



**Traffic Impact Study:  
Proposed Multi-Use Development**

**Midtown North  
Halifax, NS**

**Presented to:  
Westwood Construction**

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**Project # 161-00492**



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## 1.0 Introduction

### *Background*

Plans are being prepared for the development of Midtown North, a multi-use development in Halifax, NS. The proposed development includes 16 currently developed parcels located at the southwest corner of the intersection of Robie Street at Almon Street in Halifax, Nova Scotia (See Figure 1).

The development is planned to include approximately 311 residential units, 139,000 square feet of leasable retail floor space, and 68,000 square feet of office floor space. There will be an underground parking garage with 490 parking spaces as well as some available on-site surface parking. Completion of the development is anticipated by 2019.

WSP Canada Inc. has been retained to complete a Traffic Impact Study satisfactory to the Halifax Regional Municipality (HRM).

### *A Traffic Impact Study Usually Considers Four Questions*

A Traffic Impact Study (TIS) usually consists of determining answers for the following questions:

1. **What are the existing traffic situations** on roads adjacent to the study site? How have traffic volumes changed historically?
2. **What traffic changes are expected** at Study Area intersections? How many vehicle trips will be generated by the proposed development during weekday peak hours? How will the traffic be distributed at the exits from the development and to Study Area roads and intersections?
3. **What traffic impacts will occur** on Study Area roads and intersections? How will level of service of roads and intersections be affected?
4. **What road or intersection improvements are required** to mitigate project impacts on Study Area traffic movements?

### *Study Objectives*

- 1) Develop projected 2019 background weekday AM and PM peak hourly volumes for Study Area roads that do not include trips generated by proposed site development.
- 2) Estimate the number of weekday AM and PM peak hour trips that will be generated by the proposed development.
- 3) Distribute and assign site generated trips to Study Area intersections to project 2019 peak hourly volumes that include site generated trips.
- 4) Evaluate impacts of site generated traffic on the performance and level of service of study intersections.
- 5) Complete traffic signal and turn lane warrant analyses, as necessary, for Study Area intersections and recommend improvements that may be needed at study intersections to mitigate the impacts of site development.

