

Appendix D: Transportation Assessment and Cycling Facility Selection Analysis



IBI GROUP
100 – 175 Galaxy Boulevard
Toronto ON M9W 0C9 Canada
tel 416 679 1930 fax 416 675 4620
ibigroup.com

Memorandum

To/Attention	City of Hamilton	Date	December 4, 2019
From	Scott Johnston	Project No	121767
cc	Josh Wilson; Gary Yeung		
Subject	Birch Avenue Two-Way Conversion Transportation Assessment		

Introduction

Birch Avenue is a three-lane, one-way minor arterial serving traffic and goods movement in north Hamilton. The City has initiated a Class Environmental Assessment (EA) to address drainage and bridge clearance issues along Birch Avenue between Barton Street and Burlington Street. The EA study is also tasked to develop a recommended lane configuration considering the plan to convert the street to two-way traffic.

This memo is a traffic operations assessment in support of the EA. The assessment provides existing conditions analysis, development of traffic forecasts, future conditions traffic analysis, and recommended lane configuration. This memo is one of several (others include active transportation, structural engineering) that will be assembled into the final EA.

Study Area

The study area is shown in Exhibit 1. It extends approximately 1.1 kilometers along Birch Avenue from Barton Street E to Burlington Street. Birch Avenue is currently a three-lane southbound one-way minor arterial road with an assumed speed limit of 50 km/h. The study area includes illustration of the planned transit Maintenance and Service Facility (MSF), which is a large facility housing approximately 250 buses that will have access to Birch Avenue. For analysis purposes the study area consists of the following intersections:

- Birch Avenue & Burlington Street E (*signalized*);
- Birch Avenue & Brant Street (*signalized*);
- Brant Street & MSF emergency bus access (*unsignalized*);
- Birch Avenue & MSF bus access (*unsignalized*);
- Birch Avenue & Princess Street (*unsignalized*); and
- Birch Avenue & Barton Street E (*signalized*).

City of Hamilton – December 4, 2019

Exhibit 1: Study Area



Existing Conditions (2019)

Existing turning movement counts (TMCs) and signal timing plans at the subject intersections were collected from the City of Hamilton. Exhibit 2 provides a summary of count dates and control types at each subject intersection. Two of these counts are aging (>2 years), however it was noted that this area of Hamilton is stable and traffic volumes on Birch Avenue are low overall. A 2% annual growth rate was applied to the 2014 and 2015 count to provide a conservative analysis. The resultant volumes are shown in Exhibit 3.

Exhibit 2: Data Collection Summary Table

INTERSECTION	CONTROL TYPE	COUNT DATE
Birch Avenue & Burlington Street E	Signalized	2014-12-08
Birch Avenue & Brant Street	Signalized	2018-04-25
Birch Avenue & Princess Street	Unsignalized	2019-02-26
Birch Avenue & Barton Street E	Signalized	2015-02-19

City of Hamilton – December 4, 2019

Existing Traffic Operations

Intersection operations analysis was conducted using Synchro (version 9) and following Highway Capacity Manual (HCM 2000) methodologies of intersection analysis. Analysis periods were the weekday a.m. and p.m. peak hours, when background traffic is considered highest. Critical traffic movements are identified following criteria set out by the City of Hamilton Traffic Impact Study (TIS) guidelines and are as follows:

For signalized intersections,

- Volume-to-capacity (V/C) ratios for through movements or shared through/turning movements will operate at 0.85 or greater;
- V/C ratios for exclusive turning movements at 0.90 or greater;
- Queues for an individual movement are projected to exceed available turning lane storage at 95th percentile volumes.

For unsignalized intersections,

- Level-of-service (LOS), based on average control delay per vehicle or individual movements is LOS 'D' or greater;
- The estimated 95th percentile queue length for an individual movement exceeds the available queue storage.

For existing traffic operations, a summary of the analysis for the AM and PM peaks is found in Exhibit 4 with full Synchro outputs provided in the Appendix.

Based on the results, the intersections in the study area are currently operating well, with signalized intersections at level-of-service B or better. No movements in either peak periods are considered critical according to the City's TIS guidelines, indicating stable traffic conditions without significant delay or disruptions.

City of Hamilton – December 4, 2019

Exhibit 4: Existing Traffic Analysis (All Movements) Summary

Intersection Name	Overall LOS	All Movements			
		Mvmt	LOS	V/C Ratio	95th Percentile Queue (m)
AM Peak					
Birch Avenue & Burlington Street E (Signalized)	A	EBTR	A	0.25	23
		WBL	C	0.34	31
		WBT	A	0.35	-
Birch Avenue & Brant Street (Signalized)	B	EBTR	B	0.06	9
		WBTL	B	0.09	13
		SBTLR	A	0.13	21
Birch Avenue & Princess Street (Unsignalized)	-	EBTR	A	0.05	1
		WBTL	A	0.04	1
		SBTLR	-	0.01	0
Birch Avenue & Barton Street E (Signalized)	B	EBTR	B	0.30	34
		WBL	B	0.15	12
		WBT	B	0.33	39
		SBTL	A	0.12	6
		SBR	A	0.05	-
PM Peak					
Birch Avenue & Burlington Street E (Signalized)	A	EBTR	A	0.39	41
		WBL	C	0.31	29
		WBT	A	0.28	-
Birch Avenue & Brant Street (Signalized)	B	EBTR	B	0.05	8
		WBTL	B	0.14	18
		SBTLR	A	0.12	20
Birch Avenue & Princess Street (Unsignalized)	-	EBTR	B	0.10	2
		WBTL	B	0.05	1
		SBTLR	-	0.02	1
Birch Avenue & Barton Street E (Signalized)	B	EBTR	B	0.42	50
		WBL	B	0.22	15
		WBT	C	0.50	61
		SBTL	B	0.15	11
		SBR	A	0.04	3

Future Conditions

Future traffic volumes were developed using the City's EMME demand model to estimate growth and the effects of conversion to two-way traffic. Future traffic volumes also included the planned Hamilton Transit Maintenance and Service Facility. The following describes the one-way scenario and two-way scenario including traffic forecasts and analysis findings.

One-Way Scenario

This scenario describes the case where Birch Ave is not converted into a two way street,. The MSF is constructed and the entrance faces along Birch Ave as planned.

The City of Hamilton provided a macro model to assist in calculating the background growth rate to be used in forecasting trips in 2031. The 2011 and 2031 base traffic volumes were compared to calculate annual compound background growth rates, summarized in Exhibit 5.

City of Hamilton – December 4, 2019

Exhibit 5: Birch Ave from Burlington St to Barton Growth Rate Summary from EMME

2011 Base SB Trips	2031 Base SB Trips	Growth Rate From 2011 to 2031
240	369	2.2%

Additionally, the annual compound background growth rate was separately checked using the City of Hamilton's locally forecasted 2016 to 2031 population and employment growth rates of 1.0% and 0.7%, respectively. The EMME model provided by the City indicated a larger growth, than the forecasted local population and employment growth. Therefore, the growth rate of 2.2% will be used as a conservative estimate along the Birch Ave within the study limits.

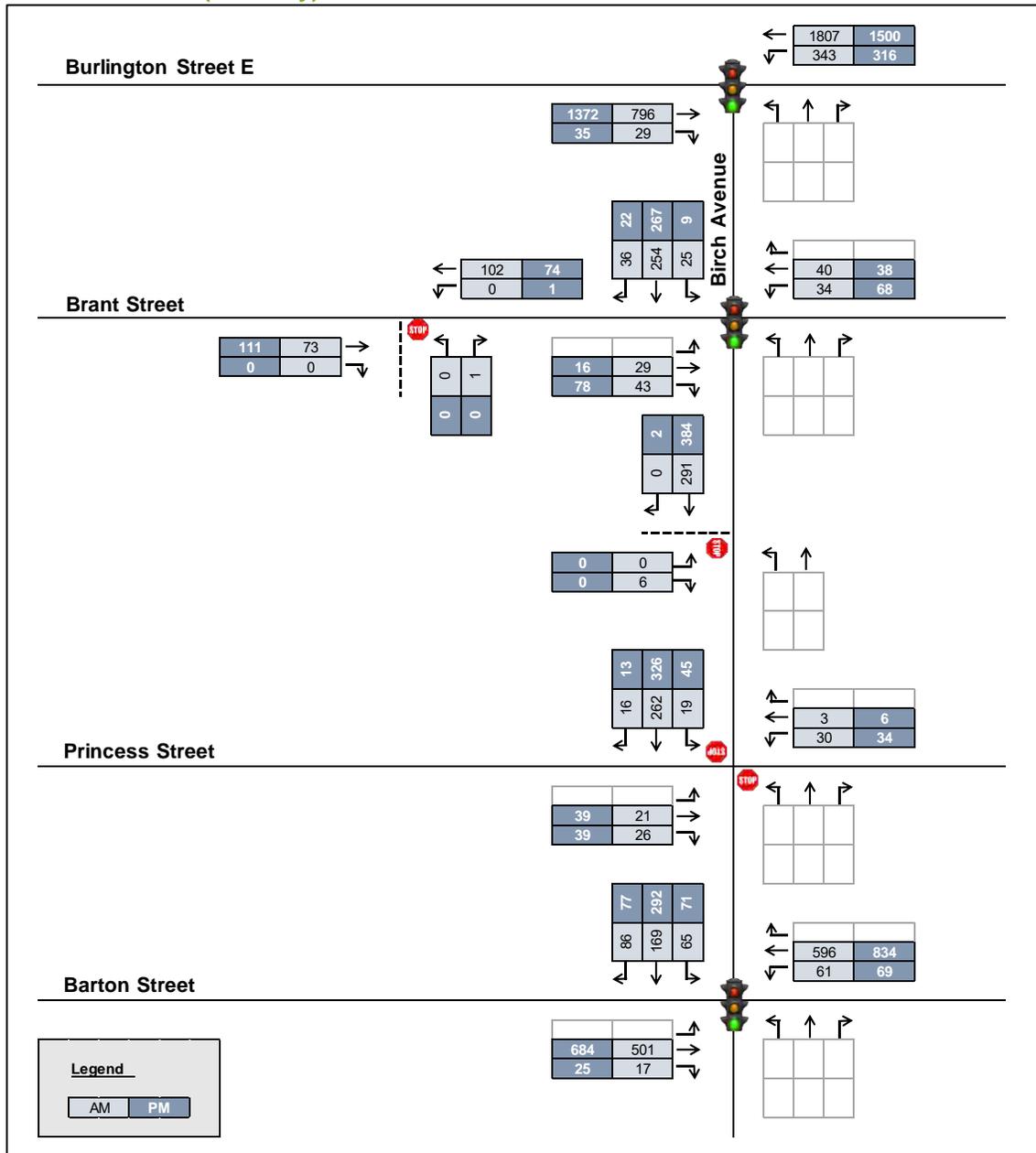
The resulting one-way traffic volumes are show in Exhibit 6.

The results of the intersection operations analysis performed in Synchro are shown below in Exhibit 7. Under Future 2031 one-way conditions, the analysis shows that the study area is performing well with all signalized intersections performing at a level-of-service of B or better. No movements in either peak periods are considered critical according to the City's TIS guidelines, indicating stable traffic conditions without significant delay or disruptions.



IBI GROUP
 100 – 175 Galaxy Boulevard
 Toronto ON M9W 0C9 Canada
 tel 416 679 1930 fax 416 675 4620
 ibigroup.com

Exhibit 6: Future (One-way) 2031 Traffic Volumes



City of Hamilton – December 4, 2019

Exhibit 7: Future 2031 One-Way Traffic Analysis (All Movements) Summary

Intersection Name	Overall LOS	All Movements			
		Mvmt	LOS	V/C Ratio	95th Percentile Queue (m)
AM Peak					
Birch Avenue & Burlington Street E <i>(Signalized)</i>	A	EBTR	A	0.32	30
		WBL	C	0.47	41
		WBT	A	0.45	-
Birch Avenue & Brant Street <i>(Signalized)</i>	B	EBTR	B	0.08	11
		WBTL	B	0.12	16
		SBTLR	A	0.17	22
Birch Avenue & Princess Street <i>(Unsignalized)</i>	-	EBTR	B	0.07	2
		WBTL	B	0.05	1
		SBTLR	-	0.01	0
Birch Avenue & Barton Street E <i>(Signalized)</i>	B	EBTR	B	0.39	44
		WBL	B	0.23	16
		WBT	B	0.43	52
		SBTL	B	0.16	9
		SBR	A	0.06	-
PM Peak					
Birch Avenue & Burlington Street E <i>(Signalized)</i>	A	EBTR	A	0.39	41
		WBL	C	0.31	29
		WBT	A	0.28	-
Birch Avenue & Brant Street <i>(Signalized)</i>	B	EBTR	B	0.05	8
		WBTL	B	0.14	18
		SBTLR	A	0.12	20
Birch Avenue & Princess Street <i>(Unsignalized)</i>	-	EBTR	B	0.1	2
		WBTL	B	0.05	1
		SBTLR	-	0.02	1
Birch Avenue & Barton Street E <i>(Signalized)</i>	B	EBTR	B	0.42	50
		WBL	B	0.22	15
		WBT	C	0.5	61
		SBTL	B	0.15	11
		SBR	A	0.04	3

City of Hamilton – December 4, 2019

Two-way Conversion Scenario

This scenario describes the case where Birch Street is converted into a two-way road. Traffic forecasts were developed using the City's EMME travel demand model. Forecasts also account for the proposed Maintenance and Service Facility (MSF). A preliminary assumed road geometry was taken from the Pavement Marking Plans provided by the City of Hamilton and attached in the Appendix.

Two-Way Conversion Forecast

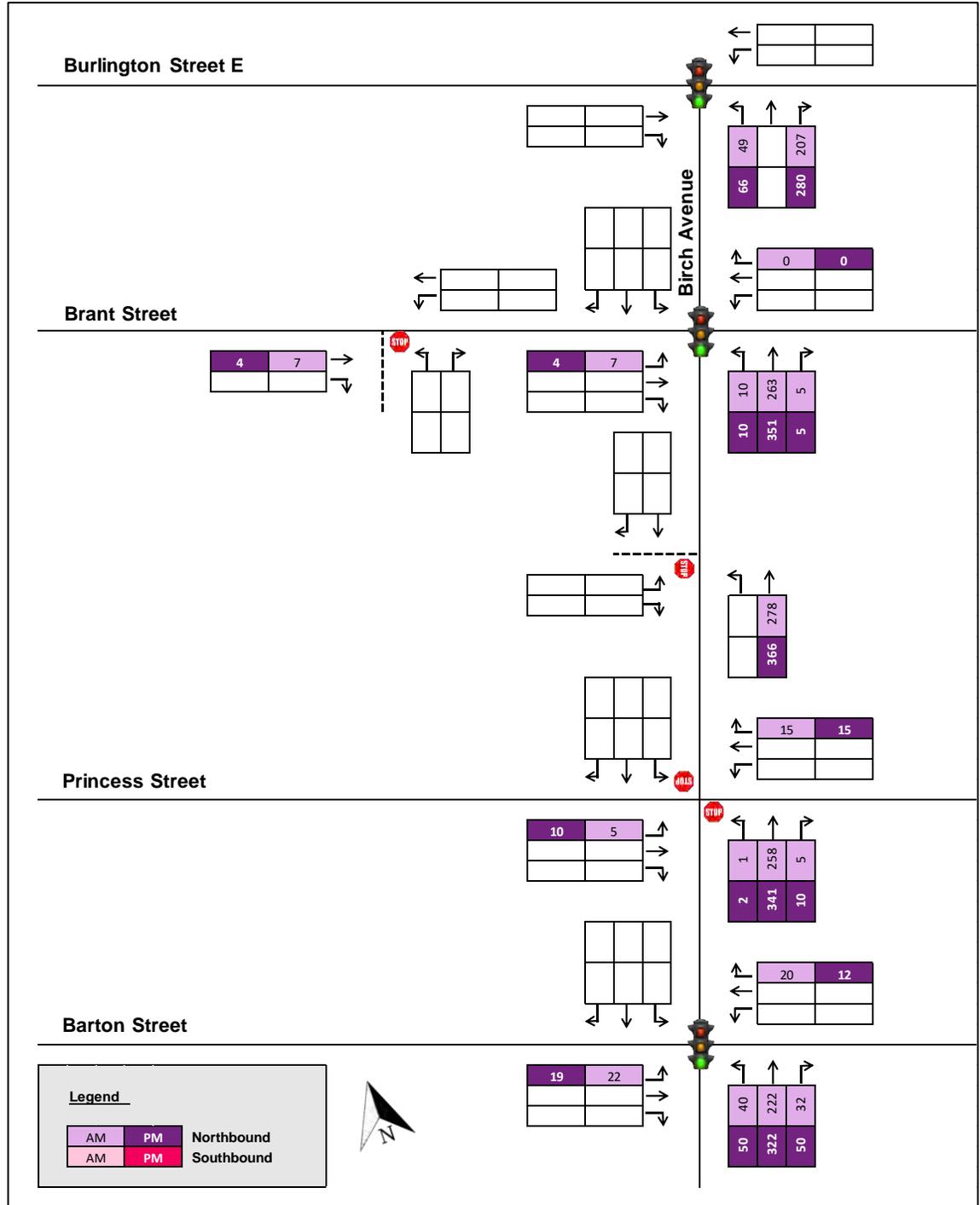
Two-way traffic was estimated through a conversion ratio between southbound and northbound trips, from the City's 2031 EMME model scenario with two-way traffic. As EMME models tend to be approximate at a local level and may under-predict traffic volumes, the conversion approach pivots from observed traffic counts and helps to address model deficiencies.

According to the 2031 Birch Avenue two-way EMME results, 227 northbound trips and 238 southbound trips are expected on Birch Avenue. The southbound flow is less than observed existing counts. The conversion ratio of 95% reflects that the model expects roughly equal traffic northbound and southbound on the road. Therefore the 2031 forecast volumes southbound were multiplied by the same ratio to estimate northbound volumes. Once link volumes were estimated, turning movements at intersections were estimated using proportions derived from the EMME model with considerations to the local land-use and existing travel patterns from nearby intersections.

Resultant northbound traffic volumes are shown in Exhibit 8.

City of Hamilton – December 4, 2019

Exhibit 8: Birch Avenue Two-Way Conversion Added Trips



City of Hamilton – December 4, 2019

Hamilton Transit MSF Site Traffic

The *Hamilton Transit Maintenance Storage Traffic Impact Study - DRAFT (2019)* provides a transportation impact assessment of the City of Hamilton MSF, including traffic and bus-related operations up to the horizon year 2027. It identified a primary MSF bus access oriented to Birch Avenue and a secondary bus access off of Brant Street, which is reflected in Exhibit 1 of the current study.

The study identified that the MSF is expected to generate a total of 94 and 134 two-way trips for passenger vehicles in the AM and PM peak hour respectively. Separately, for bus fleet vehicles, a total of 9 and 14 vehicle trips are expected to be generated during the two peak periods. The majority of site generated traffic is generated outside of background peak periods. Under both the 2022 and 2027 future total conditions, traffic operations are expected to be similar to future background conditions. The study also recommended a single northbound left-turn lane with a minimum storage length of 20 meters for the primary bus access oriented to Birch Avenue.

The resultant employee and bus fleet trip distribution are shown in Exhibit 9 and Exhibit 10.

