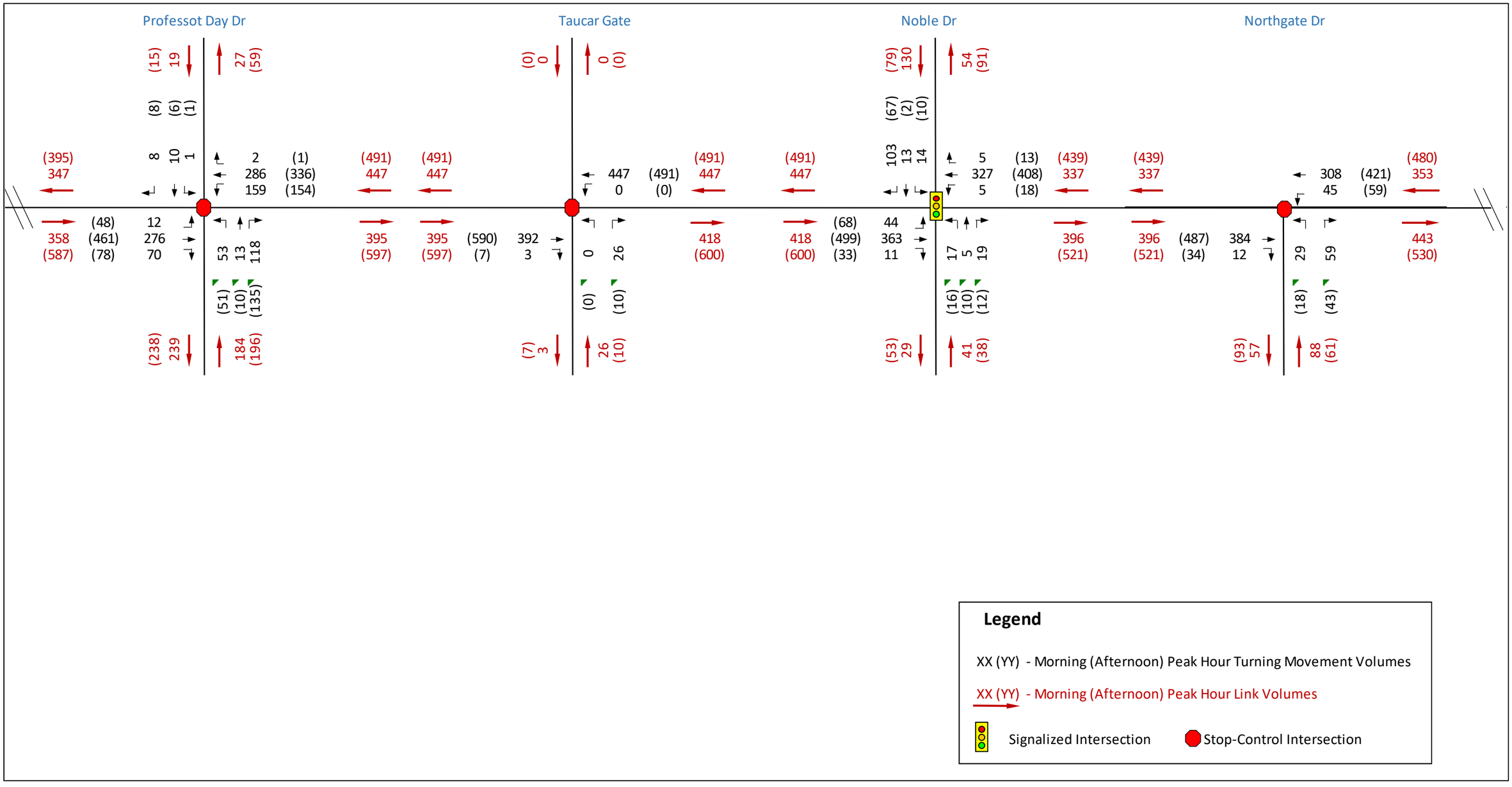
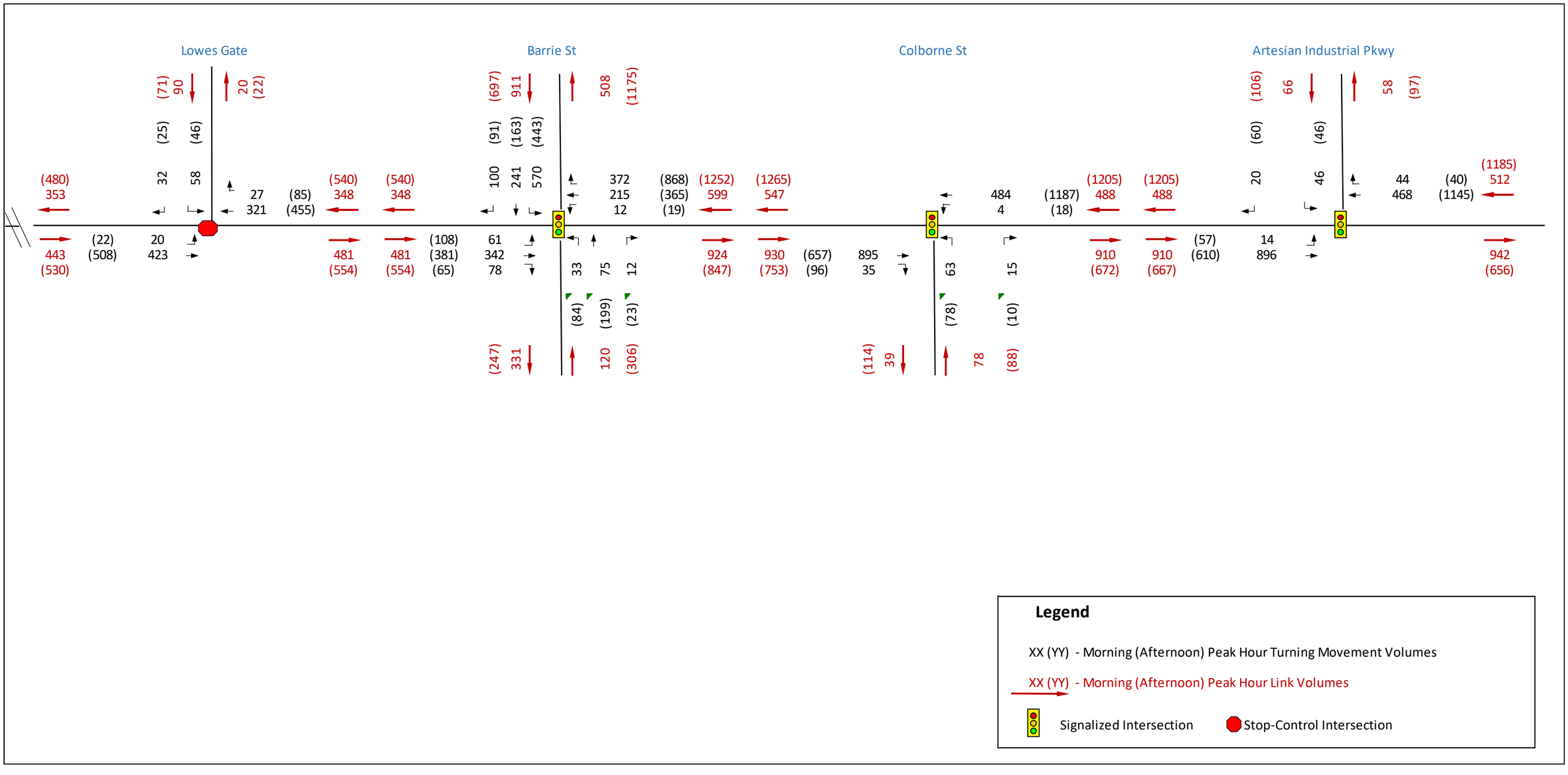


Figure 2-2: Existing Balanced weekday AM and PM peak hour Turning Movement Volumes – Line 8 and 10 Sideroad (continued)



The following is noted for the Existing Baseline intersection volumes along the Line 8 corridor:

- PM peak hour volumes are critical for both eastbound and westbound directions. West of Barrie Street, the eastbound peak hour volumes are higher and east of Barrie Street, the westbound peak hour volumes are higher.
- Since Line 8 west of 10 Sideroad and Professor Day Drive north of Line 8 are newly constructed, the volumes to and from these approaches show very low volumes.
- Volume levels on the north and east approaches of the intersection of Line 8 and Barrie Street show relatively higher than that for other intersections. This may be due to the presence of the Bradford GO Station near Holland Street/Dissette Street intersection. As well as due to the fact that the intersection serves as the route from north side crossing Holland River between Highways 400 and 404 – north of Davis Drive, which passes through Newmarket.
- The turning movement volume data has shown very low pedestrian movements (0-5 pedestrians per hour) during the peak hours.

2.3 TRAFFIC VOLUME DISTRIBUTION

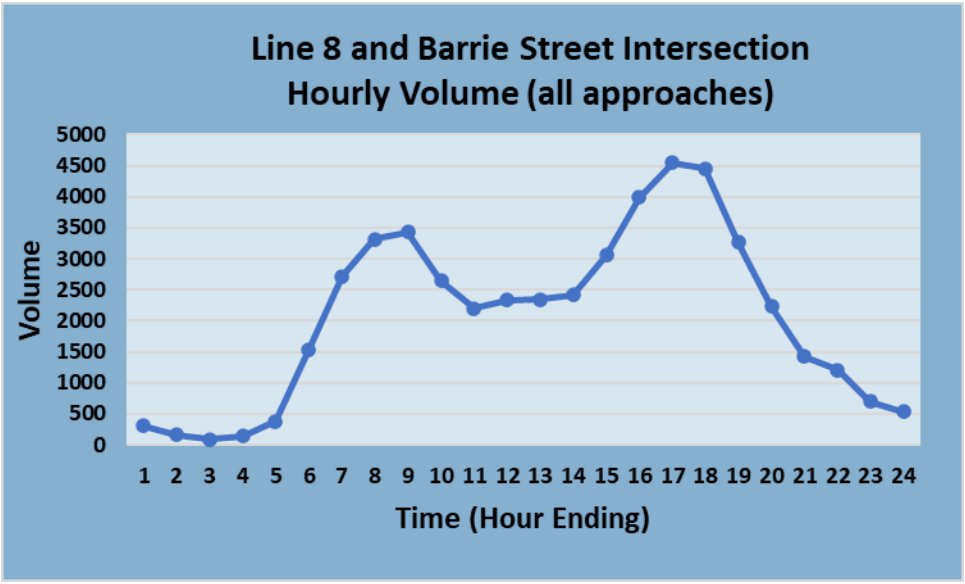
Table 2-3 shows the distribution of traffic at the highest volume location within the study area at Line and Barrie Street intersection based on the existing turning Movement Count (TMC). Percentage of traffic with respect to the peak hour volume is shown in the last column with AM and PM peak periods shaded. Graphical representation of the same volume distribution for the typical weekday is shown in Figure 2-3.

Table 2-3: Traffic Volume Distribution

Hour Ending	Volume (all approaches)	% with respect to highest
1:00	309	6.8%
2:00	158	3.5%
3:00	85	1.9%
4:00	136	3.0%
5:00	376	8.3%
6:00	1543	33.9%
7:00	2716	59.7%
8:00	3316	72.8%
9:00	3431	75.4%
10:00	2640	58.0%

11:00	2199	48.3%
12:00	2336	51.3%
13:00	2348	51.6%
14:00	2422	53.2%
15:00	3058	67.2%
16:00	3986	87.5%
17:00	**4553**	100.0%
18:00	4455	97.8%
19:00	3261	71.6%
20:00	2234	49.1%
21:00	1426	31.3%
22:00	1205	26.5%
23:00	699	15.4%
0:00	531	11.7%

Figure 2-3: Line 8 and Barrie Street Traffic Volume Distribution



2.4 EXISTING SIGNAL TIMING PLANS

The Town provided the existing signal timing plans for all the signalized intersections within the study corridor. These signals are currently operating with a fully actuated signal control plan. Pedestrian crossing facility along with push button application is available at all the signalised intersections except at the intersection of Line 8 and 10 Sideroad. The pedestrian signal will only be activated when there are pedestrians available for crossing. The intersection evaluations for the Existing conditions were conducted using existing signal plans supplied.

2.5 EVALUATION METHEDOLOGY

Existing traffic operations along Line 8 and 10 Sideroad corridor intersections has been conducted using Synchro Software as well as using a detailed microsimulation analysis. Synchro is a macroscopic analysis tool which is a deterministic model that is best suited for evaluating traditional stop-controlled or signal-controlled intersections using HCM (Highway Capacity Manual) methodologies. However, this would not be able to capture the complex vehicle behaviour and interactions between various vehicle types and vehicular movements between intersections as well as capturing sustained queue formation during the peak period. This is a case of highway sections with anticipated oversaturated and congested conditions for future and where accumulating queues and delay are possible. Therefore, the use of a microsimulation analysis such as Aimsun for the evaluation of existing and future alternate scenarios are recommended. Even though, for the existing conditions, Synchro models are used as a starting point to generate signal timing plans, for future baseline and alternative scenarios, only the microsimulation models were used. Since these two categories of models are totally different – one is static and deterministic and other one dynamic with detailed vehicle interactions and behaviours, the results need not match, and comparison cannot be made between these two methodologies. Therefore, for all evaluations, comparison was made with the modelling results from Aimsun microsimulation model which is calibrated to existing field conditions.

The performance measures used to evaluate the operation of intersection configurations are summarized in Table 2-4 and delay thresholds for Level-of Service (LOS) is shown in Table 2-5.

Capacity is defined as the maximum number of vehicles that can pass over a road segment or through an intersection within a set time duration. Capacity is combined with a Level-of-Service (LOS) to describe the operating characteristics of a road segment or intersection. LOS is a qualitative measure that describes operational conditions within a traffic stream. The Highway Capacity Manual (HCM) defines six levels of service for

autos, LOS A through LOS F. LOS A represents lower average delay and LOS F represents the higher average delay.

Table 2-4: Description of analysis performance measures

Performance Measure	Description
V/C (Volume-to-Capacity Ratio)	• Represents the degree to which an intersection turning-movement can accommodate the traffic demand. • This measure was only produced by Synchro
Delay	• Increase in travel time through an intersection as a result of geometry, queuing, or control (stop, yield, or signal). • Geometric delay is negligible for standard stop or signal controlled intersection
LOS (Level of Service)	• Indicator of traffic performance based on total delay for a movement, approach, or intersection overall. Delay thresholds are shown in Table 2-4
95th Percentile Queue	• Queue length which has only a 5% chance of being exceeded within the analysis period (AM or PM peak hour).
Maximum Queue Length (Aimsun)	• Maximum queue length observed during the analysis period (AM or PM peak hour).

Table 2-5: Level-of-Service delay thresholds

LOS	Intersection Control Type	
	Signal-Control	**Stop-Control**
A	Under 10 seconds	Under 10 seconds
B	10-20 seconds	10-15 seconds
C	20-35 seconds	15-25 seconds
D	35-55 seconds	25-35 seconds
E	55-80 seconds	35-50 seconds
F	Over 80 seconds	Over 50 seconds

2.6 EXISTING (2022) TRAFFIC OPERATIONS USING SYNCHRO SOFTWARE

Traffic analysis of all the signalised and stop controlled intersections on the Line 8 and 10 Sideroad corridors within the study area were conducted using Synchro software for the existing weekday AM and PM peak hour traffic conditions. Turning movement

volumes for the existing conditions shown in Figure 2-1 were used for the AM and PM peak hour evaluations. The existing signal timing plans as described before, and existing intersection configurations were used for the analysis. Synchro results such as level-of-service (LOS), average delay, v/c ratio, and 95th percentile queues were used for the intersection evaluation.

Table 2-6 presents the results of Synchro for the existing weekday AM and PM peak hour conditions. The LOS are highlighted as per the legend shown in Table 2-5. Wherever the queue length exceeds the available storage length on turning lanes are also highlighted. The Synchro files and reports for the existing conditions are provided in Appendix A-1.

Table 2-6: Synchro based Intersection Evaluation Results – Peak hour conditions – Existing Scenario

Intersection	Direction/ Movement		Available Storage Length (m)	AM Peak Hour					PM Peak Hour				
				Volume (veh/h)	V/C Ratio	Delay (sec)	LOS	95th %ile Queue (m)	Volume (veh/h)	V/C Ratio	Delay (sec)	LOS	95th %ile Queue (m)
10 Sideroad at Reagens Industrial pkwy (Signalized)	Westbound	WBL	30	53	0.42	27	C	10	129	0.75	33	C	22
		WBR	-	4	0.03	12	B	0	27	0.17	5	A	0
		Approach	**-**	**57**	**-**	**26**	**C**	**-**	**156**	**-**	**27**	**C**	**-**
	Northbound	NBT	-	205	0.14	5	A	5	501	0.33	11	B	38
		NBR	50	109	0.21	2	A	0	127	0.20	3	A	7
		Approach	**-**	**314**	**-**	**4**	**A**	**-**	**628**	**-**	**9**	**A**	**-**
	Southbound	SBL	60	16	0.08	6	A	2	5	0.03	10	A	2
		SBT	-	295	0.18	6	A	7	321	0.22	10	A	24
		Approach	**-**	**311**	**-**	**6**	**A**	**-**	**326**	**-**	**10**	**A**	**-**
				682	**0.42**	**7**	**A**	**-**	**1110**	**0.75**	**14**	**B**	**-**
Line 8 at 10 Sideroad (Signalized)	Eastbound	EBL	120	1	0.02	20	B	1	4	0.04	23	C	2
		EBT	-	2	0.08	14	B	1	7	0.09	15	B	6
		EBR	-	6					10				
		Approach	**-**	**9**	**-**	**15**	**B**	**-**	**21**	**-**	**17**	**B**	**-**
	Westbound	WBL	80	166	0.49	19	B	28	162	0.45	19	B	30
		WBT	-	6	0.16	6	A	6	11	0.30	6	A	3
		WBR	-	57					137				
		Approach	**-**	**229**	**-**	**15**	**B**	**-**	**310**	**-**	**12**	**B**	**-**
	Northbound	NBL	-	5	0.45	13	B	25	6	0.86	29	C	#118.3
		NBT	-	89					242				
		NBR	-	92					330				
		Approach	**-**	**186**	**-**	**13**	**B**	**-**	**578**	**-**	**29**	**C**	**-**
	Southbound	SBL	-	107	0.33	9	A	27	85	0.39	9	A	27
		SBT	-	128					155				
		SBR	-	5					3				
		Approach	**-**	**240**	**-**	**9**	**A**	**-**	**243**	**-**	**9**	**A**	**-**
		Intersection Overall		**664**	**0.49**	**12**	**B**	**-**	**1152**	**0.97**	**20**	**B**	**-**
Line 8 at Reagens Industrial Parkway (Stop-controlled)	Eastbound	EBT	-	163	-	-	-	0	463	-	-	-	-
		EBR	-	31	-	-	-		6	-	-	-	-
		Approach	-	**194**	**-**	**-**	**-**	**-**	**469**	**-**	**0**	**-**	-
	Westbound	WBL	70	79	0.12	8	A	0	30	0.05	9	A	0
		WBT	-	243	-	-	-	-	220	-	-	-	-
		Approach	-	**322**	**-**	**3**	**-**	**-**	**250**	**-**	**1**	**-**	**-**
	Northbound	NBL	-	16	0.20	16	C	5	37	0.48	20	C	19
		NBR	-	28	-	-			113	-	-	-	
		Approach	-	**44**	**-**	**16**	**C**	**-**	**150**	**-**	**20**	**C**	-

Intersection	Direction/ Movement		Available Storage Length (m)	AM Peak Hour					PM Peak Hour				
				Volume (veh/h)	V/C Ratio	Delay (sec)	LOS	95th %ile Queue (m)	Volume (veh/h)	V/C Ratio	Delay (sec)	LOS	95th %ile Queue (m)
		Intersection Overall		**560**	-	**3**	-	-	**869**	-	**4**	-	-
Line 8 at Langford Boulevard (Signalized)	**Eastbound**	EBL	50	15	0.05	4	A	2	67	0.12	4	A	6
		EBT	-	118	0.14	7	A	16	449	0.44	11	B	61
		EBR	50	0	-	-	-	-	62	0.08	2	A	3
		Approach	-	**133**	-	**6**	**A**	-	**578**	-	**9**	**A**	-
	Westbound	WBL	100	14	0.66	4	A	2	59	0.14	4	A	5
		WBT	-	351	0.61	9	A	45	195	0.26	9	A	25
		WBR	70	1	0.61	0	A	0	5	0.01	0	A	0
		Approach	-	**366**	-	**9**	**A**		**259**	-	**8**	**A**	-
	Northbound	NBL	40	36	0.29	30	C	12	20	0.13	28	C	9
		NBT	-	10	0.19	18	B	6	42	0.44	20	B	15
		NBR	-	13					43				
		Approach	-	**59**		**25**	**C**	-	**105**	-	**21**	**C**	-
	Southbound	SBL	50	7	0.06	26	C	4	5	0.07	27	C	3
		SBT	-	10	0.35	12	B	12	30	0.32	18	B	13
		SBR	-	71					29				
		Approach	-	**88**		**13**	**B**	-	**64**	-	**19**	**B**	-
		Intersection Overall		**646**	**0.44**	**11**	**B**	-	**1006**	**0.44**	**11**	**B**	-
Line 8 at Summerlyn/Rogers Trail (Signalized)	**Eastbound**	EBL	50	16	0.03	14	B	6	23	0.05	13	B	8
		EBT	-	174	0.27	14	B	39	450	0.55	17	B	111
		EBR	-	6					25				
		Approach	-	**196**	-	**14**	**B**	-	**498**	-	**16**	**B**	-
	Westbound	WBL	45	37	0.12	8	A	7	67	0.19	7	A	12
		WBT	-	191	0.20	9	A	32	241	0.27	8	A	39
		WBR	55	117	0.17	2	A	4	81	0.10	2	A	5
		Approach	-	**345**	-	**6**	**A**	-	**389**	-	**7**	**A**	-
	Northbound	NBL	20	7	0.03	19	B	4	9	0.06	21	C	4
		NBT	-	33	0.42	13	B	5	23	0.30	11	B	8
		NBR	-	81					62				
		Approach	-	**121**	-	**13**	**B**	-	**94**	-	**12**	**B**	-
	Southbound	SBL	35	109	0.67	37	D	26	80	0.35	26	C	20
		SBT	-	23	0.18	16	B	6	25	0.20	16	B	7
		SBR	-	18					16				
		Approach	-	**150**	-	**31**	**C**	-	**121**	-	**22**	**C**	-
		Intersection Overall		**812**	**0.67**	**14**	**B**	-	**1102**	**0.55**	**13**	**B**	-
	Eastbound	EBL	-	12	0.01	8	A	0	48	0.05	8	A	-
		EBT	-	254	-	0	A	-	468	-	0	A	-

Intersection	Direction/ Movement		Available Storage Length (m)	AM Peak Hour					PM Peak Hour				
				Volume (veh/h)	V/C Ratio	Delay (sec)	LOS	95th %ile Queue (m)	Volume (veh/h)	V/C Ratio	Delay (sec)	LOS	95th %ile Queue (m)
Line 8 at Professor Day Drive (Stop-controlled)		EBR	-	70	-	-	-	-	78	-	-	-	-
		Approach	-	**336**	**-**	**0**	**-**	**-**	**594**	**-**	**1**	**-**	**-**
	Westbound	WBL	-	159	0.17	9	A	5	154	0.21	10	A	6
		WBT	-	270	-	0	A	-	336	-	0	A	-
		WBR	-	2	-	-	-	-	1	-	-	-	-
		Approach	**-**	**431**	**-**	**3**	**-**	**-**	**491**	**-**	**3**	**-**	**-**
	Northbound	NBL	140	53	0.54	57	F	20	51	1.16	276	F	44
		NBT	-	13	0.14	29	D	4	10	0.24	63	F	7
		NBR	-	118	0.27	12	B	8	135	0.34	15	C	11
		Approach	**-**	**184**	**-**	**26**	**D**	**-**	**196**	**-**	**86**	**F**	**-**
	Southbound	SBL	42	1	0.04	46	E	1	1	0.12	125	F	3
		SBT	-	10	0.05	29	D	2	6	0.08	56	F	2
		SBR	38	8	0.07	17	C	2	8	0.10	27	D	2
		Approach	**-**	**19**	**-**	**23**	**C**	**-**	**15**	**-**	**47**	**E**	**-**
		Intersection Overall		**970**	**-**	**8**	**-**	**-**	**1296**	**-**	**17**	**-**	**-**
Line 8 at Taucar Gate (Stop-controlled)	Eastbound	EBT	-	373	-	-	-	-	600	-	-	-	-
		EBR	-	3	-	-	-	-	7	-	-	-	-
		Approach	-	**376**	**-**	**0**	**-**	**-**	**607**	**-**	**0**	**-**	**-**
	Westbound	WBT	-	434	-	-	-	-	490	-	-	-	-
		Approach	-	**434**	**-**	**0**	**-**	**-**	**490**	**-**	**0**	**-**	**-**
	Northbound	NBR	-	26	0.06	11	B	2	10	0.05	13	B	2
		Approach	-	**26**	**-**	**11**	**B**	**-**	**10**	**-**	**13**	**B**	**-**
		Intersection Overall		**836**	**-**	**0**	**-**	**-**	**1107**	**-**	**0**	**-**	**-**
Line 8 at Noble Drive (Signalized)	Eastbound	EBL	70	44	0.12	5	A	5	68	0.16	5	A	7
		EBT	-	355	0.40	7	A	34	515	0.55	8	A	51
		EBR	-	11					33				
		Approach	-	**410**	**-**	**6**	**A**	**-**	**616**	**-**	**8**	**A**	**-**
	Westbound	WBL	75	5	0.01	4	A	1	18	0.07	5	A	2
		WBT	-	317	0.34	6	A	27	409	0.47	7	A	32
		WBR	60	5	0.02	1	A	0	13	0.03	1	A	0
		Approach	**-**	**327**	**-**	**6**	**A**	**-**	**440**	**-**	**7**	**A**	**-**
	Northbound	NBL	-	17	0.27	16	B	7	16	0.21	17	B	7
		NBT	-	5					10				
		NBR	-	19					12				
		Approach	**-**	**41**	**-**	**16**	**B**	**-**	**38**	**-**	**17**	**B**	**-**
	Southbound	SBL	55	14	0.11	20	B	5	10	0.09	20	B	4
		SBT	-	13	0.39	10	B	4	2	0.31	9	A	2

Intersection	Direction/ Movement		Available Storage Length (m)	AM Peak Hour Volume (veh/h)	AM Peak Hour V/C Ratio	AM Peak Hour Delay (sec)	AM Peak Hour LOS	AM Peak Hour 95th %ile Queue (m)	PM Peak Hour Volume (veh/h)	PM Peak Hour V/C Ratio	PM Peak Hour Delay (sec)	PM Peak Hour LOS	PM Peak Hour 95th %ile Queue (m)
		SBR	-	103					67				
		Approach	**-**	**130**	**-**	**12**	**B**	**-**	**79**	**-**	**10**	**B**	**-**
		Intersection Overall		**908**	**0.40**	**7**	**A**	**-**	**1173**	**0.55**	**8**	**A**	**-**
`Line 8 at Northgate Drive (Stop-controlled)	**Eastbound**	EBT	-	373				-	500				-
		EBR	-	12				-	34				-
		Approach	-	**385**	**-**	**0**	**-**	**-**	**534**	**-**	**0**	**-**	**-**
	Westbound	WBL	65	45	0.06	9	A	2	59	0.08	9	A	2
		WBT	-	291				-	428				-
		Approach	-	**336**	**-**	**1**	**-**	**-**	**487**	**-**	**1**	**-**	**-**
	Northbound	NBL	-	29	0.29	17	C	9	18	0.28	22	C	8
		NBR	-	59				-	43				-
		Approach	-	**88**	**-**	**17**	**C**	**-**	**61**	**-**	**22**	**C**	**-**
		Intersection Overall		**809**	**-**	**3**	**-**	**-**	**1082**	**-**	**2**	**-**	**-**
Line 8 at Lowes Gate (Stop-controlled)	**Eastbound**	EBL	-	20	0.04	9	A	1	22	0.03	9	A	1
		EBT	-	401		0	A	-	520		0	A	-
		Approach	-	**421**	**-**	**1**	**-**	**-**	**542**	**-**	**0**		**-**
	Westbound	WBT	-	301	-	-	-	-	454	-	-	-	-
		WBR	-	27	-	-	-	-	85	-	-	-	-
		Approach	-	**328**	**-**	**0**	**-**	**-**	**539**	**-**	**0**	**-**	**-**
	Southbound	SBL	-	58	0.35	20	C	12	46	0.50	36	E	20
		SBR	-	32				-	25				-
		Approach	-	**90**	**-**	**20**	**C**	**-**	**71**	**-**	**36**	**E**	**-**
		Intersection Overall		**839**	**-**	**3**	**-**	**-**	**1152**	**-**	**3**	**-**	**-**
Line 8 at Barrie Street (Signalized)	**Eastbound**	EBL	45	61	0.16	15	B	17	108	0.39	18	B	26
		EBT	-	301	0.86	47	D	#167.4	381	0.87	47	D	#172.4
		EBR	-	78					65				
		Approach	**-**	**440**	**-**	**42**	**D**	**-**	**554**	**-**	**40**	**D**	**-**
	Westbound	WBL	120	12	0.08	15	B	5	19	0.10	15	B	7
		WBT	-	188	0.37	28	C	60	365	0.60	32	C	109
		WBR	-	372	0.38	1	A	0	868	0.61	2	A	0
		Approach	**-**	**572**	**-**	**8**	**A**	**-**	**1252**	**-**	**11**	**B**	**-**
	Northbound	NBL	50	33	0.21	22	C	10	84	0.34	25	C	23
		NBT		75	0.37	45	D	30	199	0.69	51	D	71
		NBR	110	12	0.05	0	A	0	23	0.08	0	A	0
		Approach		**120**	**-**	**32**	**C**	**-**	**306**	**-**	**39**	**D**	**-**
	Southbound	SBL (dual)	152	570	0.93	62	E	#120.8	443	0.85	59	E	#99.8

Intersection	Direction/ Movement		Available Storage Length (m)	AM Peak Hour					PM Peak Hour				
				Volume (veh/h)	V/C Ratio	Delay (sec)	LOS	95th %ile Queue (m)	Volume (veh/h)	V/C Ratio	Delay (sec)	LOS	95th %ile Queue (m)
		SBT		241	0.55	36	D	72	163	0.37	33	C	52
		SBR		100	0.23	5	A	9	91	0.24	6	A	7
		Approach		**911**	**-**	**49**	**D**	**-**	**697**	**-**	**44**	**D**	**-**
		Intersection Overall		**2043**	**0.93**	**35**	**C**	**-**	**2809**	**0.87**	**29**	**C**	**-**
Line 8 at Colborne Street (Signalized)	Eastbound	EBT	-	895	0.63	15	B	77	570	0.39	11	B	46
		EBR	-	35					83				
		Approach	**-**	**930**	**-**	**15**	**B**	**-**	**653**	**-**	**11**	**B**	**-**
	Westbound	WBL	60	4	0.01	4	A	1	18	0.04	4	A	3
		WBT	-	431	0.24	6	A	21	1109	0.62	9	A	62
		Approach	**-**	**435**	**-**	**6**	**A**	**-**	**1127**	**-**	**9**	**A**	**-**
	Northbound	NBL	-	63	0.48	33	C	21	78	0.43	32	C	27
		NBR	-	15					10				
		Approach	**-**	**78**	**-**	**33**	**C**	**-**	**88**	**-**	**32**	**C**	**-**
		Intersection Overall		**1443**	**0.63**	**14**	**B**	**-**	**1868**	**0.62**		**B**	**-**
Line 8/Dissette Street at Artesian Industrial Pkwy (Signalized)	Eastbound	EBL	50	14	0.03	3	A	2	47	0.16	5	A	5
		EBT	-	873	0.40	5	A	35	510	0.23	4	A	21
		Approach	**-**	**887**	**-**	**5**	**A**	**-**	**557**	**-**	**4**	**A**	**-**
	Westbound	WBT	-	366	0.25	8	A	23	1145	0.62	13	B	86
		WBR	-	44					40				
		Approach	**-**	**410**	**-**	**8**	**A**	**-**	**1185**	**-**	**13**	**B**	**-**
	Southbound	SBL	-	20	0.39	20	B	7	60	0.54	27	C	20
		SBT	-	46					46				
		Approach	**-**	**66**	**-**	**20**	**B**	**-**	**106**	**-**	**27**	**C**	**-**
		Intersection Overall		**1363**	**0.40**	**7**	**A**	**-**	**1848**	**0.62**	**11**	**B**	**-**

Note:

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

2.6.1 SYNCHRO RESULTS - INTERSECTIONS ON LINE 8 AND 10 SIDEROAD

As presented in Table 2-6, the existing intersection capacity analysis results for the Line 8 corridor from 10 Sideroad to Barrie Street indicate that all the study area intersections are operating at an overall LOS 'C' or better with an average delay up to 35 seconds/vehicle during both the morning and afternoon peak hours. The major east-west direction movements at all the intersections show very good LOS of C or better. The intersection of 10 Sideroad and Reagens Industrial Parkway also shows very good LOS C or better for all the turning movements.

The individual movements that operate at LOS 'E' or 'F' include:

- At the stop-controlled intersection of Line 8 and Professor Day Drive, the northbound and southbound left and through movements indicate LOS F especially during PM peak hour. Auxiliary turn lanes are available for NBL, NBR and SBL direction movements. However, the volume levels for these movements are low (<50 vph) with v/c ratio less than 0.54 for all movements except for NBL with v/c ratio exceeding 1.0. The 95th percentile queue lengths for these movements are within the available storage length. Since east-west direction movements are free flowing, the north-south approach vehicles may experience higher delay while waiting to get a gap for making the turns indicating that signal controls may be necessary for the intersection to improve the operation. (Note: micro-simulation model of the corridor did not show high delay for the north and south approach movements at this intersection. This is because vehicles on these approaches were able to get gaps during the period when the upstream signalised intersections are on red phase for the east-west direction movements. That means the vehicle arrivals at this intersection is intermittent and simulation models are able to capture this phenomenon!).
- At the stop-controlled intersection of Line 8 and Lowes Gate, the southbound left-turn movement operates with LOS E. However, the volume is less than 50 veh/h with v/c ratio 0.5 indicating volume levels much below capacity. The 95th percentile queue length for the movement is also small.
- At the signalised intersection of Line 8 at Barrie Street, the southbound left-turning movement operates with LOS E during the morning and afternoon peak hours with maximum v/c ratio of 0.93 indicating that movement operates close to capacity. However, the 95th percentile queue lengths for all the movements are within the available storage length. This intersection would require improvement of signal timing/phasing plans or signal optimisation for future conditions. The intersection currently has fully actuated signal control with advanced left-turn phases and pedestrian crossings on all the approaches.

2.7 DEVELOPMENT AND CALIBRATION OF EXISTING (2022) AIMSUN MICROSIMULATION MODEL

Aimsun is an integrated traffic modelling program that incorporates macroscopic functionalities with mesoscopic and microscopic traffic simulation. It facilitates detailed assessment of traffic operations for different road network configurations and intersections, combined with dynamic traffic route choice assignment options related to the local road network, inclusive of the study area. The Aimsun model for this study builds on information and traffic data received from the town and initial traversal demand matrices based on the Transportation Master Plan (TMP) model (EMME) for the existing conditions. The following model components were incorporated in the model development.

The model was developed to include the study area described earlier (Figure 1-2). The roadway network was coded with different functional types such as major arterials, minor arterials, collectors and local road etc. and their planning capacities.

The traffic demands (traversal matrices) were extracted from the Town's travel demand forecasting model prepared as part of their Transportation Master Plan (EMME model) for weekday morning and afternoon peak hour conditions. These class-specific matrices for the study subarea were first adjusted, using *Fratar* process to the balanced traffic volumes for the subarea boundary locations (control volumes representing traffic origin-destination zones). These adjusted matrices were further refined within Aimsun model using the demand adjustment module available in Aimsun software as well as by using the real data set comprising of all the balanced existing turning movement counts (TMCs). The adjustment was performed for two vehicle classes: passenger vehicles and commercial vehicles (i.e., autos and trucks).

One key step in the calibration process involves ensuring that the simulated traffic flows replicated observed conditions, with particular emphasis of turning movement volumes on Line 8 and 10 Sideroad corridor intersections within the study area. Simulation parameters were adjusted to obtain a good match between observed and simulated conditions.

The model validation sought to ensure consistency between simulated travel time and observed travel time on Line 8, where the travel time data is available. Simulation was conducted for two hours – including shoulder peak (one hour before peak hour) hour and peak hour for both AM and PM peak period simulation runs. Existing signal timing plans as described earlier were used at the signalized intersections.

The following qualifications must be kept in mind when considering the results of the validation/calibration exercise:

- The counted traffic flows show some variations between intersections and were balanced before using it in the model.
- The traversal matrices obtained for AM and PM peak hour existing conditions (from the EMME model as part of TMP modelling) does not show proper correlation with existing counts.
- The larger areawide EMME model does not include few of the stop-controlled intersections and the corresponding crossing roads, however, the microsimulation model developed included all the intersections within the study area.
- With iterative adjustment process between the traversal matrices and the control volumes and turning movement volumes based on counts, the simulation outputs (throughputs) are brought more-or-less in line with the real balanced field counts.

The following sections summarize calibration/validation measures in the form of volume comparison tables (field, and simulated volume), comparison of travel times etc. for both the morning and afternoon peak hours.

2.7.1 OBSERVED AND SIMULATED TRAFFIC VOLUMES

The GEH Statistic is a formula used in traffic engineering, traffic forecasting, and traffic modelling to compare two sets of traffic volumes. The GEH formula gets its name from Geoffrey E. Havers, who invented it.

The GEH statistic was evaluated for each control volume (Turning Movement Volume) flow in both the peak hours to assess differences between simulated and observed volumes. It is an industry-standard validation measure for simulation models which measures the agreement between simulated and observed traffic volumes.

The formula is expressed as:

$$GEH = \sqrt{\frac{2(M-C)^2}{M+C}}$$

where M is the simulated volume and C is the observed count

Lower GEH values represent more reliable simulated traffic volumes. A GEH statistic value less than 5 may be considered as good fit. Generally achieving a situation whereby 70% of all locations have a GEH less than 5 may be considered an acceptable validation result based on the generally used industry guidelines for intersections. A GEH value >10 suggests an issue with the data or with the model. Logical and supportable corrections or adjustments shall be made to achieve a GEH ≤ 10 for all control locations.

The Aimsun model was simultaneously calibrated to observed volumes and speed/travel times as well as to the observed congestion or queuing to ensure that the

model is representing a comprehensive picture of how the Line 8 and 10 Sideroad corridors are operating so that it may be used to evaluate future baseline and alternative scenarios of improvements.

Table 2-7 summarizes the GEH compliance for the morning and afternoon peak hours as based on average simulation results from five simulation runs (replications). The modeling results indicate that all calibration targets were met during both peak hours. Overall, around 94% GEH less than 5.0 criteria and 100% GEH less than 10.0 criteria were met for both peak hours.

Table 2-7: GEH Summary (TMCs for all the intersections) – AM and PM Peak Hours

		Morning Peak Hour (8-9 AM)		Afternoon Peak Hour (4:30-5:30 PM)	
Criteria	Target	#	%	#	%
GEH<5	65-70%	103	92%	107	96%
10<GEH	90%	112	100%	112	100%

Figure 2-4 and Figure 2-5 present the scatterplots illustrating the correlation/relationship between the simulated volumes (vertical axis) and observed volumes (horizontal axis) for turning movements at intersections. Each point on the graph represents a turning movement volume data (observed and simulated). These figures also present the linear regression line, including equation and R^2 value, and an envelop defined by GEH = 5. In data comparison cases, the R-square value greater than 0.9 indicates a close fit between observed and simulated traffic volumes, where 1.0 is a perfect match. The R^2 values derived from the modelling results are over 0.98 during both peak hours, indicating a very good match between the observed and simulated volumes at the intersections.

Figure 2-4: Simulated vs Raw Counts – AM Peak Hour

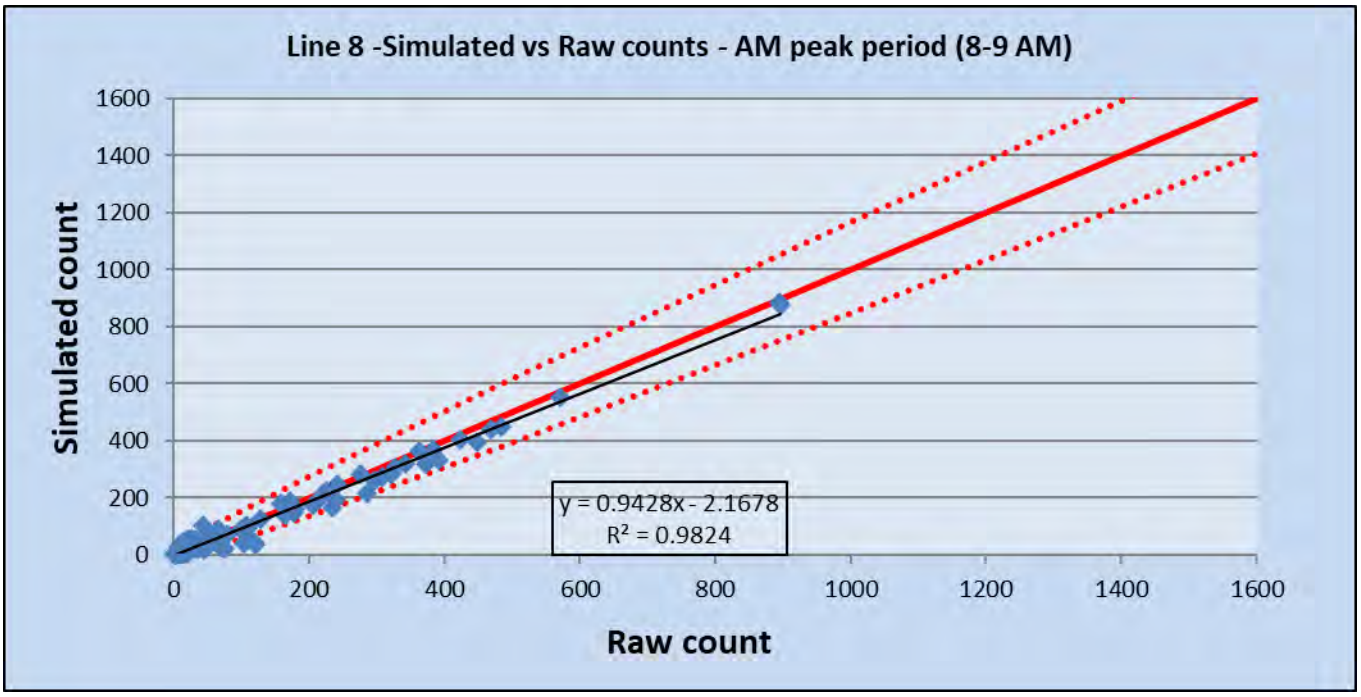
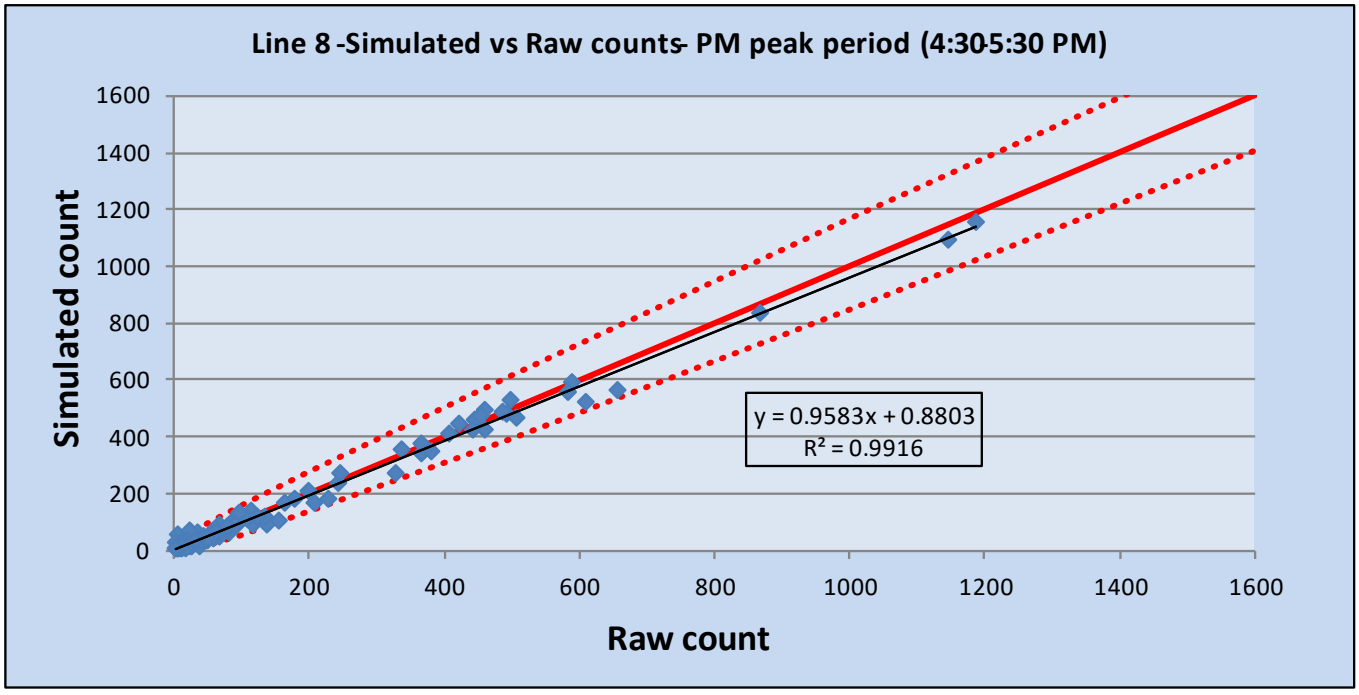


Figure 2-5: Simulated vs Raw Counts – PM Peak Hour



2.7.2 TRAVEL TIME COMPARISON

This section compares the real and simulated travel times along Line 8 corridor between 10 Sideroad and Barrie Street. The vehicle travel time data was collected by Planmac Engineering Inc. by arranging a visit to the study area during the PM peak hour. Table 2-8 presents the travel time comparison during the morning and afternoon peak hour conditions.

Table 2-8: Travel Time Comparison – Existing peak hour conditions

Morning Peak Hour					
Road Segment	**Distance in km**	**Observed Travel Time (min)**	**Simulated Travel Time (min)**	**Difference (min)**	**% Difference**
Line 8 from 10 Sideroad to Barrie Street (EB)	3.1	-	4.57	-	-
Line 8 from Barrie Street to 10 Sideroad (WB)	3.1	-	4.30	-	-
Afternoon Peak Hour					
Road Segment	**Distance in km**	**Observed Travel Time (min)**	**Simulated Travel Time (min)**	**Difference (min)**	**% Difference**
Line 8 from 10 Sideroad to Barrie Street (EB)	3.1	3.82	4.61	0.79	20.7%
Line 8 from Barrie Street to 10 Sideroad (WB)	3.1	3.83	4.25	0.42	10.9%

On comparing the travel time during afternoon peak hour, simulated travel times on Line 8 segment is higher than observed travel time by approximately 0.79 minute in the eastbound direction and 0.42 minute in the westbound direction. Generally, a 25% travel time difference is acceptable. It should be noted that the field observation is based on just one run on each direction along the corridor, while the simulation result represents the average of all vehicles that have traversed the segment during the peak hour and by considering an average of 5 replications.

2.7.3 CONCLUSION – AIMSUN MODEL CALIBRATION

Based on the volume comparisons and travel time comparisons presented in the above sections between the observed and simulated conditions for the Existing AM and PM peak hour scenarios, the micro-simulation models developed for the study area concluded to closely represent observed traffic conditions. Both AM and PM peak period simulation models can be considered as well calibrated for intersection and corridor evaluations for existing 2022 conditions. The Aimsun models developed for the existing traffic condition analysis will be updated to accommodate future road network improvements as well for evaluating various intersection alternatives. The traffic operations may be assessed for different scenarios for future conditions and preferred improvement design concept may be identified.

2.8 EXISTING CONDITIONS ANALYSIS RESULTS USING CALIBRATED AIMSUN MODEL

An evaluation of the existing operations for the intersections within the study area was performed using the calibrated Aimsun micro-simulation model. The study area, as presented in Figure 1-2, considered for micro-simulation-based intersection operational analysis included the following:

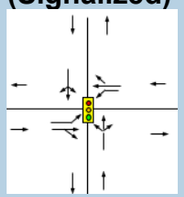
- Intersections on Line 8 from 10 Sideroad to Artesian Industrial Parkway
- Intersection on 10 Sideroad at Reagens Industrial Parkway

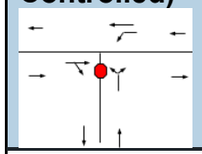
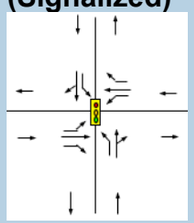
The intersection operational analysis was assessed based on average vehicular delays, level of service (LOS), queuing conditions, as well as by providing speed and queue profiles for Line 8 corridor. The LOS criteria for signalized and stop-controlled intersections were provided previously in Table 2-5. The calibrated Aimsun model files for the existing conditions are provided in Appendix A-2.

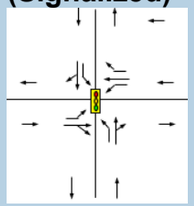
2.8.1 INTERSECTION OPERATIONAL ANALYSIS

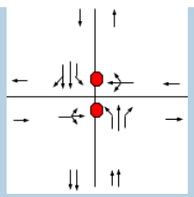
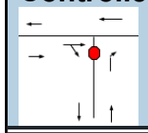
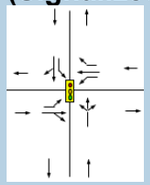
This section presents the existing weekday peak hour intersection operations within the study area. The summary of existing intersection operations during peak hours are provided in Table 2-9.

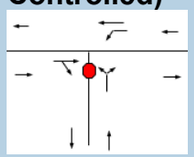
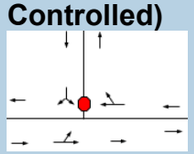
Table 2-9: Micro-simulation-based Intersection Evaluation Results – Peak hour conditions – Existing Scenario

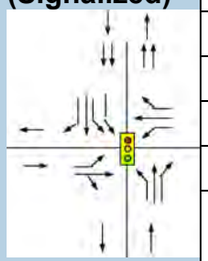
Intersection	Movement	Available Storage Length (m)	AM Peak Hour								PM Peak Hour							
			Observed Volume (Balanced)	Simulated Volume	Intersection		Movement				Observed Volume (Balanced)	Simulated Volume	Intersection		Movement			
					Delay	LOS	Delay	LOS	95th Queue (m)	Max Queue (m)			Delay	LOS	Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and 10 Side Road (Signalized) 	EBL	120	1	1	21	C	6	A	0	2	4	5	23	C	25	C	5	6
	EBT		2	2			15	B	5	6	7	8			23	C	7	8
	EBR		6	5			6	A	5	6	15	16			7	A	7	8
	WBL	80	177	148			30	C	28	31	136	84			29	C	21	23
	WBT		6	25			26	C	15	18	11	15			25	C	20	23
	WBR		57	57			10	A	15	18	117	90			11	B	20	23
	NBL		5	8			20	B	25	29	6	11			25	C	66	79
	NBT		102	87			19	B	25	29	242	237			26	C	66	79
	NBR		102	83			12	B	25	29	366	338			21	C	66	79
	SBL		107	102			21	C	33	39	94	84			29	C	48	56
	SBT		128	126			20	B	33	39	178	175			27	C	48	56
	SBR		5	3			20	C	33	39	3	3			15	B	48	56
	Intersection Overall						**21**	**C**							**23**	**C**		
Line 8 and Reagens Industrial Parkway (Stop-	EBT		180	162	2	A	1	A	0	1	461	420	4	A	2	A	0	2
	EBR		31	25			2	A	0	1	6	10			2	A	0	2
	WBL	70	67	52			2	A	6	9	30	34			4	A	6	7
	WBT		224	224			1	A	0	0	227	178			1	A	0	1
	NBL		16	7			11	B	8	13	37	10			12	B	16	18

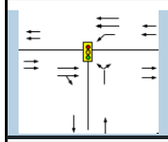
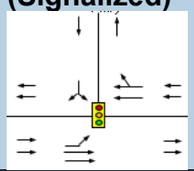
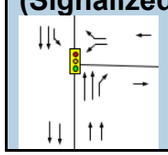
Intersection	Movement	Available Storage Length (m)	AM Peak Hour								PM Peak Hour							
			Observed Volume (Balanced)	Simulated Volume	Intersection		Movement				Observed Volume (Balanced)	Simulated Volume	Intersection		Movement			
					Delay	LOS	Delay	LOS	95th Queue (m)	Max Queue (m)			Delay	LOS	Delay	LOS	95th Queue (m)	Max Queue (m)
Controlled) 	NBR		28	32			10	A	8	13	113	138			11	B	16	18
	Intersection Overall						**2**	**A**							**4**	**A**		
Line 8 and Langford Boulevard (Signalized) 	EBL	50	27	42	10	B	9	A	7	12	67	44	9	A	6	A	9	10
	EBT		164	138			10	A	21	29	445	458			9	A	38	44
	EBR	50	17	13			4	A	4	5	62	55			4	A	6	7
	WBL	100	26	51			9	A	10	11	59	67			10	A	13	16
	WBT		234	167			11	B	20	23	208	167			8	A	18	27
	WBR	70	5	11			6	A	5	5	5	51			4	A	7	8
	NBL	40	15	10			17	B	5	5	20	20			21	C	9	11
	NBT		22	14			19	B	11	15	42	37			22	C	15	19
	NBR		21	53			7	A	11	15	43	43			7	A	15	19
	SBL	50	10	16			20	C	7	9	5	4			23	C	3	5
	SBT		22	17			23	C	15	20	30	30			20	B	10	14
	SBR		42	101			8	A	15	20	29	28			8	A	10	14
	Intersection Overall						**10**	**B**							**9**	**A**		
Line 8 and Rogers Trail	EBL	50	13	17	10	A	13	B	7	7	7	36	9	A	12	B	10	13
	EBT		172	188			9	A	22	23	22	455			9	A	40	48

Intersection	Movement	Available Storage Length (m)	AM Peak Hour								PM Peak Hour							
			Observed Volume (Balanced)	Simulated Volume	Intersection		Movement				Observed Volume (Balanced)	Simulated Volume	Intersection		Movement			
					Delay	LOS	Delay	LOS	95th Queue (m)	Max Queue (m)			Delay	LOS	Delay	LOS	95th Queue (m)	Max Queue (m)
/ Summerlyn Trail (Signalized) 	EBR		10	3			4	A	22	23	22	10			8	A	40	48
	WBL	45	32	55			9	A	10	13	10	84			9	A	16	18
	WBT		240	193			8	A	21	24	21	265			7	A	24	28
	WBR	55	75	24			4	A	5	5	5	60			4	A	6	9
	NBL	20	6	7			18	B	5	5	5	7			18	B	5	7
	NBT		33	23			16	B	16	21	16	8			23	C	10	14
	NBR		66	90			7	A	16	21	16	72			8	A	10	14
	SBL	35	120	36			22	C	10	14	10	66			21	C	15	17
	SBT		18	13			20	C	9	12	9	23			19	B	9	11
	SBR		19	30			7	A	9	12	9	13			7	A	9	11
	Intersection Overall						**10**	**A**							**9**	**A**		
Line 8 and Professor Day Drive (Stop-Controlled)	EBL		12	5	4	A	4	A	1	3	48	29	5	A	6	A	10	24
	EBT		276	282			2	A	1	3	461	489			4	A	10	25
	EBR		70	25			4	A	1	2	78	76			5	A	10	24
	WBL		159	179			4	A	15	19	154	102			6	A	20	27
	WBT		286	214			2	A	14	19	336	351			3	A	20	27
	WBR		2	3			2	A	14	19	1	25			4	A	20	27
	NBL	140	53	56			13	B	10	13	51	47			15	B	11	12
	NBT		13	33			12	B	9	12	10	10			16	C	5	6

Intersection	Movement	Available Storage Length (m)	AM Peak Hour								PM Peak Hour							
			Observed Volume (Balanced)	Simulated Volume	Intersection		Movement				Observed Volume (Balanced)	Simulated Volume	Intersection		Movement			
					Delay	LOS	Delay	LOS	95th Queue (m)	Max Queue (m)			Delay	LOS	Delay	LOS	95th Queue (m)	Max Queue (m)
	NBR		118	46			8	A	9	13	135	116			11	B	15	16
	SBL	42	1	3			10	A	3	5	1	1			5	A	1	2
	SBT		10	41			10	B	5	6	6	5			15	C	5	5
	SBR	38	8	3			7	A	5	6	8	11			8	A	5	5
	Intersection Overall						**4**	**A**							**5**	**A**		
Line 8 and Taucar Gate (Stop Controlled) 	EBT		392	332	1	A	1	A	1	6	590	590	1	A	1	A	1	14
	EBR		3	0			0	A	1	6	7	14			2	A	1	14
	WBT		447	395			0	A	0	0	491	478			0	A	0	1
	NBR		26	58			9	A	10	12	10	20			10	A	6	8
	Intersection Overall						**1**	**A**							**1**	**A**		
Line 8 and Noble Drive (Signalized) 	EBL	70	44	18	10	B	11	B	7	8	68	54	7	A	12	B	11	16
	EBT		363	363			9	A	35	40	499	523			6	A	35	39
	EBR		11	7			5	A	35	40	33	33			6	A	35	39
	WBL	75	5	2			12	B	2	3	18	16			13	B	5	7
	WBT		327	306			9	A	32	40	408	409			8	A	32	38
	WBR	60	5	6			5	A	3	4	13	35			5	A	6	8
	NBL		17	49			20	C	14	17	16	21			19	B	9	10
	NBT		5	4			22	C	14	17	10	4			21	C	9	10

Intersection	Movement	Available Storage Length (m)	AM Peak Hour								PM Peak Hour							
			Observed Volume (Balanced)	Simulated Volume	Intersection		Movement				Observed Volume (Balanced)	Simulated Volume	Intersection		Movement			
					Delay	LOS	Delay	LOS	95th Queue (m)	Max Queue (m)			Delay	LOS	Delay	LOS	95th Queue (m)	Max Queue (m)
	NBR		19	8			10	B	14	17	12	14			8	A	9	10
	SBL	55	14	12			21	C	6	8	10	7			18	B	6	9
	SBT		13	16			18	B	9	13	2	1			12	B	5	7
	SBR		103	40			7	A	9	13	67	49			7	A	9	12
	Intersection Overall						**10**	**B**							**7**	**A**		
Line 8 and Northgate Drive (Stop-Controlled) 	EBT		384	369	3	A	2	A	0	0	487	483	2	A	3	A	0	0
	EBR		12	15			3	A	0	0	34	59			3	A	0	1
	WBL	65	45	38			3	A	6	8	59	42			3	A	5	7
	WBT		308	273			0	A	0	0	421	445			0	A	0	0
	NBL		29	42			12	B	10	11	18	18			14	B	11	15
	NBR		59	51			9	A	10	11	43	46			10	B	11	15
	Intersection Overall						**3**	**A**							**2**	**A**		
Line 8 and Lowes Gate (Stop-Controlled) 	EBL		20	17	2	A	3	A	6	17	22	63	3	A	5	A	23	29
	EBT		423	403			1	A	6	17	508	466			1	A	23	29
	WBT		321	283			1	A	0	0	455	468			2	A	0	0
	WBR		27	37			2	A	0	0	85	81			3	A	0	0
	SBL		58	49			12	B	10	16	46	41			14	B	10	13
	SBR		32	28			10	A	10	16	25	19			11	B	9	13
	Intersection Overall						**2**	**A**							**3**	**A**		

Intersection	Movement	Available Storage Length (m)	AM Peak Hour								PM Peak Hour							
			Observed Volume (Balanced)	Simulated Volume	Intersection		Movement				Observed Volume (Balanced)	Simulated Volume	Intersection		Movement			
					Delay	LOS	Delay	LOS	95th Queue (m)	Max Queue (m)			Delay	LOS	Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and Barrie Street (Signalized) 	EBL	45	61	60	30	C	30	C	14	17	108	108	21	C	22	C	19	22
	EBT		342	321			37	D	73	88	381	343			25	C	60	80
	EBR		78	73			30	C	73	88	65	53			17	B	60	80
	WBL	120	12	6			16	B	4	7	19	32			17	B	10	16
	WBT		215	198			23	C	33	42	365	370			16	B	43	51
	WBR		372	321			0	A	2	3	868	835			1	A	8	13
	NBL	50	33	33			18	B	8	13	84	92			14	B	14	20
	NBT		75	63			32	C	17	20	199	204			26	C	38	48
	NBR	110	12	36			6	A	5	8	23	27			7	A	6	7
	SBL (dual)	152	570	552			32	C	41	43	443	419			26	C	30	33
	SBT		241	249			32	C	43	48	163	165			25	C	27	37
	SBR		100	89			7	A	11	12	91	87			5	A	10	12
	Intersection Overall						**30**	**C**							**21**	**C**		
Line 8 and Colborne Street (Signalized)	EBT		895	886	14	B	16	B	52	56	657	563	9	A	9	A	35	39
	EBR		35	24			14	B	52	56	96	131			9	A	35	39
	WBL	60	4	3			12	B	3	5	18	1			5	A	1	1
	WBT		484	447			8	A	23	28	1187	1156			7	A	45	53
	NBL		63	57			29	C	16	21	78	83			26	C	21	26
	NBR		15	6			15	B	16	21	10	12			10	B	21	26

Intersection	Movement	Available Storage Length (m)	AM Peak Hour								PM Peak Hour							
			Observed Volume (Balanced)	Simulated Volume	Intersection		Movement				Observed Volume (Balanced)	Simulated Volume	Intersection		Movement			
					Delay	LOS	Delay	LOS	95th Queue (m)	Max Queue (m)			Delay	LOS	Delay	LOS	95th Queue (m)	Max Queue (m)
	**Intersection Overall**						**14**	**B**							**9**	**A**		
Line 8 and Artesian Industrial Parkway (Signalized)	EBL	50	14	7	8	A	7	A	3	4	57	49	9	A	16	B	12	16
	EBT		896	877			7	A	43	49	610	519			5	A	22	25
	WBT		468	438			9	A	26	31	1145	1091			10	B	39	46
	WBR		44	35			8	A	26	31	40	35			10	A	39	46
	SBL		46	32			33	C	11	15	46	40			24	C	17	24
	SBR		20	6			9	A	11	15	60	59			9	A	17	24
	**Intersection Overall**						**8**	**A**							**9**	**A**		
10 Sideroad and Reagens Industrial Parkway (Signalized)	WBL	30	53	37	8	A	20	B	10	12	122	114	6	A	16	B	16	22
	WBR		4	1			2	A	2	4	31	29			8	A	5	10
	NBT		205	175			8	A	10	12	583	553			4	A	15	16
	NBR	50	109	95			4	A	9	11	48	36			3	A	5	5
	SBL	60	16	7			15	B	5	5	2	5			10	B	5	5
	SBT		296	262			8	A	15	18	327	267			4	A	12	15
	**Intersection Overall**						**8**	**A**							**6**	**C**		

Morning Peak Hour

As presented in Table 2-9, all the study area intersections operate at overall acceptable LOS “C” or better under the existing conditions during the morning peak hour with an average vehicular delay up to 30 seconds. None of the individual movements have been identified as critical movement – operating at LOS “E/F”. The individual movements operate with an average vehicular delay of up to 37 seconds. Also, 95th percentile queue lengths for all turning lanes are within the available storage lengths under existing conditions.

