



September 12, 2024

Via: Email

Connor Wilson
 Development Planner
 Niagara Region
 1815 Sir Isaac Brock Way
 Thorold ON L2V 4T7

Muhammad Ali Khan, M.A.Sc; P.Eng.
 Manager, Traffic/Parking/ Bylaws
 City of Welland
 60 East Main Street
 Welland ON L3B 3X4

Dear Connor and Ali:

Re: 418-430 Aqueduct St & 650-678 Niagara St Response to Transportation Comments Welland, ON
City File No.: OPA No. 49 & 2024-01
Region File No.: D.10.11.OPA-24-0001 & D.18.11.ZA-24-0003
Project No.: 300052233.0000

R.J. Burnside & Associates Limited (Burnside) provides this response to the comments received from the City of Welland (City) via an email, dated April 15, 2024, and Niagara Region’s (Region) Growth Strategy and Economic Development Department comments, dated March 18, 2024, on Burnside’s Transportation Study, dated November 2023 (TIS).

Due to these and other comments provided by the City, the proposed site plan has been updated and is shown in Attachment 1. The updated site plan, dated August 27, 2024, is discussed below followed by the transportation-related comments and our responses.

1.0 The Updated Site Plan

A comparison of the changes between the previous and current site plan is shown in Table 1.

Table 1: Site Plan Change Summary

Element		TIS	Current	Difference
Uses	Townhouse	26	26	0
	Apartment (Building A & B)	810	542	-268
	Apartment (Building C)	360	311	-49
	Total	1,196	879	-317
Parking	Retail	1,121	1,121	0
	Resident – Townhouse	26	26	0
	Resident – Apartment	796	657	-139
	Visitor	57	0	-57
	Retail	37	40	+3
	Total	916	723	-193

The changes to the site plan and their impact on the conclusions and recommendations of the TIS are discussed below.

1.1 Traffic and Parking Review

1.1.1 Traffic Operations

The current site plan proposes 317 fewer apartments compared to the site plan examined in the TIS. This is estimated to generate 74 fewer trips in the weekday a.m. peak hour and 88 fewer trips in the weekday p.m. peak hour, after accounting for the 15% non-vehicle trip reduction. This reduction in traffic will not change the traffic operations analysis conclusions and recommendations contained in the TIS.

1.2 Parking and Loading

1.2.1 Vehicular Parking

Parking was reviewed for the updated site plan based on the City's Zoning By-law 2017-117 (ZBL). The updated parking analysis is summarized in Table 2.

Table 2: Vehicle Parking Requirements

Use	ZBL Use	Size (units or sqm)	Parking Rate	Required Spaces	Supply	Deficit / Surplus
Townhouse	Townhouse Dwelling	26	1 / unit	26	26	+48
Apartment (Building A & B)	Apartment Dwelling (unit < 50 sqm)	250	0.3 / unit	367	657	
	Apartment Dwelling	292	1 / unit			
Apartment (Building C)	Apartment Dwelling (unit < 50 sqm)	98	0.3 / unit	242		
	Apartment Dwelling	213	1 / unit			
Residential Subtotal				635		
Retail	Retail	1,121	1 / 30 sqm	37		40
Total				672	723	+51

Note: As per the ZBL, the minimum number of spaces required is increased to the next highest whole number if the fraction is greater than or equal to 0.5.

The proposed site plan includes 51 surplus parking spaces, which exceeds the ZBL requirements. Although the previously designated visitor parking spaces are being removed, the total of 657 parking spaces in Towers A, B, and C will accommodate both residents and visitors. The specific allocation of spaces provided to visitors has not been identified, as this is not a requirement of the ZBL.

1.2.2 Accessible Parking

The ZBL requires a minimum of two barrier-free parking spaces plus one space for every additional 100 required spaces for a parking supply of 100 or more spaces, which results in a minimum requirement of eight barrier-free parking spaces. The current site plan proposes 11 barrier-free parking spaces, which exceeds the ZBL requirement.

1.2.3 Bicycle Parking

The ZBL contains bicycle parking requirements for long-term resident spaces and for short-term retail spaces. The resulting bicycle parking requirements for the development are summarized in Table 3.

Table 3: ZBL Bicycle Parking Requirements

Proposed Use	Parking Rate	Required Parking	Proposed Supply	Deficit / Surplus
Townhouse and Apartment Dwelling (879 Units)	0.25 / unit	220	393	+173
Retail (1,121 m ²)	1 per 1,000 m ²	2	2	0
Total		222	395	+173

Note: As per the ZBL, the minimum number of spaces required is increased to the next highest whole number if the fraction is greater than or equal to 0.5.

The proposed long-term spaces will exceed the ZBL requirements and short-term bicycle spaces will meet the ZBL requirements.

1.2.4 Loading

According to the ZBL, a minimum of one loading space is required in conjunction with every principal building, excluding residential buildings less than four stories high. Therefore, a minimum of three loading spaces will be required according to the ZBL. The proposed supply of loading spaces will meet the ZBL requirements.

2.0 Response to Comments

Those comments relevant to transportation have been repeated below in italics (with their respective headings) with our responses following each set of comments. Where there is no numbering system, we have numbered the comments for ease of reference.

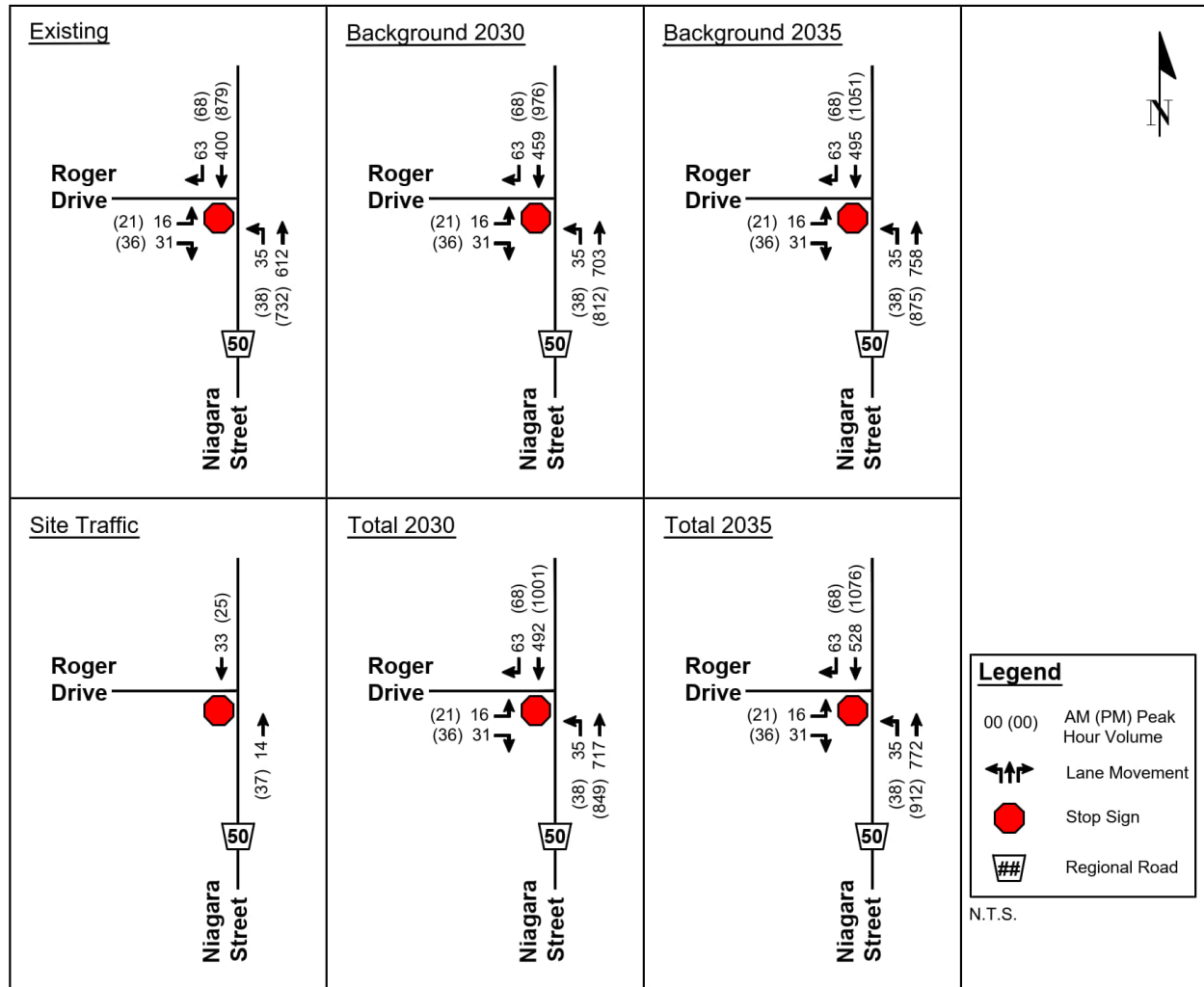
2.1 City Comments

- As a result of any revisions to TIS (due to potential changes to proposed development), please include the intersection of Roger Street/Niagara Street.*

Existing weekday a.m. and p.m. traffic counts were conducted by Pyramid Traffic Inc. on behalf of Burnside, for the weekday morning (7:00 a.m. to 9:00 a.m.) and weekday evening (4:00 p.m. to 6:00 p.m.) peak periods on May 1, 2024, at the Regional intersection of Niagara Street / Roger Drive. Traffic counts are provided in Attachment 2. Please note that traffic

corresponding to an east approach was picked up in the traffic count from a nearby driveway, which does not align with Roger Drive, so was therefore ignored for the purposes of this analysis. Existing and projected traffic volumes at this intersection for all horizon scenarios are shown in Figure 1. Projected traffic volumes were based on the site stats used in the TIS.

Figure 1: Existing and Projected Traffic Volumes at Niagara Street / Roger Drive



A synchro analysis was conducted at this intersection for all scenarios. The results are summarized in Table 4. The Synchro reports are included in Attachment 3.

Table 4: Niagara Street / Roger Drive Intersection Operations

Scenario & Movement	Existing Storage / Link Distance (m)	Weekday AM Peak Hour			Weekday PM Peak Hour		
		v/c	LOS	95th Queue (m)	v/c	LOS	95th Queue (m)
Existing Conditions							
EBLR	50+	0.08	B	2	0.13	B	4
NBL	50+	0.04	A	1	0.06	B	2
Background 2030 Conditions							
EBLR	50+	0.09	B	3	0.13	B	4
NBL	50+	0.04	A	1	0.06	B	2
Total 2030 Conditions							
EBLR	50+	0.09	B	3	0.14	B	4
NBL	50+	0.04	A	1	0.06	B	2
Background 2035 Conditions							
EBLR	50+	0.09	B	3	0.14	B	4
NBL	50+	0.04	A	1	0.06	B	2
Total 2035 Conditions							
EBLR	50+	0.09	B	3	0.14	B	4
NBL	50+	0.04	A	1	0.07	B	2

Notes: 1. The assumed saturation flow rates and peak hour factors were based on the Region's *Transportation Impact Assessment guidelines (2023)*.

During both peak hours for all scenarios, all movements are operating and will operate with excess capacity and level of service (LOS) B or better. All queues are and will be contained within their respective link distances and storage lengths. This confirms the original professional opinion of the Region and Burnside that this intersection did not need to be examined in the TIS.

2.2 Region Comments

Road Allowance

1. *The subject property has frontage along Niagara Street (Regional Road 50). This section of road meets the required road allowance as identified in the Niagara Official Plan. As such, no widening is required; however, the Region requires a daylight easement triangle at the intersection of the new access and Niagara Street. The size of the daylight will be 6 metres x 6 metres. Future site plans are to show the daylight easements to ensure there are no obstructions to the sight lines; transfer of the easement will be part of the future site plan requirements.*

The required six metre by six metre daylight easement triangles are now shown at the intersection of the new access on Niagara Street at Abby Road.

Regional Transportation Impact Study

Regional Transportation staff reviewed the Transportation study completed by RJ Burnside & Associates Limited dated November 2023 and have provided the following comments to be addressed in an updated TIS submitted with the future site plan application.

1. *The Region still requires a sightline assessment to assess the driveway location on the horizontal curve opposite to Abby Road.*

A sightline analysis was conducted at the driveway location on Niagara Street opposite Abbey Road. Based on the *Geometric Design Guide for Canadian Roads* from the Transportation Association of Canada (TAC), the minimum required intersection sight distance (ISD) is 150 m and 130 m for left turn and right turn, respectively, and the minimum required stopping sight distance (SSD) is 105 m, considering a design speed of 70 km/h. The available sightline is greater than 300 m and 250 m to the north (left turn) and south (right turn), respectively. The SSD and ISD requirements are met, as shown in the figures provided in Attachment 4.