2031 Total Forecast

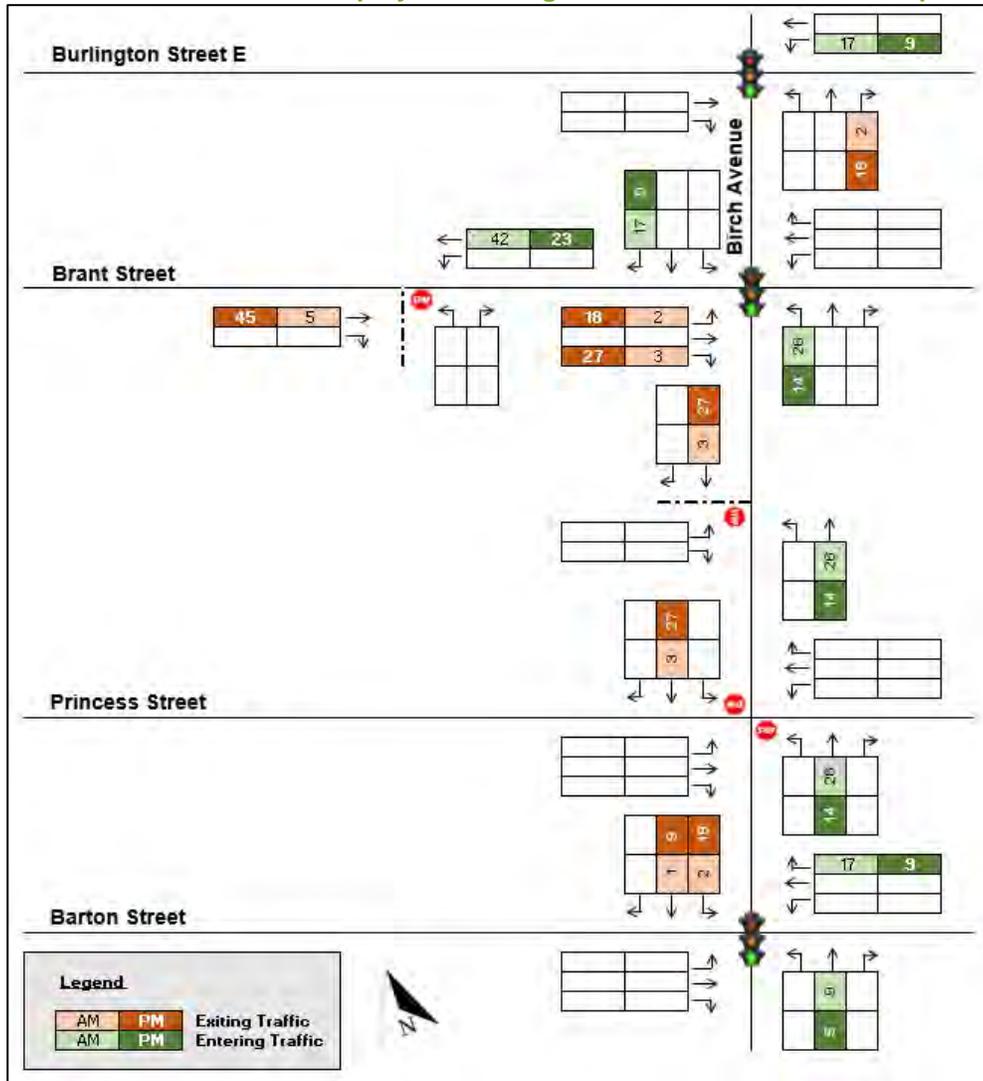
A forecast for total future traffic volumes in 2031, shown in Exhibit 11, was determined based on existing 2019 volumes, background growth, MSF employee and bus added trips, and resultant trips from the Birch Avenue two-way conversion.

Barton Street Lane Configuration

The intersection of Barton Street and Birch Avenue was originally configured to have a SBL, SBT and SBR lane configuration. However, upon closer analysis, the receiving lane would not be wide enough to accommodate large vehicle traffic, especially WBR turning vehicles. To provide an adequate turning radius the southbound left lane was dropped in favour of a shared through left, allowing for a wider northbound receiving lane. A Synchro analysis of the changes revealed that the a.m. peak period is expected to be minimally affected with no change in operating performance and intersection delay. The p.m. peak experienced more impacts with intersection delays increasing by 3 seconds to 25 seconds and the SBTL operating at a LOS of D and v/c of 0.9. A summary is shown in Exhibit 12.

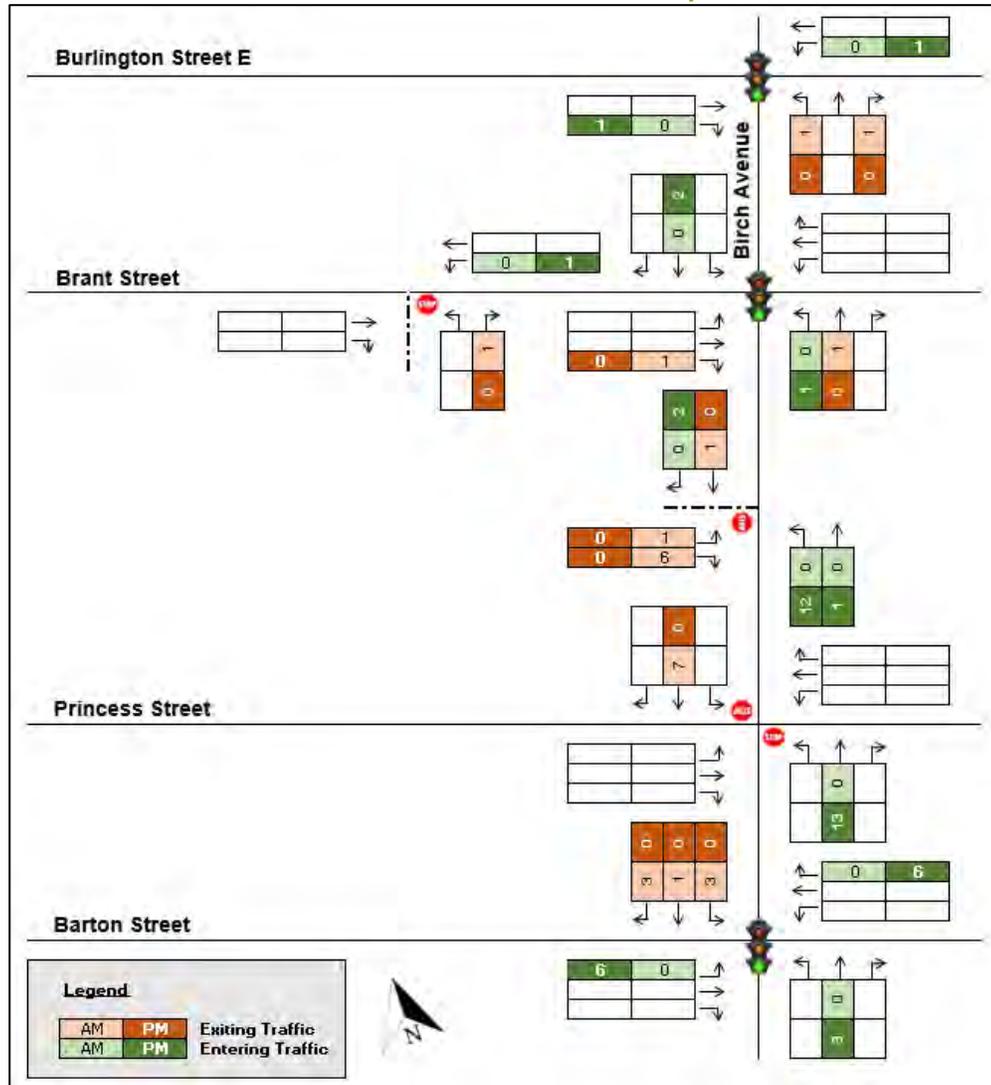
City of Hamilton – December 4, 2019

Exhibit 9: Hamilton MSF Employee Passenger Vehicle Site Generated Trips



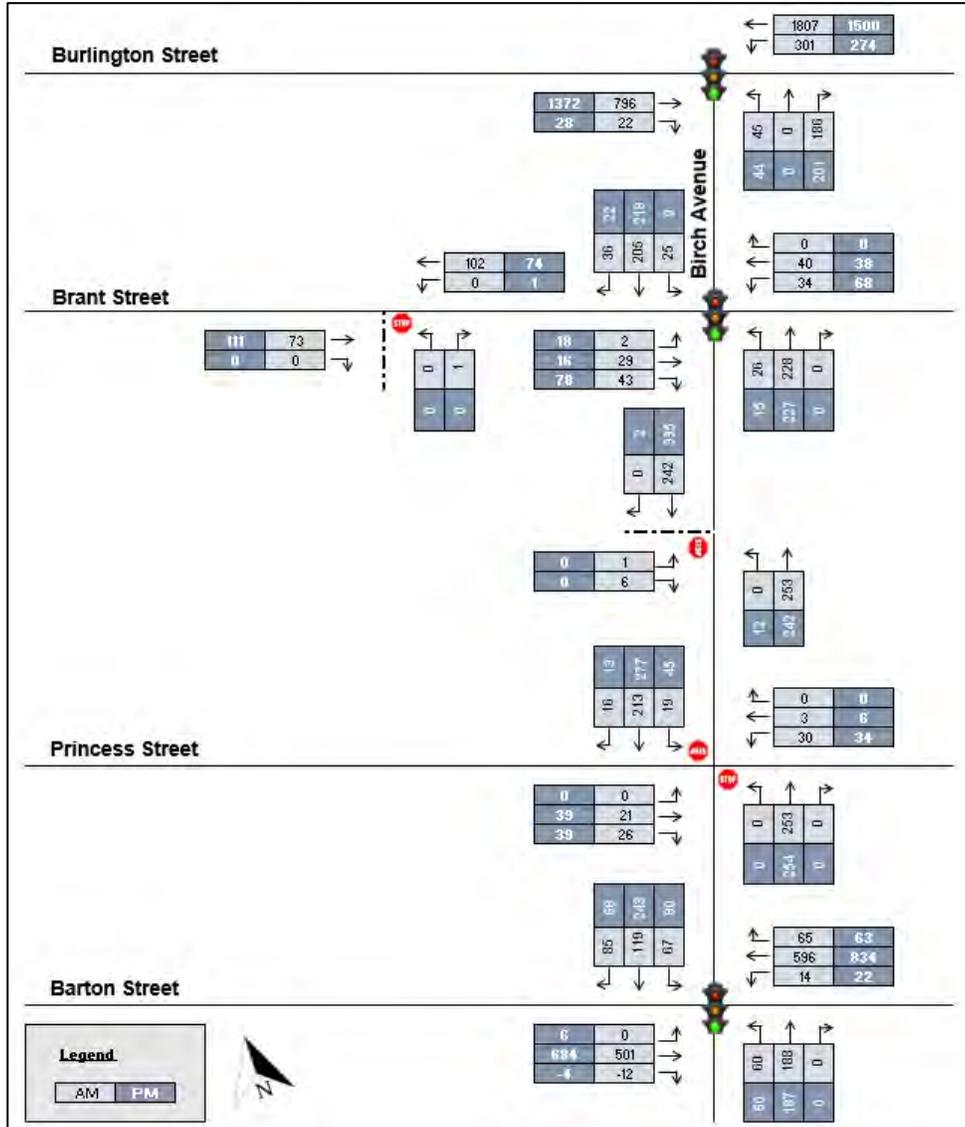
City of Hamilton – December 4, 2019

Exhibit 10: Hamilton MSF Bus Fleet Site Generated Trips



City of Hamilton – December 4, 2019

Exhibit 11: Future 2031 Two-Way Traffic Volumes



City of Hamilton – December 4, 2019

Exhibit 12: Summary of Barton Street Changes

Peak Period	Intersection	Intersection LOS	Intersection Delay	Intersection V/C Ratio	All Movements				
					Mvnt	LOS	Delay (s)	V/C Ratio	95th Percentile Queue (m)
Without Changes									
AM PEAK	Barton Street E and Birch Avenue	B	18.4	0.45	EBT	B	19	0.48	52
					WBL	B	18	0.26	17
					WBT	B	19	0.48	57
					NBL	B	19	0.12	12
					NBT	C	22	0.41	56
					SBL	B	13	0.21	11
					SBT	B	13	0.45	28
	Barton Street E	C	22.4	0.64	EBT	C	24	0.67	77
					WBL	C	26	0.44	23
					WBT	C	23	0.66	86
					NBL	B	19	0.20	14
					NBT	C	25	0.58	83
					SBL	B	15	0.30	13
					SBT	B	18	0.65	47
Southbound Shared Through Left and Right Lane									
PM PEAK	Barton Street E and Birch Avenue	B	18.4	0.47	EBT	B	19	0.48	52
					WBL	B	18	0.26	17
					WBT	B	19	0.48	57
					NBL	B	19	0.12	12
					NBT	C	22	0.41	56
					SBT	B	15	0.51	31
					SBR	A	8	0.07	-
	Barton Street E	C	25.2	0.75	EBT	C	24	0.67	77
					WBL	C	26	0.44	23
					WBT	C	23	0.66	86
					NBL	B	19	0.20	14
					NBT	C	25	0.58	83
					SBT	D	39	0.90	114
					SBR	A	8	0.06	4

City of Hamilton – December 4, 2019

2031 Traffic Operations

An assumed initial lane 2031 lane configuration was drawn from the City of Hamilton's proposed pavement markings plan which is provided in the Appendix. The lane configuration includes the following:

- Reduction of westbound left at Burlington Street from double-left turn (two lanes) to single.
- Shared left, through, and right turning lanes for all approaches at Birch Avenue and Brant Street.
- Shared left, through, and right turning lanes for all approaches at Birch Avenue and Princess Street.
- Dedicated left-turning and shared through-right turning lanes for the northbound and southbound approach at Birch Avenue and Barton Street.

Exhibit 13 summarizes the level-of-service and critical movements for the study intersections. Synchro was used to optimize signal timing splits for all signalized intersections. Detailed Synchro HCM reports are included in the Appendix. The following were observed:

- The study area performs well with all intersections having at a level-of-service of C or greater.
- In comparison to Future 2031 do nothing condition, the intersections of Birch Avenue & Burlington Street dropped in level-of-service. This is due to the removal of a westbound left turn lane as described. The storage length remains sufficient.
- The MSF bus access is expected to operate well, with expected general free-flow conditions during both peak periods.
- Level-of-service at Birch Ave and Barton Street dropped from B to C due to the introduced allowance of northbound movements.

Overall, the network is still performing well with no movements operating past capacity at any of the study intersections indicating stable traffic conditions without significant delay or disruption.

City of Hamilton – December 4, 2019

Exhibit 13: Future 2031 Two-Way Traffic Analysis (All Movements) Summary

Intersection Name	Overall LOS	All Movements			
		Mvmt	LOS	V/C Ratio	95th Percentile Queue (m)
AM Peak					
Birch Avenue & Burlington Street E <i>(Signalized)</i>	C	EBT	B	0.43	46
		WBL	E	0.95	116
		WBT	A	0.55	48
		NBL	C	0.28	20
		NBR	C	0.3	58
Birch Avenue & Brant Street <i>(Signalized)</i>	B	EBT	B	0.1	12
		WBT	B	0.12	16
		NBT	C	0.45	62
		SBT	B	0.5	65
Birch Avenue & MSF Bus Access <i>(Unsignalized)</i>	-	EBL	B	0	0
		EBR	B	0.02	1
		NBL	A	0	0
		NBT	A	0	0
		SBTR	A	0.19	0
Birch Avenue & Princess Street <i>(Unsignalized)</i>	-	EB	B	0.11	3
		WB	C	0.13	3
		NB	-	0	0
		SB	-	0.02	0
Birch Avenue & Barton Street E <i>(Signalized)</i>	C	EBT	B	0.48	52
		WBL	B	0.26	17
		WBT	B	0.48	57
		NBL	B	0.12	12
		NBT	C	0.41	56
		SBL	B	0.21	11
		SBT	B	0.45	28
PM Peak					
Birch Avenue & Burlington Street E <i>(Signalized)</i>	C	EBT	C	0.73	93
		WBL	E	0.87	104
		WBT	A	0.46	36
		NBL	C	0.37	23
		NBR	C	0.57	85
Birch Avenue & Brant Street <i>(Signalized)</i>	B	EBT	B	0.12	14
		WBT	B	0.19	22
		NBT	C	0.55	79
		SBT	B	0.46	67
Birch Avenue & MSF Bus Access <i>(Unsignalized)</i>	-	EBL	-	0	0
		EBR	-	0	1
		NBL	A	0.01	1
		NBT	A	0.02	1
		SBTR	A	0.25	0
Birch Avenue & Princess Street <i>(Unsignalized)</i>	-	EB	C	0.26	8
		WB	C	0.24	7
		NB	-	0	0
		SB	-	0.04	1
Birch Avenue & Barton Street E <i>(Signalized)</i>	C	EBT	C	0.67	77
		WBL	C	0.44	23
		WBT	C	0.66	86
		NBL	B	0.20	14
		NBT	C	0.58	83
		SBL	B	0.30	13
		SBT	B	0.65	47

City of Hamilton – December 4, 2019

Mitigation Measures

Signal warrants were performed and lane requirements were analyzed in consideration of safety and performance. The following measures are recommended in Exhibit 14.

Exhibit 14: Signal Warrants and Lane Requirements

Birch Ave Intersecting	Signalized	Signal Warranted	Lane Requirements	Lane Constraints
Burlington Street	Yes	Yes	Reduction to a single WBL lane Preferably a NBL: 30m Storage	Hydro tower
Brant Street	Yes	No, But are needed due to sight line concerns	Provide Left turn lane if space permits	
MSF Bus Access	No	No	NBL: 30m Storage	May require relocation of hydro tower south of bridge 330
Princess Street	No	No	SBL: 15m Storage Opposing NBL	Constructability issues due to structure on west side
Barton Street	Yes	Yes	SBL: 45m Storage NBL: 20m Storage	

The intersection of Birch Avenue & Burlington Street warrants signals. From a traffic operations perspective, providing a single NBL turning lane (with 30m storage) is preferable to separate from NBR demands with better allowance for right-turns-on-red (RTOR). Presently, there are some hydro concerns (hydro tower), with final recommendations of the NBL turning lane subject to further design review. Reducing the dual WBL lane to a single lane also appears appropriate, with the movement operating below capacity and with sufficient storage. At Birch Avenue & Brant Street, signals are not warranted however are deemed required due to traffic safety / sightline concerns. Short pocket left-turn lanes should also be provided for safety if space permits. At the bus access off Birch Avenue, it is noted that bus fleet vehicles entering the MSF will occur in a short duration (i.e. platooning effect). To ensure that appropriate separation is provided from through traffic, a dedicated NBL turning lane should be provided with storage for at least two buses (i.e. 30m storage). Birch Avenue & Princess Street only requires a southbound left with 15m storage. Birch Avenue & Barton Street will require northbound (45m) and southbound (20m) left turning lanes.

City of Hamilton – December 4, 2019

Conclusion

Under current conditions, all intersections in the study area in 2019 are performing well, with a level-of-service of B or greater, and there are no critical intersections or movements.

To determine the future growth along Birch Avenue, a macro model and historical data was used to determine a growth rate of 2.2% per year. Using this growth rate, future traffic volumes were forecasted into the horizon year of 2031 for both future do nothing (one-way) scenario and the two-way conversion of Birch Avenue scenario. Under the one-way scenario, traffic continues to operate well with no new critical movements.

Findings with conversion into a two-way street revealed no major impact to the network performance, however a number of changes to intersection lane configuration were developed to accommodate traffic and safety. With recommendations, all intersections are performing at a level-of-service of C or greater indicating moderate to little delay. No changes to intersection signalization are necessary. Recommended lane configuration is provided in Exhibit 14.