Afternoon Peak Hour

Similar to that of AM peak hour conditions, Table 2-9, indicate that all the study area intersections operate at good LOS “C” or better during the afternoon peak hour with an average vehicular delay up to 23 seconds. All the individual movements operate without any issues during the afternoon peak hour at LOS “C” or better with an average vehicular delay up to 29 seconds. Also, 95th percentile queue lengths for all turning lanes are within the available storage lengths under existing conditions.

Overall, all the intersections in the study area show very good LOS with queue lengths within available storage lengths for both AM and PM peak hour conditions.

2.8.2 MAXIMUM QUEUE LENGTHS

To review the queue lengths more thoroughly, queue plots for the Line 8 intersections are generated from model outputs for both eastbound and westbound directions for both peak hours. These queue plots show the maximum queue lengths observed in an hour (morning/afternoon peak hour) at the study area intersections and indicate if these maximum queues extend back to the upstream intersections. The queue plots represent the worst-case conditions that may occur during a particular situation in the peak hour (when the signal phase is on red), but do not last throughout the entire peak hour.

The existing conditions queue plots for the Line 8 intersections during the morning peak and afternoon peak hours in both the eastbound and westbound directions are presented in Figure 2-6 and Figure 2-7, respectively. The queue length plots indicate that in the study area intersections, none of the intersections have eastbound or westbound queue reaching the upstream intersections for both AM and PM peak hour conditions.

Figure 2-6: Plot of Maximum Queue Lengths – Morning Peak Hour Eastbound and Westbound – Existing Conditions

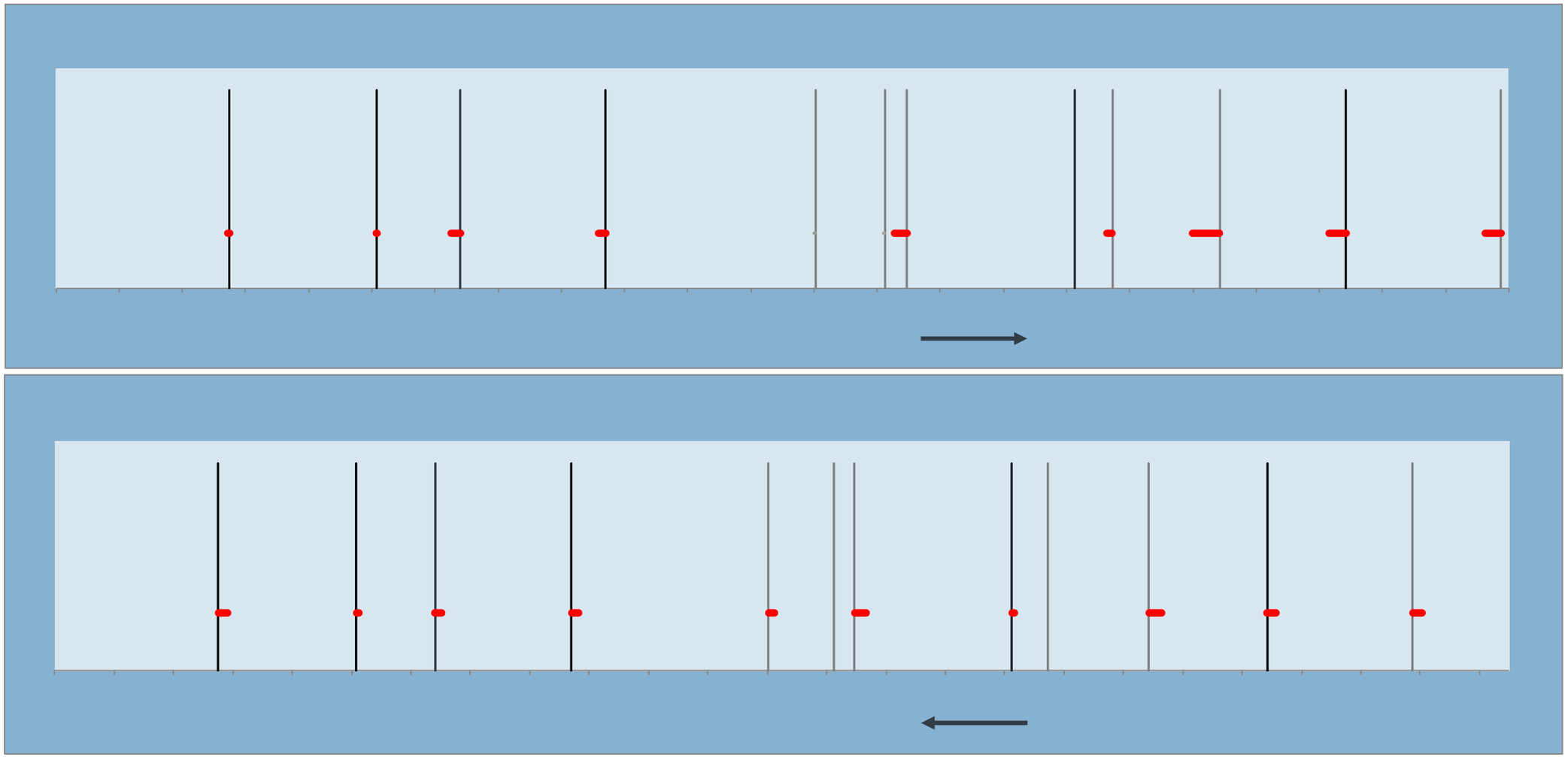
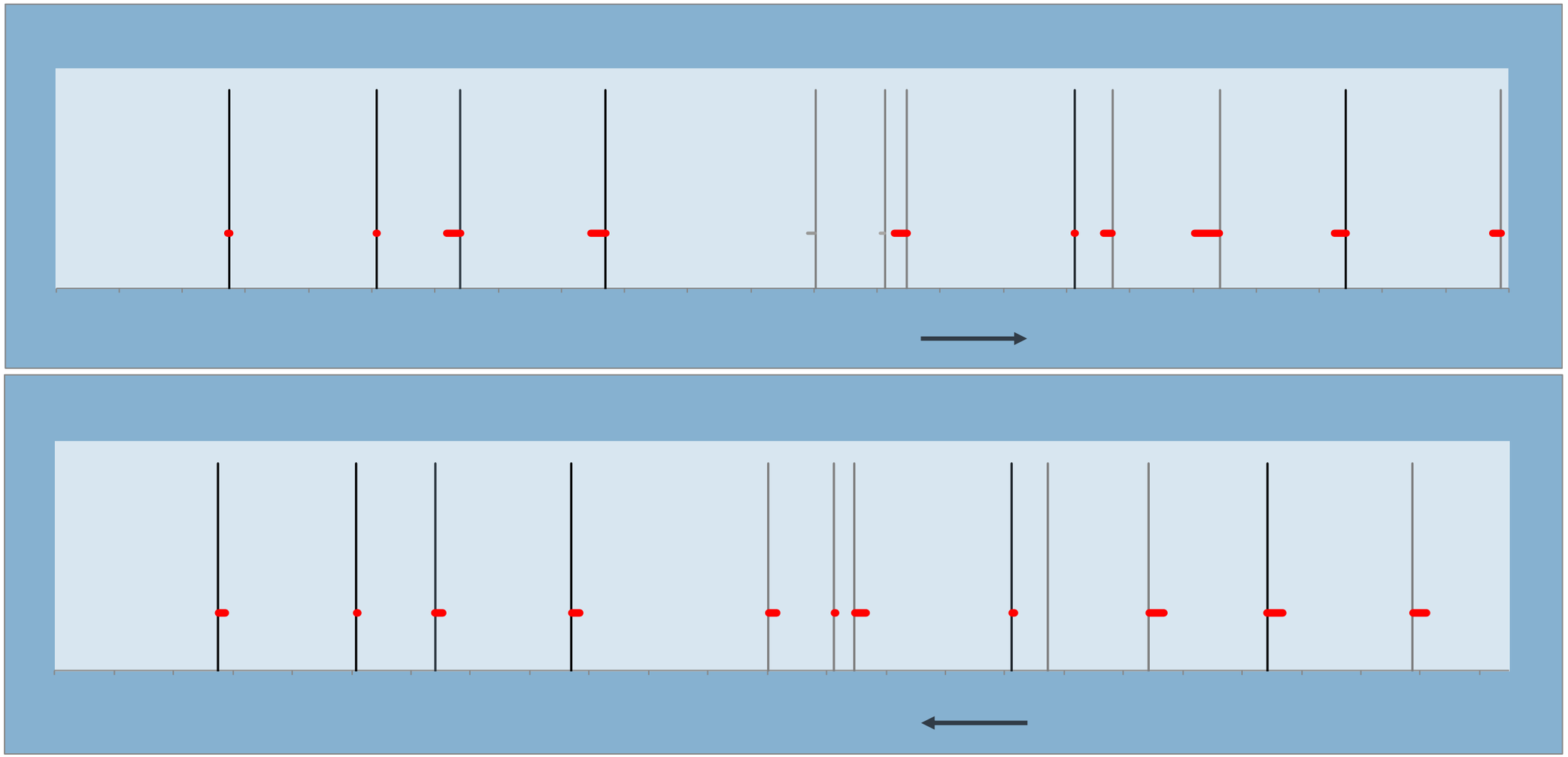


Figure 2-7: Plot of Maximum Queue Lengths – Afternoon Peak Hour Eastbound and Westbound – Existing Conditions



2.8.3 SPEED CONTOUR PLOTS

To evaluate the existing operations on Line 8, speed contour plots were developed utilizing the model outputs for both eastbound and westbound directions for both peak hours. These speed plots show the average speed of vehicles along the Line 8 corridor between 10 Sideroad and Artesian Industrial Parkway for each 2-minute interval during a peak hour. The horizontal distance is divided into 50 m intervals and vertical axis divided into 2-minute intervals.

The existing conditions Line 8 speed contour plots during the morning and afternoon peak hours in both the eastbound and westbound directions are presented in Figure 2-8 and Figure 2-9, respectively.

Morning Peak Hour

The speed contour plots, presented in Figure 2-8, indicate that Line 8 operates close to the posted speed limit of 40-50 km/h during the morning peak hour. The localized speed reductions to 20-30 km/h are observed at Line 8 and Barrie Street in the eastbound direction and 30-40 km/h speed at all other signalised intersections. These localised average speed reductions at the intersections are attributed to the traffic signal operations.

Afternoon Peak Hour

The speed contour plots, presented in Figure 2-9, indicate that Line 8 operates well without major speed reductions during the afternoon peak hour. Similar to that of AM peak hour conditions, localised average speed reductions to 30-40 km/h occurs at all the signalised intersections.

It can be concluded from the existing conditions speed contour plots that Line 8 provides very good operations during both morning and afternoon peak hour conditions.

Figure 2-8: Speed Contour Plot for Line 8 – Morning Peak Hour Eastbound and Westbound – Existing Conditions

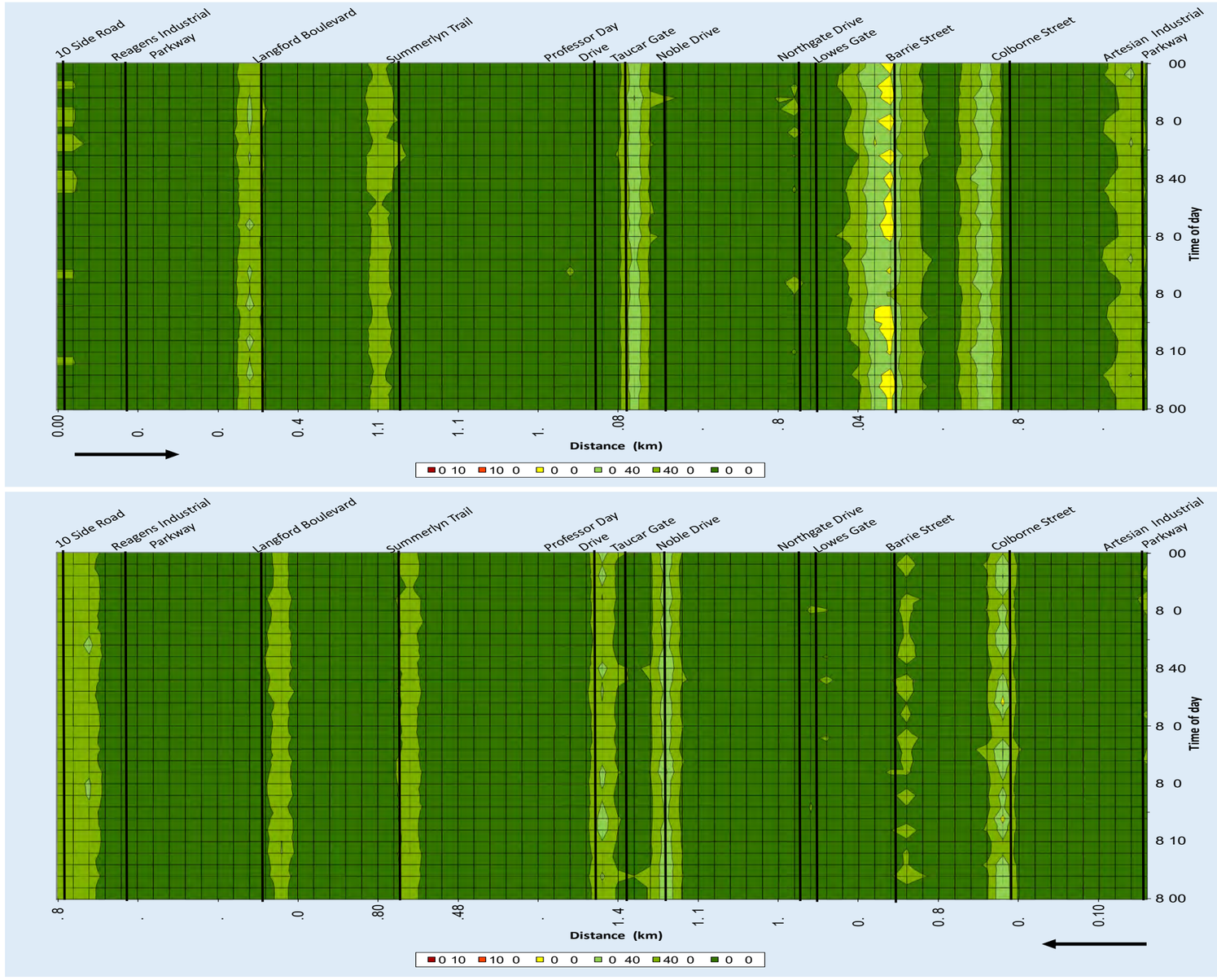
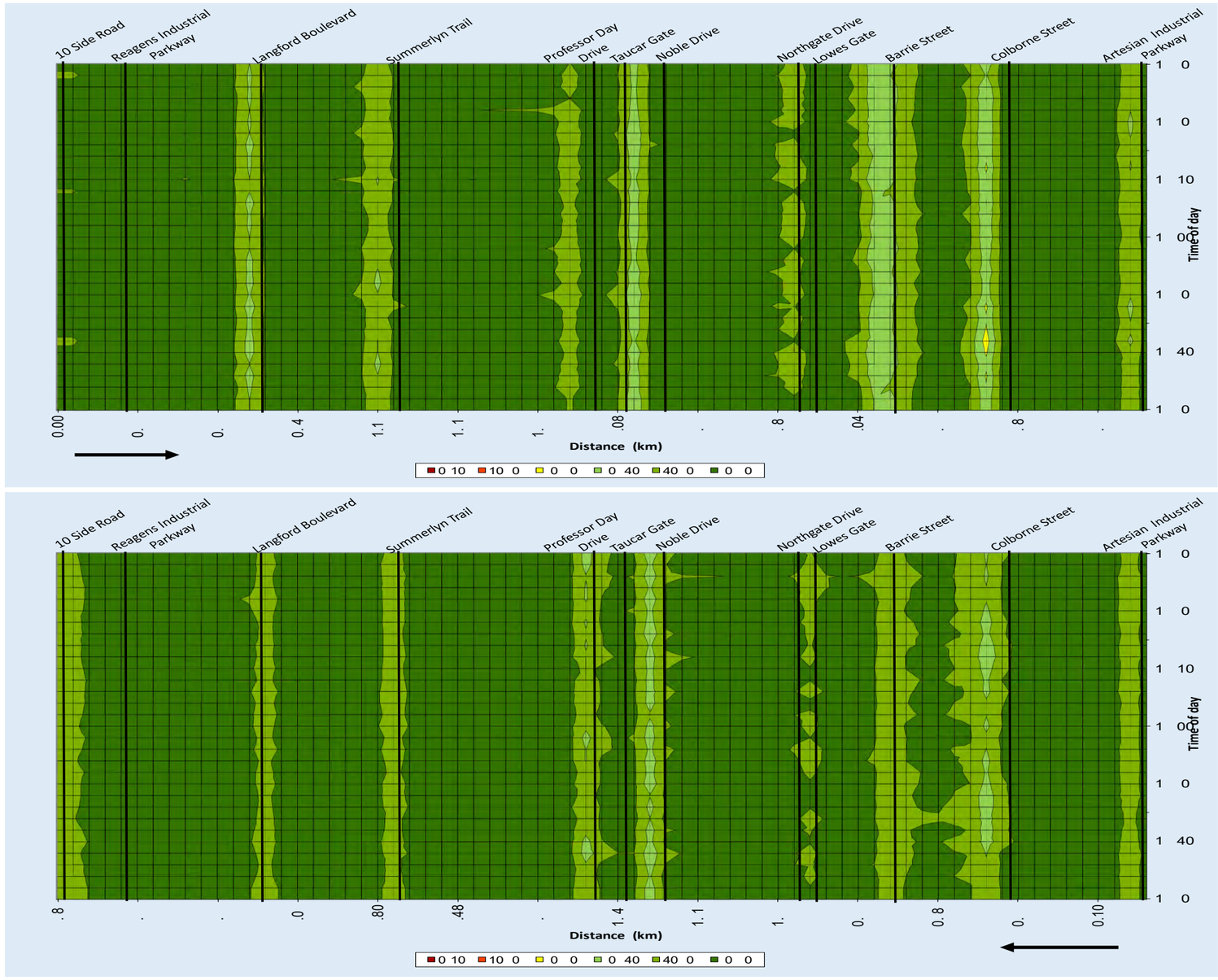


Figure 2-9: Speed Contour Plot for Line 8 – Afternoon Peak Hour Eastbound and Westbound – Existing Conditions



2.8.4 CONCLUSION BASED ON MICRO-SIMULATION ANALYSIS

Based on the operational evaluation of intersections on Line 8 and 10 Sideroad within the study area, using the calibrated micro-simulation models have shown very good operation for all the intersections under Existing AM and PM peak hour conditions. The calibrated 2022 AM and PM peak period Aimsun models will be used as base for developing future conditions models for assessment as well as for the development of alternative scenarios for improvements.

2.9 PROPOSED TEMPORARY SIGNALS AT THE PROFESSOR DAY DRIVE INTERSECTION

The temporary new signals are expected to be installed on the Line 8 intersection with Professor Day Drive in the winter 0 4. The intersection currently operates with “two-way-stop-control”, where the eastbound and westbound movements along Line 8 operate without any controls (i.e., free flow movements). An annual growth rate of 4% was applied to the existing 2022 peak hour traffic volumes to reflect the 2024 traffic conditions. The Synchro analysis was conducted using the designed new signal timings for this intersection and the results are presented in Table 2-10.

Table 2-10: Synchro based Professor Day Drive Intersection Evaluation Results with Temporary Signals – Peak hour conditions – Existing 2024 Scenario

Intersection	Direction/ Movement		Available Storage Length (m)	AM Peak Hour						PM Peak Hour					
				Signal Timing Plan – Splits (sec)	Volume (veh/h)	V/C Ratio	Delay (sec)	LOS	95th %ile Queue (m)	Signal Timing Plan – Splits (sec)	Volume (veh/h)	V/C Ratio	Delay (sec)	LOS	95th %ile Queue (m)
Line 8 at Professor Day Drive (New Signals)	Eastbound	EBL		Cycle 0 EBT 44 WBT 44 NBT SBT Control Type Semi actuated Uncoordinated	1	0.		A		Cycle 0 EBT 44 WBT 44 NBT SBT Control Type Semi actuated Uncoordinated		0.	10	A	80
		EBT			4						0				
		EBR									84				
		Approach			**365**	**-**	**7**	**A**	**-**		**641**	**-**	**10**	**A**	**-**
	Westbound	WBL			1	0.	11	B	8		1	0.8	1	C	#
		WBT													
		WBR									1				
		Approach	**-**		**466**	**-**	**11**	**B**	**-**		**530**	**-**	**21**	**C**	**-**
	Northbound	NBL	140			0.44	0	C	1		1	0.	8	C	1
		NBT			14	0.0	1	C			11	0.0	1	C	4
		NBR			1	0. 0		A			14	0.48	8	A	8
		Approach	**-**		**198**	**-**	**16**	**B**	**-**		**208**	**-**	**14**	**B**	**-**
	Southbound	SBL	4		1	0.0	0	B	1		1	0.0	0	B	1
		SBT			11	0.0	14	B				0.0	1	B	
		SBR	8												
		Approach	**-**		**21**	**-**	**14**	**B**	**-**		**16**	**-**	**15**	**B**	**-**
	Intersection Overall				**1050**	**-**	**11**	**B**	**-**		**1395**	**-**	**15**	**B**	**-**
Phasing Diagram															

Note # :95th percentile volume exceeds capacity; queue may be longer. If the reported v/c < 1 for the movement, the methods used represent a valid method for estimating the 95th percentile queue. In practise, 95th percentile queue shown will rarely be exceeded and the queues shown with the # footnote are acceptable for the design of storage bays.

As presented in Table 2-10, the Professor Day Drive intersection is expected to operate at an overall very good LOS “B” in both the peak hours, and all the individual movements would operate at LOS “C” or better during the morning and afternoon peak hours.

3 FUTURE (2031) TRAFFIC CONDITIONS

3.1 FUTURE DEMAND

For the Town's Transportation Master Plan evaluations, the future horizon year of 2031 has been considered. To assess the impact on the functionality and service levels of the Line 8 and 10 Sideroad corridor study area network with future demand, the existing calibrated microsimulation model was updated for future conditions. Traversal matrices obtained from the updated EMME based macro level travel demand model based on the future 2031 population and employment projections, and other network and mode share expectations were used as input for developing demand matrices to be used in the future microsimulation models. The 2031 EMME based traversal matrices were adjusted based on the difference between Existing EMME based Traversal Matrices and the Existing Demand Matrices for the Calibrated Aimsun model. Future scenarios were modelled for the 2-hour AM and PM peak periods for the 2031 conditions.

It must be noted that all Future 2031 alternatives considered the completion of the proposed Highway 400-404 connecting link as well as the Holland Street Diet condition as proposed under Schedule 'C' Municipal Class Environmental Assessment (MCEA) Study for Holland Street East and West (October 2022).

As mentioned earlier, the Highway 400-404 connecting link would connect Provincial Highway 404 between Line 8 and Line 9 (located north of the Holland Street corridor in the Town of Bradford West Gwillimbury) to Provincial Highway 400 between Queensville Sideroad and Holborn Road (located in the Town of East Gwillimbury). The connecting link is expected to relieve traffic on Line 8, Line 9, Holland Street, Dissette Street and Bridge Street etc. by attracting the influx of traffic that travels to/from Highway 404 via these corridors.

3.1.1 INPUT DEMAND COMPARISON – EMME TRAVERSAL AND CALIBRATED AIMSUN BASED

A comparison of EMME based Traversal Demand and adjusted demand for the 2031 Aimsun model for the AM and PM peak hours are illustrated in Table 3-1. Demand comparison with respect to Existing Conditions are also included. It may be noted that there is an increase of approximately 24%-53% volumes for traversals between Existing and Future conditions (with Bradford Bypass and Holland Street Diet conditions).

The calibrated model demand used in Aimsun got decreased by 23%-36% under Existing Conditions and 13%-22% for Future conditions with respect to the corresponding Traversal Matrices from EMME.

Table 3-1: Origin – Destination (OD) Demand comparison

OD Demand (veh/h)	AM		PM	
	Existing	2031	Existing	2031
EMME Subarea Traversal OD Demand	5,299	6,583	5,834	7,890
Aimsun Adjusted Traversal OD Demand	3,416	5,114	4,516	6,889
Difference - EMME and Calibrated	**1,883 (36%)**	**1,469 (22%)**	**1,318 (23%)**	**1,001 (13%)**

3.1.2 ESTIMATED FUTURE INTERSECTION TURNING MOVEMENT VOLUMES

Figure 3-1 shows approximate turning movement volumes expected at the intersections on Line 8 and 10 Sideroad for the 2031 weekday AM and PM peak hours based on the Future Aimsun model output.

Figure 3-1: Estimated weekday AM and PM peak hour Turning Movement Volumes (2031) – Line 8 and 10 Sideroad intersections

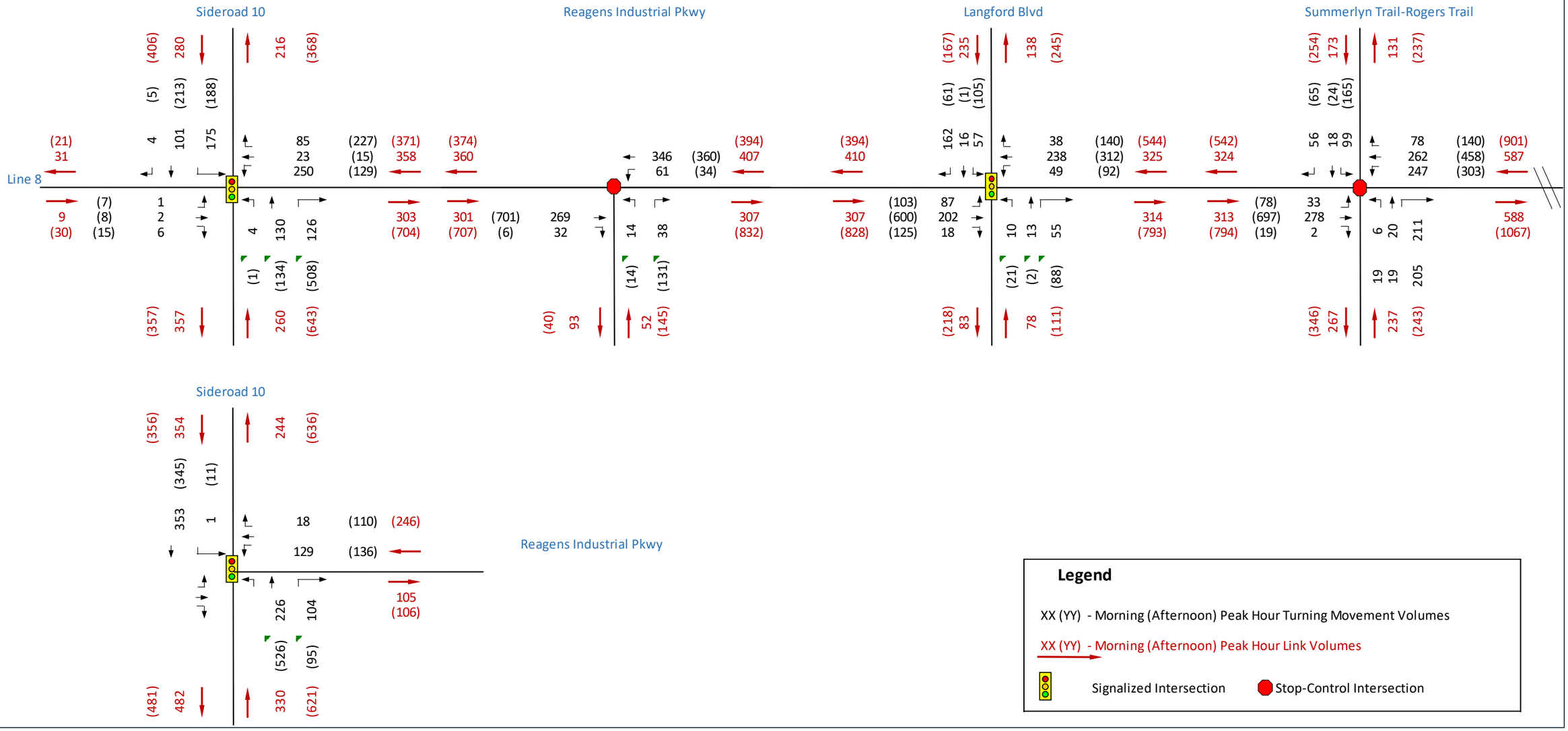


Figure 3-1: Estimated weekday AM and PM peak hour Turning Movement Volumes (2031) – Line 8 and 10 Sideroad (continued)

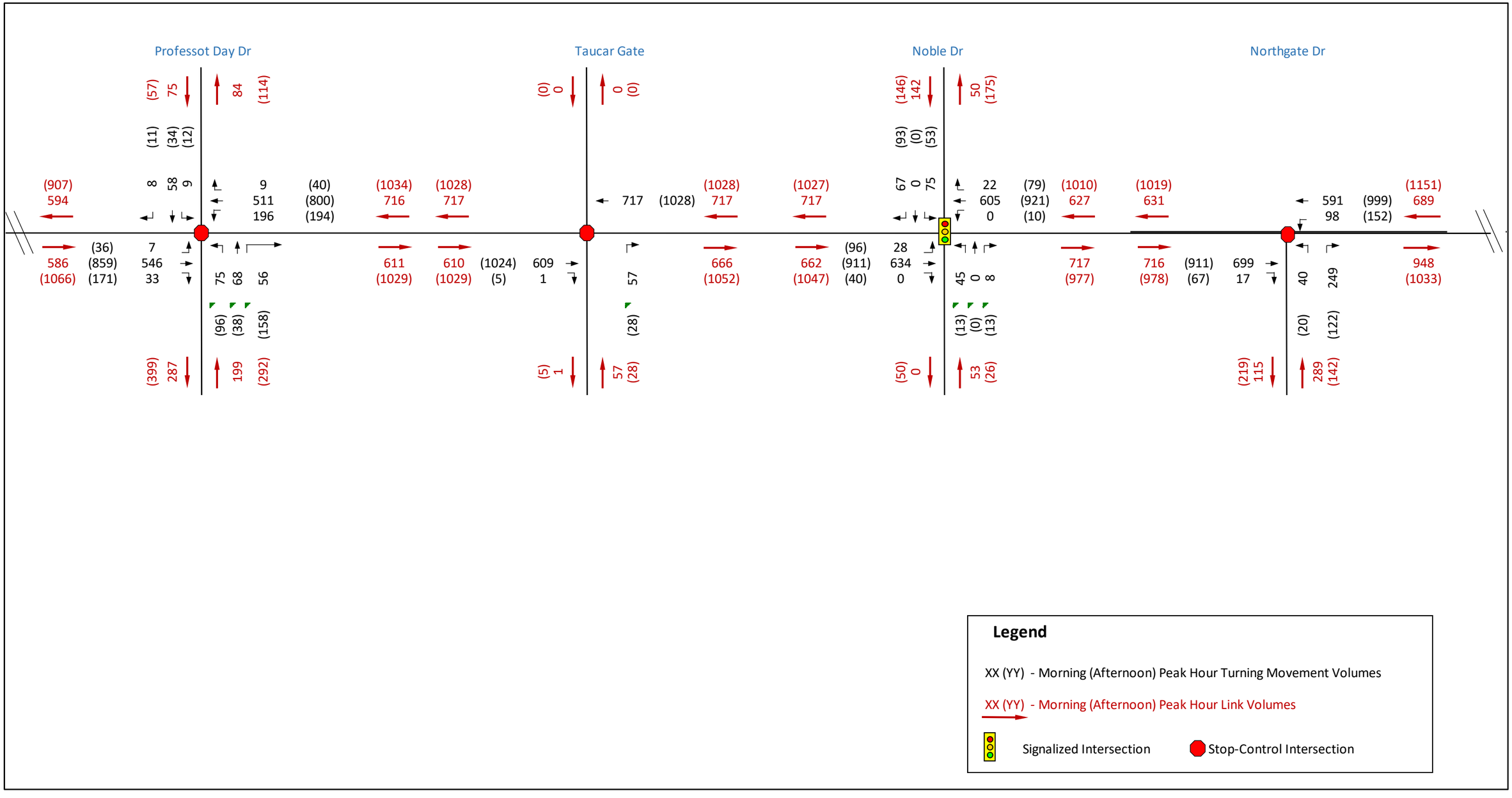
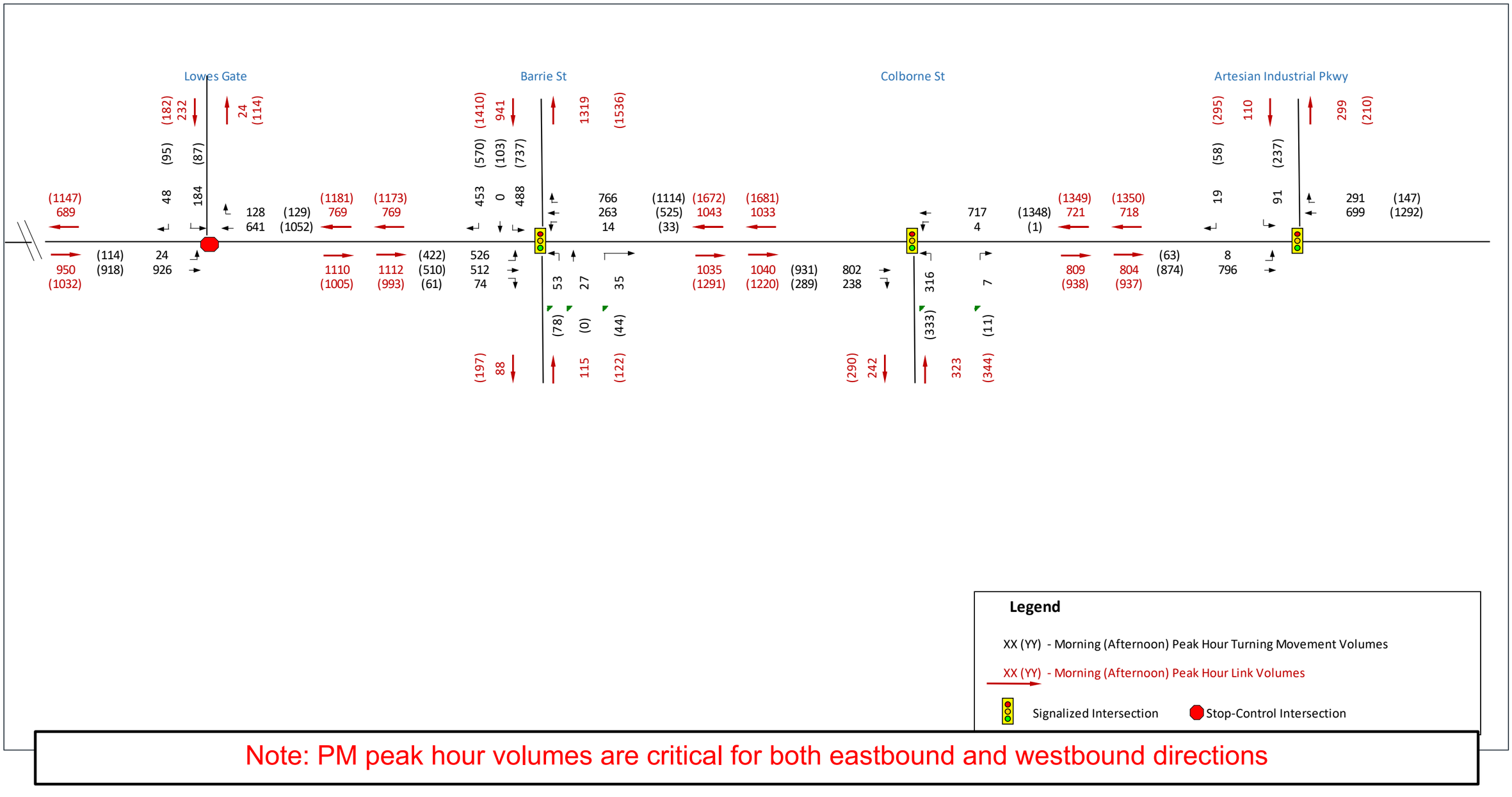


Figure 3-1: Estimated weekday AM and PM peak hour Turning Movement Volumes (2031) – Line 8 and 10 Sideroad (continued)



Note: PM peak hour volumes are critical for both eastbound and westbound directions

3.1.3 ESTIMATED FUTURE ANNUAL AVERAGE DAILY TRAFFIC (AADT) VOLUMES

The following methodology was used for calculating AADT volumes:

- Existing AADT: from the 24-hour count for existing conditions, calculate AADT by applying a seasonality factor assuming urban commuter Type.
- Future 2031 AADT: For Future 2031 with Bradford Bypass and Holland Diet conditions, we only have estimated AM and PM peak hour volumes on intersections on Line 8 and Sideroad 10 corridors. The following steps were adopted for obtaining 2031 AADT:
    A. Calculate a factor between the Existing AADT for a section and the EB and WB AM and PM peak hour volume totals.
    B. Calculate 2031 Estimated EB and WB AM and PM peak hour volume totals.
    C. Apply the factor from Step A to the total from Step B to obtain 2031 AADT for the section.

Table 3-2 provides AADT (considering both directions combined) for Line 8 and Sideroad 10 sections for Existing (2022) and Future (2031) conditions. Truck percentages were assumed as in existing.

Table 3-2: Estimated AADT and Truck Percentages

Location	Existing (2022) AADT	Future (2031) AADT	Truck percentage (Existing)
Line 8 – East of Barrie Street	20,680	29,330	5.1%
Line 8 – between Barrie Street and Lowes Gate	10,950	24,010	4.9%
Line 8 – between Lowes Gate Northgate Drive	10,050	21,620	5.2%
Line 8 – between Northgate Drive and Noble Drive	9,460	18,700	5.3%

Line 8 – between Noble Drive and Taucar Gate	10,360	18,350	5.1%
Line 8 – between Taucar Gate and Professor Day Drive	11,030	23,260	4.8%
Line 8 – between Professor Day Drive and Summerlyn Trail/Rogers Trail	9,880	18,830	5.6%
Line 8 – between Summerlyn Trail/Rogers Trail and Langford Blvd.	7,880	12,360	6.4%
Line 8 – between Langford Blvd. and Reagens Industrial Pkwy	8,920	12,120	5.7%
Line 8 – between Reagens Industrial Pkwy and Sideroad 10	7,780	11,680	6.3%
Line 8 – west of Sideroad 10	470	650	8%
Sideroad 10 – between Line 8 and Reagens Industrial Pkwy	9,720	11,440	5%
Sideroad 10 – just south of Reagens Industrial Pkwy	11,800	12,980	6.7%

3.1.4 FUTURE (2031) ALTERNATIVE SCENARIOS

Table 3-3 provides a list of various alternative scenarios assessed for the future traffic operational analysis of the study area network and the features assumed.

Table 3-3: Future (2031) Alternative Scenarios description

Scenarios	Changes with respect to Existing Configuration/Intersection control/Pedestrian facilities
Do-Nothing ***(Section 3-1)***	Same configuration as in Existing
Alternative 1 ***(Section 3-2)***	**Widening:** • An additional EBT (eastbound through) lane from Noble Drive to Barrie Street. **At Line 8 & Barrie Street Intersection:** • Increased EB left-turn lane storage length to 150 m. • Eastbound approach configuration: 1EBL+1EBT+1EBTR. • Increased EB left-turn phase Max green from 7sec to 15 sec. **At Line 8 & Professor Day Drive Intersection:** • Intersection signalised (fully actuated, pedestrians not considered) from Stop-control. • Storage lanes added for EB left-turn and WB left-turn movements. **Pedestrian Crossing facilities:** As in Existing but with 5 times existing volume of pedestrians/hour.

Alternative 2 ***(Section 3-3)***	**Widening:** • An additional EBT lane from Summerlyn/Rogers Trail to Barrie Street. • An additional WBT lane from Barrie Street to Lowes Gate. • 2 lanes each direction on Barrie Street north of Line 8. **At Line 8 & Barrie Street Intersection:** • Increased EBL Lane storage length to 150 m. • Eastbound approach configuration: 1EBL+1EBLT+1EBTR. • Southbound approach configuration:1SBR+1SBT+2SBL. **At Line 8 & Professor Day Drive Intersection:** • Intersection signalised (fully actuated, pedestrians not added) from Stop-control. • Storage lanes added for EB left-turn and WB left-turn movements. **Pedestrian Crossing facilities:** • As in Existing but with 5 times existing volume of pedestrians/hour.
Alternative 3 ***(Section 3-4)***	**Widening:** • An additional EBT lane from Noble Drive to Barrie Street with the additional lane becomes the second left-turn lane at Barrie Street intersection. **Intersection Control:** • Signal Control at Line 8 & Professor Day Drive (kept same lane configuration as in Existing for north and south approaches). • Signal control at the intersection of Line 8 and Northgate Drive. • For the above intersections, N-S direction signal flashing DON'T WALK will be activated only upon pedestrian activation. **At Line 8 & Barrie Street intersection:** • Increased EB left-turn lane storage length to 150 m. • Added an additional EB left-turn lane (dual left-turn provided for EB direction). • NB direction north of Line 8, additional lane added to accept traffic from dual EB left turn and reduced to a single lane at north end (as in existing). • Revised signal plan used. **At Line 8 & Professor Day Drive Intersection:** • Intersection signalised (fully actuated, pedestrians crossing considered). • Storage lanes added for EB left-turn and WB left-turn.

	• Added protected WB left-turn phase at Professor Day Drive (because of high WB left-turn volume, a protected phase is justified). **At Line 8 and 10 Sideroad:** • Added NB right-turn and SB left-turn lanes of 80 m each. **Pedestrian Crossing facilities:** • Pedestrian crossing facilities included at all signalised intersections. • Assumed 20 ped/h crossing at all the crossing (under existing condition it is 0-5 ped/h).
Alternative 4 – Preferred Alternative *(Section 3-5)*	**Widening:** • An additional EBT lane from Professor Day Drive to Barrie Street with the additional lane becomes the second left-turn lane at Barrie Street intersection. • An additional WBT lanes from Barrie Street to Noble Drive. **Intersection Control:** • Signal Control at Line 8 & Professor Day Drive (kept same lane configuration as in Existing for north and south approaches). • Signal control at the intersection of Line 8 and Northgate Drive. • For the above intersections, N-S direction signal flashing DON'T WALK will be activated only upon pedestrian activation. **At Line 8 & Barrie Street intersection:** • Increased EB left-turn lane storage length to 150 m. • Added an additional EB left-turn lane (dual left-turn provided for EB direction). • NB direction north of Line 8, additional lane added to accept traffic from dual EB left turn and reduced to a single lane at north end (as in existing). • Added an EB right-turn lane (70 m) - may not be required, but it will improve eastbound operation. • Revised signal plan used. **At Line 8 & Professor Day Drive Intersection:** • Intersection signalised (fully actuated, pedestrians crossing considered). • Storage lanes added for EB left-turn and WB left-turn.

	• Added protected WB left-turn phase at Professor Day Drive (because of high WB left-turn volume, a protected phase is justified). **At Line 8 and 10 Sideroad Intersection:** • Added NB right-turn and SB left-turn lanes of 80 m each. **At Line 8 and Rogers Trail/Summerlyn Trail Intersection:** • Increased WB left-turn and SB left-turn storage lengths. **Pedestrian Crossing facilities:** • Pedestrian crossing facilities included at all signalised intersections. • Assumed 20 ped/h crossing at all the crossing (under existing condition it is 0-5 ped/h).

The future traffic operational analysis was conducted for the AM and PM peak period conditions for 2031 planning horizon year using the signal timing plans as specified. The lane configurations assumed for each alternative were coded in the future Aimsun models to perform the future traffic operational analysis. The Aimsun files for the future conditions are provided in Appendix A-3. The following sections provide the evaluation results of the above Alternative Scenarios.

3.2 DO-NOTHING SCENARIO

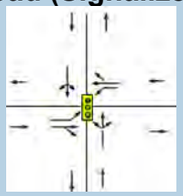
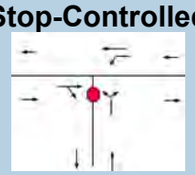
Do-Nothing (2031) Scenario considered existing (2022) lane configurations on Line 8 and 10 Sideroad corridors and intersections. As mentioned earlier, the connecting link between Highway 400 and Highway 404 and Holland Street Diet conditions were considered in Future EMME models while extracting traversal matrices. It should be noted that there is approximately 50% and 53% increase in total demand for the modelled study area network for the AM and PM peak hour respectively with respect to corresponding demands for the Existing Network.

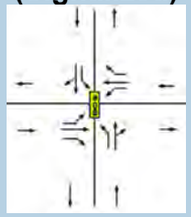
3.2.1 INTERSECTION OPERATIONAL ANALYSIS

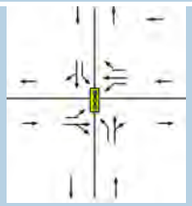
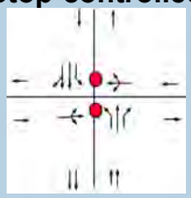
This section presents the Do-Nothing (2031) peak hour intersection operations within the study area. The summary of Do-Nothing (2031) intersection operations during the peak hours are provided in Table 3-4. The operation performance evaluation from the Table 3-4 indicates the following:

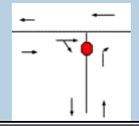
- For both AM and PM peak hours, Do-Nothing (2031) Scenario operational analysis results indicate that the study area intersections are expected to operate at an overall LOS “C” or better for all the intersections except for intersections on Line 8 at Barrie Street, Lowes Gate and Northgate Drive with LOS “E/F”. These intersections show severe operational impact for the eastbound direction movement with queue from Barrie Street intersection extending back to the west of Northgate Drive. Poor performance at Lowes Grate and Northgate Drive are due to this eastbound direction queue. Since these intersections would be blocked by queueing, traffic from the side streets may not get gap for turning on to Line 8 as indicated by poor LOS for turning from north and south respectively at Lowes Gate and Northgate Drive. At the intersection of Line 8/Barrie Street, eastbound left-turn volume is high for a single turning lane and would block the through traffic movement.
- Line 8 and Professor Day Drive intersection is currently stop controlled on Professor Day Drive. LOS “F” for the northbound left-turn and right-turn movements at this intersection for the PM peak hour indicates that signalization is required. A poor LOS “E” for the eastbound direction is because of the left-turning vehicles blocking the through traffic and would suggest proving a left-turn lane.
- Poor LOS “F” for the northbound right-turn movement at Line 8 and Taucar Gate for the PM peak hour is due to delay in getting gap for the movement at the stop-controlled intersection. This intersection is very close to the downstream intersection at Noble Drive (~70m) and the eastbound queue from the Noble Dive intersection is expected to block this intersection.

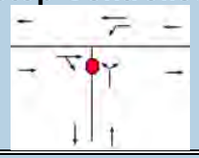
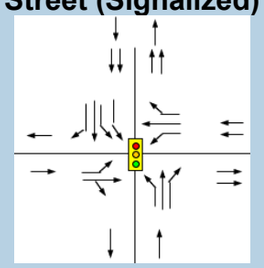
Table 3-4: Micro-simulation-based Intersection Evaluation Results – Peak hour conditions - 2031 Do-Nothing Scenario

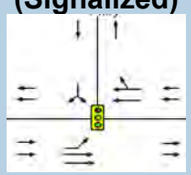
Intersection	Movement	Available Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and 10 Side Road (Signalized) 	EBL	120	1	13	B	0	2	7	25	C	4	6
	EBT		2	22	C	5	12	9	26	C	10	13
	EBR		6	9	A	5	12	15	7	A	10	13
	WBL	80	236	37	D	59	63	85	30	C	32	35
	WBT		23	23	C	23	27	22	30	C	24	32
	WBR		81	11	B	23	27	129	12	B	24	32
	NBL		5	19	B	52	60	29	39	D	119	145
	NBT		130	21	C	52	60	157	38	D	119	145
	NBR		125	13	B	52	60	497	32	C	119	145
	SBL		173	24	C	47	51	188	33	C	82	94
	SBT		101	22	C	47	51	213	32	C	82	94
	SBR		5	16	B	47	51	5	28	C	82	94
	Intersection Overall			24	C				31	C		
Line 8 and Reagens Industrial Parkway (Stop-Controlled) 	EBT		269	2	A	0	4	674	3	A	5	10
	EBR		31	2	A	0	4	20	4	A	5	10
	WBL	70	59	4	A	7	17	55	7	A	12	18
	WBT		328	1	A	0	1	221	1	A	0	0
	NBL		13	13	B	20	24	14	16	C	22	26
	NBR		38	10	A	20	24	130	14	B	22	26

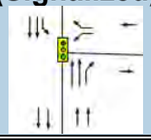
Intersection	Movement	Available Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
	Intersection Overall			2	A				4	A		
Line 8 and Langford Boulevard (Signalized) 	EBL	50	87	11	B	19	25	101	11	B	15	18
	EBT		202	12	B	42	46	570	15	B	68	74
	EBR	50	18	5	A	8	16	128	7	A	15	20
	WBL	100	41	8	A	9	12	82	14	B	13	17
	WBT		216	12	B	34	41	184	14	B	37	44
	WBR	70	38	4	A	6	13	143	6	A	15	19
	NBL	40	10	26	C	5	8	23	24	C	10	11
	NBT		13	21	C	12	15	45	21	C	15	19
	NBR		55	7	A	12	20	43	8	A	15	19
	SBL	50	58	24	C	15	17	13	25	C	7	9
	SBT		16	24	C	23	31	84	23	C	24	31
	SBR		162	10	A	27	31	69	12	B	24	31
	Intersection Overall			12	B				13	B		
Line 8 and Rogers Trail / Summerlyn Trail (Signalized)	EBL	50	33	14	B	15	17	78	20	B	15	17
	EBT		279	13	B	40	50	540	18	B	69	76
	EBR		2	7	A	40	50	13	15	B	69	76
	WBL	45	249	14	B	31	35	312	23	C	47	59
	WBT		234	9	A	29	37	357	12	B	40	49
	WBR	55	78	6	A	8	13	145	7	A	11	17

Intersection	Movement	Available Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
	NBL	20	7	22	C	5	7	19	25	C	8	10
	NBT		20	19	B	27	36	19	21	C	23	28
	NBR		211	8	A	28	37	206	12	B	25	30
	SBL	35	97	24	C	21	26	169	26	C	28	35
	SBT		17	25	C	18	23	54	23	C	20	27
	SBR		56	9	A	18	23	33	13	B	20	27
	Intersection Overall			12	B				17	B		
Line 8 and Professor Day Drive (Stop-controlled) 	EBL		7	8	A	13	34	54	44	E	153	178
	EBT		546	4	A	14	34	723	39	E	153	178
	EBR		33	5	A	13	34	121	40	E	153	178
	WBL		173	8	A	32	44	134	13	B	63	80
	WBT		477	4	A	32	44	712	7	A	63	80
	WBR		9	4	A	32	44	59	7	A	63	80
	NBL	140	75	21	C	18	20	77	53	F	28	35
	NBT		69	23	C	18	22	16	30	D	7	9
	NBR		56	12	B	17	22	184	127	F	98	110
	SBL	42	9	17	C	5	6	4	40	E	4	6
	SBT		58	14	B	6	10	23	24	C	11	14
	SBR	38	8	12	B	6	10	30	17	C	11	14
	Intersection Overall			7	A				34	D		

Intersection	Movement	Available Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and Taucar Gate (Stop Controlled) 	EBT		604	6	A	53	68	874	38	E	307	340
	EBR		0	4	A	53	68	20	34	D	307	340
	WBT		659	1	A	0	0	908	1	A	6	9
	NBR		57	22	C	24	31	27	52	F	12	15
	Intersection Overall			4	A				20	C		
Line 8 and Noble Drive (Signalized) 	EBL	70	27	18	B	61	81	115	44	D	333	371
	EBT		628	12	B	111	129	739	23	C	372	407
	EBR		0	1	A	111	129	41	20	C	372	407
	WBL	75	0	3	A	2	3	12	24	C	7	10
	WBT		547	11	B	55	63	771	14	B	75	84
	WBR	60	23	6	A	5	7	81	8	A	10	12
	NBL		45	20	B	14	18	13	21	C	8	11
	NBT		0	8	A	14	18	0	0	A	8	11
	NBR		9	15	B	14	18	13	17	B	8	11
	SBL	55	75	23	C	24	27	18	29	C	7	9
	SBT		0	11	B	12	17	4	16	B	14	21
	SBR		67	10	A	15	22	124	12	B	19	27
	Intersection Overall			12	B				19	B		
	EBT		653	129	F	313	355	683	255	F	453	485
	EBR		17	110	F	313	355	57	247	F	453	485

Intersection	Movement	Available Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and Northgate Drive (Stop-Controlled) 	WBL	65	97	7	A	23	26	161	8	A	25	33
	WBT		556	0	A	0	0	856	0	A	0	0
	NBL		15	893	F	203	209	5	1865	F	168	171
	NBR		98	911	F	203	209	32	1959	F	168	171
	Intersection Overall			132	F				146	F		
Line 8 and Lowes Gate (Stop-Controlled) 	EBL		23	41	E	402	456	131	51	F	541	579
	EBT		730	40	E	402	456	585	45	E	541	579
	WBT		639	2	A	6	12	993	3	A	0	3
	WBR		128	3	A	6	12	136	5	A	0	3
	SBL		59	1897	F	527	530	49	1744	F	529	530
	SBR		14	1949	F	527	530	26	1677	F	529	530
	Intersection Overall			107	F				87	F		
Line 8 and Barrie Street (Signalized) 	EBL	45	344	182	F	455	511	238	277	F	596	638
	EBT		365	170	F	658	727	340	210	F	805	855
	EBR		76	171	F	658	727	60	220	F	805	855
	WBL	120	13	22	C	12	19	35	18	B	10	13
	WBT		263	21	C	53	65	527	22	C	95	109
	WBR		767	1	A	14	22	1120	1	A	4	13
	NBL	50	53	18	B	12	18	33	19	B	9	13
	NBT		27	29	C	9	12	81	36	D	20	26

Intersection	Movement	Available Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
	NBR	110	35	6	A	6	7	8	7	A	4	4
	SBL (dual)	152	486	32	C	49	55	728	40	D	80	89
	SBT		0	0	A	0	0	101	37	D	25	31
	SBR		453	15	B	52	75	571	15	B	70	84
	Intersection Overall			80	E				76	E		
Line 8 and Colborne Street (Signalized) 	EBT		679	17	B	68	81	766	18	B	79	86
	EBR		214	20	C	68	81	253	20	C	79	86
	WBL	60	4	15	B	3	6	1	7	A	1	2
	WBT		717	11	B	61	71	1348	15	B	74	80
	NBL		315	32	C	60	71	333	36	D	77	82
	NBR		7	28	C	60	71	11	32	C	77	82
	Intersection Overall			18	B				19	B		
Line 8 and Artesian Industrial Parkway (Signalized) 	EBL	50	4	10	B	8	13	48	22	C	18	27
	EBT		681	6	A	33	48	726	10	A	52	62
	WBT		699	11	B	67	83	1292	16	B	59	69
	WBR		290	12	B	67	83	147	17	B	59	69
	SBL		91	28	C	29	33	237	29	C	49	60
	SBR		19	15	B	29	33	58	21	C	49	60
	Intersection Overall			10	B				16	B		
	WBL	30	127	22	C	36	42	137	19	B	27	36

Intersection	Movement	Available Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
10 Sideroad and Reagens Industrial Parkway (Signalized) 	WBR		19	8	A	17	20	110	9	A	18	23
	NBT		226	9	A	21	24	573	9	A	29	34
	NBR	50	104	4	A	19	22	48	5	A	16	22
	SBL	60	1	10	B	0	12	20	17	B	8	13
	SBT		340	9	A	22	25	293	7	A	16	22
	Intersection Overall			11	B				10	A		

3.2.2 MAXIMUM QUEUE LENGTHS

The Do-Nothing conditions queue plots for the Line 8 intersections during the morning peak and afternoon peak hours in both the eastbound and westbound directions are presented in Figure 3-2 and Figure 3-3, respectively.

Eastbound Direction

The maximum queue lengths in the eastbound direction movements that extend beyond the upstream intersections are listed below.

- At Barrie Street, the maximum queue length is expected to go beyond Northgate Drive intersection on Line 8 with queue lengths of approximately 730m and 860m respectively for the AM and PM peak hour conditions. This may be a combined effect of queueing at Barrie Street, Lowes Gate and Northgate Drive intersections.
- At Noble Drive, the maximum queue length extends back to the upstream stop-controlled intersection at Taucar Gate for the AM peak hour and Professor Day Drive for the PM peak hour conditions (with maximum queue length range of 129-407m) which is located very close to each other.
- All other intersections, the queue lengths are small and do not reach the upstream intersections.

Westbound Direction

For the westbound direction, the queue lengths are small for all the intersections for both AM and PM peak hour conditions.

Figure 3-2: Plot of Maximum Queue Lengths – Morning Peak Hour Eastbound and Westbound – 2031 Do-Nothing Scenario

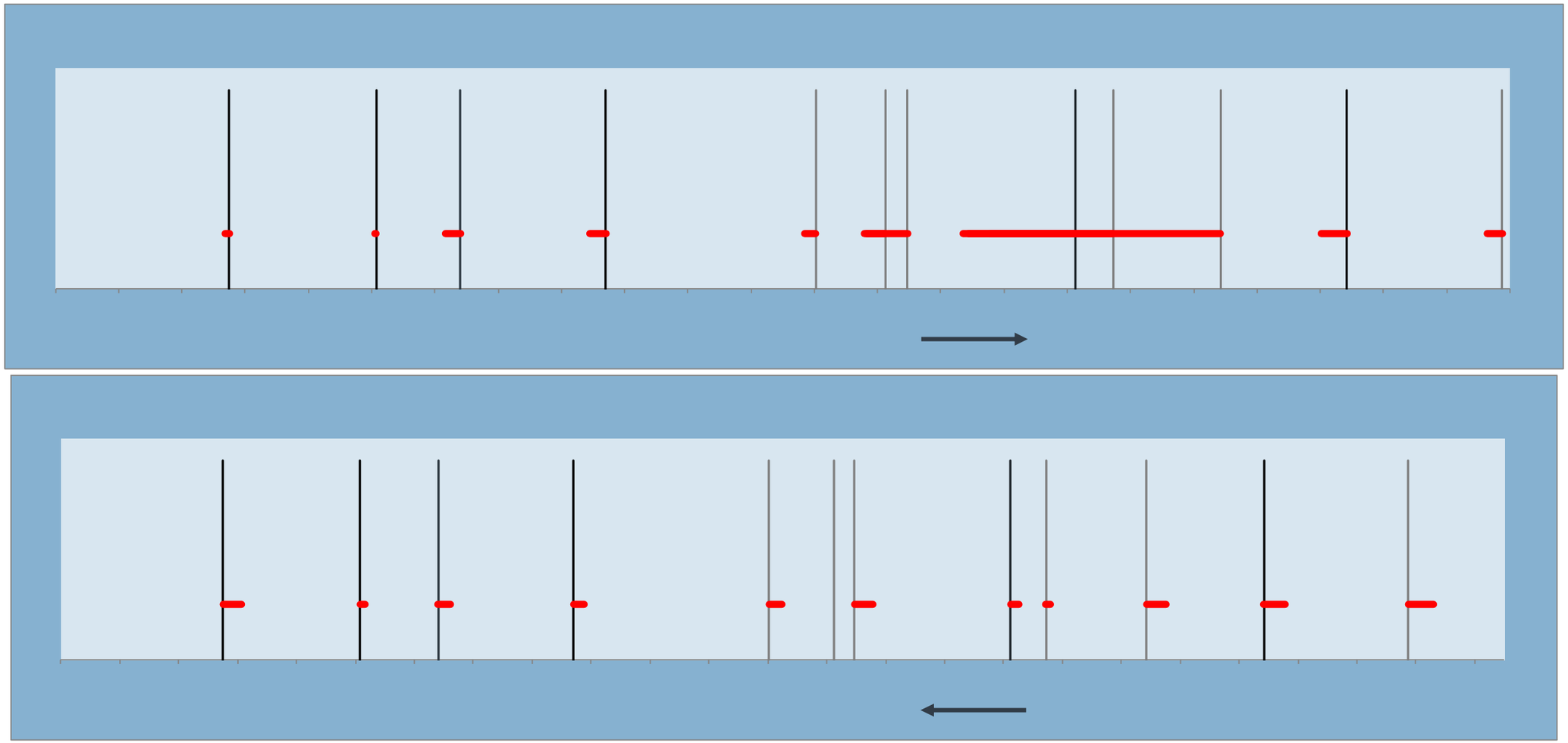
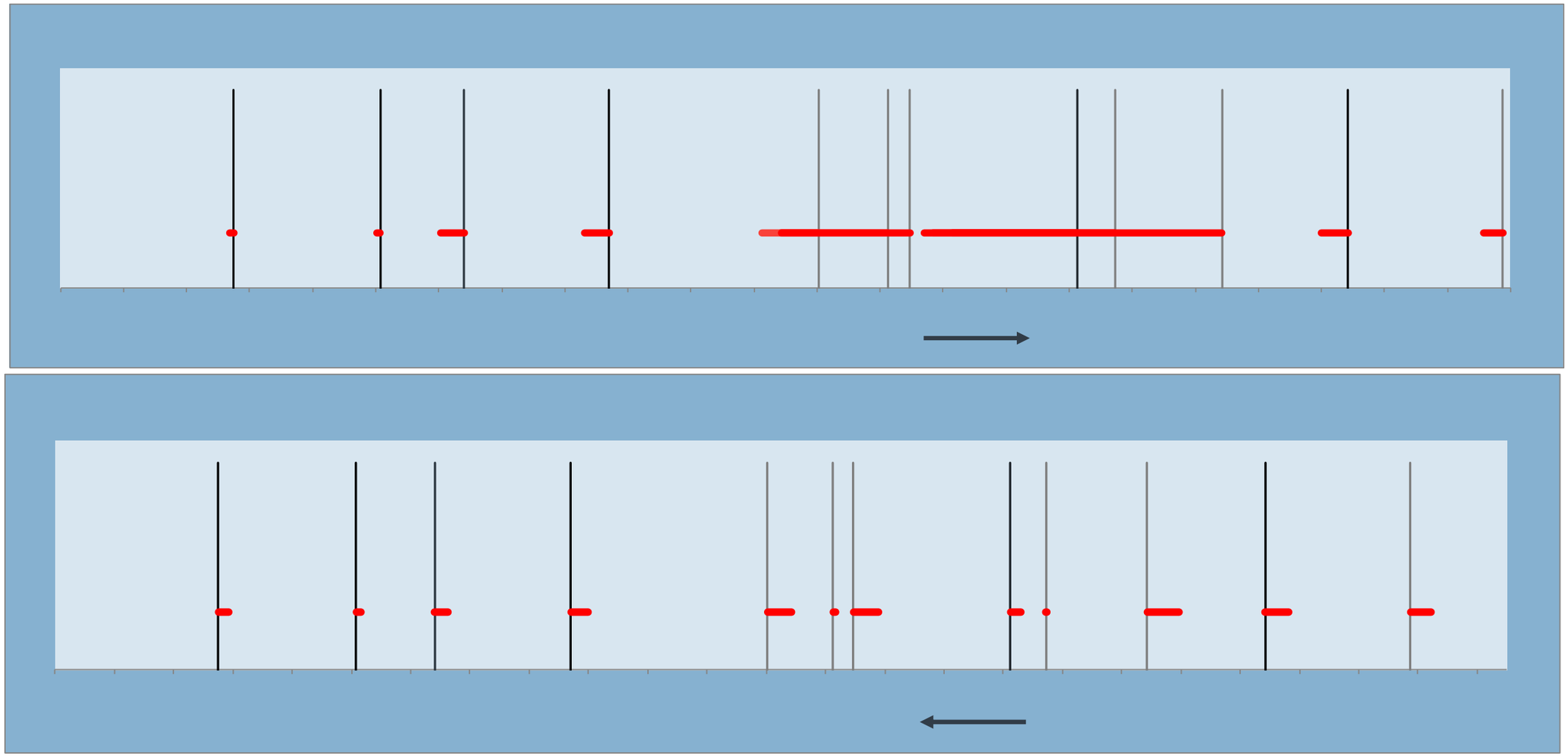


Figure 3-3: Plot of Maximum Queue Lengths – Afternoon Peak Hour Eastbound and Westbound – 2031 Do-Nothing



3.2.3 SPEED CONTOUR PLOTS

The morning and afternoon peak hour Do-Nothing (2031) conditions Line 8 speed contour plots in both the eastbound and westbound directions are presented in Figures 3-4 and Figure 3-5, respectively.