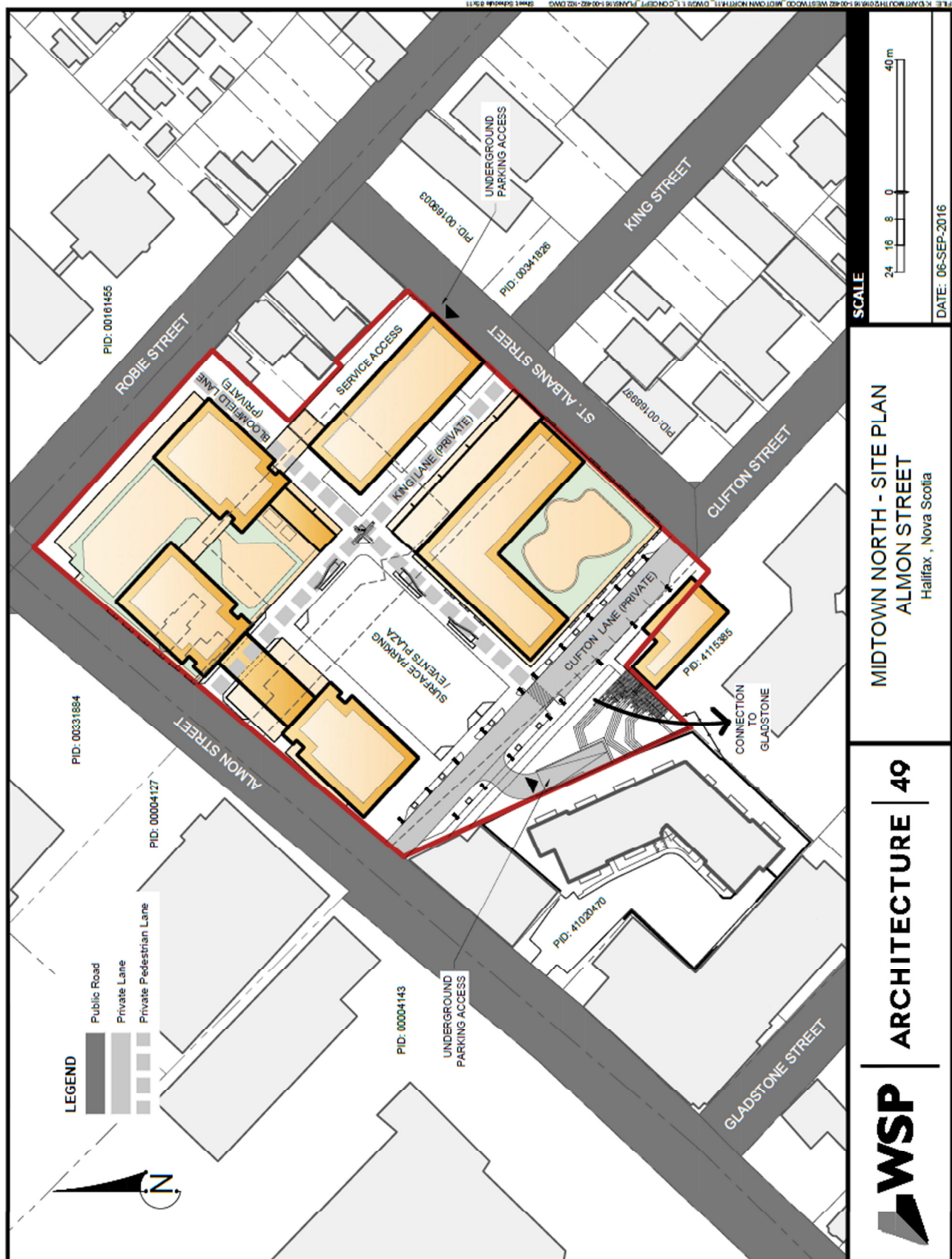


Figure 1: Site Plan



## 2.0 Study Area Descriptions

### Site Description

The proposed site is an approximately 1.7 hectare set of 16 parcels bounded by Almon Street, Robie Street, St. Albans Street, and existing development in the west. The development is planned to include approximately 311 residential units, 139,000 square feet of leasable retail floor space, and 68,000 square feet of office floor space.

Vehicular access to the development will be via an underground parking garage with access from Almon Street and St. Albans Street. It is anticipated that buildout of the development will complete by 2019.

### Road Descriptions

**Robie Street**, just to the east of the site is a 2-lane arterial roadway with concrete sidewalks on both sides and time restricted parking on the east side. Robie Street is an important north-south corridor on the Halifax Peninsula that provides access to the hospitals and universities and serves as a key link for several bus routes. Traffic volume data collected in 2012 by HRM Traffic Management show that Robie Street in the vicinity of the site had a two-way traffic volume of approximately 17,000 vehicles per weekday. Data collected at the intersection with Almon Street in 2014 by HRM shows that there were 1025 two-way vehicles per hour (vph) in the AM Peak Hour and 1142 vph in the PM peak. Robie Street has a 50 km/h speed limit.

**Almon Street**, just to the north of the site is a 2-lane major collector roadway with concrete sidewalks and time restricted parking on both sides. Data collected by HRM in 2014 at the Robie Street intersection show that there were 1108 two-way vehicles per hour (vph) in the AM Peak Hour and 1089 vph in the PM peak hour. Almon Street has a 50 km/h speed limit.

**St. Albans Street**, just to the south of the site is a 2-lane local roadway with concrete sidewalks on both sides. Parking is restricted on the south side and permitted on the north side. St. Albans Street has a 50 km/h speed limit.

### Intersection Descriptions

**1- The Robie Street / Almon Street** intersection is signalized with pedestrian crossings of all approaches. The northbound approach is dual lane while the southbound approach has a left-turn lane, a through lane, and a right-turn lane (See Photo 1). The eastbound approach has a left-turn lane and a through / right shared lane while the westbound approach is dual lane.



Photo 1: Looking south on Robie Street toward Almon Street

**Intersection  
Descriptions  
(Continued)**

**2- The Robie Street – St. Albans Street** T-intersection is unsignalized with STOP control on St. Albans Street (See Photos 2 and 3). There is an existing RA-5 crosswalk crossing the Robie Street north approach and all approaches to the intersection include a single lane.