Appendix A – Existing (2019)
Conditions Synchro Output

Lanes, Volumes, Timings
9: Birch Avenue & Burlington Street E

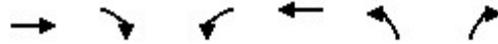
AM Peak Period
09-18-2019



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑		↵↵	↑↑↑		
Traffic Volume (vph)	631	22	251	1392	0	0
Future Volume (vph)	631	22	251	1392	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)		0.0	125.0		0.0	0.0
Storage Lanes		0	2		0	0
Taper Length (m)			15.0		15.0	
Lane Util. Factor	0.91	0.91	0.97	0.91	1.00	1.00
Frt	0.995					
Flt Protected			0.950			
Satd. Flow (prot)	4457	0	3134	4643	0	0
Flt Permitted			0.950			
Satd. Flow (perm)	4457	0	3134	4643	0	0
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	11					
Link Speed (k/h)	50			50	50	
Link Distance (m)	358.3			130.8	242.7	
Travel Time (s)	25.8			9.4	17.5	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	12%	10%	8%	8%	0%	0%
Adj. Flow (vph)	686	24	273	1513	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	710	0	273	1513	0	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	6.6			6.6	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane	Yes					
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (k/h)		14	24		24	14
Turn Type	NA		Prot	NA		
Protected Phases	2		4	2 4		
Permitted Phases						
Minimum Split (s)	47.0		15.1			
Total Split (s)	62.0		28.0			
Total Split (%)	68.9%		31.1%			
Maximum Green (s)	57.0		22.9			
Yellow Time (s)	3.7		3.7			
All-Red Time (s)	1.3		1.4			
Lost Time Adjust (s)	0.0		0.0			
Total Lost Time (s)	5.0		5.1			
Lead/Lag						
Lead-Lag Optimize?						
Walk Time (s)	30.0					
Flash Dont Walk (s)	12.0					
Pedestrian Calls (#/hr)	0					
Act Effct Green (s)	57.0		22.9	90.0		
Actuated g/C Ratio	0.63		0.25	1.00		

Lanes, Volumes, Timings
 9: Birch Avenue & Burlington Street E

AM Peak Period
 09-18-2019



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
v/c Ratio	0.25		0.34	0.33		
Control Delay	7.3		28.9	0.2		
Queue Delay	0.0		0.0	0.0		
Total Delay	7.3		28.9	0.2		
LOS	A		C	A		
Approach Delay	7.3			4.6		
Approach LOS	A			A		
Queue Length 50th (m)	17.3		19.8	0.0		
Queue Length 95th (m)	22.8		30.5	0.0		
Internal Link Dist (m)	334.3			106.8	218.7	
Turn Bay Length (m)			125.0			
Base Capacity (vph)	2826		797	4643		
Starvation Cap Reductn	0		0	0		
Spillback Cap Reductn	0		0	0		
Storage Cap Reductn	0		0	0		
Reduced v/c Ratio	0.25		0.34	0.33		

Intersection Summary

Area Type: Other
 Cycle Length: 90
 Actuated Cycle Length: 90
 Offset: 0 (0%), Referenced to phase 2:EBWB and 6:, Start of Green
 Natural Cycle: 65
 Control Type: Pretimed
 Maximum v/c Ratio: 0.34
 Intersection Signal Delay: 5.4
 Intersection Capacity Utilization 31.1%
 Analysis Period (min) 15
 Intersection LOS: A
 ICU Level of Service A

Splits and Phases: 9: Birch Avenue & Burlington Street E



Lanes, Volumes, Timings
11: Barton Street E

AM Peak Period
09-18-2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	386	13	47	459	0	0	0	0	48	128	63
Future Volume (vph)	0	386	13	47	459	0	0	0	0	48	128	63
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	25.0		0.0	0.0		0.0	0.0		115.0
Storage Lanes	0		0	1		0	0		0	0		1
Taper Length (m)	15.0			15.0			15.0			15.0		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	1.00	1.00	1.00	1.00	0.91	0.91	1.00
Frt		0.995										0.850
Flt Protected				0.950							0.987	
Satd. Flow (prot)	0	3136	0	1466	3231	0	0	0	0	0	4300	1432
Flt Permitted				0.479							0.987	
Satd. Flow (perm)	0	3136	0	739	3231	0	0	0	0	0	4300	1432
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		5										68
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		267.6			160.3			258.1			238.7	
Travel Time (s)		19.3			11.5			18.6			17.2	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	11%	2%	19%	8%	2%	2%	2%	2%	2%	20%	9%
Adj. Flow (vph)	0	420	14	51	499	0	0	0	0	52	139	68
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	434	0	51	499	0	0	0	0	0	191	68
Enter Blocked Intersection	No	No	No	No	No	No						
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane					Yes							
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type		NA		Perm	NA					Perm	NA	Perm
Protected Phases		2			2						4	
Permitted Phases				2						4		4
Minimum Split (s)		21.3		21.3	21.3					32.5	32.5	32.5
Total Split (s)		47.0		47.0	47.0					38.0	38.0	38.0
Total Split (%)		52.2%		52.2%	52.2%					42.2%	42.2%	42.2%
Maximum Green (s)		41.7		41.7	41.7					32.5	32.5	32.5
Yellow Time (s)		3.3		3.3	3.3					3.3	3.3	3.3
All-Red Time (s)		2.0		2.0	2.0					2.2	2.2	2.2
Lost Time Adjust (s)		0.0		0.0	0.0						0.0	0.0
Total Lost Time (s)		5.3		5.3	5.3						5.5	5.5
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)		7.0		7.0	7.0					16.0	16.0	16.0
Flash Dont Walk (s)		9.0		9.0	9.0					11.0	11.0	11.0
Pedestrian Calls (#/hr)		0		0	0					0	0	0
Act Effct Green (s)		41.7		41.7	41.7						32.5	32.5
Actuated g/C Ratio		0.46		0.46	0.46						0.36	0.36

Lane Group	Ø8
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (m)	
Storage Lanes	
Taper Length (m)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (k/h)	
Link Distance (m)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(m)	
Link Offset(m)	
Crosswalk Width(m)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (k/h)	
Turn Type	
Protected Phases	8
Permitted Phases	
Minimum Split (s)	5.0
Total Split (s)	5.0
Total Split (%)	6%
Maximum Green (s)	3.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Walk Time (s)	5.0
Flash Dont Walk (s)	0.0
Pedestrian Calls (#/hr)	0
Act Effct Green (s)	
Actuated g/C Ratio	

Lanes, Volumes, Timings
11: Barton Street E

AM Peak Period
09-18-2019

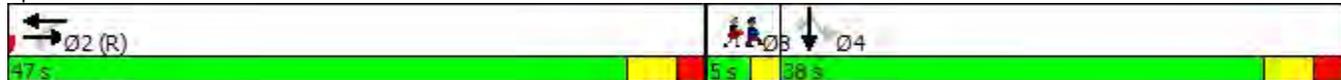


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio		0.30		0.15	0.33						0.12	0.12
Control Delay		15.6		15.4	16.1						9.1	1.5
Queue Delay		0.0		0.0	0.0						0.0	0.0
Total Delay		15.6		15.4	16.1						9.1	1.5
LOS		B		B	B						A	A
Approach Delay		15.6			16.1						7.1	
Approach LOS		B			B						A	
Queue Length 50th (m)		23.3		4.9	27.7						3.6	0.0
Queue Length 95th (m)		33.5		11.9	38.8						6.1	0.0
Internal Link Dist (m)		243.6			136.3			234.1			214.7	
Turn Bay Length (m)				25.0								115.0
Base Capacity (vph)		1455		342	1497						1552	560
Starvation Cap Reductn		0		0	0						0	0
Spillback Cap Reductn		0		0	0						0	0
Storage Cap Reductn		0		0	0						0	0
Reduced v/c Ratio		0.30		0.15	0.33						0.12	0.12

Intersection Summary

Area Type:	Other
Cycle Length:	90
Actuated Cycle Length:	90
Offset:	0 (0%), Referenced to phase 2:EBWB, Start of Green
Natural Cycle:	60
Control Type:	Pretimed
Maximum v/c Ratio:	0.33
Intersection Signal Delay:	14.0
Intersection LOS:	B
Intersection Capacity Utilization:	41.2%
ICU Level of Service:	A
Analysis Period (min):	15

Splits and Phases: 11: Barton Street E



Lane Group	Ø8
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (m)	
Queue Length 95th (m)	
Internal Link Dist (m)	
Turn Bay Length (m)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

Lanes, Volumes, Timings
15: Brant Street & Birch Avenue

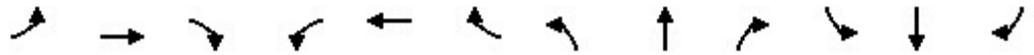
AM Peak Period
09-18-2019



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	22	30	26	31	0	0	0	0	19	196	15
Future Volume (vph)	0	22	30	26	31	0	0	0	0	19	196	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	0.0		0.0	0.0		0.0	0.0		150.0
Storage Lanes	0		0	0		0	0		0	0		0
Taper Length (m)	15.0			15.0			15.0			15.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.91	0.91
Frt		0.922										0.990
Flt Protected					0.978							0.996
Satd. Flow (prot)	0	1400	0	0	1649	0	0	0	0	0	4466	0
Flt Permitted					0.891							0.996
Satd. Flow (perm)	0	1400	0	0	1502	0	0	0	0	0	4466	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		33										15
Link Speed (k/h)		50			50			50				50
Link Distance (m)		157.8			106.5			75.7				242.7
Travel Time (s)		11.4			7.7			5.5				17.5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	36%	10%	4%	13%	0%	0%	0%	0%	16%	10%	13%
Adj. Flow (vph)	0	24	33	28	34	0	0	0	0	21	213	16
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	57	0	0	62	0	0	0	0	0	250	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0				0.0
Link Offset(m)		0.0			0.0			0.0				0.0
Crosswalk Width(m)		1.6			1.6			1.6				1.6
Two way Left Turn Lane												
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type		NA		Perm	NA						Perm	NA
Protected Phases		4			8							2
Permitted Phases				8						2		
Minimum Split (s)		32.5		32.5	32.5					23.4	23.4	
Total Split (s)		46.0		46.0	46.0					44.0	44.0	
Total Split (%)		51.1%		51.1%	51.1%					48.9%	48.9%	
Maximum Green (s)		40.5		40.5	40.5					38.6	38.6	
Yellow Time (s)		3.3		3.3	3.3					3.3	3.3	
All-Red Time (s)		2.2		2.2	2.2					2.1	2.1	
Lost Time Adjust (s)		0.0			0.0							0.0
Total Lost Time (s)		5.5			5.5							5.4
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)		17.0		17.0	17.0					7.0	7.0	
Flash Dont Walk (s)		10.0		10.0	10.0					11.0	11.0	
Pedestrian Calls (#/hr)		0		0	0					0	0	
Act Effct Green (s)		40.5			40.5							38.6
Actuated g/C Ratio		0.45			0.45							0.43

Lanes, Volumes, Timings
15: Brant Street & Birch Avenue

AM Peak Period
09-18-2019

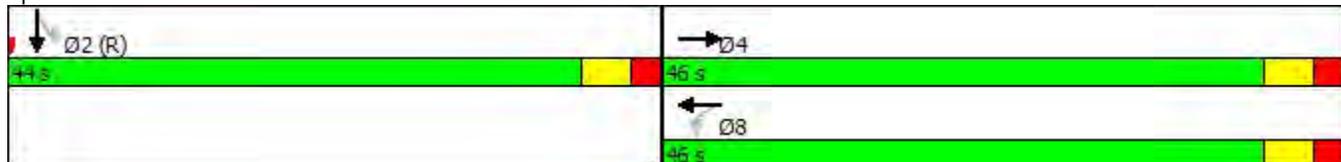


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio		0.09			0.09							0.13
Control Delay		8.1			14.8							7.6
Queue Delay		0.0			0.0							0.0
Total Delay		8.1			14.8							7.6
LOS		A			B							A
Approach Delay		8.1			14.8							7.6
Approach LOS		A			B							A
Queue Length 50th (m)		2.2			6.0							13.4
Queue Length 95th (m)		8.7			13.1							20.8
Internal Link Dist (m)		133.8			82.5			51.7				218.7
Turn Bay Length (m)												
Base Capacity (vph)		648			675							1923
Starvation Cap Reductn		0			0							0
Spillback Cap Reductn		0			0							0
Storage Cap Reductn		0			0							0
Reduced v/c Ratio		0.09			0.09							0.13

Intersection Summary

Area Type:	Other
Cycle Length:	90
Actuated Cycle Length:	90
Offset:	0 (0%), Referenced to phase 2:SBTL and 6:, Start of Green
Natural Cycle:	60
Control Type:	Pretimed
Maximum v/c Ratio:	0.13
Intersection Signal Delay:	8.9
Intersection Capacity Utilization	27.2%
Analysis Period (min)	15
Intersection LOS:	A
ICU Level of Service	A

Splits and Phases: 15: Brant Street & Birch Avenue



Lanes, Volumes, Timings
38: Princess Street & Birch Ave

AM Peak Period
09-18-2019



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔						↕↕↕	↗
Traffic Volume (vph)	0	16	20	23	2	0	0	0	0	15	194	12
Future Volume (vph)	0	16	20	23	2	0	0	0	0	15	194	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	0.0		0.0	0.0		0.0	0.0		50.0
Storage Lanes	0		0	0		0	0		0	0		1
Taper Length (m)	15.0			15.0			15.0			15.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.91	1.00
Frt		0.924										0.850
Flt Protected					0.956						0.996	
Satd. Flow (prot)	0	1636	0	0	1719	0	0	0	0	0	4627	1249
Flt Permitted					0.956						0.996	
Satd. Flow (perm)	0	1636	0	0	1719	0	0	0	0	0	4627	1249
Link Speed (k/h)		48			48			48			48	
Link Distance (m)		182.7			76.5			238.7			195.6	
Travel Time (s)		13.7			5.7			17.9			14.7	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	6%	2%	2%	4%	2%	2%	2%	2%	7%	8%	25%
Adj. Flow (vph)	0	17	22	25	2	0	0	0	0	16	211	13
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	39	0	0	27	0	0	0	0	0	227	13
Enter Blocked Intersection	No	No	No									
Lane Alignment	Left	Left	Right									
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	18.8%
ICU Level of Service	A
Analysis Period (min)	15

Lanes, Volumes, Timings
9: Birch Avenue & Burlington Street E

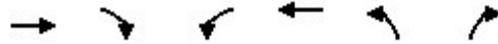
PM Peak Period
09-18-2019



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑		↔	↑↑↑		
Traffic Volume (vph)	1057	26	236	1155	0	0
Future Volume (vph)	1057	26	236	1155	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)		0.0	125.0		0.0	0.0
Storage Lanes		0	2		0	0
Taper Length (m)			15.0		15.0	
Lane Util. Factor	0.91	0.91	0.97	0.91	1.00	1.00
Frt	0.996					
Flt Protected			0.950			
Satd. Flow (prot)	4718	0	3224	4821	0	0
Flt Permitted			0.950			
Satd. Flow (perm)	4718	0	3224	4821	0	0
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	8					
Link Speed (k/h)	50			50	50	
Link Distance (m)	358.3			130.8	242.7	
Travel Time (s)	25.8			9.4	17.5	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	6%	0%	5%	4%	0%	0%
Adj. Flow (vph)	1149	28	257	1255	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1177	0	257	1255	0	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	6.6			6.6	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane	Yes					
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (k/h)		14	24		24	14
Turn Type	NA		Prot	NA		
Protected Phases	2		4	2 4		
Permitted Phases						
Minimum Split (s)	47.0		15.1			
Total Split (s)	62.0		28.0			
Total Split (%)	68.9%		31.1%			
Maximum Green (s)	57.0		22.9			
Yellow Time (s)	3.7		3.7			
All-Red Time (s)	1.3		1.4			
Lost Time Adjust (s)	0.0		0.0			
Total Lost Time (s)	5.0		5.1			
Lead/Lag						
Lead-Lag Optimize?						
Walk Time (s)	30.0					
Flash Dont Walk (s)	12.0					
Pedestrian Calls (#/hr)	0					
Act Effct Green (s)	57.0		22.9	90.0		
Actuated g/C Ratio	0.63		0.25	1.00		

Lanes, Volumes, Timings
 9: Birch Avenue & Burlington Street E

PM Peak Period
 09-18-2019



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
v/c Ratio	0.39		0.31	0.26		
Control Delay	8.5		28.5	0.1		
Queue Delay	0.0		0.0	0.0		
Total Delay	8.5		28.5	0.1		
LOS	A		C	A		
Approach Delay	8.5			4.9		
Approach LOS	A			A		
Queue Length 50th (m)	32.5		18.6	0.0		
Queue Length 95th (m)	40.5		28.8	0.0		
Internal Link Dist (m)	334.3			106.8	218.7	
Turn Bay Length (m)			125.0			
Base Capacity (vph)	2991		820	4821		
Starvation Cap Reductn	0		0	0		
Spillback Cap Reductn	0		0	0		
Storage Cap Reductn	0		0	0		
Reduced v/c Ratio	0.39		0.31	0.26		

Intersection Summary

Area Type: Other
 Cycle Length: 90
 Actuated Cycle Length: 90
 Offset: 0 (0%), Referenced to phase 2:EBWB and 6:, Start of Green
 Natural Cycle: 65
 Control Type: Pretimed
 Maximum v/c Ratio: 0.39
 Intersection Signal Delay: 6.5
 Intersection Capacity Utilization 37.8%
 Analysis Period (min) 15
 Intersection LOS: A
 ICU Level of Service A

Splits and Phases: 9: Birch Avenue & Burlington Street E



Lanes, Volumes, Timings
11: Barton Street E

PM Peak Period
09-18-2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	527	19	53	642	0	0	0	0	48	218	52
Future Volume (vph)	0	527	19	53	642	0	0	0	0	48	218	52
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	25.0		0.0	0.0		0.0	0.0		115.0
Storage Lanes	0		0	1		0	0		0	0		1
Taper Length (m)	15.0			15.0			15.0			15.0		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	1.00	1.00	1.00	1.00	0.91	0.91	1.00
Frt		0.995										0.850
Flt Protected				0.950							0.991	
Satd. Flow (prot)	0	3372	0	1616	3355	0	0	0	0	0	4757	1561
Flt Permitted				0.363							0.991	
Satd. Flow (perm)	0	3372	0	617	3355	0	0	0	0	0	4757	1561
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		5										57
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		267.6			160.3			258.1			238.7	
Travel Time (s)		19.3			11.5			18.6			17.2	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	3%	2%	8%	4%	2%	2%	2%	2%	2%	5%	0%
Adj. Flow (vph)	0	573	21	58	698	0	0	0	0	52	237	57
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	594	0	58	698	0	0	0	0	0	289	57
Enter Blocked Intersection	No	No	No	No	No	No						
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane					Yes							
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type		NA		Perm	NA					Perm	NA	Perm
Protected Phases		2			2						4	
Permitted Phases				2						4		4
Minimum Split (s)		21.3		21.3	21.3					40.5	40.5	40.5
Total Split (s)		43.0		43.0	43.0					42.0	42.0	42.0
Total Split (%)		47.8%		47.8%	47.8%					46.7%	46.7%	46.7%
Maximum Green (s)		37.7		37.7	37.7					36.5	36.5	36.5
Yellow Time (s)		3.3		3.3	3.3					3.3	3.3	3.3
All-Red Time (s)		2.0		2.0	2.0					2.2	2.2	2.2
Lost Time Adjust (s)		0.0		0.0	0.0						0.0	0.0
Total Lost Time (s)		5.3		5.3	5.3						5.5	5.5
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)		7.0		7.0	7.0					24.0	24.0	24.0
Flash Dont Walk (s)		9.0		9.0	9.0					11.0	11.0	11.0
Pedestrian Calls (#/hr)		0		0	0					0	0	0
Act Effct Green (s)		37.7		37.7	37.7						36.5	36.5
Actuated g/C Ratio		0.42		0.42	0.42						0.41	0.41

Lane Group	Ø8
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (m)	
Storage Lanes	
Taper Length (m)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (k/h)	
Link Distance (m)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(m)	
Link Offset(m)	
Crosswalk Width(m)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (k/h)	
Turn Type	
Protected Phases	8
Permitted Phases	
Minimum Split (s)	5.0
Total Split (s)	5.0
Total Split (%)	6%
Maximum Green (s)	3.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Walk Time (s)	5.0
Flash Dont Walk (s)	0.0
Pedestrian Calls (#/hr)	0
Act Effct Green (s)	
Actuated g/C Ratio	

Lanes, Volumes, Timings
11: Barton Street E

PM Peak Period
09-18-2019

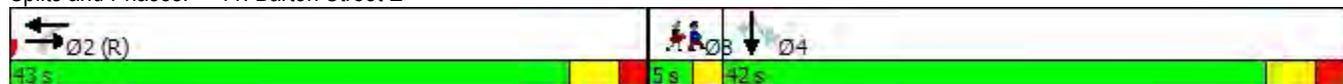


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio		0.42		0.22	0.50						0.15	0.09
Control Delay		19.4		19.8	20.7						10.7	2.3
Queue Delay		0.0		0.0	0.0						0.0	0.0
Total Delay		19.4		19.8	20.7						10.7	2.3
LOS		B		B	C						B	A
Approach Delay		19.4			20.6						9.3	
Approach LOS		B			C						A	
Queue Length 50th (m)		36.6		6.3	45.4						6.9	0.0
Queue Length 95th (m)		50.3		15.0	61.0						10.6	2.8
Internal Link Dist (m)		243.6			136.3			234.1			214.7	
Turn Bay Length (m)				25.0								115.0
Base Capacity (vph)		1415		258	1405						1929	666
Starvation Cap Reductn		0		0	0						0	0
Spillback Cap Reductn		0		0	0						0	0
Storage Cap Reductn		0		0	0						0	0
Reduced v/c Ratio		0.42		0.22	0.50						0.15	0.09

Intersection Summary

Area Type:	Other
Cycle Length:	90
Actuated Cycle Length:	90
Offset:	0 (0%), Referenced to phase 2:EBWB, Start of Green
Natural Cycle:	70
Control Type:	Pretimed
Maximum v/c Ratio:	0.50
Intersection Signal Delay:	17.9
Intersection LOS:	B
Intersection Capacity Utilization:	45.3%
ICU Level of Service:	A
Analysis Period (min):	15

Splits and Phases: 11: Barton Street E



Lane Group	Ø8
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (m)	
Queue Length 95th (m)	
Internal Link Dist (m)	
Turn Bay Length (m)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