Eastbound Direction

The speed contour plots, presented in Figures 3-4 and 3-5, indicate degradation of Line 8 operations west of Barrie Street, Lowes Gate, Northgate Drive and Noble Drive with more severe degradation during the PM peak hour conditions. The main reason is due to the eastbound direction queueing from the Barrie Street intersection on Line 8. Speed reductions to 15-20 km/h are expected approaching Barrie Street intersection and 20-30 km/h speed approaching Lowes Gate and Northgate Drive.

Westbound Direction

Westbound direction speed contour plots for the AM and PM peak hour conditions show good operation with average speed close to 50 km/h except at close to the signalised intersections with average speed approximately 35 km/h.

Figure 3-4: Speed Contour Plot for Line 8 – Morning Peak Hour Eastbound and Westbound – 2031 Do-Nothing Scenario

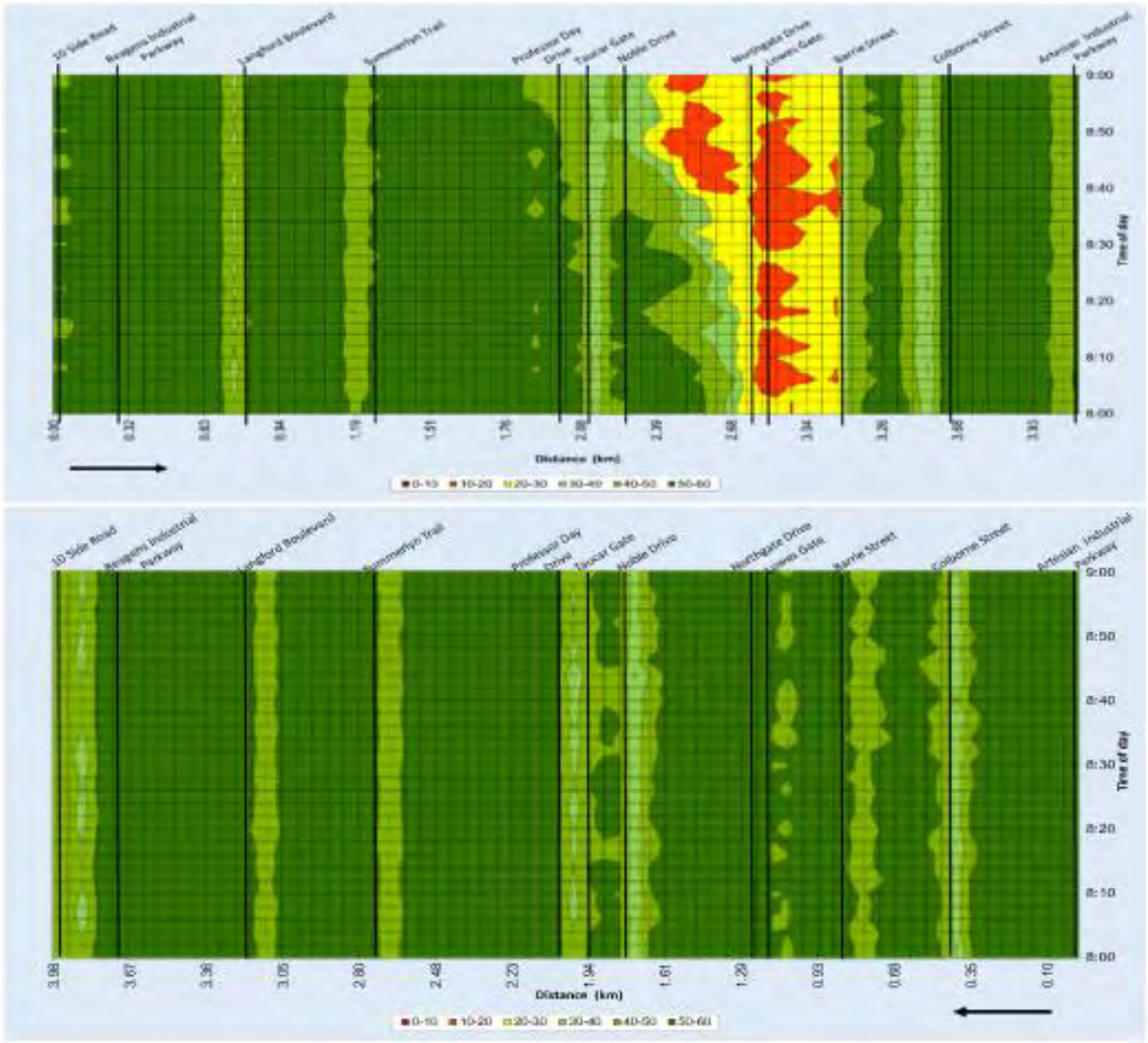
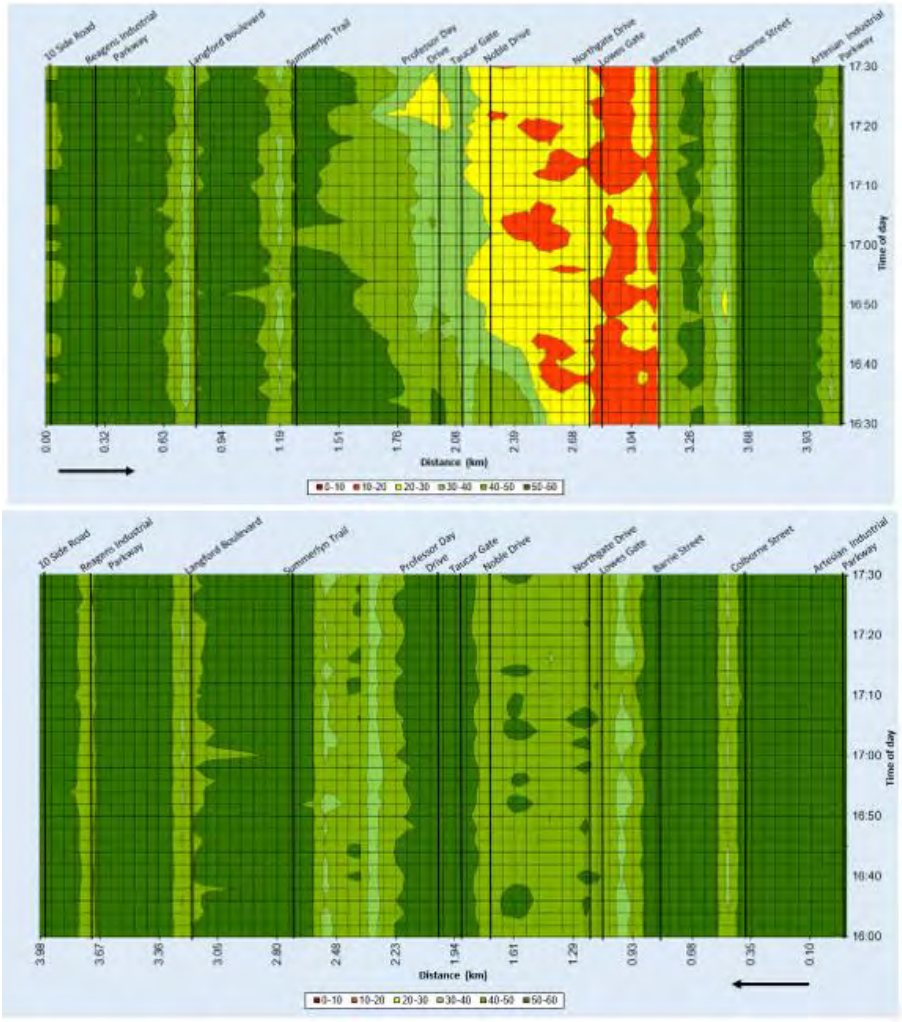


Figure 3-5: Speed Contour Plot for Line 8 – Afternoon Peak Hour Eastbound and Westbound – 2031 Do-Nothing Scenario



3.2.4 TRAVEL TIME

The vehicle travel time under the Do-Nothing (2031) conditions during the morning and afternoon peak hours for both the eastbound and westbound directions are presented in Table 3-5.

Table 3-5: Travel Time Comparison – Existing and 2031 Do-Nothing Scenario

Morning Peak Hour					
Road Segment	**Distance in km**	**Simulated Travel Time Existing (min)**	**Simulated Travel Time 2031 Do-Nothing Scenario (min)**	**Difference (min)**	**% Difference**
Line 8 from 10 Sideroad to Barrie Street (EB)	3.1	4.57	8.9	4.3	94.4%
Line 8 from Barrie Street to 10 Sideroad (WB)	3.1	4.30	4.3	0.0	0.8%
Afternoon Peak Hour					
Road Segment	**Distance in km**	**Simulated Travel Time Existing (min)**	**Simulated Travel Time 2031 Do-Nothing Scenario (min)**	**Difference (min)**	**% Difference**
Line 8 from 10 Sideroad to Barrie Street (EB)	3.1	4.61	14.4	9.8	212.7%
Line 8 from Barrie Street to 10 Sideroad (WB)	3.1	4.25	4.5	0.3	6.3%

The Do-Nothing morning and afternoon peak hour travel time results, presented in Table 3-5 shows that the time to travel Line 8 between 10 Sideroad and Barrie Street in the eastbound direction is expected to be increased by 4.3 minutes (~94%) and 9.8 minutes (~213%) respectively compared to the existing (2022) simulated conditions.

However, in the westbound direction, the travel times for the 2031 Do-Nothing scenario would provide approximately similar travel times of that with respect to existing conditions.

3.2.5 SUMMARY OF DO-NOTHING SCENARIO

The following summarizes the results of 2031 Do-Scenario:

- Eastbound direction results for the PM peak hour represents the worst case.
- On the westbound direction, the operation is approximately similar to that of existing condition.
- The main problem of queueing in the eastbound direction west of Barrie Street is due to eastbound left-turn movement queue backing up on to the through lane.
- The queue backs up to west of Northgate Drive and the intersection operation at Lowes Gate and Northgate Drive are affected.
- Poor LOS at the stop-controlled intersection of Line 8 at Professor Day Drive shows that signalisation and additional eastbound left-turn lanes are required.
- Poor LOS for the northbound right at Line 8 and Taucar Gate intersection is due to close proximity of this intersection to Noble Drive and the eastbound queue from this downstream intersection would block right-turn movement.
- Travel time in the eastbound direction is much higher than the existing condition (by 94%-213%) because of the queuing and speed reduction in the eastbound direction for both AM and PM peak periods. Westbound direction travel times are comparable to that of Existing conditions.

3.3 ALTERNATIVE 1

The 2031 Alternative 1 Scenario considered the following improvements over the Do-Nothing Scenario:

- An additional eastbound through (EBT) lane from Noble Drive to Barrie St.
- At Line 8 & Barrie Street Intersection:
    - Increased eastbound left-turn (EBL) Lane storage length to 150 m.
    - Eastbound approach configuration: 1EBL+1EBT+1EBTR.
    - Increased EBL phase Max green from 7-15 sec.
- At Line 8 & Professor Day Drive Intersection:
    - The intersection is provided with signalised control (fully actuated, pedestrians not added) instead of the existing Stop-control.
    - Storage lanes added for EBL and WBL movements
- Pedestrian Crossing facilities: As in Existing but have assumed 5 times existing volume of pedestrians per hour.

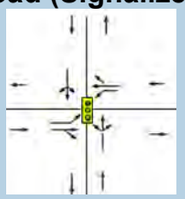
3.3.1 INTERSECTION OPERATIONAL ANALYSIS

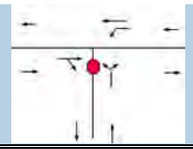
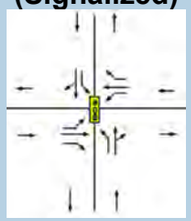
This section presents the Alternative 1 peak hour intersection operations within the study area. The summary of Alternative 1 (2031) intersection operations during the peak hours are provided in Table 3-6. The Table 3-6 indicates the following:

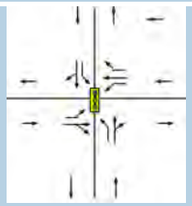
- For both AM and PM peak hours, Alternative 1 (2031) Scenario operational analysis results indicate that the study area intersections are expected to operate at an overall LOS “C” or better for all the intersections except for intersection at Line 8 at Barrie Street with LOS “E” for the AM peak hour. Even with additional through lane and increased storage length, the eastbound left-turn (EBL) movement at Barrie Street would operate with unacceptable LOS “F” and queues blocking the through movement extending back to the upstream intersection at Lowes Gate. At the intersection of Line 8/Barrie Street, a dual left-turn lane may be required to improve the operation. Poor performance at Lowes Gate with LOS “D/E” is due to this eastbound direction queue. However, overall, the intersections at Lowes Gate and Northgate Drive got improved because of the additional eastbound through lane.
- At Line 8 and Professor Day Drive intersection, signalisation have improved the overall operation with very good LOS “C” or better.
- Because of signalization at Professor Day Drive, as well as due to the additional eastbound through lane has improved the operation at Taucar Gate. Traffic from the stop controlled Taucar Gate will receive more gaps for making the right-turn

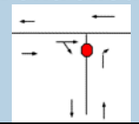
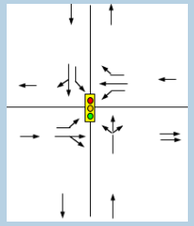
when the upstream signal (at Professor Day Drive) is red for the eastbound direction.

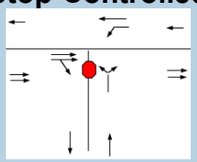
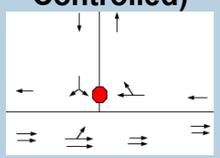
Table 3-6: Micro-simulation-based Intersection Evaluation Results – Peak hour conditions – 2031 Alternative 1 Scenario

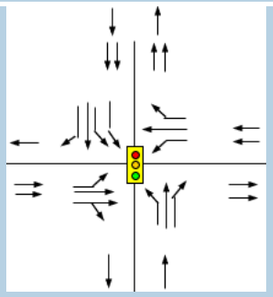
Intersection	Movement	Available Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and 10 Side Road (Signalized) 	EBL	120	1	11	B	1	2	7	26	C	5	6
	EBT		2	21	C	6	12	9	19	B	9	13
	EBR		6	6	A	6	12	15	8	A	9	13
	WBL	80	249	42	D	62	68	92	27	C	29	34
	WBT		23	30	C	27	31	22	29	C	23	29
	WBR		86	12	B	27	31	131	11	B	23	29
	NBL		4	26	C	52	62	29	37	D	102	119
	NBT		130	20	C	52	62	157	33	C	102	119
	NBR		125	12	B	52	62	501	28	C	102	119
	SBL		175	22	C	45	54	189	31	C	76	83
	SBT		101	22	C	45	54	214	29	C	76	83
	SBR		5	12	B	45	54	5	20	C	76	83
	Intersection Overall			25	C				27	C		
Line 8 and Reagens Industrial Parkway (Stop-Controlled)	EBT		269	2	A	0	1	678	3	A	2	8
	EBR		32	3	A	0	1	20	3	A	2	8
	WBL	70	61	4	A	10	21	58	7	A	15	18
	WBT		348	1	A	0	0	234	1	A	0	0
	NBL		13	14	B	20	23	14	17	C	23	29

Intersection	Movement	Available Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
	NBR		38	10	A	20	23	130	14	B	23	29
	Intersection Overall			2	A				4	A		
Line 8 and Langford Boulevard (Signalized) 	EBL	50	88	11	B	21	27	102	12	B	16	22
	EBT		202	12	B	37	42	575	15	B	64	78
	EBR	50	18	4	A	8	16	129	7	A	14	21
	WBL	100	49	9	A	9	13	86	16	B	15	22
	WBT		237	12	B	38	50	199	12	B	31	40
	WBR	70	39	5	A	8	12	143	6	A	13	18
	NBL	40	10	17	B	6	8	23	26	C	9	10
	NBT		13	22	C	13	18	45	22	C	15	20
	NBR		55	7	A	16	20	43	7	A	15	20
	SBL	50	58	25	C	16	18	13	20	B	7	10
	SBT		16	22	C	23	28	84	24	C	25	31
	SBR		162	10	A	25	28	69	12	B	25	31
	Intersection Overall			12	B				13	B		
Line 8 and Rogers Trail / Summerlyn Trail (Signalized)	EBL	50	33	14	B	13	19	78	19	B	15	18
	EBT		277	13	B	43	61	540	17	B	70	86
	EBR		2	10	A	43	61	13	14	B	70	86
	WBL	45	247	19	B	45	55	317	24	C	48	56

Intersection	Movement	Available Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
	WBT		263	12	B	34	45	375	12	B	41	57
	WBR	55	77	7	A	10	14	146	7	A	11	17
	NBL	20	6	24	C	6	6	19	21	C	6	9
	NBT		20	20	B	23	33	19	23	C	27	32
	NBR		211	8	A	28	35	206	12	B	27	32
	SBL	35	99	23	C	21	24	169	27	C	28	37
	SBT		17	23	C	14	25	54	23	C	20	28
	SBR		56	9	A	14	25	33	12	B	20	28
	Intersection Overall			13	B				17	B		
Line 8 and Professor Day Drive (Stop-controlled)	EBL	80	7	34	C	7	11	55	23	C	12	15
	EBT		544	26	C	98	112	735	15	B	74	82
	EBR		33	22	C	98	112	123	15	B	74	82
	WBL	80	193	53	D	62	73	146	29	C	31	39
	WBT		509	25	C	101	117	733	11	B	75	92
	WBR		10	31	C	101	117	63	12	B	75	92
	NBL	140	75	27	C	19	25	77	22	C	17	19
	NBT		69	21	C	17	20	16	18	B	6	10
	NBR		55	8	A	14	20	201	11	B	20	25
	SBL	42	9	28	C	6	7	4	21	C	3	6
	SBT		58	22	C	7	9	23	21	C	11	12

Intersection	Movement	Available Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
	SBR	38	8	7	A	7	9	31	11	B	11	12
	Intersection Overall			28	C				14	B		
Line 8 and Taucar Gate (Stop Controlled) 	EBT		604	5	A	53	73	916	3	A	46	55
	EBR		0	2	A	53	72	22	3	A	46	55
	WBT		715	1	A	7	17	942	1	A	3	8
	NBR		57	18	C	18	26	28	17	C	7	8
	Intersection Overall			3	A				2	A		
Line 8 and Noble Drive (Signalized) 	EBL	70	28	17	B	10	16	122	49	D	74	85
	EBT		631	11	B	113	142	774	10	A	101	117
	EBR		0	1	A	113	142	42	9	A	101	117
	WBL	75	0	11	B	3	6	14	24	C	6	10
	WBT		602	12	B	57	73	804	16	B	73	83
	WBR	60	23	7	A	5	8	81	8	A	11	14
	NBL		45	20	B	14	18	13	20	C	8	10
	NBT		0	8	A	14	18	0	0	A	8	10
	NBR		9	10	A	14	18	13	6	A	8	10
	SBL	55	75	18	B	16	22	18	18	B	6	9
	SBT		0	11	B	9	18	4	15	B	14	20
	SBR		67	9	A	15	21	124	12	B	17	26
	Intersection Overall			12	B				15	B		

Intersection	Movement	Available Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and Northgate Drive (Stop-Controlled) 	EBT		698	1	A	7	9	746	1	A	3	7
	EBR		17	3	A	4	7	60	2	A	0	1
	WBL	65	98	6	A	23	26	171	8	A	24	30
	WBT		589	0	A	0	3	877	0	A	0	0
	NBL		40	21	C	31	36	21	21	C	29	35
	NBR		250	16	C	31	36	122	12	B	29	35
	Intersection Overall			4	A				2	A		
Line 8 and Lowes Gate (Stop-Controlled) 	EBL		24	9	A	33	44	145	17	C	26	30
	EBT		921	3	A	33	44	723	1	A	26	30
	WBT		642	2	A	7	12	990	4	A	0	4
	WBR		128	3	A	7	12	136	5	A	0	5
	SBL		181	27	D	40	53	120	47	E	41	50
	SBR		47	26	D	40	53	60	42	E	41	50
	Intersection Overall			6	A				7	A		
Line 8 and Barrie Street (Signalized)	EBL	150	427	237	F	413	424	358	152	F	172	196
	EBT		539	92	F	210	237	415	35	C	52	63
	EBR		73	75	E	210	237	65	27	C	52	63
	WBL	120	14	23	C	10	17	34	19	B	11	13
	WBT		262	26	C	60	71	525	25	C	113	121
	WBR		767	1	A	14	27	1121	1	A	13	27

Intersection	Movement	Available Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
	NBL	50	52	22	C	14	16	33	23	C	9	12
	NBT		27	41	D	11	12	80	43	D	23	25
	NBR	110	35	6	A	6	8	8	6	A	5	5
	SBL (dual)	152	488	39	D	37	43	732	56	E	93	101
	SBT		0	0	A	43	50	103	43	D	27	34
	SBR		454	10	B	46	56	570	15	B	64	74
	Intersection Overall			80	E				49	D		
Line 8 and Colborne Street (Signalized) 	EBT		796	18	B	77	90	808	19	B	75	87
	EBR		247	19	B	77	90	268	20	B	75	87
	WBL	60	4	15	B	2	6	1	10	B	0	3
	WBT		717	11	B	61	71	1348	15	B	74	80
	NBL		315	32	C	60	71	333	36	D	77	82
	NBR		7	28	C	60	71	11	33	C	77	82
	Intersection Overall			18	B				19	B		
Line 8 and Artesian Industrial Parkway (Signalized)	EBL	50	15	13	B	9	18	53	22	C	25	28
	EBT		782	7	A	44	51	763	9	A	56	66
	WBT		699	11	B	67	83	1292	16	B	59	69
	WBR		290	12	B	67	83	147	17	B	59	69
	SBL		91	28	C	29	33	237	29	C	49	60

Intersection	Movement	Available Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
	SBR		19	15	B	29	33	58	21	C	49	60
	Intersection Overall			10	B				16	B		
10 Sideroad and Reagens Industrial Parkway (Signalized) 	WBL	30	127	20	C	36	44	136	20	B	29	39
	WBR		18	8	A	17	22	110	10	A	20	25
	NBT		226	9	A	19	24	571	9	A	29	34
	NBR	50	104	4	A	18	20	48	5	A	17	21
	SBL	60	1	5	A	0	6	20	14	B	8	14
	SBT		354	9	A	19	24	302	7	A	16	23
	Intersection Overall			10	B				10	A		

3.3.2 MAXIMUM QUEUE LENGTHS

Alternative 1 conditions queue plot for the Line 8 intersections during the morning peak and afternoon peak hours in both the eastbound and westbound directions are presented in Figure 3-6 and Figure 3-7, respectively.

Eastbound Direction

The maximum queue lengths in the eastbound direction movements that extends beyond the upstream intersections are listed below.

- At Barrie Street, the maximum queue length is expected to go beyond Lowes Gate intersection on Line 8 with queue lengths of approximately 424m and 196m respectively for the AM and PM peak hour conditions. However, the queuing impact is lower than that in the Do-Nothing scenario.
- At Noble Drive, the maximum queue length even though smaller than the Do-Nothing scenario, extends back to the upstream stop-controlled intersection of Taucar Gate (with maximum queue length range of 117-142m) which is located very close to each other.
- All other intersections, the queue lengths are small and do not reach the upstream intersections.

Westbound Direction

For the westbound direction, the queue lengths are small for all the intersections for both AM and PM peak hour conditions.

Figure 3-6: Plot of Maximum Queue Lengths – Morning Peak Hour Eastbound and Westbound – 2031 Alternative 1 Scenario

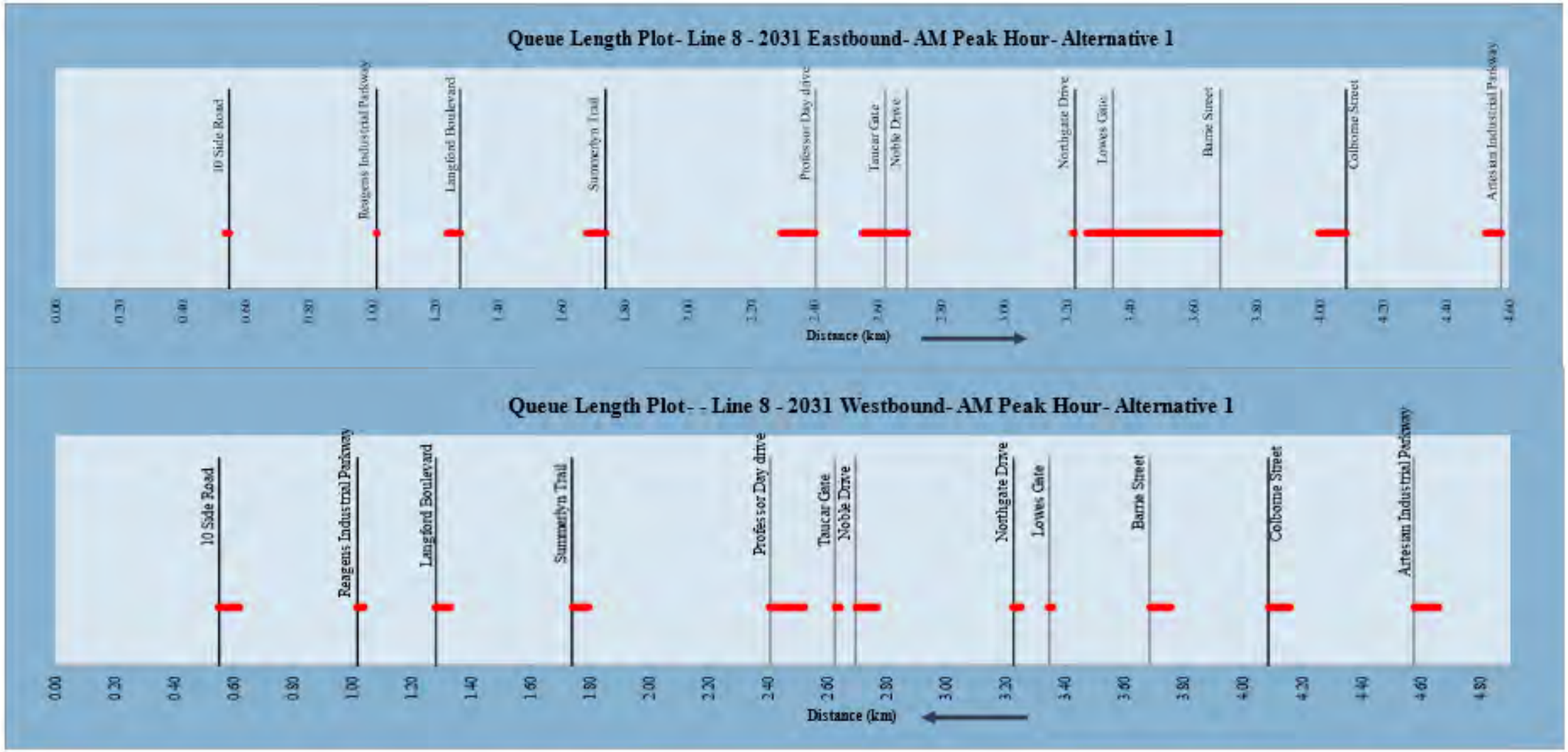
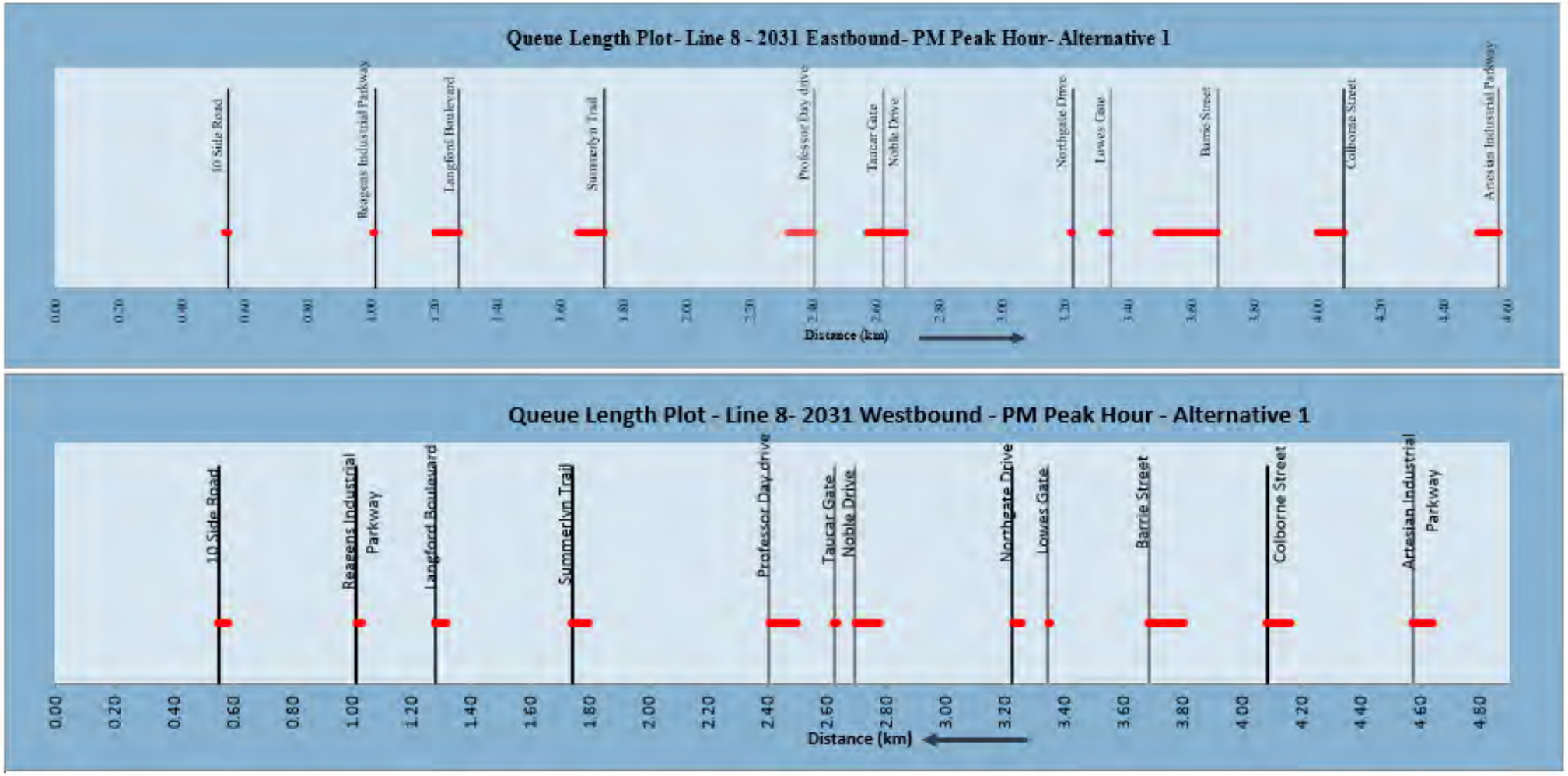


Figure 3-7: Plot of Maximum Queue Lengths – Afternoon Peak Hour Eastbound and Westbound – 2031 Alternative 1 Scenario



3.3.3 SPEED CONTOUR PLOTS

The morning and afternoon peak hour Alternative 1 (2031) conditions Line 8 speed contour plots in both the eastbound and westbound directions are presented in Figure 3-8 and Figure 3-9, respectively.

Eastbound Direction

The speed contour plots, presented in Figures 3-8 and 3-9, indicate degradation of Line 8 operations near Barrie Street in the eastbound direction, during the AM peak hour conditions. This is because of the left-turn lane queue backing on to the through lane. Speed reductions to 15-30 km/h are expected approaching Barrie Street intersection.

Westbound Direction

Westbound direction speed contour plots for the AM and PM peak hour conditions show good operation with average speed close to 50 km/h except at close to the signalised intersections with average speed approximately 35 km/h.

Figure 3-8: Speed Contour Plot for Line 8 – Morning Peak Hour Eastbound and Westbound – 2031 Alternative 1 Scenario

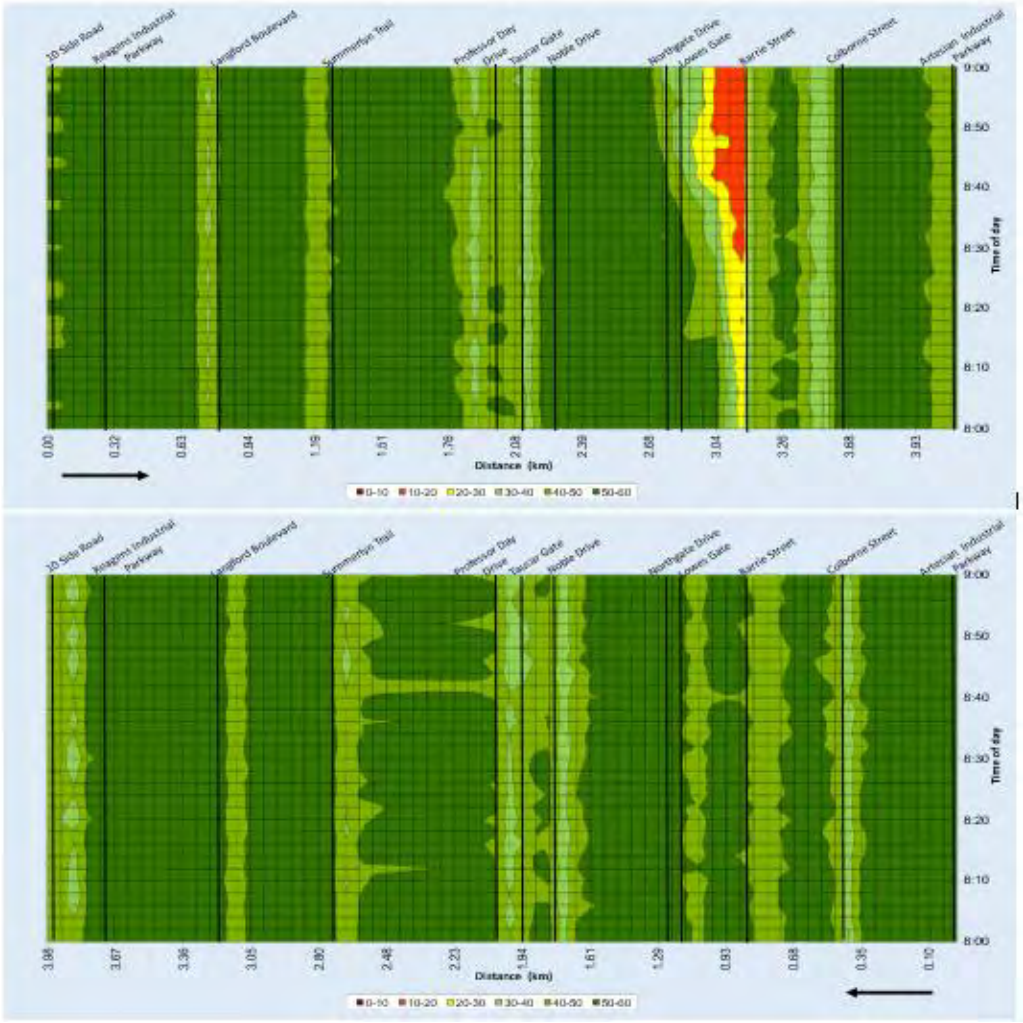
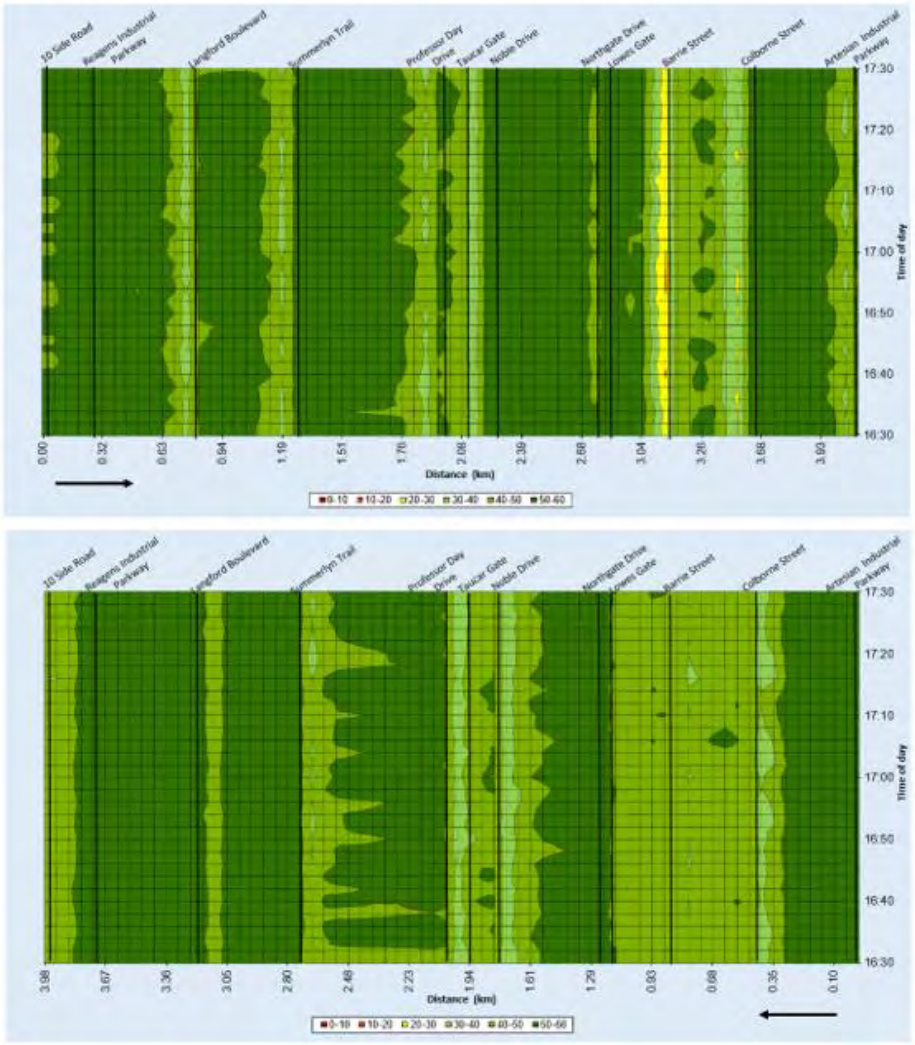


Figure 3-9: Speed Contour Plot for Line 8 – Afternoon Peak Hour Eastbound and Westbound – 2031 Alternative 1 Scenario



3.3.4 TRAVEL TIME

The vehicle travel time under the Alternative 1 (2031) conditions during the morning and afternoon peak hours for both the eastbound and westbound directions are presented in Table 3-7.

Table 3-7: Travel Time Comparison – Existing and 2031 Alternative 1 Scenario

Morning Peak Hour					
Road Segment	**Distance in km**	**Simulated Travel Time Existing (min)**	**Simulated Travel Time 2031 Alternative 1 Scenario (min)**	**Difference (min)**	**% Difference**
Line 8 from 10 Sideroad to Barrie Street (EB)	3.1	4.57	6.2	1.6	34.6%
Line 8 from Barrie Street to 10 Sideroad (WB)	3.1	4.30	4.8	0.5	12.3%
Afternoon Peak Hour					
Road Segment	**Distance in km**	**Simulated Travel Time Existing (min)**	**Simulated Travel Time 2031 Alternative 1 Scenario (min)**	**Difference (min)**	**% Difference**
Line 8 from 10 Sideroad to Barrie Street (EB)	3.1	4.61	5.0	0.4	8.6%
Line 8 from Barrie Street to 10 Sideroad (WB)	3.1	4.25	4.6	0.3	7.6%

The Alternative 1 morning and afternoon peak hour travel time results, presented in Table 3-7 show that the time to travel Line 8 between 10 Sideroad and Barrie Street in

the eastbound direction is expected to increase by 1.6 minutes (~35%) for the morning peak hour condition compared to the existing (2022) simulated conditions.

However, afternoon peak hour for the eastbound as well as for the westbound direction, the travel times for the 2031 Alternative 1 scenario would provide approximately similar travel times (<15% increase) with respect to existing conditions.

3.3.5 SUMMARY OF ALTERNATIVE 1 SCENARIO

- Increased left-turn lane length and additional green time for the protected left-turn phase could not alleviate the eastbound left-turn queue at Barrie Street intersection. This indicates that a dual left-turn lane is required for the Eastbound direction at Line 8 and Barrie Street.
- Performance at the intersection of Line 8 and Professor Day Drive improved because of signalisation.
- The presence of two through lanes from Noble Drive to Barrie Street also provides better operation.
- Travel time in the eastbound direction is higher than the existing condition (by 35%) because of minor queuing and speed reduction in the eastbound direction for the AM peak hour conditions. Eastbound direction for the afternoon peak hour and Westbound direction travel times are comparable to Existing condition.

3.4 ALTERNATIVE 2

This scenario assumed a workaround at the intersection of Barrie Street and Line 8 to provide an additional lane for eastbound left-turn with one of the through lane combined with a left-turn movement. The 2031 Alternative 2 Scenario considered the following improvements over the Do-Nothing Scenario:

- An additional eastbound through (EBT) lane from Summerlyn Trail/Rogers Trail to Barrie Street.
- An additional westbound through lane from Barrie Street to Lowes Gate.
- Additional through lanes on each direction on Barrie Street north of Line 8.
- At Line 8 & Barrie Street intersection:
    - Increased eastbound left-turn (EBL) Lane storage length to 150 m.
    - Eastbound approach configuration: 1EBL+1EBLT+1EBTR.
    - Southbound approach configuration: 1SBR+1SBT+2SBL.
- At Line 8 & Professor Day Drive intersection:
    - The intersection is provided with signalised control (fully actuated, pedestrians not added) instead of the existing Stop-control.
    - Storage lanes added for EBL and WBL movements.
- Pedestrian Crossing facilities: As in Existing, but have assumed 5 times existing volume of pedestrians per hour.

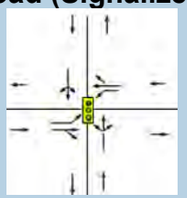
3.4.1 INTERSECTION OPERATIONAL ANALYSIS

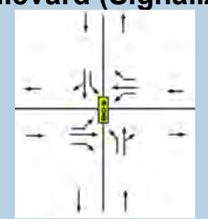
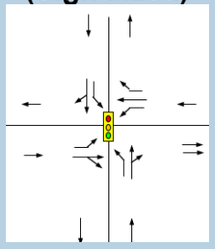
This section presents the Alternative 2 peak hour intersection operations within the study area. The summary of Alternative 2 (2031) intersection operations during the peak hours are provided in Table 3-8. The operation performance evaluation from Table 3.8 indicates the following:

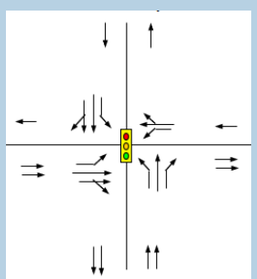
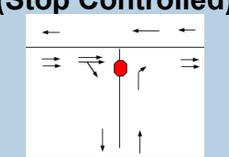
- For both AM and PM peak hours, Alternative 2 (2031) Scenario operational analysis results indicate that the study area intersections are expected to operate at an overall LOS “C” or better for all the intersections including the intersection at Line 8 and Barrie Street. Additional eastbound combined through and left-turn lane at Barrie Street intersection has improved the operation of eastbound left-turn movement with LOS “C” and with reduced queue length of approximately 50m. However, double left-turn movements would require dedicated lanes and protected phase (which is included in the next alternative scenario).
- Because of the additional through lane from Rogers Trail/Summerlyn Trail to Barrie Street provides better operation for all the in-between intersections.

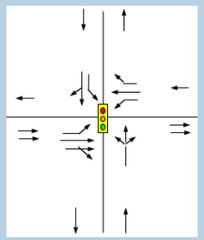
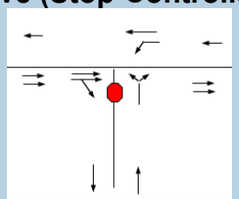
- The presence two lanes in the westbound direction from just east of Barrie Street to Lowes Gate also has improved LOS and queue lengths at the intersections within this stretch.
- Widening on Barrie Street north of Line 8 would provide better operation on Barrie Street north of Line 8 (however, this widening may not be required).

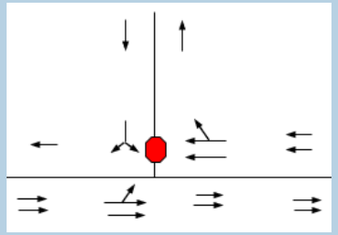
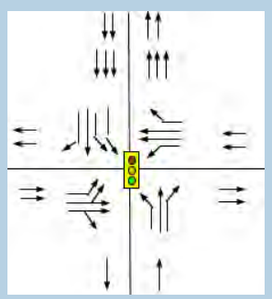
Table 3-8: Micro-simulation-based Intersection Evaluation Results – Peak hour conditions – 2031 Alternative 2

Intersection	Movement	Available Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and 10 Side Road (Signalized) 	EBL	120	1	10	B	1	2	7	19	B	5	5
	EBT		2	24	C	7	12	9	24	C	8	14
	EBR		6	7	A	7	12	15	7	A	8	14
	WBL	80	251	37	D	60	70	129	30	C	34	40
	WBT		23	30	C	27	33	15	27	C	33	48
	WBR		85	13	B	27	33	227	13	B	33	48
	NBL		4	22	C	51	58	1	15	B	77	83
	NBT		130	20	C	51	58	134	27	C	77	83
	NBR		125	13	B	51	58	508	19	B	77	83
	SBL		175	22	C	46	54	189	30	C	73	82
	SBT		101	20	C	46	54	214	29	C	73	82
	SBR		5	13	B	46	54	5	18	B	73	82
	Intersection Overall			24	C				23	C		
Line 8 and Reagens Industrial Parkway (Stop-Controlled) 	EBT		269	2	A	0	0	701	3	A	4	11
	EBR		32	2	A	0	0	6	5	A	4	11
	WBL	70	61	4	A	13	19	33	7	A	6	16
	WBT		346	1	A	1	2	359	1	A	0	0
	NBL		13	14	B	21	25	14	17	C	22	28
	NBR		38	10	A	21	25	131	14	B	22	28
	Intersection Overall			2	A				4	A		

Intersection	Movement	Available Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and Langford Boulevard (Signalized) 	EBL	50	88	11	B	22	29	103	14	B	17	20
	EBT		202	12	B	45	55	601	16	B	71	86
	EBR	50	18	5	A	9	17	124	7	A	14	21
	WBL	100	49	10	B	12	15	92	16	B	16	20
	WBT		238	13	B	34	44	312	15	B	44	54
	WBR	70	38	5	A	8	13	140	6	A	15	18
	NBL	40	10	25	C	5	9	21	21	C	9	11
	NBT		13	19	B	10	14	2	15	B	9	13
	NBR		55	7	A	15	21	88	10	A	12	16
	SBL	50	57	23	C	15	18	106	23	C	19	28
	SBT		16	23	C	21	34	1	20	C	5	7
	SBR		161	9	A	27	34	60	8	A	11	13
	Intersection Overall			12	B				14	B		
Line 8 and Rogers Trail / Summerlyn Trail (Signalized) 	EBL	50	33	17	B	13	19	78	29	C	20	23
	EBT		277	14	B	45	55	697	21	C	86	98
	EBR		2	6	A	44	55	20	18	B	86	98
	WBL	45	247	18	B	42	49	302	31	C	54	62
	WBT		263	12	B	39	46	458	14	B	49	59
	WBR	55	78	7	A	9	13	140	8	A	11	13
	NBL	20	6	20	C	5	6	19	24	C	7	10
	NBT		20	26	C	26	32	19	23	C	23	36
	NBR		212	8	A	28	34	206	8	A	23	36

Intersection	Movement	Available Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
	SBL	35	99	23	C	18	24	166	26	C	29	38
	SBT		17	20	B	15	24	24	23	C	18	23
	SBR		56	9	A	15	24	65	11	B	18	23
	Intersection Overall			14	B				19	B		
Line 8 and Professor Day Drive (Signalized) 	EBL	80	7	37	D	5	10	36	22	C	10	14
	EBT		547	20	C	53	59	860	9	A	41	42
	EBR		33	20	C	53	59	171	10	B	41	42
	WBL	80	196	32	C	44	52	194	22	C	30	36
	WBT		511	24	C	91	101	800	11	B	77	86
	WBR		9	24	C	91	101	41	10	B	77	86
	NBL	140	75	29	C	22	29	96	22	C	18	25
	NBT		69	21	C	19	20	38	19	B	10	15
	NBR		56	6	A	15	18	158	8	A	15	19
	SBL	42	9	24	C	6	7	12	22	C	5	10
	SBT		58	21	C	7	9	34	20	C	5	7
	SBR	38	8	6	A	7	8	11	9	A	5	6
	Intersection Overall			23	C				12	B		
Line 8 and Taucar Gate (Stop Controlled) 	EBT		609	1	A	8	18	1024	1	A	2	4
	EBR		1	1	A	8	18	5	2	A	2	4
	WBT		718	1	A	2	14	1028	1	A	3	7
	NBR		57	10	A	18	24	28	10	B	7	7
	Intersection Overall			1	A				1	A		

Intersection	Movement	Available Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and Noble Drive (Signalized) 	EBL	70	28	18	B	11	14	96	33	C	27	33
	EBT		634	8	A	48	54	911	8	A	40	51
	EBR		0	1	A	48	54	40	7	A	40	51
	WBL	75	0	3	A	2	3	10	20	B	5	7
	WBT		606	11	B	56	66	921	16	B	76	82
	WBR	60	23	6	A	6	9	78	8	A	8	12
	NBL		45	20	B	14	18	13	22	C	9	10
	NBT		0	8	A	14	18	0	0	A	9	10
	NBR		9	10	A	14	18	13	6	A	9	10
	SBL	55	75	18	B	16	22	54	19	B	13	22
	SBT		0	11	B	9	18	0	0	A	10	15
	SBR		66	9	A	15	22	93	13	B	16	20
	Intersection Overall			11	B				13	B		
Line 8 and Northgate Drive (Stop-Controlled) 	EBT		700	2	A	4	13	911	2	A	2	6
	EBR		18	4	A	2	13	67	3	A	1	3
	WBL	65	98	6	A	23	31	152	8	A	25	30
	WBT		591	0	A	2	4	998	1	A	0	4
	NBL		40	22	C	33	39	21	20	C	28	34
	NBR		251	17	C	33	39	122	13	B	28	34
	Intersection Overall			4	A				2	A		
Line 8 and Lowes Gate (Stop-Controlled)	EBL		24	6	A	11	17	114	15	B	26	34
	EBT		925	1	A	11	17	919	1	A	26	34

Intersection	Movement	Available Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
	WBT		641	1	A	5	8	1053	4	A	0	2
	WBR		128	3	A	1	4	129	7	A	1	2
	SBL		184	20	C	30	39	87	38	E	37	43
	SBR		48	19	C	30	39	95	33	D	37	43
	Intersection Overall			3	A				6	A		
Line 8 and Barrie Street (Signalized)	EBL	150	525	29	C	49	53	422	32	C	47	50
	EBT		513	31	C	64	68	510	33	C	61	71
	EBR		74	29	C	64	68	60	28	C	61	71
	WBL	120	13	16	B	13	17	33	18	B	9	12
	WBT		263	23	C	37	51	525	25	C	39	46
	WBR		766	1	A	29	63	1115	4	A	63	83
	NBL	50	53	19	B	13	18	78	19	B	15	20
	NBT		27	31	C	9	10	0	0	A	0	0
	NBR	110	35	6	A	7	8	44	6	A	6	9
	SBL (dual)	152	488	32	C	50	54	737	38	D	78	89
	SBT		0	4	A	3	10	103	33	C	27	32
	SBR		453	10	B	43	59	570	18	B	70	88
	Intersection Overall			25	C				29	C		
Line 8 and Colborne Street (Signalized)	EBT		801	17	B	73	79	931	18	B	83	89
	EBR		238	18	B	73	79	289	21	C	83	89
	WBL	60	4	14	B	2	6	1	9	A	1	2

Intersection	Movement	Available Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
	WBT		717	11	B	61	71	1348	14	B	75	79
	NBL		315	32	C	60	71	333	36	D	77	82
	NBR		7	28	C	60	71	11	33	C	77	82
	Intersection Overall			17	B				19	B		
Line 8 and Artesian Industrial Parkway (Signalized) 	EBL	50	8	13	B	7	15	62	23	C	25	33
	EBT		795	7	A	45	53	875	10	A	60	69
	WBT		699	11	B	67	83	1292	16	B	60	67
	WBR		290	12	B	67	83	147	17	B	60	67
	SBL		91	28	C	29	33	237	30	C	49	60
	SBR		19	15	B	29	33	58	21	C	49	60
	Intersection Overall			10	B				16	B		
10 Sideroad and Reagens Industrial Parkway (Signalized) 	WBL	30	129	21	C	36	45	136	19	B	30	35
	WBR		18	8	A	17	24	110	9	A	18	20
	NBT		226	9	A	21	24	526	9	A	26	29
	NBR	50	104	5	A	17	20	95	5	A	17	21
	SBL	60	1	9	A	2	9	12	14	B	6	12
	SBT		353	9	A	23	27	345	8	A	17	25
	Intersection Overall			10	B				9	A		

3.4.2 MAXIMUM QUEUE LENGTHS

Alternative 2 conditions queue plots for the Line 8 intersections during the morning peak and afternoon peak hours in both the eastbound and westbound directions are presented in Figure 3-10 and Figure 3-11, respectively.

Eastbound Direction

At Noble Drive, the maximum queue length (with maximum queue length range of 51-54m) extends back close to the upstream stop-controlled intersection at Taucar Gate which is located very close to each other. All other intersections, the queue lengths are small and do not reach the upstream intersections.

Westbound Direction

For the westbound direction, the queue lengths are small for all the intersections for both AM and PM peak hour conditions.

Figure 3-10: Plot of Maximum Queue Lengths – Morning Peak Hour Eastbound and Westbound – 2031 Alternative 2

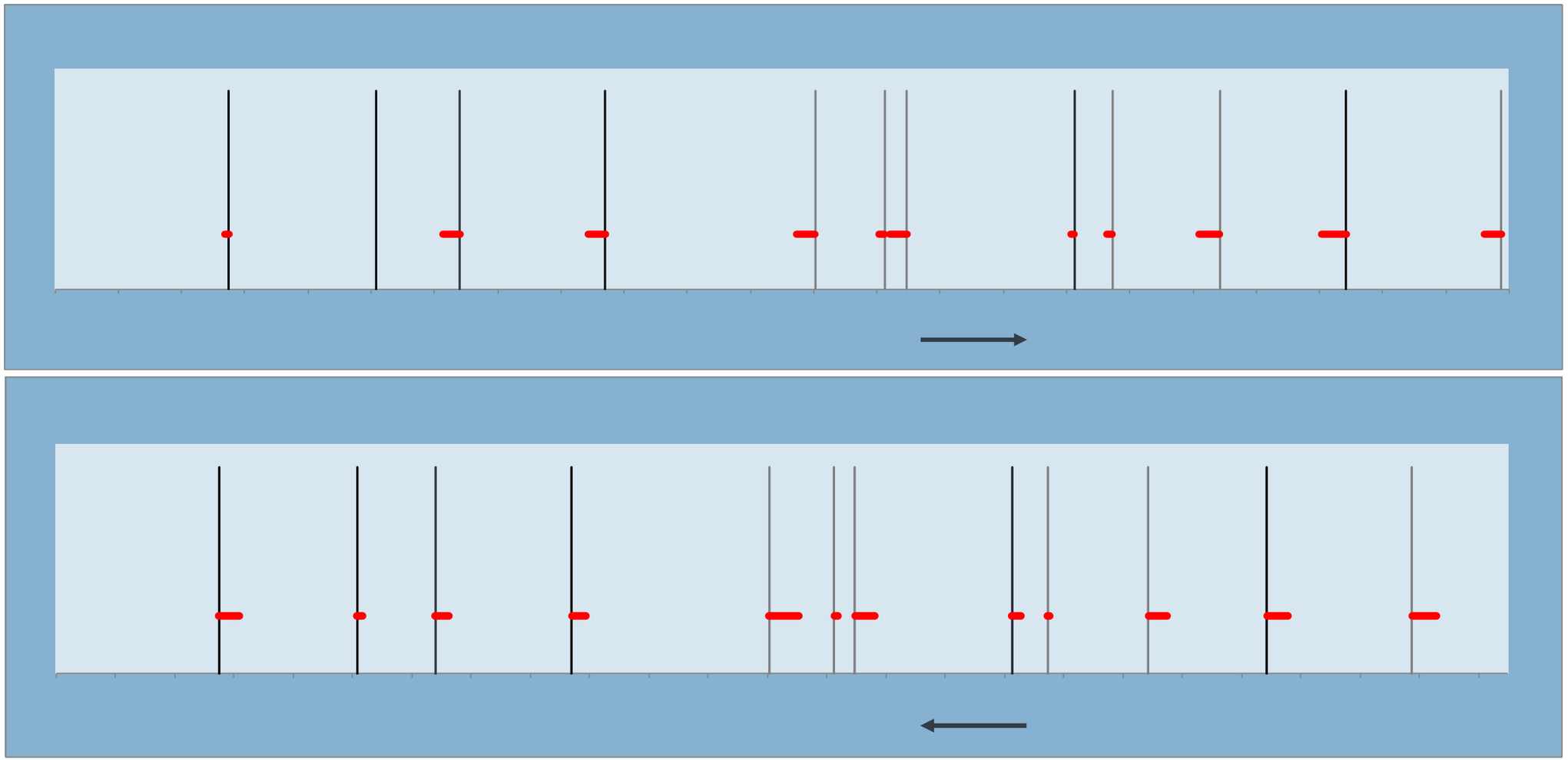
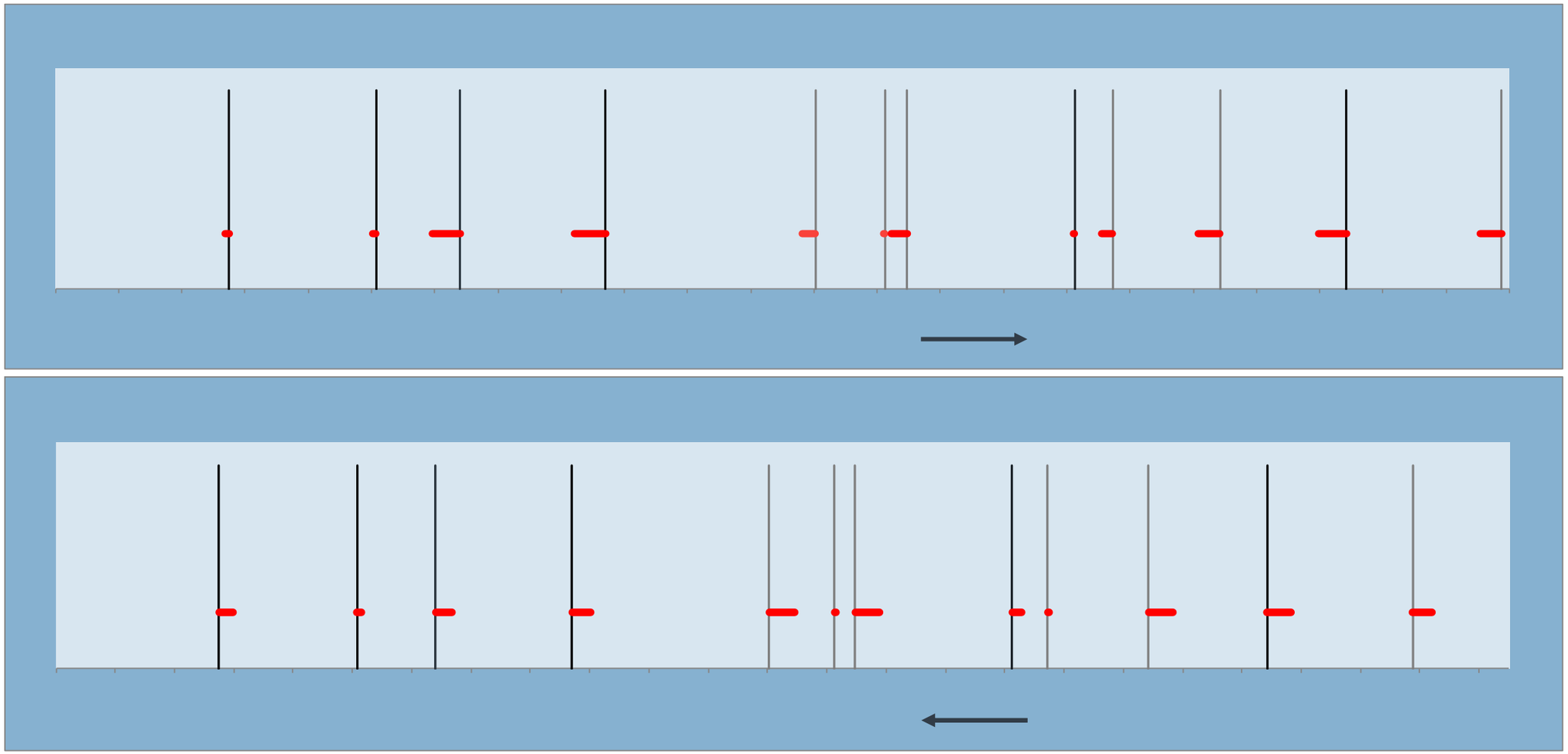


Figure 3-11: Plot of Maximum Queue Lengths – Afternoon Peak Hour Eastbound and Westbound – 2031 Alternative 2



3.4.3 SPEED CONTOUR PLOTS

The morning and afternoon peak hour Alternative 2 (2031) conditions Line 8 speed contour plots in both the eastbound and westbound directions are presented in Figure 3-12 and Figure 3-13, respectively.

Eastbound Direction

The speed contour plots, presented in Figures 3-12 and 3-13, indicate good operation on Line 8 for both AM and PM peak hour conditions with minor degradation near Barrie Street in the eastbound direction, during the AM peak hour conditions.