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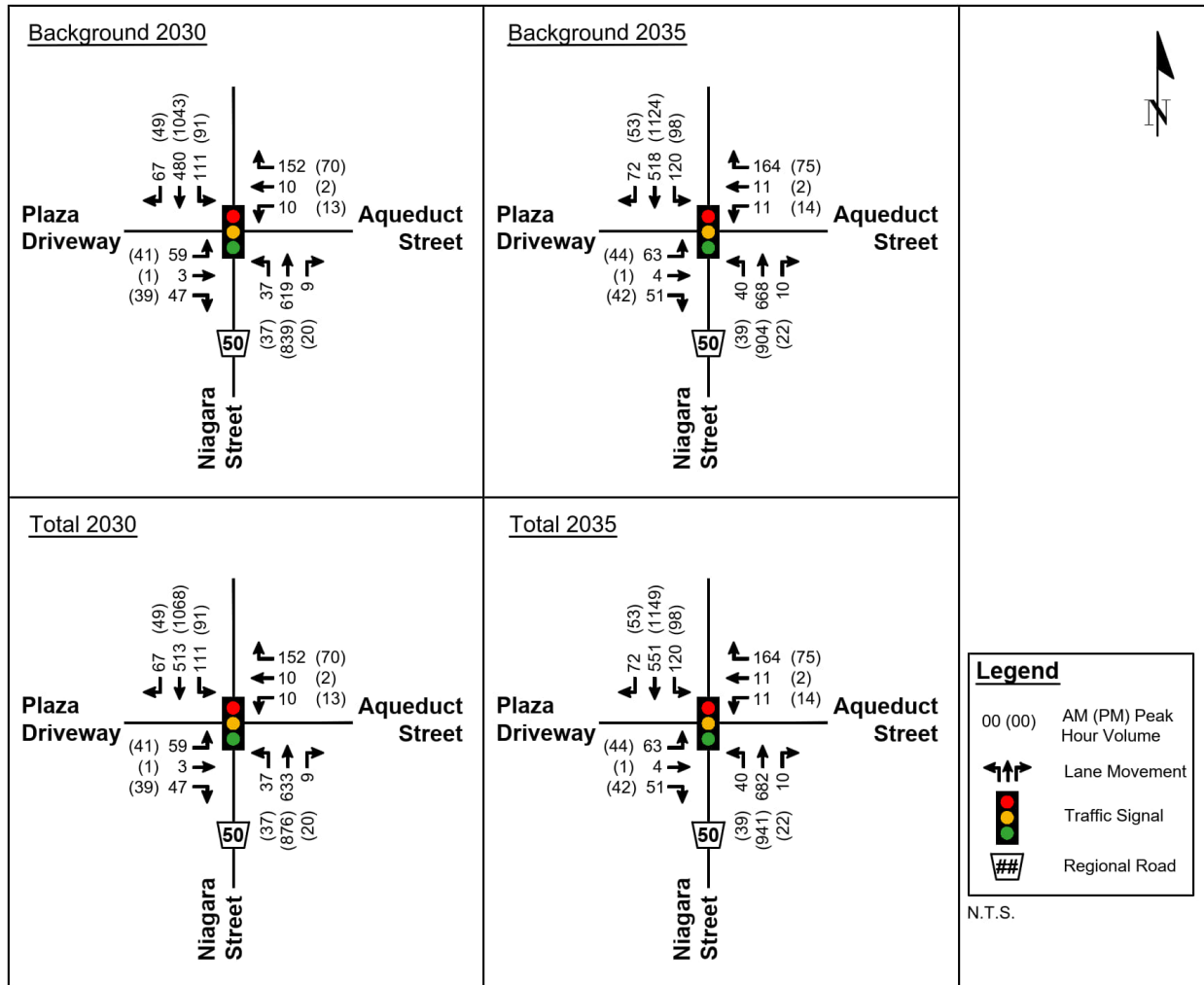
2. *Please clarify why the growth rate is applied only on the “through” movements at Niagara Street / Aqueduct Street intersection. The vehicular turning volume on this intersection is high under the existing baseline year, and it will be impacted further in the future with the addition of this development. In general, there is an overall background growth in any study area.*

We disagree that there is an overall background growth in **any** study area. Growth comes primarily from new development. The land on both sides of Aqueduct Street, south of Niagara Street, is fully built out with no known future redevelopment plans. Furthermore, the road does not provide significant external connections other than serving the existing development so cut-through traffic is not to be expected to utilize it. It is unclear where growth is expected.

3. *Avoidance of the growth rate application will impact the signal warrant result at this intersection. Please revise the traffic volume counts and the subsequent assessments accordingly.*

Please see the response to comment 2 above. Regardless, as requested growth was applied to all movements at the Niagara Street / Aqueduct Street intersection under background and total conditions. The resulting traffic volumes are shown in Figure 2. There were no changes to the projected site traffic volumes at this intersection since the TIS does not assume any site-related traffic would desire to use Aqueduct Street.

Figure 2: Future Traffic Volumes at Niagara Street / Aqueduct Street



The updated future traffic operations analyses are summarized in Table 5. The Synchro reports are included in Attachment 5.

Table 5: Niagara Street / Aqueduct Street Intersection Operations

Scenario & Movement	Existing Storage / Link Distance (m)	Weekday AM Peak Hour			Weekday PM Peak Hour		
		v/c	LOS	95th Queue (m)	v/c	LOS	95th Queue (m)
Background 2030 Conditions							
Overall	-	0.33	B	-	0.48	A	-
EBL	25+	0.46	D	21	0.38	D	16
EBTR	15+	0.06	C	10	0.04	C	9
WBL	20	0.07	C	6	0.12	D	7
WBTR	200+	0.19	C	18	0.07	C	12
NBL	92	0.08	A	6	0.15	A	6
NBTR	200+	0.30	A	33	0.38	A	42
SBL	67	0.27	A	17	0.27	A	14
SBTR	200+	0.27	A	27	0.49	A	58
Total 2030 Conditions							
Overall	-	0.33	B	-	0.48	A	-
EBL	25+	0.46	D	21	0.38	D	16
EBTR	15+	0.06	C	10	0.04	C	9
WBL	20	0.07	C	6	0.12	D	7
WBTR	200+	0.19	C	18	0.07	C	12
NBL	92	0.08	A	6	0.16	A	7
NBTR	200+	0.31	A	33	0.40	A	44
SBL	67	0.27	A	17	0.29	A	14
SBTR	200+	0.28	A	29	0.50	A	60
Background 2035 Conditions							
Overall	-	0.39	B	-	0.51	A	-
EBL	25+	0.51	D	22	0.40	D	17
EBTR	15+	0.06	C	10	0.04	C	9
WBL	20	0.07	C	6	0.12	C	8
WBTR	200+	0.20	C	19	0.08	C	13
NBL	92	0.09	A	7	0.18	A	7
NBTR	200+	0.33	A	36	0.41	A	47
SBL	67	0.31	A	20	0.32	A	17
SBTR	200+	0.29	A	30	0.53	A	67
Total 2035 Conditions							
Overall	-	0.36	B	-	0.52	A	-
EBL	25+	0.55	D	23	0.42	D	18
EBTR	15+	0.06	C	11	0.11	D	11
WBL	20	0.07	C	7	0.13	D	8
WBTR	200+	0.31	D	24	0.18	D	15
NBL	92	0.09	A	7	0.18	A	7
NBTR	200+	0.33	A	38	0.42	A	50
SBL	67	0.31	A	20	0.33	A	17
SBTR	200+	0.30	A	33	0.53	A	70

Notes: 1. Signal timing plans were optimized.
 2. The assumed saturation flow rates and peak hour factors were based on the Region's *Transportation Impact Assessment guidelines (2023)*.

During both peak hours, all movements will operate with excess capacity and LOS D or better. All queues are and will be contained within their respective link distances and storage lengths.

The conclusions and recommendations of the TIS remain the same for this intersection.

An updated signal warrant analysis was also conducted for this intersection with the requested adjustments to growth. The signal warrant analysis was based on the methodology contained in the *Ontario Traffic Manual Book 12*, published by the Ministry of Transportation. The results are summarized in Table 6. Detailed analyses are provided in Attachment 5.

Table 6: Niagara Street / Aqueduct Street Signal Warrant Analysis

Condition	Justification	Justification 1 Minimum Vehicular Volume ¹		Justification 2 Delay to Cross Traffic ¹		Justification 3 Combination ²	
		1A	1B	2A	2B	3A	3B
Background 2030	Compliance	107%	66%	95%	45%	66%	45%
	Justified	No		No		No	
Total 2030	Compliance	110%	66%	98%	45%	66%	45%
	Justified	No		No		No	
Background 2035	Compliance	115%	71%	102%	48%	71%	48%
	Justified	No		No		No	
Total 2035	Compliance	118%	71%	105%	48%	71%	48%
	Justified	No		No		No	

Notes: 1. Justification 1A and 2A are total intersection volumes while 1B and 2B are crossing (of the main road) volumes.

2. Justification 3A is justification 1, while 3B is justification 2.

For each justification, the lower percentage governs the warrant. A signal can be warranted by just one of the justifications, provided it meets the threshold for both subcategories. The threshold required for existing volumes is 100% for Justification 1 and 2, and 80% for Justification 3. The threshold required for each justification is 120% for projected volumes. Therefore, a traffic signal continues to not be warranted under future conditions at this intersection. The requested changes to growth do not affect the conclusions of the analysis.

The conclusions and recommendations of the TIS remain the same for this intersection.

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- Under Section 4.1 Trip Generation, please clarify on how it was assumed that the modal split is to be 15%. The Region has concerns that this assumption is relatively high compared to the travel modal split found in the 2016 Transportation Tomorrow Survey. This will underestimate the impact of the trips generated from this development and ultimately impact the capacity analysis for the future scenarios.*

A review of the 2016 *Transportation Tomorrow Survey* (TTS) results published by the Data Management Group at the University of Toronto Transportation Research Institute indicate that 17% of trips made by residents of Welland (TTS Planning District 58) are by transit (11%), walking (1%) or cycling (5%). According to the Region's *Transportation Master Plan*, dated October 2017, the total number of trips made by public transportation (transit) in the Region is

forecast to increase 80% from the existing modal split by 2041. This increase would result in transit going from 11% to 14%. In our opinion, a 15% non-auto mode share is therefore conservative. The site is designed to encourage many modes of travel other than the single occupant motor vehicle and the site is located close to many commercial retail locations, including being within a 10-minute walk of the Seaway Mall where there is a bus hub. This modal split is also consistent with other approved applications in the area (i.e., Seaway Mall). To be conservative, no reductions for pass-by trips or internal interaction trips were applied for the retail uses.

Page 24-28 Access's clear throat assessment

5. *Under Section 6 Traffic Operation Analysis, Table 8 and Table 11 provide the capacity analysis and the queue assessment for the South Driveway and North Driveway respectively. As per the 95% queue length shown, the generated traffic from the development is well accommodated within the clear throat length recommended in the site plan (Existing Storage / Link Distance). As per the analysis, it is proven that one driveway will suffice this development, and the generated queue can be accommodated within one access with a clear throat length of 30 metres.*

Acknowledged. However, two driveways will lessen the impact of each driveway and provide better connectivity for the site without undue impact to Niagara Street.

Appendices B-F (Detail Synchro Reports)

6. *The queue reports mentioned under Section 6 Traffic Operation Analysis are not attached to the appendices. Please attach in the resubmission for the Region's review.*

The 95th percentile queues were shown in the included Synchro reports that were provided in Appendices B to F.

7. *The saturation flow rate used for the Synchro analysis are higher than the values specified in the Transportation Impact Assessment guidelines (2023). Additionally, the peak hour factor was not consistent throughout the intersections in the study area and higher in the intersection of Niagara Street and Woodlawn Road. This will result in overestimating the existing and the background traffic conditions. Please revise capacity analysis using the rates highlighted in Table 1 of the TIA guidelines and use a peak hour factor of 0.92.*
8. *The comment above is applicable on all the scenarios provided.*

The peak hour factor (PHF) that was assumed in the TIS was based on existing conditions at each existing intersection and the Synchro default of 0.92 at the proposed driveways as shown in the Synchro reports. The assumed ideal saturation flow rate (ISFR) as shown in the provided Synchro reports was the Synchro default of 1,900. HCM7 recommends that existing PHF be used in this type of analysis since it is more representative of actual conditions. HCM7 also notes that as traffic volumes increase both the PHF and the ISFR are expected to also increase.


It is our opinion that the Region's guidelines are underestimating capacity and that the analysis in the TIS is consistent with HCM7 calibration guidance that will be a more accurate predictor of future conditions.

Should you require any clarification on the above, please contact either of the undersigned.

Yours truly,

R.J. Burnside & Associates Limited


Rebecca Rust
Transportation Planner
RR/DWA:cvh/tp


David Angelakis, C.E.T.
Senior Project Manager – Transportation

Enclosures: Attachment 1: Site Plan
Attachment 2: Traffic Counts
Attachment 3: Niagara Street / Roger Drive Synchro Reports
Attachment 4: Niagara Street / South Driveway Sightline Analysis
Attachment 5: Niagara Street / Aqueduct Street Synchro Reports and Signal Warrant Analysis

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240911_LTR_418-430 Aqueduct 650-678 Niagara Response to Comments
12/09/2024 8:42 AM

Floor	No. Typ. Floors	AREA				UNIT BREAKDOWN											Parking			
		GBA (Typ. Floor [m ²])	GBA (Parking)	GBA (Total)	Indoor Amenity (m ²)	GFA (Retail)	Studio (35-45m)	1BR (45-60m)	1BR+D (55-65m)	2BR (65-80m)	2BR+D (75-90m)	3BR (90+sm)	Total Suites Per Typical Level	Total Suites	Parking Spaces provided	Bike Parking Provided	Units less than 50sm			
BUILDING A																				
Level 1	1	2,375	-	2,375	449	-	-	-	-	-	12	-	12	12	-	-	0			
Level 2-5	4	1,512	-	6,048	-	-	2	11	4	2	-	21	84	-	-	52				
Levels 6-8	3	1,406	-	4,218	-	-	2	12	5	-	1	30	60	-	-	42				
Levels 9-10	2	1,098	-	2,196	-	-	-	9	7	-	-	17	34	-	-	18				
Typical Parking Level	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0				
MPH	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0				
Total	10	300	-	14,837	449	-	14	98	45	8	14	11	190	-	-	112				
BUILDING B																				
Level 1	1	4,492	1,836	4,492	416	429	-	-	-	-	9	-	9	-	32	0				
Parking Mezzanine	1	1,836	1,836	-	-	-	-	-	-	-	-	-	-	34	-	0				
Level 2-3	2	4,550	9,100	-	-	-	7	6	2	2	1	6	24	48	110	14				
amen. Level 4	1	2,636	-	2,636	797	-	9	12	8	2	-	31	31	-	12	0				
Level 5-8	4	2,636	-	10,544	-	-	9	17	9	3	-	38	152	-	48	0				
Level 9-16 (West Tower)	8	805	-	6,440	-	-	2	6	10	2	2	22	44	-	6	0				
Parking P1	1	12,065	10,479	12,065	-	-	-	-	-	-	-	-	-	275	156	0				
MPH (East building)	1	300	-	300	-	-	-	-	-	-	-	-	-	-	-	0				
MPH (West Tower)	1	300	-	300	-	-	-	-	-	-	-	-	-	-	-	0				
Total	16	300	14,495	47,113	1,213	429	75	156	64	34	11	12	352	451	156	138				
BUILDING C																				
Level 1	1	2,354	-	2,354	-	692	-	-	-	-	9	-	9	-	-	0				
Level 2	1	2,122	-	2,122	-	-	2	13	14	1	1	31	31	-	4	0				
Level 3-5	3	2,046	-	6,138	-	-	2	13	14	1	1	31	93	-	12	0				
Level 6	1	1,503	-	1,503	303	-	2	6	10	2	2	22	22	-	6	0				
Level 7-8	2	1,503	-	3,006	-	-	2	6	10	2	2	22	44	-	12	0				
Level 9-16	8	805	-	6,440	-	-	2	8	2	2	-	14	112	-	64	0				
Parking P1	1	5087	4433	5087	-	-	-	-	-	-	-	-	-	100	239	0				
MPH	1	5087	4997	5087	-	-	-	-	-	-	-	-	-	106	-	0				
Total	16	300	9,030	31,737	303	692	30	134	102	26	19	-	311	206	239	98				
CONDO TOTAL	42	-	23,525	93,687	1,965	1,121	119	388	211	68	44	23	TOTAL UNITS	853	TOTAL PARKING	395				
BUILDING D & E (STACKED)																				
Block D	4	500	-	2,360	sm	-	-	-	-	-	-	-	14	-	-	-				
Block E	4	504	-	2,016	sm	-	-	-	-	-	-	-	12	-	-	-				
Total	8	1,004	-	4,376	sm	-	-	-	-	-	-	-	26	-	-	-				
DEVELOPMENT TOTAL																				
TOTAL GBA	98,063	sm	SITE AREA	3.88	ha	LANDSCAPE AREA	8,020	sm	PROPOSED DENSITY	227	units	ha	TOTAL UNITS	879	Total Parking	723				
													Total Barrier Free Parking	11						