Lanes, Volumes, Timings
15: Brant Street & Birch Avenue

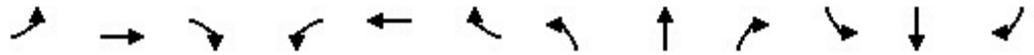
PM Peak Period
09-18-2019



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	12	39	52	29	0	0	0	0	7	204	10
Future Volume (vph)	0	12	39	52	29	0	0	0	0	7	204	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	0.0		0.0	0.0		0.0	0.0		150.0
Storage Lanes	0		0	0		0	0		0	0		0
Taper Length (m)	15.0			15.0			15.0			15.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.91	0.91
Frt		0.897										0.993
Flt Protected					0.969							0.998
Satd. Flow (prot)	0	1559	0	0	1691	0	0	0	0	0	4749	0
Flt Permitted					0.820							0.998
Satd. Flow (perm)	0	1559	0	0	1431	0	0	0	0	0	4749	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		42										10
Link Speed (k/h)		50			50			50				50
Link Distance (m)		157.8			106.5			75.7				242.7
Travel Time (s)		11.4			7.7			5.5				17.5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	8%	5%	2%	11%	0%	0%	0%	0%	29%	3%	20%
Adj. Flow (vph)	0	13	42	57	32	0	0	0	0	8	222	11
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	55	0	0	89	0	0	0	0	0	241	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0				0.0
Link Offset(m)		0.0			0.0			0.0				0.0
Crosswalk Width(m)		1.6			1.6			1.6				1.6
Two way Left Turn Lane												
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type		NA		Perm	NA						Perm	NA
Protected Phases		4			8							2
Permitted Phases				8						2		
Minimum Split (s)		32.5		32.5	32.5					23.4	23.4	
Total Split (s)		46.0		46.0	46.0					44.0	44.0	
Total Split (%)		51.1%		51.1%	51.1%					48.9%	48.9%	
Maximum Green (s)		40.5		40.5	40.5					38.6	38.6	
Yellow Time (s)		3.3		3.3	3.3					3.3	3.3	
All-Red Time (s)		2.2		2.2	2.2					2.1	2.1	
Lost Time Adjust (s)		0.0			0.0							0.0
Total Lost Time (s)		5.5			5.5							5.4
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)		17.0		17.0	17.0					7.0	7.0	
Flash Dont Walk (s)		10.0		10.0	10.0					11.0	11.0	
Pedestrian Calls (#/hr)		0		0	0					0	0	
Act Effct Green (s)		40.5			40.5							38.6
Actuated g/C Ratio		0.45			0.45							0.43

Lanes, Volumes, Timings
 15: Brant Street & Birch Avenue

PM Peak Period
 09-18-2019

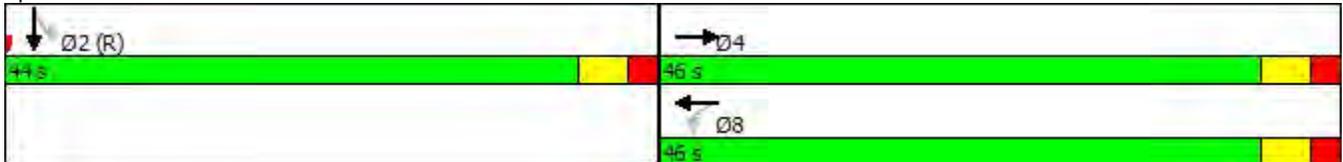


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio		0.08			0.14							0.12
Control Delay		6.5			15.3							7.9
Queue Delay		0.0			0.0							0.0
Total Delay		6.5			15.3							7.9
LOS		A			B							A
Approach Delay		6.5			15.3							7.9
Approach LOS		A			B							A
Queue Length 50th (m)		1.2			8.7							12.9
Queue Length 95th (m)		7.5			17.5							20.1
Internal Link Dist (m)		133.8			82.5			51.7				218.7
Turn Bay Length (m)												
Base Capacity (vph)		724			643							2042
Starvation Cap Reductn		0			0							0
Spillback Cap Reductn		0			0							0
Storage Cap Reductn		0			0							0
Reduced v/c Ratio		0.08			0.14							0.12

Intersection Summary

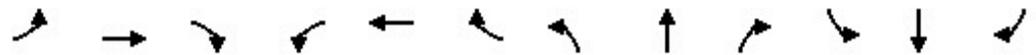
Area Type:	Other
Cycle Length:	90
Actuated Cycle Length:	90
Offset:	0 (0%), Referenced to phase 2:SBTL and 6:, Start of Green
Natural Cycle:	60
Control Type:	Pretimed
Maximum v/c Ratio:	0.14
Intersection Signal Delay:	9.4
Intersection Capacity Utilization	28.5%
Analysis Period (min)	15
Intersection LOS:	A
ICU Level of Service	A

Splits and Phases: 15: Brant Street & Birch Avenue



Lanes, Volumes, Timings
38: Princess Street & Birch Ave

PM Peak Period
09-18-2019



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔						↕↕↕	↗
Traffic Volume (vph)	0	30	30	26	5	0	0	0	0	35	230	10
Future Volume (vph)	0	30	30	26	5	0	0	0	0	35	230	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	0.0		0.0	0.0		0.0	0.0		50.0
Storage Lanes	0		0	0		0	0		0	0		1
Taper Length (m)	15.0			15.0			15.0			15.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.91	1.00
Frt		0.932										0.850
Flt Protected					0.959						0.993	
Satd. Flow (prot)	0	1556	0	0	1732	0	0	0	0	0	4769	1201
Flt Permitted					0.959						0.993	
Satd. Flow (perm)	0	1556	0	0	1732	0	0	0	0	0	4769	1201
Link Speed (k/h)		48			48			48			48	
Link Distance (m)		182.7			76.5			238.7			195.6	
Travel Time (s)		13.7			5.7			17.9			14.7	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	17%	3%	2%	0%	2%	2%	2%	2%	7%	4%	30%
Adj. Flow (vph)	0	33	33	28	5	0	0	0	0	38	250	11
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	66	0	0	33	0	0	0	0	0	288	11
Enter Blocked Intersection	No	No	No									
Lane Alignment	Left	Left	Right									
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	20.2%
ICU Level of Service	A
Analysis Period (min)	15

Appendix B – Future Base (2031)
Conditions Synchro Output

Lanes, Volumes, Timings
9: Birch Avenue & Burlington Street E

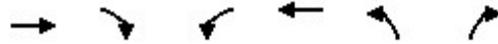
AM Peak Period
09-18-2019



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑		↔	↑↑↑		
Traffic Volume (vph)	796	29	343	1807	0	0
Future Volume (vph)	796	29	343	1807	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)		0.0	125.0		0.0	0.0
Storage Lanes		0	2		0	0
Taper Length (m)			15.0		15.0	
Lane Util. Factor	0.91	0.91	0.97	0.91	1.00	1.00
Frt	0.995					
Flt Protected			0.950			
Satd. Flow (prot)	4457	0	3134	4643	0	0
Flt Permitted			0.950			
Satd. Flow (perm)	4457	0	3134	4643	0	0
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	12					
Link Speed (k/h)	50			50	50	
Link Distance (m)	358.3			130.8	242.7	
Travel Time (s)	25.8			9.4	17.5	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	12%	10%	8%	8%	0%	0%
Adj. Flow (vph)	865	32	373	1964	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	897	0	373	1964	0	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	6.6			6.6	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane	Yes					
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (k/h)		14	24		24	14
Turn Type	NA		Prot	NA		
Protected Phases	2		4	2 4		
Permitted Phases						
Minimum Split (s)	47.0		15.1			
Total Split (s)	62.0		28.0			
Total Split (%)	68.9%		31.1%			
Maximum Green (s)	57.0		22.9			
Yellow Time (s)	3.7		3.7			
All-Red Time (s)	1.3		1.4			
Lost Time Adjust (s)	0.0		0.0			
Total Lost Time (s)	5.0		5.1			
Lead/Lag						
Lead-Lag Optimize?						
Walk Time (s)	30.0					
Flash Dont Walk (s)	12.0					
Pedestrian Calls (#/hr)	0					
Act Effct Green (s)	57.0		22.9	90.0		
Actuated g/C Ratio	0.63		0.25	1.00		

Lanes, Volumes, Timings
 9: Birch Avenue & Burlington Street E

AM Peak Period
 09-18-2019



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
v/c Ratio	0.32		0.47	0.42		
Control Delay	7.8		30.7	0.3		
Queue Delay	0.0		0.0	0.0		
Total Delay	7.8		30.7	0.3		
LOS	A		C	A		
Approach Delay	7.8			5.1		
Approach LOS	A			A		
Queue Length 50th (m)	23.1		28.1	0.0		
Queue Length 95th (m)	29.6		41.1	0.0		
Internal Link Dist (m)	334.3			106.8	218.7	
Turn Bay Length (m)			125.0			
Base Capacity (vph)	2827		797	4643		
Starvation Cap Reductn	0		0	0		
Spillback Cap Reductn	0		0	0		
Storage Cap Reductn	0		0	0		
Reduced v/c Ratio	0.32		0.47	0.42		

Intersection Summary

Area Type: Other
 Cycle Length: 90
 Actuated Cycle Length: 90
 Offset: 0 (0%), Referenced to phase 2:EBWB and 6:, Start of Green
 Natural Cycle: 65
 Control Type: Pretimed
 Maximum v/c Ratio: 0.47
 Intersection Signal Delay: 5.9
 Intersection Capacity Utilization 39.1%
 Analysis Period (min) 15
 Intersection LOS: A
 ICU Level of Service A

Splits and Phases: 9: Birch Avenue & Burlington Street E



Lanes, Volumes, Timings
11: Barton Street E

AM Peak Period
09-18-2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	501	17	61	596	0	0	0	0	65	169	86
Future Volume (vph)	0	501	17	61	596	0	0	0	0	65	169	86
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	25.0		0.0	0.0		0.0	0.0		115.0
Storage Lanes	0		0	1		0	0		0	0		1
Taper Length (m)	15.0			15.0			15.0			15.0		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	1.00	1.00	1.00	1.00	0.91	0.91	1.00
Frt		0.995										0.850
Flt Protected				0.950							0.986	
Satd. Flow (prot)	0	3136	0	1466	3231	0	0	0	0	0	4299	1432
Flt Permitted				0.396							0.986	
Satd. Flow (perm)	0	3136	0	611	3231	0	0	0	0	0	4299	1432
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		5										93
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		267.6			160.3			258.1			238.7	
Travel Time (s)		19.3			11.5			18.6			17.2	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	11%	2%	19%	8%	2%	2%	2%	2%	2%	20%	9%
Adj. Flow (vph)	0	545	18	66	648	0	0	0	0	71	184	93
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	563	0	66	648	0	0	0	0	0	255	93
Enter Blocked Intersection	No	No	No	No	No	No						
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane					Yes							
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type		NA		Perm	NA					Perm	NA	Perm
Protected Phases		2			2						4	
Permitted Phases				2						4		4
Minimum Split (s)		21.3		21.3	21.3					32.5	32.5	32.5
Total Split (s)		47.0		47.0	47.0					38.0	38.0	38.0
Total Split (%)		52.2%		52.2%	52.2%					42.2%	42.2%	42.2%
Maximum Green (s)		41.7		41.7	41.7					32.5	32.5	32.5
Yellow Time (s)		3.3		3.3	3.3					3.3	3.3	3.3
All-Red Time (s)		2.0		2.0	2.0					2.2	2.2	2.2
Lost Time Adjust (s)		0.0		0.0	0.0						0.0	0.0
Total Lost Time (s)		5.3		5.3	5.3						5.5	5.5
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)		7.0		7.0	7.0					16.0	16.0	16.0
Flash Dont Walk (s)		9.0		9.0	9.0					11.0	11.0	11.0
Pedestrian Calls (#/hr)		0		0	0					0	0	0
Act Effct Green (s)		41.7		41.7	41.7						32.5	32.5
Actuated g/C Ratio		0.46		0.46	0.46						0.36	0.36

Lane Group	Ø8
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (m)	
Storage Lanes	
Taper Length (m)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (k/h)	
Link Distance (m)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(m)	
Link Offset(m)	
Crosswalk Width(m)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (k/h)	
Turn Type	
Protected Phases	8
Permitted Phases	
Minimum Split (s)	5.0
Total Split (s)	5.0
Total Split (%)	6%
Maximum Green (s)	3.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Walk Time (s)	5.0
Flash Dont Walk (s)	0.0
Pedestrian Calls (#/hr)	0
Act Effct Green (s)	
Actuated g/C Ratio	

Lanes, Volumes, Timings
11: Barton Street E

AM Peak Period
09-18-2019

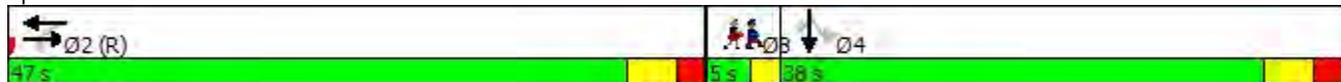


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio		0.39		0.23	0.43						0.16	0.16
Control Delay		16.6		17.4	17.4						10.2	1.7
Queue Delay		0.0		0.0	0.0						0.0	0.0
Total Delay		16.6		17.4	17.4						10.2	1.7
LOS		B		B	B						B	A
Approach Delay		16.6			17.4						7.9	
Approach LOS		B			B						A	
Queue Length 50th (m)		31.8		6.6	38.1						5.4	0.0
Queue Length 95th (m)		44.3		15.6	51.8						8.5	0.0
Internal Link Dist (m)		243.6			136.3			234.1			214.7	
Turn Bay Length (m)				25.0								115.0
Base Capacity (vph)		1455		283	1497						1552	576
Starvation Cap Reductn		0		0	0						0	0
Spillback Cap Reductn		0		0	0						0	0
Storage Cap Reductn		0		0	0						0	0
Reduced v/c Ratio		0.39		0.23	0.43						0.16	0.16

Intersection Summary

Area Type:	Other
Cycle Length:	90
Actuated Cycle Length:	90
Offset:	0 (0%), Referenced to phase 2:EBWB, Start of Green
Natural Cycle:	60
Control Type:	Pretimed
Maximum v/c Ratio:	0.43
Intersection Signal Delay:	15.1
Intersection LOS:	B
Intersection Capacity Utilization:	44.5%
ICU Level of Service:	A
Analysis Period (min):	15

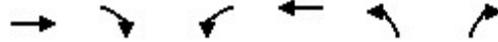
Splits and Phases: 11: Barton Street E



Lane Group	Ø8
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (m)	
Queue Length 95th (m)	
Internal Link Dist (m)	
Turn Bay Length (m)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

Lanes, Volumes, Timings
 14: Site Access #2 & Brant Street

AM Peak Period
 09-18-2019



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	73	0	0	102	0	1
Future Volume (vph)	73	0	0	102	0	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Fr _t						0.850
Fl _t Protected						
Satd. Flow (prot)	1505	0	0	1625	918	781
Fl _t Permitted						
Satd. Flow (perm)	1505	0	0	1625	918	781
Link Speed (k/h)	48			48	48	
Link Distance (m)	242.6			157.8	61.8	
Travel Time (s)	18.2			11.8	4.6	
Peak Hour Factor	0.92	0.70	0.70	0.92	0.70	0.70
Heavy Vehicles (%)	22%	100%	100%	13%	100%	100%
Adj. Flow (vph)	79	0	0	111	0	1
Shared Lane Traffic (%)						
Lane Group Flow (vph)	79	0	0	111	0	1
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	3.3	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	13.8%
ICU Level of Service	A
Analysis Period (min)	15

Lanes, Volumes, Timings
15: Brant Street & Birch Avenue

AM Peak Period
09-18-2019



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	29	43	34	40	0	0	0	0	25	254	36
Future Volume (vph)	0	29	43	34	40	0	0	0	0	25	254	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	0.0		0.0	0.0		0.0	0.0		150.0
Storage Lanes	0		0	0		0	0		0	0		0
Taper Length (m)	15.0			15.0			15.0			15.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.91	0.91
Frt		0.920										0.983
Flt Protected					0.977							0.996
Satd. Flow (prot)	0	1402	0	0	1649	0	0	0	0	0	4430	0
Flt Permitted					0.870							0.996
Satd. Flow (perm)	0	1402	0	0	1468	0	0	0	0	0	4430	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		47										32
Link Speed (k/h)		50			50			50				50
Link Distance (m)		157.8			106.5			75.7				242.7
Travel Time (s)		11.4			7.7			5.5				17.5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	36%	10%	4%	13%	0%	0%	0%	0%	16%	10%	13%
Adj. Flow (vph)	0	32	47	37	43	0	0	0	0	27	276	39
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	79	0	0	80	0	0	0	0	0	342	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0				0.0
Link Offset(m)		0.0			0.0			0.0				0.0
Crosswalk Width(m)		1.6			1.6			1.6				1.6
Two way Left Turn Lane												
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type		NA		Perm	NA						Perm	NA
Protected Phases		4			8							2
Permitted Phases				8						2		
Minimum Split (s)		32.5		32.5	32.5					23.4	23.4	
Total Split (s)		46.0		46.0	46.0					44.0	44.0	
Total Split (%)		51.1%		51.1%	51.1%					48.9%	48.9%	
Maximum Green (s)		40.5		40.5	40.5					38.6	38.6	
Yellow Time (s)		3.3		3.3	3.3					3.3	3.3	
All-Red Time (s)		2.2		2.2	2.2					2.1	2.1	
Lost Time Adjust (s)		0.0			0.0							0.0
Total Lost Time (s)		5.5			5.5							5.4
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)		17.0		17.0	17.0					7.0	7.0	
Flash Dont Walk (s)		10.0		10.0	10.0					11.0	11.0	
Pedestrian Calls (#/hr)		0		0	0					0	0	
Act Effct Green (s)		40.5			40.5							38.6
Actuated g/C Ratio		0.45			0.45							0.43

Lanes, Volumes, Timings
15: Brant Street & Birch Avenue

AM Peak Period
09-18-2019

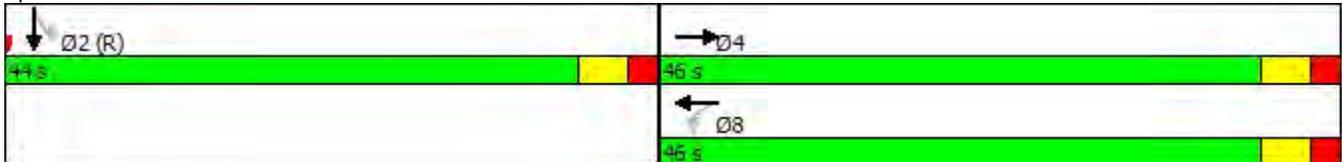


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio		0.12			0.12							0.18
Control Delay		7.7			15.1							7.0
Queue Delay		0.0			0.0							0.0
Total Delay		7.7			15.1							7.0
LOS		A			B							A
Approach Delay		7.7			15.1							7.0
Approach LOS		A			B							A
Queue Length 50th (m)		3.0			7.8							18.4
Queue Length 95th (m)		10.7			16.0							22.0
Internal Link Dist (m)		133.8			82.5			51.7				218.7
Turn Bay Length (m)												
Base Capacity (vph)		656			660							1918
Starvation Cap Reductn		0			0							0
Spillback Cap Reductn		0			0							0
Storage Cap Reductn		0			0							0
Reduced v/c Ratio		0.12			0.12							0.18

Intersection Summary

Area Type:	Other
Cycle Length:	90
Actuated Cycle Length:	90
Offset:	0 (0%), Referenced to phase 2:SBTL and 6:, Start of Green
Natural Cycle:	60
Control Type:	Pretimed
Maximum v/c Ratio:	0.18
Intersection Signal Delay:	8.4
Intersection Capacity Utilization	28.1%
Analysis Period (min)	15
Intersection LOS:	A
ICU Level of Service	A

Splits and Phases: 15: Brant Street & Birch Avenue



Lanes, Volumes, Timings
27: Birch Avenue & Site Access #1

AM Peak Period
09-18-2019



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	0	6	0	0	291	0
Future Volume (vph)	0	6	0	0	291	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	0.91	0.91
Fr _t	0.850					
Fl _t Protected						
Satd. Flow (prot)	1837	781	0	0	4600	0
Fl _t Permitted						
Satd. Flow (perm)	1837	781	0	0	4600	0
Link Speed (k/h)	48			50	48	
Link Distance (m)	51.6			315.9	75.7	
Travel Time (s)	3.9			22.7	5.7	
Peak Hour Factor	0.70	0.70	0.92	0.92	0.92	0.70
Heavy Vehicles (%)	0%	100%	0%	0%	9%	100%
Adj. Flow (vph)	0	9	0	0	316	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	9	0	0	316	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.3			0.0	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (k/h)	24	14	24			14
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	15.6%
Analysis Period (min)	15
	ICU Level of Service A

Lanes, Volumes, Timings
38: Princess Street & Birch Ave

AM Peak Period
09-18-2019



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔						↕↕↕	↗
Traffic Volume (vph)	0	21	26	30	3	0	0	0	0	19	262	16
Future Volume (vph)	0	21	26	30	3	0	0	0	0	19	262	16
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	0.0		0.0	0.0		0.0	0.0		50.0
Storage Lanes	0		0	0		0	0		0	0		1
Taper Length (m)	15.0			15.0			15.0			15.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.91	1.00
Frt		0.926										0.850
Flt Protected					0.956						0.997	
Satd. Flow (prot)	0	1638	0	0	1719	0	0	0	0	0	4632	1249
Flt Permitted					0.956						0.997	
Satd. Flow (perm)	0	1638	0	0	1719	0	0	0	0	0	4632	1249
Link Speed (k/h)		48			48			48			48	
Link Distance (m)		182.7			76.5			238.7			195.6	
Travel Time (s)		13.7			5.7			17.9			14.7	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	6%	2%	2%	4%	2%	2%	2%	2%	7%	8%	25%
Adj. Flow (vph)	0	23	28	33	3	0	0	0	0	21	285	17
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	51	0	0	36	0	0	0	0	0	306	17
Enter Blocked Intersection	No	No	No									
Lane Alignment	Left	Left	Right									
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	20.6%
ICU Level of Service	A
Analysis Period (min)	15