**Photo 2: Looking south on Robie Street toward St. Albans Street**



**Photo 3: Looking east on St. Albans Street toward Robie Street**

**Public  
Transportation**

Halifax Transit operates Routes 7 (Robie), 42 (Lacewood / Dalhousie), 80 (Sackville), and 81 (Hemlock Ravine) on Robie Street with northbound and southbound stops within 100 metres of the site (See Photo 4).



**Photo 4: Robie Street as a busy transit corridor  
(Three southbound buses can be seen on Robie Street)**

Additional transit service within 500 m is available on North Street (Routes 2, 4, 52), Windsor Street (17, 18, 82, 90), and Gottingen Street (Routes 21, 31, 33, 34, 35, 86).

**Public  
Transportation  
(Continued)**

HRM plans to install a Transit Priority Measure (TPM) at the intersection of Robie Street at Almon Street to permit southbound transit vehicles to conduct a through movement on Robie Street from the existing right-turn only lane. As there is currently no receiving lane south of Almon Street, a transit signal phase is required with the measure. The installation of this transit priority measure is anticipated in 2016.

The redevelopment of this site may provide HRM an opportunity to install a receiving lane for southbound transit vehicles south of Almon Street. This receiving lane would enable the transit priority signal to be removed following the installation of the lane.

Additional benefit could be obtained by relocating the transit stop for southbound vehicles on Robie Street from nearside (north of) Almon Street to farside (south of) Almon Street into the new receiving lane and may improve the progression of transit vehicles at this intersection.

**Parking**

The proposed development is planned to include 490 onsite parking spaces in an underground parking garage as well as some available on-site surface parking. With redevelopment of the site, it is anticipated that the demand for on-street parking surrounding this development will be reduced, mitigating the impact of any potential loss of on-street parking near the site.

**Proposed Site  
Access**

Vehicular access to the proposed development will be via a driveway onto Almon Street and two driveways to St. Albans Street as shown in Figure 1. There is sufficient sight distance at all proposed site driveways.

**Turning  
Movement  
Counts**

Turning Movement Counts were obtained by HRM Traffic Management during AM, and PM peak periods and provided to WSP. Turning movement count data for the following intersections are summarized in Appendix A:

- Robie Street @ Almon Street on Thursday, September 25, 2014 (Table A-1);
- Robie Street @ St. Albans Street on Tuesday, November 25, 2014 (Table A-2);

**Traffic Growth  
Rate**

Counted 2014 peak hour volumes on Almon Street and Robie Street have been increased by an annual growth rate of 0.5%, which is considered typical for this area, to project background traffic volumes without site development.

**Projected 2016  
and 2019  
Background  
Volumes**

Projected 2016 and 2019 AM and PM peak hour background volumes are shown diagrammatically in Figure A-1, Appendix A.



### 3.0 Trip Generation, Distribution, and Assignment

#### **Anticipated Land Use for Proposed Multi- Use Development**

The proposed development is planned to include:

- 311 residential units;
- 139,000 square feet of leasable retail floor space; and,
- 68,000 square feet of office floor space.

#### **Estimation of Total Site Generated Trips**

Two types of trips are included in the external trips that will be generated by the proposed development - *Pass-by* and *Primary Trips*.

**Pass-by trips** are those which are made as ‘intervening opportunity’ stops to commercial and retail land uses by vehicle trips already passing by the site. Although these trips will be included in the driveway volumes to the site, they will not increase the overall traffic volumes on Study Area roads. *Trip Generation Handbook, 2<sup>nd</sup> Edition* (Institute of Transportation Engineers, 2012) indicates an average of 34% pass-by trips for a Shopping Centre (Table 5.6, Page 46). Since a significant percentage of peak hour trips generated by this site can be expected to come from traffic passing the site on Robie Street and Almon Street, a 35% pass-by rate has been used for the retail trips in both the AM and PM peak hours.

**Primary trips** for this Study include all external site generated trips that are not considered pass-by trips.

The number of trips that will be generated by the proposed multi-use development has been estimated using rates published in *Trip Generation, 9th Edition* (Washington, 2012). Trip generation estimates are summarized in Table 1.