DEVELOPMENT STATISTICS 3 A001.S

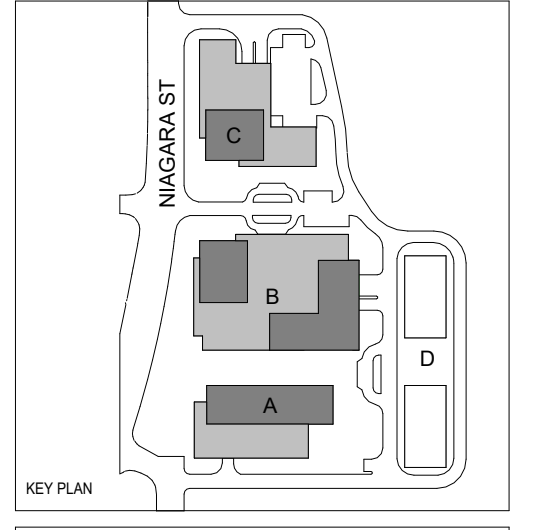
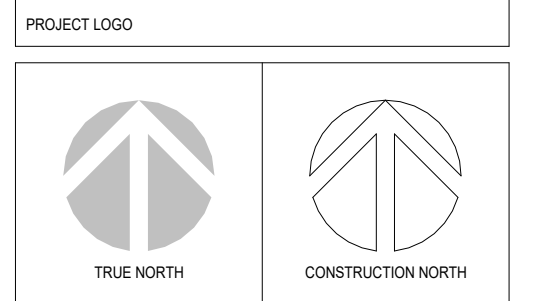
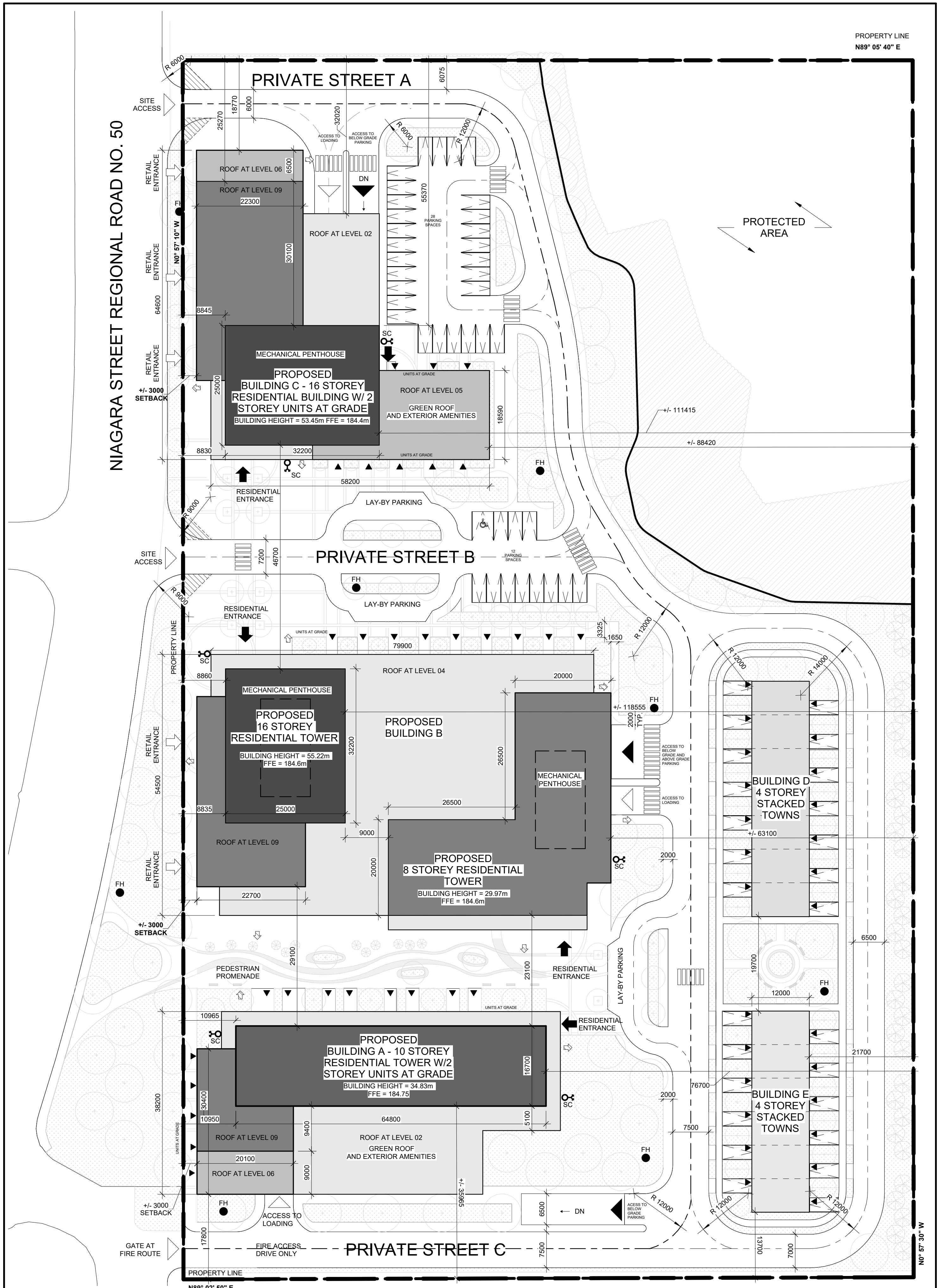
Parking Required			
Residential			
Unit Area	Parking Rate/Unit	Unit Count	Spaces Required
<50sm	0.3	348	104
>50sm	1	505	505
Townhouses	1	26	26
Sub-Total			635
Retail			
Parking Rate	Area	Spaces Required	
1/30sm	1121	37	
Sub-Total			37
TOTAL REQUIRED			672

Parking Provided	
Location	Count
Below Grade	481
At Grade	66
Above Grade	176
Total	723

PARKING STATISTICS 4 A001.S

- SITE LEGEND**
- BOUNDARY OF PROTECTED EXTENTS
 - PROPERTY LINE
 - FIRE ROUTE CENTERLINE
 - MAIN BUILDING ENTRANCE
 - MAIN BUILDING EXIT
 - ACCESS TO LOADING
 - ACCESS TO PARKING
 - EXTERIOR RESIDENTIAL ENTRANCE
 - FIRE ACCESS ROUTE
 - GRAVEL
 - SOFT LANDSCAPING
 - PEDESTRIAN PROMENADE
 - 6M X 6M DAYLIGHT TRIANGLE
 - F.F.E.
 - TOP OF FINISHED FLOOR
 - PARKING
 - ACCESSIBLE PARKING

SITE LEGEND 2 A001.S



3 Issued for Reasoning 2024-08-27
 2 Issued for Reasoning 2024-06-17
 1 Issued for Reasoning 2023-11-17

No.	DESCRIPTION	DATE
1	Issued for Reasoning	2023-11-17

REVISIONS:

DISCREPANCIES MUST BE REPORTED IMMEDIATELY TO THE ARCHITECT BEFORE PROCEEDING. ONLY FIGURED DIMENSIONS MUST BE USED. THE CONTRACTOR MUST CHECK THE DIMENSIONS ON SITE. THE DRAWING IS PROTECTED BY COPYRIGHT. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS.

DO NOT SCALE THE DRAWINGS.

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SEAL

CONSULTANTS:

PROJECT:
WELLAND DEVELOPMENT

670 Niagara Street, Welland ON.

DRAWING TITLE:
SITE PLAN

DRAWN BY: DW DATE: 17/11/2023
 CHECKED BY: NC SCALE:

PROJECT NO: **23029**

DRAWING NO: **A100**

Niagara St @ Roger Dr

Morning Peak Diagram

Specified Period

From: 7:00:00

To: 9:00:00

One Hour Peak

From: 8:00:00

To: 9:00:00

Municipality: Welland
Site #: 000000002
Intersection: Niagara St & Roger Dr
TFR File #: 2
Count date: 23-Apr-2024

Weather conditions:
 Cloudy/Dry
Person(s) who counted:
 Pyramid Traffic Inc

**** Non-Signalized Intersection ****

Major Road: Niagara St runs N/S

North Leg Total: 1093
 North Entering: 464
 North Peds: 1
 Peds Cross: \times

Heavys	2	20	0	22
Trucks	0	0	0	0
Cars	61	380	1	442
Totals	63	400	1	



Heavys	14
Trucks	0
Cars	615
Totals	629

East Leg Total: 11
 East Entering: 2
 East Peds: 4
 Peds Cross: \times

Heavys	Trucks	Cars	Totals
2	0	96	98

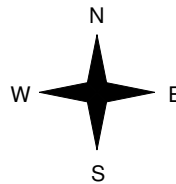


Niagara St

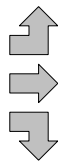
Cars	Trucks	Heavys	Totals
1	0	0	1
0	0	0	0
1	0	0	1
2	0	0	



Roger Dr



Heavys	Trucks	Cars	Totals
0	0	16	16
0	0	0	0
1	0	30	31
1	0	46	



Niagara St

Driveway



Cars	Trucks	Heavys	Totals
9	0	0	9

Peds Cross: \times
 West Peds: 6
 West Entering: 47
 West Leg Total: 145

Cars	411	Cars	35	598	8	641
Trucks	0	Trucks	0	0	0	0
Heavys	21	Heavys	0	14	0	14
Totals	432	Totals	35	612	8	



Peds Cross: \times
 South Peds: 0
 South Entering: 655
 South Leg Total: 1087

Comments

Niagara St @ Roger Dr

Afternoon Peak Diagram

Specified Period

From: 16:00:00

To: 18:00:00

One Hour Peak

From: 16:00:00

To: 17:00:00

Municipality: Welland
Site #: 000000002
Intersection: Niagara St & Roger Dr
TFR File #: 2
Count date: 23-Apr-2024

Weather conditions:
 Cloudy/Dry
Person(s) who counted:
 Pyramid Traffic Inc

**** Non-Signalized Intersection ****

Major Road: Niagara St runs N/S

North Leg Total: 1732
 North Entering: 961
 North Peds: 2
 Peds Cross: \times

Heavys	0	10	0	10
Trucks	0	0	0	0
Cars	68	869	14	951
Totals	68	879	14	



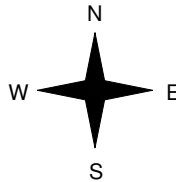
Heavys	11
Trucks	0
Cars	760
Totals	771

East Leg Total: 77
 East Entering: 37
 East Peds: 7
 Peds Cross: \times

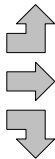
Heavys	0	0	108	108
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Roger Dr



Heavys	0	0	21	21
Trucks	0	0	3	3
Cars	0	0	36	36
Totals	0	0	60	



Niagara St

Cars	18	0	0	18
Trucks	0	0	0	0
Heavys	2	0	0	2
Totals	17	0	0	17
	37	0	0	

Driveway



Cars	40	0	0	40
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Peds Cross: \times
 West Peds: 8
 West Entering: 60
 West Leg Total: 168

Cars	922	38	721	23	782
Trucks	0	0	0	0	0
Heavys	10	0	11	0	11
Totals	932	38	732	23	



Peds Cross: \times
 South Peds: 1
 South Entering: 793
 South Leg Total: 1725

Comments

HCM Unsignalized Intersection Capacity Analysis 6: Niagara St. & Roger Dr.

2023 Existing AM

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y		Y	↑↑	↑↑	
Traffic Volume (veh/h)	16	31	35	612	400	63
Future Volume (Veh/h)	16	31	35	612	400	63
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	17	34	38	665	435	68
Pedestrians	6		1			
Lane Width (m)	3.7		3.7			
Walking Speed (m/s)	1.1		1.1			
Percent Blockage	1		0			
Right turn flare (veh)						
Median type			TWLTL		TWLTL	
Median storage (veh)			2		2	
Upstream signal (m)			344		274	
pX, platoon unblocked						
vC, conflicting volume	884	258	509			
vC1, stage 1 conf vol	475					
vC2, stage 2 conf vol	410					
vCu, unblocked vol	884	258	509			
tC, single (s)	6.8	7.0	4.1			
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3	2.2			
p0 queue free %	96	95	96			
cM capacity (veh/h)	485	734	1060			
Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	51	38	332	332	290	213
Volume Left	17	38	0	0	0	0
Volume Right	34	0	0	0	0	68
cSH	627	1060	1700	1700	1700	1700
Volume to Capacity	0.08	0.04	0.20	0.20	0.17	0.13
Queue Length 95th (m)	2.0	0.8	0.0	0.0	0.0	0.0
Control Delay (s)	11.3	8.5	0.0	0.0	0.0	0.0
Lane LOS	B	A				
Approach Delay (s)	11.3	0.5	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay	0.7					
Intersection Capacity Utilization	30.7%		ICU Level of Service		A	
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis 6: Niagara St. & Roger Dr.