Lanes, Volumes, Timings
9: Birch Avenue & Burlington Street E

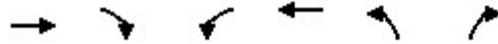
PM Peak Period
09-18-2019



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑		↵↵	↑↑↑		
Traffic Volume (vph)	1372	35	316	1500	0	0
Future Volume (vph)	1372	35	316	1500	0	0
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900
Storage Length (m)		0.0	125.0		0.0	0.0
Storage Lanes		0	2		0	0
Taper Length (m)			15.0		15.0	
Lane Util. Factor	0.91	0.91	0.97	0.91	1.00	1.00
Frt	0.996					
Flt Protected			0.950			
Satd. Flow (prot)	4718	0	3224	4821	0	0
Flt Permitted			0.950			
Satd. Flow (perm)	4718	0	3224	4821	0	0
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	8					
Link Speed (k/h)	50			50	50	
Link Distance (m)	358.3			130.8	242.7	
Travel Time (s)	25.8			9.4	17.5	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	6%	0%	5%	4%	0%	0%
Adj. Flow (vph)	1491	38	343	1630	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1529	0	343	1630	0	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	6.6			6.6	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane	Yes					
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (k/h)		14	24		24	14
Turn Type	NA		Prot	NA		
Protected Phases	2		4	2 4		
Permitted Phases						
Minimum Split (s)	47.0		15.1			
Total Split (s)	62.0		28.0			
Total Split (%)	68.9%		31.1%			
Maximum Green (s)	57.0		22.9			
Yellow Time (s)	3.7		3.7			
All-Red Time (s)	1.3		1.4			
Lost Time Adjust (s)	0.0		0.0			
Total Lost Time (s)	5.0		5.1			
Lead/Lag						
Lead-Lag Optimize?						
Walk Time (s)	30.0					
Flash Dont Walk (s)	12.0					
Pedestrian Calls (#/hr)	0					
Act Effct Green (s)	57.0		22.9	90.0		
Actuated g/C Ratio	0.63		0.25	1.00		

Lanes, Volumes, Timings
 9: Birch Avenue & Burlington Street E

PM Peak Period
 09-18-2019



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
v/c Ratio	0.51		0.42	0.34		
Control Delay	9.6		29.9	0.2		
Queue Delay	0.0		0.0	0.0		
Total Delay	9.6		29.9	0.2		
LOS	A		C	A		
Approach Delay	9.6			5.4		
Approach LOS	A			A		
Queue Length 50th (m)	47.0		25.5	0.0		
Queue Length 95th (m)	57.3		37.6	0.0		
Internal Link Dist (m)	334.3			106.8	218.7	
Turn Bay Length (m)			125.0			
Base Capacity (vph)	2991		820	4821		
Starvation Cap Reductn	0		0	0		
Spillback Cap Reductn	0		0	0		
Storage Cap Reductn	0		0	0		
Reduced v/c Ratio	0.51		0.42	0.34		

Intersection Summary

Area Type: Other
 Cycle Length: 90
 Actuated Cycle Length: 90
 Offset: 0 (0%), Referenced to phase 2:EBWB and 6:, Start of Green
 Natural Cycle: 65
 Control Type: Pretimed
 Maximum v/c Ratio: 0.51
 Intersection Signal Delay: 7.2
 Intersection Capacity Utilization 44.7%
 Analysis Period (min) 15
 Intersection LOS: A
 ICU Level of Service A

Splits and Phases: 9: Birch Avenue & Burlington Street E



Lanes, Volumes, Timings
11: Barton Street E

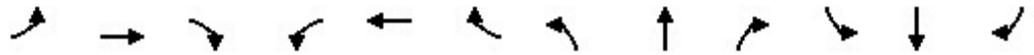
PM Peak Period
09-18-2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	684	25	69	834	0	0	0	0	71	292	77
Future Volume (vph)	0	684	25	69	834	0	0	0	0	71	292	77
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	25.0		0.0	0.0		0.0	0.0		115.0
Storage Lanes	0		0	1		0	0		0	0		1
Taper Length (m)	15.0			15.0			15.0			15.0		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	1.00	1.00	1.00	1.00	0.91	0.91	1.00
Frt		0.995										0.850
Flt Protected				0.950							0.990	
Satd. Flow (prot)	0	3372	0	1616	3355	0	0	0	0	0	4754	1561
Flt Permitted				0.265							0.990	
Satd. Flow (perm)	0	3372	0	451	3355	0	0	0	0	0	4754	1561
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		5										84
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		267.6			160.3			258.1			238.7	
Travel Time (s)		19.3			11.5			18.6			17.2	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	3%	2%	8%	4%	2%	2%	2%	2%	2%	5%	0%
Adj. Flow (vph)	0	743	27	75	907	0	0	0	0	77	317	84
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	770	0	75	907	0	0	0	0	0	394	84
Enter Blocked Intersection	No	No	No	No	No	No						
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane					Yes							
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type		NA		Perm	NA					Perm	NA	Perm
Protected Phases		2			2						4	
Permitted Phases				2						4		4
Minimum Split (s)		21.3		21.3	21.3					40.5	40.5	40.5
Total Split (s)		43.0		43.0	43.0					42.0	42.0	42.0
Total Split (%)		47.8%		47.8%	47.8%					46.7%	46.7%	46.7%
Maximum Green (s)		37.7		37.7	37.7					36.5	36.5	36.5
Yellow Time (s)		3.3		3.3	3.3					3.3	3.3	3.3
All-Red Time (s)		2.0		2.0	2.0					2.2	2.2	2.2
Lost Time Adjust (s)		0.0		0.0	0.0						0.0	0.0
Total Lost Time (s)		5.3		5.3	5.3						5.5	5.5
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)		7.0		7.0	7.0					24.0	24.0	24.0
Flash Dont Walk (s)		9.0		9.0	9.0					11.0	11.0	11.0
Pedestrian Calls (#/hr)		0		0	0					0	0	0
Act Effct Green (s)		37.7		37.7	37.7						36.5	36.5
Actuated g/C Ratio		0.42		0.42	0.42						0.41	0.41

Lane Group	Ø8
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (m)	
Storage Lanes	
Taper Length (m)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (k/h)	
Link Distance (m)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(m)	
Link Offset(m)	
Crosswalk Width(m)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (k/h)	
Turn Type	
Protected Phases	8
Permitted Phases	
Minimum Split (s)	5.0
Total Split (s)	5.0
Total Split (%)	6%
Maximum Green (s)	3.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Walk Time (s)	5.0
Flash Dont Walk (s)	0.0
Pedestrian Calls (#/hr)	0
Act Effct Green (s)	
Actuated g/C Ratio	

Lanes, Volumes, Timings
11: Barton Street E

PM Peak Period
09-18-2019

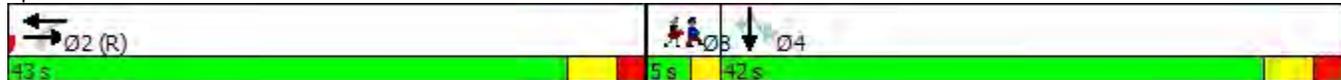


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio		0.54		0.40	0.65						0.20	0.12
Control Delay		21.3		26.3	23.5						11.5	2.2
Queue Delay		0.0		0.0	0.0						0.0	0.0
Total Delay		21.3		26.3	23.5						11.5	2.2
LOS		C		C	C						B	A
Approach Delay		21.3			23.7						9.9	
Approach LOS		C			C						A	
Queue Length 50th (m)		51.0		8.8	63.9						10.1	0.0
Queue Length 95th (m)		67.9		21.8	84.0						14.8	3.5
Internal Link Dist (m)		243.6			136.3			234.1			214.7	
Turn Bay Length (m)				25.0								115.0
Base Capacity (vph)		1415		188	1405						1928	683
Starvation Cap Reductn		0		0	0						0	0
Spillback Cap Reductn		0		0	0						0	0
Storage Cap Reductn		0		0	0						0	0
Reduced v/c Ratio		0.54		0.40	0.65						0.20	0.12

Intersection Summary

Area Type:	Other
Cycle Length:	90
Actuated Cycle Length:	90
Offset:	0 (0%), Referenced to phase 2:EBWB, Start of Green
Natural Cycle:	70
Control Type:	Pretimed
Maximum v/c Ratio:	0.65
Intersection Signal Delay:	19.9
Intersection LOS:	B
Intersection Capacity Utilization:	49.8%
ICU Level of Service:	A
Analysis Period (min):	15

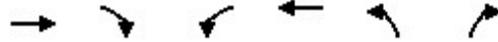
Splits and Phases: 11: Barton Street E



Lane Group	Ø8
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (m)	
Queue Length 95th (m)	
Internal Link Dist (m)	
Turn Bay Length (m)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

Lanes, Volumes, Timings
 14: Site Access #2 & Brant Street

PM Peak Period
 09-18-2019



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	111	0	1	74	0	0
Future Volume (vph)	111	0	1	74	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt						
Flt Protected				0.999		
Satd. Flow (prot)	1733	0	0	1608	918	918
Flt Permitted				0.999		
Satd. Flow (perm)	1733	0	0	1608	918	918
Link Speed (k/h)	48			48	48	
Link Distance (m)	242.6			157.8	61.8	
Travel Time (s)	18.2			11.8	4.6	
Peak Hour Factor	0.92	0.70	0.70	0.92	0.70	0.70
Heavy Vehicles (%)	6%	100%	100%	13%	100%	100%
Adj. Flow (vph)	121	0	1	80	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	121	0	0	81	0	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	3.3	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	9.2%
	ICU Level of Service A
Analysis Period (min)	15

Lanes, Volumes, Timings
15: Brant Street & Birch Avenue

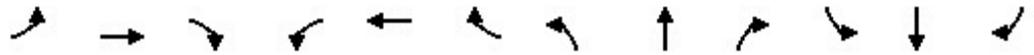
PM Peak Period
09-18-2019



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔						↔↔↔	
Traffic Volume (vph)	0	16	78	68	38	0	0	0	0	9	267	22
Future Volume (vph)	0	16	78	68	38	0	0	0	0	9	267	22
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	0.0		0.0	0.0		0.0	0.0		150.0
Storage Lanes	0		0	0		0	0		0	0		0
Taper Length (m)	15.0			15.0			15.0			15.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.91	0.91
Frt		0.887										0.989
Flt Protected					0.969							0.998
Satd. Flow (prot)	0	1544	0	0	1692	0	0	0	0	0	4711	0
Flt Permitted					0.782							0.998
Satd. Flow (perm)	0	1544	0	0	1365	0	0	0	0	0	4711	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		85										18
Link Speed (k/h)		50			50			50				50
Link Distance (m)		157.8			106.5			75.7				242.7
Travel Time (s)		11.4			7.7			5.5				17.5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	8%	5%	2%	11%	0%	0%	0%	0%	29%	3%	20%
Adj. Flow (vph)	0	17	85	74	41	0	0	0	0	10	290	24
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	102	0	0	115	0	0	0	0	0	324	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0				0.0
Link Offset(m)		0.0			0.0			0.0				0.0
Crosswalk Width(m)		1.6			1.6			1.6				1.6
Two way Left Turn Lane												
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type		NA		Perm	NA					Perm		NA
Protected Phases		4			8							2
Permitted Phases				8						2		
Minimum Split (s)		32.5		32.5	32.5					23.4	23.4	
Total Split (s)		46.0		46.0	46.0					44.0	44.0	
Total Split (%)		51.1%		51.1%	51.1%					48.9%	48.9%	
Maximum Green (s)		40.5		40.5	40.5					38.6	38.6	
Yellow Time (s)		3.3		3.3	3.3					3.3	3.3	
All-Red Time (s)		2.2		2.2	2.2					2.1	2.1	
Lost Time Adjust (s)		0.0			0.0							0.0
Total Lost Time (s)		5.5			5.5							5.4
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)		17.0		17.0	17.0					7.0	7.0	
Flash Dont Walk (s)		10.0		10.0	10.0					11.0	11.0	
Pedestrian Calls (#/hr)		0		0	0					0	0	
Act Effct Green (s)		40.5			40.5							38.6
Actuated g/C Ratio		0.45			0.45							0.43

Lanes, Volumes, Timings
15: Brant Street & Birch Avenue

PM Peak Period
09-18-2019

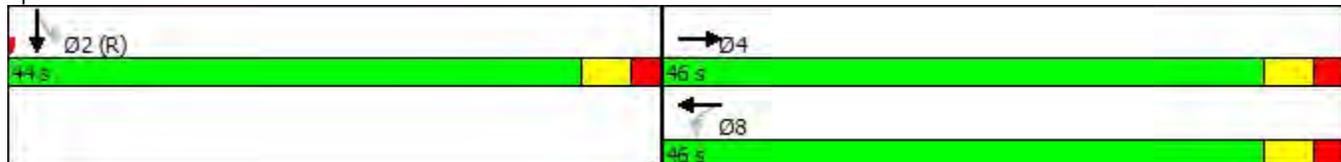


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio		0.14			0.19							0.16
Control Delay		5.1			15.9							7.6
Queue Delay		0.0			0.0							0.0
Total Delay		5.1			15.9							7.6
LOS		A			B							A
Approach Delay		5.1			15.9							7.6
Approach LOS		A			B							A
Queue Length 50th (m)		1.6			11.5							17.3
Queue Length 95th (m)		9.9			22.0							23.7
Internal Link Dist (m)		133.8			82.5			51.7				218.7
Turn Bay Length (m)												
Base Capacity (vph)		741			614							2030
Starvation Cap Reductn		0			0							0
Spillback Cap Reductn		0			0							0
Storage Cap Reductn		0			0							0
Reduced v/c Ratio		0.14			0.19							0.16

Intersection Summary

Area Type:	Other
Cycle Length:	90
Actuated Cycle Length:	90
Offset:	0 (0%), Referenced to phase 2:SBTL and 6:, Start of Green
Natural Cycle:	60
Control Type:	Pretimed
Maximum v/c Ratio:	0.19
Intersection Signal Delay:	8.9
Intersection Capacity Utilization	29.8%
Analysis Period (min)	15
Intersection LOS:	A
ICU Level of Service	A

Splits and Phases: 15: Brant Street & Birch Avenue



Lanes, Volumes, Timings
 27: Birch Avenue & Site Access #1

PM Peak Period
 09-18-2019



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	0	6	0	0	384	2
Future Volume (vph)	0	6	0	0	384	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	0.91	0.91
Fr _t		0.850			0.999	
Fl _t Protected						
Satd. Flow (prot)	1837	781	0	0	4785	0
Fl _t Permitted						
Satd. Flow (perm)	1837	781	0	0	4785	0
Link Speed (k/h)	48			50	48	
Link Distance (m)	51.6			315.9	75.7	
Travel Time (s)	3.9			22.7	5.7	
Peak Hour Factor	0.70	0.70	0.92	0.92	0.92	0.70
Heavy Vehicles (%)	0%	100%	0%	0%	4%	100%
Adj. Flow (vph)	0	9	0	0	417	3
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	9	0	0	420	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.3			0.0	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (k/h)	24	14	24			14
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	17.5%
Analysis Period (min)	15
	ICU Level of Service A

Lanes, Volumes, Timings
38: Princess Street & Birch Ave

PM Peak Period
09-18-2019



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔						↕↕↕	↗
Traffic Volume (vph)	0	39	39	34	6	0	0	0	0	45	326	13
Future Volume (vph)	0	39	39	34	6	0	0	0	0	45	326	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	0.0		0.0	0.0		0.0	0.0		50.0
Storage Lanes	0		0	0		0	0		0	0		1
Taper Length (m)	15.0			15.0			15.0			15.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.91	1.00
Frt		0.932										0.850
Flt Protected					0.960						0.994	
Satd. Flow (prot)	0	1556	0	0	1734	0	0	0	0	0	4776	1201
Flt Permitted					0.960						0.994	
Satd. Flow (perm)	0	1556	0	0	1734	0	0	0	0	0	4776	1201
Link Speed (k/h)		48			48			48			48	
Link Distance (m)		182.7			76.5			238.7			195.6	
Travel Time (s)		13.7			5.7			17.9			14.7	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	17%	3%	2%	0%	2%	2%	2%	2%	7%	4%	30%
Adj. Flow (vph)	0	42	42	37	7	0	0	0	0	49	354	14
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	84	0	0	44	0	0	0	0	0	403	14
Enter Blocked Intersection	No	No	No									
Lane Alignment	Left	Left	Right									
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	22.7%
ICU Level of Service	A
Analysis Period (min)	15

Appendix C – Future TWC (2031)
Conditions Synchro Output

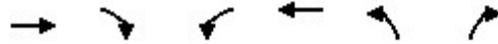
Lanes, Volumes, Timings
9: Birch Avenue & Burlington Street E

AM Peak Period
09-18-2019

	→	↘	↙	←	↖	↗
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑		↘	↑↑↑	↘	↗
Traffic Volume (vph)	796	29	343	1807	50	210
Future Volume (vph)	796	29	343	1807	50	210
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)		0.0	125.0		30.0	0.0
Storage Lanes		0	1		1	1
Taper Length (m)			15.0		15.0	
Lane Util. Factor	0.91	0.91	1.00	0.91	1.00	1.00
Frt	0.995					0.850
Flt Protected			0.950		0.950	
Satd. Flow (prot)	4457	0	1616	4643	1745	1561
Flt Permitted			0.950		0.950	
Satd. Flow (perm)	4457	0	1616	4643	1745	1561
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	8					93
Link Speed (k/h)	50			50	50	
Link Distance (m)	358.3			130.8	242.7	
Travel Time (s)	25.8			9.4	17.5	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	12%	10%	8%	8%	0%	0%
Adj. Flow (vph)	865	32	373	1964	54	228
Shared Lane Traffic (%)						
Lane Group Flow (vph)	897	0	373	1964	54	228
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.3			3.3	3.3	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane	Yes					
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (k/h)		14	24		24	14
Turn Type	NA		Prot	NA	Prot	pm+ov
Protected Phases	2		1	6	4	1
Permitted Phases						4
Minimum Split (s)	47.0		15.1	47.0	16.0	15.1
Total Split (s)	47.0		27.0	74.0	16.0	27.0
Total Split (%)	52.2%		30.0%	82.2%	17.8%	30.0%
Maximum Green (s)	42.0		21.9	69.0	10.0	21.9
Yellow Time (s)	3.7		3.7	3.7	4.0	3.7
All-Red Time (s)	1.3		1.4	1.3	2.0	1.4
Lost Time Adjust (s)	0.0		0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0		5.1	5.0	6.0	5.1
Lead/Lag	Lag		Lead			Lead
Lead-Lag Optimize?	Yes		Yes			Yes
Walk Time (s)	30.0			30.0		
Flash Dont Walk (s)	12.0			12.0		
Pedestrian Calls (#/hr)	0			0		
Act Effct Green (s)	42.0		21.9	69.0	10.0	37.9
Actuated g/C Ratio	0.47		0.24	0.77	0.11	0.42

Lanes, Volumes, Timings
 9: Birch Avenue & Burlington Street E

AM Peak Period
 09-18-2019



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
v/c Ratio	0.43		0.95	0.55	0.28	0.32
Control Delay	16.7		69.8	4.9	23.6	21.2
Queue Delay	0.0		0.0	0.0	0.0	0.0
Total Delay	16.7		69.8	4.9	23.6	21.2
LOS	B		E	A	C	C
Approach Delay	16.7			15.3	21.6	
Approach LOS	B			B	C	
Queue Length 50th (m)	36.0		63.6	39.5	8.8	34.2
Queue Length 95th (m)	46.3		#116.4	48.0	19.9	58.2
Internal Link Dist (m)	334.3			106.8	218.7	
Turn Bay Length (m)			125.0		30.0	
Base Capacity (vph)	2084		393	3559	193	711
Starvation Cap Reductn	0		0	0	0	0
Spillback Cap Reductn	0		0	0	0	0
Storage Cap Reductn	0		0	0	0	0
Reduced v/c Ratio	0.43		0.95	0.55	0.28	0.32

Intersection Summary

Area Type: Other
 Cycle Length: 90
 Actuated Cycle Length: 90
 Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Green
 Natural Cycle: 90
 Control Type: Pretimed
 Maximum v/c Ratio: 0.95
 Intersection Signal Delay: 16.2
 Intersection LOS: B
 Intersection Capacity Utilization 56.8%
 ICU Level of Service B
 Analysis Period (min) 15
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 9: Birch Avenue & Burlington Street E