Westbound Direction

Westbound direction speed contour plots for the AM and PM peak hour conditions show good operation with average speed close to 50 km/h except at close to the signalised intersections with average speed approximately 35 km/h.

Figure 3-12: Speed Contour Plot for Line 8 – Morning Peak Hour Eastbound and Westbound – 2031 Alternative 2

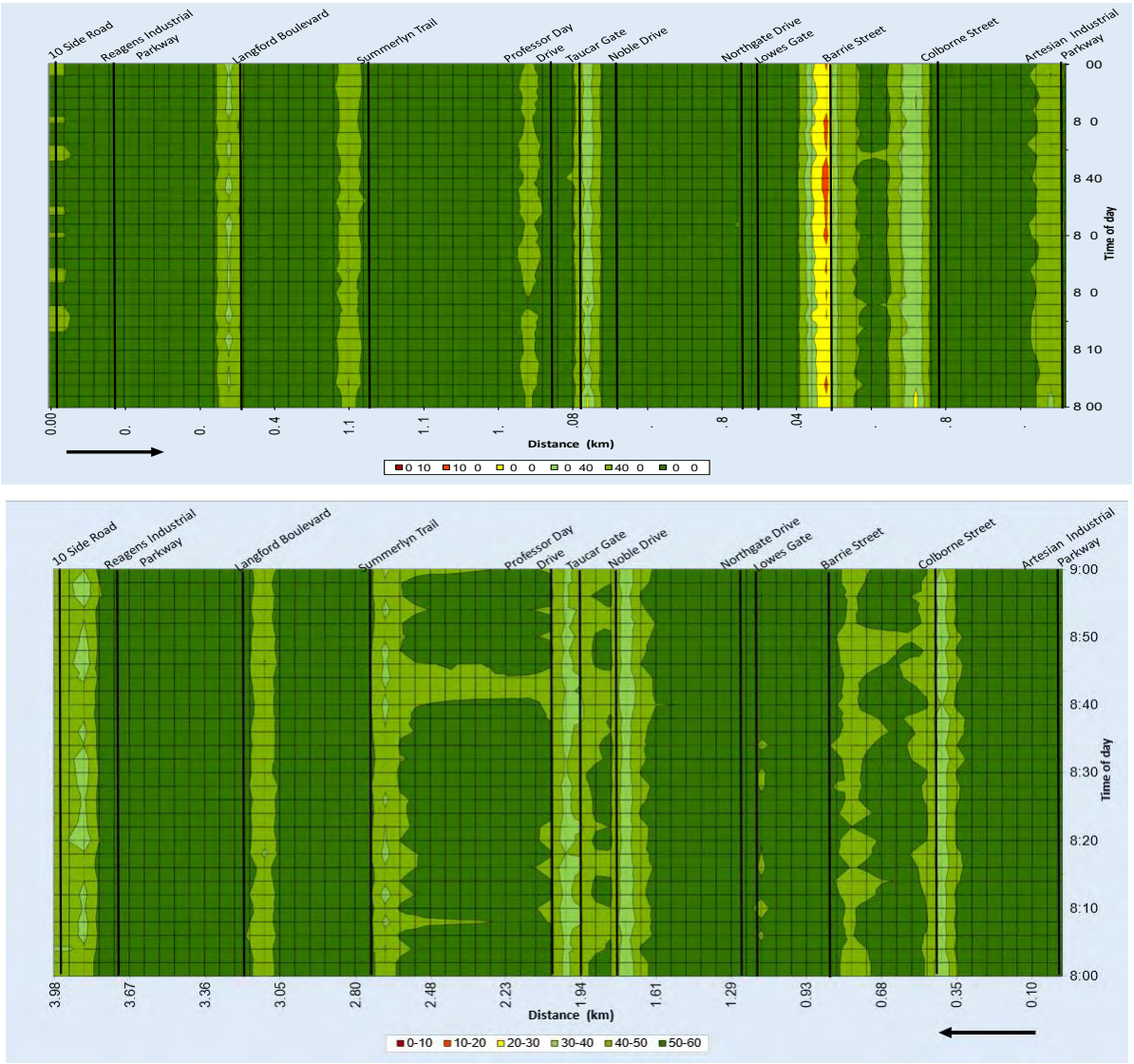
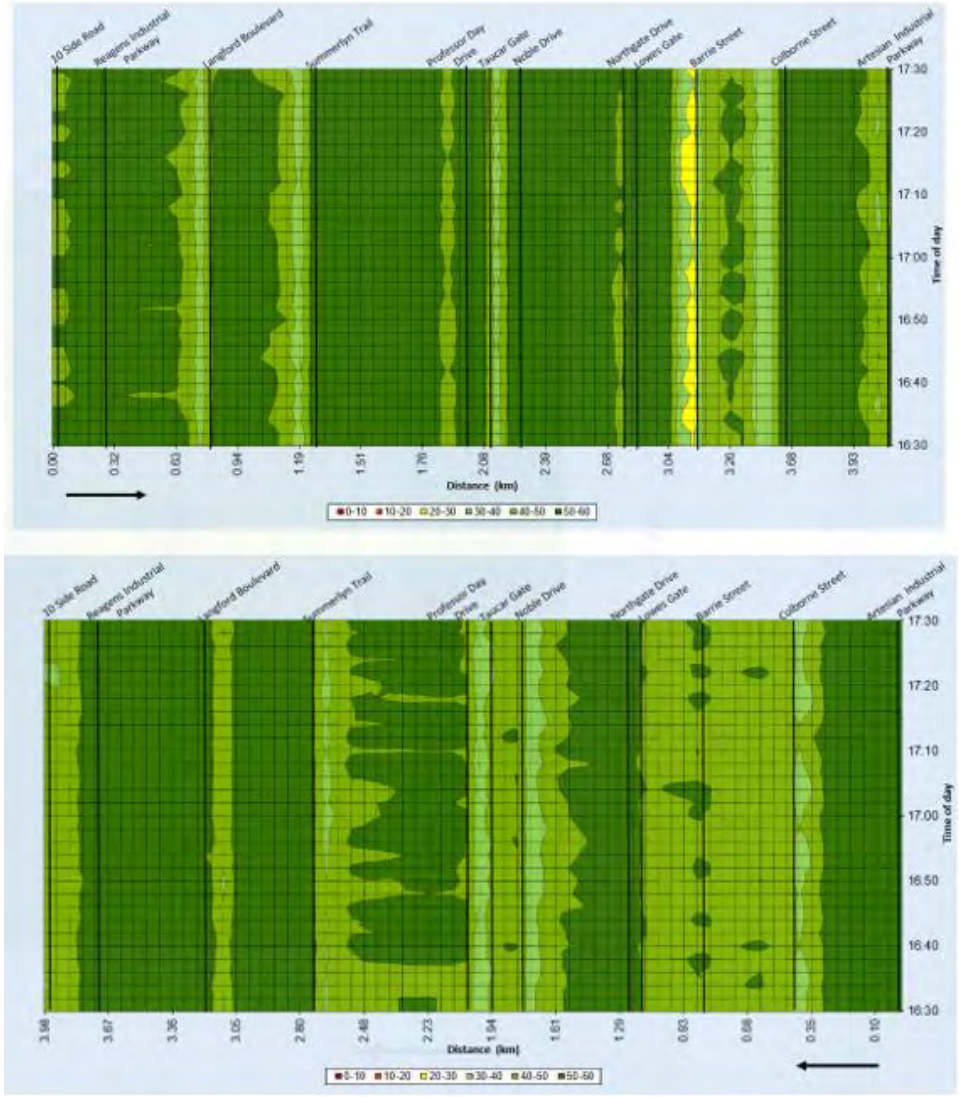


Figure 3-13: Speed Contour Plot for Line 8 – Afternoon Peak Hour Eastbound and Westbound – 2031 Alternative 2



3.4.4 TRAVEL TIME

The vehicle travel time under the Alternative 2 (2031) conditions during the morning and afternoon peak hours for both the eastbound and westbound directions are presented in Table 3-9.

Table 3-9: Travel Time Comparison – Existing and 2031 Alternative 2 Scenario

Morning Peak Hour					
Road Segment	**Distance in km**	**Simulated Travel Time Existing (min)**	**Simulated Travel Time 2031 Alternative 1 Scenario (min)**	**Difference (min)**	**% Difference**
Line 8 from 10 Sideroad to Barrie Street (EB)	3.1	4.57	4.8	0.3	5.5%
Line 8 from Barrie Street to 10 Sideroad (WB)	3.1	4.30	4.7	0.4	9.7%
Afternoon Peak Hour					
Road Segment	**Distance in km**	**Simulated Travel Time Existing (min)**	**Simulated Travel Time 2031 Alternative 1 Scenario (min)**	**Difference (min)**	**% Difference**
Line 8 from 10 Sideroad to Barrie Street (EB)	3.1	4.61	4.8	0.2	5.1%
Line 8 from Barrie Street to 10 Sideroad (WB)	3.1	4.25	4.7	0.5	11.3%

The Alternative 2 morning and afternoon peak hour travel time results, presented in Table 3-9 show that the time to travel Line 8 between 10 Sideroad and Barrie Street in

the eastbound and westbound directions are expected to be similar to that of existing conditions (<15% increase).

3.4.5 SUMMARY OF ALTERNATIVE 2 SCENARIO

- This scenario is a workaround to Scenario 1 for providing an additional lane for EBL at Barrie Street by providing one of the through lanes combined with a left-turn movement. However, double left-turn movements would require dedicated lanes and protected phase (which is included in the next alternative scenario).
- The presence of two through lanes in the eastbound direction from Rogers Trail/Summerlyn Trail to Barrie Street provides better operation for all the in-between intersections.
- Similarly, the presence two lanes in the westbound direction from just east of Line 8 to Lowes Gate also improved LOS and queue lengths at the intersections within this stretch.
- Travel times for both AM and PM peak hour conditions in the eastbound and westbound direction are comparable to that of existing conditions.
- This scenario includes widening on Barrie Street north of Line 8 (however, this widening may not be required except for the eastbound left-turn receiving lanes in the northbound direction).
- The next scenario – Alternative 3 considers minimum requirements to satisfy future conditions.

3.5 ALTERNATIVE 3

This scenario assumed minimum requirements to achieve satisfactory operation for the intersections on Line 8 for the 2031 future conditions. As the Town is not intended for any widening on north, south or east side of Line 8 and Barrie Street intersection, no widening assumed for these approaches except the required lane on the northside to accept the eastbound left-turning vehicles from the dual eastbound left-turn lane at the intersection. Even though, signalised control is not warranted at Line 8 and Northgate Drive intersection, signalization would provide safe pedestrian crossing at the intersection. The 2031 Alternative 3 Scenario considered the following improvements over the Do-Nothing Scenario:

- An additional eastbound lane from Noble Drive to Barrie Street with the additional lane becomes the second left-turn lane at Barrie Street intersection.
- At Line 8 & Barrie Street intersection:
    - Increased eastbound left-turn (EBL) Lane storage length to 150 m.
    - Additional EB left-turn lane (ie. dual left-turn lanes provided for eastbound direction) with eastbound lane configuration as 2EBL+1EBTR.
    - NB direction north of Line 8, additional lane added to accept traffic from dual EBL, reduced to single lane at north end (as in existing).
    - Revised signal plan used.
- Intersection controls:
    - Signal Control at Line 8 & Professor Day Drive (kept same lane configuration as in Existing for north and south approaches).
    - Signal control at Line 8 & Northgate Drive instead of existing Stop-control.
    - For the above intersections, N-S direction signal pedestrian WALK and flashing DON'T WALK will be activated only upon pedestrian activation.
- At Line 8 & Professor Day Drive intersection:
    - Intersection signalised (fully actuated, pedestrians crossing considered)
    - Storage lanes added for EBL and WBL
    - Added protected WB left-turn phase (due to high WB left-turning volume, a protected phase is warranted)
    - Control was provided such that the N-S direction signal pedestrian WALK and flashing DON'T WALK will be activated only upon pedestrian activation.
- At Line 8 & Northgate Drive intersection:
    - Intersection signalised (semi-actuated, pedestrians crossing considered)
    - Added protected WBL phase (due to high WBL volume, a protected phase is warranted)

    - Control was provided such that the N-S direction signal pedestrian WALK and flashing DON'T WALK will be activated only upon pedestrian activation.
- At Line 8 and 10 Sideroad intersection:
    - Added NB right-turn and SB left-turn lanes of 80 m each.
- Pedestrian Crossing facilities:
    - Pedestrian crossing facilities included at all signalised intersections.
    - Assumed 20 pedestrians/h crossing at all the crossing (under existing condition it is 0-5 ped/h)

3.5.1 INTERSECTION OPERATIONAL ANALYSIS

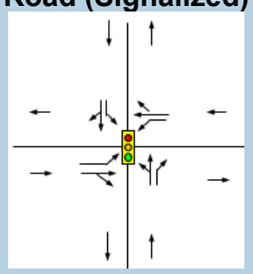
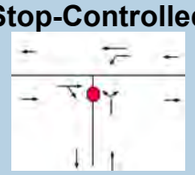
This section presents the Alternative 3 peak hour intersection operations within the study area. The summary of Alternative 3 (2031) intersection operations during the peak hours are provided in Table 3-10. The operational performance evaluation from the Table 3-10 indicates the following:

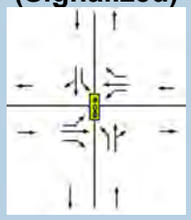
- Under Alternative 2, because of the presence of 2 eastbound through lanes, westbound left-turn movement at Line 8 and Professor Day Drive has provided good LOS. However, with a single eastbound through lane assumed under Alternative 3, a protected phase is warranted and with a protected WB left-turn phase at Line 8 and Professor Day Drive, has provided good LOS and operation of all the movements at the intersection.
- Since Taucar Gate is close to Noble Drive (~60 m), the eastbound direction queue is expected to reach the Taucar Gate intersection when the signal phase is red at Noble Drive intersection. LOS "E" for the NBR reflects this. Also, because of the single through lane these turning vehicles may not get gap to make the turn and may have to wait longer. Extending the 2 eastbound through lanes from Barrie Street to Professor Day Drive (as in Alternative 4) is expected to improve this situation.
- At the intersection of Line 8 and Noble Drive, the evaluation indicates eastbound left-turn movement with queue length exceeding the available storage length. However, there is no room for increasing this length as the upstream intersection (at Taucar Gate) is so close as described above. The operation may be improved with an additional through lane in the westbound direction (as assumed in Alternative 4).
- Even though signal is not warranted at Line 8 and Northgate Drive intersection, signalisation would provide opportunities for safe pedestrian crossing at the intersection and therefore included. However, since the intersection is very close to Lowes Gate (~70m), the westbound queue from Northgate Drive intersection is

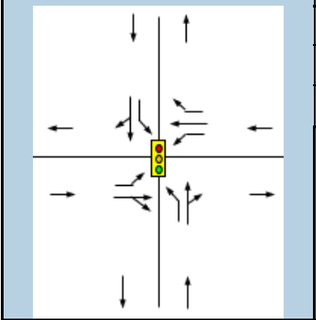
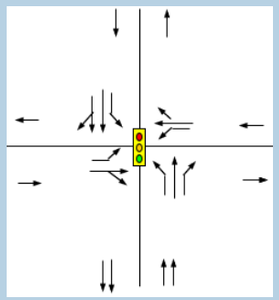
expected to reach or go beyond Lowes Gate intersection as shown in the table (maximum queue length of 190 m for PM peak hour). As a result, the southbound left and right-turn traffic from Lowes Gate would experience higher delay and may not be able to make turns when the signal phase is red. This is indicated by LOS “F” for these turns. This problem may be eliminated by providing an additional through lane for the westbound direction from Barrie Street to Noble Drive (assumed in Alternative 4).

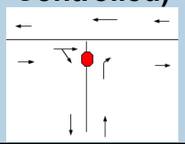
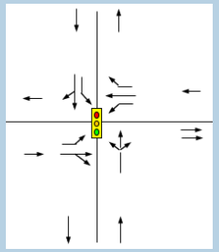
- At Line 8 and Barrie Street, eastbound though movement shows LOS “F” for the morning peak hour conditions, and the operation may be improved by providing an additional right-turn lane as in Alternative 4 as well as by adjusting signal timing plans of various phases.

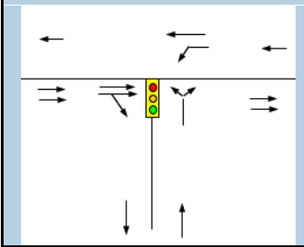
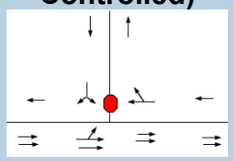
Table 3-10: Micro-simulation-based Intersection Evaluation Results – Peak hour conditions – 2031 Alternative 3

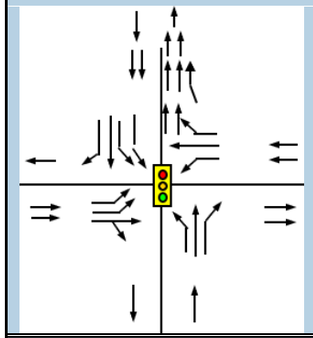
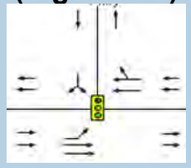
Intersection	Movement	Available/ *Modified* Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and 10 Side Road (Signalized) 	EBL	120	1	18	B	1	2	7	26	C	6	6
	EBT		2	11	B	2	4	9	30	C	10	13
	EBR		6	8	A	5	9	15	7	A	10	13
	WBL	80	249	36	D	57	66	128	25	C	35	51
	WBT		23	28	C	24	29	16	23	C	25	28
	WBR		86	13	B	24	29	223	11	B	25	32
	NBL		4	30	C	35	44	1	17	B	29	37
	NBT		129	25	C	35	44	133	27	C	29	37
	NBR	*80*	126	8	A	28	36	508	17	B	61	72
	SBL	*80*	173	29	C	36	46	190	35	D	46	57
	SBT		101	21	C	27	31	215	27	C	46	54
	SBR		5	12	B	27	31	5	22	C	46	54
	Intersection Overall			25	C				21	C		
Line 8 and Reagens Industrial Parkway (Stop-Controlled) 	EBT		271	2	A	10	13	702	3	A	9	16
	EBR		32	3	A	10	13	5	4	A	9	16
	WBL	70	62	4	A	10	15	33	7	A	9	15
	WBT		348	1	A	3	11	353	1	A	0	0
	NBL		13	14	B	20	26	14	17	C	23	30
	NBR		38	10	A	20	26	131	15	B	23	30
	Intersection Overall			2	A				4	A		

Intersection	Movement	Available/ *Modified* Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and Langford Boulevard (Signalized) 	EBL	50	87	12	B	24	30	103	13	B	16	19
	EBT		201	13	B	36	45	601	16	B	74	87
	EBR	50	18	6	A	12	17	125	7	A	16	20
	WBL	100	48	11	B	12	16	90	17	B	19	20
	WBT		237	13	B	37	44	305	15	B	48	54
	WBR	70	39	6	A	9	15	140	6	A	14	21
	NBL	40	10	22	C	5	8	21	19	B	9	11
	NBT		13	17	B	9	13	2	19	B	6	8
	NBR		55	6	A	11	18	88	5	A	10	11
	SBL	50	58	24	C	14	18	105	23	C	23	29
	SBT		16	22	C	25	34	1	4	A	7	9
	SBR		161	11	B	28	34	60	8	A	12	14
	Intersection Overall			13	B				14	B		
Line 8 and Rogers Trail / Summerlyn Trail (Signalized)	EBL	50	33	16	B	13	20	77	28	C	18	22
	EBT		278	14	B	43	53	697	23	C	84	101
	EBR		2	7	A	43	53	20	17	B	84	101
	WBL	45	248	20	C	42	47	295	34	C	59	65
	WBT		262	13	B	39	45	454	16	B	55	63
	WBR	55	77	8	A	10	15	138	9	A	14	16
	NBL	20	7	21	C	5	8	19	24	C	7	9
	NBT		20	22	C	30	34	19	25	C	26	38
	NBR		211	9	A	31	35	206	15	B	29	38

Intersection	Movement	Available/ *Modified* Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
	SBL	35	98	26	C	19	24	165	28	C	33	40
	SBT		17	22	C	18	22	25	21	C	16	20
	SBR		56	9	A	18	22	65	12	B	16	20
	Intersection Overall			15	B				21	C		
Line 8 and Professor Day Drive (Signalized) 	EBL	*80*	7	18	B	5	9	37	27	C	12	14
	EBT		543	13	B	66	78	855	20	B	88	94
	EBR		33	13	B	66	78	171	19	B	88	94
	WBL	*80*	197	30	C	44	51	188	23	C	32	36
	WBT		507	24	C	78	93	778	8	A	65	77
	WBR		9	23	C	78	93	38	8	A	65	77
	NBL	140	75	33	C	21	23	96	37	D	24	28
	NBT		69	29	C	18	26	38	28	C	12	18
	NBR		56	10	A	14	20	159	7	A	15	15
	SBL	42	9	34	C	7	7	12	32	C	8	11
	SBT		58	27	C	7	9	35	28	C	6	7
	SBR	38	8	7	A	6	8	11	6	A	6	6
	Intersection Overall			21	C				16	B		
	EBT		606	3	A	39	52	1018	8	A	61	67
	EBR		0	5	A	39	52	4	6	A	61	67

Intersection	Movement	Available/ *Modified* Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and Taucar Gate (Stop Controlled) 	WBT		717	1	A	3	9	1006	1	A	1	3
	NBR		57	15	C	19	27	28	38	E	10	13
	Intersection Overall			2	A				5	A		
Line 8 and Noble Drive (Signalized) 	EBL	70	28	19	B	46	67	97	52	D	86	98
	EBT		633	10	B	96	116	907	13	B	123	136
	EBR		0	8	A	96	116	40	13	B	123	136
	WBL	75	0	4	A	0	3	10	31	C	6	10
	WBT		605	14	B	74	88	901	20	B	88	106
	WBR	60	23	9	A	5	11	77	13	B	15	19
	NBL		45	20	B	11	16	13	18	B	9	12
	NBT		0	0	A	11	16	0	0	A	9	12
	NBR		9	11	B	11	16	13	5	A	9	12
	SBL	55	75	19	B	17	24	53	20	C	14	21
	SBT		0	4	A	5	12	0	0	A	10	11
	SBR		66	9	A	13	19	93	13	B	16	17
	Intersection Overall			13	B				18	B		
Line 8 and Northgate Drive (Signalized)	EBT		701	19	B	55	63	902	20	B	54	59
	EBR		17	19	B	55	63	67	19	B	54	59
	WBL	65	97	17	B	63	75	149	24	C	131	156

Intersection	Movement	Available/ *Modified* Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
	WBT		592	13	B	99	113	978	15	B	170	190
	NBL		40	36	D	57	70	20	31	C	26	28
	NBR		250	35	D	57	70	122	9	A	26	30
	Intersection Overall			19	B				17	B		
Line 8 and Lowes Gate (Stop-Controlled) 	EBL		25	9	A	23	34	111	26	D	46	52
	EBT		927	1	A	23	34	914	3	A	46	52
	WBT		642	4	A	36	46	1035	11	B	96	110
	WBR		127	4	A	36	46	128	10	A	96	110
	SBL		184	26	D	34	46	79	158	F	93	101
	SBR		47	25	C	34	46	89	168	F	93	101
	Intersection Overall			5	A				20	C		
Line 8 and Barrie Street (Signalized)	EBL	*Ln1 = 150, Ln2=290*	519	77	E	84	93	421	48	D	50	58
	EBT		500	89	F	191	202	513	49	D	118	131
	EBR		72	89	F	191	202	59	45	D	118	131
	WBL	120	15	29	C	16	18	35	26	C	11	18
	WBT		263	30	C	66	79	528	23	C	102	108
	WBR		765	9	A	107	118	1118	2	A	10	40
	NBL	50	53	22	C	14	17	78	25	C	16	22
	NBT		27	34	C	9	11	0	0	A	0	0
	NBR	110	35	6	A	7	8	44	7	A	7	9

Intersection	Movement	Available/ *Modified* Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
	SBL (dual)	Ln1 = 120, Ln 2 = 190	491	41	D	57	63	730	49	D	88	95
	SBT		0	0	A	0	0	101	41	D	26	30
	SBR		454	13	B	46	60	561	79	E	169	175
	Intersection Overall			52	D				48	D		
Line 8 and Colborne Street (Signalized) 	EBT		790	19	B	80	93	924	21	C	90	101
	EBR		237	22	C	80	93	288	23	C	90	101
	WBL	60	4	15	B	3	7	1	5	A	1	2
	WBT		717	12	B	64	73	1351	16	B	80	90
	NBL		312	40	D	68	76	331	42	D	73	87
	NBR		7	43	D	68	75	11	35	D	73	87
	Intersection Overall			20	C				21	C		
Line 8 and Artesian Industrial Parkway (Signalized) 	EBL	50	8	14	B	8	15	62	27	C	24	30
	EBT		785	7	A	44	52	868	11	B	67	82
	WBT		703	12	B	67	82	1289	18	B	71	76
	WBR		291	14	B	67	82	146	19	B	71	76
	SBL		90	34	C	33	45	236	37	D	54	65
	SBR		19	18	B	33	45	58	27	C	54	65
	Intersection Overall			12	B				18	B		

Intersection	Movement	Available/ *Modified* Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
10 Sideroad and Reagens Industrial Parkway (Signalized) 	WBL	30	127	21	C	36	45	137	20	B	32	38
	WBR		19	8	A	20	30	109	10	A	17	23
	NBT		226	9	A	19	24	527	10	A	25	32
	NBR	50	104	5	A	16	20	95	6	A	19	26
	SBL	60	1	19	B	3	9	12	15	B	7	12
	SBT		352	10	A	26	29	345	8	A	21	27
	Intersection Overall			11	B				10	B		

3.5.2 MAXIMUM QUEUE LENGTHS

Alternative 3 conditions queue plots for the Line 8 intersections during the morning peak and afternoon peak hours in both the eastbound and westbound directions are presented in Figure 3-14 and Figure 3-15, respectively.

Eastbound Direction

At Noble Drive, the maximum queue length (with maximum queue length range of 116-136 m) extends beyond the upstream stop-controlled intersection at Taucar Gate which is located at 70 m upstream. All other intersections, the queue lengths do not reach the upstream intersections.

Westbound Direction

For the westbound direction, the queue from Northgate Drive intersection would extend beyond the nearby upstream intersection (at Lowes Gate which is only 80m away) with queue lengths ranging from 113-190m. All other intersections, the queue lengths do not reach the upstream intersections.

Figure 3-14: Plot of Maximum Queue Lengths – Morning Peak Hour Eastbound and Westbound – 2031 Alternative 3

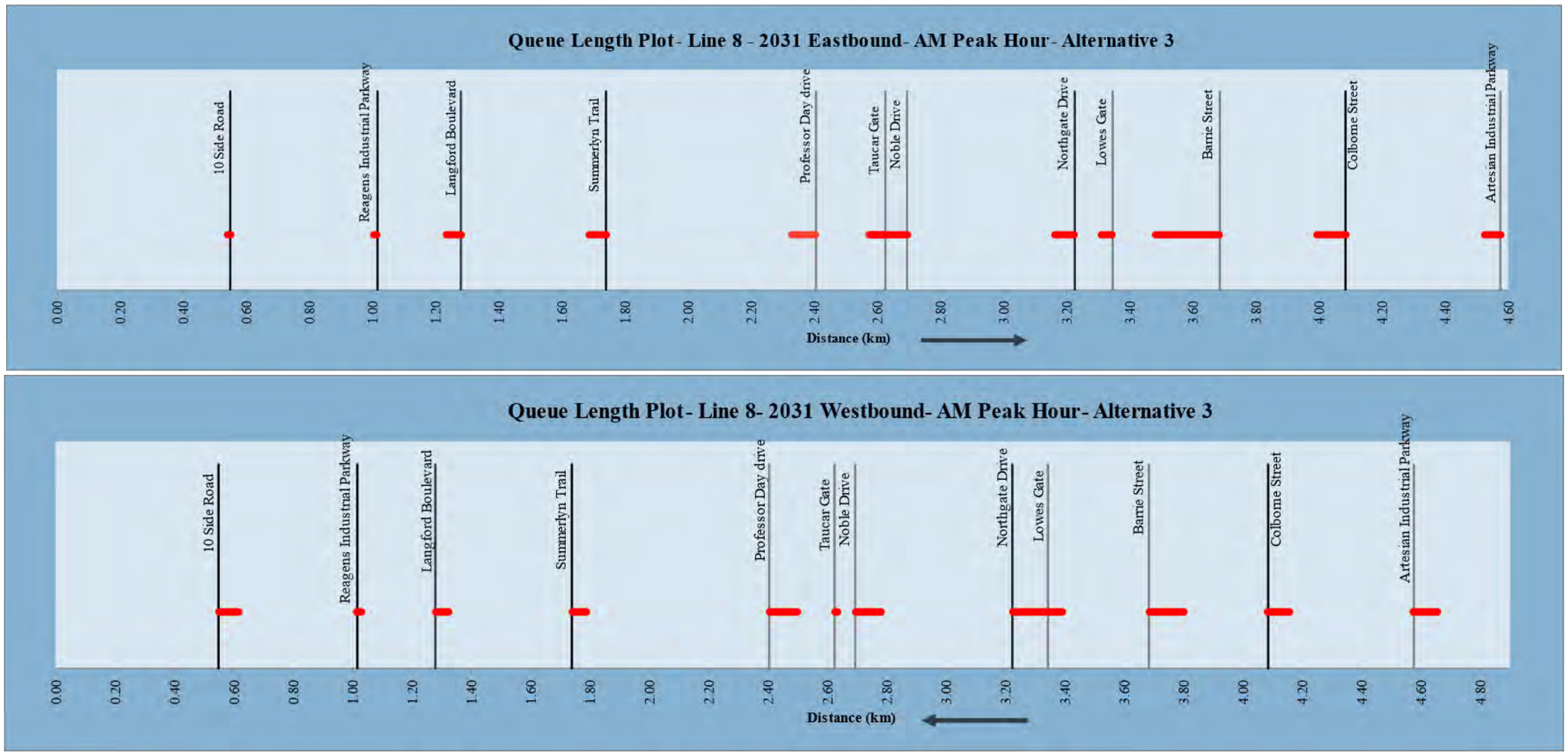
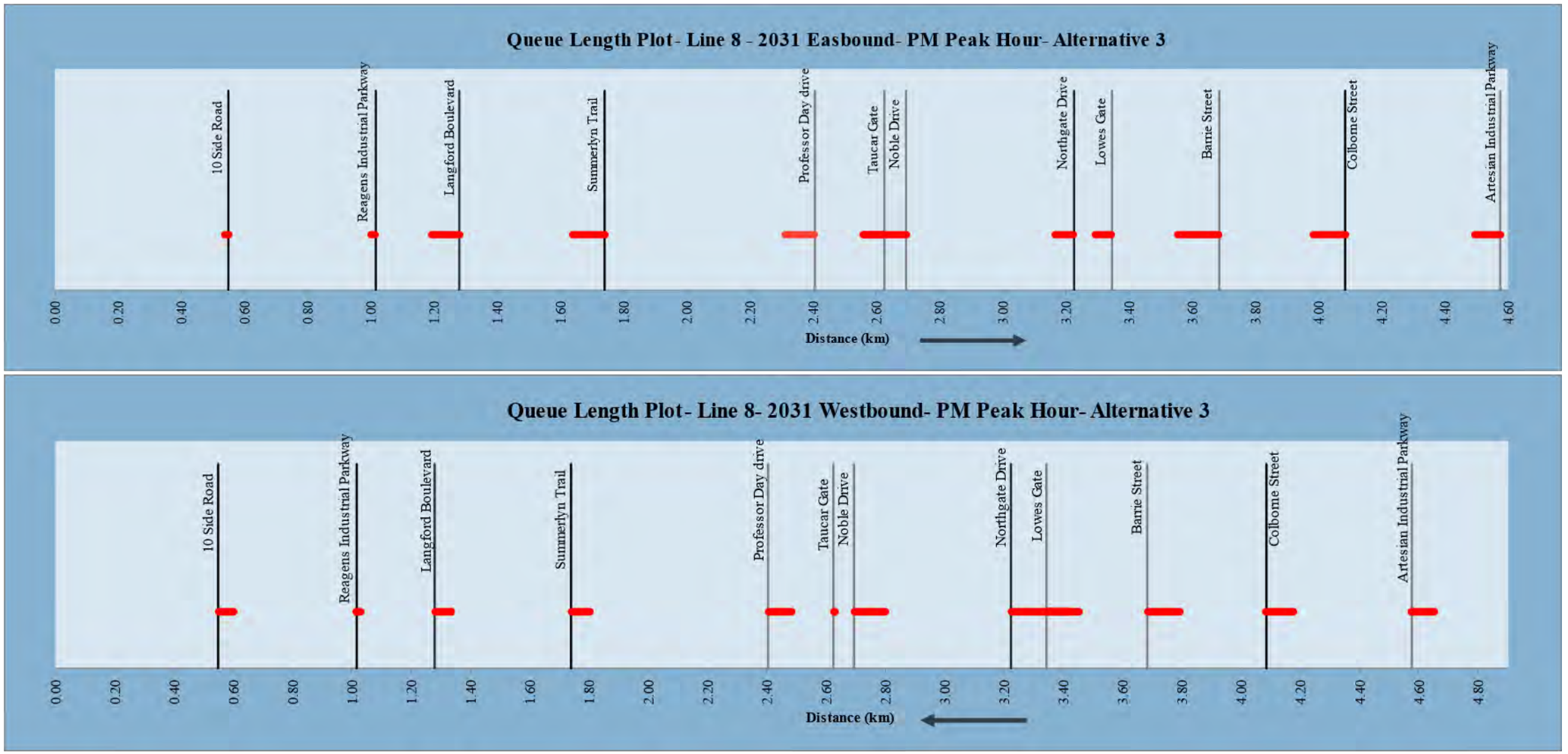


Figure 3-15: Plot of Maximum Queue Lengths – Afternoon Peak Hour Eastbound and Westbound – 2031 Alternative 3



3.5.3 SPEED CONTOUR PLOTS

The morning and afternoon peak hour Alternative 3 (2031) conditions Line 8 speed contour plots in both the eastbound and westbound directions are presented in Figure 3-16 and Figure 3-17, respectively.

Eastbound Direction

The speed contour plots, presented in Figures 3-16 and 3-17, indicate good operation on Line 8 for both AM and PM peak hour conditions except with marginally higher degradation near Barrie Street in the eastbound direction, during the AM peak hour conditions.

Westbound Direction

Westbound direction speed contour plots for the AM and PM peak hour conditions show good operation with average speed close to 50 km/h except at close to the signalised intersections with average speed approximately 35 km/h.

Figure 3-16: Speed Contour Plot for Line 8 – Morning Peak Hour Eastbound and Westbound – 2031 Alternative 3

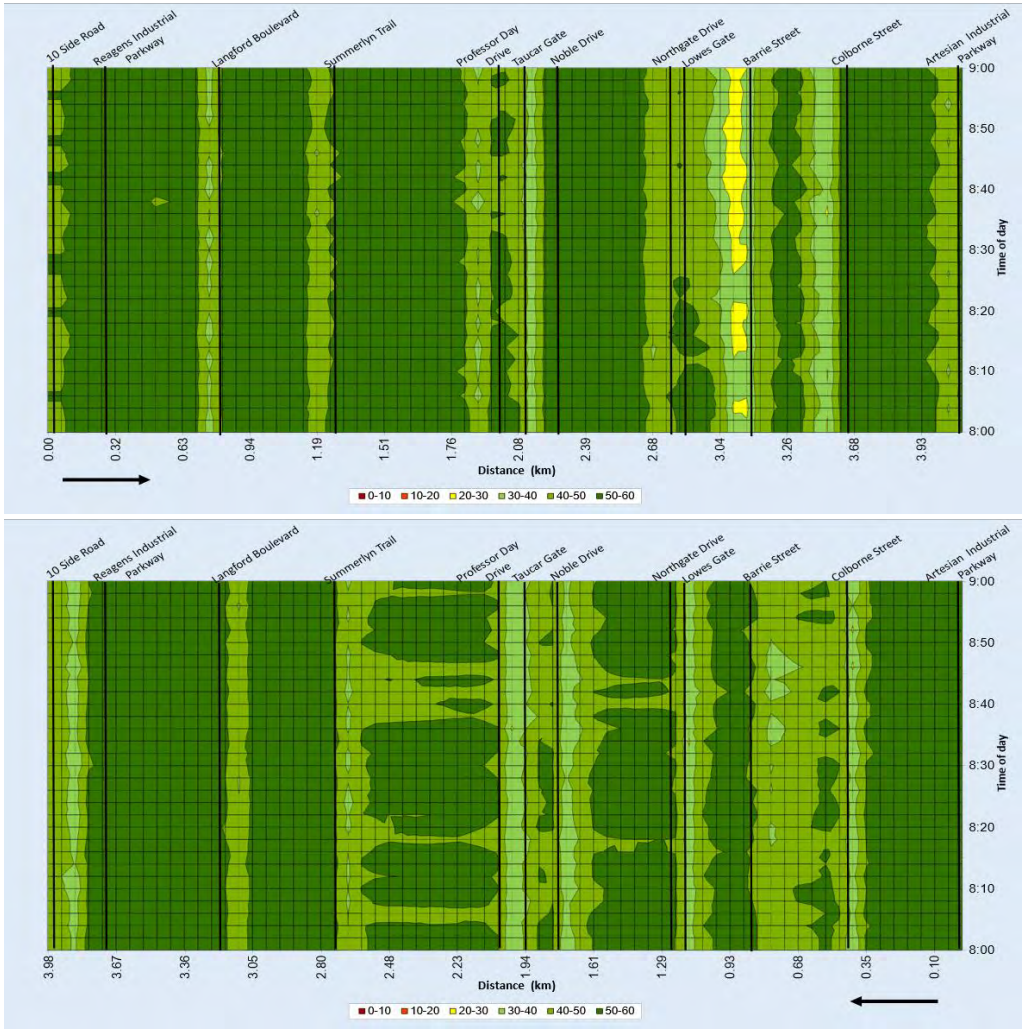
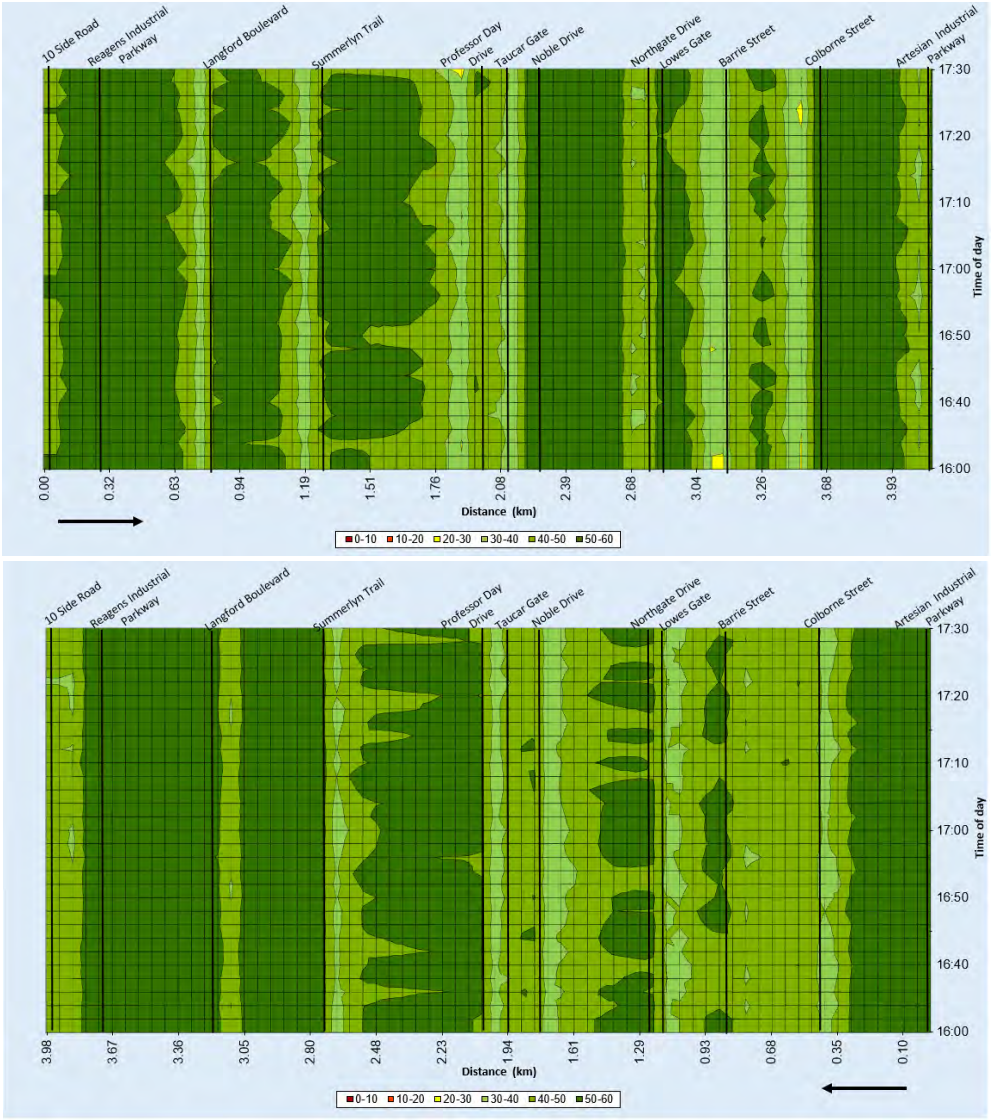


Figure 3-17: Speed Contour Plot for Line 8 – Afternoon Peak Hour Eastbound and Westbound – 2031 Alternative 3



3.5.4 TRAVEL TIME

The vehicle travel time under the Alternative 3 (2031) conditions increase by approximately 30% in the eastbound direction and 20% in the westbound directions for both morning and afternoon peak hours as presented in Table 3-11.

Table 3-11: Travel Time Comparison – Existing and 2031 Alternative 3 Scenario

Morning Peak Hour					
Road Segment	**Distance in km**	**Simulated Travel Time Existing (min)**	**Simulated Travel Time 2031 Alternative 1 Scenario (min)**	**Difference (min)**	**% Difference**
Line 8 from 10 Sideroad to Barrie Street (EB)	3.1	4.57	6.0	1.5	31.8%
Line 8 from Barrie Street to 10 Sideroad (WB)	3.1	4.30	5.2	0.9	21.7%
Afternoon Peak Hour					
Road Segment	**Distance in km**	**Simulated Travel Time Existing (min)**	**Simulated Travel Time 2031 Alternative 1 Scenario (min)**	**Difference (min)**	**% Difference**
Line 8 from 10 Sideroad to Barrie Street (EB)	3.1	4.61	6.1	1.5	31.7%
Line 8 from Barrie Street to 10 Sideroad (WB)	3.1	4.25	5.0	0.8	17.9%

3.5.5 SUMMARY OF ALTERNATIVE 3 SCENARIO

- This scenario represents the anticipated improvements required on Line 8 and 10 Sideroad intersections.
- There are no modifications assumed at the intersection of Line 8 and Barrie Street for the east, north and south approaches as intended by the Town. However, dual eastbound left-turn lanes are required at the intersection to provide good LOS and to sustain the queue lengths within the approach.
- Providing 2 eastbound through lanes from Noble Dive to Barrie Street have provided better performance within this stretch.
- By providing protected WB left-turn phase at Line 8 and Professor Day Drive has improved the LOS and operation of all the movements at the intersection.
- Since Taucar Gate is close to Noble Drive (~60 m), the eastbound direction queue is expected to reach the Taucar Gate intersection when the signal phase is red at Noble Drive intersection. LOS “E” for the NBR reflects this. Also, because of the single eastbound through lane, these turning vehicles may not get gap to make the turn and may have to wait longer. Extending the 2 eastbound through lanes from Barrie Street to Professor Day Drive (as in Alternative 4) is expected to improve this situation.
- At the intersection of Line 8 and Noble Drive, the evaluation indicated eastbound left-turn movement with queue length exceeding the available storage length. However, there is no room for increasing this length as the upstream intersection (at Taucar Gate) is so close as described above. The operation may be improved with an additional through lane in the westbound direction (as assumed in Alternative 4).
- Even though signal is not warranted at Line 8 and Northgate Drive intersection, signalisation would provide opportunities for safe pedestrian crossing at the intersection and therefore included. However, since the intersection is very close to Lowes Gate (~70m), the westbound queue from Northgate Drive intersection is expected to reach or go beyond Lowes Gate intersection. As a result, southbound left and right-turn traffic from Lowes Gate would experience higher delay and may not be able to make turns when the signal phase is red. This problem has been eliminated in Alternative 4 by assuming 2 through lanes for the westbound direction from Barrie Street to Noble Drive.
- At Line 8 and Barrie Street, eastbound though movement shows LOS “F” for morning peak hour conditions, and the operation may be improved by providing an additional right-turn lane as in Alternative 4 as well as by adjusting signal timing plans of various phases.

- Travel times for both AM and PM peak hour conditions in the eastbound and westbound directions increase by approximately 30% and 20% respectively with respect to the existing conditions.

3.6 ALTERNATIVE 4 (PROPOSED)

Alternative 4 may be considered as scenario addressing all the issues with the previous alternative and is expected to provide good performance on Line 8 and 10 Sideroad intersections. Further adjustments may be required with storage lengths at different intersections.

The 2031 Alternative 4 Scenario considered the following improvements over the Do-Nothing Scenario (modifications with respect to Alternative 3 has been shown in bold letters):

- An additional eastbound lane from **Professor Day Drive to Barrie Street** with the additional lane becomes the second left-turn lane at Barrie Street intersection.
- **An additional westbound lane from Barrie Street to Noble Drive.**
- At Line 8 & Barrie Street intersection:
    - Increased eastbound left-turn (EBL) Lane storage length to 150 m.
    - **Additional eastbound right-turn lane (70 m).**
    - Additional eastbound left-turn lane (added eastbound through lane from west converted) with eastbound approach configuration as 2EBL+1EBT+1EBR.
    - NB direction north of Line 8: additional lane added to accept traffic from dual EBL, reduced to single lane at north end (as in existing).
    - **Revised signal plan used**.
- Intersection controls:
    - Signal Control at Line 8 & Professor Day Drive (kept same lane configuration as in Existing for north and south approaches)
    - Signal control at Line 8 & Northgate Drive instead of existing Stop-control.
    - For the above intersections, N-S direction signal pedestrian WALK and flashing DON'T WALK will be activated only upon pedestrian activation.
- At Line 8 & Professor Day Drive intersection:
    - Intersection signalised (fully actuated, pedestrians crossing considered).
    - Storage lanes added for EB left-turn and WB left-turn.
    - Added protected WB left-turn phase (due to high WBL volume, a protected phase is warranted).
    - Control was provided such that the N-S direction signal pedestrian WALK and flashing DON'T WALK will be activated only upon pedestrian activation.
- At Line 8 & Northgate Drive intersection:

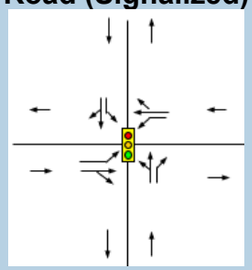
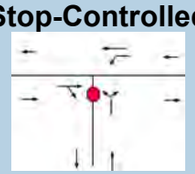
    - Intersection signalised (semi-actuated, pedestrians crossing considered)
    - Added protected WB left-turn phase (due to high WBL volume, a protected phase is warranted)
    - Control was provided such that the N-S direction signal pedestrian WALK and flashing DON'T WALK will be activated only upon pedestrian activation.
- At Line 8 and 10 Sideroad intersection:
    - Added northbound right-turn (NBR) and southbound left-turn (SBL) lanes of 80 m each.
- At Line 8 and Rogers Trail/Summerlyn Trail intersection:
    - **Increased westbound left-turn (WBL) and southbound left-turn (SBL) storage lengths to 70 m and 50 m respectively.**
- Pedestrian Crossing facilities:
    - Pedestrian crossing facilities included at all signalised intersections.
    - Assumed 20 pedestrians/h crossing at all the crossing (under existing condition it is 0-5 ped/h)

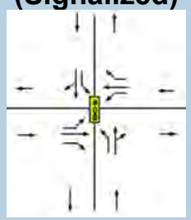
3.6.1 INTERSECTION OPERATIONAL ANALYSIS

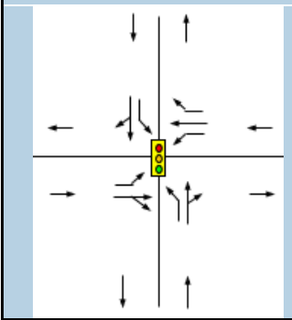
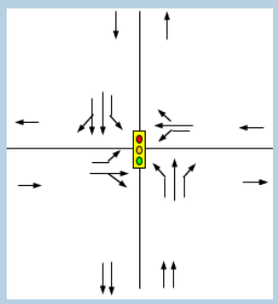
This section presents the Alternative 4 peak hour intersection operations within the study area. The summary of Alternative 4 (2031) intersection operations during the peak hours are provided in Table 3-12. The operational performance evaluation from the Table 3-12 indicates the following:

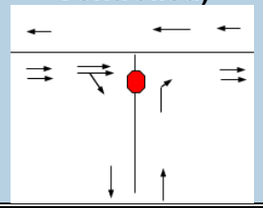
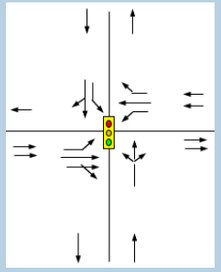
- The proposed Alternative 4 Scenario is expected to provide good operation for all the intersections within the study area with LOS "D" better for all the turning movements for both AM and PM peak periods for the 2031 conditions except for eastbound left-turn movement at Barrie Street during AM peak hour conditions with LOS "E". It is typical to assume LOS "E" as manageable condition for left-turn movements as long as the queue does not exceed available storage length. All the intersections are expected to operate with an overall LOS "C" or better except for the intersection of Line 8 and Barrie Street with LOS "D".
- None of the queue lengths reach upstream intersections for both AM and PM peak hour conditions.
- The queue lengths on all the left-turn and right-turn lanes are expected to be within the storage length assumed except for a marginally higher queue length (37-51 m) for the westbound left-turn (WBL) at the intersection 10 Sideroad and Reagens Industrial Parkway.

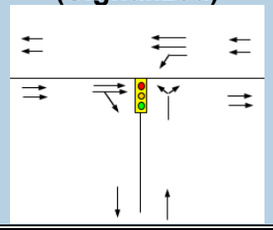
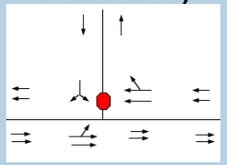
Table 3-12: Micro-simulation-based Intersection Evaluation Results – Peak hour conditions – 2031 Alternative 4

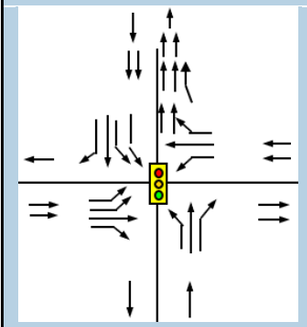
Intersection	Movement	Available/ *Modified* Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and 10 Side Road (Signalized) 	EBL	120	1	16	B	1	2	7	29	C	6	7
	EBT		2	17	B	2	5	9	25	C	7	13
	EBR		6	6	A	4	11	15	7	A	7	13
	WBL	80	251	38	D	61	76	128	24	C	33	38
	WBT		23	31	C	23	30	15	22	C	29	37
	WBR		85	13	B	24	30	223	12	B	29	38
	NBL		4	26	C	35	43	1	13	B	27	32
	NBT		128	26	C	35	43	134	26	C	27	32
	NBR	*80*	126	9	A	27	30	509	17	B	58	66
	SBL	*80*	173	29	C	39	47	190	35	D	47	57
	SBT		101	24	C	27	32	216	26	C	45	52
	SBR		5	11	B	27	32	6	11	B	45	52
	Intersection Overall			26	C				21	C		
Line 8 and Reagens Industrial Parkway (Stop-Controlled) 	EBT		269	2	A	11	16	701	3	A	10	12
	EBR		32	3	A	11	16	5	4	A	10	12
	WBL	70	61	4	A	11	19	32	6	A	7	14
	WBT		346	1	A	2	8	355	1	A	0	0
	NBL		13	15	B	20	27	14	19	C	22	30
	NBR		38	10	B	20	27	131	15	B	22	30
	Intersection Overall			2	A				4	A		

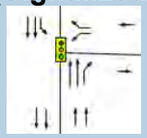
Intersection	Movement	Available/ *Modified* Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and Langford Boulevard (Signalized) 	EBL	50	89	12	B	22	26	104	14	B	17	21
	EBT		202	12	B	36	49	602	15	B	69	80
	EBR	50	18	5	A	12	16	125	7	A	13	20
	WBL	100	48	11	B	10	11	89	17	B	18	20
	WBT		237	12	B	36	47	305	15	B	53	65
	WBR	70	38	5	A	7	9	141	6	A	15	20
	NBL	40	10	16	B	4	6	22	18	B	9	10
	NBT		13	18	B	12	17	2	19	B	6	9
	NBR		54	7	A	13	19	88	6	A	10	11
	SBL	50	57	23	C	14	18	105	23	C	23	30
	SBT		16	23	C	24	36	1	10	A	5	7
	SBR		161	11	B	26	36	60	7	A	10	14
	Intersection Overall			12	B				14	B		
Line 8 and Rogers Trail / Summerlyn Trail (Signalized)	EBL	50	33	17	B	16	22	77	28	C	18	21
	EBT		277	14	B	42	49	695	24	C	93	107
	EBR		2	5	A	42	49	19	21	C	93	107
	WBL	*70*	249	16	B	36	46	306	32	C	48	54
	WBT		262	11	B	36	46	454	15	B	57	69
	WBR	55	78	6	A	10	11	139	8	A	14	17
	NBL	20	7	25	C	5	6	19	26	C	7	9
	NBT		20	21	C	29	36	19	24	C	29	37
	NBR		211	9	A	30	36	206	15	B	29	37
	SBL	*50*	98	25	C	20	24	165	29	C	32	38

Intersection	Movement	Available/ *Modified* Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
	SBT		17	23	C	17	23	25	27	C	15	21
	SBR		56	9	A	17	23	65	14	B	15	21
	Intersection Overall			14	B				22	C		
Line 8 and Professor Day Drive (Signalized)	EBL	*80*	7	18	B	6	12	36	28	C	12	15
	EBT		543	14	B	65	81	857	19	B	90	104
	EBR		33	15	B	65	81	171	19	B	90	104
	WBL	*80*	195	12	B	31	41	192	21	C	30	34
	WBT		507	6	A	56	66	793	8	A	64	83
	WBR		9	7	A	56	66	40	9	A	64	83
	NBL	140	75	37	D	23	30	95	36	D	24	24
	NBT		69	27	C	19	24	38	27	C	11	17
	NBR		56	6	A	15	20	159	6	A	15	17
	SBL	42	9	33	C	6	8	12	32	C	6	11
	SBT		59	32	C	9	11	34	27	C	6	8
	SBR	38	8	7	A	8	10	11	5	A	6	7
	**Intersection Overall**			14	B				16	B		
	EBT		608	1	A	4	5	1020	1	A	1	4
	EBR		0	1	A	4	5	4	2	A	1	4

Intersection	Movement	Available/ *Modified* Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and Taucar Gate (Stop Controlled) 	WBT		714	1	A	4	9	1024	1	A	1	2
	NBR		57	10	A	18	24	28	11	B	7	8
	Intersection Overall			1	A				1	A		
Line 8 and Noble Drive (Signalized) 	EBL	70	28	17	B	11	17	97	33	C	24	33
	EBT		635	9	A	41	45	910	9	A	39	44
	EBR		0	1	A	41	45	40	8	A	39	44
	WBL		1	16	B	5	11	13	23	C	19	29
	WBT		603	14	B	77	85	919	23	C	97	120
	WBR	60	22	8	A	5	6	78	15	B	14	20
	NBL		45	20	B	12	18	13	18	B	9	12
	NBT		0	0	A	12	18	0	0	A	9	12
	NBR		9	12	B	12	18	13	5	A	9	12
	SBL	55	75	19	B	17	24	53	20	C	14	21
	SBT		0	4	A	6	15	0	0	A	10	13
	SBR		66	9	A	14	20	93	13	B	15	18
	Intersection Overall			12	B				17	B		
	EBT		699	19	B	55	62	907	20	C	60	67
	EBR		17	16	B	55	62	67	21	C	60	67

Intersection	Movement	Available/ *Modified* Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and Northgate Drive (Signalized) 	WBL	65	98	17	B	33	43	151	21	C	41	44
	WBT		590	11	B	34	39	992	12	B	51	57
	NBL		41	28	C	39	47	20	30	C	26	28
	NBR		251	14	B	39	47	122	9	A	26	30
	Intersection Overall			15	B				16	B		
Line 8 and Lowes Gate (Stop-Controlled) 	EBL		24	6	A	15	24	114	13	B	36	48
	EBT		926	1	A	15	24	916	2	A	36	48
	WBT		640	1	A	8	14	1047	1	A	10	20
	WBR		128	2	A	8	14	129	3	A	10	20
	SBL		185	21	C	32	37	86	26	D	26	31
	SBR		48	17	C	32	37	95	19	C	26	31
	Intersection Overall			3	A				4	A		
Line 8 and Barrie Street (Signalized)	EBL (dual)	*Ln1 = 150, Ln2=290*	522	68	E	78	85	425	51	D	52	58
	EBT		507	33	C	88	106	515	33	C	99	110
	EBR		73	11	B	24	27	59	12	B	11	13
	WBL	120	12	26	C	10	16	34	24	C	13	19
	WBT		260	27	C	61	77	525	23	C	107	113
	WBR		767	1	A	12	22	1121	2	A	18	40
	NBL	50	53	22	C	12	18	78	25	C	18	21

Intersection	Movement	Available/ *Modified* Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
	NBT		27	39	D	10	11	0	0	A	0	0
	NBR	110	35	6	A	6	8	44	7	A	7	9
	SBL (dual)	Ln1 = 120, Ln 2 = 190	489	41	D	55	62	735	47	D	83	93
	SBT		0	0	A	0	0	102	42	D	27	35
	SBR		455	14	B	51	70	571	24	C	89	101
	Intersection Overall			37	D				35	C		
Line 8 and Colborne Street (Signalized) 	EBT		798	19	B	77	92	928	21	C	86	99
	EBR		238	22	C	77	92	289	23	C	86	99
	WBL	60	4	15	B	4	7	1	11	B	2	2
	WBT		717	12	B	66	73	1352	17	B	81	90
	NBL		312	40	D	68	76	331	43	D	74	88
	NBR		7	43	D	68	75	11	36	D	74	88
	Intersection Overall			20	C				22	C		
Line 8 and Artesian Industrial Parkway (Signalized)	EBL	50	8	13	B	5	12	64	24	C	25	30
	EBT		795	7	A	43	52	875	11	B	63	72
	WBT		703	12	B	67	82	1292	17	B	70	76
	WBR		291	14	B	67	82	146	19	B	70	76
	SBL		90	34	C	33	45	235	36	D	55	61
	SBR		19	18	B	33	45	58	27	C	55	61

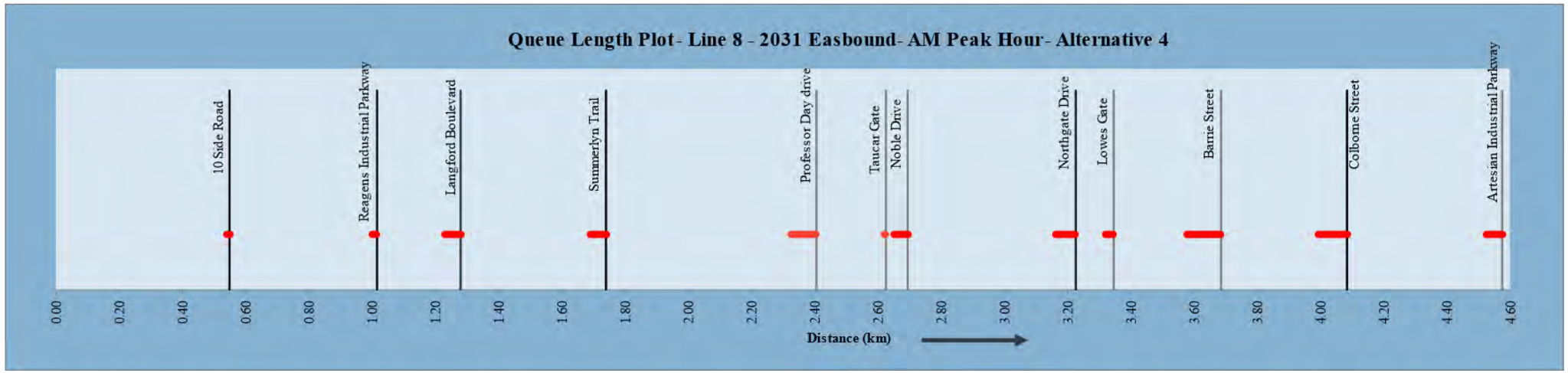
Intersection	Movement	Available/ *Modified* Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
	**Intersection Overall**			11	B				17	B		
10 Sideroad and Reagens Industrial Parkway (Signalized) 	WBL	30	128	23	C	42	51	137	20	B	31	37
	WBR		18	9	A	23	29	109	9	A	17	24
	NBT		226	10	A	18	25	526	9	A	25	27
	NBR	50	104	5	A	17	20	95	5	A	21	32
	SBL	60	1	8	A	2	9	12	16	B	8	12
	SBT		352	9	A	24	29	346	8	A	19	24
	Intersection Overall			11	B				10	A		

3.6.2 MAXIMUM QUEUE LENGTHS

Alternative 4 conditions queue plots for the Line 8 intersections during the morning peak and afternoon peak hours in both the eastbound and westbound directions are presented in Figure 3-18 and Figure 3-19, respectively.

It may be shown that none of the queue lengths reach the upstream intersections for both AM and PM peak hour conditions for both eastbound and westbound directions. Even though, the intersection of Noble Drive is so close to Taucar Drive, the eastbound direction queue is not expected to block Noble Drive intersection. Similarly, the westbound direction queue from Northgate Drive is not expected to reach the nearby intersections at Lowes Gate. This has been achieved because of the additional through lanes in the eastbound and westbound directions assumed under this alternative.