2023 Existing PM

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y		Y	↑↑	↑↑	
Traffic Volume (veh/h)	21	36	38	732	879	68
Future Volume (Veh/h)	21	36	38	732	879	68
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	23	39	41	796	955	74
Pedestrians	8		1		2	
Lane Width (m)	3.7		3.7		3.7	
Walking Speed (m/s)	1.1		1.1		1.1	
Percent Blockage	1		0		0	
Right turn flare (veh)						
Median type			TWLTL		TWLTL	
Median storage (veh)			2		2	
Upstream signal (m)			344		274	
pX, platoon unblocked	0.92	0.92	0.92			
vC, conflicting volume	1482	524	1037			
vC1, stage 1 conf vol	1000					
vC2, stage 2 conf vol	482					
vCu, unblocked vol	1281	294	855			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3	2.2			
p0 queue free %	93	94	94			
cM capacity (veh/h)	322	643	721			
Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	62	41	398	398	637	392
Volume Left	23	41	0	0	0	0
Volume Right	39	0	0	0	0	74
cSH	470	721	1700	1700	1700	1700
Volume to Capacity	0.13	0.06	0.23	0.23	0.37	0.23
Queue Length 95th (m)	3.4	1.4	0.0	0.0	0.0	0.0
Control Delay (s)	13.8	10.3	0.0	0.0	0.0	0.0
Lane LOS	B	B				
Approach Delay (s)	13.8	0.5	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay	0.7					
Intersection Capacity Utilization	46.0%		ICU Level of Service		A	
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
6: Niagara St. & Roger Dr.

2030 Background AM

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y		Y	↑↑	↑↑	
Traffic Volume (veh/h)	16	31	35	703	459	63
Future Volume (Veh/h)	16	31	35	703	459	63
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	17	34	38	764	499	68
Pedestrians	6					
Lane Width (m)	3.7			3.7		
Walking Speed (m/s)	1.1			1.1		
Percent Blockage	1			0		
Right turn flare (veh)						
Median type			TWLTL	TWLTL		
Median storage (veh)			2	2		
Upstream signal (m)			344	274		
pX, platoon unblocked	1.00					
vC, conflicting volume	998	290	573			
vC1, stage 1 conf vol	539					
vC2, stage 2 conf vol	459					
vCu, unblocked vol	998	290	573			
tC, single (s)	6.8	7.0	4.1			
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3	2.2			
p0 queue free %	96	95	96			
cM capacity (veh/h)	445	700	1004			
Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	51	38	382	382	333	234
Volume Left	17	38	0	0	0	0
Volume Right	34	0	0	0	0	68
cSH	588	1004	1700	1700	1700	1700
Volume to Capacity	0.09	0.04	0.22	0.22	0.20	0.14
Queue Length 95th (m)	2.2	0.9	0.0	0.0	0.0	0.0
Control Delay (s)	11.7	8.7	0.0	0.0	0.0	0.0
Lane LOS	B	A				
Approach Delay (s)	11.7	0.4			0.0	
Approach LOS	B					
Intersection Summary						
Average Delay	0.7					
Intersection Capacity Utilization	32.5%		ICU Level of Service		A	
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
6: Niagara St. & Roger Dr.

2030 Background PM

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y		Y	↑↑	↑↑	
Traffic Volume (veh/h)	21	36	38	812	976	68
Future Volume (Veh/h)	21	36	38	812	976	68
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	23	39	41	883	1061	74
Pedestrians	8					
Lane Width (m)	3.7			3.7		
Walking Speed (m/s)	1.1			1.1		
Percent Blockage	1			0		
Right turn flare (veh)						
Median type			TWLTL	TWLTL		
Median storage (veh)			2	2		
Upstream signal (m)			344	274		
pX, platoon unblocked	0.91	0.88	0.88			
vC, conflicting volume	1632	576	1143			
vC1, stage 1 conf vol	1106					
vC2, stage 2 conf vol	526					
vCu, unblocked vol	1209	260	901			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3	2.2			
p0 queue free %	93	94	94			
cM capacity (veh/h)	307	653	670			
Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	62	41	442	442	707	428
Volume Left	23	41	0	0	0	0
Volume Right	39	0	0	0	0	74
cSH	460	670	1700	1700	1700	1700
Volume to Capacity	0.13	0.06	0.26	0.26	0.42	0.25
Queue Length 95th (m)	3.5	1.5	0.0	0.0	0.0	0.0
Control Delay (s)	14.0	10.7	0.0	0.0	0.0	0.0
Lane LOS	B	B				
Approach Delay (s)	14.0	0.5			0.0	
Approach LOS	B					
Intersection Summary						
Average Delay	0.6					
Intersection Capacity Utilization	47.3%		ICU Level of Service		A	
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
6: Niagara St. & Roger Dr.

2030 Background PM

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y		Y	↑↑	↑↑	
Traffic Volume (veh/h)	21	36	38	812	976	68
Future Volume (Veh/h)	21	36	38	812	976	68
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	23	39	41	883	1061	74
Pedestrians	8		1		2	
Lane Width (m)	3.7		3.7		3.7	
Walking Speed (m/s)	1.1		1.1		1.1	
Percent Blockage	1		0		0	
Right turn flare (veh)						
Median type			TWLTL		TWLTL	
Median storage (veh)			2		2	
Upstream signal (m)			344		274	
pX, platoon unblocked	0.91	0.88	0.88			
vC, conflicting volume	1632	576	1143			
vC1, stage 1 conf vol	1106					
vC2, stage 2 conf vol	526					
vCu, unblocked vol	1209	260	901			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3	2.2			
p0 queue free %	93	94	94			
cM capacity (veh/h)	307	653	670			
Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	62	41	442	442	707	428
Volume Left	23	41	0	0	0	0
Volume Right	39	0	0	0	0	74
cSH	460	670	1700	1700	1700	1700
Volume to Capacity	0.13	0.06	0.26	0.26	0.42	0.25
Queue Length 95th (m)	3.5	1.5	0.0	0.0	0.0	0.0
Control Delay (s)	14.0	10.7	0.0	0.0	0.0	0.0
Lane LOS	B	B				
Approach Delay (s)	14.0	0.5			0.0	
Approach LOS	B					
Intersection Summary						
Average Delay	0.6					
Intersection Capacity Utilization	47.3%		ICU Level of Service		A	
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
6: Niagara St. & Roger Dr.

2030 Total PM

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y		Y	↑↑	↑↑	
Traffic Volume (veh/h)	21	36	38	849	1001	68
Future Volume (Veh/h)	21	36	38	849	1001	68
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	23	39	41	923	1088	74
Pedestrians	8		1		2	
Lane Width (m)	3.7		3.7		3.7	
Walking Speed (m/s)	1.1		1.1		1.1	
Percent Blockage	1		0		0	
Right turn flare (veh)						
Median type			TWLTL		TWLTL	
Median storage (veh)			2		2	
Upstream signal (m)			343		277	
pX, platoon unblocked	0.92	0.88	0.88			
vC, conflicting volume	1678	590	1170			
vC1, stage 1 conf vol	1133					
vC2, stage 2 conf vol	546					
vCu, unblocked vol	1179	253	914			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3	2.2			
p0 queue free %	92	94	94			
cM capacity (veh/h)	303	655	657			
Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	62	41	462	462	725	437
Volume Left	23	41	0	0	0	0
Volume Right	39	0	0	0	0	74
cSH	458	657	1700	1700	1700	1700
Volume to Capacity	0.14	0.06	0.27	0.27	0.43	0.26
Queue Length 95th (m)	3.5	1.5	0.0	0.0	0.0	0.0
Control Delay (s)	14.1	10.8	0.0	0.0	0.0	0.0
Lane LOS	B	B				
Approach Delay (s)	14.1	0.5			0.0	
Approach LOS	B					
Intersection Summary						
Average Delay	0.6					
Intersection Capacity Utilization	47.3%		ICU Level of Service		A	
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
6: Niagara St. & Roger Dr.

2035 Background AM

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y		Y	↑↑	↑↑	
Traffic Volume (veh/h)	16	31	35	758	495	63
Future Volume (Veh/h)	16	31	35	758	495	63
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	17	34	38	824	538	68
Pedestrians	6		1			
Lane Width (m)	3.7		3.7			
Walking Speed (m/s)	1.1		1.1			
Percent Blockage	1		0			
Right turn flare (veh)						
Median type			TWLTL		TWLTL	
Median storage (veh)			2		2	
Upstream signal (m)			344		274	
pX, platoon unblocked	0.98					
vC, conflicting volume	1067		612			
vC1, stage 1 conf vol	578					
vC2, stage 2 conf vol	489					
vCu, unblocked vol	1030		309		612	
tC, single (s)	6.8	7.0	4.1			
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3	2.2			
p0 queue free %	96	95	96			
cM capacity (veh/h)	431	680	971			
Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	51	38	412	412	359	247
Volume Left	17	38	0	0	0	0
Volume Right	34	0	0	0	0	68
cSH	570	971	1700	1700	1700	1700
Volume to Capacity	0.09	0.04	0.24	0.24	0.21	0.15
Queue Length 95th (m)	2.2	0.9	0.0	0.0	0.0	0.0
Control Delay (s)	11.9	8.9	0.0	0.0	0.0	0.0
Lane LOS	B	A				
Approach Delay (s)	11.9	0.4	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay	0.6					
Intersection Capacity Utilization	33.5%		ICU Level of Service		A	
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
6: Niagara St. & Roger Dr.

2035 Background PM

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y		Y	↑↑	↑↑	
Traffic Volume (veh/h)	21	36	38	875	1051	68
Future Volume (Veh/h)	21	36	38	875	1051	68
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	23	39	41	951	1142	74
Pedestrians	8		1		2	
Lane Width (m)	3.7		3.7		3.7	
Walking Speed (m/s)	1.1		1.1		1.1	
Percent Blockage	1		0		0	
Right turn flare (veh)						
Median type			TWLTL		TWLTL	
Median storage (veh)			2		2	
Upstream signal (m)			344		274	
pX, platoon unblocked	0.90	0.86	0.86			
vC, conflicting volume	1746	617	1224			
vC1, stage 1 conf vol	1187					
vC2, stage 2 conf vol	560					
vCu, unblocked vol	1221	228	934			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3	2.2			
p0 queue free %	92	94	94			
cM capacity (veh/h)	290	666	632			
Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	62	41	476	476	761	455
Volume Left	23	41	0	0	0	0
Volume Right	39	0	0	0	0	74
cSH	449	632	1700	1700	1700	1700
Volume to Capacity	0.14	0.06	0.28	0.28	0.45	0.27
Queue Length 95th (m)	3.6	1.6	0.0	0.0	0.0	0.0
Control Delay (s)	14.3	11.1	0.0	0.0	0.0	0.0
Lane LOS	B	B				
Approach Delay (s)	14.3	0.5	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay	0.6					
Intersection Capacity Utilization	47.3%		ICU Level of Service		A	
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
6: Niagara St. & Roger Dr.

2035 Total AM

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y		Y	↑↑	↑↑	
Traffic Volume (veh/h)	16	31	35	772	528	63
Future Volume (Veh/h)	16	31	35	772	528	63
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	17	34	38	839	574	68
Pedestrians	6		1			
Lane Width (m)	3.7		3.7			
Walking Speed (m/s)	1.1		1.1			
Percent Blockage	1		0			
Right turn flare (veh)						
Median type			TWLTL		TWLTL	
Median storage (veh)			2		2	
Upstream signal (m)			343		277	
pX, platoon unblocked	0.97					
vC, conflicting volume	1110		327		648	
vC1, stage 1 conf vol	614					
vC2, stage 2 conf vol	496					
vCu, unblocked vol	1061		327		648	
tC, single (s)	6.8	7.0	4.1			
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3	2.2			
p0 queue free %	96	95	96			
cM capacity (veh/h)	418	662	942			
Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	51	38	420	420	383	259
Volume Left	17	38	0	0	0	0
Volume Right	34	0	0	0	0	68
cSH	554	942	1700	1700	1700	1700
Volume to Capacity	0.09	0.04	0.25	0.25	0.23	0.15
Queue Length 95th (m)	2.3	1.0	0.0	0.0	0.0	0.0
Control Delay (s)	12.1	9.0	0.0	0.0	0.0	0.0
Lane LOS	B	A				
Approach Delay (s)	12.1	0.4	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay	0.6					
Intersection Capacity Utilization	34.5%		ICU Level of Service		A	
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
6: Niagara St. & Roger Dr.

2035 Total PM

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y		Y	↑↑	↑↑	
Traffic Volume (veh/h)	21	36	38	912	1076	68
Future Volume (Veh/h)	21	36	38	912	1076	68
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	23	39	41	991	1170	74
Pedestrians	8		1		2	
Lane Width (m)	3.7		3.7		3.7	
Walking Speed (m/s)	1.1		1.1		1.1	
Percent Blockage	1		0		0	
Right turn flare (veh)						
Median type			TWLTL		TWLTL	
Median storage (veh)			2		2	
Upstream signal (m)			343		277	
pX, platoon unblocked	0.90	0.86	0.86			
vC, conflicting volume	1794	631	1252			
vC1, stage 1 conf vol	1215					
vC2, stage 2 conf vol	580					
vCu, unblocked vol	1221	240	963			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3	2.2			
p0 queue free %	92	94	93			
cM capacity (veh/h)	281	653	616			
Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	62	41	496	496	780	464
Volume Left	23	41	0	0	0	0
Volume Right	39	0	0	0	0	74
cSH	438	616	1700	1700	1700	1700
Volume to Capacity	0.14	0.07	0.29	0.29	0.46	0.27
Queue Length 95th (m)	3.7	1.6	0.0	0.0	0.0	0.0
Control Delay (s)	14.6	11.3	0.0	0.0	0.0	0.0
Lane LOS	B	B				
Approach Delay (s)	14.6	0.4	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay	0.6					
Intersection Capacity Utilization	47.3%		ICU Level of Service		A	
Analysis Period (min)	15					



670 NIAGARA STREET
WELLAND, ONTARIO

DRIVEWAY SIGHTLINE ANALYSIS

R.J Burnside & Associates Limited
RR / DWA

SEPTEMBER 5, 2024

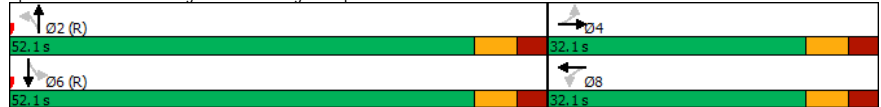
N.T.S

Timings 2023 Existing AM
4: Niagara St. & Parking Lot/Aqueduct St.