Lanes, Volumes, Timings
11: Barton Street E

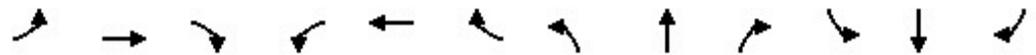
AM Peak Period
09-18-2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	31	501	17	61	596	29	40	231	32	65	169	86
Future Volume (vph)	31	501	17	61	596	29	40	231	32	65	169	86
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	25.0		0.0	20.0		0.0	45.0		115.0
Storage Lanes	0		0	1		0	1		0	1		0
Taper Length (m)	15.0			15.0			15.0			15.0		
Lane Util. Factor	0.95	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.995			0.993			0.982				0.950
Flt Protected		0.997		0.950			0.950			0.950		
Satd. Flow (prot)	0	3141	0	1466	3217	0	1711	1768	0	1711	1500	0
Flt Permitted		0.885		0.369			0.511			0.500		
Satd. Flow (perm)	0	2788	0	570	3217	0	920	1768	0	900	1500	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		4			7			9				33
Link Speed (k/h)		50			50			50				50
Link Distance (m)		267.6			160.3			258.1				238.7
Travel Time (s)		19.3			11.5			18.6				17.2
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	11%	2%	19%	8%	2%	2%	2%	2%	2%	20%	9%
Adj. Flow (vph)	34	545	18	66	648	32	43	251	35	71	184	93
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	597	0	66	680	0	43	286	0	71	277	0
Enter Blocked Intersection	No	No	No	No	No	No						
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3				3.3
Link Offset(m)		0.0			0.0			0.0				0.0
Crosswalk Width(m)		1.6			1.6			1.6				1.6
Two way Left Turn Lane					Yes							
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			2			4				4
Permitted Phases	2			2			4			4		
Minimum Split (s)	21.3	21.3		21.3	21.3		32.5	32.5		32.5	32.5	
Total Split (s)	45.0	45.0		45.0	45.0		40.0	40.0		40.0	40.0	
Total Split (%)	50.0%	50.0%		50.0%	50.0%		44.4%	44.4%		44.4%	44.4%	
Maximum Green (s)	39.7	39.7		39.7	39.7		34.5	34.5		34.5	34.5	
Yellow Time (s)	3.3	3.3		3.3	3.3		3.3	3.3		3.3	3.3	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.2	2.2		2.2	2.2	
Lost Time Adjust (s)		0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		5.3		5.3	5.3		5.5	5.5		5.5	5.5	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	7.0	7.0		7.0	7.0		16.0	16.0		16.0	16.0	
Flash Dont Walk (s)	9.0	9.0		9.0	9.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effct Green (s)		39.7		39.7	39.7		34.5	34.5		34.5	34.5	
Actuated g/C Ratio		0.44		0.44	0.44		0.38	0.38		0.38	0.38	

Lane Group	Ø8
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (m)	
Storage Lanes	
Taper Length (m)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (k/h)	
Link Distance (m)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(m)	
Link Offset(m)	
Crosswalk Width(m)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (k/h)	
Turn Type	
Protected Phases	8
Permitted Phases	
Minimum Split (s)	5.0
Total Split (s)	5.0
Total Split (%)	6%
Maximum Green (s)	3.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Walk Time (s)	
Flash Dont Walk (s)	
Pedestrian Calls (#/hr)	
Act Effct Green (s)	
Actuated g/C Ratio	

Lanes, Volumes, Timings
11: Barton Street E

AM Peak Period
09-18-2019



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio		0.48		0.26	0.48		0.12	0.42		0.21	0.47	
Control Delay		19.4		19.5	19.0		19.2	22.0		12.9	11.7	
Queue Delay		0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay		19.4		19.5	19.0		19.2	22.0		12.9	11.7	
LOS		B		B	B		B	C		B	B	
Approach Delay		19.4			19.1			21.7			11.9	
Approach LOS		B			B			C			B	
Queue Length 50th (m)		37.1		7.0	41.9		4.7	34.4		4.1	12.4	
Queue Length 95th (m)		51.7		16.7	56.8		11.7	55.6		m10.9	28.2	
Internal Link Dist (m)		243.6			136.3			234.1			214.7	
Turn Bay Length (m)				25.0			20.0			45.0		
Base Capacity (vph)		1232		251	1422		352	683		345	595	
Starvation Cap Reductn		0		0	0		0	0		0	0	
Spillback Cap Reductn		0		0	0		0	0		0	0	
Storage Cap Reductn		0		0	0		0	0		0	0	
Reduced v/c Ratio		0.48		0.26	0.48		0.12	0.42		0.21	0.47	

Intersection Summary

Area Type: Other
 Cycle Length: 90
 Actuated Cycle Length: 90
 Offset: 0 (0%), Referenced to phase 2:EBWB, Start of Green
 Natural Cycle: 60
 Control Type: Pretimed
 Maximum v/c Ratio: 0.48
 Intersection Signal Delay: 18.4
 Intersection Capacity Utilization 73.2%
 Analysis Period (min) 15
 Intersection LOS: B
 ICU Level of Service D
 m Volume for 95th percentile queue is metered by upstream signal.

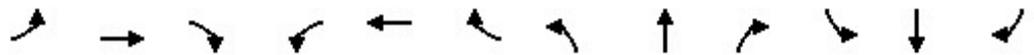
Splits and Phases: 11: Barton Street E



Lane Group	Ø8
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (m)	
Queue Length 95th (m)	
Internal Link Dist (m)	
Turn Bay Length (m)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

Lanes, Volumes, Timings
15: Brant Street & Birch Avenue

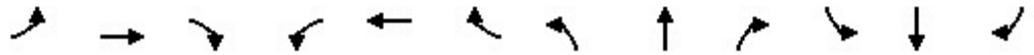
AM Peak Period
09-18-2019



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Volume (vph)	9	29	43	34	40	0	36	264	5	25	254	36
Future Volume (vph)	9	29	43	34	40	0	36	264	5	25	254	36
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	0.0		0.0	0.0		0.0	0.0		150.0
Storage Lanes	0		0	0		0	0		0	0		0
Taper Length (m)	15.0			15.0			15.0			15.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.929						0.998			0.985	
Flt Protected		0.994			0.977			0.994			0.996	
Satd. Flow (prot)	0	1435	0	0	1649	0	0	1822	0	0	1626	0
Flt Permitted		0.977			0.867			0.928			0.956	
Satd. Flow (perm)	0	1410	0	0	1463	0	0	1701	0	0	1561	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		47						1			9	
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		157.8			106.5			75.7			242.7	
Travel Time (s)		11.4			7.7			5.5			17.5	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	36%	10%	4%	13%	0%	0%	0%	0%	16%	10%	13%
Adj. Flow (vph)	10	32	47	37	43	0	39	287	5	27	276	39
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	89	0	0	80	0	0	331	0	0	342	0
Enter Blocked Intersection	No											
Lane Alignment	Left	Left	Right									
Median Width(m)		0.0			0.0			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	Perm	NA										
Protected Phases		4			8			2			2	
Permitted Phases	4			8			2			2		
Minimum Split (s)	32.5	32.5		32.5	32.5		23.4	23.4		23.4	23.4	
Total Split (s)	46.0	46.0		46.0	46.0		44.0	44.0		44.0	44.0	
Total Split (%)	51.1%	51.1%		51.1%	51.1%		48.9%	48.9%		48.9%	48.9%	
Maximum Green (s)	40.5	40.5		40.5	40.5		38.6	38.6		38.6	38.6	
Yellow Time (s)	3.3	3.3		3.3	3.3		3.3	3.3		3.3	3.3	
All-Red Time (s)	2.2	2.2		2.2	2.2		2.1	2.1		2.1	2.1	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		5.5			5.5			5.4			5.4	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	17.0	17.0		17.0	17.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)	10.0	10.0		10.0	10.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effct Green (s)		40.5			40.5			38.6			38.6	
Actuated g/C Ratio		0.45			0.45			0.43			0.43	

Lanes, Volumes, Timings
15: Brant Street & Birch Avenue

AM Peak Period
09-18-2019

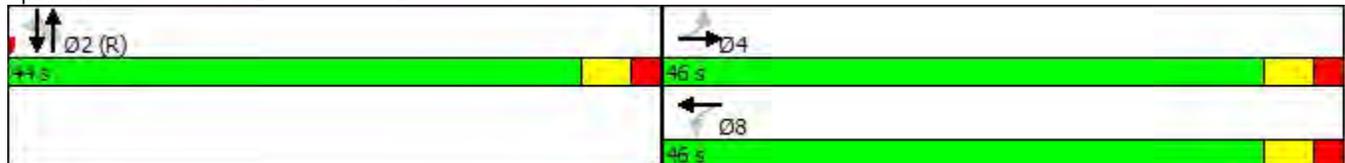


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio		0.13			0.12			0.45			0.51	
Control Delay		8.4			15.1			20.7			10.3	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		8.4			15.1			20.7			10.3	
LOS		A			B			C			B	
Approach Delay		8.4			15.1			20.7			10.3	
Approach LOS		A			B			C			B	
Queue Length 50th (m)		4.0			7.8			39.3			60.0	
Queue Length 95th (m)		12.2			16.1			61.7			65.2	
Internal Link Dist (m)		133.8			82.5			51.7			218.7	
Turn Bay Length (m)												
Base Capacity (vph)		660			658			730			674	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.13			0.12			0.45			0.51	

Intersection Summary

Area Type: Other
 Cycle Length: 90
 Actuated Cycle Length: 90
 Offset: 0 (0%), Referenced to phase 2:NBSB and 6:, Start of Green
 Natural Cycle: 60
 Control Type: Pretimed
 Maximum v/c Ratio: 0.51
 Intersection Signal Delay: 14.7
 Intersection Capacity Utilization 43.7%
 Analysis Period (min) 15
 Intersection LOS: B
 ICU Level of Service A
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 15: Brant Street & Birch Avenue



Lanes, Volumes, Timings
27: Birch Avenue & Site Access #1

AM Peak Period
09-18-2019



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	1	6	0	304	291	0
Future Volume (vph)	1	6	0	304	291	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.3	3.3	3.5	3.3	3.3	3.3
Storage Length (m)	0.0	0.0	30.0			0.0
Storage Lanes	1	1	1			0
Taper Length (m)	15.0		15.0			
Lane Util. Factor	1.00	1.00	0.95	0.95	1.00	1.00
Fr _t	0.850					
Fl _t Protected	0.950					
Satd. Flow (prot)	1745	781	1785	1745	1685	0
Fl _t Permitted	0.950					
Satd. Flow (perm)	1745	781	1785	1745	1685	0
Link Speed (k/h)	48			50	48	
Link Distance (m)	51.6			315.9	75.7	
Travel Time (s)	3.9			22.7	5.7	
Peak Hour Factor	0.70	0.70	0.92	0.92	0.92	0.70
Heavy Vehicles (%)	0%	100%	0%	0%	9%	100%
Adj. Flow (vph)	1	9	0	330	316	0
Shared Lane Traffic (%)			0%			
Lane Group Flow (vph)	1	9	0	330	316	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.3			3.5	3.5	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.04	1.04	1.01	1.04	1.04	1.04
Turning Speed (k/h)	24	14	24			14
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	26.0%
ICU Level of Service	A
Analysis Period (min)	15

Lanes, Volumes, Timings
38: Princess Street & Birch Ave

AM Peak Period
09-18-2019



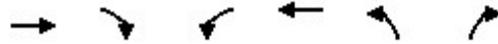
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	5	21	26	30	3	15	1	284	5	19	262	16
Future Volume (vph)	5	21	26	30	3	15	1	284	5	19	262	16
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	0.0		0.0	0.0		0.0	15.0		50.0
Storage Lanes	0		0	0		0	0		0	1		0
Taper Length (m)	15.0			15.0			15.0			15.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.932			0.958			0.998			0.992	
Flt Protected		0.996			0.969					0.950		
Satd. Flow (prot)	0	1645	0	0	1670	0	0	1797	0	1631	1672	0
Flt Permitted		0.996			0.969					0.950		
Satd. Flow (perm)	0	1645	0	0	1670	0	0	1797	0	1631	1672	0
Link Speed (k/h)		48			48			48			48	
Link Distance (m)		182.7			76.5			238.7			195.6	
Travel Time (s)		13.7			5.7			17.9			14.7	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	6%	2%	2%	4%	2%	2%	2%	2%	7%	8%	25%
Adj. Flow (vph)	5	23	28	33	3	16	1	309	5	21	285	17
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	56	0	0	52	0	0	315	0	21	302	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	32.1%
ICU Level of Service	A
Analysis Period (min)	15

Lanes, Volumes, Timings
9: Birch Avenue & Burlington Street E

PM Peak Period
09-18-2019



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑		↙	↑↑↑	↙	↗
Traffic Volume (vph)	1372	35	316	1500	66	298
Future Volume (vph)	1372	35	316	1500	66	298
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)		0.0	125.0		20.0	0.0
Storage Lanes		0	1		1	1
Taper Length (m)			15.0		15.0	
Lane Util. Factor	0.91	0.91	1.00	0.91	1.00	1.00
Frt	0.996					0.850
Flt Protected			0.950		0.950	
Satd. Flow (prot)	4461	0	1616	4643	1745	1561
Flt Permitted			0.950		0.950	
Satd. Flow (perm)	4461	0	1616	4643	1745	1561
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	5					14
Link Speed (k/h)	50			50	50	
Link Distance (m)	358.3			130.8	242.7	
Travel Time (s)	25.8			9.4	17.5	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	12%	10%	8%	8%	0%	0%
Adj. Flow (vph)	1491	38	343	1630	72	324
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1529	0	343	1630	72	324
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.3			3.3	3.3	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane	Yes					
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (k/h)		14	24		24	14
Turn Type	NA		Prot	NA	Prot	pm+ov
Protected Phases	2		1	6	4	1
Permitted Phases						4
Minimum Split (s)	47.0		15.1	47.0	16.0	15.1
Total Split (s)	47.0		27.0	74.0	16.0	27.0
Total Split (%)	52.2%		30.0%	82.2%	17.8%	30.0%
Maximum Green (s)	42.0		21.9	69.0	10.0	21.9
Yellow Time (s)	3.7		3.7	3.7	4.0	3.7
All-Red Time (s)	1.3		1.4	1.3	2.0	1.4
Lost Time Adjust (s)	0.0		0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0		5.1	5.0	6.0	5.1
Lead/Lag	Lag		Lead			Lead
Lead-Lag Optimize?	Yes		Yes			Yes
Walk Time (s)	30.0			30.0		
Flash Dont Walk (s)	12.0			12.0		
Pedestrian Calls (#/hr)	0			0		
Act Effct Green (s)	42.0		21.9	69.0	10.0	37.9
Actuated g/C Ratio	0.47		0.24	0.77	0.11	0.42

Lanes, Volumes, Timings
 9: Birch Avenue & Burlington Street E

PM Peak Period
 09-18-2019



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
v/c Ratio	0.73		0.87	0.46	0.37	0.49
Control Delay	22.0		57.0	4.3	25.1	26.8
Queue Delay	0.0		0.0	0.0	0.0	0.0
Total Delay	22.0		57.0	4.3	25.1	26.8
LOS	C		E	A	C	C
Approach Delay	22.0			13.4	26.5	
Approach LOS	C			B	C	
Queue Length 50th (m)	75.3		57.1	29.1	11.9	58.4
Queue Length 95th (m)	92.5		#103.7	35.6	m22.9	84.9
Internal Link Dist (m)	334.3			106.8	218.7	
Turn Bay Length (m)			125.0		20.0	
Base Capacity (vph)	2084		393	3559	193	665
Starvation Cap Reductn	0		0	0	0	0
Spillback Cap Reductn	0		0	0	0	0
Storage Cap Reductn	0		0	0	0	0
Reduced v/c Ratio	0.73		0.87	0.46	0.37	0.49

Intersection Summary

Area Type: Other
 Cycle Length: 90
 Actuated Cycle Length: 90
 Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Green
 Natural Cycle: 90
 Control Type: Pretimed
 Maximum v/c Ratio: 0.87
 Intersection Signal Delay: 18.1
 Intersection LOS: B
 Intersection Capacity Utilization 66.5%
 ICU Level of Service C
 Analysis Period (min) 15
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 9: Birch Avenue & Burlington Street E



Lanes, Volumes, Timings
11: Barton Street E

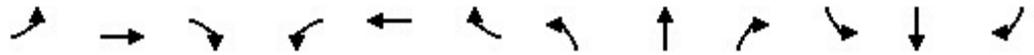
PM Peak Period
09-18-2019

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	30	684	25	69	834	20	50	331	50	71	292	77
Future Volume (vph)	30	684	25	69	834	20	50	331	50	71	292	77
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	25.0		0.0	20.0		0.0	45.0		115.0
Storage Lanes	0		0	1		0	1		0	1		0
Taper Length (m)	15.0			15.0			15.0			15.0		
Lane Util. Factor	0.95	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.995			0.996			0.980				0.969
Flt Protected		0.998		0.950			0.950			0.950		
Satd. Flow (prot)	0	3141	0	1466	3222	0	1711	1765	0	1711	1512	0
Flt Permitted		0.872		0.253			0.374			0.360		
Satd. Flow (perm)	0	2744	0	390	3222	0	673	1765	0	648	1512	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		5			3			10				18
Link Speed (k/h)		50			50			50				50
Link Distance (m)		267.6			160.3			258.1				238.7
Travel Time (s)		19.3			11.5			18.6				17.2
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	11%	2%	19%	8%	2%	2%	2%	2%	2%	20%	9%
Adj. Flow (vph)	33	743	27	75	907	22	54	360	54	77	317	84
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	803	0	75	929	0	54	414	0	77	401	0
Enter Blocked Intersection	No	No	No	No	No	No						
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.3			3.3			3.3				3.3
Link Offset(m)		0.0			0.0			0.0				0.0
Crosswalk Width(m)		1.6			1.6			1.6				1.6
Two way Left Turn Lane					Yes							
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			2			4				4
Permitted Phases	2			2			4			4		
Minimum Split (s)	21.3	21.3		21.3	21.3		32.5	32.5		32.5	32.5	
Total Split (s)	44.0	44.0		44.0	44.0		41.0	41.0		41.0	41.0	
Total Split (%)	48.9%	48.9%		48.9%	48.9%		45.6%	45.6%		45.6%	45.6%	
Maximum Green (s)	39.0	39.0		39.0	39.0		35.8	35.8		35.8	35.8	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.2	2.2		2.2	2.2	
Lost Time Adjust (s)		0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)		5.0		5.0	5.0		5.2	5.2		5.2	5.2	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	7.0	7.0		7.0	7.0		16.0	16.0		16.0	16.0	
Flash Dont Walk (s)	9.0	9.0		9.0	9.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effct Green (s)		39.0		39.0	39.0		35.8	35.8		35.8	35.8	
Actuated g/C Ratio		0.43		0.43	0.43		0.40	0.40		0.40	0.40	

Lane Group	Ø8
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (m)	
Storage Lanes	
Taper Length (m)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (k/h)	
Link Distance (m)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(m)	
Link Offset(m)	
Crosswalk Width(m)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (k/h)	
Turn Type	
Protected Phases	8
Permitted Phases	
Minimum Split (s)	5.0
Total Split (s)	5.0
Total Split (%)	6%
Maximum Green (s)	3.0
Yellow Time (s)	2.0
All-Red Time (s)	0.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Walk Time (s)	
Flash Dont Walk (s)	
Pedestrian Calls (#/hr)	
Act Effct Green (s)	
Actuated g/C Ratio	

Lanes, Volumes, Timings
11: Barton Street E

PM Peak Period
09-18-2019



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio		0.67		0.44	0.66		0.20	0.58		0.30	0.66	
Control Delay		23.8		28.3	23.1		20.4	24.8		15.7	18.1	
Queue Delay		0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay		23.8		28.3	23.1		20.4	24.8		15.7	18.1	
LOS		C		C	C		C	C		B	B	
Approach Delay		23.8			23.5			24.3			17.7	
Approach LOS		C			C			C			B	
Queue Length 50th (m)		56.3		8.8	65.0		6.0	53.6		5.6	29.7	
Queue Length 95th (m)		76.8		22.9	85.7		14.4	82.5		12.7	47.2	
Internal Link Dist (m)		243.6			136.3			234.1			214.7	
Turn Bay Length (m)				25.0			20.0			45.0		
Base Capacity (vph)		1191		169	1397		267	708		257	612	
Starvation Cap Reductn		0		0	0		0	0		0	0	
Spillback Cap Reductn		0		0	0		0	0		0	0	
Storage Cap Reductn		0		0	0		0	0		0	0	
Reduced v/c Ratio		0.67		0.44	0.66		0.20	0.58		0.30	0.66	