Figure 3-18: Plot of Maximum Queue Lengths – Morning Peak Hour Eastbound and Westbound – 2031 Alternative 4



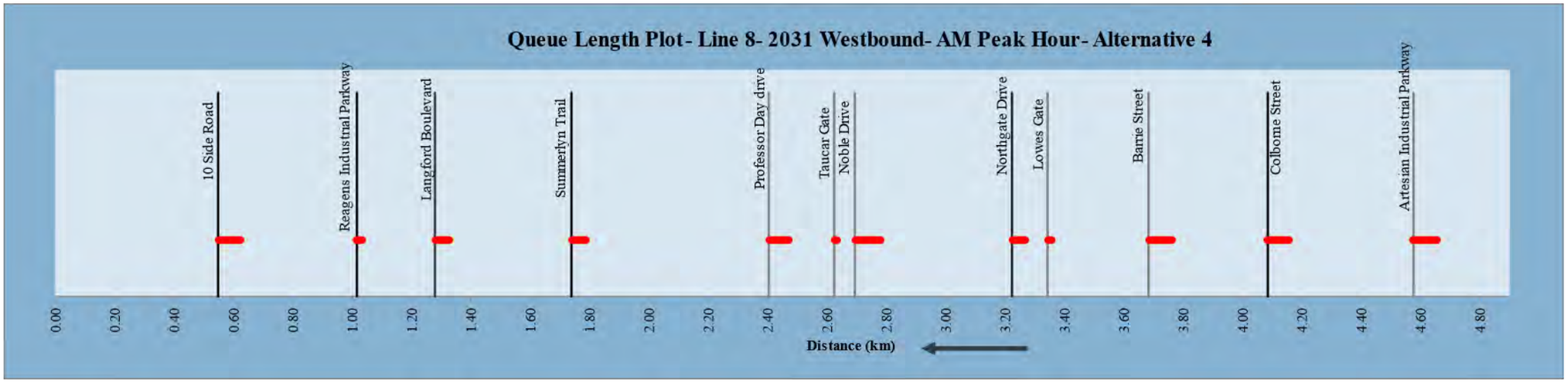
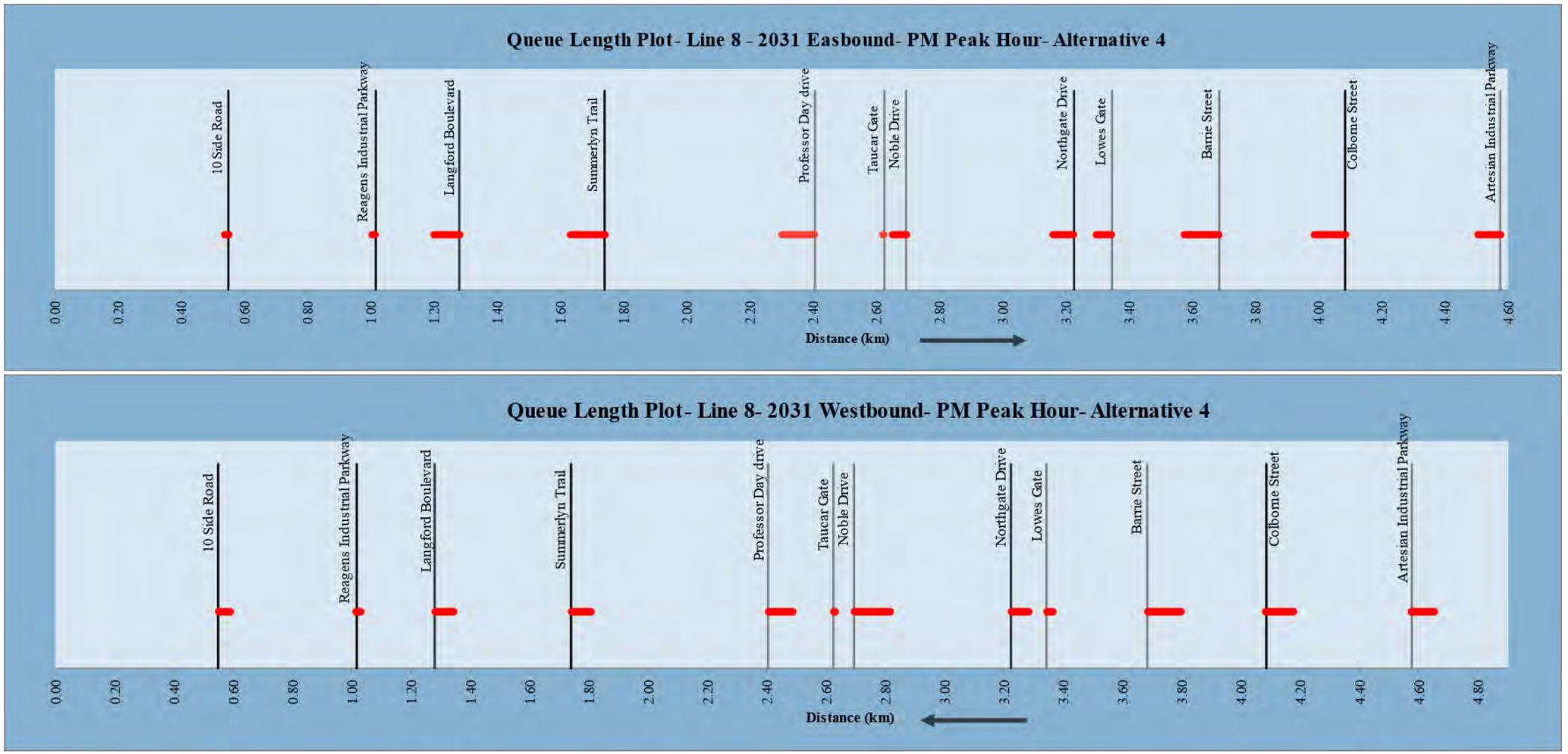


Figure 3-19: Plot of Maximum Queue Lengths – Afternoon Peak Hour Eastbound and Westbound – 2031 Alternative 4



3.6.3 SPEED CONTOUR PLOTS

The morning and afternoon peak hour Alternative 4 (2031) conditions Line 8 speed contour plots in both the eastbound and westbound directions are presented in Figure 3-20 and Figure 3-21, respectively. The speed contour plots, presented in these figures indicate good operation on Line 8 for both AM and PM peak hour conditions for both eastbound and westbound directions with average speed close to 50 km/h except at close to the signalised intersections with average speed approximately 35 km/h.

Figure 3-20: Speed Contour Plot for Line 8 – Morning Peak Hour Eastbound and Westbound – 2031 Alternative 4

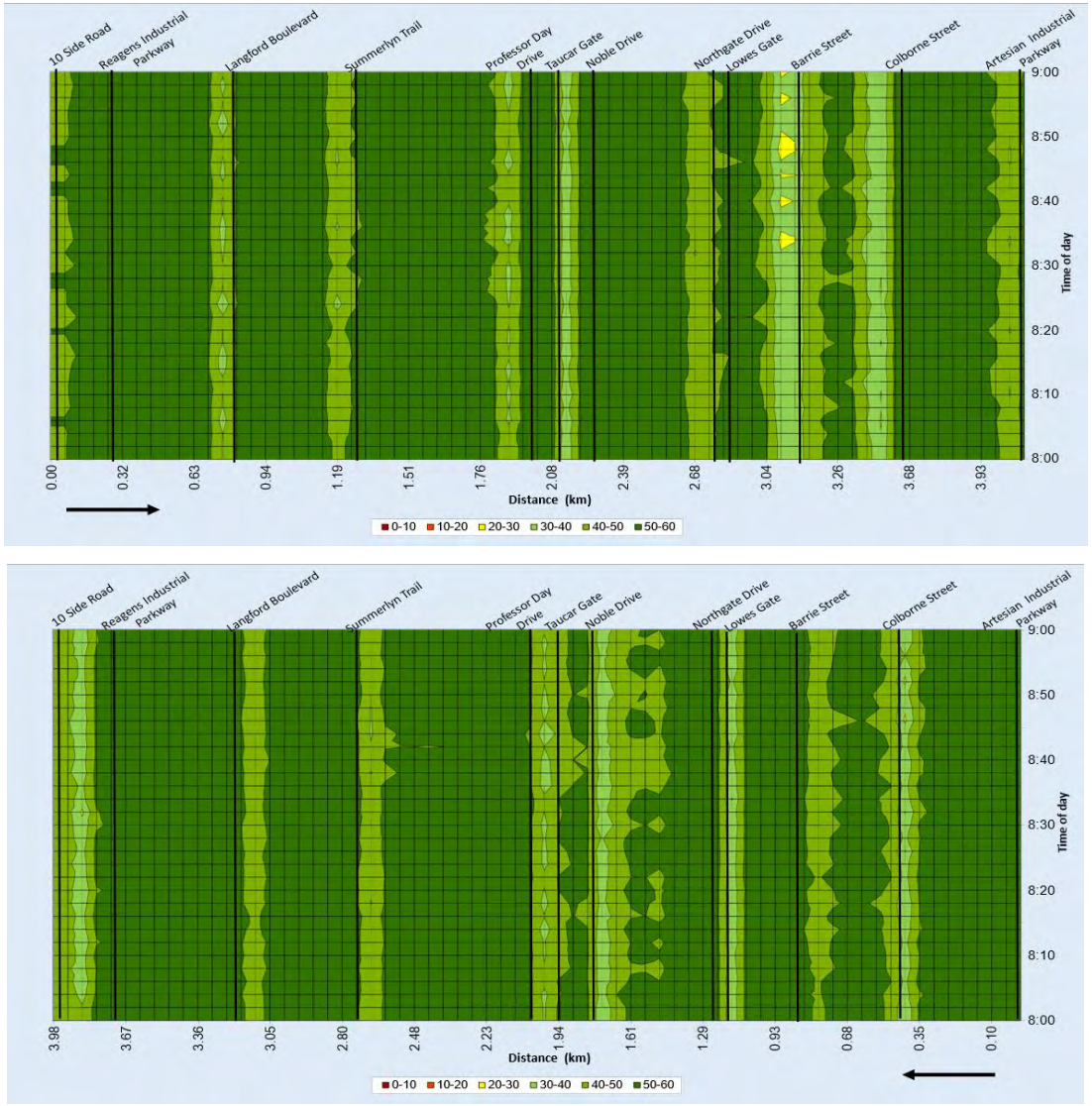
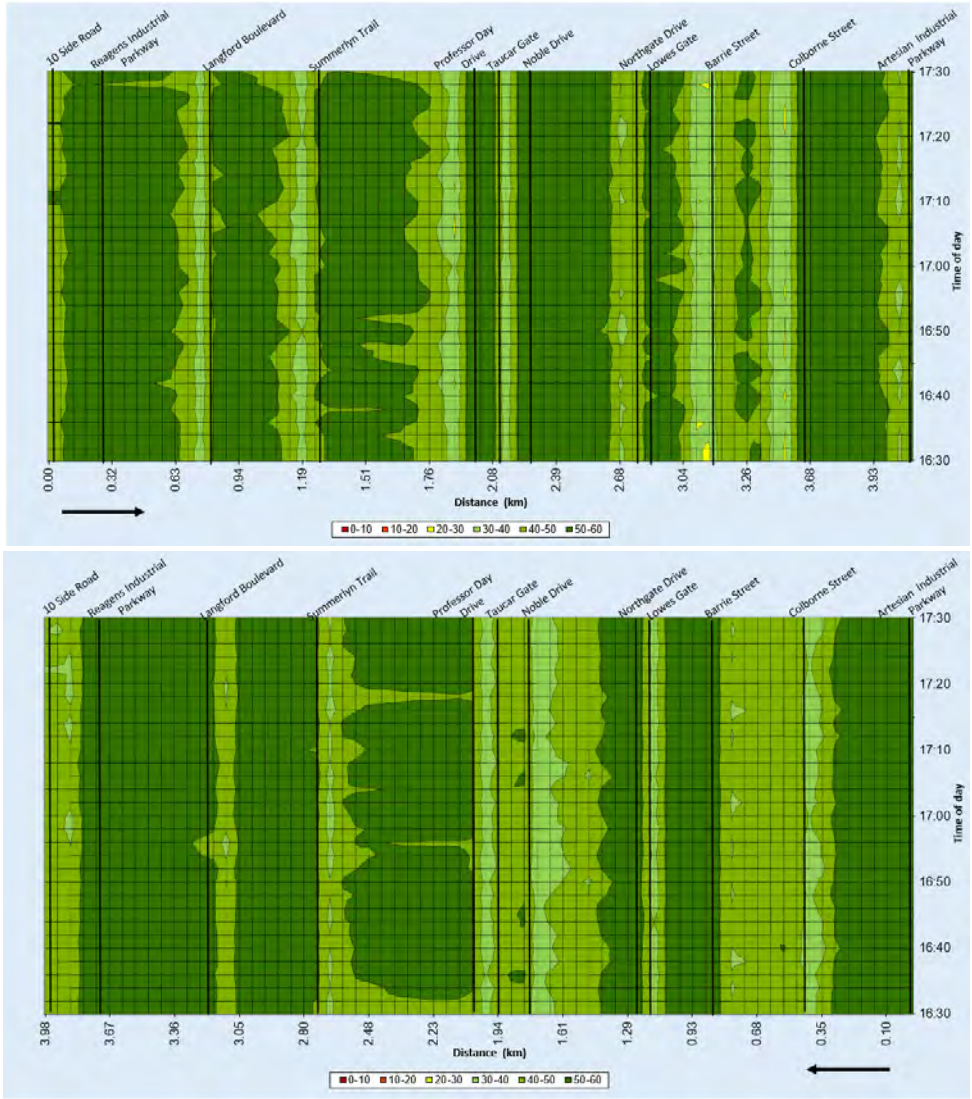


Figure 3-21: Speed Contour Plot for Line 8 – Afternoon Peak Hour Eastbound and Westbound – 2031 Alternative 4



3.6.4 TRAVEL TIME

The vehicle travel time under the Alternative 4 (2031) conditions are expected to increase by less than one minute only approximately 9-17% in the eastbound and westbound directions for the morning and afternoon peak hours as presented in Table 3-13.

Table 3-13: Travel Time Comparison – Existing and 2031 Alternative 4 Scenario

Morning Peak Hour					
Road Segment	**Distance in km**	**Simulated Travel Time Existing (min)**	**Simulated Travel Time 2031 Alternative 4 Scenario (min)**	**Difference (min)**	**% Difference**
Line 8 from 10 Sideroad to Barrie Street (EB)	3.1	4.57	5.18	0.62	13.5%
Line 8 from Barrie Street to 10 Sideroad (WB)	3.1	4.30	4.69	0.39	9.1%
Afternoon Peak Hour					
Road Segment	**Distance in km**	**Simulated Travel Time Existing (min)**	**Simulated Travel Time 2031 Alternative 4 Scenario (min)**	**Difference (min)**	**% Difference**
Line 8 from 10 Sideroad to Barrie Street (EB)	3.1	4.61	5.43	0.82	17.7%
Line 8 from Barrie Street to 10 Sideroad (WB)	3.1	4.25	4.85	0.60	14.1%

3.6.5 SUMMARY OF ALTERNATIVE 4 (PROPOSED) SCENARIO

- Alternative 4 provides good operation for all the intersections within the study area with LOS “D” better for all the turning movements for both AM and PM peak periods for the 2031 conditions except for eastbound left-turn movement at Barrie Street during AM peak hour conditions with LOS “E” which may be considered acceptable for a left-turn movement with queues not exceeding the available storage length.
- None of the queue lengths are expected to reach upstream intersections for both AM and PM peak hour conditions.
- The storage length for the westbound left-turn (WBL) at the intersection of 10 Sideroad and Reagens Industrial Parkway may have to be improved as the queue length is marginally greater than the available storage.
- It may be noted that Alternative 4 assumed additional storage lengths at the following intersections:
    - Line 8 and 10 Sideroad (SBL and NBR)
    - Line 8 and Rogers Trail/Summerlyn Trail (WBL)
    - Line 8 and Professor Day Drive (EBL and WBL)
    - Line 8 and Barrie Street (EBL & EBR)
- It is expected to experience less than 1 minute increase of travel time between Barrie Street and 10 Sideroad for the critical PM peak hour for the eastbound direction compared to existing condition

3.7 ADDITIONAL ALTERNATIVES

From a traffic perspective, Alternative 4 provides the best overall operations and is therefore recommended as Preferred Alternative for future conditions. The Future alternatives were analysed for 2031 conditions and higher traffic volumes should be expected for 2041 conditions. However, the implementation of Alternative 4 is problematic at the intersection of Line 8 and Barrie Street due to property constraints and the total 20.2m wide road required to accommodate 6 lanes (i.e., 2 WB through lanes, 2 EB left turn lanes, 1 EB through lane and 1 EB right turn lane). From the Town's perspective, moving forward with a -lane cross section at the west approach to the Line 8/Barrie Street intersection is not feasible.

As a result, it was suggested to assess the following additional scenarios for the Line 8 and Barrie Street intersection:

- **Alternative 5**: 5 lane cross section consisting of 1 WB through, 2 EB left, 1 EB through and 1 EB right.
- **Alternative 6**: 4 lane cross section consisting of 1 WB through, 2 EB left, and 1 EB shared through/right turn lane.

Also, considerations were made to improve the Barrie Street and Professor Day Drive intersections without extensive through lanes in the eastbound direction. Therefore, another scenario, **Alternative 7**, was evaluated assuming 1 EB through lane compared to 2 EB through lanes under Alternative 6, from Professor Day Drive to Barrie Street.

The following sections provide evaluation results and discussions of the above three additional alternatives.

3.7.1 ALTERNATIVE 5

The 2031 Alternative 5 Scenario is considered to limit the number of lanes on Barrie Street west approach to 5 lanes.

Alternative 5 considered the following modifications over the preferred Alternative 4 Scenario:

- Reduction from 2 WB Lanes to 1 WB Lane from Barrie Street to Noble Drive
- Line 8 & Barrie Street Intersection:
    - 1 WB through lane as in existing.
    - 2EB left-turn lanes (one of the through lane from Lowes Gate is converted to a left-turn lane at the intersection).
    - 1 EB through lane.

    - 1 EB right-turn lane.
- Added EB left-turn phase protected at Noble Drive (protected left-turn phase is justified for the volume/lane configuration).
- Increased the storage length to 60 metres for WBL at Sideroad 10 and Reagens Industrial Parkway Intersection (as shown required from Alternative 4).
- The Alternative did not consider the vehicles making left-turns to houses on either side of Line 8. It is suggested to extend the middle left-turn lanes at the intersections to mid-block sections as a Two-way Left-turn Lane (TWLT) to provide access to and from those houses.

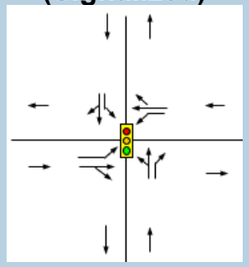
3.7.1.1 *INTERSECTION OPERATIONAL ANALYSIS*

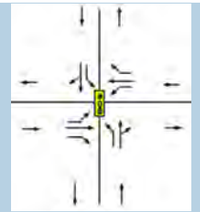
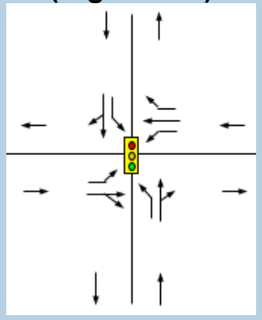
This section presents the Alternative 5 peak hour intersection operations within the study area. The summary of Alternative 5 (2031) intersection operations during the peak hours are provided in Table 3-14. The operational performance evaluation from the Table 3-14 indicates the following:

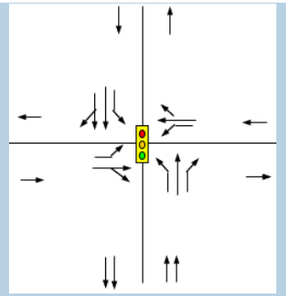
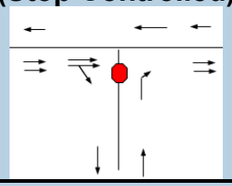
- The proposed Alternative 5 Scenario is expected to provide good operation for all the intersections within the study area with LOS “D” better for all the turning movements for both AM and PM peak periods for the 2031 conditions except for the following with respect to Alternative 4:
    - Westbound through and left-turn movements at Noble Drive with LOS “E” and maximum queue length equal to 187m during the PM peak hour conditions as compared to Alternative 4 with LOS “C” and maximum queue length equal to 120 m. This may be considered manageable as the queue does not block upstream intersections and LOS is not critical.
    - Southbound movement at Lowes Gate with LOS “F” and maximum queue length equal to 94m during PM peak hour conditions. This intersection is stop-controlled on Lowes Gate and with only one westbound through lane (which is almost at capacity), the vehicles turning left/right may not get gap to enter Line 8. The condition is expected to improve by providing an auxiliary southbound right-turn lane.
    - At Barrie Street, eastbound left-turn movement operation with LOS “E” and maximum queue length of 86 m for the AM peak hour is similar to that of Alternative 4. However, southbound right-turn movement is expected to deteriorate with LOS “E” and maximum queue length qual to 1 1 m when not having double lanes for the westbound direction. This long queue length may be acceptable as the upstream intersection is a kilometer away.

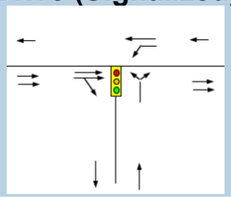
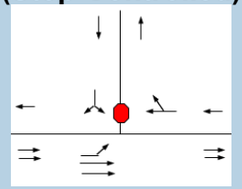
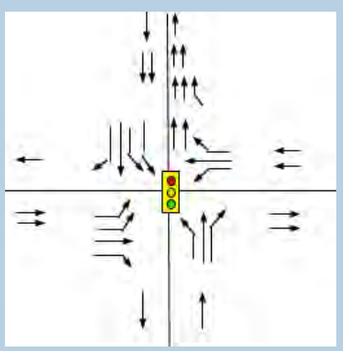
    - The queue length for westbound left-turn movement at the intersection of 10 Sideroad and Reagens Parkway got improved with maximum queue length of 36m because of the revised storage length of 60m.
- The queue lengths on all the left-turn and right-turn lanes are expected to be within the storage length assumed.

Table 3-14: Micro-simulation-based Intersection Evaluation Results – Peak hour conditions – 2031 Alternative 5

Intersection	Movement	Available/ *Modified* Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and 10 Side Road (Signalized) 	EBL	120	1	12	B	0	2	7	29	C	5	6
	EBT		2	13	B	3	5	9	25	C	8	11
	EBR		6	7	A	4	11	15	6	A	8	11
	WBL	80	250	35	D	59	65	126	23	C	30	35
	WBT		23	29	C	24	29	15	18	B	21	30
	WBR		85	13	B	24	29	221	10	B	25	33
	NBL		4	24	C	33	40	1	21	C	25	30
	NBT		127	24	C	33	40	134	26	C	25	30
	NBR	*80*	126	9	A	26	33	506	16	B	56	67
	SBL	*80*	174	29	C	33	45	193	34	C	46	51
	SBT		101	22	C	27	31	217	27	C	45	51
	SBR		5	11	B	27	31	5	13	B	45	51
	Intersection Overall			25	C				21	C		
Line 8 and Reagens Industrial Parkway (Stop-Controlled) 	EBT		270	2	A	11	15	701	3	A	11	15
	EBR		32	3	A	11	15	5	5	A	11	15
	WBL	70	61	4	A	12	23	32	6	A	8	13
	WBT		347	1	A	2	13	352	1	A	0	0
	NBL		13	14	B	20	26	14	17	C	21	31
	NBR		38	10	A	20	26	131	14	B	21	31
	Intersection Overall			2	A				4	A		
Line 8 and Langford Boulevard (Signalized)	EBL	50	88	12	B	23	30	104	14	B	16	19
	EBT		202	12	B	42	49	604	16	B	79	98

	EBR	50	18	4	A	10	15	125	8	A	16	23
	WBL	100	48	10	B	11	13	89	17	B	16	22
	WBT		236	12	B	31	42	303	14	B	45	54
	WBR	70	38	5	A	7	11	137	6	A	15	17
	NBL	40	10	22	C	5	8	21	22	C	8	10
	NBT		13	21	C	13	16	2	12	B	5	8
	NBR		54	7	A	15	19	88	6	A	10	12
	SBL	50	58	23	C	14	17	105	23	C	21	28
	SBT		16	21	C	24	31	1	22	C	6	8
	SBR		162	10	B	25	31	60	8	A	11	14
	Intersection Overall			12	B				14	B		
Line 8 and Rogers Trail / Summerlyn Trail (Signalized) 	EBL	50	33	16	B	14	20	77	26	C	18	21
	EBT		277	14	B	42	46	692	22	C	89	102
	EBR		2	3	A	42	46	20	19	B	89	102
	WBL	*70*	248	16	B	35	40	298	32	C	48	55
	WBT		262	10	A	32	37	444	15	B	55	67
	WBR	55	77	6	A	10	17	137	8	A	14	19
	NBL	20	6	24	C	5	7	19	24	C	7	10
	NBT		19	21	C	28	32	19	24	C	29	39
	NBR		211	9	A	28	32	206	15	B	29	39
	SBL	*50*	99	26	C	21	26	165	29	C	32	35
	SBT		17	21	C	17	23	25	26	C	15	18
	SBR		56	9	A	17	23	65	12	B	15	21
	Intersection Overall			13	B				21	C		
Line 8 and Professor Day Drive (Signalized)	EBL	*80*	7	22	C	7	13	37	27	C	11	13
	EBT		543	15	B	73	89	855	21	C	94	112
	EBR		33	14	B	73	89	171	21	C	94	112
	WBL	*80*	196	12	B	28	35	189	21	C	31	35

	WBT		506	6	A	47	54	776	8	A	56	68
	WBR		9	7	A	47	54	39	8	A	56	68
	NBL	140	75	36	D	21	28	96	31	C	23	29
	NBT		69	29	C	20	27	39	27	C	12	16
	NBR		57	6	A	15	20	158	6	A	14	17
	SBL	42	9	31	C	6	8	12	28	C	6	8
	SBT		59	32	C	9	11	34	27	C	6	8
	SBR	38	8	8	A	8	11	11	6	A	6	7
	Intersection Overall			14	B				16	B		
Line 8 and Taucar Gate (Stop Controlled) 	EBT		608	1	A	4	5	1020	1	A	1	6
	EBR		0	1	A	4	5	4	3	A	1	6
	WBT		713	1	A	3	8	1003	1	A	0	2
	NBR		57	10	A	18	24	28	13	B	7	9
	Intersection Overall			1	A				1	A		
Line 8 and Noble Drive (Signalized) 	EBL	70	28	11	B	8	16	98	18	B	18	22
	EBT		638	9	A	41	47	911	10	A	43	53
	EBR		0	0	A	41	47	39	11	B	43	53
	WBL		0	1	A	0	0	10	59	E	6	8
	WBT		602	33	C	112	124	896	61	E	173	187
	WBR	60	23	16	B	8	14	76	42	D	25	32
	NBL		45	20	B	12	18	13	18	B	7	10
	NBT		0	0	A	12	18	0	0	A	7	10
	NBR		9	11	B	12	18	13	6	A	7	10
	SBL	55	75	19	B	17	24	54	20	B	15	20
	SBT		0	4	A	6	14	0	0	A	9	14
	SBR		66	9	A	13	19	93	11	B	15	17
	Intersection Overall			20	B				33	C		

Line 8 and Northgate Drive (Signalized) 	EBT		701	19	B	53	58	911	21	C	57	73
	EBR		18	18	B	53	58	67	19	B	57	73
	WBL	65	97	17	B	28	35	149	25	C	38	45
	WBT		591	13	B	61	64	975	15	B	71	77
	NBL		41	28	C	39	48	20	29	C	26	29
	NBR		251	14	B	39	48	122	9	A	26	29
	Intersection Overall			16	B				18	B		
Line 8 and Lowes Gate (Stop-Controlled) 	EBL	*65*	25	7	A	8	13	111	25	D	34	38
	EBT		927	1	A	0	6	921	1	A	2	10
	WBT		640	3	A	30	52	1032	10	B	90	105
	WBR		128	4	A	30	52	126	9	A	90	105
	SBL		184	26	D	37	44	82	146	F	89	94
	SBR		48	24	C	37	44	91	162	F	89	94
	Intersection Overall			5	A				18	C		
Line 8 and Barrie Street (Signalized) 	EBL (dual)	*Ln1 = 150, Ln2=290*	520	73	E	81	86	428	50	D	51	66
	EBT		507	34	C	93	98	517	33	C	104	116
	EBR	*50*	74	12	B	26	31	59	11	B	11	11
	WBL	120	13	23	C	10	15	34	23	C	11	15
	WBT		261	28	C	63	73	523	24	C	113	115
	WBR		767	1	A	13	23	1120	2	A	8	27
	NBL	50	53	22	C	14	18	78	26	C	17	20
	NBT		27	42	D	11	11	0	0	A	0	0
	NBR	110	35	6	A	6	8	44	7	A	7	9
	SBL (dual)	Ln1 = 120, Ln 2 = 190	490	43	D	58	66	726	51	D	93	103
	SBT		0	0	A	0	0	101	43	D	27	34
	SBR		455	14	B	53	68	561	70	E	157	171

	Intersection Overall			39	D				44	D		
Line 8 and Colborne Street (Signalized) 	EBT		796	18	B	79	87	927	21	C	94	106
	EBR		238	21	C	79	87	288	24	C	94	106
	WBL	60	4	14	B	3	7	1	13	B	1	3
	WBT		717	12	B	66	73	1351	16	B	80	91
	NBL		312	40	D	68	76	331	44	D	77	93
	NBR		7	43	D	68	75	11	34	C	77	93
	Intersection Overall			20	B				22	C		
Line 8 and Artesian Industrial Parkway (Signalized) 	EBL	50	8	16	B	7	13	62	26	C	28	34
	EBT		792	7	A	40	54	871	11	B	64	77
	WBT		703	12	B	67	82	1292	17	B	70	76
	WBR		291	14	B	67	82	146	19	B	70	76
	SBL		90	34	C	33	45	235	36	D	55	61
	SBR		19	18	B	33	45	58	27	C	55	61
	Intersection Overall			11	B				17	B		
10 Sideroad and Reagens Industrial Parkway (Signalized) 	WBL	*60*	129	23	C	50	54	138	21	C	29	36
	WBR		18	9	A	16	19	109	10	A	16	23
	NBT		227	9	A	21	26	526	9	A	29	34
	NBR	50	104	5	A	18	21	95	6	A	21	23
	SBL	60	1	8	A	2	12	12	17	B	6	10
	SBT		352	10	A	24	29	343	8	A	18	22
	Intersection Overall			11	B				10	B		

3.7.1.2 *MAXIMUM QUEUE LENGTHS*

Alternative 5 conditions queue plots for the Line 8 intersections during the morning peak and afternoon peak hours in both the eastbound and westbound directions are presented in Figure 3-22 and Figure 3-23, respectively.

It may be shown that none of the queue lengths reach the upstream intersections for both AM and PM peak hour conditions for both eastbound and westbound directions. The intersection of Noble Drive is so close to Taucar Drive and the eastbound direction queue from Noble Drive would reach close to Taucar Drive intersection. Similar to that for Alternative 4, the westbound direction queue from Northgate Drive is not expected to reach the nearby intersection at Lowes Gate.

Figure 3-22: Plot of Maximum Queue Lengths – Morning Peak Hour Eastbound and Westbound – 2031 Alternative 5

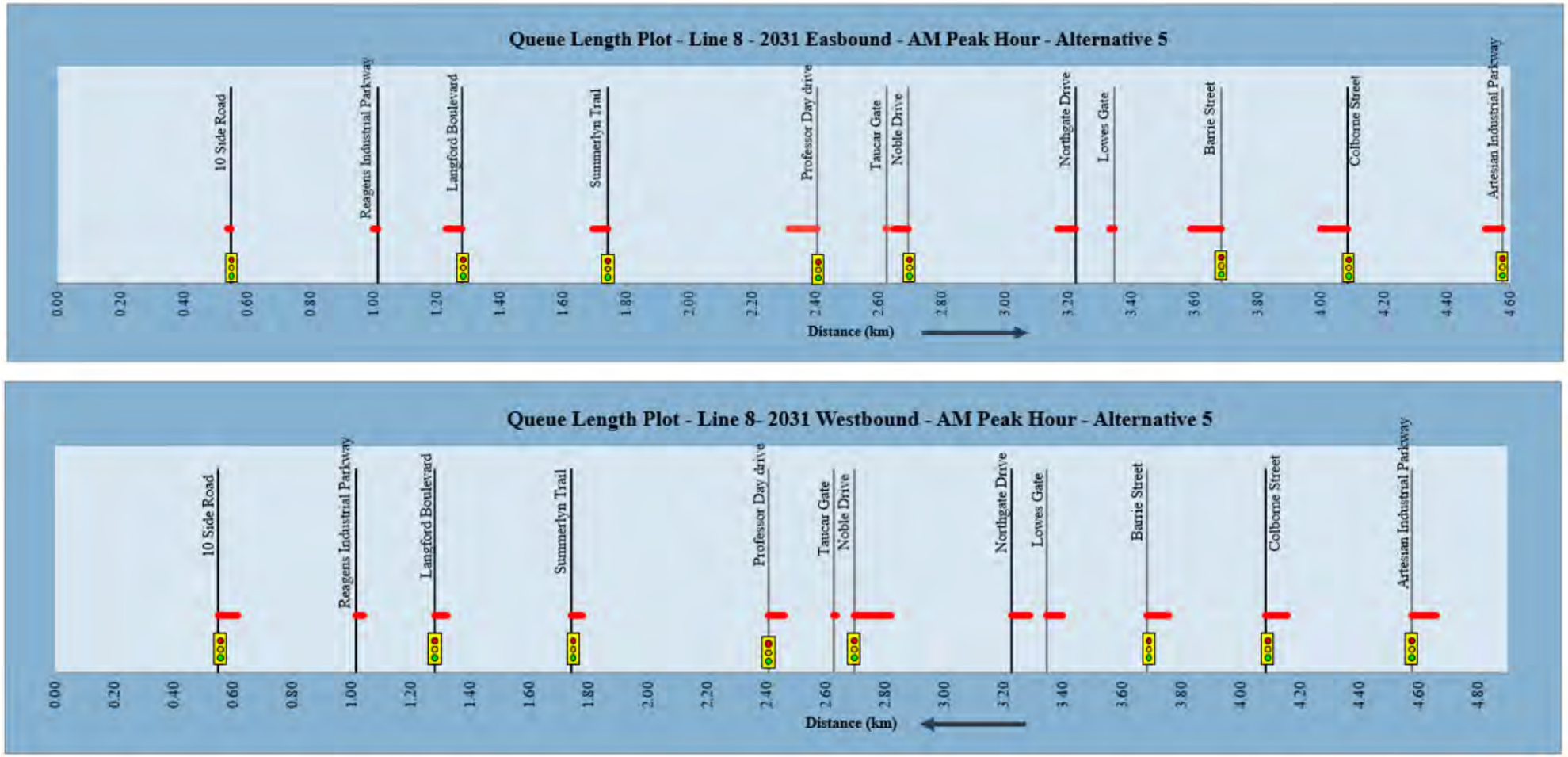
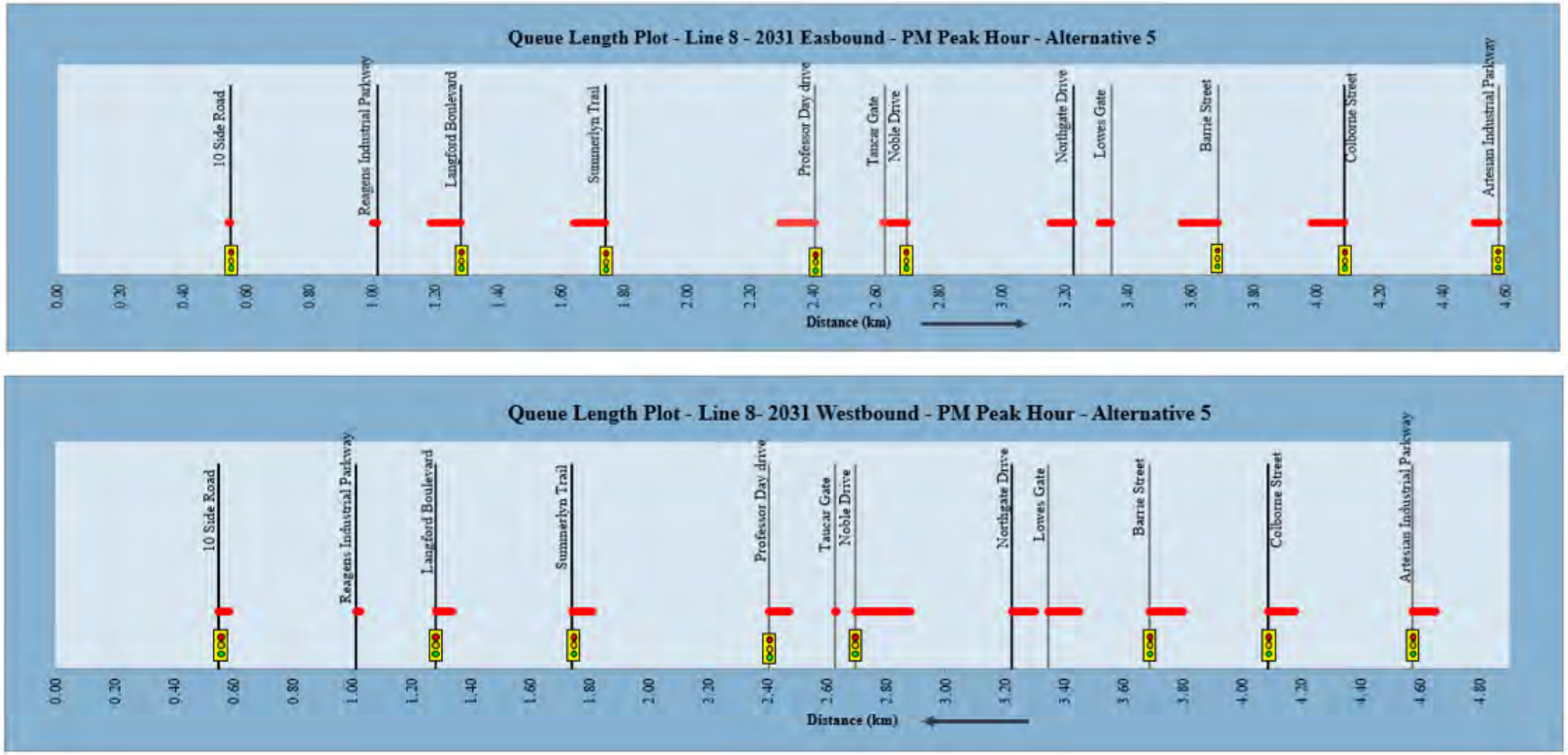


Figure 3-23: Plot of Maximum Queue Lengths – Afternoon Peak Hour Eastbound and Westbound – 2031 Alternative 5



3.7.1.3 *SPEED CONTOUR PLOTS*

The morning and afternoon peak hour Alternative 4 (2031) conditions Line 8 speed contour plots in both the eastbound and westbound directions are presented in Figure 3-24 and Figure 3-25, respectively. The speed contour plots, presented in these figures indicate similar operations as that of Alternative 4 on Line 8 for both AM and PM peak hour conditions for both eastbound and westbound directions. There are marginal speed reductions on Line 8 at Barrie Street in the eastbound direction during AM peak hour and at Noble Street in the westbound direction during PM peak hour conditions.

Figure 3-24: Speed Contour Plot for Line 8 – Morning Peak Hour Eastbound and Westbound – 2031 Alternative 5

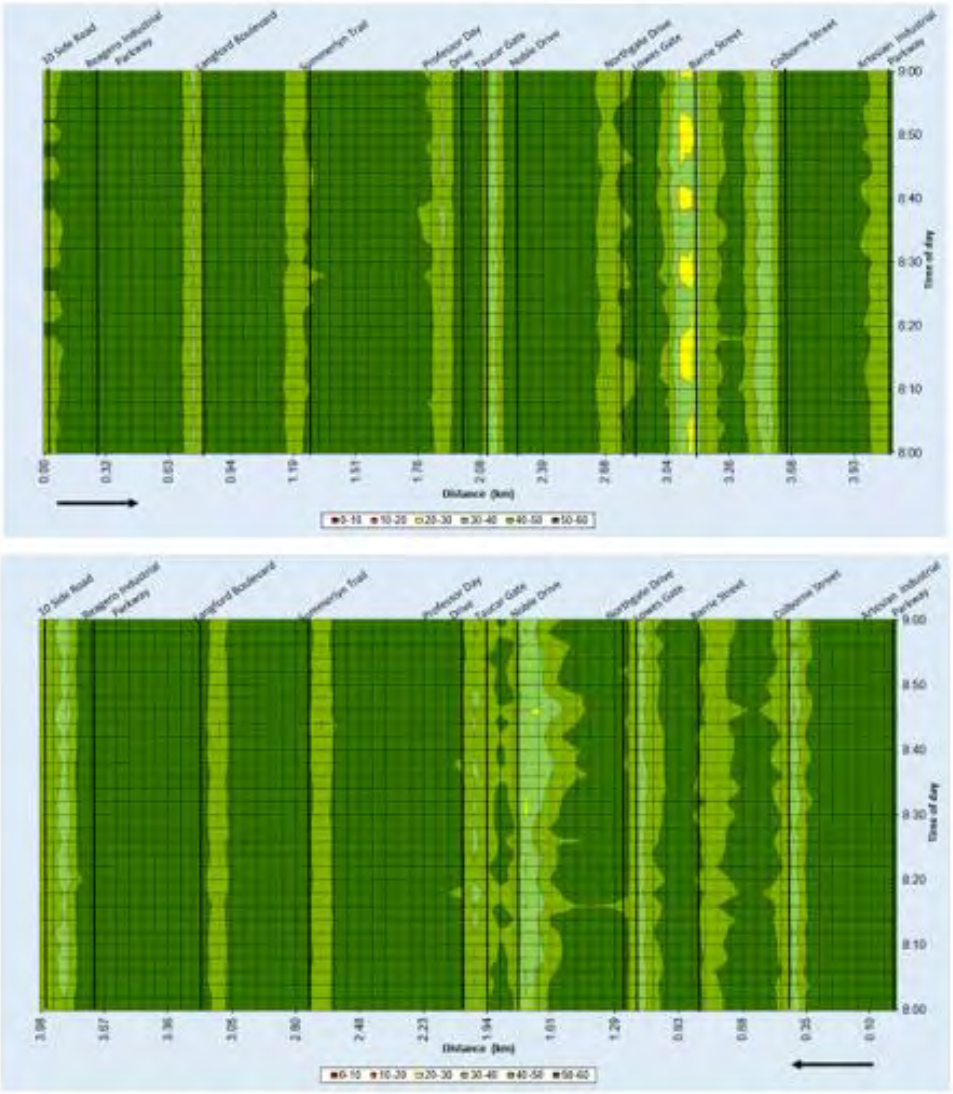
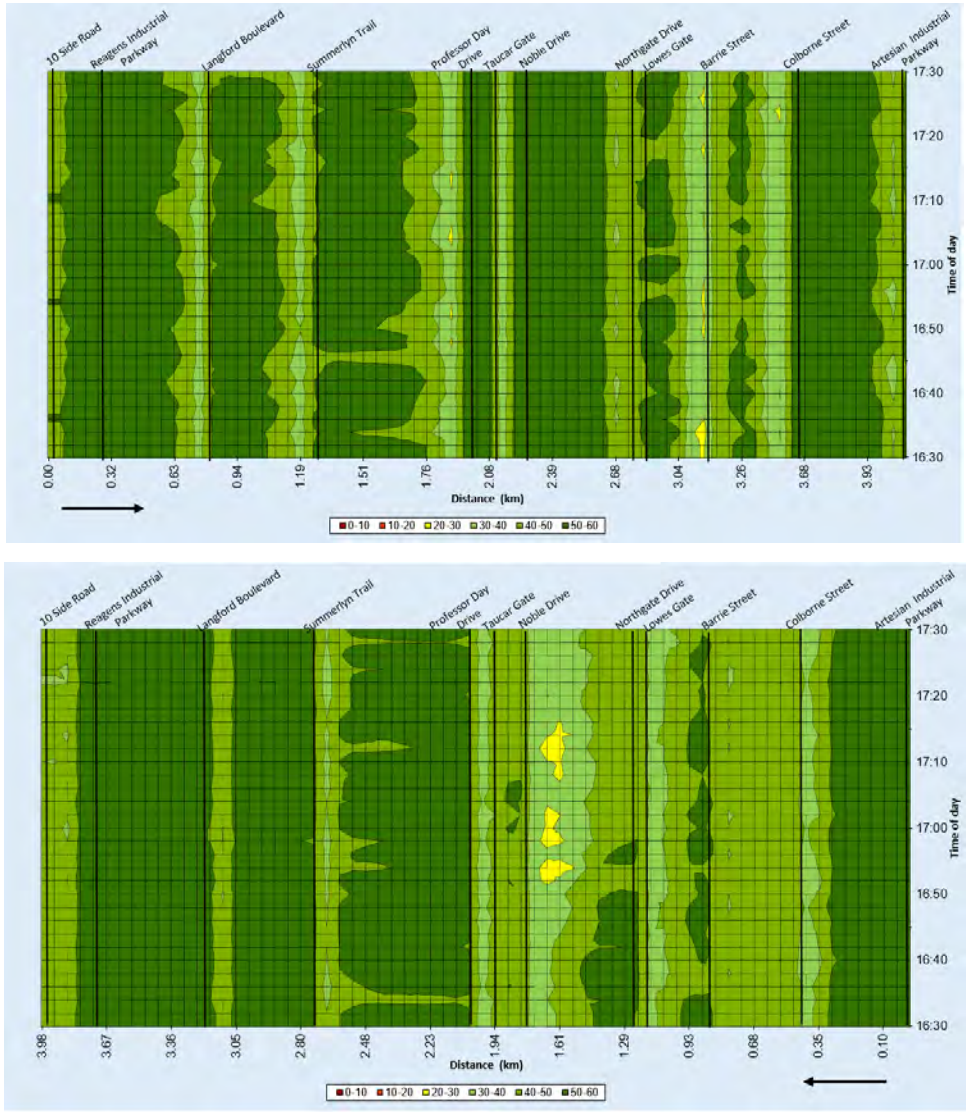


Figure 3-25: Speed Contour Plot for Line 8 – Afternoon Peak Hour Eastbound and Westbound – 2031 Alternative 5



3.7.1.4 *TRAVEL TIME*

The vehicle travel time under the Alternative 5 (2031) conditions are expected to increase by less than one minute only approximately 14-17% in the morning peak hour. For the afternoon peak hour, the eastbound direction travel time is similar that of Alternative 4, however, there would be an increase of approximately 39% for the westbound direction travel time with respect to existing conditions as presented in Table 3-15.

Table 3-15: Travel Time Comparison – Existing and 2031 Alternative 5 Scenario

Morning Peak Hour					
Road Segment	**Distance in km**	**Simulated Travel Time Existing (min)**	**Simulated Travel Time 2031 Alternative 5 Scenario (min)**	**Difference (min)**	**% Difference**
Line 8 from 10 Sideroad to Barrie Street (EB)	3.1	4.57	5.22	0.65	14.2%
Line 8 from Barrie Street to 10 Sideroad (WB)	3.1	4.30	5.03	0.73	17.1%
Afternoon Peak Hour					
Road Segment	**Distance in km**	**Simulated Travel Time Existing (min)**	**Simulated Travel Time 2031 Alternative 5 Scenario (min)**	**Difference (min)**	**% Difference**
Line 8 from 10 Sideroad to Barrie Street (EB)	3.1	4.61	5.52	0.91	19.7%
Line 8 from Barrie Street to 10 Sideroad (WB)	3.1	4.25	5.90	1.65	38.8%

3.7.1.5 *SUMMARY OF ALTERNATIVE 5 SCENARIO*

Alternative 5 provides good operation for all the intersections within the study area with LOS “D” better for all the turning movements for both AM and PM peak periods for the 2031 conditions except the following:

- Westbound through and left-turn movements at Noble Drive with LOS “E” and maximum queue length equal to 187m during the PM peak hour conditions as compared to Alternative 4 with LOS “C” and maximum queue length equal to 1 0 m. This may be considered manageable as the queue does not block upstream intersections and LOS is not critical.
- Southbound movement at Lowes Gate with LOS “F” and maximum queue length equal to 94m during PM peak hour conditions. This intersection is stop-controlled on Lowes Gate and with only one westbound through lane (which is almost at capacity), the vehicles turning left/right may not get gap to enter Line 8. The condition is expected to improve by providing an auxiliary southbound right-turn lane.
- Eastbound left-turn movement at Barrie Street with LOS “E” and maximum queue lengths 86 m for the AM peak hour is similar to that of Alternative 4. However, southbound right-turn movement is expected to deteriorate with LOS “E” and maximum queue length qual to 171 m when not having double lanes for the westbound direction. This long queue length may be acceptable.
- The queue length for westbound left-turn movement at the intersection of 10 Sideroad and Reagens Parkway got improved with maximum queue length of 36m because of the additional storage length of 60m.
- The queue lengths on all the left-turn and right-turn lanes are expected to be within the storage length assumed.
- None of the queue lengths reach the upstream intersections for both AM and PM peak hour conditions for both eastbound and westbound directions. The intersection of Noble Drive is so close to Taucar Drive and the eastbound direction queue from Noble Drive would reach close to Taucar Drive intersection. Similar to that for Alternative 4, The westbound direction queue from Northgate Drive is not expected to reach the nearby intersection at Lowes Gate.
- The speed contour plots indicate that there are marginal speed reductions on Line 8 at Barrie Street in the eastbound direction during AM peak hour and at Noble Street in the westbound direction during PM peak hour conditions.
- The travel times are expected to increase by less than one minute with approximately 14-17% increase in the morning peak hour. For the afternoon

peak hour, the eastbound direction travel time is similar that of Alternative 4, however, there would be an increase of approximately 39% for the westbound direction travel time with respect to existing conditions.

3.7.2 ALTERNATIVE 6

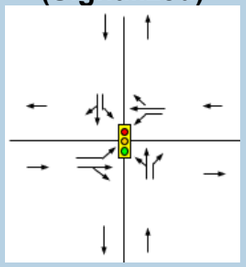
Alternative 6 configuration is similar to Alternative 5 except that at Line 8 & Barrie Street intersection, a shared lane is provided for eastbound through and right-turn movements as in existing. The lane configuration assumed on west approach at Line 8 and Barrie Street is as below:

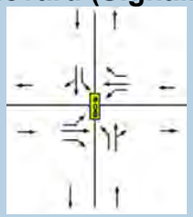
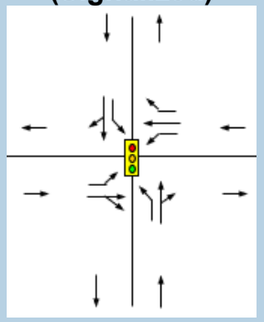
- 1 WB through lane as in existing,
- 2EB left-turn lanes (one of the through lane from Lowes Gate is converted to a left-turn lane at the intersection),
- 1 lane shared for EB through and right turn movements.

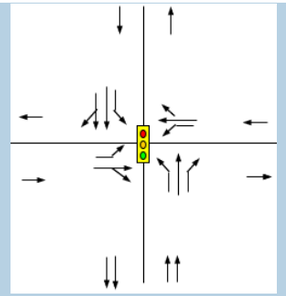
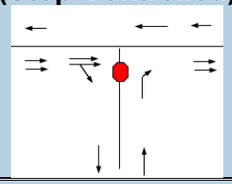
3.7.2.1 *INTERSECTION OPERATIONAL ANALYSIS*

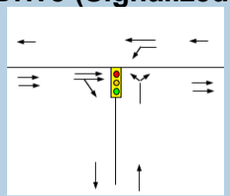
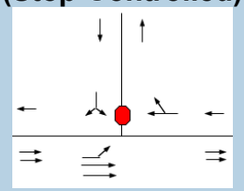
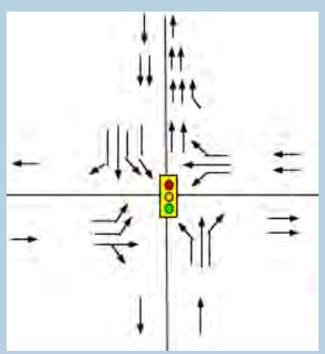
This section presents the Alternative 6 peak hour intersection operations within the study area. The summary of Alternative 6 (2031) intersection operations during the peak hours are provided in Table 3-16. The operation of the intersections is similar to that of Alternative 5. Because of the shared eastbound through and right-turn movement, there is marginal deterioration of LOS for this movement from “C” to “D”.

Table 3-16: Micro-simulation-based Intersection Evaluation Results – Peak hour conditions – 2031 Alternative 6

Intersection	Movement	Available/ *Modified* Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and 10 Side Road (Signalized) 	EBL	120	1	15	B	1	2	7	26	C	5	5
	EBT		2	19	B	3	5	9	24	C	7	11
	EBR		6	8	A	5	9	15	6	A	7	11
	WBL	80	250	35	D	56	67	126	23	C	31	36
	WBT		23	32	C	23	26	15	26	C	26	35
	WBR		85	13	B	23	26	222	11	B	26	35
	NBL		4	16	B	32	42	1	16	B	26	29
	NBT		129	25	C	32	42	135	27	C	27	30
	NBR	*80*	126	9	A	26	31	508	17	B	61	64
	SBL	*80*	174	29	C	35	49	193	33	C	43	51
	SBT		101	24	C	28	33	217	26	C	45	55
	SBR		5	8	A	28	33	6	20	C	45	55
	Intersection Overall			25	C				21	C		
Line 8 and Reagens Industrial Parkway (Stop-Controlled) 	EBT		270	2	A	8	14	701	3	A	6	15
	EBR		32	3	A	8	14	5	4	A	6	15
	WBL	70	61	3	A	11	17	32	7	A	10	13
	WBT		346	1	A	2	6	352	1	A	0	0
	NBL		13	15	B	20	27	14	18	C	21	28
	NBR		38	10	A	20	27	131	14	B	21	28
	Intersection Overall			2	A				4	A		
	EBL	50	88	12	B	22	29	104	13	B	15	20

Line 8 and Langford Boulevard (Signalized) 	EBT		202	11	B	38	46	601	16	B	71	83
	EBR	50	18	6	A	11	17	124	7	A	15	22
	WBL	100	48	10	B	11	13	88	16	B	17	19
	WBT		237	13	B	38	52	303	14	B	45	54
	WBR	70	38	5	A	8	12	138	6	A	14	19
	NBL	40	10	21	C	6	8	21	22	C	10	11
	NBT		13	19	B	11	13	2	18	B	6	8
	NBR		55	7	A	12	21	88	5	A	10	11
	SBL	50	58	25	C	15	17	105	23	C	22	28
	SBT		16	23	C	26	31	1	15	B	4	7
	SBR		161	11	B	28	31	60	7	A	10	15
	Intersection Overall			12	B				14	B		
Line 8 and Rogers Trail / Summerlyn Trail (Signalized) 	EBL	50	33	19	B	16	23	78	26	C	17	18
	EBT		278	13	B	43	58	692	24	C	95	107
	EBR		2	4	A	43	58	20	20	B	95	107
	WBL	*70*	248	16	B	37	41	296	31	C	49	56
	WBT		262	10	B	33	38	444	15	B	52	60
	WBR	55	78	7	A	9	15	136	8	A	14	19
	NBL	20	7	23	C	5	6	19	27	C	7	10
	NBT		20	20	C	31	36	19	24	C	28	38
	NBR		212	9	A	31	40	207	15	B	28	38
	SBL	*50*	98	25	C	22	27	165	29	C	31	34
	SBT		17	21	C	19	23	25	24	C	15	19
	SBR		56	9	A	19	23	65	12	B	15	19
	Intersection Overall			13	B				21	C		
Line 8 and Professor Day Drive (Signalized)	EBL	*80*	7	18	B	7	10	37	27	C	12	13
	EBT		544	14	B	68	76	852	22	C	104	123
	EBR		33	14	B	68	76	170	22	C	104	123

	WBL	*80*	195	12	B	29	36	188	22	C	27	35
	WBT		507	6	A	46	53	779	8	A	58	73
	WBR		9	6	A	46	53	39	8	A	58	73
	NBL	140	75	36	D	22	29	96	34	C	22	28
	NBT		69	26	C	19	24	38	29	C	13	19
	NBR		57	6	A	16	18	159	6	A	15	17
	SBL	42	9	32	C	6	7	12	29	C	7	11
	SBT		59	32	C	8	11	34	27	C	6	8
	SBR	38	8	7	A	8	11	11	6	A	6	6
	Intersection Overall			13	B				17	B		
Line 8 and Taucar Gate (Stop Controlled) 	EBT		608	1	A	4	5	1018	1	A	1	6
	EBR		0	1	A	4	5	4	2	A	0	6
	WBT		713	1	A	3	8	1009	1	A	1	4
	NBR		57	9	A	18	23	28	13	B	7	10
	Intersection Overall			1	A				1	A		
Line 8 and Noble Drive (Signalized) 	EBL	70	28	12	B	9	17	97	18	B	19	22
	EBT		635	9	A	38	47	908	9	A	41	50
	EBR		0	5	A	38	47	39	9	A	41	50
	WBL		0	6	A	0	3	10	55	D	7	9
	WBT		601	33	C	115	123	902	56	E	153	170
	WBR	60	23	13	B	7	11	76	37	D	20	28
	NBL		45	20	B	12	18	13	17	B	7	11
	NBT		0	0	A	12	18	0	0	A	7	11
	NBR		9	12	B	12	18	13	7	A	7	11
	SBL	55	75	19	B	17	24	53	19	B	13	19
	SBT		0	4	A	6	14	0	0	A	10	16
	SBR		66	9	A	13	19	93	12	B	15	21

	Intersection Overall			20	B				30	C			
Line 8 and Northgate Drive (Signalized) 	EBT		702	20	B	57	70	910	21	C	60	65
	EBR		18	17	B	57	70	68	20	B	60	65
	WBL	65	97	16	B	30	40	150	24	C	37	47
	WBT		590	13	B	63	69	982	15	B	69	73
	NBL		41	28	C	39	48	20	29	C	26	29
	NBR		251	14	B	39	48	122	9	A	26	29
	Intersection Overall			16	B				18	B		
Line 8 and Lowes Gate (Stop-Controlled) 	EBL	*65*	24	9	A	10	18	111	25	C	32	36
	EBT		929	1	A	0	1	920	1	A	2	5
	WBT		638	3	A	40	55	1039	11	B	98	111
	WBR		127	4	A	40	55	126	10	A	98	111
	SBL		184	25	C	36	43	82	145	F	87	96
	SBR		48	23	C	36	43	91	154	F	87	96
	Intersection Overall			5	A				18	C		
Line 8 and Barrie Street (Signalized) 	EBL (dual)	*Ln1 = 150, Ln2=290*	524	73	E	80	93	421	51	D	56	60
	EBT		508	43	D	119	131	515	42	D	113	122
	EBR	*50*	74	40	D	119	131	59	40	D	113	122
	WBL	120	13	26	C	11	16	34	25	C	12	16
	WBT		262	28	C	66	74	524	23	C	108	112
	WBR		767	1	A	11	15	1119	2	A	20	51
	NBL	50	52	25	C	16	19	78	27	C	18	22
	NBT		27	37	D	11	14	0	0	A	0	0
	NBR	110	35	7	A	6	8	44	6	A	7	10
	SBL (dual)	Ln1 = 120, Ln 2 = 190	487	43	D	56	59	732	49	D	88	105
	SBT		0	0	A	0	0	102	41	D	25	35

	SBR		454	14	B	51	65	565	68	E	150	162
	Intersection Overall			41	D				45	D		
Line 8 and Colborne Street (Signalized) 	EBT		799	19	B	80	86	927	21	C	88	97
	EBR		238	22	C	80	86	290	23	C	88	97
	WBL	60	4	16	B	3	7	1	10	B	2	2
	WBT		716	13	B	64	71	1351	17	B	79	89
	NBL		312	40	D	68	76	331	46	D	81	98
	NBR		7	40	D	68	74	11	38	D	81	98
	Intersection Overall			20	C				22	C		
Line 8 and Artesian Industrial Parkway (Signalized) 	EBL	50	8	15	B	7	13	63	25	C	24	33
	EBT		791	7	A	45	55	871	11	B	60	70
	WBT		703	12	B	67	82	1293	17	B	69	76
	WBR		291	14	B	67	82	147	19	B	69	76
	SBL		90	34	C	33	45	235	36	D	55	61
	SBR		19	18	B	33	45	58	28	C	55	61
	Intersection Overall			11	B				18	B		
10 Sideroad and Reagens Industrial Parkway (Signalized) 	WBL	*60*	129	22	C	48	56	138	22	C	31	37
	WBR		18	9	A	17	19	108	9	A	16	22
	NBT		226	10	A	21	25	525	9	A	27	32
	NBR	50	104	5	A	17	20	95	6	A	20	30
	SBL	60	1	13	B	5	12	12	16	B	7	12
	SBT		353	10	A	24	36	346	8	A	20	25
	Intersection Overall			11	B				10	B		

3.7.2.2 *MAXIMUM QUEUE LENGTHS*

Queue lengths for eastbound and westbound directions for AM and PM periods are approximately similar to that of Alternative 5, with marginal increase on eastbound at Barrie Street as indicated in Figures 3-26 and 3-27.