	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↖	↗	↖	↗	↖	↗	↖	↗
Traffic Volume (vph)	51	3	9	9	32	539	97	418
Future Volume (vph)	51	3	9	9	32	539	97	418
Lane Group Flow (vph)	55	48	10	153	35	595	105	517
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	8.0	8.0	8.0	8.0	10.0	10.0	10.0	10.0
Minimum Split (s)	15.1	15.1	15.1	15.1	17.1	17.1	17.1	17.1
Total Split (s)	32.1	32.1	32.1	32.1	52.1	52.1	52.1	52.1
Total Split (%)	38.1%	38.1%	38.1%	38.1%	61.9%	61.9%	61.9%	61.9%
Yellow Time (s)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
All-Red Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	C-Max	C-Max	C-Max	C-Max
v/c Ratio	0.39	0.23	0.06	0.52	0.07	0.26	0.21	0.23
Control Delay	40.6	13.5	31.1	13.9	5.1	5.2	6.3	4.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	40.6	13.5	31.1	13.9	5.1	5.2	6.3	4.8
Queue Length 50th (m)	8.3	0.4	1.5	1.5	1.5	15.0	4.9	12.0
Queue Length 95th (m)	18.3	9.3	5.5	16.7	5.0	26.0	13.2	21.5
Internal Link Dist (m)		33.7		300.3		249.8		113.5
Turn Bay Length (m)			20.0		90.0		100.0	
Base Capacity (vph)	326	422	359	484	538	2298	494	2233
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.17	0.11	0.03	0.32	0.07	0.26	0.21	0.23

Intersection Summary
 Cycle Length: 84.2
 Actuated Cycle Length: 84.2
 Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green
 Natural Cycle: 40
 Control Type: Actuated-Coordinated

Splits and Phases: 4: Niagara St. & Parking Lot/Aqueduct St.



HCM Signalized Intersection Capacity Analysis 2023 Existing AM
4: Niagara St. & Parking Lot/Aqueduct St.

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗	↘	↖	↗	↘	↖	↗	↘	↖	↗	↘
Traffic Volume (vph)	51	3	41	9	9	132	32	539	8	97	418	58
Future Volume (vph)	51	3	41	9	9	132	32	539	8	97	418	58
Ideal Flow (vphpl)	1651	1535	1535	1651	1535	1535	1651	1776	1535	1651	1776	1535
Total Lost time (s)	7.1	7.1		7.1	7.1		7.1	7.1		7.1	7.1	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.86		1.00	0.86		1.00	1.00		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1584	1317		1583	1293		1582	3274		1568	3172	
Flt Permitted	0.66	1.00		0.73	1.00		0.46	1.00		0.43	1.00	
Satd. Flow (perm)	1100	1317		1210	1293		767	3274		705	3172	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	55	3	45	10	10	143	35	586	9	105	454	63
RTOR Reduction (vph)	0	39	0	0	124	0	0	1	0	0	8	0
Lane Group Flow (vph)	55	9	0	10	29	0	35	594	0	105	509	0
Confl. Peds. (#/hr)	2		2	2		2	4		2	2		4
Heavy Vehicles (%)	0%	0%	0%	0%	0%	2%	0%	4%	0%	1%	6%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	10.9	10.9		10.9	10.9		59.1	59.1		59.1	59.1	
Effective Green, g (s)	10.9	10.9		10.9	10.9		59.1	59.1		59.1	59.1	
Actuated g/C Ratio	0.13	0.13		0.13	0.13		0.70	0.70		0.70	0.70	
Clearance Time (s)	7.1	7.1		7.1	7.1		7.1	7.1		7.1	7.1	
Vehicle Extension (s)	4.0	4.0		4.0	4.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	142	170		156	167		538	2298		494	2226	
v/s Ratio Prot		0.01			0.02			c0.18			0.16	
v/s Ratio Perm	c0.05			0.01			0.05			0.15		
v/c Ratio	0.39	0.05		0.06	0.17		0.07	0.26		0.21	0.23	
Uniform Delay, d1	33.6	32.1		32.2	32.6		3.9	4.6		4.4	4.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.4	0.2		0.2	0.7		0.2	0.3		1.0	0.2	
Delay (s)	36.0	32.3		32.4	33.3		4.2	4.8		5.4	4.7	
Level of Service	D	C		C	C		A	A		A	A	
Approach Delay (s)		34.3			33.2			4.8			4.8	
Approach LOS		C			C			A			A	

Intersection Summary
 HCM 2000 Control Delay: 9.9
 HCM 2000 Volume to Capacity ratio: 0.28
 HCM 2000 Level of Service: A
 Actuated Cycle Length (s): 84.2
 Sum of lost time (s): 14.2
 Intersection Capacity Utilization: 75.5%
 ICU Level of Service: D
 Analysis Period (min): 15
 c Critical Lane Group

Timings
4: Niagara St. & Parking Lot/Aqueduct St.

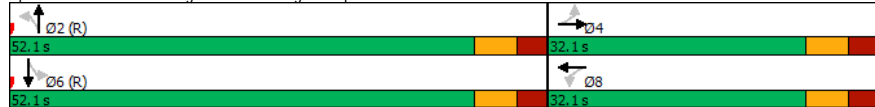
2023 Existing PM

	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↖	↗	↖	↗	↖	↗	↖	↗
Traffic Volume (vph)	37	1	12	2	33	756	82	940
Future Volume (vph)	37	1	12	2	33	756	82	940
Lane Group Flow (vph)	40	39	13	70	36	842	89	1070
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	8.0	8.0	8.0	8.0	10.0	10.0	10.0	10.0
Minimum Split (s)	15.1	15.1	15.1	15.1	17.1	17.1	17.1	17.1
Total Split (s)	32.1	32.1	32.1	32.1	52.1	52.1	52.1	52.1
Total Split (%)	38.1%	38.1%	38.1%	38.1%	61.9%	61.9%	61.9%	61.9%
Yellow Time (s)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
All-Red Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	C-Max	C-Max	C-Max	C-Max
v/c Ratio	0.29	0.21	0.09	0.33	0.11	0.33	0.21	0.42
Control Delay	39.0	14.3	33.5	13.9	5.2	4.7	5.9	5.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	39.0	14.3	33.5	13.9	5.2	4.7	5.9	5.2
Queue Length 50th (m)	6.0	0.2	1.9	0.3	1.5	21.6	3.9	30.2
Queue Length 95th (m)	14.6	8.2	6.8	11.1	5.2	35.0	11.0	48.3
Internal Link Dist (m)		33.7		300.3		249.8		113.5
Turn Bay Length (m)			20.0		90.0		100.0	
Base Capacity (vph)	351	413	361	436	325	2559	425	2552
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.11	0.09	0.04	0.16	0.11	0.33	0.21	0.42

Intersection Summary

Cycle Length: 84.2
 Actuated Cycle Length: 84.2
 Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green
 Natural Cycle: 40
 Control Type: Actuated-Coordinated

Splits and Phases: 4: Niagara St. & Parking Lot/Aqueduct St.



HCM Signalized Intersection Capacity Analysis
 4: Niagara St. & Parking Lot/Aqueduct St.

2023 Existing PM

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗		↖	↗		↖	↗	
Traffic Volume (vph)	37	1	35	12	2	63	33	756	18	82	940	44
Future Volume (vph)	37	1	35	12	2	63	33	756	18	82	940	44
Ideal Flow (vphpl)	1651	1535	1535	1651	1535	1535	1651	1776	1535	1651	1776	1535
Total Lost time (s)	7.1	7.1		7.1	7.1		7.1	7.1		7.1	7.1	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.98		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		0.99	1.00	
Frt	1.00	0.85		1.00	0.85		1.00	1.00		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1583	1303		1578	1308		1580	3332		1576	3320	
Flt Permitted	0.71	1.00		0.73	1.00		0.25	1.00		0.33	1.00	
Satd. Flow (perm)	1186	1303		1216	1308		423	3332		554	3320	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	40	1	38	13	2	68	36	822	20	89	1022	48
RTOR Reduction (vph)	0	34	0	0	61	0	0	1	0	0	2	0
Lane Group Flow (vph)	40	5	0	13	9	0	36	841	0	89	1068	0
Confl. Peds. (#/hr)	2		6	6		2	12		14	14		12
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	2%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	8.1	8.1		8.1	8.1		61.9	61.9		61.9	61.9	
Effective Green, g (s)	8.1	8.1		8.1	8.1		61.9	61.9		61.9	61.9	
Actuated g/C Ratio	0.10	0.10		0.10	0.10		0.74	0.74		0.74	0.74	
Clearance Time (s)	7.1	7.1		7.1	7.1		7.1	7.1		7.1	7.1	
Vehicle Extension (s)	4.0	4.0		4.0	4.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	114	125		116	125		310	2449		407	2440	
v/s Ratio Prot		0.00			0.01			0.25			c0.32	
v/s Ratio Perm	c0.03			0.01			0.09			0.16		
v/c Ratio	0.35	0.04		0.11	0.07		0.12	0.34		0.22	0.44	
Uniform Delay, d1	35.6	34.5		34.8	34.6		3.2	4.0		3.5	4.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.5	0.2		0.6	0.3		0.8	0.4		1.2	0.6	
Delay (s)	38.1	34.7		35.4	34.9		4.0	4.3		4.8	4.9	
Level of Service	D	C		D	C		A	A		A	A	
Approach Delay (s)		36.4			35.0			4.3			4.9	
Approach LOS		D			C			A			A	

Intersection Summary

HCM 2000 Control Delay: 6.9, HCM 2000 Level of Service: A
 HCM 2000 Volume to Capacity ratio: 0.43
 Actuated Cycle Length (s): 84.2, Sum of lost time (s): 14.2
 Intersection Capacity Utilization: 67.4%, ICU Level of Service: C
 Analysis Period (min): 15
 c Critical Lane Group

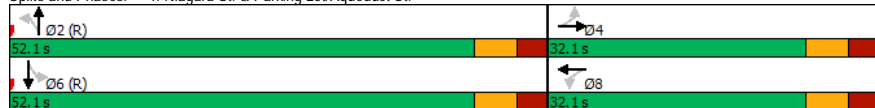
Timings 2030 Background AM

4: Niagara St. & Parking Lot/Aqueduct St.

	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↖	↗	↖	↗	↖	↗	↖	↗
Traffic Volume (vph)	59	3	10	10	37	619	111	480
Future Volume (vph)	59	3	10	10	37	619	111	480
Lane Group Flow (vph)	64	54	11	176	40	683	121	595
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	8.0	8.0	8.0	8.0	10.0	10.0	10.0	10.0
Minimum Split (s)	15.1	15.1	15.1	15.1	17.1	17.1	17.1	17.1
Total Split (s)	32.1	32.1	32.1	32.1	52.1	52.1	52.1	52.1
Total Split (%)	38.1%	38.1%	38.1%	38.1%	61.9%	61.9%	61.9%	61.9%
Yellow Time (s)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
All-Red Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	C-Max	C-Max	C-Max	C-Max
v/c Ratio	0.46	0.24	0.07	0.55	0.08	0.30	0.27	0.27
Control Delay	43.4	12.6	30.2	13.3	5.6	5.8	7.6	5.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	43.4	12.6	30.2	13.3	5.6	5.8	7.6	5.4
Queue Length 50th (m)	9.7	0.4	1.6	1.6	1.8	18.6	6.2	14.9
Queue Length 95th (m)	20.4	9.5	5.7	17.8	5.9	32.1	16.8	26.5
Internal Link Dist (m)		33.7		300.3		249.8		113.5
Turn Bay Length (m)			20.0		90.0		100.0	
Base Capacity (vph)	298	426	357	499	492	2270	448	2207
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.21	0.13	0.03	0.35	0.08	0.30	0.27	0.27

Intersection Summary
 Cycle Length: 84.2
 Actuated Cycle Length: 84.2
 Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green
 Natural Cycle: 45
 Control Type: Actuated-Coordinated

Splits and Phases: 4: Niagara St. & Parking Lot/Aqueduct St.



HCM Signalized Intersection Capacity Analysis 2030 Background AM

4: Niagara St. & Parking Lot/Aqueduct St.