Intersection Summary

Area Type:	Other
Cycle Length:	90
Actuated Cycle Length:	90
Offset:	0 (0%), Referenced to phase 2:EBWB, Start of Green
Natural Cycle:	65
Control Type:	Pretimed
Maximum v/c Ratio:	0.67
Intersection Signal Delay:	22.7
Intersection LOS:	C
Intersection Capacity Utilization:	90.1%
ICU Level of Service:	E
Analysis Period (min):	15

Splits and Phases: 11: Barton Street E



Lane Group	Ø8
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (m)	
Queue Length 95th (m)	
Internal Link Dist (m)	
Turn Bay Length (m)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

Lanes, Volumes, Timings
15: Brant Street & Birch Avenue

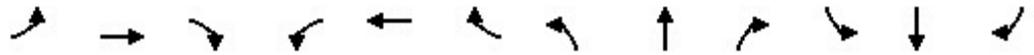
PM Peak Period
09-18-2019



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Volume (vph)	22	16	78	68	38	0	25	351	5	9	267	22
Future Volume (vph)	22	16	78	68	38	0	25	351	5	9	267	22
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	0.0		0.0	0.0		0.0	0.0		150.0
Storage Lanes	0		0	0		0	0		0	0		0
Taper Length (m)	15.0			15.0			15.0			15.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.909						0.998			0.990	
Flt Protected		0.991			0.969			0.997			0.998	
Satd. Flow (prot)	0	1482	0	0	1660	0	0	1827	0	0	1644	0
Flt Permitted		0.943			0.770			0.964			0.985	
Satd. Flow (perm)	0	1411	0	0	1319	0	0	1767	0	0	1622	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		85						1			6	
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		157.8			106.5			75.7			242.7	
Travel Time (s)		11.4			7.7			5.5			17.5	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	36%	10%	4%	13%	0%	0%	0%	0%	16%	10%	13%
Adj. Flow (vph)	24	17	85	74	41	0	27	382	5	10	290	24
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	126	0	0	115	0	0	414	0	0	324	0
Enter Blocked Intersection	No											
Lane Alignment	Left	Left	Right									
Median Width(m)		0.0			0.0			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	Perm	NA										
Protected Phases		4			8			2			2	
Permitted Phases	4			8			2			2		
Minimum Split (s)	32.5	32.5		32.5	32.5		23.4	23.4		23.4	23.4	
Total Split (s)	46.0	46.0		46.0	46.0		44.0	44.0		44.0	44.0	
Total Split (%)	51.1%	51.1%		51.1%	51.1%		48.9%	48.9%		48.9%	48.9%	
Maximum Green (s)	40.5	40.5		40.5	40.5		38.6	38.6		38.6	38.6	
Yellow Time (s)	3.3	3.3		3.3	3.3		3.3	3.3		3.3	3.3	
All-Red Time (s)	2.2	2.2		2.2	2.2		2.1	2.1		2.1	2.1	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		5.5			5.5			5.4			5.4	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	17.0	17.0		17.0	17.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)	10.0	10.0		10.0	10.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effct Green (s)		40.5			40.5			38.6			38.6	
Actuated g/C Ratio		0.45			0.45			0.43			0.43	

Lanes, Volumes, Timings
15: Brant Street & Birch Avenue

PM Peak Period
09-18-2019

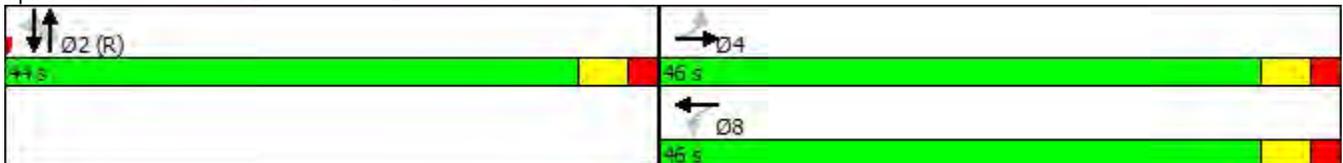


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio		0.19			0.19			0.55				0.46
Control Delay		6.6			16.0			22.5				10.6
Queue Delay		0.0			0.0			0.0				0.0
Total Delay		6.6			16.0			22.5				10.6
LOS		A			B			C				B
Approach Delay		6.6			16.0			22.5				10.6
Approach LOS		A			B			C				B
Queue Length 50th (m)		3.9			11.6			51.7				55.3
Queue Length 95th (m)		13.6			22.2			79.0				67.3
Internal Link Dist (m)		133.8			82.5			51.7				218.7
Turn Bay Length (m)												
Base Capacity (vph)		681			593			758				699
Starvation Cap Reductn		0			0			0				0
Spillback Cap Reductn		0			0			0				0
Storage Cap Reductn		0			0			0				0
Reduced v/c Ratio		0.19			0.19			0.55				0.46

Intersection Summary

Area Type: Other
 Cycle Length: 90
 Actuated Cycle Length: 90
 Offset: 0 (0%), Referenced to phase 2:NBSB and 6:, Start of Green
 Natural Cycle: 60
 Control Type: Pretimed
 Maximum v/c Ratio: 0.55
 Intersection Signal Delay: 15.7
 Intersection Capacity Utilization 51.4%
 Analysis Period (min) 15
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 15: Brant Street & Birch Avenue



Lanes, Volumes, Timings
27: Birch Avenue & Site Access #1

PM Peak Period
09-18-2019



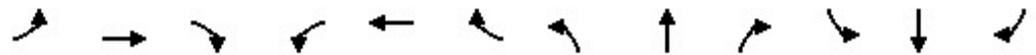
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	0	0	12	381	384	2
Future Volume (vph)	0	0	12	381	384	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.3	3.3	3.5	3.3	3.3	3.3
Storage Length (m)	0.0	0.0	30.0			0.0
Storage Lanes	1	1	1			0
Taper Length (m)	15.0		15.0			
Lane Util. Factor	1.00	1.00	0.95	0.95	1.00	1.00
Fr _t					0.999	
Fl _t Protected			0.950			
Satd. Flow (prot)	1837	918	1696	1745	1673	0
Fl _t Permitted			0.950			
Satd. Flow (perm)	1837	918	1696	1745	1673	0
Link Speed (k/h)	48			50	48	
Link Distance (m)	51.6			315.9	75.7	
Travel Time (s)	3.9			22.7	5.7	
Peak Hour Factor	0.70	0.70	0.92	0.92	0.92	0.70
Heavy Vehicles (%)	0%	100%	0%	0%	9%	100%
Adj. Flow (vph)	0	0	13	414	417	3
Shared Lane Traffic (%)			10%			
Lane Group Flow (vph)	0	0	12	415	420	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.3			3.5	3.5	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	1.04	1.04	1.01	1.04	1.04	1.04
Turning Speed (k/h)	24	14	24			14
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	23.7%
ICU Level of Service	A
Analysis Period (min)	15

Lanes, Volumes, Timings
38: Princess Street & Birch Ave

PM Peak Period
09-18-2019



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	39	39	34	6	15	2	368	10	45	326	13
Future Volume (vph)	10	39	39	34	6	15	2	368	10	45	326	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	0.0		0.0	0.0		0.0	15.0		50.0
Storage Lanes	0		0	0		0	0		0	1		0
Taper Length (m)	15.0			15.0			15.0			15.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.940			0.964			0.996			0.994	
Flt Protected		0.994			0.970					0.950		
Satd. Flow (prot)	0	1654	0	0	1680	0	0	1793	0	1631	1680	0
Flt Permitted		0.994			0.970					0.950		
Satd. Flow (perm)	0	1654	0	0	1680	0	0	1793	0	1631	1680	0
Link Speed (k/h)		48			48			48			48	
Link Distance (m)		182.7			76.5			238.7			195.6	
Travel Time (s)		13.7			5.7			17.9			14.7	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	6%	2%	2%	4%	2%	2%	2%	2%	7%	8%	25%
Adj. Flow (vph)	11	42	42	37	7	16	2	400	11	49	354	14
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	95	0	0	60	0	0	413	0	49	368	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.3			3.3	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Free			Free	

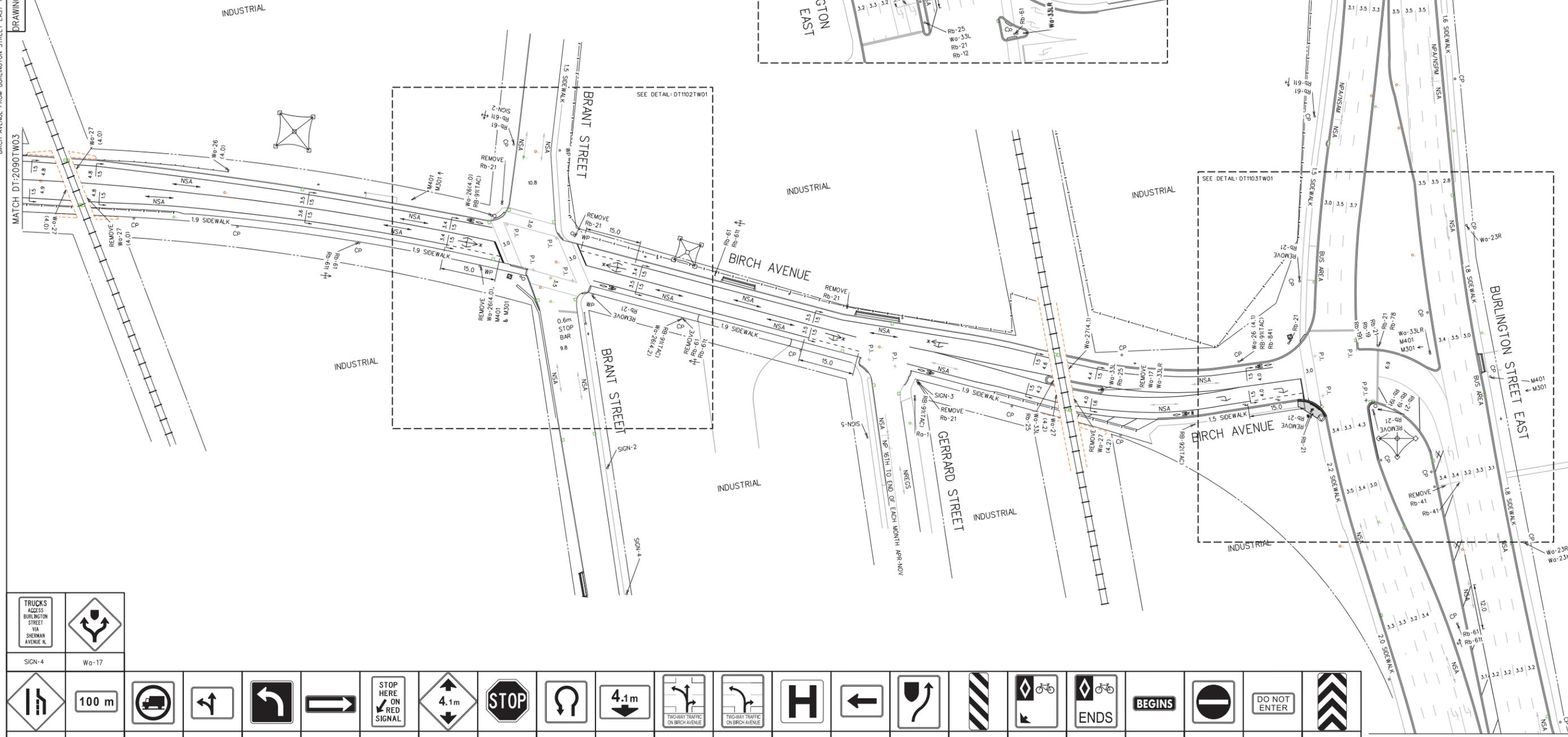
Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	51.1%
ICU Level of Service	A
Analysis Period (min)	15

Appendix D – Birch Ave Two Way Conversion Pavement Marking Drawings

NOTES:

1. DATA EXHIBITED ARE COMPILED FROM AERIAL IMAGERY AND FIELD OBSERVATIONS
2. STENCILS WITH ASTERISK (*) ARE ONE TIME PAINT APPLICATION ONLY; ALL OTHER STENCILS TO BE APPLIED IN DURABLE MATERIAL
3. PROPOSED CURB AND GUTTER TO BE CONSTRUCTED AS PER OPSD 0600.0400
4. PEDESTRIAN RAMPS TO BE CONSTRUCTED AS PER CITY OF HAMILTON STANDARD RD-124



Wa-23R	Wa-231	Rb-61	Rb-61t	Rb-41	Rb-21	Rb-78	Wa-26	Ro-1	SIGN-5	Wa-27	SIGN-2	SIGN-3	M401	M301	Rb-25	Wa-33L	RB-91	RB-92	Rb-841	Rb-19	Rb-19t	Wa-33LR
--------	--------	-------	--------	-------	-------	-------	-------	------	--------	-------	--------	--------	------	------	-------	--------	-------	-------	--------	-------	--------	---------

LEGEND

PROPOSED	EXISTING	DESCRIPTION
		TRAFFIC SIGNAL CONTROLLER
		DISCONNECT BOX, SERVICE ENTRANCE
		TRAFFIC JUNCTION BOX
		TRAFFIC HANDHOLE
		POLE
		POST
		OVERHEAD LINE CONTROL ARM AND SIGNS
		PAVEMENT MARKING LINES
		PAVEMENT MARKING STENCILS
		PARKING METERS: DOUBLE-HEAD, SINGLE-HEAD
		FIRE HYDRANT
		POINT OF INTERSECTION
		TANGENT POINT

POLE CODES FORMAT: TYPE, LENGTH, OWNER, POLE NO. (MAY BE TRUNCATED)	DESCRIPTION
TYPE:	
CONCRETE	BELL TELEPHONE
CONCRETE-TEMPORARY	CITY, STREET LIGHTING
DECORATIVE-CONCRETE	HYDRO ONE
DECORATIVE-METAL	HORIZON UTILITIES
METAL	MINISTRY OF TRANSPORTATION
SIGNAL UTILITY	CITY, TRAFFIC
WOOD	CITY, TRAFFIC, HEAVY DUTY
WOOD-TEMPORARY	PVT

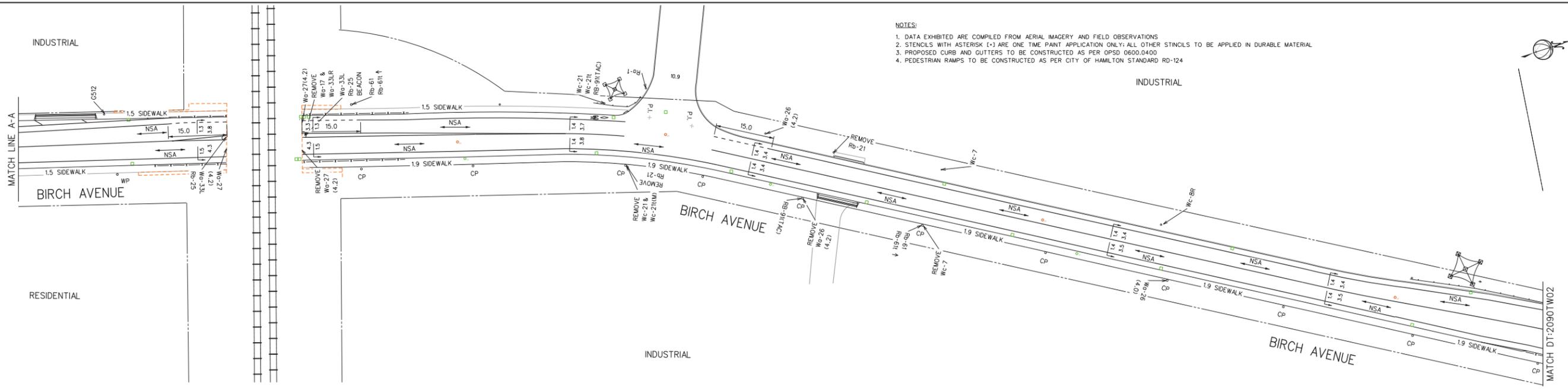
PARKING REGULATIONS	DESCRIPTION
NREGS	NO REGULATIONS
NPA	NO PARKING ANYTIME
NSA	NO STOPPING ANYTIME
NSAM	NO STOPPING 7am-9am
NSPM	NO STOPPING 4pm-6pm
NPLZ	NO PARKING LOADING ZONE
CVLZ	COMMERCIAL VEHICLE LOADING ZONE
SBLZ	SCHOOL BUS LOADING ZONE
WCLZ	WHEELCHAIR LOADING ZONE
ASP	ALTERNATE SIDE PARKING

STANDARD PRACTICES, UNLESS NOTED

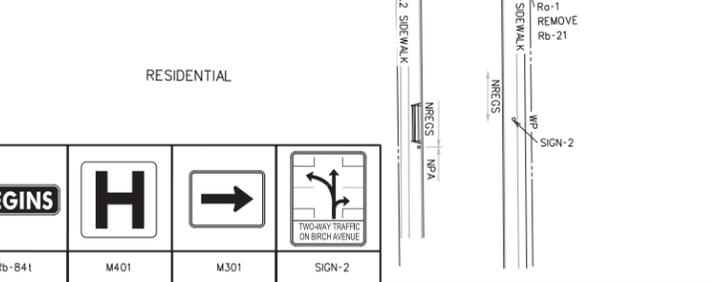
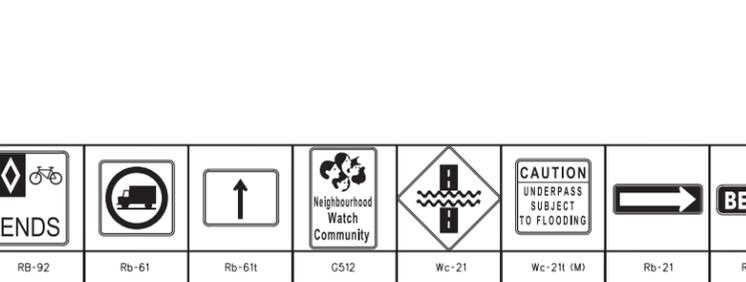
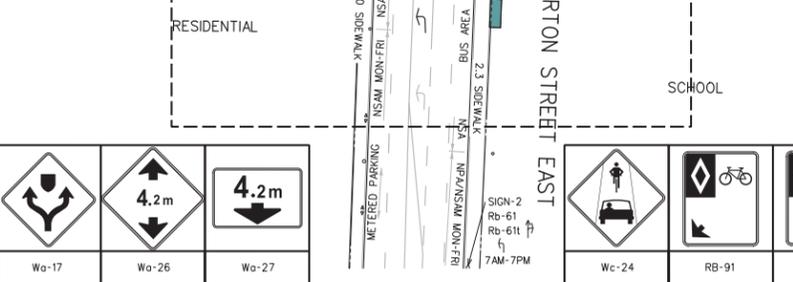
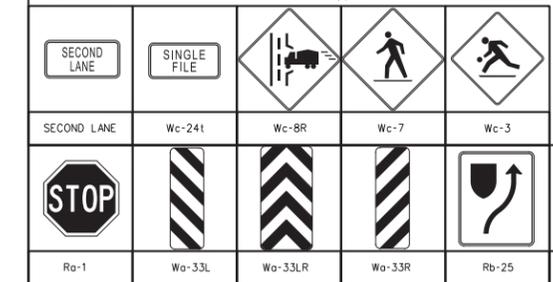
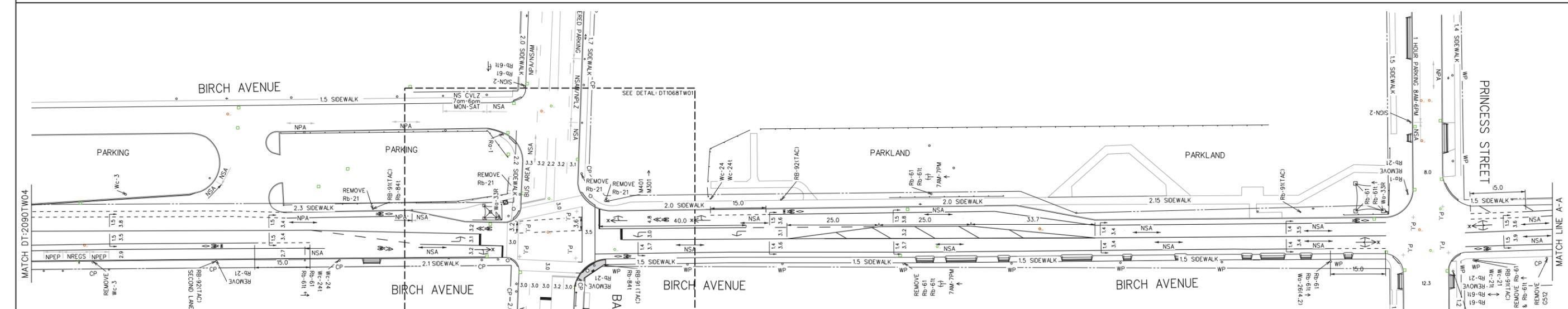
- DIMENSIONS WITH DECIMAL PLACES ARE METRES; WHOLE NUMBERS ARE MILLIMETRES
- SIDEWALKS AND ISLANDS AT ALL PEDESTRIAN CROSSINGS TO HAVE WHEELCHAIR DEPRESSIONS BETWEEN CROSSWALK LINES
- DIRECTIONAL LINES IN PEDESTRIAN CROSSINGS NOT SHOWN
- CROSSING STRIPES FOR LADDER CROSSWALKS TO BE 450mm WIDE WITH 450mm SPACING.
- POINT OF INTERSECTION TO CROSSWALK: 0.6m
- POINT OF INTERSECTION TO TERMINUS OF LONGITUDINAL PAINT LINES WHERE NO STOP BAR: 3.0m
- STOP BAR WIDTH: 0.3m AT 1.0m SET-BACK FROM CROSSWALK
- SPEED LIMIT 50 km/h
- BICYCLE SIGNING AND MARKINGS FROM OTM BOOK 18 AND TAC, BIKEWAY TRAFFIC CONTROL GUIDELINES FOR CANADA, FEB. 2012.
- LANE DIMENSIONS TO E OF MARKINGS, AND EDGE OF ASPHALT