Figure 3-26: Plot of Maximum Queue Lengths – Morning Peak Hour Eastbound and Westbound – 2031 Alternative 6

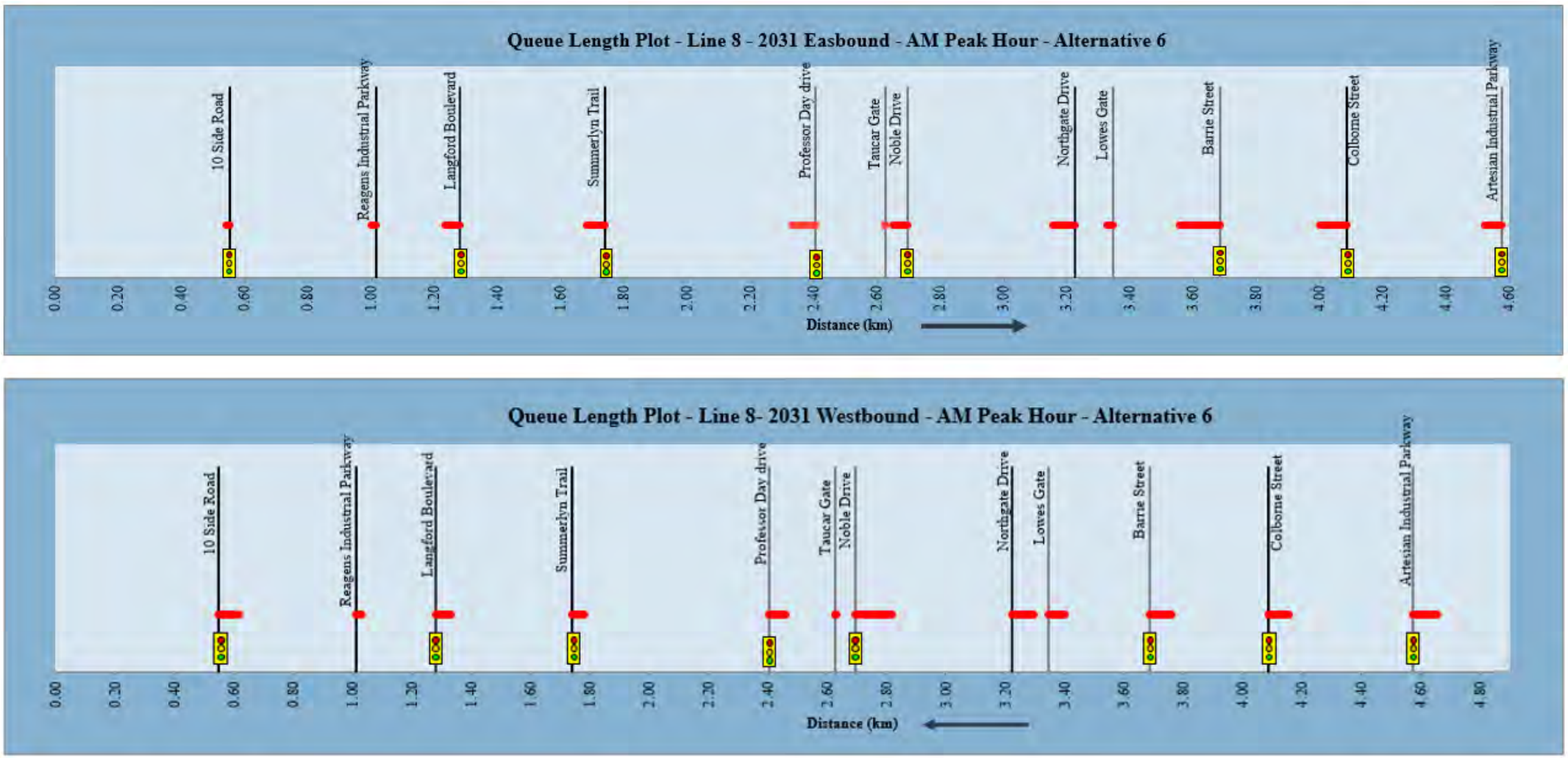
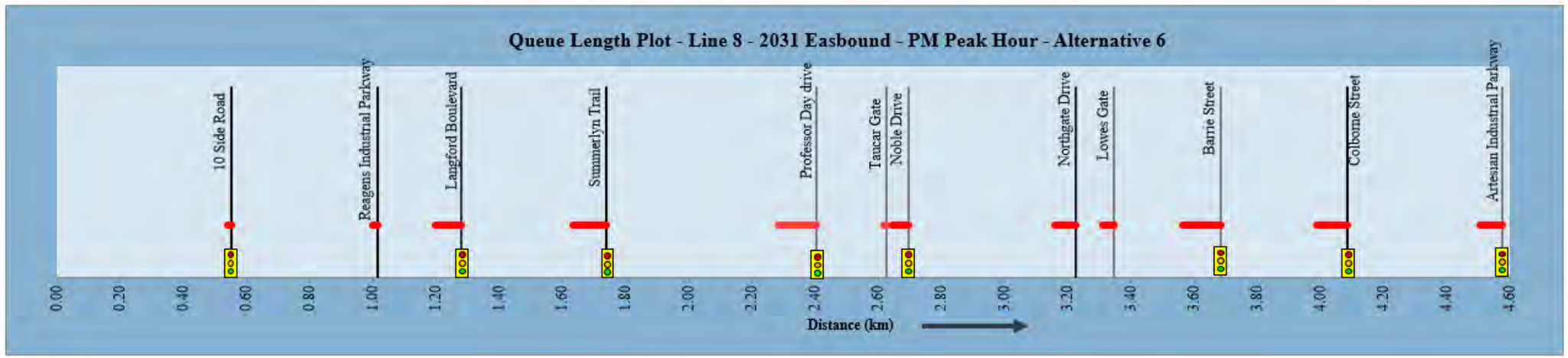
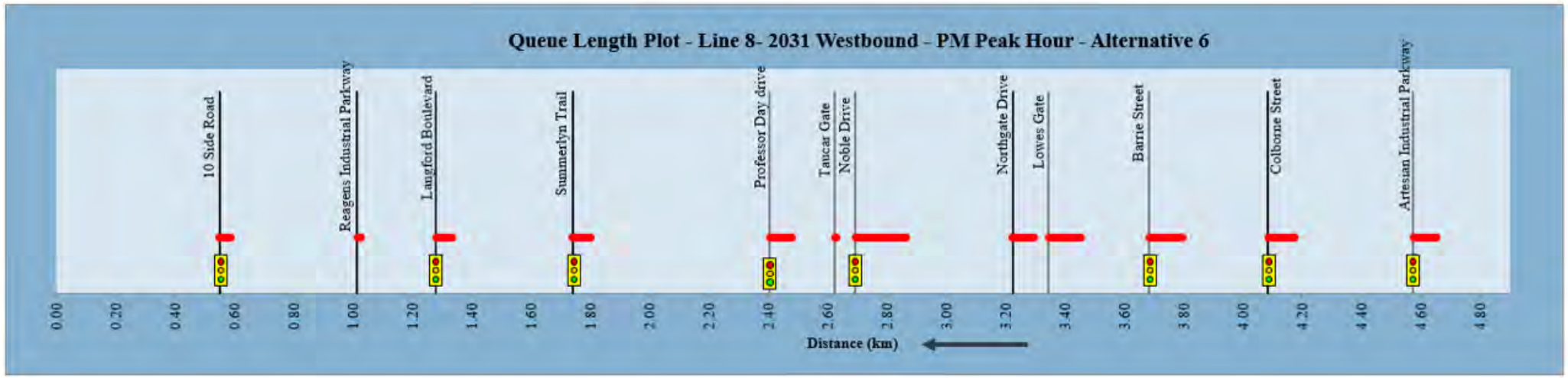


Figure 3-27: Plot of Maximum Queue Lengths – Afternoon Peak Hour Eastbound and Westbound – 2031 Alternative 6





3.7.2.3 *SPEED CONTOUR PLOTS*

Speed contour plots on Figure 3-28 and Figure 3-29 indicate similar pattern as that for Alternative 5. There is marginal decrease of speed on the eastbound direction at Barrie Street during the AM peak hour.

Figure 3-28: Speed Contour Plot for Line 8 – Morning Peak Hour Eastbound and Westbound – 2031 Alternative 6

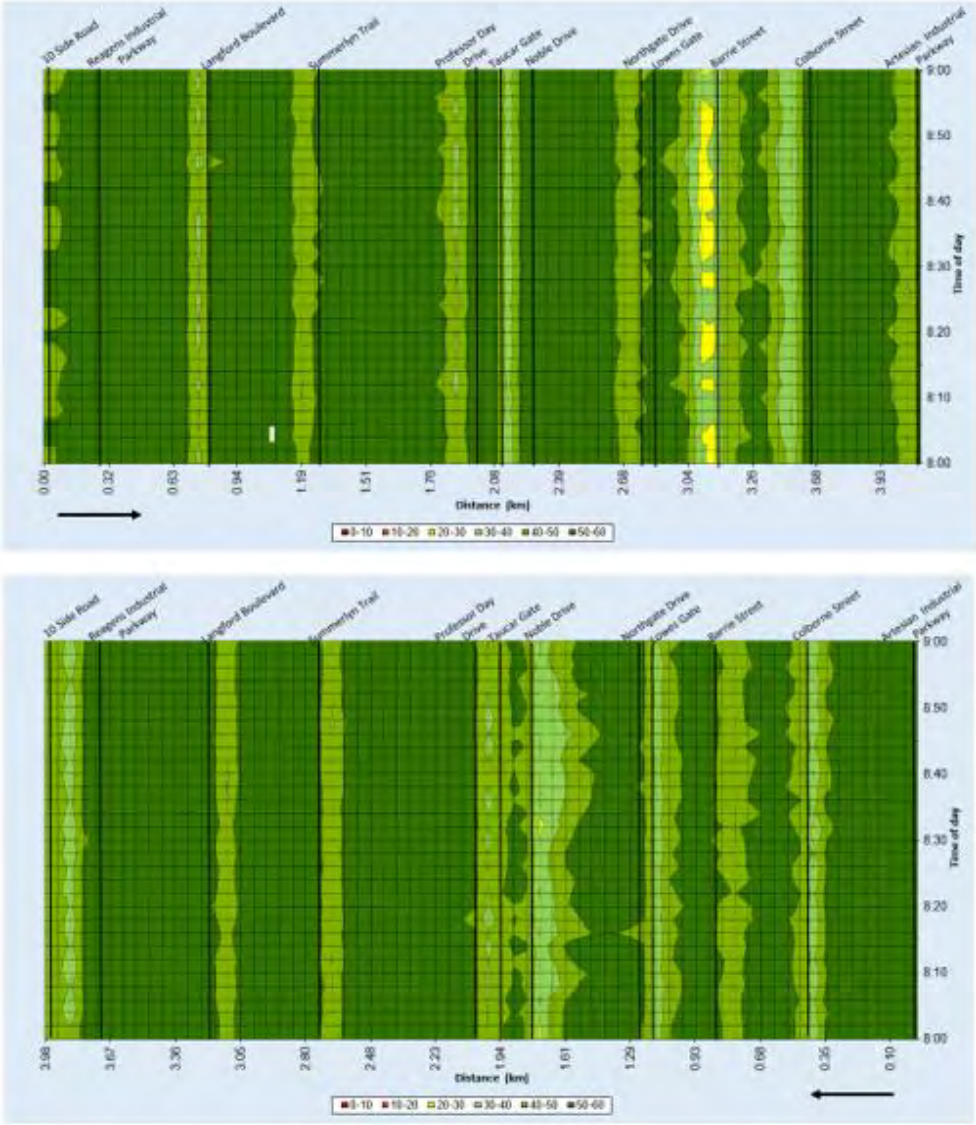
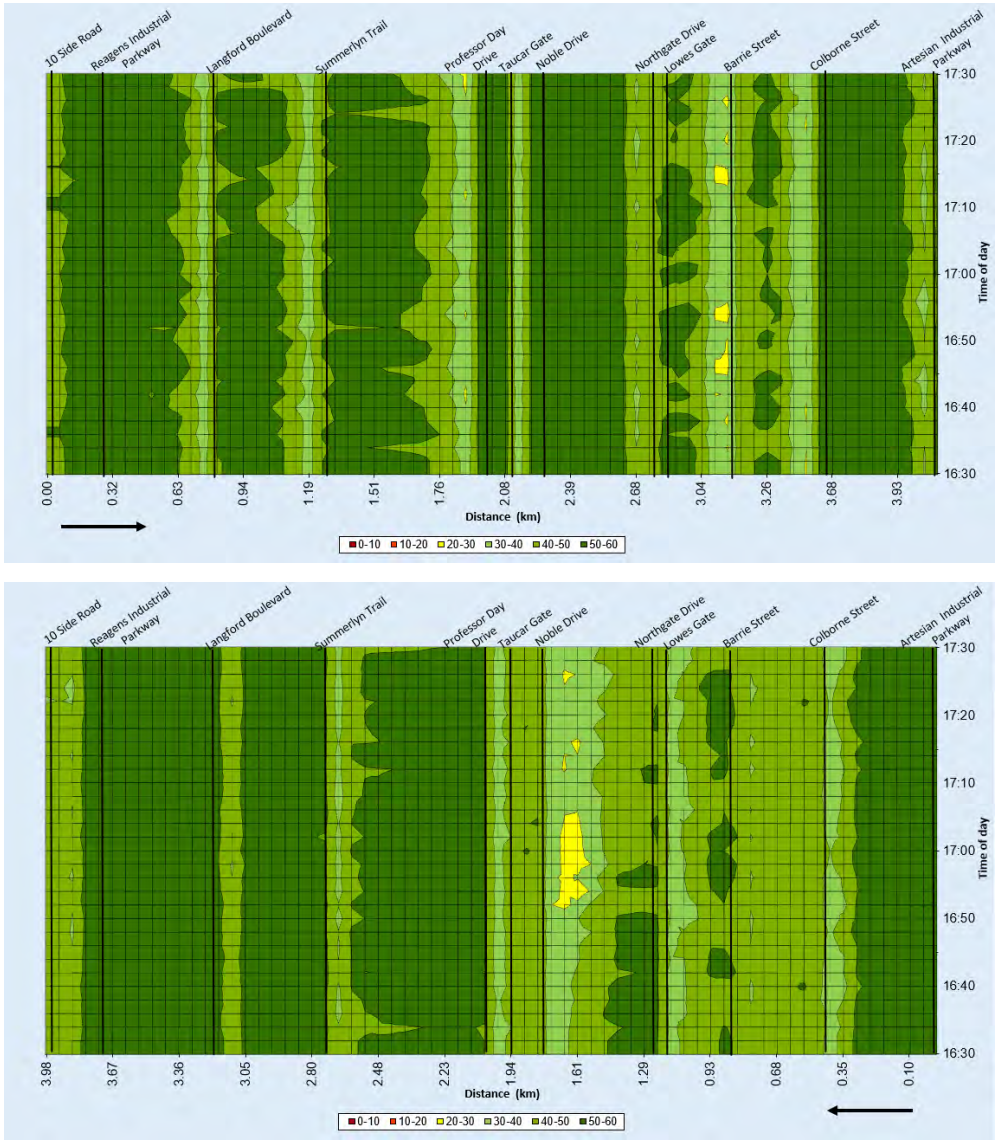


Figure 3-29: Speed Contour Plot for Line 8 – Afternoon Peak Hour Eastbound and Westbound – 2031 Alternative 6



3.7.2.4 *TRAVEL TIME*

Similar to other evaluation statistics, the travel times shown in Table 3-17 shows similar values as that of Alternative 5 with marginal increase of 1-2% for the eastbound direction.

Table 3-17: Travel Time Comparison – Existing and 2031 Alternative 6 Scenario

Morning Peak Hour					
Road Segment	**Distance in km**	**Simulated Travel Time Existing (min)**	**Simulated Travel Time 2031 Alternative 6 Scenario (min)**	**Difference (min)**	**% Difference**
Line 8 from 10 Sideroad to Barrie Street (EB)	3.1	4.57	5.34	0.77	16.8%
Line 8 from Barrie Street to 10 Sideroad (WB)	3.1	4.30	5.08	0.78	18.1%
Afternoon Peak Hour					
Road Segment	**Distance in km**	**Simulated Travel Time Existing (min)**	**Simulated Travel Time 2031 Alternative 6 Scenario (min)**	**Difference (min)**	**% Difference**
Line 8 from 10 Sideroad to Barrie Street (EB)	3.1	4.61	5.58	0.97	21.0%
Line 8 from Barrie Street to 10 Sideroad (WB)	3.1	4.25	5.63	1.38	32.4%

3.7.2.5 *SUMMARY OF ALTERNATIVE 6 SCENARIO*

Alternative 6 results are approximately similar to that of Alternative 5 with additional eastbound right-turn lane at Barrie Street. There is only marginal deterioration of speed and travel time in the eastbound direction.

3.7.3 ALTERNATIVE 7

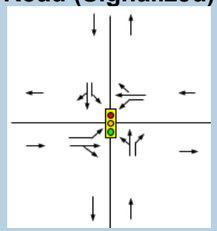
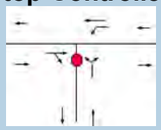
Alternative 7 was established since the Town wanted to look at the corridor operation without assuming any widening on Line 8. Alternative 7 configuration is similar to Alternative 6 except of lane reduction from Professor Day Drive to Barrie Street in the eastbound direction from 2 through lanes to 1 through lane.

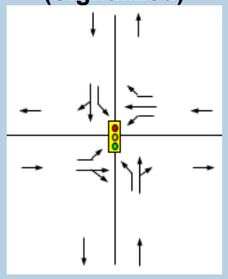
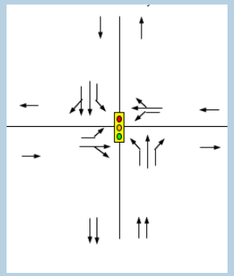
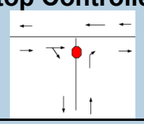
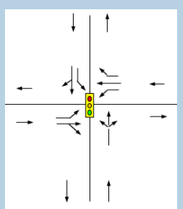
3.7.3.1 *INTERSECTION OPERATIONAL ANALYSIS*

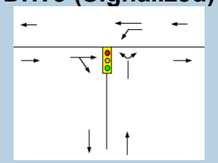
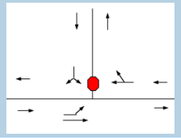
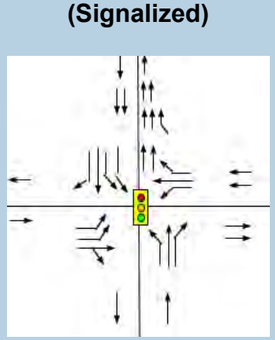
This section presents the Alternative 7 peak hour intersection operations within the study area. The summary of Alternative 7 (2031) intersection operations during the peak hours are provided in Table 3-18. With single through lane from Professor Day Drive to Barrie Street, the following movements will be impacted with LOS “F/E” on Line 8 intersections:

- EB at Northgate Drive for the PM peak hour with LOS “F”,
- SB at Lowes Gate Drive for both AM and PM peak hours with LOS “F” and queue length exceeding the available storage length for PM peak hour,
- NBR at Taucar Gate, WB at Noble Drive, and EBL and SBR at Barrie Street with LOS “E”.

Table 3-18: Micro-simulation-based Intersection Evaluation Results – Peak hour conditions – 2031 Alternative 7

Intersection	Movement	Available/ *Modified* Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and 10 Side Road (Signalized) 	EBL	120	1	2	A	0	1	7	26	C	5	5
	EBT		2	14	B	3	6	9	26	C	8	13
	EBR		6	6	A	6	11	15	6	A	8	13
	WBL	80	251	36	D	56	67	125	26	C	34	44
	WBT		23	25	C	23	26	15	22	C	24	33
	WBR		85	12	B	23	26	222	11	B	25	34
	NBL		4	21	C	31	42	1	13	B	26	31
	NBT		129	24	C	31	42	134	26	C	27	31
	NBR	*80*	126	8	A	28	32	509	16	B	54	63
	SBL	*80*	172	29	C	38	47	190	33	C	46	53
	SBT		100	24	C	27	31	217	26	C	42	52
	SBR		5	13	B	27	31	6	16	B	42	52
	Intersection Overall			25	C				21	C		
Line 8 and Reagens Industrial Parkway (Stop-Controlled) 	EBT		269	2	A	10	16	702	3	A	7	12
	EBR		32	3	A	10	16	5	5	A	7	12
	WBL	70	62	4	A	13	21	32	8	A	9	12
	WBT		346	1	A	5	12	348	1	A	0	0
	NBL		13	15	C	21	30	14	18	C	23	27
	NBR		38	10	B	21	30	131	15	B	23	27
	Intersection Overall			2	A				4	A		
Line 8 and Langford Boulevard (Signalized) 	EBL	50	87	12	B	23	27	104	13	B	18	24
	EBT		202	12	B	42	53	601	15	B	71	79
	EBR	50	18	6	A	12	17	125	7	A	13	18
	WBL	100	48	11	B	11	15	88	17	B	19	22
	WBT		236	12	B	36	49	298	13	B	40	53
	WBR	70	38	5	A	9	11	136	6	A	14	18
	NBL	40	10	21	C	5	7	21	23	C	9	11
	NBT		13	19	B	9	15	2	23	C	6	6
	NBR		55	7	A	11	19	88	5	A	9	10
	SBL	50	57	22	C	13	15	106	23	C	21	26
	SBT		16	19	B	20	28	1	17	B	5	8
	SBR		162	10	A	25	28	60	7	A	10	14
	Intersection Overall			12	B				13	B		
	EBL	50	33	17	B	16	23	78	28	C	19	21

Line 8 and Rogers Trail / Summerlyn Trail (Signalized) 	EBT		276	14	B	47	54	698	23	C	91	108
	EBR		2	8	A	47	54	20	26	C	91	108
	WBL	*70*	249	16	B	35	39	295	31	C	49	59
	WBT		262	11	B	34	36	438	16	B	58	64
	WBR	55	78	7	A	11	16	137	7	A	11	17
	NBL	20	7	25	C	6	6	19	26	C	7	10
	NBT		20	23	C	29	39	19	22	C	29	37
	NBR		211	9	A	31	41	205	14	B	31	37
	SBL	*50*	99	25	C	20	23	165	30	C	31	36
	SBT		17	20	B	18	24	24	23	C	15	20
	SBR		56	9	A	18	24	66	11	B	15	20
	Intersection Overall			14	B				21	C		
Line 8 and Professor Day Drive (Signalized) 	EBL	*80*	7	21	C	5	8	36	30	C	11	15
	EBT		542	14	B	70	77	843	30	C	132	156
	EBR		33	13	B	70	77	168	31	C	132	156
	WBL	*80*	196	12	B	27	33	184	23	C	28	35
	WBT		506	6	A	47	54	769	8	A	61	79
	WBR		9	10	B	47	54	39	8	A	61	79
	NBL	140	76	35	D	22	29	96	34	C	23	28
	NBT		69	26	C	19	22	38	28	C	12	15
	NBR		56	9	A	16	21	159	7	A	14	17
	SBL	42	9	35	C	6	8	12	33	C	8	11
	SBT		59	33	C	8	11	34	24	C	5	8
	SBR	38	8	7	A	8	11	11	6	A	5	6
	Intersection Overall			13	B				20	C		
Line 8 and Taucar Gate (Stop Controlled) 	EBT		606	3	A	35	57	998	15	C	93	103
	EBR		0	1	A	35	57	4	12	B	93	103
	WBT		713	1	A	3	8	993	1	A	0	0
	NBR		57	15	B	19	25	27	41	E	10	15
	Intersection Overall			2	A				8	A		
Line 8 and Noble Drive (Signalized) 	EBL	70	28	12	B	10	16	96	18	B	18	20
	EBT		636	11	B	63	65	892	16	B	68	73
	EBR		0	2	A	62	64	39	14	B	68	73
	WBL		0	1	A	0	0	11	63	E	7	9
	WBT		602	30	C	101	110	887	64	E	179	207
	WBR	60	23	12	B	9	11	76	43	D	26	35
	NBL		45	20	B	12	18	13	18	B	8	10
	NBT		0	0	A	12	18	0	0	A	8	10
	NBR		9	12	B	12	18	13	7	A	8	10
	SBL	55	75	19	B	16	24	53	22	C	12	23

	SBT		0	4	A	6	14	0	0	A	9	12
	SBR		66	9	A	13	19	93	12	B	15	19
	Intersection Overall			19	B				37	D		
Line 8 and Northgate Drive (Signalized) 	EBT		698	30	C	115	130	868	114	F	262	293
	EBR		17	25	C	115	130	65	114	F	262	293
	WBL	65	97	23	C	34	45	148	39	D	47	53
	WBT		588	12	B	63	67	978	15	B	69	75
	NBL		41	30	C	41	46	20	31	C	28	31
	NBR		251	18	B	41	46	122	18	B	30	39
	Intersection Overall			22	C				59	E		
Line 8 and Lowes Gate (Stop-Controlled) 	EBL	*65*	25	8	A	10	20	108	22	C	26	27
	EBT		925	1	A	6	11	881	1	A	12	14
	WBT		639	3	A	40	55	1040	12	B	91	104
	WBR		128	4	A	40	55	128	10	B	91	104
	SBL	93*	183	59	F	61	70	77	231	F	132	140
	SBR	93*	47	51	F	61	70	86	257	F	132	140
	Intersection Overall			9	A				24	C		
Line 8 and Barrie Street (Signalized) 	EBL (dual)	*Ln1 = 150, Ln2=170*	524	69	E	76	86	411	48	D	48	55
	EBT		507	39	D	106	128	496	33	C	90	100
	EBR	*50*	74	37	D	106	128	55	30	C	90	100
	WBL	120	13	24	C	11	16	34	24	C	13	17
	WBT		260	28	C	59	69	529	24	C	108	108
	WBR		766	1	A	12	18	1120	2	A	7	35
	NBL	50	53	22	C	12	16	76	25	C	18	23
	NBT		27	36	D	11	11	0	0	A	0	0
	NBR	110	35	6	A	7	8	44	6	A	7	11
	SBL (dual)	Ln1 = 120, Ln 2 = 190	487	42	D	58	60	724	52	D	92	101
	SBT		0	0	A	0	0	101	41	D	28	34
	SBR	331	455	14	B	49	69	561	74	E	189	209
	Intersection Overall			39	D				45	D		
Line 8 and Colborne Street (Signalized) 	EBT		798	19	B	79	94	911	20	C	83	100
	EBR		238	22	C	79	94	289	23	C	83	100
	WBL	60	4	17	B	3	7	1	14	B	1	3
	WBT		717	12	B	64	73	1353	16	B	79	90
	NBL		312	40	D	67	76	331	44	D	77	93
	NBR		7	42	D	67	74	11	34	C	77	93
	Intersection Overall			20	C				17	B		
	EBL	50	8	11	B	6	8	61	25	C	24	30

Line 8 and Artesian Industrial Parkway (Signalized) 	EBT		796	7	A	42	55	856	11	B	61	72
	WBT		703	12	B	67	82	1291	17	B	69	75
	WBR		291	14	B	67	82	146	19	B	69	75
	SBL		90	34	C	33	45	236	35	D	55	61
	SBR		19	18	B	33	45	58	27	C	55	61
	Intersection Overall			11	B				17	B		
10 Sideroad and Reagens Industrial Parkway (Signalized) 	WBL	*60*	129	24	C	51	59	137	20	C	27	32
	WBR		17	7	A	15	18	109	10	A	17	22
	NBT		227	10	A	21	25	526	9	A	24	28
	NBR	50	104	5	A	19	21	96	6	A	20	27
	SBL	60	1	13	B	2	12	12	15	B	7	12
	SBT		353	10	B	26	30	342	8	A	18	23
	Intersection Overall			12	B				10	A		

Note: Available Link Length in Field*

3.7.3.2 *MAXIMUM QUEUE LENGTHS*

Queue lengths for eastbound and westbound directions for AM and PM periods are shown in Figures 3-30 and 3-31. Eastbound directions queue lengths at Taucar Gate, Noble Drive and Northgate Drive are higher for the PM peak hour condition.

Figure 3-30: Plot of Maximum Queue Lengths – Morning Peak Hour Eastbound and Westbound – 2031 Alternative 7

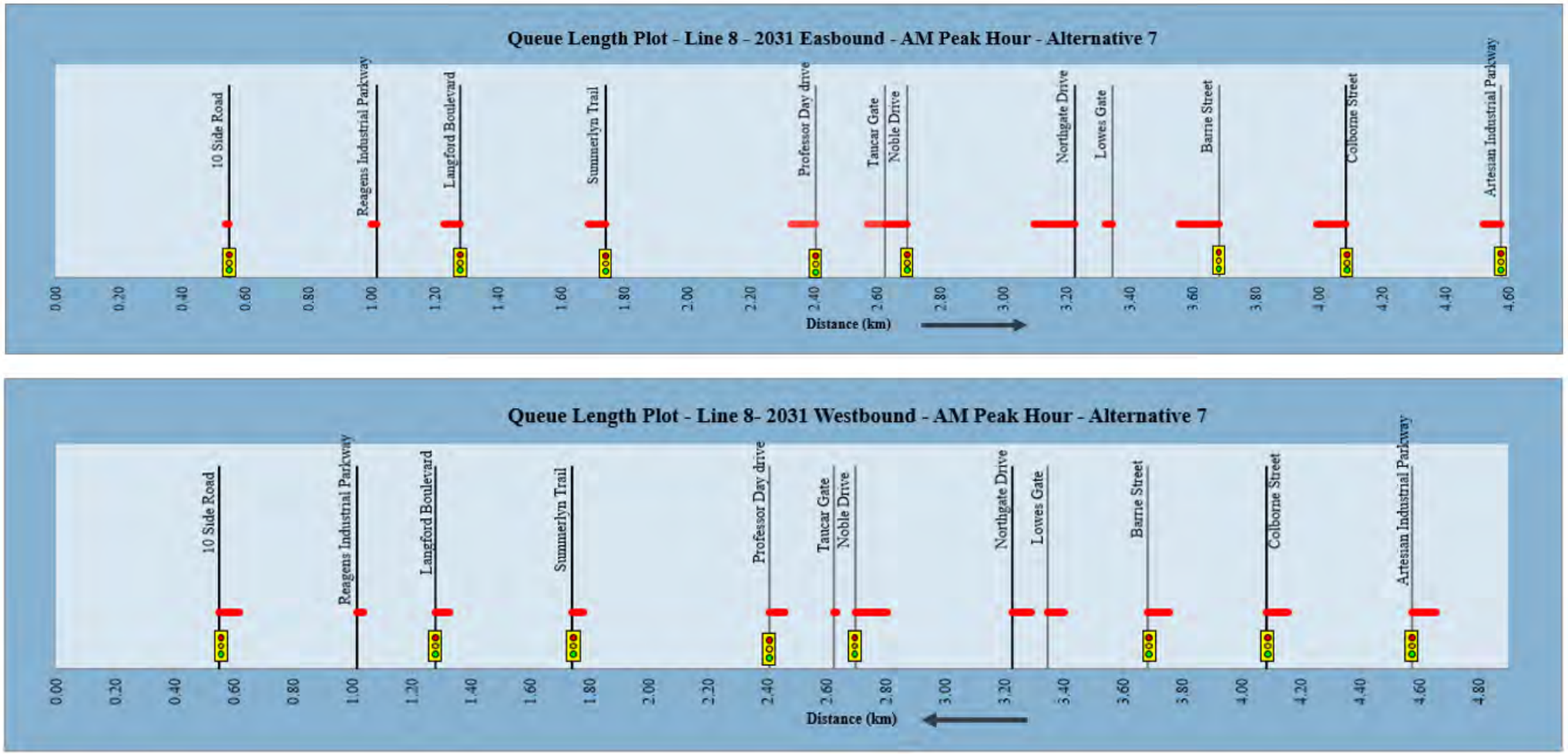
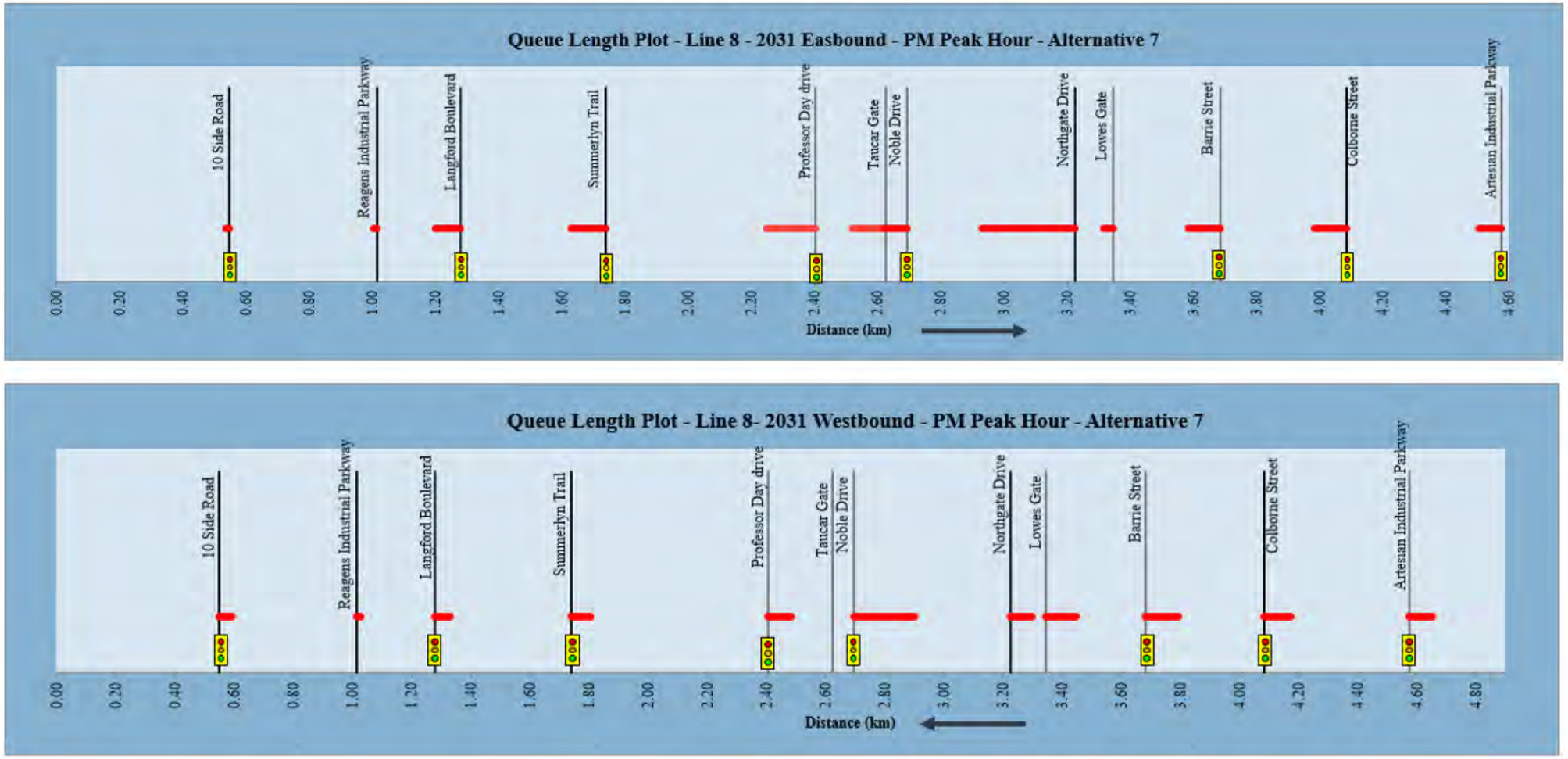


Figure 3-31: Plot of Maximum Queue Lengths – Afternoon Peak Hour Eastbound and Westbound – 2031 Alternative 7



3.7.3.3 *SPEED CONTOUR PLOTS*

Speed contour plots as shown in Figure 3-32 and Figure 3-33 indicate decrease of speed on the eastbound direction between Noble Drive and Northgate Drive during the afternoon peak hour.

Figure 3-32: Speed Contour Plot for Line 8 – Morning Peak Hour Eastbound and Westbound – 2031 Alternative 7

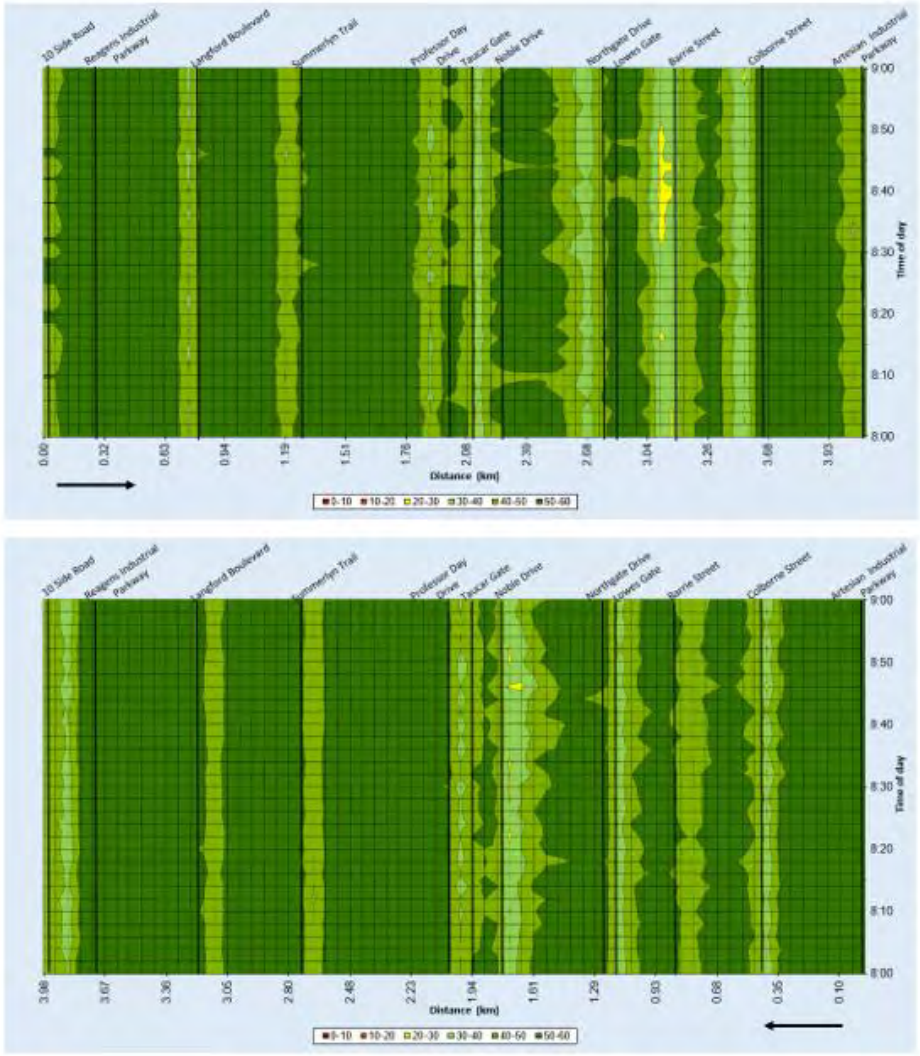
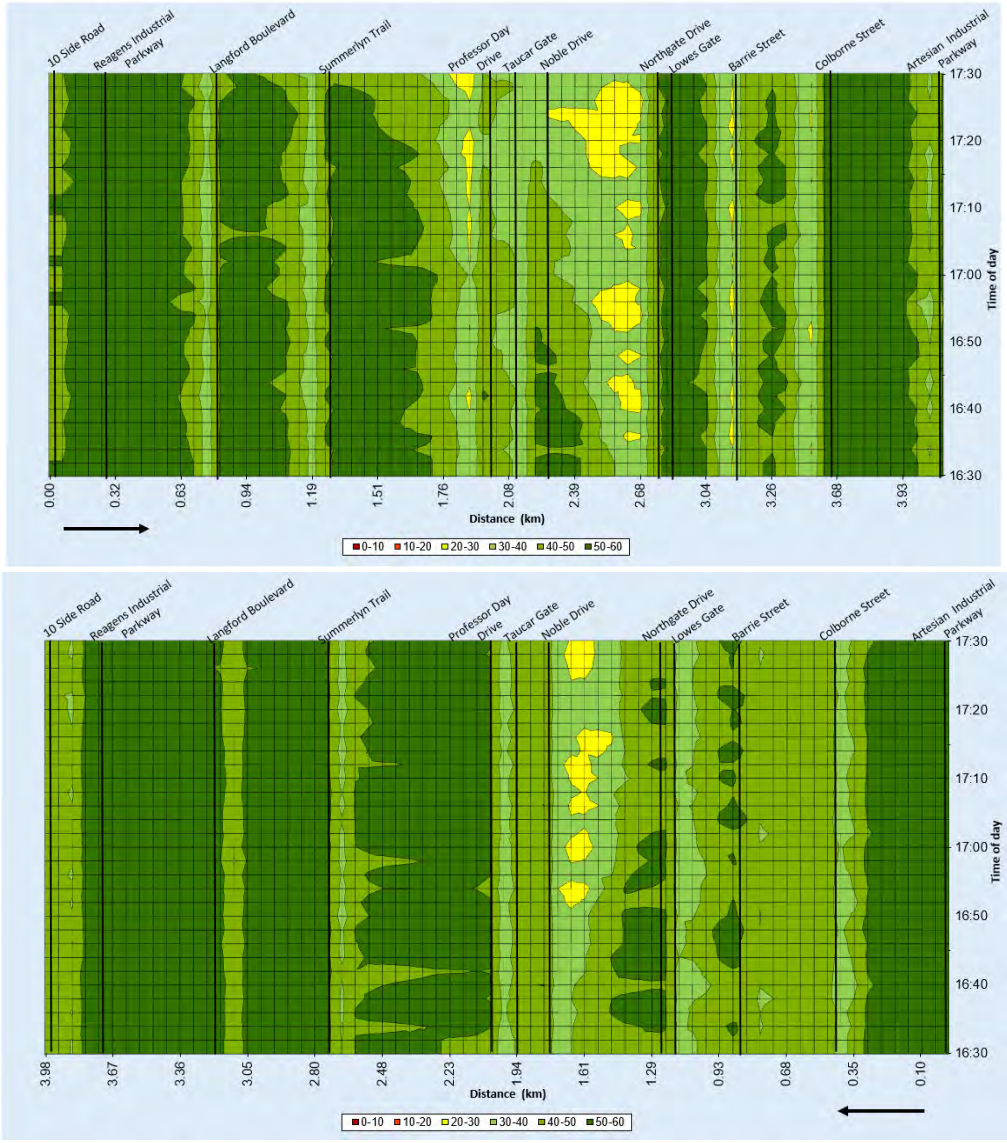


Figure 3-33: Speed Contour Plot for Line 8 – Afternoon Peak Hour Eastbound and Westbound – 2031 Alternative 7



3.7.3.4 *TRAVEL TIME*

The vehicle travel time for the eastbound direction under Alternative 7 (2031) conditions are expected to increase by one minute (22%) in the morning peak hour and 3.3 min (72%) for the afternoon peak hour, and for the westbound direction, an increase of 16-34% are expected as presented in Table 3-19.

Table 3-19: Travel Time Comparison – Existing and 2031 Alternative 7 Scenario

Morning Peak Hour					
Road Segment	**Distance in km**	**Simulated Travel Time Existing (min)**	**Simulated Travel Time 2031 Alternative 7 Scenario (min)**	**Difference (min)**	**% Difference**
Line 8 from 10 Sideroad to Barrie Street (EB)	3.1	4.57	5.56	1.0	21.7%
Line 8 from Barrie Street to 10 Sideroad (WB)	3.1	4.30	5.00	0.7	16.2%
Afternoon Peak Hour					
Road Segment	**Distance in km**	**Simulated Travel Time Existing (min)**	**Simulated Travel Time 2031 Alternative7 Scenario (min)**	**Difference (min)**	**% Difference**
Line 8 from 10 Sideroad to Barrie Street (EB)	3.1	4.61	7.93	3.3	71.9%
Line 8 from Barrie Street to 10 Sideroad (WB)	3.1	4.25	5.69	1.4	33.9%

3.7.3.5 *SUMMARY OF ALTERNATIVE 7 SCENARIO*

Alternative 7 results show deterioration of LOS for the eastbound movements at Northgate Drive intersection. Due to lane reduction (with respect to Alternatives 4-6) in the eastbound direction, longer queues (in the eastbound direction) at the Taucar Gate, Noble Drive and Northgate Drive are expected. Also, due to congestion, the southbound traffic at Taucar Gate waiting to turn /merge on Line 8 is expected to experience higher delay. The queue lengths for the southbound traffic at the Taucar Gate intersection is expected to surpass the available storage length.

There would deterioration of travel times in the eastbound direction. The afternoon peak hour travel time in eastbound direction is expected to increase by 2.4 minutes (45%) compared to Alternative 6 and by 3.3 minutes (72%) with respect to existing conditions.

3.7.4 ALTERNATIVE 8 - WITH PROFESSOR DAY DRIVE EXTENDED

Alternative 8 is an additional scenario suggested by the Town. This scenario assumed an extension of Professor Day Drive (PDD) to north of the Bradford Bypass to connect to CR4 (County Road 4) for the 2031 model with Bradford Bypass and with Holland Street Diet conditions. The intension is to achieve some traffic diversion from Barrie Street to Professor Day Drive. The EMME model has been modified to reflect this change. Currently, Professor Day Drive has been coded with 40km/h speed and the same has been assumed for the extended section. The updated EMME model was then used to extract traversal matrices for the Line 8 Corridor subarea as before and these traversal matrices were adjusted to use in the microsimulation model based on the adjustment that were used under existing conditions.

From the EMME assignment considering extension of PDD, it was found that the updated model resulted in marginal reduction in the assignment volumes. Only local traffic was able to attract to PDD as the speed (40 km/h) was much lower than that used for Barrie Street north (80 km/h). Table 3-20 provides a summary of Traffic demand on Line 8 Corridor. It may be noted that the total demand in the Line 8 Corridor is expected to reduce approximately by 120 and 190 vehicles for the AM and PM peak hours respectively. The eastbound left-turn volumes at Barrie Street intersection are expected to reduce marginally by 37 and 57 vehicles during the AM and PM peak hours.

Alternative 8 Aimsun model assumed the same network configuration as that of Alternative 7 with the updated demand matrices as mentioned above.

Table 3-20: Summary of Demand comparison for the Line 8 Corridor for 2031 conditions without and with Professor Day Drive Extension

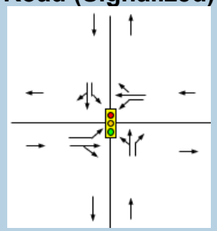
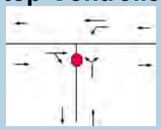
	AM Peak hour			PM peak hour		
	Without PDD Extension	With PDD Extension	Difference	Without PDD Extension	With PDD Extension	Difference
Eastbound left (EBL) volume at Barrie Street	526	489	**-37**	431	364	**-67**
Total demand	5058	4936	**-122**	6852	6662	**-190**

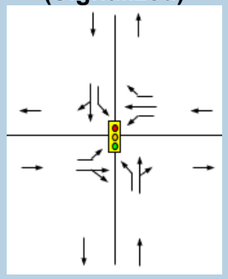
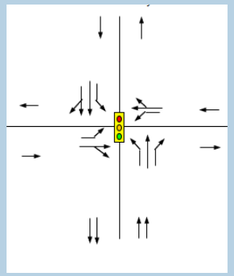
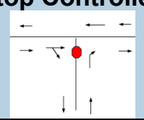
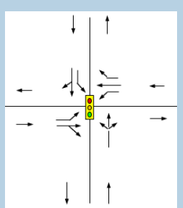
3.7.4.1 *INTERSECTION OPERATIONAL ANALYSIS*

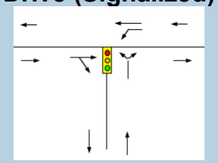
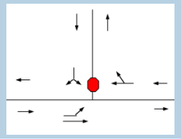
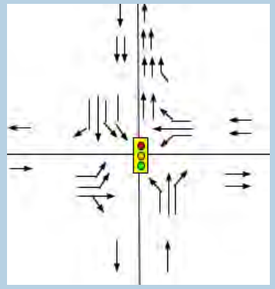
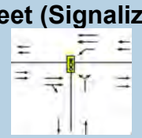
This section presents the Alternative 8 peak hour intersection operations within the study area. The summary of Alternative 8 (2031) intersection operations during the peak hours are provided in Table 3-21. The extension of PDD resulted in marginally low throughput volumes on Line 8 intersections compared to Alternative 7 because of the marginal decrease in demand. The following improvements were observed in the Line 8 traffic operations with respect to that of Alternative 7:

- Noble Drive WB direction in the PM peak hour from LOS “E” to “D”.
- Northgate Drive EB direction in the PM peak hour from LOS “F” to LOS “E”.
- Lowes Gate Drive SB direction in the AM peak hour from LOS “F” to LOS “E”. During the PM peak hour, the delay would reduce from around 200 seconds to 80 seconds for the SB movements and the queue lengths would remain within the storage length during both the peak hours.
- EBL movement at Barrie Street in the AM peak hour from LOS “E” to “D”. The maximum queue length for the movement would be around 64 metres compared to 84 metres in Alternative 7.
- SBR movement at Barrie Street int the PM peak hour from LOS “E” to LOS “D” with the maximum queue length of around 130 metres compared to 209 metres in Alternative7.

Table 3-21: Micro-simulation-based Intersection Evaluation Results – Peak hour conditions – 2031 Alternative 8 – With Professor Day Drive Extended

Intersection	Movement	Available/ *Modified* Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and 10 Side Road (Signalized) 	EBL	120	1	5	A	1	2	7	24	C	5	6
	EBT		2	15	B	3	5	9	29	C	7	10
	EBR		6	7	A	6	11	15	6	A	7	10
	WBL	80	258	34	C	54	66	134	24	C	37	41
	WBT		23	30	C	21	24	15	22	C	25	31
	WBR		77	11	B	21	24	225	11	B	25	31
	NBL		4	23	C	29	33	1	21	C	25	32
	NBT		123	24	C	29	33	133	26	C	25	32
	NBR	*80*	121	9	A	27	34	511	16	B	57	65
	SBL	*80*	173	29	C	39	49	167	33	C	39	47
	SBT		103	25	C	26	30	215	25	C	44	52
	SBR		3	5	B	1	2	3	8	A	44	52
	Intersection Overall			25	C				20	C		
Line 8 and Reagens Industrial Parkway (Stop-Controlled) 	EBT		271	2	A	10	16	677	3	A	11	12
	EBR		27	3	A	10	16	6	4	A	11	12
	WBL	70	62	4	A	12	16	29	6	A	7	11
	WBT		340	1	A	4	11	365	1	A	0	0
	NBL		18	14	B	23	31	11	17	C	20	27
	NBR		38	10	B	23	31	137	14	B	20	27
	Intersection Overall			2	A				4	A		
Line 8 and Langford Boulevard (Signalized) 	EBL	50	91	12	B	22	30	102	12	B	16	19
	EBT		198	12	B	40	46	590	14	B	66	74
	EBR	50	20	5	A	11	17	122	6	A	12	16
	WBL	100	54	10	A	11	15	88	16	B	17	19
	WBT		234	11	B	34	43	307	15	B	48	55
	WBR	70	26	5	A	6	8	111	6	A	13	19
	NBL	40	8	23	C	5	6	23	21	C	8	11
	NBT		14	19	B	10	14	2	11	B	8	9
	NBR		54	7	A	11	16	82	6	A	10	11
	SBL	50	48	23	C	12	20	92	22	C	18	23
	SBT		13	21	C	19	26	1	20	C	7	12
	SBR		159	10	A	23	30	64	8	A	11	13
	Intersection Overall			12	B				13	B		
	EBL	50	32	14	B	10	17	77	23	C	16	18

Line 8 and Rogers Trail / Summerlyn Trail (Signalized) 	EBT		261	13	B	41	45	659	21	C	85	95
	EBR		3	13	B	41	45	22	17	B	85	95
	WBL	*70*	257	15	B	38	42	306	30	C	46	55
	WBT		259	10	A	30	33	423	14	B	52	60
	WBR	55	65	6	A	8	14	104	7	A	12	16
	NBL	20	7	21	C	5	5	15	28	C	6	10
	NBT		22	25	C	24	31	19	24	C	30	36
	NBR		208	9	A	28	31	210	16	B	30	36
	SBL	*50*	77	25	C	17	22	142	28	C	28	33
	SBT		17	23	C	13	16	28	22	C	15	18
	SBR		50	9	A	13	16	65	12	B	15	21
	Intersection Overall			13	B				20	B		
Line 8 and Professor Day Drive (Signalized) 	EBL	*80*	7	16	B	5	8	35	25	C	10	12
	EBT		503	14	B	60	69	811	24	C	123	152
	EBR		34	11	B	60	69	148	23	C	123	152
	WBL	*80*	185	11	B	30	36	176	21	C	27	30
	WBT		497	6	A	47	54	737	8	A	58	70
	WBR		8	6	A	47	54	31	8	A	58	70
	NBL	140	76	38	D	27	31	93	36	D	23	26
	NBT		72	30	C	23	28	37	26	C	12	14
	NBR		62	9	A	17	21	157	7	A	13	15
	SBL	42	7	34	C	6	7	11	29	C	6	8
	SBT		60	27	C	8	10	28	27	C	6	7
	SBR	38	8	9	A	7	10	12	6	A	5	7
	Intersection Overall			13	B				18	B		
Line 8 and Taucar Gate (Stop Controlled) 	EBT		571	2	A	26	41	973	12	B	82	96
	EBR		1	1	A	26	41	3	9	A	82	96
	WBT		691	1	A	4	11	943	1	A	0	1
	NBR		56	13	B	17	21	26	46	E	13	13
	Intersection Overall			2	A				7	A		
Line 8 and Noble Drive (Signalized) 	EBL	70	26	13	B	9	16	91	17	B	16	22
	EBT		603	10	B	61	68	866	15	B	63	71
	EBR		0	2	A	61	68	34	15	B	63	71
	WBL		0	12	B	0	3	13	53	D	9	11
	WBT		580	29	C	98	115	843	47	D	137	152
	WBR	60	21	12	B	6	9	53	27	C	16	19
	NBL		49	20	B	18	24	12	23	C	6	10
	NBT		2	32	C	18	24	0	0	A	6	10
	NBR		7	10	A	18	24	12	7	A	6	10
	SBL	55	53	19	B	13	16	46	20	B	11	15

	SBT		0	0	A	6	11	0	0	A	7	13
	SBR		63	10	B	12	20	87	12	B	13	18
	Intersection Overall			19	B				29	C		
Line 8 and Northgate Drive (Signalized) 	EBT		651	28	C	102	118	832	80	E	221	232
	EBR		15	26	C	102	118	72	72	E	221	232
	WBL	65	84	20	C	24	31	211	47	D	66	76
	WBT		565	13	B	62	66	898	15	B	72	79
	NBL		37	33	C	53	63	17	26	C	30	38
	NBR		275	20	B	53	63	118	18	B	33	38
	Intersection Overall			21	C				45	D		
Line 8 and Lowes Gate (Stop-Controlled) 	EBL	*65*	23	6	A	6	10	107	18	C	22	25
	EBT		903	1	A	5	7	843	1	A	5	9
	WBT		599	3	A	30	38	1026	8	A	78	89
	WBR		84	4	A	30	38	89	7	A	78	89
	SBL	93*	167	39	E	43	48	74	84	F	61	68
	SBR	93*	48	37	E	43	48	86	87	F	61	68
	Intersection Overall			6	A				11	B		
Line 8 and Barrie Street (Signalized) 	EBL (dual)	*Ln1 = 150, Ln2=170*	479	54	D	56	64	356	46	D	42	51
	EBT		514	39	D	113	126	486	35	C	89	98
	EBR	*50*	77	36	D	113	126	72	30	C	89	98
	WBL	120	13	30	C	16	21	37	28	C	15	20
	WBT		244	29	C	45	58	518	23	C	108	115
	WBR		746	1	A	4	12	1133	2	A	13	37
	NBL	50	47	22	C	13	17	74	26	C	15	21
	NBT		7	37	D	5	6	0	0	A	0	0
	NBR	110	38	7	A	9	13	38	7	A	7	8
	SBL (dual)	Ln1 = 120, Ln 2 = 190	497	41	D	57	62	707	47	D	81	98
	SBT		0	0	A	0	4	70	45	D	21	28
	SBR	331	390	12	B	45	51	524	44	D	109	130
	Intersection Overall			36	D				38	D		
Line 8 and Colborne Street (Signalized) 	EBT		829	19	B	78	88	874	19	B	76	85
	EBR		218	22	C	78	88	292	22	C	76	85
	WBL	60	2	14	B	2	4	1	7	A	1	2
	WBT		683	12	B	53	65	1386	16	B	79	95
	NBL		310	36	D	60	69	310	39	D	74	92
	NBR		4	30	C	60	69	8	38	D	74	92
	Intersection Overall			20	B				20	B		
	EBL	50	9	12	B	7	13	53	24	C	30	34

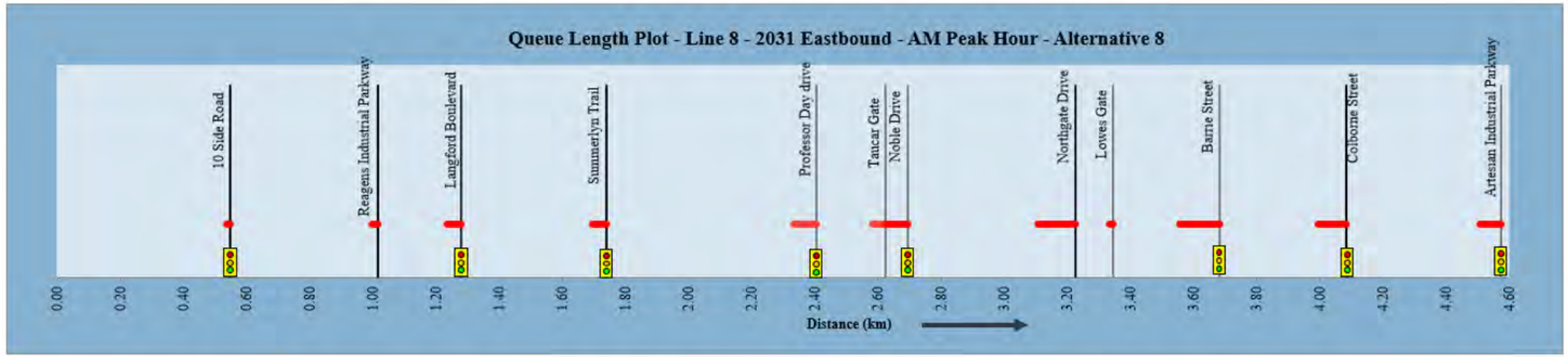
Line 8 and Artesian Industrial Parkway (Signalized) 	EBT		824	8	A	50	68	837	11	B	59	67
	WBT		671	11	B	58	67	1337	18	B	72	79
	WBR		277	13	B	58	67	145	20	B	72	79
	SBL		93	35	C	33	41	238	36	D	53	60
	SBR		18	21	C	33	41	61	25	C	53	60
	Intersection Overall			11	B				17	B		
10 Sideroad and Reagens Industrial Parkway (Signalized) 	WBL	*60*	128	24	C	48	57	137	21	C	28	35
	WBR		14	8	A	16	20	101	9	A	13	20
	NBT		224	10	A	19	24	535	8	A	24	29
	NBR	50	96	5	A	16	21	98	5	A	20	28
	SBL	60	1	1	A	0	0	11	17	B	6	8
	SBT		363	9	A	25	33	350	7	A	21	25
	Intersection Overall			11	B				9	A		

Note: Available Link Length in Field*

3.7.4.2 *MAXIMUM QUEUE LENGTHS*

Queue lengths for eastbound and westbound directions for AM and PM periods are shown in Figures 3-34 and 3-35. Similar to Alternative 7, the higher eastbound direction queue lengths are observed at Taucar Gate, Noble Drive and Northgate Drive in the Alternative 8 PM peak hour.

Figure 3-34: Plot of Maximum Queue Lengths – Morning Peak Hour Eastbound and Westbound – 2031 Alternative 8 – With Professor Day Drive Extended



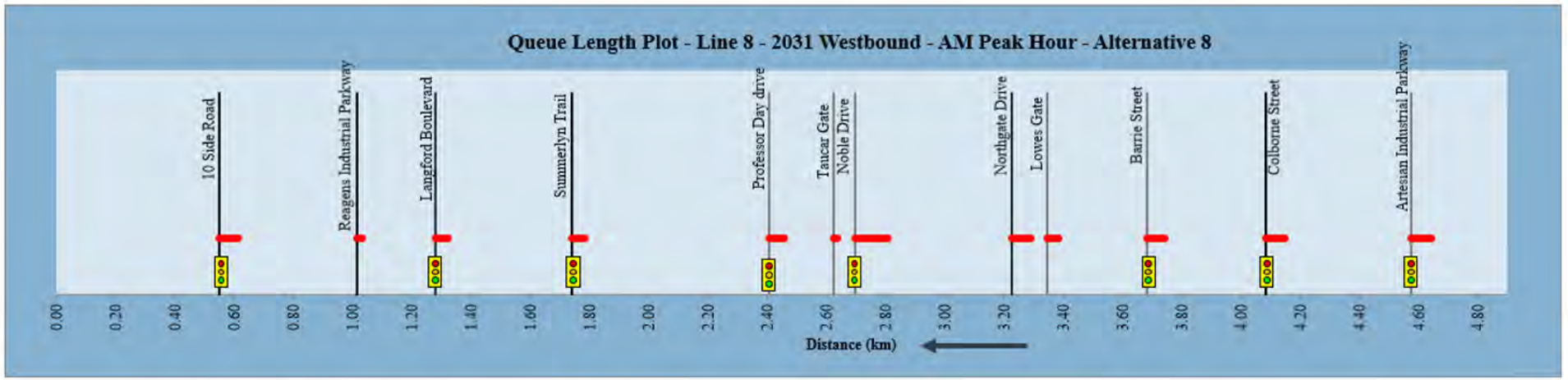
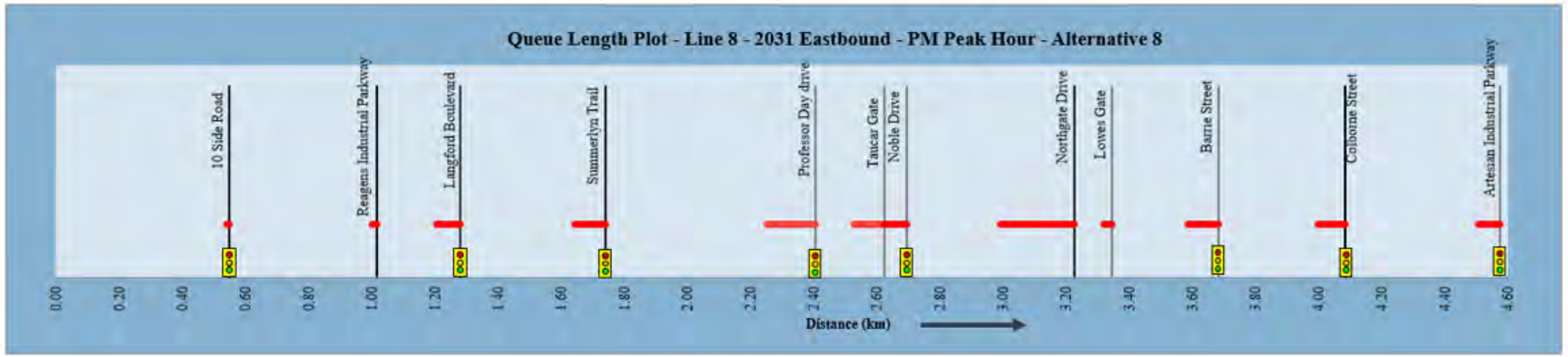
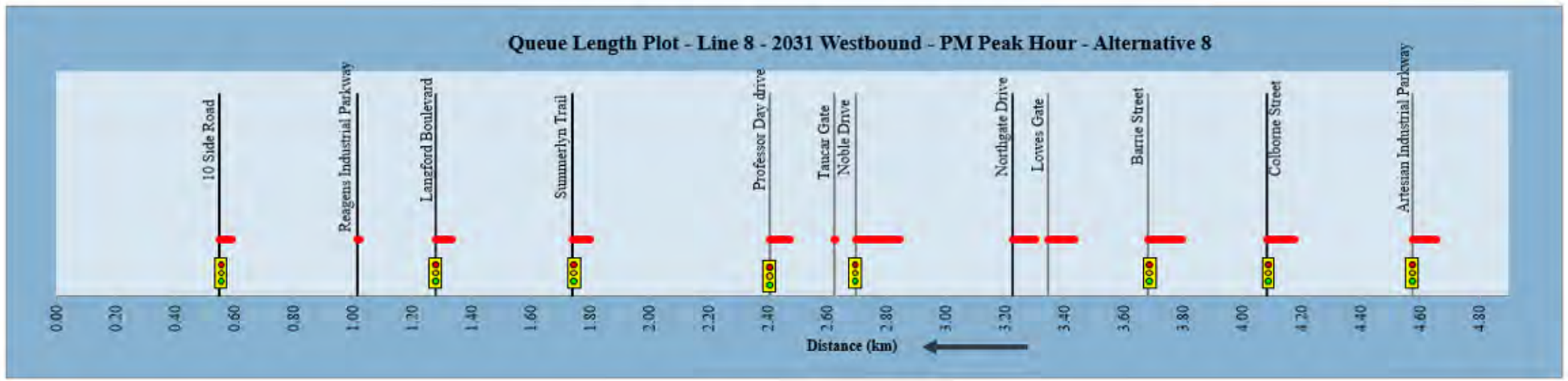


Figure 3-35: Plot of Maximum Queue Lengths – Afternoon Peak Hour Eastbound and Westbound – 2031 Alternative 8 – With Professor Day Drive Extended





3.7.4.3 *SPEED CONTOUR PLOTS*

Speed contour plots as shown in Figure 3-36 and Figure 3-37 indicate marginal improvement in the afternoon peak hour speed on the eastbound direction between Noble Drive and Northgate Drive, compared to Alternative 7.