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗	↘	↖	↗	↘	↖	↗	↘	↖	↗	↘
Traffic Volume (vph)	59	3	47	10	10	152	37	619	9	111	480	67
Future Volume (vph)	59	3	47	10	10	152	37	619	9	111	480	67
Ideal Flow (vphpl)	1651	1535	1535	1651	1535	1535	1651	1776	1535	1651	1776	1535
Total Lost time (s)	7.1	7.1		7.1	7.1		7.1	7.1		7.1	7.1	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.86		1.00	0.86		1.00	1.00		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1584	1315		1583	1292		1582	3274		1568	3172	
Flt Permitted	0.60	1.00		0.72	1.00		0.43	1.00		0.39	1.00	
Satd. Flow (perm)	1006	1315		1203	1292		711	3274		647	3172	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	64	3	51	11	11	165	40	673	10	121	522	73
RTOR Reduction (vph)	0	44	0	0	142	0	0	1	0	0	9	0
Lane Group Flow (vph)	64	10	0	11	34	0	40	682	0	121	586	0
Confl. Peds. (#/hr)	2		2	2		2	4		2	2		4
Heavy Vehicles (%)	0%	0%	0%	0%	0%	2%	0%	4%	0%	1%	6%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	11.6	11.6		11.6	11.6		58.4	58.4		58.4	58.4	
Effective Green, g (s)	11.6	11.6		11.6	11.6		58.4	58.4		58.4	58.4	
Actuated g/C Ratio	0.14	0.14		0.14	0.14		0.69	0.69		0.69	0.69	
Clearance Time (s)	7.1	7.1		7.1	7.1		7.1	7.1		7.1	7.1	
Vehicle Extension (s)	4.0	4.0		4.0	4.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	138	181		165	177		493	2270		448	2200	
v/s Ratio Prot		0.01			0.03			c0.21			0.18	
v/s Ratio Perm	c0.06			0.01			0.06			0.19		
v/c Ratio	0.46	0.06		0.07	0.19		0.08	0.30		0.27	0.27	
Uniform Delay, d1	33.4	31.5		31.6	32.1		4.2	5.0		4.9	4.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.3	0.2		0.2	0.7		0.3	0.3		1.5	0.3	
Delay (s)	36.8	31.7		31.8	32.9		4.5	5.3		6.3	5.1	
Level of Service	D	C		C	C		A	A		A	A	
Approach Delay (s)		34.5			32.8			5.3			5.3	
Approach LOS		C			C			A			A	

Intersection Summary
 HCM 2000 Control Delay: 10.2
 HCM 2000 Level of Service: B
 HCM 2000 Volume to Capacity ratio: 0.33
 Actuated Cycle Length (s): 84.2
 Sum of lost time (s): 14.2
 Intersection Capacity Utilization: 77.0%
 ICU Level of Service: D
 Analysis Period (min): 15
 c Critical Lane Group

Timings 2030 Background PM

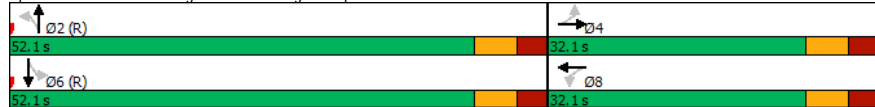
4: Niagara St. & Parking Lot/Aqueduct St.

	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↖	↗	↖	↗	↖	↗	↖	↗
Traffic Volume (vph)	41	1	13	2	37	839	91	1043
Future Volume (vph)	41	1	13	2	37	839	91	1043
Lane Group Flow (vph)	45	43	14	78	40	934	99	1187
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	8.0	8.0	8.0	8.0	10.0	10.0	10.0	10.0
Minimum Split (s)	15.1	15.1	15.1	15.1	17.1	17.1	17.1	17.1
Total Split (s)	32.1	32.1	32.1	32.1	52.1	52.1	52.1	52.1
Total Split (%)	38.1%	38.1%	38.1%	38.1%	61.9%	61.9%	61.9%	61.9%
Yellow Time (s)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
All-Red Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	C-Max	C-Max	C-Max	C-Max
v/c Ratio	0.32	0.23	0.10	0.35	0.14	0.37	0.26	0.47
Control Delay	39.5	13.9	33.2	13.3	6.0	5.0	6.9	5.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	39.5	13.9	33.2	13.3	6.0	5.0	6.9	5.8
Queue Length 50th (m)	6.8	0.2	2.1	0.3	1.7	25.3	4.6	36.0
Queue Length 95th (m)	15.8	8.8	7.0	11.7	6.0	41.2	13.5	57.8
Internal Link Dist (m)		33.7		300.3		249.8		113.5
Turn Bay Length (m)			20.0		90.0		100.0	
Base Capacity (vph)	349	416	359	441	279	2549	380	2542
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.13	0.10	0.04	0.18	0.14	0.37	0.26	0.47

Intersection Summary

Cycle Length: 84.2
 Actuated Cycle Length: 84.2
 Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green
 Natural Cycle: 45
 Control Type: Actuated-Coordinated

Splits and Phases: 4: Niagara St. & Parking Lot/Aqueduct St.



HCM Signalized Intersection Capacity Analysis 2030 Background PM

4: Niagara St. & Parking Lot/Aqueduct St.

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗		↖	↗		↖	↗	
Traffic Volume (vph)	41	1	39	13	2	70	37	839	20	91	1043	49
Future Volume (vph)	41	1	39	13	2	70	37	839	20	91	1043	49
Ideal Flow (vphpl)	1651	1535	1535	1651	1535	1535	1651	1776	1535	1651	1776	1535
Total Lost time (s)	7.1	7.1		7.1	7.1		7.1	7.1		7.1	7.1	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.98		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		0.99	1.00	
Frt	1.00	0.85		1.00	0.85		1.00	1.00		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1583	1303		1578	1308		1581	3332		1578	3320	
Flt Permitted	0.71	1.00		0.73	1.00		0.22	1.00		0.30	1.00	
Satd. Flow (perm)	1177	1303		1211	1308		364	3332		497	3320	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	45	1	42	14	2	76	40	912	22	99	1134	53
RTOR Reduction (vph)	0	38	0	0	68	0	0	1	0	0	2	0
Lane Group Flow (vph)	45	5	0	14	10	0	40	933	0	99	1185	0
Confl. Peds. (#/hr)	2		6	6		2	12		14	14		12
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	2%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	8.4	8.4		8.4	8.4		61.6	61.6		61.6	61.6	
Effective Green, g (s)	8.4	8.4		8.4	8.4		61.6	61.6		61.6	61.6	
Actuated g/C Ratio	0.10	0.10		0.10	0.10		0.73	0.73		0.73	0.73	
Clearance Time (s)	7.1	7.1		7.1	7.1		7.1	7.1		7.1	7.1	
Vehicle Extension (s)	4.0	4.0		4.0	4.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	117	129		120	130		266	2437		363	2428	
v/s Ratio Prot		0.00			0.01			0.28			c0.36	
v/s Ratio Perm	c0.04			0.01			0.11			0.20		
v/c Ratio	0.38	0.04		0.12	0.07		0.15	0.38		0.27	0.49	
Uniform Delay, d1	35.5	34.3		34.5	34.4		3.4	4.2		3.8	4.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.9	0.2		0.6	0.3		1.2	0.5		1.8	0.7	
Delay (s)	38.3	34.4		35.1	34.7		4.6	4.7		5.6	5.4	
Level of Service	D	C		D	C		A	A		A	A	
Approach Delay (s)		36.4			34.8			4.7			5.4	
Approach LOS		D			C			A			A	

Intersection Summary

HCM 2000 Control Delay: 7.4, HCM 2000 Level of Service: A
 HCM 2000 Volume to Capacity ratio: 0.48
 Actuated Cycle Length (s): 84.2, Sum of lost time (s): 14.2
 Intersection Capacity Utilization: 70.8%, ICU Level of Service: C
 Analysis Period (min): 15
 c Critical Lane Group

Timings

2030 Total AM

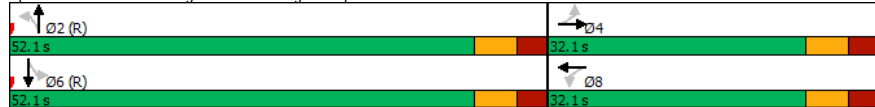
4: Niagara St. & Parking Lot/Aqueduct St.

	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↖	→	↖	→	↖	↖	↖	↖
Traffic Volume (vph)	59	3	10	10	37	633	111	513
Future Volume (vph)	59	3	10	10	37	633	111	513
Lane Group Flow (vph)	64	54	11	176	40	698	121	631
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	8.0	8.0	8.0	8.0	10.0	10.0	10.0	10.0
Minimum Split (s)	15.1	15.1	15.1	15.1	17.1	17.1	17.1	17.1
Total Split (s)	32.1	32.1	32.1	32.1	52.1	52.1	52.1	52.1
Total Split (%)	38.1%	38.1%	38.1%	38.1%	61.9%	61.9%	61.9%	61.9%
Yellow Time (s)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
All-Red Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	C-Max	C-Max	C-Max	C-Max
v/c Ratio	0.46	0.24	0.07	0.55	0.08	0.31	0.27	0.29
Control Delay	43.4	12.6	30.2	13.3	5.6	5.8	7.7	5.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	43.4	12.6	30.2	13.3	5.6	5.8	7.7	5.5
Queue Length 50th (m)	9.7	0.4	1.6	1.6	1.8	19.1	6.2	16.1
Queue Length 95th (m)	20.4	9.5	5.7	17.8	5.9	32.9	16.9	28.6
Internal Link Dist (m)		33.7		300.3		252.9		113.5
Turn Bay Length (m)			20.0		90.0		100.0	
Base Capacity (vph)	298	426	357	499	475	2270	441	2209
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.21	0.13	0.03	0.35	0.08	0.31	0.27	0.29

Intersection Summary

Cycle Length: 84.2
 Actuated Cycle Length: 84.2
 Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green
 Natural Cycle: 45
 Control Type: Actuated-Coordinated

Splits and Phases: 4: Niagara St. & Parking Lot/Aqueduct St.



HCM Signalized Intersection Capacity Analysis

2030 Total AM

4: Niagara St. & Parking Lot/Aqueduct St.

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	→	↖	↖	→	↖	↖	↖	↖	↖	↖	↖
Traffic Volume (vph)	59	3	47	10	10	152	37	633	9	111	513	67
Future Volume (vph)	59	3	47	10	10	152	37	633	9	111	513	67
Ideal Flow (vphpl)	1651	1535	1535	1651	1535	1535	1651	1776	1535	1651	1776	1535
Total Lost time (s)	7.1	7.1		7.1	7.1		7.1	7.1		7.1	7.1	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.86		1.00	0.86		1.00	1.00		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1584	1315		1583	1292		1582	3274		1569	3174	
Flt Permitted	0.60	1.00		0.72	1.00		0.41	1.00		0.39	1.00	
Satd. Flow (perm)	1006	1315		1203	1292		687	3274		638	3174	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	64	3	51	11	11	165	40	688	10	121	558	73
RTOR Reduction (vph)	0	44	0	0	142	0	0	1	0	0	8	0
Lane Group Flow (vph)	64	10	0	11	34	0	40	697	0	121	623	0
Confl. Peds. (#/hr)	2		2	2		2	4		2	2		4
Heavy Vehicles (%)	0%	0%	0%	0%	0%	2%	0%	4%	0%	1%	6%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	11.6	11.6		11.6	11.6		58.4	58.4		58.4	58.4	
Effective Green, g (s)	11.6	11.6		11.6	11.6		58.4	58.4		58.4	58.4	
Actuated g/C Ratio	0.14	0.14		0.14	0.14		0.69	0.69		0.69	0.69	
Clearance Time (s)	7.1	7.1		7.1	7.1		7.1	7.1		7.1	7.1	
Vehicle Extension (s)	4.0	4.0		4.0	4.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	138	181		165	177		476	2270		442	2201	
v/s Ratio Prot		0.01			0.03			c0.21			0.20	
v/s Ratio Perm	c0.06			0.01			0.06			0.19		
v/c Ratio	0.46	0.06		0.07	0.19		0.08	0.31		0.27	0.28	
Uniform Delay, d1	33.4	31.5		31.6	32.1		4.2	5.0		4.9	4.9	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.3	0.2		0.2	0.7		0.3	0.4		1.5	0.3	
Delay (s)	36.8	31.7		31.8	32.9		4.5	5.4		6.4	5.2	
Level of Service	D	C		C	C		A	A		A	A	
Approach Delay (s)		34.5			32.8			5.3			5.4	
Approach LOS		C			C			A			A	

Intersection Summary

HCM 2000 Control Delay: 10.1, HCM 2000 Level of Service: B
 HCM 2000 Volume to Capacity ratio: 0.33
 Actuated Cycle Length (s): 84.2, Sum of lost time (s): 14.2
 Intersection Capacity Utilization: 77.0%, ICU Level of Service: D
 Analysis Period (min): 15
 c Critical Lane Group

Timings

2030 Total PM

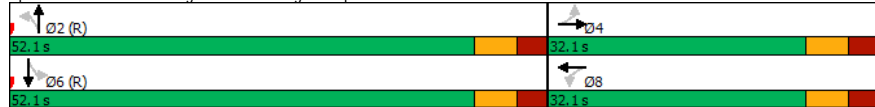
4: Niagara St. & Parking Lot/Aqueduct St.

	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗
Traffic Volume (vph)	41	1	13	2	37	876	91	1068
Future Volume (vph)	41	1	13	2	37	876	91	1068
Lane Group Flow (vph)	45	43	14	78	40	974	99	1214
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	8.0	8.0	8.0	8.0	10.0	10.0	10.0	10.0
Minimum Split (s)	15.1	15.1	15.1	15.1	17.1	17.1	17.1	17.1
Total Split (s)	32.1	32.1	32.1	32.1	52.1	52.1	52.1	52.1
Total Split (%)	38.1%	38.1%	38.1%	38.1%	61.9%	61.9%	61.9%	61.9%
Yellow Time (s)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
All-Red Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	C-Max	C-Max	C-Max	C-Max
v/c Ratio	0.32	0.23	0.10	0.35	0.15	0.38	0.27	0.48
Control Delay	39.5	13.9	33.2	13.3	6.2	5.1	7.3	5.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	39.5	13.9	33.2	13.3	6.2	5.1	7.3	5.9
Queue Length 50th (m)	6.8	0.2	2.1	0.3	1.7	26.8	4.7	37.3
Queue Length 95th (m)	15.8	8.8	7.0	11.7	6.1	43.6	13.9	59.8
Internal Link Dist (m)		33.7		300.3		252.9		113.5
Turn Bay Length (m)			20.0		90.0		100.0	
Base Capacity (vph)	349	416	359	441	268	2551	362	2542
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.13	0.10	0.04	0.18	0.15	0.38	0.27	0.48

Intersection Summary

Cycle Length: 84.2
 Actuated Cycle Length: 84.2
 Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBT, Start of Green
 Natural Cycle: 45
 Control Type: Actuated-Coordinated

Splits and Phases: 4: Niagara St. & Parking Lot/Aqueduct St.



HCM Signalized Intersection Capacity Analysis

2030 Total PM

4: Niagara St. & Parking Lot/Aqueduct St.