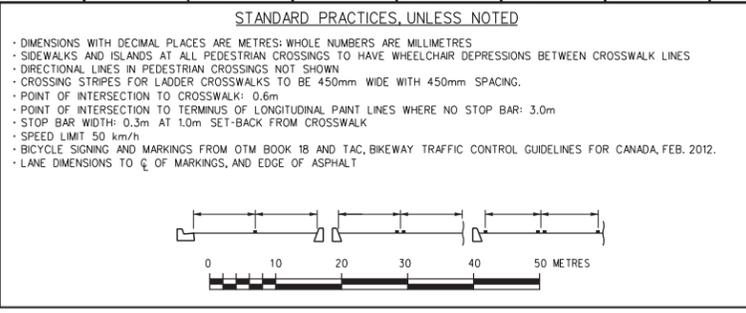
0	2017.07	OS	TWO WAY CONVERSION OF BIRCH AVENUE, SUPERSEDES DT:2090A01, 2003.
No.	DATE	DRAWN	REVISION DETAILS
CHECKED:			
APPROVAL:			
PAVEMENT MARKINGS DESIGN BIRCH AVENUE FROM BURLINGTON STREET EAST TO 120m SOUTH OF BRANT STREET IN THE CITY OF HAMILTON PREPARED BY THE CITY OF HAMILTON, TRAFFIC OPERATIONS AND ENGINEERING, TRANSPORTATION DIVISION PUBLIC WORKS DEPARTMENT			
MANAGER OF TRAFFIC OPERATIONS AND ENGINEERING	SURVEY DATE: YYYY.MM	SCALE: 1:500	DRAWING No.: DT:2090TW02
MM/DD/YY	PRINTED: 18/09/2017	DESIGN: OS	



- NOTES:
1. DATA EXHIBITED ARE COMPILED FROM AERIAL IMAGERY AND FIELD OBSERVATIONS
 2. STENCILS WITH ASTERISK (*) ARE ONE TIME PAINT APPLICATION ONLY; ALL OTHER STENCILS TO BE APPLIED IN DURABLE MATERIAL
 3. PROPOSED CURB AND GUTTERS TO BE CONSTRUCTED AS PER OPSD 0600.0400
 4. PEDESTRIAN RAMPS TO BE CONSTRUCTED AS PER CITY OF HAMILTON STANDARD RD-124



LEGEND		POLE CODES FORMAT: TYPE, LENGTH, OWNER, POLE NO. (MAY BE TRUNCATED)	
PROPOSED	EXISTING	TYPE:	OWNER:
□	□	CP-T	B BELL TELEPHONE
□	□	C	C CITY STREET LIGHTING
□	□	DP-C	HO HYDRO ONE
□	□	DP-M	HU HORIZON UTILITIES
□	□	MP	MTO MINISTRY OF TRANSPORTATION
□	□	SU	T CITY, TRAFFIC
□	□	WP	T-HD CITY, TRAFFIC, HEAVY DUTY
□	□	WP-T	PVT PRIVATE
□	□	PARKING REGULATIONS	
□	□	NREGS	NO REGULATIONS
□	□	NPA	NO PARKING ANYTIME
□	□	NSA	NO STOPPING ANYTIME
□	□	NSAM	NO STOPPING 7am-9am
□	□	NSPM	NO STOPPING 4pm-6pm
□	□	NPLZ	NO PARKING LOADING ZONE
□	□	CVLZ	COMMERCIAL VEHICLE LOADING ZONE
□	□	NPEP	NO PARKING EXCEPT BY PERMIT
□	□	WCLZ	WHEELCHAIR LOADING ZONE
□	□	ASP	ALTERNATE SIDE PARKING



0	2017.07	OS	TWO WAY CONVERSION OF BIRCH AVENUE
No.	DATE	DRAWN	REVISION DETAILS
CHECKED:			
APPROVAL:			
PAVEMENT MARKINGS DESIGN			
BIRCH AVENUE			
FROM 120m SOUTH OF BRANT STREET TO 130m SOUTH OF BARTON STREET EAST			
IN THE CITY OF HAMILTON			
PREPARED BY THE CITY OF HAMILTON, TRAFFIC OPERATIONS AND ENGINEERING, TRANSPORTATION DIVISION PUBLIC WORKS DEPARTMENT			
MANAGER OF TRAFFIC OPERATIONS AND ENGINEERING	SURVEY DATE: YYYY.MM	SCALE: 1:500	DRAWING No.: DT:2090TW03
MM/DD/YY	PRINTED: 18/09/2017	DESIGN: OS	



IBI GROUP
200 East Wing – 360 James Street North
Hamilton ON L8L 1H5 Canada
tel 905 546 1010 fax 905 546 1011
ibigroup.com

Memorandum

To/Attention Scott Johnston **Date** November 28th, 2019
From Zibby Petch **Project No** 121767
cc
Subject Birch Avenue Bikeway - Cycling Facility Selection Analysis & Functional Design Memo

Introduction & Context

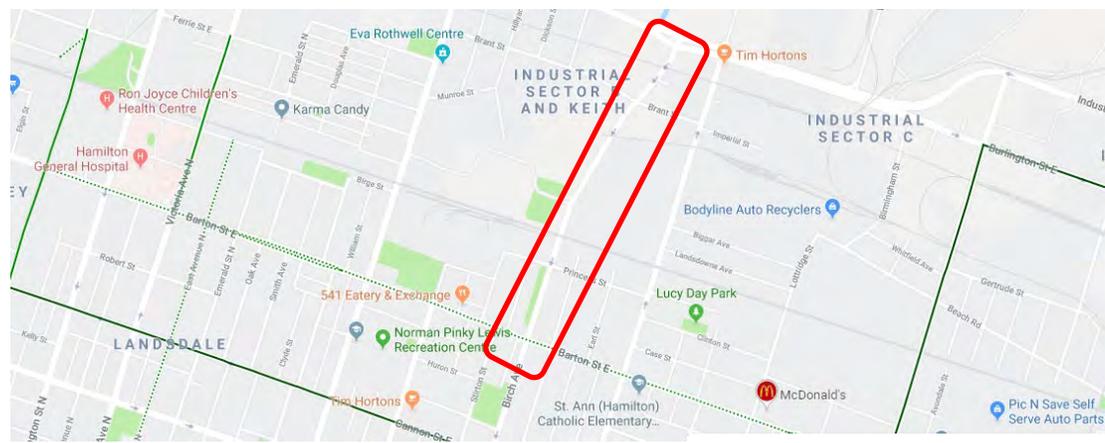
The City of Hamilton has initiated a Class B Environmental Assessment (EA) for Birch Avenue from Burlington Street East to Barton Street East. The EA is largely driven by the addition of a proposed new HSR bus shelter, which requires upgrading of the corridor to provide bus access including possible two-way conversion. As part of the development of alternatives for the EA, the addition of cycling facilities will be considered. A new cycling route along this corridor could connect residential neighbourhoods in the south to industrial lands in the north. As a subsequent project, it is anticipated cycling facilities could be extended south of the study area to Cannon Street, to connect with the City's busiest on-street cycling infrastructure.

This memo summarizes the facility selection review process for the corridor to confirm a preferred cycling facility type and evaluates functional design options.

Roadway Characteristics & Function

The study area for this memo, as shown in Exhibit 1, is the section of Birch Avenue from Burlington Avenue East to Barton Street East.

Exhibit 1: Project Study Area



Source: Google Maps

Through the study area, Birch Avenue is currently a one-way southbound, three-lane roadway with a posted speed of 50 km/hr, though the corridor is planned to undergo two-way conversion. Pertinent characteristics of this section of roadway are summarized in the *Birch Avenue EA - Design Criteria Memo* and are summarized in Exhibit 2.

Exhibit 2: Birch Avenue Characteristics

PROJECT LIMITS:	BIRCH AVENUE, BURLINGTON ST. E TO BARTON ST. E
CHARACTERISTIC	COMMENTARY
Land Use & Key Destinations	<ul style="list-style-type: none"> • Official Plan designation of adjacent land uses: neighbourhoods and industrial land • Primarily industrial lands between Burlington Street and Princess Street • Street-oriented, single-family residences between Princess Street and Barton Street • Hydro corridor on west side
Directionality & Lane Configuration	<ul style="list-style-type: none"> • Current: One-way (SB); • Future: to be converted to two-way
Posted Speed	<ul style="list-style-type: none"> • 50 km/hr
Road Class	<ul style="list-style-type: none"> • Minor Arterial
Existing AADT	<ul style="list-style-type: none"> • 2,400 vpd (assuming peak hour volumes = 10% of AADT)
Future AADT	<ul style="list-style-type: none"> • 6,450 vpd - With two-way conversion & bus garage: (assuming peak hour volumes = 10% of AADT)
Transit	<ul style="list-style-type: none"> • Not presently served by transit; however, the City of Hamilton is planning to construct a new Maintenance Storage Facility on the southwest corner of Birch Avenue and Brant Street. The facility will have storage capacity for 200 buses, with the future possibility of adding further storage for 100 additional buses. Therefore, significant bus volumes are expected to be travelling through this study area, though volumes are expected to be highest during off-peak hours as most buses will be in service during peak hours.
Commercial Vehicles / Trucks	<ul style="list-style-type: none"> • Designated as a full-time truck route

Throughout the study area, there is a hydro corridor on the west side of Birch Avenue. There is also a severe pinch point as the roadway travels underneath Bridge 332, a rail bridge approximately 80 metres north of Princess Street. These features constrain the roadway width and will need to be considered when determining an appropriate cycling facility type.

Recommended Class of Cycling Facility

A number of criteria (including road class, volume and speed) were reviewed along the corridor in order to identify an appropriate facility class (shared, separated, or dedicated) based on OTM Book 18. These classes can be broadly defined as follows:

- **Shared Facilities** – consisting of signed routes, bicycle boulevards or advisory bike lanes (most appropriate along low-volume, low-speed roadways)
- **Designated Facilities** – consisting of bike lanes along urban roadways or paved shoulders along rural roads (typically most appropriate along collector type roadways)

- **Separated Facilities** – consisting of buffered or protected bike lanes, cycle tracks or multi-use trails (typically most needed along arterial roadways, or as part of an all ages and ability (AAA) or priority network)

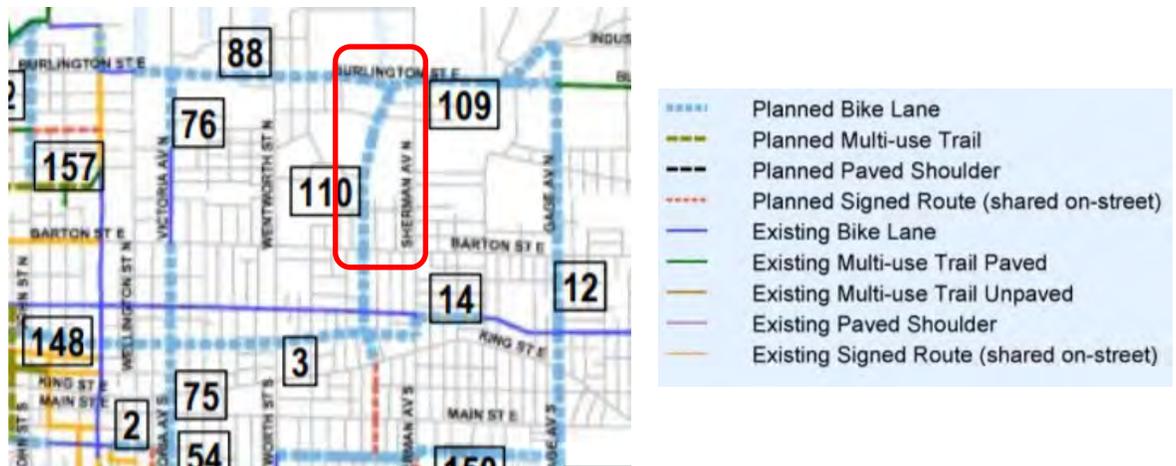
The facility selection review indicates that a **designated cycling facility (i.e. bike lane or buffered bike lane) is appropriate**. This means that any cycling facilities identified through the EA should be designated or separated cycling facilities to meet or exceed the recommended class of cycling facility.

A detailed analysis sheet is included in Appendix A.

Contextual Factors in Selecting a Cycling Facility

Reviewing the City of Hamilton's latest Cycling Plan (part of the Transportation Master Plan Update), Birch/Holton is identified for planned bike lanes (refer to Exhibit 3), and will connect to future bike lanes on Burlington Street in the north and Cannon Street in the South, with a future connection south of Cannon to Holton Avenue.

Exhibit 3: Proposed Cycling Routes



Source: City of Hamilton Transportation Master Plan (2018)

Through the review of OTM Book 18 factors, a designated or separated cycling facility is considered appropriate along this corridor. The selection of an appropriate cycling facilities within these classes depends on several factors. For example:

- **Continuity** – How will the link connect to cycling facilities upstream or downstream of the study area? How can the link provide a continuous and cohesive cycling facility?
- **Land Use Context / Driveways** – How will the land use context influence the demand for cycling facilities? Are driveways closely spaced or intermittent?
- **Access to Key Destinations** – Are destinations located on both sides of the street or only one side of the street? What key destinations does this route serve?
- **Existing / Future Demand** – Is there low/ high ridership presently? Are significant changes in land use anticipated that will impact future ridership?

These factors are explored in more detail in Exhibit 4.

Exhibit 4: Review of Contextual Factors

FACTOR	DISCUSSION	KEY NOTES
Continuity	<ul style="list-style-type: none"> • Avoiding facility transitions is important, need to consider a facility type that will allow for continuity along the full length of the corridor • Birch Avenue from Cannon to Princess is currently undergoing reconstruction without bicycle lanes; it is anticipated that a multi-use path will be added on the west side. Therefore, a multi-use path north of Princess will provide better connectivity • Multi-use path on west side requires shifting centre pier of Bridge 332 	<ul style="list-style-type: none"> • Uni-directional facilities cannot be accommodated between Cannon & Princess, so multi-use path on west side provides better continuity
Land Use Context & Driveways	<ul style="list-style-type: none"> • Cycling Master Plan suggests uni-directional facilities are most appropriate along two-way streets, so future conversion to two-way supports bike lanes or cycle tracks • Some driveways along corridor, spacing is not frequent except for between Cannon & Barton on east side, however driveways are anticipated to be higher volume commercial uses. On-road facilities improve visibility at intersections, unless there is sufficient right-of-way to apply bend-out designs to cycle tracks or multi-use paths 	<ul style="list-style-type: none"> • As road transitions to two-way, uni-directional cycling facilities are more consistent with TMP recommendations • If multi-use path applied, need to incorporate and address driveway crossings with bend-in or bend-out treatments and high-visibility conflict zone markings
Access to Key Destinations	<ul style="list-style-type: none"> • Anticipated secondary cycling route, as there are limited key destinations along the corridor • Destinations distributed along both sides of the street suggests a multi-use path on one side is less desirable 	<ul style="list-style-type: none"> • Destinations on both side of the corridors suggest that uni-directional facilities along both sides would be preferred,
Existing & Future Demand	<ul style="list-style-type: none"> • Anticipated to be a secondary cycling route, providing a connection between Burlington & Cannon, however the corridor is not anticipated to be a high-demand cycling corridor 	<ul style="list-style-type: none"> • Multi-use path may be appropriate based on lower pedestrian and cycling demand
All Ages & Abilities	<ul style="list-style-type: none"> • A wider variety of cyclists are likely to be more comfortable on separated cycling facilities compared to designated facilities, so cycle tracks or multi-use path would be preferred compared to bike lanes 	<ul style="list-style-type: none"> • Multi-use path or cycle tracks are likely to be more comfortable for more people (compared to bike lanes)
Other	<ul style="list-style-type: none"> • Sidewalks are missing from the west side of Birch through the study area (Princess to Burlington), therefore the addition of a multi-use path on the west side would have an additional benefit of improving pedestrian connectivity & safety 	<ul style="list-style-type: none"> • Multi-use path on the west side would address sidewalk gaps

One other key consideration for the cycling facility along the Birch Avenue corridor is the impact of the cycling facility design on stormwater management (SWM). Any cycling facilities that are raised from the roadway level can offer a benefit to the corridor from a SWM perspective, which suggests that raised bike lanes, cycle tracks or multi-use paths may be preferred in this context (compared to conventional on-road bicycle lanes).

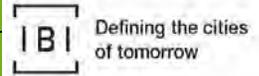
Based on this review of cycling network context, the following are key takeaways about the recommended cycling facility along the corridor:

- On-road cycling facilities are appropriate for the context, and would be less costly than other cycling facilities to build. However, on-road infrastructure will not improve conditions for stormwater management.
- Considering bike lanes, cycle tracks or a multi-use trail on one side, the greatest factor in selecting a cycling facility through the EA is continuity. Maintaining a consistent cycling facility along the length of the corridor should be a key project objective. As a result, **multi-use path on the west side is the preferred solution.**
- Should it be infeasible to shift the centre pier of Bridge 332 to accommodate a continuous multi-use path, bike lanes or cycle tracks should be explored, with a facility transition to the future multi-use path south of Princess occurring at a signalized intersection.

Appendix A - Cycling Facility Selection Analysis Worksheet

Cycling Facility Selection Review

Roadway: Birch Avenue Horizon: Future
 From: Burlington Street East To: Barton Street East



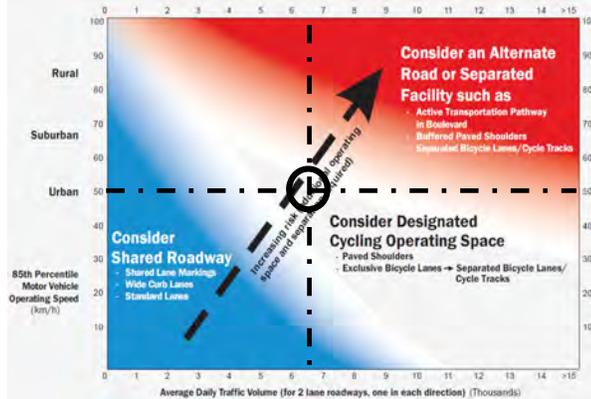
Step 1 - Pre-Selection

Input

ADT 7000
 Speed 50 km/hr

Recommendation

This pre-selection nomograph suggests a designated facility may be appropriate.



Notes:

Step 2 - Detailed Review

Primary Criteria	Input	Recommendation
3.1 Speeds	Moderate (50-69 km/hr)	Designated or separated
3.2 Volumes	2000 to 10000 vpd	Designated
3.3 Street Function	Mobility road (major collector or arterial)	Designated or separated
3.4 Vehicle Mix	>30 trucks or buses per hour in curb lane	Designated with buffer or separated (may be preferred by cyclists)
3.5 Collision History	No specific trends	No impact on facility selection
3.6 Available Space	Sufficient curb-to-curb width available with pinch points	Localized widening preferred, or consider transitions
Notes:	Speed based on posted speed, rather than operating speeds (to be confirmed) Collision history not available at time of review	

Secondary Criteria	Input	Recommendation
3.7 Costs	Budget is available for this project	No impact on facility selection
3.8 Anticipated User	Experienced cyclists (commuter or other utilitarian)	Designated or separated
3.9 Level of Use	Low (<10 cyclists per hour)	Shared may be acceptable
3.10 Route Function	New route connects adjacent existing facilities	Provide continuity with adjacent facilities
3.11 Road Project	None (Retrofit)	No impact on facility selection
3.12 Parking	Parallel on-street parking is not permitted	Designated could be explored
3.13 Intersections	Limited intersection and driveway crossings	Designated or separated
Notes:		

Step 3 - Recommendations & Justification

Final Recommendation: Designated facility is appropriate.

Designated facility is appropriate given the arterial roadway function and the vehicular volumes

*For full details of the methodology and a detailed discussion of each criterion see pages 26-39 of OTM Book 18