Figure 3-36: Speed Contour Plot for Line 8 – Morning Peak Hour Eastbound and Westbound – 2031 Alternative 8 – With Professor Day Drive Extended

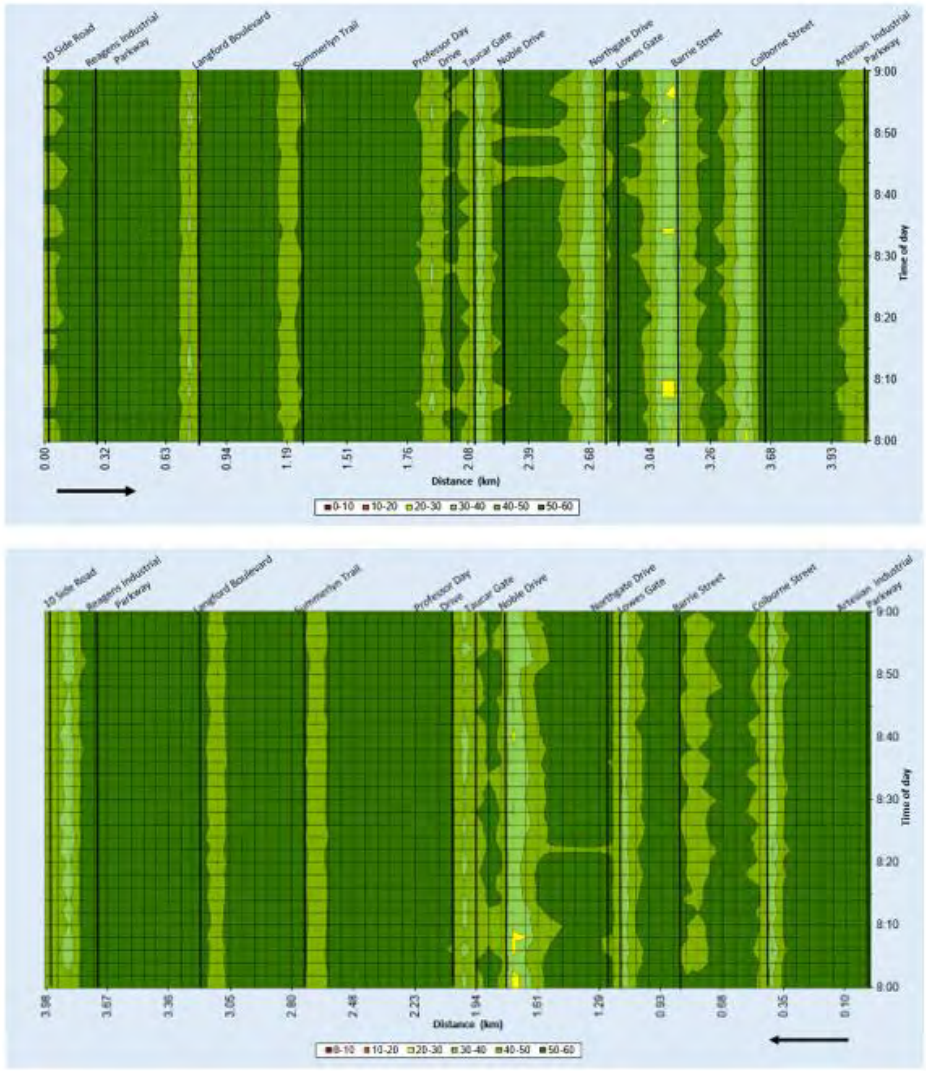
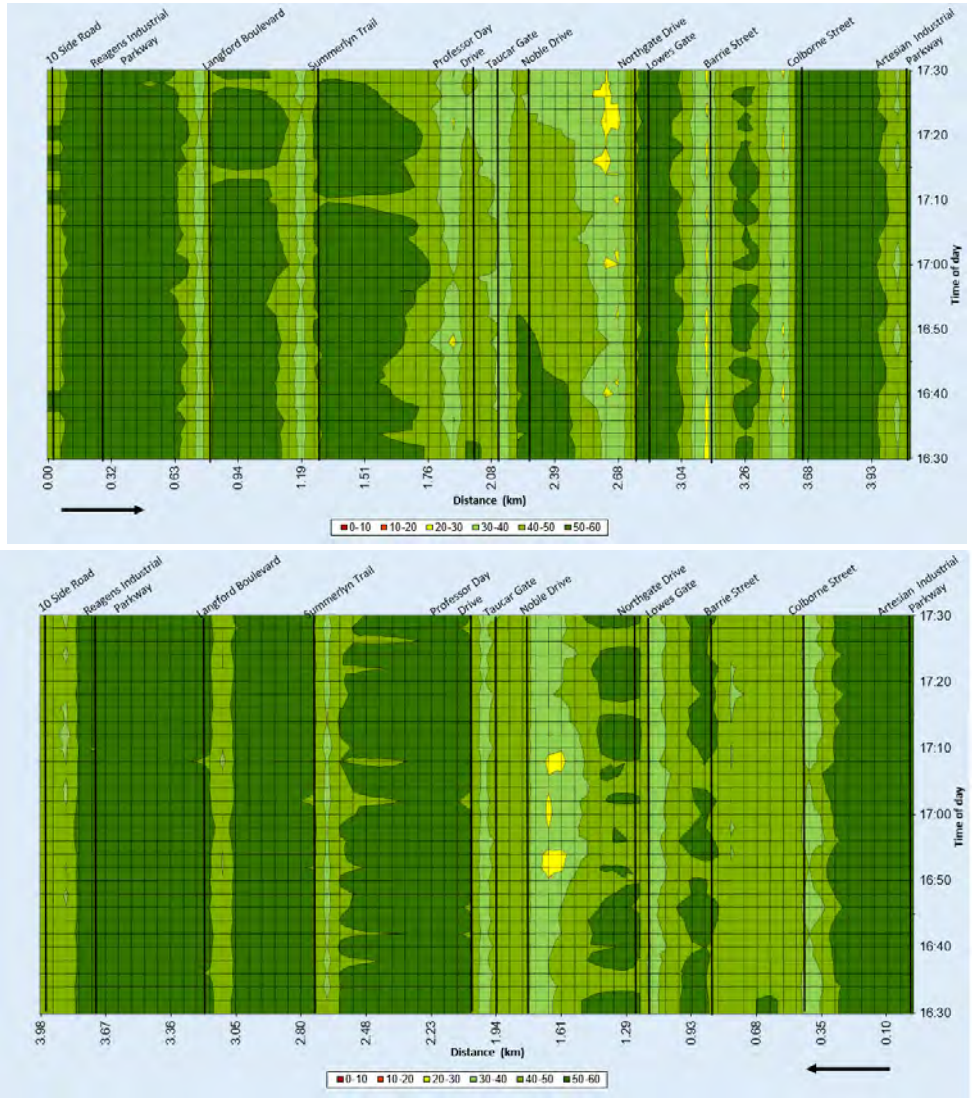


Figure 3-37: Speed Contour Plot for Line 8 – Afternoon Peak Hour Eastbound and Westbound – 2031 Alternative 8 – With Professor Day Drive Extended



3.7.4.4 *TRAVEL TIME*

Compared to the existing conditions, the vehicle travel time for the eastbound direction under Alternative 8 (2031) conditions is expected to be increased by about one minute (19%) in the morning peak hour and 2.4 min (53%) during the afternoon peak hour, presented in Table 3-22. With the extension of PDD, time to travel in the eastbound direction on Line 8 during the afternoon peak hour is expected to be lower by 1 minute compared to Alternative 7.

Table 3-22: Travel Time Comparison – Existing and 2031 Alternative 8 Scenario – With Professor Day Drive Extended

Morning Peak Hour					
Road Segment	**Distance in km**	**Simulated Travel Time Existing (min)**	**Simulated Travel Time 2031 Alternative8 Scenario (min)**	**Difference (min)**	**% Difference**
Line 8 from 10 Sideroad to Barrie Street (EB)	3.1	4.57	5.43	0.9	18.7%
Line 8 from Barrie Street to 10 Sideroad (WB)	3.1	4.30	4.94	0.6	14.8%
Afternoon Peak Hour					
Road Segment	**Distance in km**	**Simulated Travel Time Existing (min)**	**Simulated Travel Time 2031 Alternative 8 Scenario (min)**	**Difference (min)**	**% Difference**
Line 8 from 10 Sideroad to Barrie Street (EB)	3.1	4.61	7.03	2.4	52.5%
Line 8 from Barrie Street to 10 Sideroad (WB)	3.1	4.25	5.21	1.0	22.6%

3.7.4.5 *SUMMARY OF ALTERNATIVE 8 SCENARIO*

Alternative 8 results show marginal improvement in the performance of movements that were previously identified as the 'critical movements' in Alternative - westbound movements at Noble Drive intersection, eastbound movements at Northgate Drive intersection, southbound movements at Lowes Gate intersection, and eastbound left and southbound right turning movements at Barrie Street intersection. Due to slightly lower traffic demand on Line 8 corridor under Alternative 8, these movements are expected to experience less delay and provide marginally better LOS operations. Compared to Alternative 7, the southbound queues on these crossing roads are expected to remain within the available storage lengths during both the peak hours. Also, the travel time is expected to be reduced by 1 minute during the afternoon peak hour in the eastbound direction, compared to Alternative 7.

3.7.5 ALTERNATIVE 8a

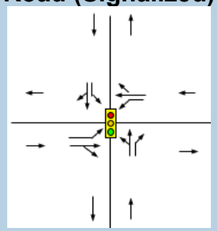
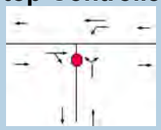
An additional Scenario, Alternative 8a, was evaluated considering a single eastbound left-turn lane at the intersection of Line 8 and Barrie Street as in existing condition. The following modifications were assumed for this scenario at Line 8 and Barrie Street intersection compared to Alternative 8:

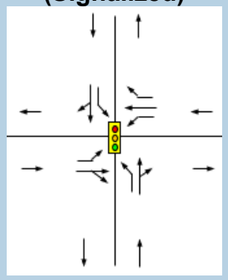
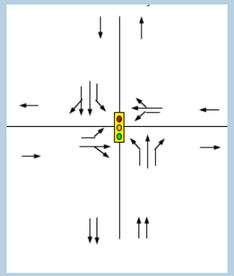
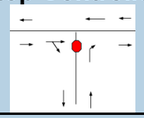
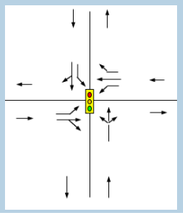
- Single EB left turn with the storage length extended up to the next upstream intersection;
- Maximum Green Time of 30 seconds for EB left turn during the AM Peak hour; and
- Maximum Green Time of 20 seconds for EB left turn during the PM Peak hour.

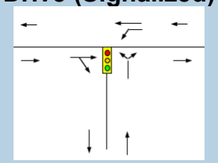
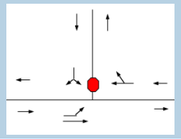
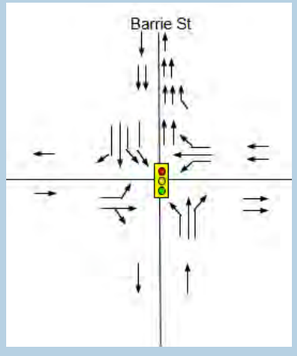
The summary of Alternative 8a (2031) intersection operations during the peak hours are provided in Table 3-23. The following summarizes the key observations of traffic operations at Barrie Street intersection under Alternative 8a:

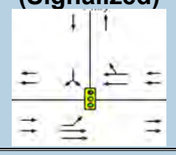
- The EBL movement would operate at LOS "F" in the peak hours, but the queue length is not expected to reach the upstream intersection.
- The EB through and right turning movements would experience longer delays in the AM peak hour and would operate at LOS "E".
- The SB left turning traffic from Barrie Steet is expected to provide operations at LOS "E" in the PM peak hour.

Table 3-23: Micro-simulation-based Intersection Evaluation Results – Peak hour conditions – 2031 Alternative 8a

Intersection	Movement	Available/ *Modified* Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and 10 Side Road (Signalized) 	EBL	120	1	6	A	1	2	7	23	C	5	6
	EBT		2	17	B	4	5	9	27	C	7	11
	EBR		6	9	A	6	11	15	6	A	7	11
	WBL	80	256	34	C	56	65	134	26	C	37	47
	WBT		23	29	C	23	26	14	22	C	28	34
	WBR		77	12	B	23	27	224	11	B	28	36
	NBL		4	27	C	30	36	1	25	C	26	32
	NBT		125	25	C	30	36	135	27	C	26	32
	NBR	*80*	120	9	A	28	34	514	15	B	55	61
	SBL	*80*	174	28	C	35	44	167	31	C	37	45
	SBT		104	23	C	25	30	215	25	C	43	53
	SBR		4	10	A	25	30	3	13	B	43	53
	Intersection Overall			25	C				20	C		
Line 8 and Reagens Industrial Parkway (Stop-Controlled) 	EBT		270	2	A	9	13	678	3	A	8	11
	EBR		27	3	A	9	13	6	5	A	8	11
	WBL	70	62	3	A	10	16	28	8	A	9	14
	WBT		340	1	A	2	7	363	1	A	0	2
	NBL		18	14	B	24	28	11	17	C	21	27
	NBR		38	10	B	24	28	137	14	B	21	27
	Intersection Overall			2	A				4	A		
Line 8 and Langford Boulevard (Signalized) 	EBL	50	90	11	B	22	26	102	14	B	16	19
	EBT		198	11	B	36	46	590	16	B	73	90
	EBR	50	20	5	A	11	17	122	7	A	13	21
	WBL	100	55	11	B	11	16	89	16	B	17	23
	WBT		234	13	B	34	40	305	13	B	44	54
	WBR	70	26	6	A	6	9	111	6	A	14	18
	NBL	40	8	29	C	6	8	23	21	C	8	10
	NBT		14	20	B	11	18	2	15	B	7	10
	NBR		54	6	A	14	18	82	6	A	10	11
	SBL	50	48	23	C	13	17	92	22	C	19	23
	SBT		13	23	C	22	29	1	19	B	8	13
	SBR		159	10	B	24	29	63	7	A	11	13
	Intersection Overall			12	B				13	B		
	EBL	50	32	17	B	14	21	76	24	C	18	21

Line 8 and Rogers Trail / Summerlyn Trail (Signalized) 	EBT		262	15	B	47	57	660	22	C	89	108
	EBR		3	15	B	47	57	22	21	C	89	108
	WBL	*70*	258	15	B	37	45	306	32	C	51	56
	WBT		260	10	B	30	41	426	14	B	51	68
	WBR	55	64	7	A	10	17	103	7	A	11	14
	NBL	20	7	22	C	5	5	15	29	C	6	9
	NBT		22	20	B	24	32	19	23	C	26	36
	NBR		207	8	A	27	33	210	15	B	27	36
	SBL	*50*	77	27	C	17	23	142	30	C	28	32
	SBT		17	21	C	12	16	28	20	C	16	27
	SBR		49	9	A	12	16	65	13	B	16	27
	Intersection Overall			13	B				21	C		
Line 8 and Professor Day Drive (Signalized) 	EBL	*80*	7	22	C	6	8	35	22	C	11	13
	EBT		502	14	B	63	71	819	20	B	105	127
	EBR		35	12	B	63	71	149	19	B	105	127
	WBL	*80*	184	11	B	29	37	175	19	B	25	30
	WBT		497	6	A	45	52	733	8	A	60	65
	WBR		8	6	A	45	52	30	9	A	60	65
	NBL	140	75	35	C	24	26	91	36	D	22	25
	NBT		72	30	C	22	28	37	23	C	11	15
	NBR		62	9	A	17	23	157	7	A	12	15
	SBL	42	7	37	D	6	7	10	30	C	7	10
	SBT		60	28	C	8	11	28	26	C	6	9
	SBR	38	8	9	A	7	11	12	7	A	6	9
	Intersection Overall			13	B				16	B		
Line 8 and Taucar Gate (Stop Controlled) 	EBT		572	2	A	32	44	979	10	B	85	104
	EBR		1	3	A	31	44	3	8	A	84	104
	WBT		689	1	A	3	11	933	1	A	0	2
	NBR		56	14	B	17	24	26	39	E	11	12
	Intersection Overall			2	A				6	A		
Line 8 and Noble Drive (Signalized) 	EBL	70	26	12	B	10	12	92	17	B	16	20
	EBT		603	11	B	60	67	873	14	B	67	73
	EBR		0	0	A	60	66	35	13	B	67	73
	WBL		0	8	A	0	3	14	40	D	8	11
	WBT		577	30	C	97	114	833	38	D	120	137
	WBR	60	22	11	B	6	10	53	17	B	12	14
	NBL		49	21	C	17	24	12	20	C	7	11
	NBT		2	30	C	17	24	0	0	A	7	11
	NBR		7	10	B	17	24	12	7	A	7	11
	SBL	55	53	19	B	13	16	45	18	B	12	18

	SBT		0	0	A	8	12	0	0	A	7	8
	SBR		63	10	B	12	19	87	11	B	12	15
	Intersection Overall			19	B				24	C		
Line 8 and Northgate Drive (Signalized) 	EBT		652	28	C	102	121	839	69	E	206	228
	EBR		14	25	C	102	121	73	60	E	206	228
	WBL	65	83	19	B	25	29	210	48	D	68	74
	WBT		565	13	B	66	75	895	15	B	74	78
	NBL		37	34	C	53	63	17	26	C	29	35
	NBR		275	20	C	53	63	118	18	B	33	37
	Intersection Overall			21	C				41	D		
Line 8 and Lowes Gate (Stop-Controlled) 	EBL	*65*	23	6	A	7	12	107	19	C	24	27
	EBT		902	1	A	5	7	851	1	A	5	11
	WBT		598	3	A	35	58	1024	11	B	95	106
	WBR		83	4	A	35	58	88	10	B	95	106
	SBL	93*	166	41	E	47	54	72	102	F	75	88
	SBR	93*	48	39	E	47	54	83	102	F	75	88
	Intersection Overall			7	A				14	B		
Line 8 and Barrie Street (Signalized) 	EBL	*288*	456	122	F	215	228	350	137	F	161	177
	EBT		502	68	E	141	153	489	39	D	93	112
	EBR	*50*	78	63	E	35	44	73	35	C	21	23
	WBL	120	12	24	C	15	20	37	24	C	14	18
	WBT		245	31	C	56	70	519	24	C	109	116
	WBR		748	1	A	10	20	1131	2	A	14	38
	NBL	50	47	31	C	14	16	73	28	C	18	22
	NBT		7	41	D	5	7	0	0	A	0	0
	NBR	110	38	6	A	9	13	38	6	A	6	9
	SBL (dual)	Ln1 = 120, Ln 2 = 190	497	47	D	57	66	695	56	E	94	127
	SBT		0	0	A	0	3	70	46	D	23	41
	SBR	331	389	12	B	40	52	520	45	D	110	124
	Intersection Overall			58	E				53	D		
Line 8 and Colborne Street (Signalized) 	EBT		823	18	B	67	72	872	19	B	82	88
	EBR		217	21	C	67	72	289	21	C	82	88
	WBL	60	2	14	B	2	4	1	10	A	1	3
	WBT		684	12	B	52	65	1385	15	B	82	95
	NBL		309	36	D	60	72	308	40	D	75	92
	NBR		4	30	C	60	72	7	41	D	75	92
	Intersection Overall			19	B				20	B		

Line 8 and Artesian Industrial Parkway (Signalized) 	EBL	50	9	13	B	6	13	53	25	C	25	27
	EBT		816	8	A	46	58	833	10	B	56	67
	WBT		671	11	B	58	67	1336	18	B	73	80
	WBR		277	13	B	58	67	145	20	B	73	80
	SBL		93	35	C	33	41	238	37	D	56	66
	SBR		18	21	C	33	41	61	27	C	56	66
	Intersection Overall			11	B				18	B		
10 Sideroad and Reagens Industrial Parkway (Signalized) 	WBL	*60*	129	22	C	46	60	135	21	C	27	32
	WBR		14	9	A	16	23	101	9	A	14	22
	NBT		224	10	A	20	25	537	9	A	27	33
	NBR	50	96	5	A	18	23	98	5	A	19	23
	SBL	60	1	6	A	0	9	12	16	B	6	10
	SBT		364	9	A	23	30	348	8	A	19	24
	Intersection Overall			11	B				10	A		

Note: Available Link Length in Field*

3.8 FUTURE OFF-PEAK ALTERNATIVES

In order to evaluate the corridor operations during off-peak hours, various off-peak scenarios were considered for the Future (2031). The network configuration as assumed under Alternative 6 was used for these off-peak scenarios. The off-peak hours considered for the analysis and the corresponding operational evaluation results table numbers are as follows:

- 9-10 AM, Table 3-23;
- 11 AM-Noon, Table 3-24;
- 1-2 PM, Table 3-25;
- 7-8 PM, Table 3-26;
- 11 PM-Midnight, Table 3-27.

The off-peak hours intersection operational analysis has shown very good operation for all the intersections with LOS “D” or better.

Table 3-24: Micro-simulation-based Intersection Evaluation Results – 10 AM off-peak hour conditions – Future 2031 with Alternative 6 Configuration

Intersection	Movement	Available/ *Modified* Storage Length (m)	9-10 AM						
			Simulated Volume	Intersection		Movement			
				Delay	LOS	Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and 10 Side Road (Signalized)	EBL	120	1	24	C	16	B	1	2
	EBT		1			24	C	1	4
	EBR		5			6	A	6	11
	WBL	80	201			34	C	54	61
	WBT		18			29	C	22	32
	WBR		75			12	B	22	32
	NBL		4			24	C	27	30
	NBT		101			26	C	27	31
	NBR	*80*	88			9	A	28	34
	SBL	*80*	143			26	C	28	40
	SBT		85			24	C	21	25
	SBR		4			9	A	21	25
Line 8 and Reagens Industrial Parkway (Stop-Controlled)	EBT		212	2	A	2	A	8	14
	EBR		22			3	A	8	14
	WBL	70	54			3	A	9	15
	WBT		279			1	A	5	10
	NBL		14			13	B	22	28
	NBR		31			10	A	22	28
Line 8 and Langford Boulevard (Signalized)	EBL	50	75	11	B	10	B	20	27
	EBT		158			10	A	31	42
	EBR	50	10			6	A	10	15

	WBL	100	39			9	A	8	10
	WBT		196			11	B	29	40
	WBR	70	29			5	A	7	13
	NBL	40	6			20	B	5	5
	NBT		8			18	B	6	7
	NBR		37			7	A	13	18
	SBL	50	43			23	C	15	18
	SBT		13			25	C	16	21
	SBR		129			9	A	25	29
Line 8 and Rogers Trail / Summerlyn Trail (Signalized)	EBL	50	24	12	B	14	B	12	14
	EBT		212			12	B	38	44
	EBR		2			14	B	38	44
	WBL	*70*	205			13	B	30	37
	WBT		214			9	A	27	35
	WBR	55	63			6	A	11	15
	NBL	20	6			30	C	5	7
	NBT		17			22	C	25	33
	NBR		166			9	A	26	35
	SBL	*50*	78			26	C	19	23
	SBT		15			24	C	12	18
	SBR		43			8	A	12	21
Line 8 and Professor Day Drive (Signalized)	EBL	*80*	6	12	B	15	B	5	5
	EBT		424			13	B	59	70
	EBR		30			10	A	59	70
	WBL	*80*	148			10	A	24	29
	WBT		411			5	A	34	42
	WBR		8			6	A	34	42
	NBL	140	63			35	C	19	20

	NBT		60			27	C	19	25
	NBR		46			6	A	16	21
	SBL	42	7			39	D	6	12
	SBT		46			28	C	7	8
	SBR	38	6			6	A	6	9
Line 8 and Taucar Gate (Stop Controlled)	EBT		477	1	A	1	A	3	12
	EBR		0			0	A	3	12
	WBT		566			1	A	3	7
	NBR		45			8	A	16	21
Line 8 and Noble Drive (Signalized)	EBL	70	26	16	B	11	B	8	13
	EBT		496			8	A	33	36
	EBR		0			6	A	33	36
	WBL		1			9	A	0	4
	WBT		473			25	C	87	101
	WBR	60	20			8	A	7	9
	NBL		42			20	B	13	17
	NBT		0			0	A	13	17
	NBR		7			6	A	13	17
	SBL	55	58			17	B	13	17
	SBT		0			12	B	5	10
	SBR		50			8	A	10	16
Line 8 and Northgate Drive (Signalized)	EBT		553	15	B	18	B	48	57
	EBR		9			15	B	48	57
	WBL	65	71			16	B	25	34
	WBT		465			12	B	59	66
	NBL		27			29	C	29	38
	NBR		209			12	B	29	38
	EBL	65	16	3	A	5	A	7	12

Line 8 and Lowes Gate (Stop-Controlled)	EBT		745			1	A	0	2
	WBT		501			2	A	18	31
	WBR		97			3	A	18	31
	SBL		146			16	C	24	27
	SBR		32			16	C	24	27
Line 8 and Barrie Street (Signalized)	EBL (dual)	*220**	427	33	C	49	D	54	66
	EBT		417			33	C	94	108
	EBR		62			31	C	94	108
	WBL	120	10			19	B	12	16
	WBT		199			29	C	51	65
	WBR		614			1	A	15	30
	NBL	50	41			21	C	10	11
	NBT		21			36	D	9	13
	NBR	110	27			6	A	7	13
	SBL (dual)	*152^*	382			40	D	48	53
	SBT		0			0	A	0	0
	SBR		358			11	B	41	52
Line 8 and Colborne Street (Signalized)	EBT		646	17	B	16	B	65	72
	EBR		183			18	B	65	72
	WBL	60	2			7	A	2	3
	WBT		568			11	B	50	58
	NBL		240			36	D	61	67
	NBR		4			18	B	60	67
Line 8 and Artesian Industrial Parkway (Signalized)	EBL	50	8	10	B	8	A	5	9
	EBT		643			7	A	35	48
	WBT		547			11	B	62	76
	WBR		247			12	B	62	76
	SBL		63			32	C	31	39

	SBR		20			19	B	31	39
10 Sideroad and Reagens Industrial Parkway (Signalized)	WBL	60	105	11	B	23	C	41	53
	WBR		12			10	B	15	22
	NBT		167			9	A	20	25
	NBR	50	79			4	A	16	20
	SBL	60	0			4	A	0	3
	SBT		292			9	A	21	23

Table 3-25: Micro-simulation-based Intersection Evaluation Results – Noon off-peak hour conditions – Future 2031 Alternative 6

Intersection	Movement	Available/ *Modified* Storage Length (m)	11 AM - Noon						
			Simulated Volume	Intersection		Movement			
				Delay	LOS	Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and 10 Side Road (Signalized)	EBL	120	1	23	C	20	C	0	3
	EBT		1			21	C	1	4
	EBR		3			6	A	5	11
	WBL	80	182			33	C	54	63
	WBT		18			25	C	18	24
	WBR		58			11	B	18	24
	NBL		5			29	C	25	29
	NBT		91			23	C	25	29
	NBR	*80*	92			8	A	28	43
	SBL	*80*	123			26	C	29	39
	SBT		64			22	C	17	18
	SBR		3			13	B	16	18

Line 8 and Reagens Industrial Parkway (Stop-Controlled)	EBT		191	2	A	2	A	13	17
	EBR		25			3	A	13	17
	WBL	70	46			3	A	7	12
	WBT		246			1	A	2	15
	NBL		11			12	B	20	22
	NBR		27			9	A	20	22
Line 8 and Langford Boulevard (Signalized)	EBL	50	66	11	B	10	B	18	24
	EBT		138			11	B	30	42
	EBR	50	13			5	A	9	17
	WBL	100	36			9	A	7	11
	WBT		170			11	B	28	45
	WBR	70	28			5	A	8	14
	NBL	40	6			26	C	5	5
	NBT		7			15	B	6	9
	NBR		36			7	A	10	15
	SBL	50	38			21	C	12	17
	SBT		10			20	B	20	25
	SBR		115			9	A	24	29
Line 8 and Rogers Trail / Summerlyn Trail (Signalized)	EBL	50	22	12	B	13	B	10	15
	EBT		188			12	B	39	49
	EBR		1			18	B	38	49
	WBL	*70*	174			12	B	27	32
	WBT		193			9	A	25	30
	WBR	55	51			5	A	9	14
	NBL	20	6			23	C	5	7
	NBT		13			20	B	22	34
	NBR		151			8	A	26	36
	SBL	*50*	82			24	C	18	21

	SBT		11			23	C	11	16
	SBR		34			8	A	13	17
Line 8 and Professor Day Drive (Signalized)	EBL	*80*	4	12	B	12	B	3	7
	EBT		389			12	B	53	62
	EBR		28			10	A	53	62
	WBL	*80*	131			9	A	22	30
	WBT		351			5	A	38	47
	WBR		9			9	A	38	47
	NBL	140	60			34	C	21	25
	NBT		51			26	C	20	26
	NBR		40			6	A	14	18
	SBL	42	7			29	C	6	7
	SBT		35			27	C	6	8
	SBR	38	6			7	A	5	7
Line 8 and Taucar Gate (Stop Controlled)	EBT		436	1	A	1	A	4	7
	EBR		1			1	A	4	7
	WBT		491			1	A	1	4
	NBR		46			8	A	17	22
Line 8 and Noble Drive (Signalized)	EBL	70	27	14	B	11	B	13	17
	EBT		454			8	A	32	41
	EBR		1			6	A	32	41
	WBL		0			7	A	0	3
	WBT		417			22	C	67	79
	WBR	60	16			8	A	6	9
	NBL		33			19	B	12	19
	NBT		1			9	A	12	19
	NBR		5			9	A	12	19
	SBL	55	50			20	B	13	18

	SBT		1			5	A	6	10
	SBR		43			7	A	11	18
Line 8 and Northgate Drive (Signalized)	EBT		494	15	B	18	B	44	50
	EBR		13			19	B	44	49
	WBL	65	70			14	B	27	35
	WBT		405			12	B	58	65
	NBL		26			31	C	30	41
	NBR		179			12	B	30	41
Line 8 and Lowes Gate (Stop-Controlled)	EBL	65	18	3	A	4	A	6	10
	EBT		656			1	A	0	0
	WBT		445			2	A	19	28
	WBR		85			3	A	19	28
	SBL		116			14	B	23	31
	SBR		28			12	B	23	31
Line 8 and Barrie Street (Signalized)	EBL (dual)	*220**	367	32	C	46	D	46	52
	EBT		356			33	C	84	96
	EBR		51			30	C	84	96
	WBL	120	8			24	C	11	15
	WBT		174			33	C	50	64
	WBR		537			1	A	10	16
	NBL	50	36			25	C	12	13
	NBT		18			38	D	8	9
	NBR	110	27			7	A	9	15
	SBL (dual)	*152^*	356			39	D	47	55
	SBT		0			0	A	0	0
	SBR		321			11	B	43	55
Line 8 and Colborne Street (Signalized)	EBT		586	17	B	15	B	63	80
	EBR		162			18	B	63	80

	WBL	60	2			11	B	3	5
	WBT		501			11	B	48	55
	NBL		208			36	D	56	65
	NBR		4			29	C	55	64
Line 8 and Artesian Industrial Parkway (Signalized)	EBL	50	8	10	A	9	A	6	10
	EBT		580			6	A	31	42
	WBT		485			11	B	55	59
	WBR		226			12	B	55	61
	SBL		62			31	C	22	28
	SBR		16			15	B	22	28
10 Sideroad and Reagens Industrial Parkway (Signalized)	WBL	60	99	11	B	23	C	38	51
	WBR		14			7	A	14	16
	NBT		161			9	A	19	25
	NBR	50	71			5	A	19	23
	SBL	60	1			10	A	2	6
	SBT		247			9	A	20	24

Table 3-26: Micro-simulation-based Intersection Evaluation Results – 2 PM off-peak hour conditions – Future 2031 with Alternative 6 Configuration

Intersection	Movement	Available/ *Modified* Storage Length (m)	1-2 PM						
			Simulated Volume	Intersection		Movement			
				Delay	LOS	Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and 10 Side Road (Signalized)	EBL	120	1	11	B	19	B	1	3
	EBT		6			16	B	6	8
	EBR		12			5	A	6	8

	WBL	80	77			15	B	30	38
	WBT		8			14	B	15	21
	WBR		130			7	A	17	24
	NBL		1			7	A	16	17
	NBT		71			20	C	16	17
	NBR	*80*	291			10	B	37	42
	SBL	*80*	100			11	B	20	22
	SBT		119			12	B	25	31
	SBR		2			4	A	25	31
Line 8 and Reagens Industrial Parkway (Stop-Controlled)	EBT		396	3	A	2	A	0	0
	EBR		3			3	A	0	0
	WBL	70	18			3	A	3	6
	WBT		207			1	A	0	0
	NBL		6			14	B	17	21
	NBR		70			10	B	17	21
Line 8 and Langford Boulevard (Signalized)	EBL	50	59	15	B	13	B	11	15
	EBT		336			16	B	48	56
	EBR	50	70			6	A	12	17
	WBL	100	47			19	B	13	16
	WBT		184			21	C	44	52
	WBR	70	69			7	A	13	16
	NBL	40	14			18	B	5	9
	NBT		1			16	B	2	4
	NBR		44			4	A	5	8
	SBL	50	49			19	B	12	15
	SBT		1			14	B	2	6
	SBR		28			6	A	6	8
	EBL	50	43	17	B	23	C	10	18

Line 8 and Rogers Trail / Summerlyn Trail (Signalized)	EBT		373			22	C	67	78
	EBR		12			21	C	67	78
	WBL	*70*	167			20	B	30	34
	WBT		257			15	B	49	55
	WBR	55	70			6	A	7	13
	NBL	20	8			16	B	6	6
	NBT		12			21	C	15	21
	NBR		116			7	A	17	22
	SBL	*50*	87			18	B	16	22
	SBT		15			21	C	10	13
	SBR		37			8	A	10	17
Line 8 and Professor Day Drive (Signalized)	EBL	*80*	21	5	A	11	B	8	9
	EBT		472			5	A	18	21
	EBR		86			6	A	18	21
	WBL	*80*	99			8	A	15	19
	WBT		438			4	A	31	47
	WBR		25			4	A	28	47
	NBL	140	49			3	A	6	7
	NBT		18			1	A	4	5
	NBR		80			2	A	6	7
	SBL	42	8			6	A	3	4
	SBT		16			1	A	0	2
	SBR	38	7			2	A	0	2
Line 8 and Taucar Gate (Stop Controlled)	EBT		557	1	A	1	A	0	0
	EBR		1			1	A	0	0
	WBT		566			1	A	0	0
	NBR		16			8	A	5	6
Line 8 and Noble Drive (Signalized)	EBL	70	48	15	B	22	C	12	14

	EBT		508			12	B	35	40
	EBR		17			10	A	35	40
	WBL		5			25	C	4	5
	WBT		507			18	B	66	71
	WBR	60	39			6	A	8	12
	NBL		6			16	B	5	5
	NBT		0			0	A	5	5
	NBR		6			4	A	5	5
	SBL	55	28			14	B	8	11
	SBT		0			0	A	4	8
	SBR		51			8	A	10	14
Line 8 and Northgate Drive (Signalized)	EBT		501	3	A	3	A	9	15
	EBR		39			4	A	6	14
	WBL	65	89			7	A	20	23
	WBT		535			2	A	25	36
	NBL		12			10	B	12	20
	NBR		71			3	A	14	21
Line 8 and Lowes Gate (Stop-Controlled)	EBL	65	62	2	A	6	A	14	19
	EBT		510			1	A	4	10
	WBT		572			2	A	0	1
	WBR		66			3	A	0	0
	SBL		47			14	B	16	20
	SBR		51			12	B	16	20
Line 8 and Barrie Street (Signalized)	EBL (dual)	*220**	245	30	C	27	C	31	37
	EBT		286			37	D	74	85
	EBR		29			30	C	74	85
	WBL	120	16			24	C	8	10
	WBT		275			26	C	43	56

	WBR		605			1	A	3	5
	NBL	50	41			24	C	12	14
	NBT		0			0	A	0	0
	NBR	110	22			5	A	5	6
	SBL (dual)	*152^*	424			48	D	61	68
	SBT		56			26	C	17	21
	SBR		322			9	A	42	51
Line 8 and Colborne Street (Signalized)	EBT		524	18	B	21	C	79	88
	EBR		161			22	C	79	88
	WBL	60	0			2	A	0	1
	WBT		727			14	B	51	54
	NBL		174			29	C	51	65
	NBR		3			26	C	51	65
Line 8 and Artesian Industrial Parkway (Signalized)	EBL	50	33	17	B	19	B	23	28
	EBT		493			14	B	50	59
	WBT		694			18	B	43	50
	WBR		81			17	B	43	50
	SBL		129			25	C	29	39
	SBR		33			17	B	29	39
10 Sideroad and Reagens Industrial Parkway (Signalized)	WBL	60	81	13	B	17	B	20	24
	WBR		60			6	A	11	18
	NBT		302			14	B	23	30
	NBR	50	59			5	A	18	21
	SBL	60	6			18	B	6	6
	SBT		203			15	B	23	26

Table 3-27: Micro-simulation-based Intersection Evaluation Results – 8 PM off-peak hour conditions – Future 2031 with Alternative 6 Configuration

Intersection	Movement	Available/ *Modified* Storage Length (m)	7-8 PM						
			Simulated Volume	Intersection		Movement			
				Delay	LOS	Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and 10 Side Road (Signalized)	EBL	120	1	12	B	16	B	2	3
	EBT		5			14	B	5	6
	EBR		7			5	A	5	6
	WBL	80	75			18	B	26	36
	WBT		8			14	B	13	22
	WBR		119			7	A	19	25
	NBL		1			15	B	17	24
	NBT		64			20	B	17	24
	NBR	*80*	270			10	B	38	46
	SBL	*80*	102			13	B	24	32
	SBT		121			12	B	23	32
	SBR		3			10	A	23	32
Line 8 and Reagens Industrial Parkway (Stop-Controlled)	EBT		375	3	A	2	A	0	3
	EBR		5			3	A	0	3
	WBL	70	15			4	A	5	10
	WBT		195			1	A	0	0
	NBL		7			11	B	13	20
	NBR		65			10	A	13	20
Line 8 and Langford Boulevard (Signalized)	EBL	50	51	15	B	15	B	11	15
	EBT		323			17	B	58	67
	EBR	50	65			6	A	11	15

	WBL	100	44			17	B	11	16
	WBT		169			20	B	40	58
	WBR	70	73			7	A	13	16
	NBL	40	12			22	C	5	7
	NBT		1			10	A	3	4
	NBR		36			4	A	6	9
	SBL	50	52			17	B	12	15
	SBT		1			15	B	1	7
	SBR		28			5	A	7	14
Line 8 and Rogers Trail / Summerlyn Trail (Signalized)	EBL	50	43	18	B	24	C	13	17
	EBT		361			23	C	65	84
	EBR		13			20	B	65	84
	WBL	*70*	152			19	B	26	30
	WBT		244			15	B	44	56
	WBR	55	70			7	A	10	15
	NBL	20	10			25	C	5	6
	NBT		8			23	C	10	16
	NBR		103			7	A	14	18
	SBL	*50*	84			19	B	17	21
	SBT		11			18	B	6	9
	SBR		30			6	A	8	13
Line 8 and Professor Day Drive (Signalized)	EBL	*80*	22	4	A	11	B	7	11
	EBT		451			5	A	16	24
	EBR		80			6	A	16	24
	WBL	*80*	90			8	A	14	22
	WBT		413			3	A	26	35
	WBR		25			4	A	24	29
	NBL	140	47			4	A	6	10

	NBT		18			1	A	1	3
	NBR		87			2	A	6	7
	SBL	42	4			8	A	3	6
	SBT		15			1	A	0	1
	SBR	38	4			2	A	0	2
Line 8 and Taucar Gate (Stop Controlled)	EBT		542	1	A	1	A	0	1
	EBR		2			2	A	0	1
	WBT		533			1	A	0	0
	NBR		11			9	A	5	5
Line 8 and Noble Drive (Signalized)	EBL	70	46	15	B	22	C	13	19
	EBT		490			13	B	36	43
	EBR		22			10	A	36	43
	WBL		6			22	C	5	5
	WBT		476			18	B	64	76
	WBR	60	36			5	A	7	15
	NBL		6			11	B	3	6
	NBT		0			0	A	3	6
	NBR		4			4	A	3	6
	SBL	55	29			13	B	9	12
	SBT		0			0	A	5	6
	SBR		52			7	A	10	13
Line 8 and Northgate Drive (Signalized)	EBT		485	3	A	3	A	9	14
	EBR		37			4	A	9	13
	WBL	65	81			6	A	20	27
	WBT		495			2	A	20	29
	NBL		8			5	A	5	11
	NBR		60			2	A	6	16
	EBL	65	62	2	A	6	A	10	15

Line 8 and Lowes Gate (Stop-Controlled)	EBT		483			0	A	1	6
	WBT		527			2	A	0	0
	WBR		76			3	A	0	0
	SBL		43			14	B	17	22
	SBR		47			12	B	17	22
Line 8 and Barrie Street (Signalized)	EBL (dual)	*220**	222	30	C	27	C	24	34
	EBT		282			35	D	65	84
	EBR		32			27	C	65	83
	WBL	120	16			27	C	10	10
	WBT		275			25	C	45	53
	WBR		581			1	A	2	7
	NBL	50	39			19	B	11	14
	NBT		0			0	A	0	0
	NBR	110	21			5	A	5	7
	SBL (dual)	*152^*	404			50	D	63	69
	SBT		54			23	C	15	19
	SBR		291			9	A	37	52
Line 8 and Colborne Street (Signalized)	EBT		520	18	B	20	C	71	77
	EBR		143			21	C	71	77
	WBL	60	0			4	A	1	1
	WBT		704			14	B	48	51
	NBL		165			26	C	41	47
	NBR		4			15	B	41	47
Line 8 and Artesian Industrial Parkway (Signalized)	EBL	50	33	16	B	18	B	26	33
	EBT		498			13	B	53	60
	WBT		671			17	B	42	44
	WBR		67			17	B	42	44
	SBL		108			23	C	24	32

	SBR		27			12	B	24	32
10 Sideroad and Reagens Industrial Parkway (Signalized)	WBL	60	70	13	B	19	B	20	22
	WBR		50			6	A	8	15
	NBT		278			14	B	23	27
	NBR	50	48			4	A	16	19
	SBL	60	7			21	C	5	6
	SBT		194			13	B	18	23

Table 3-28: Micro-simulation-based Intersection Evaluation Results – Midnight off-peak hour conditions – Future 2031 with Alternative 6 Configuration

Intersection	Movement	Available/ *Modified* Storage Length (m)	11 PM-Midnight						
			Simulated Volume	Intersection		Movement			
				Delay	LOS	Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and 10 Side Road (Signalized)	EBL	120	1	11	B	5	A	1	1
	EBT		1			10	A	3	6
	EBR		1			3	A	3	6
	WBL	80	27			17	B	22	27
	WBT		2			8	A	2	6
	WBR		29			5	A	11	16
	NBL		0			8	A	9	13
	NBT		16			19	B	9	13
	NBR	*80*	72			7	A	23	26
	SBL	*80*	30			13	B	17	18
	SBT		32			13	B	14	21
	SBR		1			3	A	14	21

Line 8 and Reagens Industrial Parkway (Stop-Controlled)	EBT		99	2	A	2	A	0	0
	EBR		6			4	A	0	0
	WBL	70	3			1	A	0	1
	WBT		55			1	A	0	0
	NBL		2			9	A	12	15
	NBR		17			8	A	12	15
Line 8 and Langford Boulevard (Signalized)	EBL	50	13	11	B	12	B	6	8
	EBT		87			13	B	24	32
	EBR	50	17			4	A	7	10
	WBL	100	11			13	B	6	9
	WBT		49			13	B	19	32
	WBR	70	22			4	A	5	6
	NBL	40	2			0	A	0	1
	NBT		0			8	A	0	2
	NBR		14			4	A	5	6
	SBL	50	10			18	B	6	12
	SBT		1			3	A	1	1
	SBR		7			5	A	6	12
Line 8 and Rogers Trail / Summerlyn Trail (Signalized)	EBL	50	8	11	B	16	B	5	8
	EBT		97			14	B	32	39
	EBR		4			6	A	32	39
	WBL	*70*	36			10	B	12	15
	WBT		71			11	B	19	35
	WBR	55	15			5	A	6	10
	NBL	20	2			19	B	2	4
	NBT		2			17	B	1	5
	NBR		27			4	A	8	12
	SBL	*50*	19			16	B	8	10

	SBT		4			9	A	2	5
	SBR		9			4	A	5	9
Line 8 and Professor Day Drive (Signalized)	EBL	*80*	5	3	A	6	A	2	5
	EBT		117			3	A	8	15
	EBR		22			4	A	6	13
	WBL	*80*	25			3	A	6	6
	WBT		110			2	A	12	22
	WBR		6			3	A	8	15
	NBL	140	12			1	A	1	4
	NBT		5			0	A	0	1
	NBR		16			1	A	2	4
	SBL	42	1			2	A	1	2
	SBT		4			0	A	0	1
	SBR	38	1			1	A	0	0
Line 8 and Taucar Gate (Stop Controlled)	EBT		133	0	A	0	A	0	1
	EBR		1			1	A	0	1
	WBT		141			0	A	0	0
	NBR		2			6	A	2	5
Line 8 and Noble Drive (Signalized)	EBL	70	10	13	B	18	B	7	10
	EBT		121			12	B	22	29
	EBR		5			8	A	22	29
	WBL		3			17	B	3	4
	WBT		126			15	B	36	44
	WBR	60	12			4	A	5	6
	NBL		3			8	A	3	3
	NBT		0			0	A	3	3
	NBR		2			3	A	3	3
	SBL	55	8			19	B	6	7

	SBT		0			0	A	0	0
	SBR		12			5	A	6	10
Line 8 and Northgate Drive (Signalized)	EBT		127	2	A	2	A	4	7
	EBR		6			3	A	1	3
	WBL	65	29			4	A	15	23
	WBT		139			2	A	10	19
	NBL		2			3	A	1	8
	NBR		21			2	A	5	13
Line 8 and Lowes Gate (Stop-Controlled)	EBL	65	15	1	A	2	A	3	5
	EBT		132			0	A	0	5
	WBT		154			1	A	0	0
	WBR		15			2	A	0	0
	SBL		10			8	A	7	11
	SBR		14			7	A	7	11
Line 8 and Barrie Street (Signalized)	EBL (dual)	*220**	63	28	C	23	C	15	18
	EBT		70			31	C	34	42
	EBR		8			18	B	34	41
	WBL	120	6			25	C	6	7
	WBT		65			31	C	20	24
	WBR		145			0	A	0	2
	NBL	50	9			27	C	5	7
	NBT		0			0	A	0	0
	NBR	110	6			5	A	5	6
	SBL (dual)	*152^*	127			48	D	37	44
	SBT		12			27	C	5	8
	SBR		94			6	A	24	35
Line 8 and Colborne Street (Signalized)	EBT		153	15	B	18	B	34	44
	EBR		41			12	B	34	44

	WBL	60	0			0	A	0	0
	WBT		168			10	A	15	18
	NBL		48			23	C	26	31
	NBR		1			6	A	26	31
Line 8 and Artesian Industrial Parkway (Signalized)	EBL	50	14	14	B	13	B	12	13
	EBT		140			12	B	27	35
	WBT		158			15	B	19	23
	WBR		17			9	A	19	23
	SBL		30			24	C	15	16
	SBR		9			8	A	15	16
10 Sideroad and Reagens Industrial Parkway (Signalized)	WBL	60	20	12	B	17	B	14	20
	WBR		13			5	A	6	11
	NBT		74			13	B	18	21
	NBR	50	20			5	A	15	18
	SBL	60	1			6	A	1	2
	SBT		59			12	B	12	17

3.9 PROPOSED ALTERNATIVE - ALTERATIVE 4 REVISED WITH NORMALISED WESTBOUNT RIGHT AT LINE 8 AND BARRIE STREET INTERSECTION

Among the alternative scenarios considered (Alternative 1-8), Alternative 4 was considered as the Preferred Alternative which is expected to provide better/manageable traffic operations for the study area intersections along Line 8 and 10 Sideroad under the future 2031 conditions. An additional modification is proposed for the intersection of Line 8 at Barrie Street. In all the alternatives, the westbound right turn lane at Barrie Street intersection is provided with a channelization island as in existing condition. It is proposed to reconfigure this intersection by removing the channelization. The reconfiguration involves removal of the channelization island and integrating the turn into the intersection. This would allow the channelization island to be removed to accommodate the second northbound receiving lane for the proposed eastbound to northbound dual left-turn lanes.

The simulation result with the revised configuration is expected to result long queue lengths for the westbound right-turn movement especially for the PM peak hour conditions due to high right-turn volume (~1110 veh/h). However, by providing a protected overlap phase for the WB right-turn along with the protected SB left-turn movement, the operation would be greatly improved, and the queue and LOS would be under manageable conditions. The proposed alternative will include the following major modification at Line 8 and Barrie Street intersection:

- **Removal of the channelized right-turn lane by bringing it to the intersection and providing a protected WB right-turn turn phase as an overlap phase with protected SB left-turn phase.**

The 2031 Proposed Alternative (Revised Alternative 4 Scenario) considered the following improvements compared to the existing conditions:

- An additional eastbound lane from Professor Day Drive to Barrie Street with the additional lane becomes the second left-turn lane at Barrie Street intersection.
- An additional westbound lane from Barrie Street to Noble Drive.
- At Line 8 & Barrie Street intersection:
    - Increased eastbound left-turn (EBL) Lane storage length to 150 m.
    - Additional eastbound right-turn lane (70 m).
    - Additional eastbound left-turn lane (added eastbound through lane from west converted) with eastbound approach configuration as 2EBL+1EBT+1EBR.

    - Removal of westbound (WB) right-turn channelization island (normalization): integrating westbound right-turn (WBR) lane into the intersection
    - NB direction north of Line 8: the existing lane from the channelization will accommodate the second northbound receiving lane to accept traffic from dual EBL, reduced to single lane at north end (as in existing).
    - Revised signal plan used with the provision of protected overlap phase for the WB right-turn (due to high WBR volume) along with the protected southbound left-turn movement.

- Intersection controls:
    - Signal Control at Line 8 & Professor Day Drive (kept same lane configuration as in Existing for north and south approaches)
    - Signal control at Line 8 & Northgate Drive instead of existing Stop-control.
    - For the above intersections, N-S direction signal pedestrian WALK and flashing DON'T WALK will be activated only upon pedestrian activation.
- At Line 8 & Professor Day Drive intersection:
    - Intersection signalised (fully actuated, pedestrians crossing considered).
    - Storage lanes added for EB left-turn and WB left-turn.
    - Added protected WB left-turn phase (due to high WBL volume, a protected phase is warranted).
    - Control was provided such that the N-S direction signal pedestrian WALK and flashing DON'T WALK will be activated only upon pedestrian activation.
- At Line 8 & Northgate Drive intersection:
    - Intersection signalised (semi-actuated, pedestrians crossing considered)
    - Added protected WB left-turn phase (due to high WBL volume, a protected phase is warranted)
    - Control was provided such that the N-S direction signal pedestrian WALK and flashing DON'T WALK will be activated only upon pedestrian activation.
- At Line 8 and 10 Sideroad intersection:
    - Added northbound right-turn (NBR) and southbound left-turn (SBL) lanes of 80 m each
    - Increased the storage length to 60 metres for the westbound left-turn (WBL) lane.
- At Line 8 and Rogers Trail/Summerlyn Trail intersection:
    - Increased westbound left-turn (WBL) and southbound left-turn (SBL) storage lengths to 70 m and 50 m respectively.
- Pedestrian Crossing facilities:
    - Pedestrian crossing facilities included at all signalised intersections.

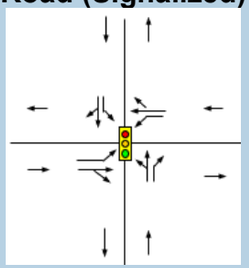
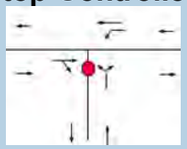
- Assumed 20 pedestrians/h crossing at all the crossing (under existing condition it is 0-5 ped/h)

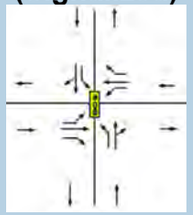
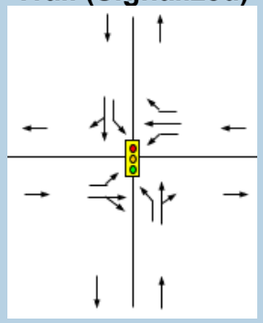
3.9.1 INTERSECTION OPERATIONAL ANALYSIS

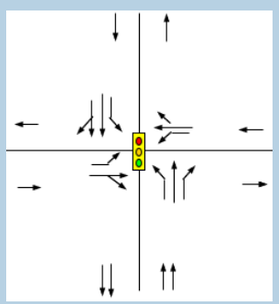
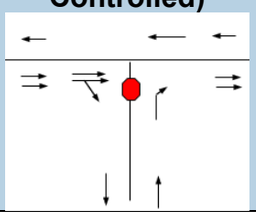
The summary of Proposed Alternative (2031) intersection operations during the peak hours are provided in Table 3-29. The operational performance evaluation from the Table 3-29 indicates the following:

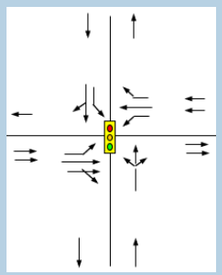
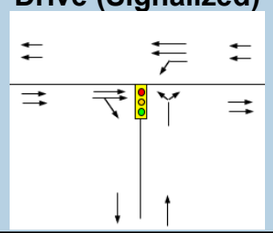
- The revised Alternative 4 Scenario is expected to provide good operation for all the intersections within the study area. The study area intersections are expected to operate with an overall LOS “C” or better except for the intersection of Line 8 and Barrie Street with LOS “D”.
- All the individual turning movements for both AM and PM peak periods under the revised 2031 Alternative 4 conditions are expected to operate with LOS “D” or better except for eastbound left-turn and southbound left-turn movements at the Barrie Street intersection with LOS “E”. The LOS “E” for left-turn movements for future condition is generally considered acceptable and the queue lengths do not exceed the available storage lengths at both these turns.
- None of the queue lengths reach upstream intersections for both AM and PM peak hour conditions. With the normalization of WBR lane at the Barrie Street intersection, the WBR lane queue length is expected to be 250 meters (maximum) which would reach beyond the upstream stop-controlled intersection at Turner Court. However, it would not reach the upstream signalized intersection of Colborne Street.
- The queue lengths on all the left-turn and right-turn lanes are expected to be within the storage length assumed except for a marginally higher maximum queue length (65 m) for the westbound left-turn (WBL) at the intersection of 10 Sideroad and Reagens Industrial Parkway.

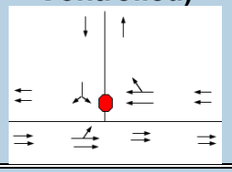
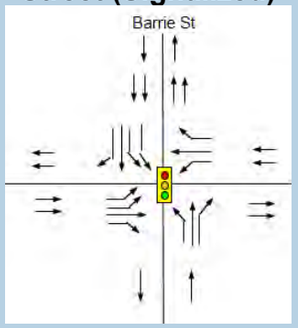
Table 3-29: Micro-simulation-based Intersection Evaluation Results – Peak hour conditions – 2031 Proposed Alternative (Revised Alternative 4)

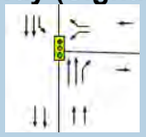
Intersection	Movement	Available/ *Modified* Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and 10 Side Road (Signalized) 	EBL	120	1	5	A	1	2	7	30	C	6	6
	EBT		2	21	C	5	7	8	25	C	7	11
	EBR		6	6	A	5	11	15	6	A	7	11
	WBL	80	251	35	D	58	65	127	23	C	34	41
	WBT		23	28	C	25	31	15	21	C	27	34
	WBR		85	13	B	25	31	225	12	B	27	34
	NBL		4	19	B	33	40	1	17	B	29	36
	NBT		129	26	C	33	40	135	25	C	29	36
	NBR	*80*	126	9	A	28	31	508	16	B	68	77
	SBL	*80*	172	29	C	40	48	190	32	C	44	48
	SBT		101	24	C	28	30	217	25	C	43	49
	SBR		5	11	B	28	30	5	24	C	43	49
	Intersection Overall			25	C				21	C		
Line 8 and Reagens Industrial Parkway (Stop-Controlled) 	EBT		269	2	A	10	15	700	3	A	11	14
	EBR		32	3	A	10	15	5	4	A	11	14
	WBL	70	61	3	A	9	14	32	6	A	10	16
	WBT		347	1	A	2	9	356	1	A	0	0
	NBL		13	15	C	21	27	14	17	C	23	30
	NBR		38	10	B	21	27	131	14	B	23	30
	Intersection Overall			2	A				4	A		
	EBL	50	88	13	B	23	30	103	14	B	16	20

Intersection	Movement	Available/ *Modified* Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and Langford Boulevard (Signalized) 	EBT		201	13	B	38	58	599	16	B	75	88
	EBR	50	18	6	A	10	13	124	7	A	15	23
	WBL	100	48	11	B	12	16	89	16	B	17	20
	WBT		236	12	B	36	50	307	14	B	46	60
	WBR	70	38	5	A	8	14	141	6	A	13	19
	NBL	40	10	25	C	6	7	21	22	C	10	11
	NBT		13	19	B	11	16	2	20	C	6	9
	NBR		55	7	A	15	21	88	5	A	10	11
	SBL	50	58	21	C	14	18	106	24	C	22	26
	SBT		16	24	C	25	29	1	23	C	5	8
	SBR		162	10	B	27	29	60	8	A	10	13
	Intersection Overall			12	B				14	B		
Line 8 and Rogers Trail / Summerlyn Trail (Signalized) 	EBL	50	33	16	B	13	17	77	24	C	17	20
	EBT		277	15	B	46	53	692	22	C	86	107
	EBR		2	10	B	46	53	20	18	B	86	107
	WBL	*70*	249	17	B	39	45	304	32	C	47	53
	WBT		261	11	B	36	47	452	15	B	57	66
	WBR	55	76	6	A	11	14	139	8	A	14	19
	NBL	20	7	19	B	5	7	19	26	C	7	10
	NBT		20	22	C	28	33	19	24	C	26	38
	NBR		211	9	A	28	36	206	15	B	29	38
	SBL	*50*	98	26	C	23	27	166	29	C	30	36
	SBT		17	19	B	17	21	25	22	C	15	20

Intersection	Movement	Available/ *Modified* Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
	SBR		56	8	A	17	21	65	12	B	15	20
	Intersection Overall			14	B				21	C		
Line 8 and Professor Day Drive (Signalized) 	EBL	*80*	7	22	C	5	11	37	30	C	11	14
	EBT		541	14	B	67	80	855	21	C	100	118
	EBR		33	13	B	67	80	171	21	C	100	118
	WBL	*80*	197	13	B	32	42	193	23	C	31	33
	WBT		507	6	A	48	65	790	8	A	61	72
	WBR		9	7	A	48	65	41	9	A	61	72
	NBL	140	75	37	D	21	28	96	35	D	22	29
	NBT		69	28	C	21	27	38	25	C	12	16
	NBR		57	6	A	16	20	159	6	A	15	17
	SBL	42	9	29	C	5	6	12	34	C	8	11
	SBT		59	32	C	9	11	35	26	C	6	8
	SBR	38	8	10	A	8	11	11	6	A	5	7
	Intersection Overall			13	B				16	B		
Line 8 and Taucar Gate (Stop Controlled) 	EBT		607	1	A	4	8	1021	1	A	0	2
	EBR		0	1	A	4	8	4	2	A	0	2
	WBT		717	1	A	4	9	1021	1	A	0	2
	NBR		57	10	B	18	25	28	11	B	7	7
	Intersection Overall			1	A				1	A		

Intersection	Movement	Available/ *Modified* Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and Noble Drive (Signalized) 	EBL	70	28	17	B	11	16	98	33	C	26	29
	EBT		638	9	A	41	47	910	9	A	39	46
	EBR		0	3	A	41	47	39	8	A	39	46
	WBL		1	16	B	4	11	13	26	C	18	32
	WBT		606	15	B	85	97	915	24	C	106	120
	WBR	60	23	9	A	7	10	79	17	B	15	24
	NBL		45	20	B	13	18	13	18	B	9	12
	NBT		0	0	A	13	18	0	0	A	9	12
	NBR		9	12	B	13	18	13	5	A	9	12
	SBL	55	75	19	B	17	24	53	20	C	14	21
	SBT		0	10	A	8	15	0	0	A	10	11
	SBR		66	9	A	13	19	93	13	B	15	17
	Intersection Overall			12	B				17	B		
Line 8 and Northgate Drive (Signalized) 	EBT		699	18	B	54	64	907	21	C	61	70
	EBR		18	17	B	54	64	67	21	C	61	70
	WBL	65	97	18	B	28	41	152	21	C	39	44
	WBT		589	10	B	33	39	994	12	B	53	62
	NBL		41	29	C	40	48	20	30	C	26	28
	NBR		251	15	B	40	48	122	9	A	26	30
	Intersection Overall			15	B				16	B		
	EBL		25	6	A	17	22	113	15	B	37	43
	EBT		926	1	A	17	22	915	2	A	37	43

Intersection	Movement	Available/ *Modified* Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and Lowes Gate (Stop-Controlled) 	WBT		639	1	A	7	13	1048	1	A	11	21
	WBR		128	3	A	7	13	127	3	A	11	21
	SBL		183	20	C	31	36	86	28	D	29	34
	SBR		48	17	C	31	36	95	20	C	29	34
	Intersection Overall			3	A				4	A		
Line 8 and Barrie Street (Signalized) 	EBL (dual)	*Ln1 = 150, Ln2=290*	524	59	E	73	79	427	68	E	68	76
	EBT		507	33	C	87	100	517	46	D	119	135
	EBR		74	10	B	25	31	59	15	B	10	15
	WBL	120	13	28	C	12	16	33	34	C	10	19
	WBT		261	35	C	81	106	524	46	D	195	226
	WBR		767	16	B	132	163	1113	32	C	224	250
	NBL	50	53	23	C	16	19	77	28	C	17	21
	NBT		27	43	D	11	14	0	0	A	0	0
	NBR	110	35	7	A	7	8	44	7	A	6	10
	SBL (dual)	Ln1 = 120, Ln 2 = 190	492	41	D	55	58	725	72	E	110	132
	SBT		0	0	A	0	0	101	50	D	29	39
	SBR		455	15	B	50	66	569	28	C	90	110
	Intersection Overall			31	C				45	D		
	EBT		797	18	B	78	89	921	21	C	89	99

Intersection	Movement	Available/ *Modified* Storage Length (m)	AM Peak Hour					PM Peak Hour				
			Simulated Volume	Movement				Simulated Volume	Movement			
				Delay	LOS	95th Queue (m)	Max Queue (m)		Delay	LOS	95th Queue (m)	Max Queue (m)
Line 8 and Colborne Street (Signalized) 	EBR		237	21	C	78	89	288	23	C	89	99
	WBL	60	4	14	B	3	7	1	16	B	2	3
	WBT		717	12	B	66	74	1349	16	B	81	89
	NBL		312	39	D	67	74	331	44	D	77	93
	NBR		7	44	D	67	74	11	36	D	77	93
	Intersection Overall			20	B				21	C		
Line 8 and Artesian Industrial Parkway (Signalized) 	EBL	50	8	13	B	8	11	62	25	C	27	32
	EBT		795	7	A	44	54	866	11	B	63	72
	WBT		703	12	B	67	82	1291	17	B	69	79
	WBR		291	14	B	67	82	146	19	B	69	79
	SBL		90	34	C	33	45	236	35	D	55	61
	SBR		19	18	B	33	45	58	27	C	55	61
	Intersection Overall			11	B				17	B		
10 Sideroad and Reagens Industrial Parkway (Signalized) 	WBL	60	129	23	C	56	64	138	21	C	32	39
	WBR		18	9	A	17	19	109	10	A	17	22
	NBT		226	10	A	20	25	526	10	A	25	32
	NBR	50	104	5	A	16	21	95	6	A	19	23
	SBL	60	1	12	B	3	12	12	18	B	7	11
	SBT		353	9	A	23	29	345	9	A	21	24
	Intersection Overall			11	B				11	B		

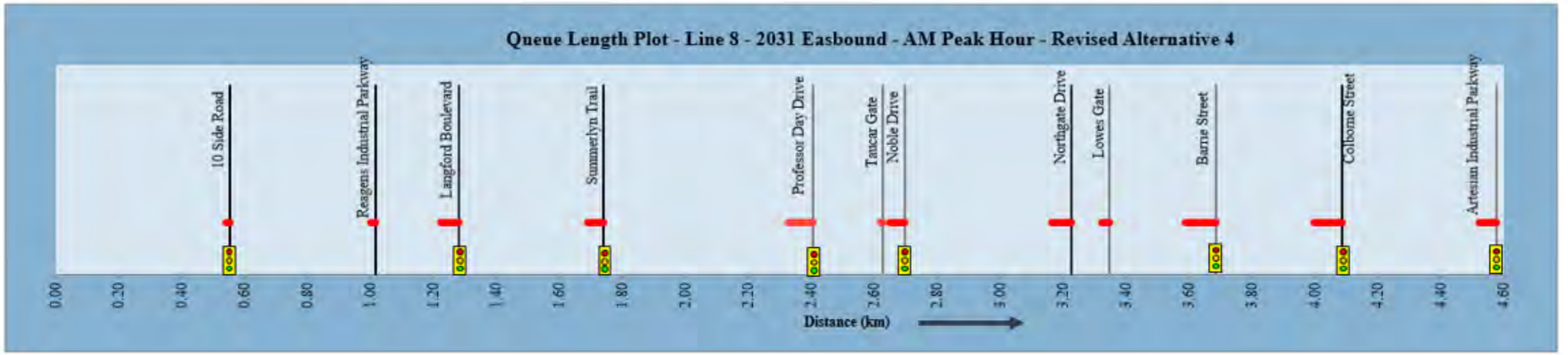
3.9.2 MAXIMUM QUEUE LENGTHS – PROPOSED ALTERNATIVE

The revised (2031) Alternative 4 conditions queue plots for the Line 8 intersections during the morning peak and afternoon peak hours in both the eastbound and westbound directions are presented in Figure 3-38 and Figure 3-39, respectively.