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖ ↗	↖ ↗		↖ ↗	↖ ↗		↖ ↗	↖ ↗		↖ ↗	↖ ↗	
Traffic Volume (vph)	41	1	39	13	2	70	37	876	20	91	1068	49
Future Volume (vph)	41	1	39	13	2	70	37	876	20	91	1068	49
Ideal Flow (vphpl)	1651	1535	1535	1651	1535	1535	1651	1776	1535	1651	1776	1535
Total Lost time (s)	7.1	7.1		7.1	7.1		7.1	7.1		7.1	7.1	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.98		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Fr	1.00	0.85		1.00	0.85		1.00	1.00		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1583	1303		1578	1308		1581	3332		1578	3321	
Flt Permitted	0.71	1.00		0.73	1.00		0.21	1.00		0.29	1.00	
Satd. Flow (perm)	1177	1303		1211	1308		352	3332		473	3321	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	45	1	42	14	2	76	40	952	22	99	1161	53
RTOR Reduction (vph)	0	38	0	0	68	0	0	1	0	0	2	0
Lane Group Flow (vph)	45	5	0	14	10	0	40	973	0	99	1212	0
Confl. Peds. (#/hr)	2		6	6		2	12		14	14		12
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	2%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	8.4	8.4		8.4	8.4		61.6	61.6		61.6	61.6	
Effective Green, g (s)	8.4	8.4		8.4	8.4		61.6	61.6		61.6	61.6	
Actuated g/C Ratio	0.10	0.10		0.10	0.10		0.73	0.73		0.73	0.73	
Clearance Time (s)	7.1	7.1		7.1	7.1		7.1	7.1		7.1	7.1	
Vehicle Extension (s)	4.0	4.0		4.0	4.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	117	129		120	130		257	2437		346	2429	
v/s Ratio Prot		0.00			0.01			0.29			c0.36	
v/s Ratio Perm	c0.04			0.01			0.11			0.21		
v/c Ratio	0.38	0.04		0.12	0.07		0.16	0.40		0.29	0.50	
Uniform Delay, d1	35.5	34.3		34.5	34.4		3.4	4.3		3.8	4.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.9	0.2		0.6	0.3		1.3	0.5		2.1	0.7	
Delay (s)	38.3	34.4		35.1	34.7		4.7	4.8		5.9	5.5	
Level of Service	D	C		D	C		A	A		A	A	
Approach Delay (s)		36.4			34.8			4.8			5.5	
Approach LOS		D			C			A			A	

Intersection Summary

HCM 2000 Control Delay: 7.4, HCM 2000 Level of Service: A
 HCM 2000 Volume to Capacity ratio: 0.48
 Actuated Cycle Length (s): 84.2, Sum of lost time (s): 14.2
 Intersection Capacity Utilization: 71.5%, ICU Level of Service: C
 Analysis Period (min): 15
 c Critical Lane Group

Timings

2035 Background AM

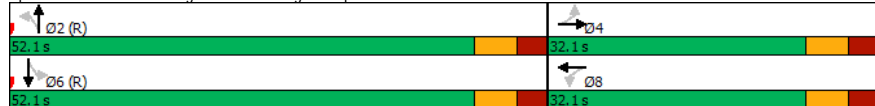
4: Niagara St. & Parking Lot/Aqueduct St.

	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗
Traffic Volume (vph)	63	4	11	11	40	668	120	518
Future Volume (vph)	63	4	11	11	40	668	120	518
Lane Group Flow (vph)	68	59	12	190	43	737	130	641
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	8.0	8.0	8.0	8.0	10.0	10.0	10.0	10.0
Minimum Split (s)	15.1	15.1	15.1	15.1	17.1	17.1	17.1	17.1
Total Split (s)	32.1	32.1	32.1	32.1	52.1	52.1	52.1	52.1
Total Split (%)	38.1%	38.1%	38.1%	38.1%	61.9%	61.9%	61.9%	61.9%
Yellow Time (s)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
All-Red Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	C-Max	C-Max	C-Max	C-Max
v/c Ratio	0.51	0.25	0.07	0.57	0.09	0.33	0.31	0.29
Control Delay	46.0	12.4	29.8	13.2	5.9	6.1	8.4	5.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	46.0	12.4	29.8	13.2	5.9	6.1	8.4	5.7
Queue Length 50th (m)	10.3	0.6	1.7	1.7	1.9	20.8	6.9	16.7
Queue Length 95th (m)	21.5	10.0	5.9	18.4	6.5	36.0	19.3	29.7
Internal Link Dist (m)		33.7		300.3		249.8		113.5
Turn Bay Length (m)			20.0		90.0		100.0	
Base Capacity (vph)	278	430	355	508	468	2257	422	2195
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.24	0.14	0.03	0.37	0.09	0.33	0.31	0.29

Intersection Summary

Cycle Length: 84.2
 Actuated Cycle Length: 84.2
 Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green
 Natural Cycle: 45
 Control Type: Actuated-Coordinated

Splits and Phases: 4: Niagara St. & Parking Lot/Aqueduct St.



HCM Signalized Intersection Capacity Analysis

2035 Background AM

4: Niagara St. & Parking Lot/Aqueduct St.

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗
Traffic Volume (vph)	63	4	51	11	11	164	40	668	10	120	518	72
Future Volume (vph)	63	4	51	11	11	164	40	668	10	120	518	72
Ideal Flow (vphpl)	1651	1535	1535	1651	1535	1535	1651	1776	1535	1651	1776	1535
Total Lost time (s)	7.1	7.1		7.1	7.1		7.1	7.1		7.1	7.1	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.86		1.00	0.86		1.00	1.00		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1584	1318		1583	1293		1582	3274		1569	3172	
Flt Permitted	0.56	1.00		0.72	1.00		0.41	1.00		0.37	1.00	
Satd. Flow (perm)	938	1318		1198	1293		680	3274		613	3172	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	68	4	55	12	12	178	43	726	11	130	563	78
RTOR Reduction (vph)	0	47	0	0	153	0	0	1	0	0	9	0
Lane Group Flow (vph)	68	12	0	12	37	0	43	736	0	130	632	0
Confl. Peds. (#/hr)	2		2	2		2	4		2	2		4
Heavy Vehicles (%)	0%	0%	0%	0%	0%	2%	0%	4%	0%	1%	6%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	12.0	12.0		12.0	12.0		58.0	58.0		58.0	58.0	
Effective Green, g (s)	12.0	12.0		12.0	12.0		58.0	58.0		58.0	58.0	
Actuated g/C Ratio	0.14	0.14		0.14	0.14		0.69	0.69		0.69	0.69	
Clearance Time (s)	7.1	7.1		7.1	7.1		7.1	7.1		7.1	7.1	
Vehicle Extension (s)	4.0	4.0		4.0	4.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	133	187		170	184		468	2255		422	2184	
v/s Ratio Prot		0.01			0.03			c0.22			0.20	
v/s Ratio Perm	c0.07			0.01			0.06			0.21		
v/c Ratio	0.51	0.06		0.07	0.20		0.09	0.33		0.31	0.29	
Uniform Delay, d1	33.4	31.2		31.3	31.9		4.4	5.3		5.2	5.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	4.4	0.2		0.2	0.7		0.4	0.4		1.9	0.3	
Delay (s)	37.7	31.4		31.5	32.6		4.7	5.6		7.1	5.4	
Level of Service	D	C		C	C		A	A		A	A	
Approach Delay (s)		34.8			32.6			5.6			5.7	
Approach LOS		C			C			A			A	

Intersection Summary

HCM 2000 Control Delay: 10.5, HCM 2000 Level of Service: B
 HCM 2000 Volume to Capacity ratio: 0.36
 Actuated Cycle Length (s): 84.2, Sum of lost time (s): 14.2
 Intersection Capacity Utilization: 77.9%, ICU Level of Service: D
 Analysis Period (min): 15
 c Critical Lane Group

Timings

2035 Background PM

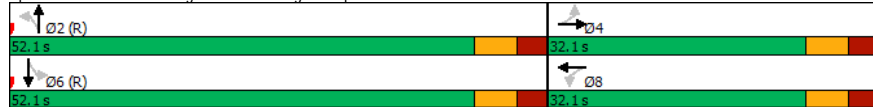
4: Niagara St. & Parking Lot/Aqueduct St.

	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗
Traffic Volume (vph)	44	1	14	2	39	904	98	1124
Future Volume (vph)	44	1	14	2	39	904	98	1124
Lane Group Flow (vph)	48	47	15	84	42	1007	107	1280
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	8.0	8.0	8.0	8.0	10.0	10.0	10.0	10.0
Minimum Split (s)	15.1	15.1	15.1	15.1	17.1	17.1	17.1	17.1
Total Split (s)	32.1	32.1	32.1	32.1	52.1	52.1	52.1	52.1
Total Split (%)	38.1%	38.1%	38.1%	38.1%	61.9%	61.9%	61.9%	61.9%
Yellow Time (s)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
All-Red Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	C-Max	C-Max	C-Max	C-Max
v/c Ratio	0.34	0.24	0.10	0.37	0.17	0.40	0.31	0.51
Control Delay	39.7	13.5	33.0	13.1	6.8	5.3	8.1	6.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	39.7	13.5	33.0	13.1	6.8	5.3	8.1	6.3
Queue Length 50th (m)	7.2	0.2	2.2	0.3	1.8	28.7	5.4	41.3
Queue Length 95th (m)	16.7	9.0	7.3	12.1	6.8	46.4	16.1	66.4
Internal Link Dist (m)		33.7		300.3		249.8		113.5
Turn Bay Length (m)			20.0		90.0		100.0	
Base Capacity (vph)	347	418	358	446	246	2540	346	2533
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.11	0.04	0.19	0.17	0.40	0.31	0.51

Intersection Summary

Cycle Length: 84.2
 Actuated Cycle Length: 84.2
 Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green
 Natural Cycle: 50
 Control Type: Actuated-Coordinated

Splits and Phases: 4: Niagara St. & Parking Lot/Aqueduct St.



HCM Signalized Intersection Capacity Analysis

2035 Background PM

4: Niagara St. & Parking Lot/Aqueduct St.

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗	↖ ↗
Traffic Volume (vph)	44	1	42	14	2	75	39	904	22	98	1124	53
Future Volume (vph)	44	1	42	14	2	75	39	904	22	98	1124	53
Ideal Flow (vphpl)	1651	1535	1535	1651	1535	1535	1651	1776	1535	1651	1776	1535
Total Lost time (s)	7.1	7.1		7.1	7.1		7.1	7.1		7.1	7.1	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.98		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpt	1.00	0.85		1.00	0.85		1.00	1.00		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1584	1302		1578	1307		1582	3331		1578	3320	
Flt Permitted	0.70	1.00		0.73	1.00		0.19	1.00		0.27	1.00	
Satd. Flow (perm)	1171	1302		1207	1307		322	3331		454	3320	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	48	1	46	15	2	82	42	983	24	107	1222	58
RTOR Reduction (vph)	0	41	0	0	74	0	0	1	0	0	2	0
Lane Group Flow (vph)	48	6	0	15	10	0	42	1006	0	107	1278	0
Confl. Peds. (#/hr)	2		6	6		2	12		14	14		12
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	2%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	8.6	8.6		8.6	8.6		61.4	61.4		61.4	61.4	
Effective Green, g (s)	8.6	8.6		8.6	8.6		61.4	61.4		61.4	61.4	
Actuated g/C Ratio	0.10	0.10		0.10	0.10		0.73	0.73		0.73	0.73	
Clearance Time (s)	7.1	7.1		7.1	7.1		7.1	7.1		7.1	7.1	
Vehicle Extension (s)	4.0	4.0		4.0	4.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	119	132		123	133		234	2429		331	2420	
v/s Ratio Prot		0.00			0.01			0.30			c0.38	
v/s Ratio Perm	c0.04			0.01			0.13			0.24		
v/c Ratio	0.40	0.04		0.12	0.08		0.18	0.41		0.32	0.53	
Uniform Delay, d1	35.4	34.1		34.4	34.2		3.6	4.4		4.0	5.0	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.0	0.2		0.6	0.3		1.7	0.5		2.6	0.8	
Delay (s)	38.4	34.3		35.0	34.6		5.2	4.9		6.6	5.8	
Level of Service	D	C		C	C		A	A		A	A	
Approach Delay (s)		36.4			34.6			5.0			5.9	
Approach LOS		D			C			A			A	

Intersection Summary

HCM 2000 Control Delay: 7.7, HCM 2000 Level of Service: A
 HCM 2000 Volume to Capacity ratio: 0.51
 Actuated Cycle Length (s): 84.2, Sum of lost time (s): 14.2
 Intersection Capacity Utilization: 73.5%, ICU Level of Service: D
 Analysis Period (min): 15
 c Critical Lane Group

Timings

2035 Total AM

4: Niagara St. & Parking Lot/Aqueduct St.

	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	63	4	11	11	40	682	120	551
Future Volume (vph)	63	4	11	11	40	682	120	551
Lane Group Flow (vph)	68	59	12	190	43	752	130	677
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	8.0	8.0	8.0	8.0	10.0	10.0	10.0	10.0
Minimum Split (s)	37.1	37.1	37.1	37.1	37.1	37.1	37.1	37.1
Total Split (s)	37.1	37.1	37.1	37.1	52.1	52.1	52.1	52.1
Total Split (%)	41.6%	41.6%	41.6%	41.6%	58.4%	58.4%	58.4%	58.4%
Yellow Time (s)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
All-Red Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	C-Max	C-Max	C-Max	C-Max
v/c Ratio	0.55	0.26	0.07	0.61	0.09	0.33	0.31	0.30
Control Delay	51.7	13.2	31.9	17.7	5.8	6.0	8.3	5.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.7	13.2	31.9	17.7	5.8	6.0	8.3	5.7
Queue Length 50th (m)	11.1	0.6	1.8	5.3	2.0	21.7	7.1	18.4
Queue Length 95th (m)	22.8	10.3	6.2	23.6	6.5	37.3	19.5	32.3
Internal Link Dist (m)		33.7		300.3		252.9		113.5
Turn Bay Length (m)			20.0		90.0		100.0	
Base Capacity (vph)	300	479	402	538	461	2302	422	2237
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.23	0.12	0.03	0.35	0.09	0.33	0.31	0.30

Intersection Summary

Cycle Length: 89.2

Actuated Cycle Length: 89.2

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 75

Control Type: Actuated-Coordinated

Splits and Phases: 4: Niagara St. & Parking Lot/Aqueduct St.



HCM Signalized Intersection Capacity Analysis

2035 Total AM

4: Niagara St. & Parking Lot/Aqueduct St.

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔		↔	↔		↔	↔		↔	↔	↔
Traffic Volume (vph)	63	4	51	11	11	164	40	682	10	120	551	72
Future Volume (vph)	63	4	51	11	11	164	40	682	10	120	551	72
Ideal Flow (vphpl)	1651	1535	1535	1651	1535	1535	1651	1776	1535	1651	1776	1535
Total Lost time (s)	7.1	7.1		7.1	7.1		7.1	7.1		7.1	7.1	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.86		1.00	0.86		1.00	1.00		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1584	1318		1583	1293		1582	3274		1569	3174	
Flt Permitted	0.54	1.00		0.72	1.00		0.39	1.00		0.36	1.00	
Satd. Flow (perm)	893	1318		1198	1293		657	3274		601	3174	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	68	4	55	12	12	178	43	741	11	130	599	78
RTOR Reduction (vph)	0	47	0	0	134	0	0	1	0	0	7	0
Lane Group Flow (vph)	68	12	0	12	56	0	43	751	0	130	670	0
Confl. Peds. (#/hr)	2		2	2		2	4		2	2		4
Heavy Vehicles (%)	0%	0%	0%	0%	0%	2%	0%	4%	0%	1%	6%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	12.3	12.3		12.3	12.3		62.7	62.7		62.7	62.7	
Effective Green, g (s)	12.3	12.3		12.3	12.3		62.7	62.7		62.7	62.7	
Actuated g/C Ratio	0.14	0.14		0.14	0.14		0.70	0.70		0.70	0.70	
Clearance Time (s)	7.1	7.1		7.1	7.1		7.1	7.1		7.1	7.1	
Vehicle Extension (s)	4.0	4.0		4.0	4.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	123	181		165	178		461	2301		422	2231	
v/s Ratio Prot		0.01			0.04			c0.23			0.21	
v/s Ratio Perm	c0.08			0.01			0.07			0.22		
v/c Ratio	0.55	0.06		0.07	0.31		0.09	0.33		0.31	0.30	
Uniform Delay, d1	35.9	33.4		33.5	34.6		4.2	5.1		5.0	5.0	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	6.5	0.2		0.3	1.4		0.4	0.4		1.9	0.3	
Delay (s)	42.4	33.6		33.7	36.0		4.6	5.5		6.9	5.3	
Level of Service	D	C		C	D		A	A		A	A	
Approach Delay (s)		38.3			35.9			5.4			5.6	
Approach LOS		D			D			A			A	

Intersection Summary

HCM 2000 Control Delay: 10.8

HCM 2000 Level of Service: B

HCM 2000 Volume to Capacity ratio: 0.36

Actuated Cycle Length (s): 89.2

Sum of lost time (s): 14.2

Intersection Capacity Utilization: 77.9%

ICU Level of Service: D

Analysis Period (min): 15

c: Critical Lane Group

Timings

2035 Total PM

4: Niagara St. & Parking Lot/Aqueduct St.

	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	44	1	14	2	39	941	98	1149
Future Volume (vph)	44	1	14	2	39	941	98	1149
Lane Group Flow (vph)	48	47	15	84	42	1047	107	1307
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	8.0	8.0	8.0	8.0	10.0	10.0	10.0	10.0
Minimum Split (s)	37.1	37.1	37.1	37.1	37.1	37.1	37.1	37.1
Total Split (s)	37.1	37.1	37.1	37.1	52.1	52.1	52.1	52.1
Total Split (%)	41.6%	41.6%	41.6%	41.6%	58.4%	58.4%	58.4%	58.4%
Yellow Time (s)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
All-Red Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	C-Max	C-Max	C-Max	C-Max
v/c Ratio	0.35	0.26	0.11	0.39	0.17	0.41	0.32	0.51
Control Delay	42.6	18.9	35.4	18.1	6.7	5.2	8.2	6.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	42.6	18.9	35.4	18.1	6.7	5.2	8.2	6.1
Queue Length 50th (m)	7.7	1.7	2.3	2.5	1.9	30.7	5.5	43.3
Queue Length 95th (m)	17.4	10.9	7.6	14.8	6.9	49.5	16.6	69.1
Internal Link Dist (m)		33.7		300.3		252.9		113.5
Turn Bay Length (m)			20.0		90.0		100.0	
Base Capacity (vph)	393	461	405	485	242	2579	335	2569
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.12	0.10	0.04	0.17	0.17	0.41	0.32	0.51

Intersection Summary

Cycle Length: 89.2
 Actuated Cycle Length: 89.2
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
 Natural Cycle: 80
 Control Type: Actuated-Coordinated

Splits and Phases: 4: Niagara St. & Parking Lot/Aqueduct St.



HCM Signalized Intersection Capacity Analysis

2035 Total PM

4: Niagara St. & Parking Lot/Aqueduct St.

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔		↔	↔		↔	↔		↔	↔	
Traffic Volume (vph)	44	1	42	14	2	75	39	941	22	98	1149	53
Future Volume (vph)	44	1	42	14	2	75	39	941	22	98	1149	53
Ideal Flow (vphpl)	1651	1535	1535	1651	1535	1535	1651	1776	1535	1651	1776	1535
Total Lost time (s)	7.1	7.1		7.1	7.1		7.1	7.1		7.1	7.1	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.98		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		0.99	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	0.85		1.00	1.00		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1583	1302		1578	1307		1582	3332		1579	3320	
Flt Permitted	0.70	1.00		0.73	1.00		0.19	1.00		0.26	1.00	
Satd. Flow (perm)	1171	1302		1206	1307		313	3332		434	3320	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	48	1	46	15	2	82	42	1023	24	107	1249	58
RTOR Reduction (vph)	0	32	0	0	61	0	0	1	0	0	2	0
Lane Group Flow (vph)	48	15	0	15	23	0	42	1046	0	107	1305	0
Confl. Peds. (#/hr)	2		6	6		2	12		14	14		12
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	2%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	8.8	8.8		8.8	8.8		66.2	66.2		66.2	66.2	
Effective Green, g (s)	8.8	8.8		8.8	8.8		66.2	66.2		66.2	66.2	
Actuated g/C Ratio	0.10	0.10		0.10	0.10		0.74	0.74		0.74	0.74	
Clearance Time (s)	7.1	7.1		7.1	7.1		7.1	7.1		7.1	7.1	
Vehicle Extension (s)	4.0	4.0		4.0	4.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	115	128		118	128		232	2472		322	2463	
v/s Ratio Prot		0.01			0.02			0.31			c0.39	
v/s Ratio Perm	c0.04			0.01			0.13			0.25		
v/c Ratio	0.42	0.11		0.13	0.18		0.18	0.42		0.33	0.53	
Uniform Delay, d1	37.8	36.6		36.7	36.9		3.4	4.3		3.9	4.9	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.3	0.5		0.7	0.9		1.7	0.5		2.8	0.8	
Delay (s)	41.1	37.2		37.4	37.8		5.1	4.9		6.7	5.7	
Level of Service	D	D		D	D		A	A		A	A	
Approach Delay (s)		39.2			37.7			4.9			5.8	
Approach LOS		D			D			A			A	

Intersection Summary

HCM 2000 Control Delay	7.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	89.2	Sum of lost time (s)	14.2
Intersection Capacity Utilization	74.2%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Input Sheet

Main Road	Niagara
Minor Road	Aqueduct
Direction of Main Road	North / South
Date:	Background 2030
No. of Lanes on Main	2 or more
T-Intersection	No
Operating Environment	Urban
Scenario	Forecasted Traffic Volumes (Existing Intersection)

Analysis Sheet

Justification 1: Minimum Vehicle Volumes

Justification	Guidance Approach Lanes				Total	Section Percent
	1 Lanes		2 or More Lanes			
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW		
1A (All Approach Lanes)	480	720	600	900	962	107%
				x		
COMPLIANCE %						
1B (Minor Street Both Approaches)	120	170	120	170	112	66%
				x		
COMPLIANCE %						
Signal Justification 1:						

Justification 2: Delay to Cross Traffic

Justification	Guidance Approach Lanes				Total	Section Percent
	1 lanes		2 or More lanes			
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW		
2A (Major Street Both Approaches)	480	720	600	900	851	95%
				x		
COMPLIANCE %						
2B (Traffic Crossing Major Street)	50	75	50	75	34	45%
				x		
COMPLIANCE %						
Signal Justification 2:						

Justification 3: Combination (Justification 1 and 2)

Justification Satisfied 80% or More	
Justification 1	Minimum Vehicular Volume
Justification 2	Delay Cross Traffic

Results Sheet

Justification	Compliance	Minimum Target	Signal Justified?		
			YES	NO	
1. Minimum Vehicular Volume	A. Total Volume	107%	120%		NO
	B. Crossing Volume	66%			
2. Delay to Cross Traffic	A. Main Road	95%	120%		NO
	B. Crossing Road	45%			
3. Combination	A. Justificaton 1	66%	120%		NO
	B. Justification 2	45%			

Input Sheet

Main Road	Niagara
Minor Road	Aqueduct
Direction of Main Road	North / South
Date:	Total 2030
No. of Lanes on Main	2 or more
T-Intersection	No
Operating Environment	Urban
Scenario	Forecasted Traffic Volumes (Existing Intersection)

Analysis Sheet

Justification 1: Minimum Vehicle Volumes

Justification	Guidance Approach Lanes				Total	Section Percent
	1 Lanes		2 or More Lanes			
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW		
1A (All Approach Lanes)	480	720	600	900	990	110%
				x		
COMPLIANCE %						
1B (Minor Street Both Approaches)	120	170	120	170	112	66%
				x		
COMPLIANCE %						
Signal Justification 1:						

Justification 2: Delay to Cross Traffic

Justification	Guidance Approach Lanes				Total	Section Percent
	1 lanes		2 or More lanes			
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW		
2A (Major Street Both Approaches)	480	720	600	900	878	98%
				x		
COMPLIANCE %						
2B (Traffic Crossing Major Street)	50	75	50	75	34	45%
				x		
COMPLIANCE %						
Signal Justification 2:						

Justification 3: Combination (Justification 1 and 2)

Justification Satisfied 80% or More	
Justification 1	Minimum Vehicular Volume
Justification 2	Delay Cross Traffic

Results Sheet

Justification	Compliance	Minimum Target	Signal Justified?	
			YES	NO
1. Minimum Vehicular Volume	A. Total Volume	110%	120%	NO
	B. Crossing Volume	66%		
2. Delay to Cross Traffic	A. Main Road	98%	120%	NO
	B. Crossing Road	45%		
3. Combination	A. Justificaton 1	66%	120%	NO
	B. Justification 2	45%		

Input Sheet

Main Road	Niagara
Minor Road	Aqueduct
Direction of Main Road	North / South
Date:	Background 2035
No. of Lanes on Main	2 or more
T-Intersection	No
Operating Environment	Urban
Scenario	Forecasted Traffic Volumes (Existing Intersection)

Analysis Sheet

Justification 1: Minimum Vehicle Volumes

Justification	Guidance Approach Lanes				Total	Section Percent
	1 Lanes		2 or More Lanes			
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW		
1A (All Approach Lanes)	480	720	600	900	1,038	115%
				x		
COMPLIANCE %						
1B (Minor Street Both Approaches)	120	170	120	170	121	71%
				x		
COMPLIANCE %						
Signal Justification 1:						

Justification 2: Delay to Cross Traffic

Justification	Guidance Approach Lanes				Total	Section Percent
	1 lanes		2 or More lanes			
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW		
2A (Major Street Both Approaches)	480	720	600	900	917	102%
				x		
COMPLIANCE %						
2B (Traffic Crossing Major Street)	50	75	50	75	36	48%
				x		
COMPLIANCE %						
Signal Justification 2:						

Justification 3: Combination (Justification 1 and 2)

Justification Satisfied 80% or More	
Justification 1	Minimum Vehicular Volume
Justification 2	Delay Cross Traffic

Results Sheet

Justification	Compliance	Minimum Target	Signal Justified?	
			YES	NO
1. Minimum Vehicular Volume	A. Total Volume	115%	120%	NO
	B. Crossing Volume	71%		
2. Delay to Cross Traffic	A. Main Road	102%	120%	NO
	B. Crossing Road	48%		
3. Combination	A. Justificaton 1	71%	120%	NO
	B. Justification 2	48%		

Input Sheet

Main Road	Niagara
Minor Road	Aqueduct
Direction of Main Road	North / South
Date:	Total 2035
No. of Lanes on Main	2 or more
T-Intersection	No
Operating Environment	Urban
Scenario	Forecasted Traffic Volumes (Existing Intersection)

Analysis Sheet

Justification 1: Minimum Vehicle Volumes

Justification	Guidance Approach Lanes				Total	Section Percent
	1 Lanes		2 or More Lanes			
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW		
1A (All Approach Lanes)	480	720	600	900	1,065	118%
				x		
COMPLIANCE %						
1B (Minor Street Both Approaches)	120	170	120	170	121	71%
				x		
COMPLIANCE %						
Signal Justification 1:						

Justification 2: Delay to Cross Traffic

Justification	Guidance Approach Lanes				Total	Section Percent
	1 lanes		2 or More lanes			
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW		
2A (Major Street Both Approaches)	480	720	600	900	944	105%
				x		
COMPLIANCE %						
2B (Traffic Crossing Major Street)	50	75	50	75	36	48%
				x		
COMPLIANCE %						
Signal Justification 2:						

Justification 3: Combination (Justification 1 and 2)

Justification Satisfied 80% or More	
Justification 1	Minimum Vehicular Volume
Justification 2	Delay Cross Traffic

Results Sheet

Justification	Compliance	Minimum Target	Signal Justified?	
			YES	NO
1. Minimum Vehicular Volume	A. Total Volume	118%	120%	NO
	B. Crossing Volume	71%		
2. Delay to Cross Traffic	A. Main Road	105%	120%	NO
	B. Crossing Road	48%		
3. Combination	A. Justificaton 1	71%	120%	NO
	B. Justification 2	48%		