It may be shown that none of the eastbound and westbound queue lengths would reach the upstream intersections during both the AM and PM peak hours. As mentioned previously, with the normalization of WBR turn at the Barrie Street intersection, the queue length for this turn is expected to surpass the upstream stop-controlled intersection of Turner Court; however, it is not expected to reach the Colborne Street intersection and this queueing will be on the rightmost lane. The left-turners from Turner Court would be able to turn into the other two lanes when they get a gap from through traffic.

Even though, the intersection of Noble Drive is located close by to the Taucar Drive intersection, the eastbound direction queue is not expected to block Noble Drive intersection. Similarly, the westbound direction queue from Northgate Drive is not expected to reach the nearby intersection at Lowes Gate. This has been achieved because of the additional through lanes in the eastbound and westbound directions assumed under the proposed alternative.

Figure 3-38: Plot of Maximum Queue Lengths – Morning Peak Hour Eastbound and Westbound – 2031 Revised Alternative 4



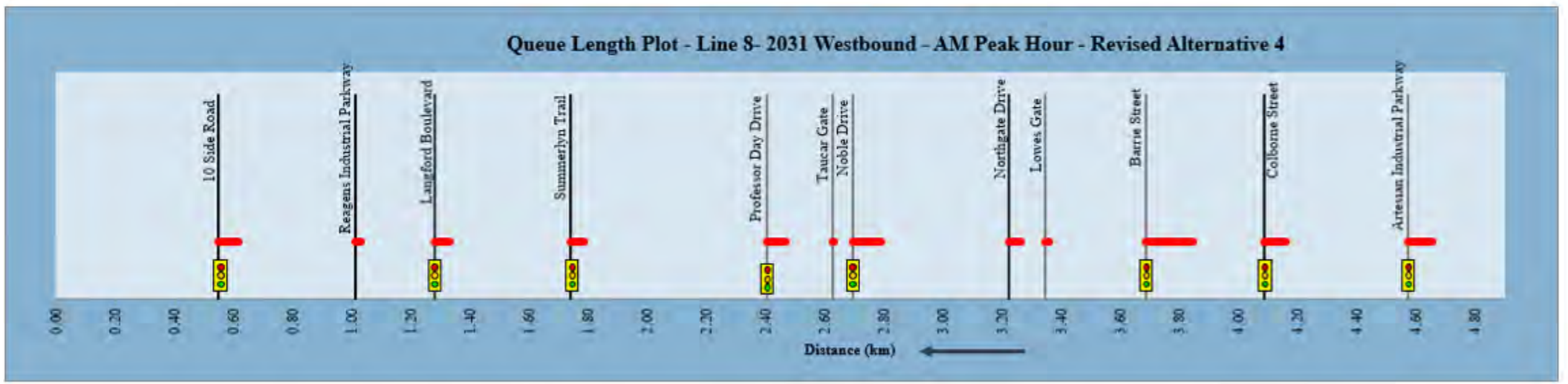
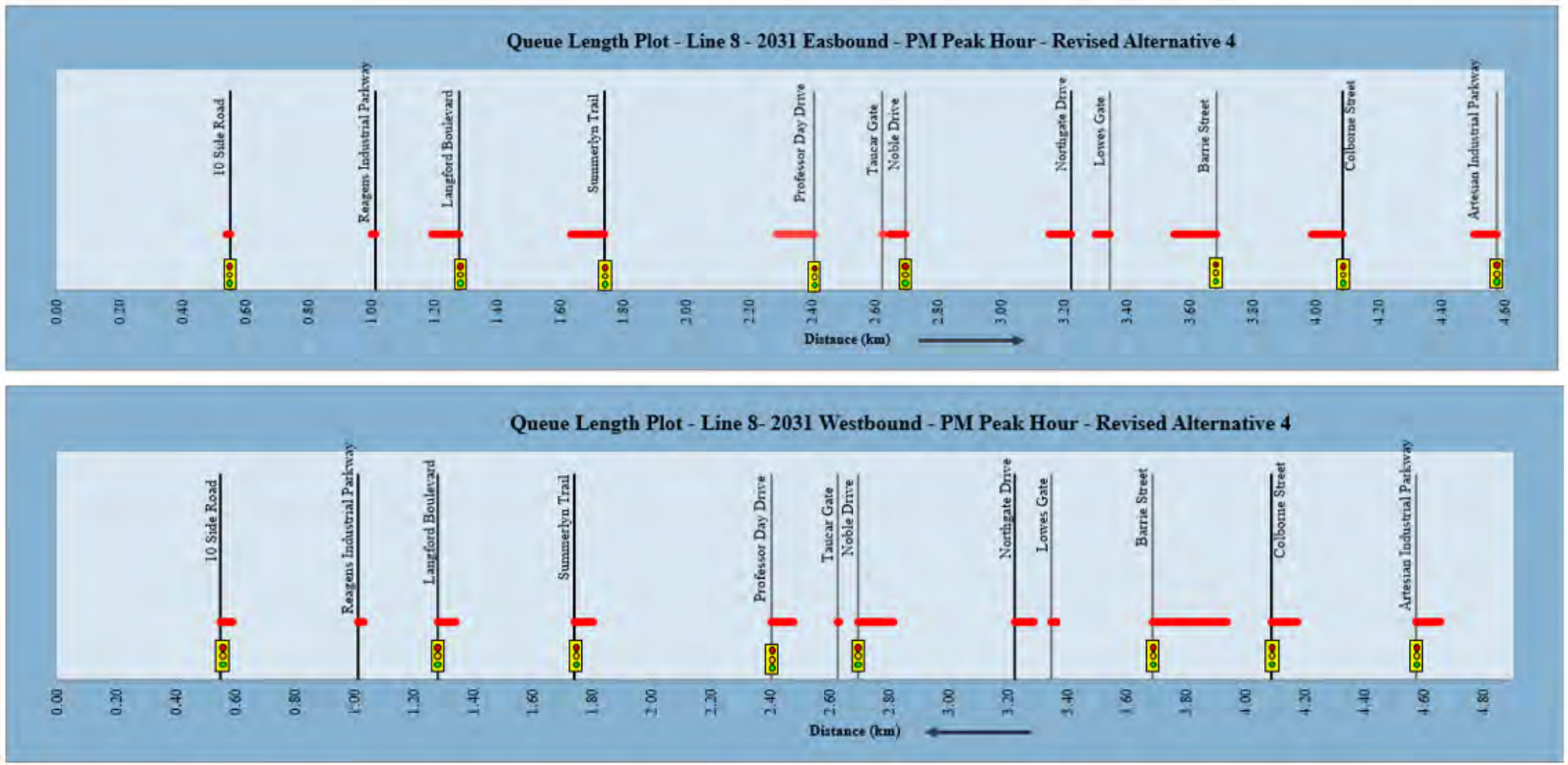


Figure 3-39: Plot of Maximum Queue Lengths – Afternoon Peak Hour Eastbound and Westbound – 2031 Revised Alternative 4



3.9.3 SPEED CONTOUR PLOTS – PROPOSED ALTERNATIVE

The morning and afternoon peak hour revised (2031) Alternative 4 conditions Line 8 speed contour plots in both the eastbound and westbound directions are presented in Figure 3-40 and Figure 3-41, respectively. The speed contour plots indicate good operation with average speed close to 50 km/h on Line 8 corridor in the eastbound and westbound directions during both the AM and PM peak hours. In the proximity of the signalized intersections, the average speed is expected to be around 35 km/h except at Barrie Street for the westbound direction during PM peak hour

At the signalized intersection of Barrie Street, marginal decrease of speed to 20-30 km/h is expected for the westbound direction during the PM peak hour conditions.

Figure 3-40: Speed Contour Plot for Line 8 – Morning Peak Hour Eastbound and Westbound – 2031 Revised Alternative 4

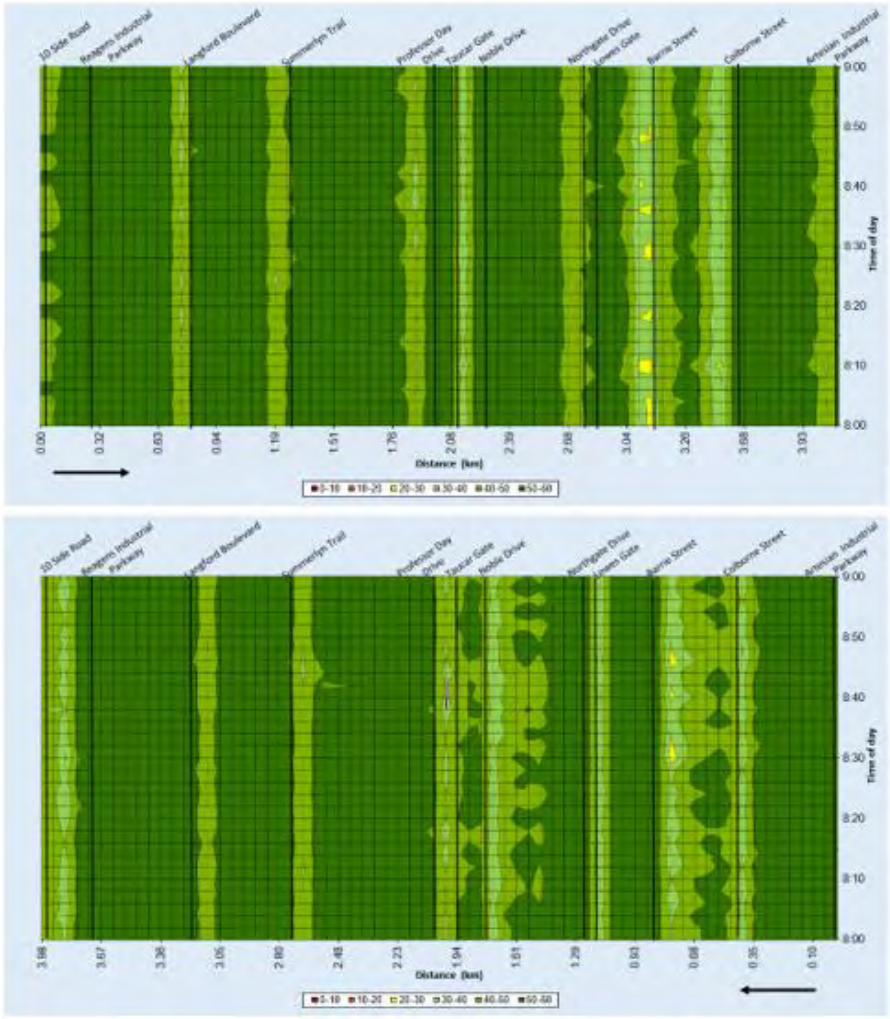
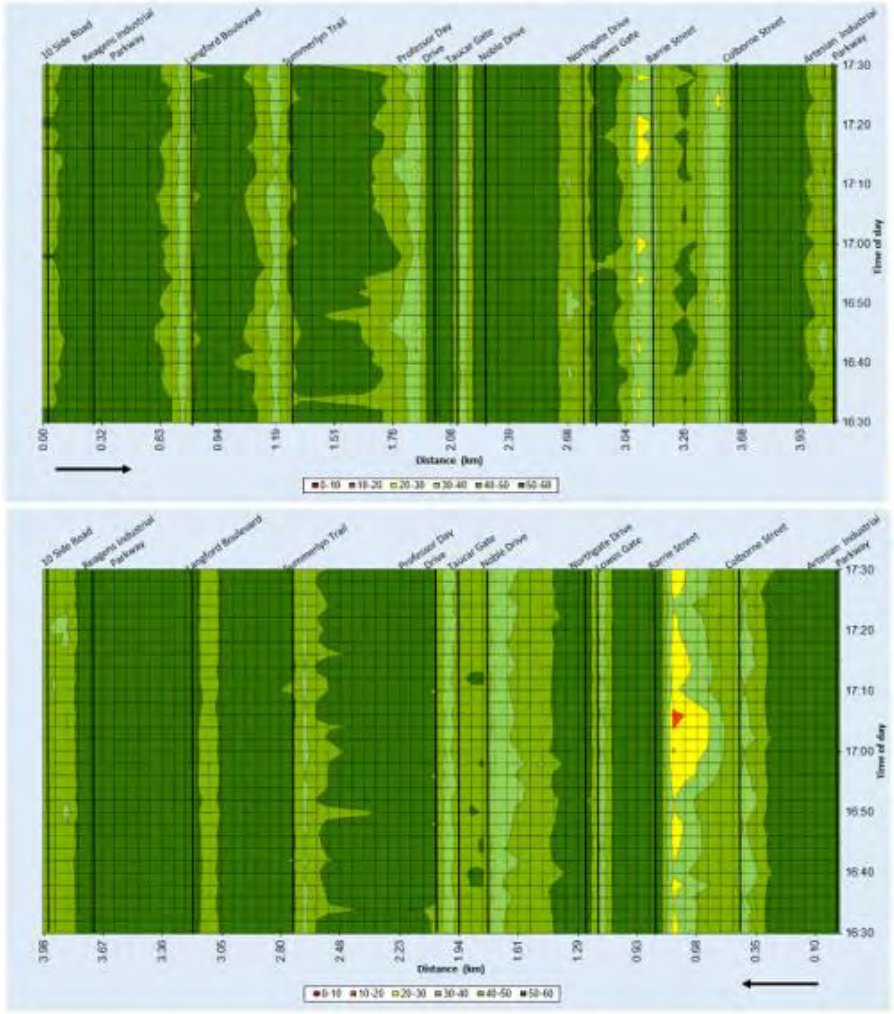


Figure 3-41: Speed Contour Plot for Line 8 – Afternoon Peak Hour Eastbound and Westbound – 2031 Revised Alternative 4



3.9.4 TRAVEL TIME

The vehicle travel time on Line 8 from 10 Sideroad to Barrie Street in the eastbound and westbound directions under the revised Alternative 4 (2031) conditions is expected to increase by less than one minute. The travel time is expected to be increased by approximately 7-12% in the morning peak hour and 13-20% in the afternoon peak hour, as presented in Table 3-30.

Table 3-30: Travel Time Comparison – Existing and 2031 Revised Alternative 4 Scenario

Morning Peak Hour					
Road Segment	**Distance in km**	**Simulated Travel Time Existing (min)**	**Simulated Travel Time 2031 Revised Alternative 4 Scenario (min)**	**Difference (min)**	**% Difference**
Line 8 from 10 Sideroad to Barrie Street (EB)	3.1	4.57	5.14	0.57	12.4%
Line 8 from Barrie Street to 10 Sideroad (WB)	3.1	4.30	4.60	0.30	7.0%
Afternoon Peak Hour					
Road Segment	**Distance in km**	**Simulated Travel Time Existing (min)**	**Simulated Travel Time 2031 Revised Alternative 4 Scenario (min)**	**Difference (min)**	**% Difference**
Line 8 from 10 Sideroad to Barrie Street (EB)	3.1	4.61	5.54	0.93	20.1%
Line 8 from Barrie Street to 10 Sideroad (WB)	3.1	4.25	4.80	0.55	13.0%

3.9.5 SUMMARY OF REVISED ALTERNATIVE 4 (PROPOSED) SCENARIO

- The Revised (2031) Alternative 4 provides good/acceptable peak hour operations for all the study area intersections and the turning movements with LOS “D” or better, except for eastbound left-turn and southbound left-turn movements at Barrie Street intersection with LOS “E”. The LOS “E” for left-turn movements for future condition is generally considered acceptable and the queue lengths do not exceed the available storage lengths at both these turns.
- None of the queue lengths are expected to reach upstream signalised intersections during both the AM and PM peak hour. Due to normalization of WBR turn at the Barrie Street intersection, the queue length for this turn is expected to surpass the upstream stop-controlled intersection of Turner Court; however, it is not expected to reach the upstream Colborne Street intersection.
- The storage length for the westbound left-turn (WBL) at the intersection of 10 Sideroad and Reagens Industrial Parkway may have to improve further as the maximum queue length (64 metres) is marginally greater than the provided storage (60 metres).
- The average peak hour speed on Line 8 study area corridor is expected to be around 50 km/h in the eastbound and westbound directions. However, close to the signalized intersections, the average speed would be approximately 35 km/h. Also, the marginal speed reductions (20-30 km/h) are expected at the Barrie Street intersection for the PM peak westbound direction.
- The travel time on Line 8 between Barrie Street and 10 Sideroad for the critical PM peak hour in the eastbound direction is expected to increase by 0.93 minutes compared to the existing conditions.

4 FUTURE CONDITIONS ANALYSIS ASSUMING ROUNDABOUTS - ARCADY (JUNCTIONS 9) SOFTWARE

4.1 INTRODUCTION

The assignment included to evaluate the following four intersections by considering a roundabout alternative:

- Line 8 and 10 Sideroad,
- Line 8 and Langford Boulevard,
- Line 8 and Rogers Trail/Summerlynn Trail, and
- Line 8 and Professor Day Drive.

This section summarizes the results of the traffic analysis undertaken for the above intersections assuming single lane or multi-lane roundabouts. ARCADY software – one of the commonly used roundabout analysis tool (MTO recommends this tool for all roundabout analysis whenever a microsimulation-based analysis is not warranted) - was used for the evaluations.

ARCADY uses the U.K. empirical model to calculate the capacity of each entry as a function of its geometry and the circulating flow crossing in front of the entry.
For standard roundabouts, the entry capacity Qe is formulated as:

Qe = Fi – fi*Qc

Where Qc = Circulating flow

Fi and fi (the intercept and slope respectively) are constants determined by the geometric characteristics of the roundabout.

For standard roundabouts, the geometric features which have the most effect on the values of Fi and fi are listed as follows:

- V approach road half-width (metres).
- E entry width measured along the normal to the nearside kerbline (metres).
- I average effective length over which the flare is developed (metres).
- RAD the entry radius measured as the minimum radius of curvature of the nearside kerb line at entry (metres).
- ICD inscribed circle diameter (metres).
- Φ (phi) the entry angle in degrees (geometric proxy for the conflict angle between entering and circulating streams).

Since the evaluation is for future conditions, the parameters were assumed based on general assumptions. Table 4-1 provides the parameters assumed for the preliminary analysis of single lane and two-lane roundabout evaluation using ARCADY. The numbers were within the range as per TAC Canadian Roundabout Guideline (2017).

Table 4-1: ARCADY Parameters assumed for single lane and two-lane roundabouts

Geometric Parameters	Single lane Roundabout	Two-lane Roundabout
Inscribed Circle Diameter (ICD)	40 m	55 m
Entry Width (E)	4.5 m	8.0 m
Effective Flare Length (L')	20 m	20 m

Half Width (V) (3.5 m per lane)	3.5 m	7 m
Entry Radius (RAD)	30	40 m
Entry Angle (phi)	25 degrees	25 degrees

Also, in order to suit the north American conditions, it is suggested to use ARCADY for the roundabout analysis with 15% capacity reduction.

ARCADY results include queue length, delay, v/c (Ratio of volume-to-capacity) and LOS (Level of Service). The Level of Service criteria for roundabout is similar to AWSC (All Way Stop Control) i.e., computed control delay expressed in sec/vehicle and are shown in Table 4.2 based on NCHRP 672.

Table 4-2: LOS criteria for Roundabouts

LOS Criteria for Roundabouts

Control Delay (s/veh)	Level of Service by Volume-to-Capacity Ratio	
	v/c ≤ 1.0	v/c > 1.0
0-10	A	F
> 10-15	B	F
> 15-25	C	F
> 25-35	D	F
> 35-50	E	F
> 50	F	F

Source: NCHRP 672 – Exhibit 4-9

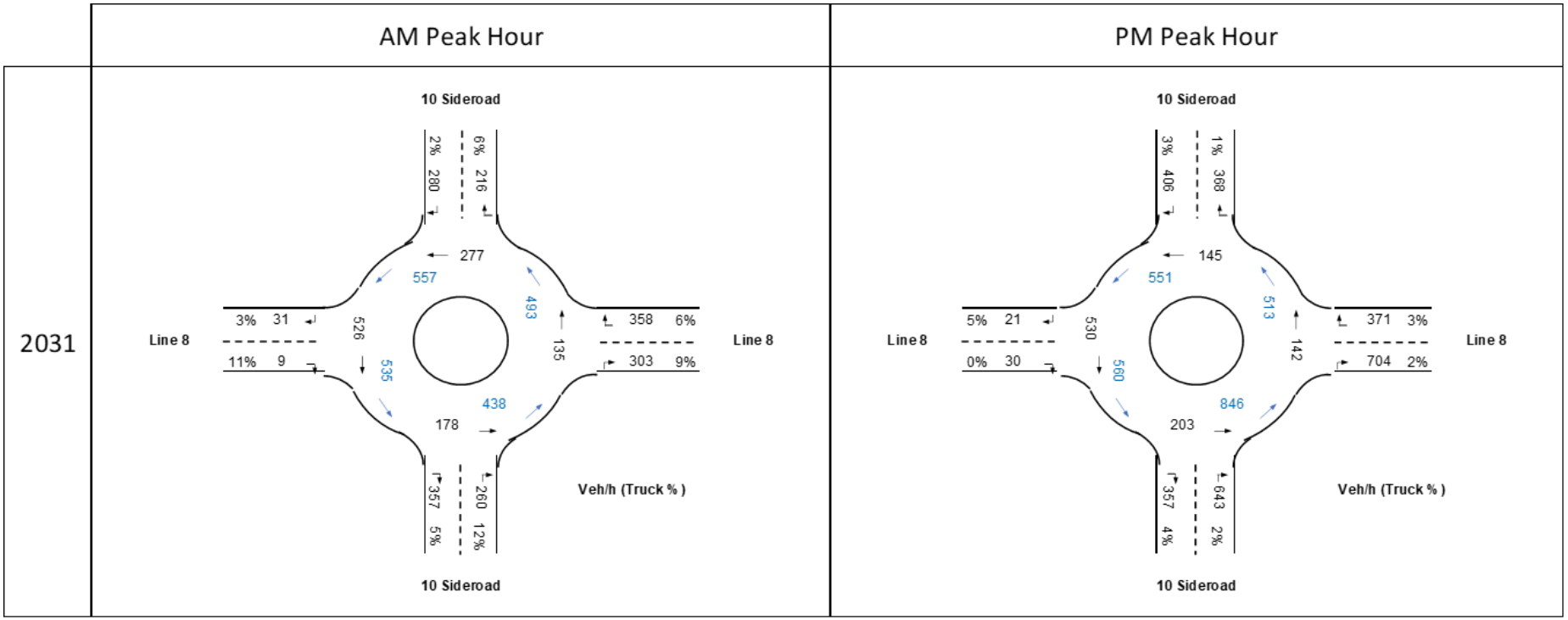
Where A = Free flow
B = Reasonably free flow
C = Stable flow
D = Approaching unstable flow
E = Unstable flow
F = Forced or breakdown flow

The following sections provide evaluation results of ARCADY analysis of each of the four intersections for the future 2031 conditions consistent with that used for signalised control evaluations.

4.2 ROUNDABOUT EVALUATION OF LINE 8 AND 10 SIDEROAD INTERSECTION

Figure 4-1 shows roundabout volumes used in the analysis for 2031 peak hour conditions for the intersection of Line 8 and 10 Sideroad. The figure shows a maximum conflicting volume of 530 veh/h and circulating volume of 846 veh/h.

Figure 4-1: Estimated future 2031 Roundabout Volumes at Line 8 and 10 Side Road



Tables 4-3 provides the results of ARCADY analysis of the single-lane roundabout at the intersection of Line 8 and 10 Sideroad for the 2031 peak hour conditions. The results indicate that a single lane roundabout is expected to operate with very good operating conditions with LOS “C” or better for all approaches with an overall intersection LOS “B” or better. The queue lengths are also minimal.

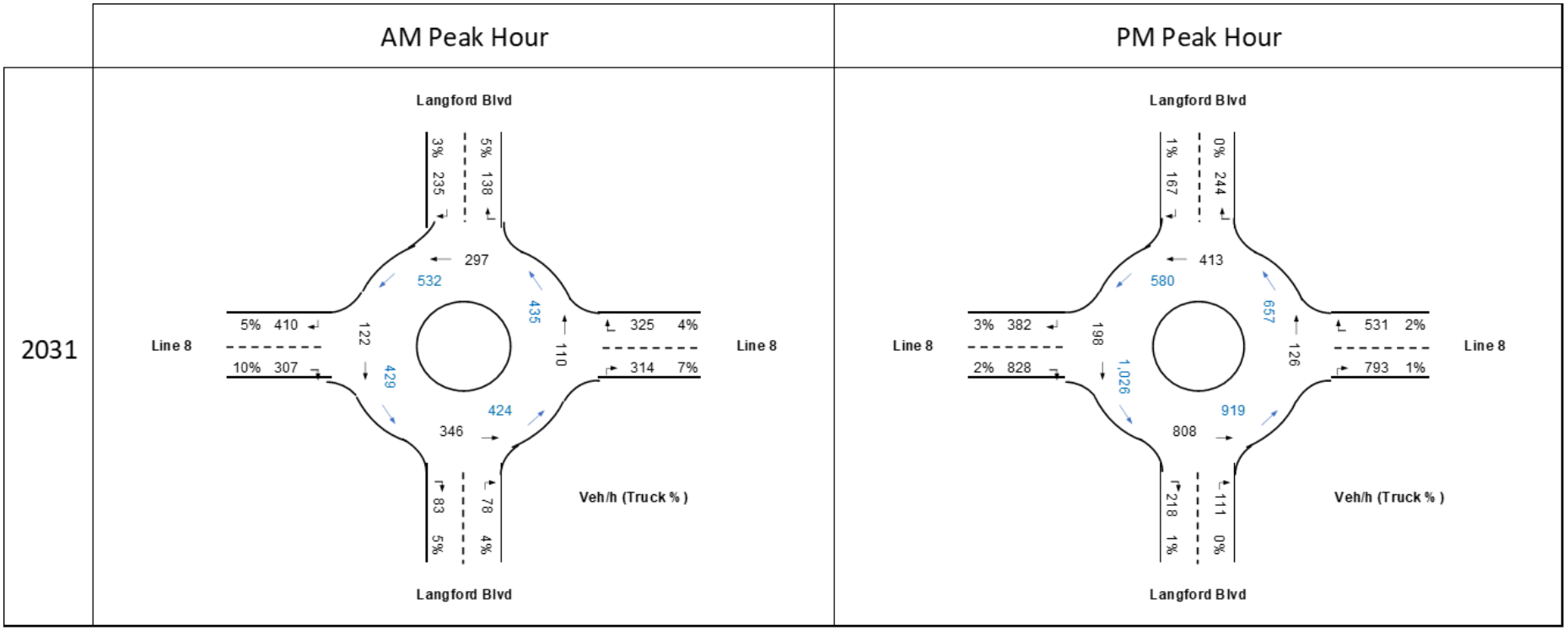
Table 4-3: Performance summary of Line 8 & 10 Sideroad - Single Lane Roundabout

Approach	2031 AM Peak hour					2031 PM Peak hour				
	Demand (veh)	V/C Ratio	Delay (sec)	LOS	Max Queue (m)	Demand (veh)	V/C Ratio	Delay (sec)	LOS	Max Queue (m)
Westbound Approach (East - Line 8)	358	0.36	5.59	A	4.5	371	0.37	5.78	A	4.5
Southbound Approach (North- 10 Sideroad)	280	0.28	5.06	A	3	406	0.39	5.58	A	4.5
Eastbound Approach (West - Line 8)	9	0.01	4.77	A	0	30	0.04	4.4	A	0
Northbound Approach (South - 10 Sideroad)	260	0.28	5.42	A	3	643	0.74	15.8	C	21
Intersection	**907**	**-**	**5.37**	**A**	**-**	**1,450**	**-**	**10.11**	**B**	**-**

4.3 INTERSECTION OF LINE 8 AND LANGFORD BLVD

Figure 4-2 shows roundabout volumes used in the analysis for 2031 peak hour conditions for the intersection of Line 8 and Langford Boulevard. The figure shows a maximum conflicting volume of 808 veh/h and circulating volume of 1026 veh/h.

Figure 4-2: Estimated future 2031 Roundabout Volumes at Line 8 and Langford Boulevard



Tables 4-4 provides the results of ARCADY analysis of the single-lane roundabout at the intersection of Line 8 and Langford Boulevard for the 2031 peak hour conditions. The results indicate that a single lane roundabout is expected to operate with very good operating conditions with LOS “C” or better for all approaches with an overall intersection LOS “B” or better. The queue lengths are also minimal.

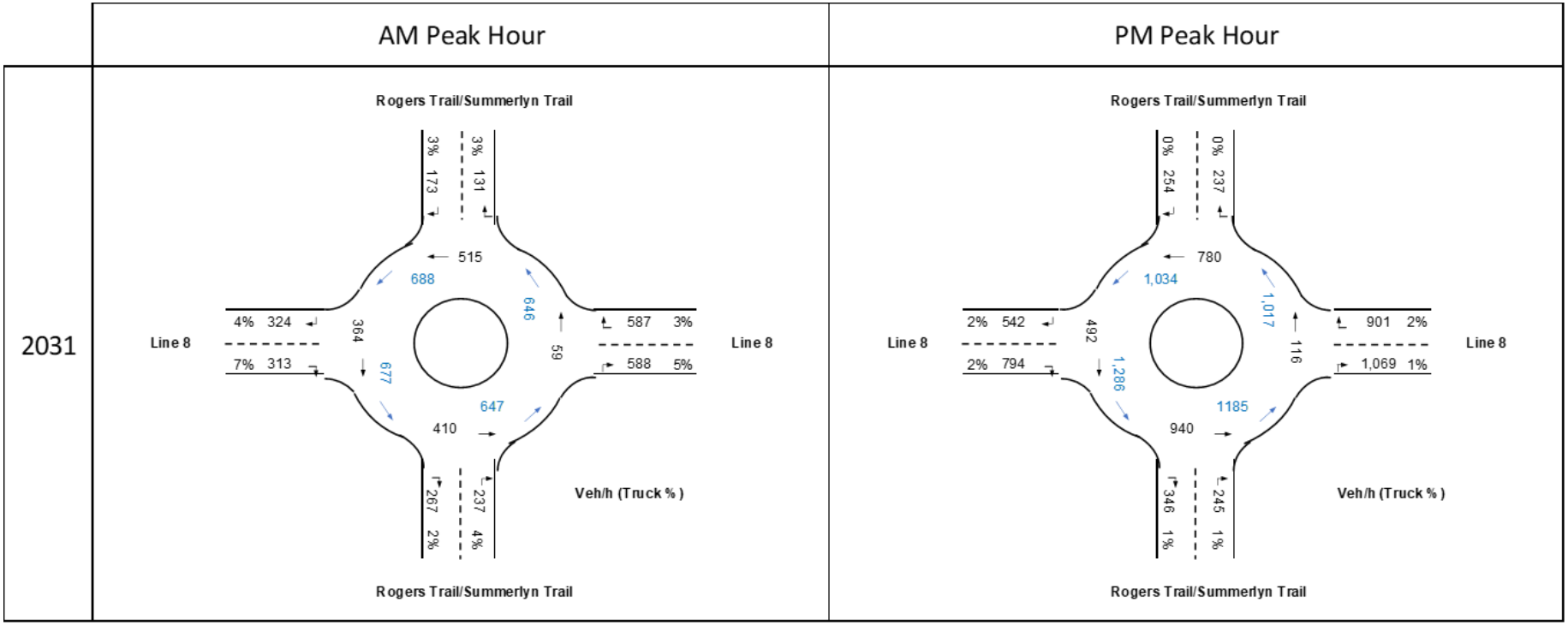
Table 4-4: Performance summary of Line 8 & Langford Blvd - Single Lane Roundabout

Approach	2031 AM Peak hour					2031 PM Peak hour				
	Demand (veh)	V/C Ratio	Delay (sec)	LOS	Max Queue (m)	Demand (veh)	V/C Ratio	Delay (sec)	LOS	Max Queue (m)
Westbound Approach (East - Line 8)	325	0.31	4.98	A	3	531	0.51	7.07	A	7.5
Southbound Approach (North- Langford Blvd)	235	0.26	5.34	A	2.25	167	0.19	5.03	A	1.5
Eastbound Approach (West - Line 8)	307	0.31	5.2	A	3	828	0.81	17.46	C	30.75
Northbound Approach (South - Langford Blvd)	78	0.09	4.34	A	0.75	111	0.19	7.37	A	1.5
Intersection	**945**	**-**	**5.09**	**A**	**-**	**1,637**	**-**	**12.14**	**B**	**-**

4.4 INTERSECTION OF LINE 8 AND ROGERS TRAIL & SUMMERLYN TRAIL

Figure 4-3 shows roundabout volumes used in the analysis for 2031 peak hour conditions for the intersection of Line 8 and Rogers Trail/Summerlyn Trail. The figure shows a maximum conflicting volume of 940 veh/h and circulating volume of 1286 veh/h.

Figure 4-3: Estimated future 2031 Roundabout Volumes at Line 8 and Rogers Trail & Summerlyn Trail



Tables 4-5 provides the results of ARCADY analysis of the single-lane roundabout at the intersection of Line 8 and Rogers Trail/Summerlyn Trail for the 2031 peak hour conditions. The results indicate that with a single lane roundabout, the west approach on Line 8 would experience high delay with LOS "E" indicating unstable flow and with volume levels close to capacity for the PM peak conditions. However, the intersection is expected to operate with very good LOS for the AM peak hour. A two-lane approach for the eastbound direction may be required to improve the operation.

Table 4-5: Performance summary of Line 8 & Rogers Trail & Summerlyn Trail - Single Lane Roundabout*

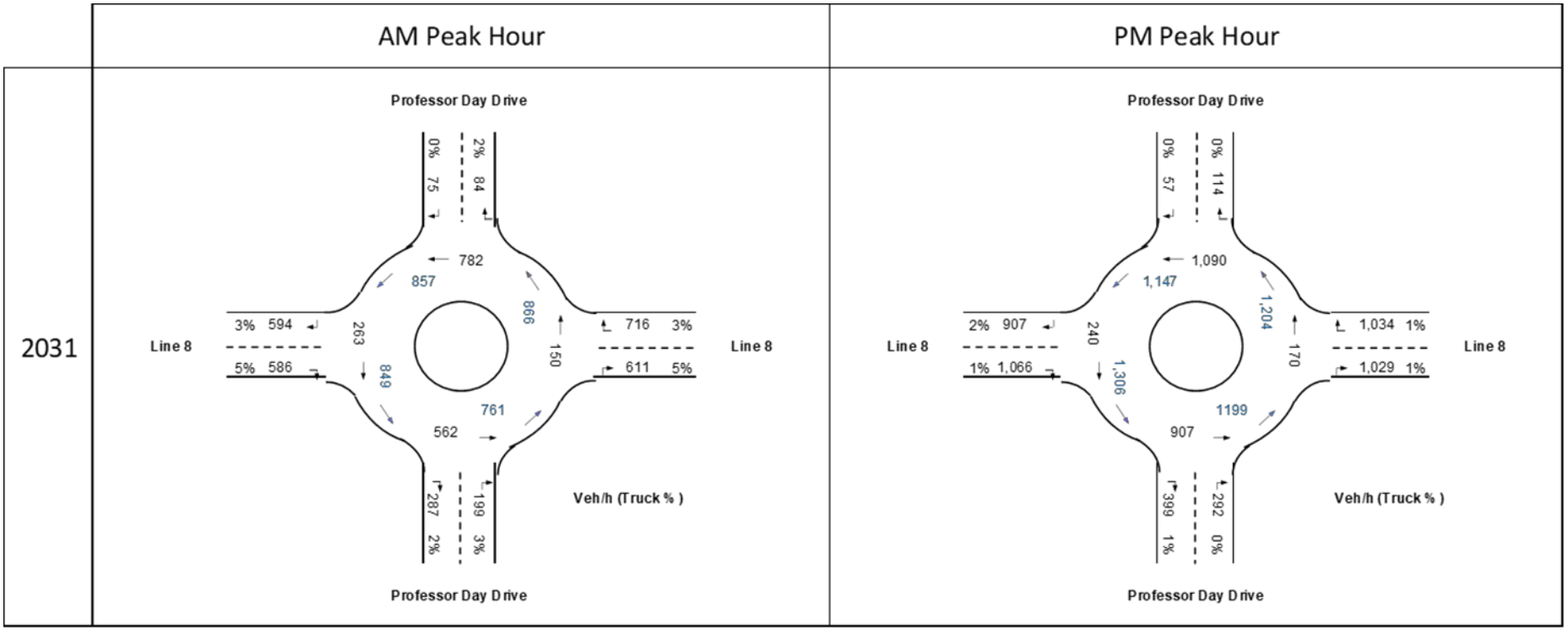
Approach	2031 AM Peak hour					2031 PM Peak hour				
	Demand (veh)	V/C Ratio	Delay (sec)	LOS	Max Queue (m)	Demand (veh)	V/C Ratio	Delay (sec)	LOS	Max Queue (m)
Westbound Approach (East - Line 8)	587	0.54	7.12	A	9	901	0.86	22.04	C	42.75
Southbound Approach (North- Rogers Trail)	173	0.21	5.47	A	2.25	254	0.38	8.52	A	4.5
Eastbound Approach (West - Line 8)	313	0.35	6.24	A	3.75	794	0.92	40.85	E	73.5
Northbound Approach (South - Summerlyn Trail)	237	0.3	6.37	A	3	245	0.56	18.2	C	9
Intersection	**1,310**	**-**	**6.55**	**A**	**-**	**2,194**	**-**	**26.89**	**D**	**-**

**West approach shows v/c > 0.9 – close to capacity.*

4.5 INTERSECTION OF LINE 8 AND PROFESSOR DAY DRIVE

Figures 4-4 shows roundabout volumes used in the analysis for 2031 peak hour conditions for the intersection of Line 8 and Professor Day Drive. The figure shows a maximum conflicting volume of 1090 veh/h and circulating volume of 1306 veh/h.

Figure 4-4: Estimated future 2031 Roundabout Volumes at Line 8 and Professor Day Drive



Tables 4-6 provides the results of ARCADY analysis of the single-lane roundabout at the intersection of Line 8 and Professor Day Drive for the 2031 peak hour conditions. The results indicate that with a single lane roundabout, the east and west approaches on Line 8 would experience high delay with LOS “F” and with volume levels at or above capacity for the PM peak hour conditions. This indicate that two lanes are required for the east and west approaches. However, the intersection is expected to operate with very good LOS for the AM peak hour.

Table 4-6: Summary of Line 8 & Professor Day Drive Single Lane Roundabout Performance

Approach	2031 AM Peak hour					2031 PM Peak hour				
	Demand (veh)	V/C Ratio	Delay (sec)	LOS	Max Queue (m)	Demand (veh)	V/C Ratio	Delay (sec)	LOS	Max Queue (m)
Westbound Approach (East - Line 8)	716	0.7	11.35	B	17.25	1,034	0.98	66.6	F	182
Southbound Approach (North- Professor Day Dr)	75	0.11	6.19	A	0.75	57	0.13	9.2	A	1
Eastbound Approach (West - Line 8)	586	0.62	9.8	A	12	1,066	1.08	188.5	F	694
Northbound Approach (South - Professor Day Dr)	199	0.28	6.9	A	3	292	0.55	15.1	C	9
Intersection	**1,576**	**-**	**9.97**	**A**	**-**	**2,449**	**-**	**112.2**	**F**	**-**

Tables 4-7 provides the results of ARCADY analysis assuming two lanes for the east and west approaches. The results indicated good operation for both AM and PM peak hour conditions.

Table 4-7: Summary of Line 8 & Professor Day Drive - Double Lanes on east and west approaches Roundabout Performance

Approach	2031 AM Peak hour					2031 PM Peak hour				
	Demand (veh)	V/C Ratio	Delay (sec)	LOS	Max Queue (m)	Demand (veh)	V/C Ratio	Delay (sec)	LOS	Max Queue (m)
Westbound Approach (East - Line 8)	716	0.37	2.99	A	4.5	1,034	0.53	3.91	A	8.25
Southbound Approach (North- Professor Day Dr)	75	0.12	6.33	A	0.75	57	0.12	8.81	A	0.75
Eastbound Approach (West - Line 8)	586	0.33	2.97	A	3.75	1,066	0.58	4.65	A	10.5
Northbound Approach (South - Professor Day Dr)	199	0.28	7.05	A	3	292	0.55	15.05	C	9
Intersection	**1,576**	**-**	**3.65**	**A**	**-**	**2,449**	**-**	**5.66**	**A**	**-**

4.6 SUMMARY OF ROUNDABOUNT ANALYSIS

- Detailed ARCADY output files are included in Appendix-4.
- Based on the preliminary Roundabout evaluation using ARCADY (JUNCTION 9) software, it may be noted that a single lane roundabout is expected to provide good operation at the intersections of Line 8 at 10 Sideroad and Langford Drive. However, at Rogers Trail/Summerlyn Trail as well as at Professor Day Drive, double lanes are required at east and west approaches to obtain good operation.
- Because of the following reasons a detailed microsimulation analysis may be required to confirm the results:
    - Requirement of varying number of lanes on the circulatory roadway.
    - Because of the close proximity of the intersections to other signalised intersection, the vehicle arrivals may be “non-random” (platooned) which may reduce the reliability of methods alternative to micro-simulation.
    - When the conflicting circulating flows are greater than 600-650 vehicles/hour/lane, it is recommended to use micro-simulation methodology.
    - There is significant imbalance in approach traffic volumes.
    - If there are significant pedestrians crossing at the roundabout approaches, a micro-simulation evaluation may be required.
- Since a signalised intersection could also provide good operation at the above intersections, the decision of whether to go for a roundabout should consider other criterion such as, property/space requirements, cost, expectation of drivers (drivers unfamiliar with using multi-lane roundabouts), other policy/site constraints, pedestrian safety, maintenance costs (low for roundabouts than signal control), traffic calming etc.

5 SIGNAL WARRANT ANALYSIS

5.1 INTRODUCTION

This section provides a summary of signal warrant analysis conducted for the existing stop-controlled intersections on Line 8 based on the anticipated future conditions. The signal warrant analysis for the future conditions was conducted for the “stop-controlled” intersections that are not expected to provide satisfactory operations in the 2031planning horizon (assuming Highway 400-Highway 404 connecting link in place).

In this study, traffic signal warrant analysis is based on the projected traffic volumes for the morning and afternoon peak hours. The following “stop-controlled” intersections within the study area were assessed for the future (2031) signal warrant analysis:

- Line 8 and Reagens Industrial Parkway
- Line 8 and Professor Day Drive
- Line 8 and Taucar Gate
- Line 8 and Northgate Drive
- Line 8 and Lowes Gate

The analysis was conducted as per OTM Book 12, Justification 7 using projected peak hour volumes for AM and PM peak hours.

5.2 SUMMARY OF SIGNAL WARRANT ANALYSIS

Table 5-1 provides a summary of the signal warrant analysis conducted. The detailed analysis results are included in Appendix A-5. Based on the table, none of the intersections except the intersection of Line 8 and Professor Day Drive are satisfied either 100% or Combination 80% for signal warrants.

It should be noted that as per OTM Book 12, in the case that the volume estimates are based on the expansion of peak hour volumes, the effect on Justifications 1 or 2 of the requirement to meet the warrant for each of eight hours would be lessened by averaging. As well, increased uncertainty is introduced by estimating from as little as one hour of traffic volume. For this reason, the thresholds are raised and, for traffic signals to be considered, Justification 7 should be used with a 20% increase over the required volumes for an existing intersection. Based on this, the intersection of Line 8 and Professor Day Drive is not warranted as it is not 120% satisfied. However, a poor LOS for the north-south approach as indicated in the Do-Nothing Scenario for the intersection would call for signalisation.

Table 5-1: Summary of Signal Warrant Analysis of stop-controlled intersections for future 2031 conditions

Intersection	Justification Compliance		
	120% Satisfied	100% Satisfied	Combinations 80% Satisfied
Line 8 and Reagens Industrial Parkway	No	No	No
Line 8 and Professor Day Drive	No	Yes	Yes
Line 8 and Taucar Gate	No	No	No
Line 8 and Northgate Drive	No	No	No
Line 8 and Lowes Gate	No	No	No

A signal warrant analysis was also conducted for the intersection of Line 8 and Professor Day Drive using the 8-peak pour existing volumes. Table 5-2 summarizes the justifications for signalization based on the guidelines in OTM Book 12. The analysis shows that signalization is **warranted** based on the Combination Justification – Justification 3.

Table 5-2: Line 8 and Professor Day Drive – Signal Warrant Summary for Existing Conditions

Justification		Compliance	Signal Justified?
1. Minimum Vehicular Volume	A. Total Volume	100%	**No**
	B. Crossing Volume	97%	
2. Delay to Cross Traffic	A. Main Road	96%	**No**
	B. Crossing Road	87%	
3. Combination	A. Justification 1	97%	**Yes**
	B. Justification 2	87%	
4-Hour Volume		33%	**No**

6 LEFT-TURN AND RIGHT-TURN LANES – JUSTIFICATION AND STORAGE LENGTHS FOR FUTURE 2031 CONDITIONS

6.1 LEFT-TURN LANES

As per TAC 2017 manual, as a general guideline, left-turn lanes must be considered on all highway approaches and on high speed sideroad approaches at all signalized intersections whether the left turn warrants are met or not, unless the left turn is prohibited by geometrics (T-intersection) or traffic regulations (one-way traffic). Separate left turn lanes at signalized intersections have the advantages of increased safety, and improved intersection capacity. It is preferable to include left-turn lanes at intersections of 2-lane sections as the left-turning vehicles will obstruct the free movement of through traffic. As a result, additional left-turn lanes (with respect to existing conditions) are proposed at the following intersections (as included under 2031 Revised Alternative Scenario 4 – Proposed Alternative):

- Eastbound and westbound left-turn lanes at the intersection of Line 8 and Professor Day Drive.
- Southbound left-turn lane at Line 8 and 10 Sideroad.

6.2 LEFT-TURN PHASE

As per OTM Book 12, a left-turn phase may be justified:

- If the left-turning vehicles are not finding suitable turning gaps, volume exceeds at least two vehicles per cycle, and the Level of Service at the intersection will not be jeopardized; or
- If the left-turning volume plus the opposing volume > 720 vehicles per hour; or
- If a field check, shows that vehicles consistently require more than two cycles in the queue in order to turn left; or
- If an over-representation of left turning collisions is identified at the intersection.

Based on the above, additional protected left-turn phases (with respect to existing conditions) are proposed at the following intersections (as included under 2031 Alternative Scenario 4):

- Westbound left-turn movement at the intersection of Line 8 and Professor Day Drive. Anticipated future left-turn volume plus the opposing volume (including right-turn volume) for this movement is 1224 veh/h for the critical PM peak hour conditions.
- At the intersection of Line 8 and Northgate Drive, under Future Alternative 4 Scenario, with signalisation and with additional eastbound and westbound lanes, westbound left-turn protected phase is justified as the anticipated future left-turn volume plus the opposing volume for this movement is 763 veh/h for the critical PM peak hour conditions. Also, since this intersection is very close to Lowes Gate intersection, providing a protected westbound left-turn phase (as assumed under Alternative 4) would reduce the queue length and will improve the operation in the westbound direction.

6.3 RIGHT-TURN LANES

As per TAC 2017, the following guidelines are suggested for the use of right-turn auxiliary lane on urban and rural roads for signalised intersections:

- When the volume of right-turning vehicles compared with the through traffic volumes causes undue hazard.
- When the volume of right-turning traffic is 10% to 20% of the total approach volume.

Based on the above, additional right-turn lane (with respect to existing conditions) are proposed at the following intersections (as included under 2031 Alternative Scenario 4):

- Eastbound right-turn lane at the intersection of Line 8 and Barrie Street. The right-turning volume at this intersection would be approximately 13% and a separate right-turn lane would improve LOS and reduce queue length for the eastbound through movement.
- Northbound right-turn lane at Line 8 and 10 Sideroad. The northbound right-turning volume at this intersection is expected to be approximately 71% and a separate right-turn lane would be justified.

6.4 LEFT-TURN AND RIGHT-TURN STORAGE LENGTHS

Figure 6-1 shows a pictorial representation of left-turn lane lengths (Storage Lane + Deceleration length + Taper) based on Geometric Design Guide for Canadian Roads (TAC 2017). Deceleration length was based on the distance needed for the driver to brake comfortably to come to a full stop at the intersection assuming a deceleration rate of 3.4m/s2. If the approach grade is greater than 2%, the necessary correction for approach grade should be applied to the deceleration length. Desirably, the distance needed for deceleration is provided by the auxiliary lane, exclusive of storage requirements. However, in a constrained urban environment, where it is not feasible to provide both deceleration distance and storage length due to other considerations, such as intersection spacing, access needs, and other physical controls the taper length may be used for deceleration distance. Taper length required will be based on design speed and the Design Domain for Taper Ratio (with respect to the width of the turning lane) as shown in Table 6-1.

Figure 6-1: Left Turn Lane - Pictorial representation of terms (From Geometric Design Guide for Canadian Roads – TAC 2017)

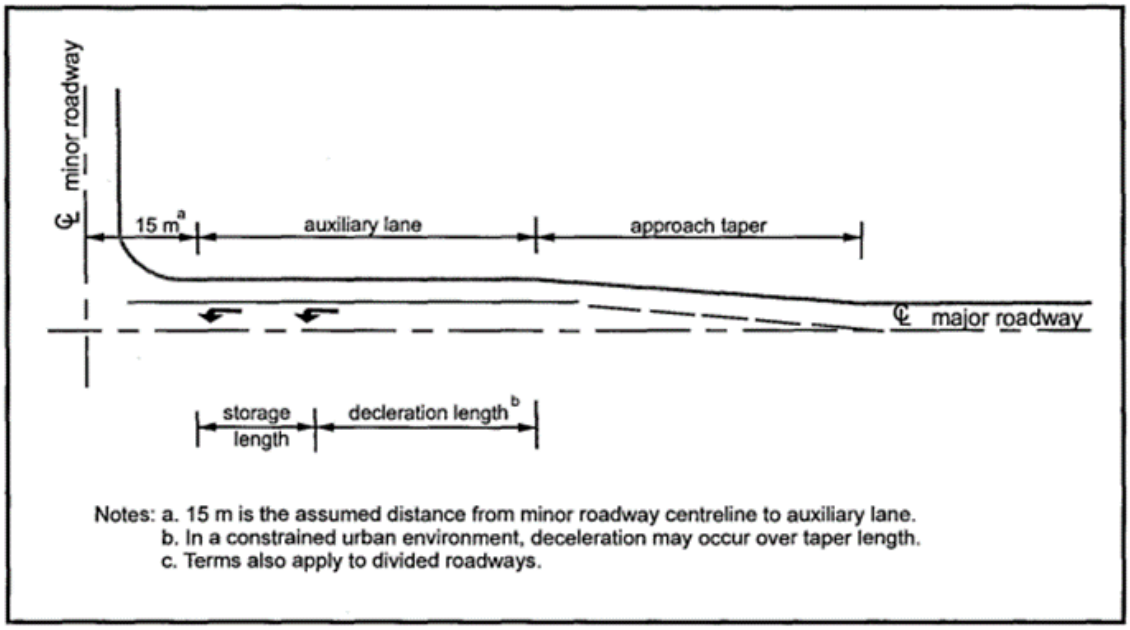
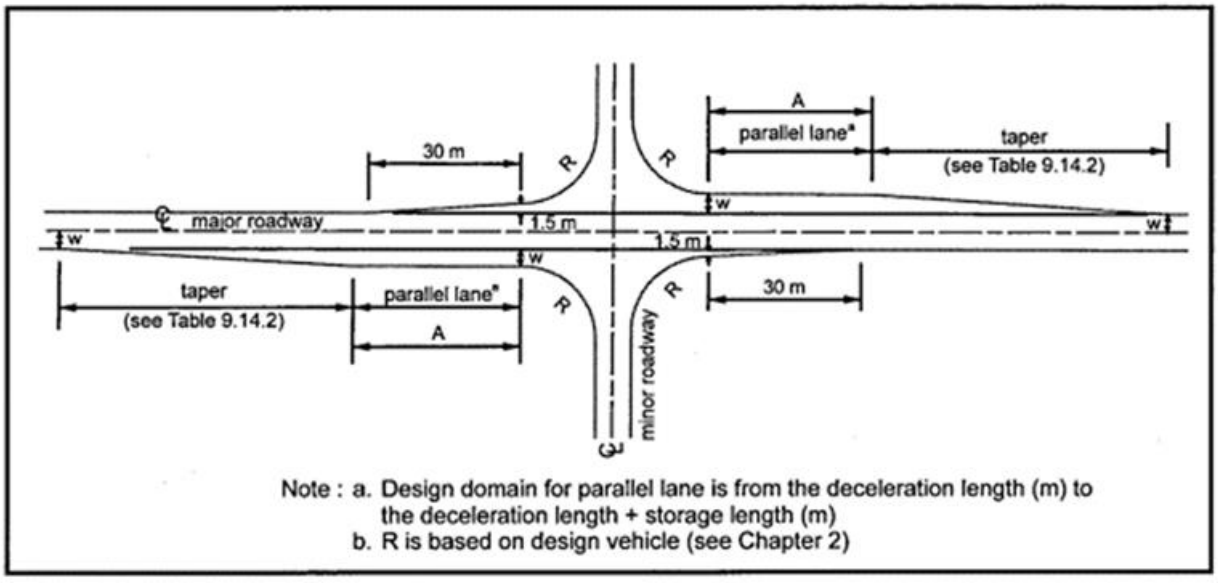


Table 6-1: Approach and Departure Taper Ratios (From Geometric Design Guide for Canadian Roads – TAC 2017)

Design Speed (km/h)	Design Domain for Taper Ratio	Horizontal Curve to Smooth Taper R (m)
50	8:1 – 30:1	500
60	15:1 – 36:1	750
70	15:1 – 42:1	1,000
80	15:1 – 48:1	1,200
90	27:1 – 54:1	1,500
100	30:1 – 60:1	2,000
110	33:1 – 66:1	2,500
120	36:1 – 72:1	3,000

Figure 6-2 shows design elements for typical right-turn taper lane with auxiliary lane and suggested taper and parallel lengths are shown in Table 6-2. If the percentage grade of approach is higher than 2%, deceleration length should be adjusted. The deceleration length decreases for positive grade and increases for negative grade. The design domain for parallel lane is from deceleration lane length to the deceleration lane length + storage length.

Figure 6-2: Right Turn Lane - Pictorial representation of terms (From Geometric Design Guide for Canadian Roads – TAC 2017)



Note : a. Design domain for parallel lane is from the deceleration length (m) to the deceleration length + storage length (m)
b. R is based on design vehicle (see Chapter 2)

Table 6-2: Right-turn Taper with Parallel Deceleration Lane Design (From Geometric Design Guide for Canadian Roads – TAC 2017)

Design Speed (km/h)	Taper Ratio[a] Design Domain	Radius for Reverse[a] Curves (m)	Parallel Lane Length[b] Design Domain
50	11:1–17:1	90–150	35–75
60	14:1–17:1	150	40–90
70	17:1–20:1	150–220	50–110
80[c]	17:1–24:1	150–300	60–130

Notes:
a) Taper may be straight line or may be symmetrical reverse curves; length is derived from design values calculated for a 3 s lane change criterion for the appropriate operating speed.
b) Additional parallel lane length may be required for storage.
c) For higher design speeds, refer to **Chapter 10**.

Based on the Geometric Design Guide for Canadian Roads (TAC 2017) as described above as well based on the storage lengths from Aimsun micro-simulation analysis of the recommended Revised Alternative 4 Scenario (Table 3-29), the recommended storage lengths for left-turn and right-turn lanes for the intersections within the study area are shown in Table 6-3 and Table 6-4 respectively. Note that if there is any change in the approach grades or lane widths as assumed, the values may have to be modified accordingly.

Table 6-3: Left-turn storage lengths for the intersections on Line 8 and 10 Sideroad for future 2031 conditions (Revised Alternative 4)

Intersection	Movement	Posted Speed (km/h)	Storage Length (m) as per Aimsun		Maximum Storage (m) Required	Approach Grade	Deceleration Lane length* (m)	Width Assumed (m)	Taper Range	Taper (m)*	Auxiliary Lane Length (m)
			AM	PM							
Line 8 and 10 Side Road	EBL	50	1	6	6	0%	83	3.5	15:1 to 36:1	53-126	89
	WBL	50	58	34	58	0%	83	3.5	15:1 to 36:1	53-126	141
	SBL	60	40	44	44	0%	104	3.5	15:1 to 42:1	53-147	148
Line 8 and Langford Boulevard	EBL	50	23	16	23	0%	83	3.5	15:1 to 36:1	53-126	106
	WBL	50	12	17	17	0%	83	3.2	15:1 to 36:1	48-115	100
	NBL	40	6	10	10	0%	63	3.5	8:1 to 30:1	28-105	73
	SBL	40	14	22	22	0%	63	3.2	8:1 to 30:1	26-96	85
Line 8 and Rogers Trail / Summerlyn Trail	EBL	50	13	17	17	0%	83	3.5	15:1 to 36:1	53-126	100
	WBL	50	39	47	47	0%	83	3.2	15:1 to 36:1	48-115	130
	NBL	40	5	7	7	0%	63	3.5	8:1 to 30:1	28-105	70
	SBL	40	23	30	30	0%	63	3.2	8:1 to 30:1	26-96	93
Line 8 and Professor Day Drive	EBL	50	5	11	11	0%	83	3.5	15:1 to 36:1	53-126	94
	WBL	50	32	31	32	-3%	87	3.5	15:1 to 36:1	53-126	119
	NBL	40	21	22	22	0%	63	3.2	8:1 to 30:1	26-96	85
	SBL	40	5	8	8	0%	63	3.2	8:1 to 30:1	26-96	71
Line 8 and Noble Drive	EBL	50	11	26	26	6%	77	3.5	15:1 to 36:1	53-126	103
	WBL	50	4	18	18	-4%	88	3.5	15:1 to 36:1	53-126	106
	SBL	40	17	14	17	3%	61	4.2	8:1 to 30:1	34-126	78
Line 8 and Northgate Dr	WBL	50	28	39	39	0%	83	3.7	15:1 to 36:1	56-133	122
Line 8 and Barrie Street	EBL	50	73	68	73	0%	83	3.3	15:1 to 36:1	50-119	156
	WBL	50	12	10	12	4%	78	3.3	15:1 to 36:1	50-119	90
	NBL	50	16	17	17	3%	79	3.3	15:1 to 36:1	50-119	96

	SBL	50	55	110	110	-4%	88	3.6	15:1 to 36:1	54-130	198
Line 8 and Colborne Street	WBL	50	3	2	3	0%	83	3.2	15:1 to 36:1	48-115	86
Line 8 and Artesian Industrial Parkway	EBL	50	8	27	27	0%	83	3.2	15:1 to 36:1	48-115	110
10 Sideroad and Reagens Industrial Parkway	WBL	50	56	32	56	0%	83	3.7	15:1 to 36:1	56-133	139
	SBL	60	3	7	7	0%	104	3.2	15:1 to 42:1	48-134	111

**As per Geometric Design Guide for Canadian Roads – TAC 2017*

Table 6-4: Right-turn storage length for the intersections of Line 8 and 10 Sideroad for future 2031 conditions (Revised Alternative 4)

Intersection	Movement	Posted Speed (km/h)	Storage Length (m) as per Aimsun		Maximum Storage (m) Required	Approach Grade	Deceleration Lane Length* (m)	Width Assumed (m)	Taper Range	Taper (m)*
			AM	PM						
Line 8 and 10 Side Road	NBR	60	28	68	68	0%	50-110	3.8	17:1-20:1	65-76
Line 8 and Langford Boulevard	EBR	50	10	15	15	0%	40-90	3.0	14:1-17:1	42-51
	WBR	50	8	13	13	0%	40-90	3.0	14:1-17:1	42-51
Line 8 and Rogers Trail / Summerlyn Trail	WBR	50	11	14	14	0%	40-90	3.0	14:1-17:1	42-51
Line 8 and Noble Drive	WBR	50	7	15	15	-4%	48-108	3.0	14:1-17:1	42-51
Line 8 and Barrie Street	EBR	50	25	10	25	0%	40-90	3.0	14:1-17:1	42-51
	WBR	50	132	224	224	4%	36-81	3.0	14:1-17:1	42-51
	NBR	50	7	6	7	3%	40-90	3.0	14:1-17:1	42-51
	SBR	50	50	90	90	-4%	48-108	4.0	14:1-17:1	56-68
10 Sideroad and Reagens Industrial Parkway	NBR	60	16	19	19	0%	50-110	3.8	17:1-20:1	65-76

**As per Geometric Design Guide for Canadian Roads – TAC 2017*

NOTE: Supporting model files and output files are provided separately as Appendices.

Appendix A-1: Synchro files and reports for the Existing Conditions

Appendix A-2: Aimsun files – Existing Scenarios

Appendix A-3: Aimsun files – Future Scenarios

Appendix A-4: ARCADY Output Files

Appendix A-5: Signal Warrant Analysis