A 25% reduction of vehicle trips was used for this development and accounts for the following:

- **Onsite Synergies**- Since this proposed development includes 311 apartment units, 68,000 SF of office space, and 139,000 SF of retail space, it is probable that there will be many onsite trips between the mix of land uses. Using the internal capture rates provided in Tables 7.1 and 7.2, Pages 93 and 94, *Trip Generation Handbook, 2<sup>nd</sup> Edition* (Institute of Transportation Engineers, Washington, 2012) yields a trip reduction of 15%.
- **Pedestrian Access**- With good nearby pedestrian infrastructure, the site is located within 350 metres of Sobeys, 500 metres of CFB Stadacona, and is located in close proximity to existing large residential areas, benefiting the retail and office land uses.
- **Cycling**- The Agricola Street bicycle route is within 200 metres of the site, providing connection to the Halifax Common via North Park Street and the downtown via Rainnie Drive. HRM has also provided bicycle lanes on Windsor Street within 400 metres of the site, providing a reasonably flat cycling route between north end Halifax and the Quinpool Road area.



**Estimation of Total  
Site Generated Trips  
(Continued)**

- **Public Transit-** With four well served transit routes traveling directly past the site on Robie Street and an additional 13 transit routes within 500 metres of the site, it is anticipated that the modal share for transit users will be high.

During the AM peak hour it is estimated that the development will generate:

- 204 two-way primary vehicle trips (131 entering and 73 exiting); and,
- 46 two-way pass-by vehicle trips (23 entering and 23 exiting).

During the PM peak hour it is estimated that the development will generate:

- 373 two-way primary vehicle trips (161 entering and 212 exiting); and,
- 180 two way pass-by vehicle trips (90 entering and 90 exiting).

**Table 1 - Trip Generation Estimates**

Land Use <sup>1</sup>	Units <sup>2</sup>	Trip Generation Rates <sup>3</sup>				Trips Generated <sup>4</sup>			
		AM Peak		PM Peak		AM Peak		PM Peak	
		In	Out	In	Out	In	Out	In	Out
Mid-Rise Apartment (ITE 223)	311	0.09	0.21	0.23	0.16	29	64	70	51
Shopping Centre (ITE 820)	139.0	0.60	0.36	1.78	1.93	83	51	248	268
General Office (ITE 710)	68.0	1.37	0.19	0.25	1.24	93	13	17	84
Total Trip Generation Estimate						205	128	335	403
Estimated 25% Reduction of Trips for onsite Synergies and non-vehicle trips <sup>5</sup>						51	32	84	101
Trip Generation Estimate After Adjustment for Synergies						154	96	251	302
35% Shopping Centre Pass-by Trips Assumed for this Location <sup>6</sup>						23	23	90	90
<b>Estimated Primary Trips Attracted to the Site</b>						<b>131</b>	<b>73</b>	<b>161</b>	<b>212</b>

Notes: 1. Land use codes are from *Trip Generation, 9th Edition*, (Institute of Transportation Engineers, Washington, 2012).

2. 'Number of residential units' for Apartments, 'Gross Leasable Area x 1000 square feet' for Shopping Centre and 'Gross Floor Area x 1000 square feet' for Office.

3. Trip generation rates are 'vehicles per hour per unit' for Apartments and 'vehicles per hour per 1000 sq. ft.' for Retail and Office.

4. Trips generated are 'vehicles per hour' for AM and PM peak hours.

5. Since high pedestrian / cycling / transit usage is expected in the Study Area, and there will be on-site synergies between the residential, office and retail land uses, a 25% reduction has been applied to site generated trip estimates.

6. Trip Generation Handbook, 2nd Edition (Institute of Transportation Engineers, 2012) indicates an average of 34% pass-by trips for a Shopping Centre (Table 5.6, Page 46). Since a significant percentage of peak hour trips generated by this site can be expected to come from traffic passing the site on Robie Street and Almon Street, a 35% pass-by rate has been used.

***Primary Trip  
Distribution and  
Assignment***

Primary site trips generated by the proposed development were assigned to the roadway network based on counted volumes and local knowledge of the area considering major trip origins and destinations in the region. In the trip distribution, consideration is given to the expected high rate of non-vehicle trips from / to the south, due to the shorter distances and higher anticipated active transportation and transit mode shares.

North	35%	(North end Halifax, Dartmouth / Burnside / Bedford / Fall River via MacKay Bridge, Airport, etc.)
East	15%	(Dartmouth via Macdonald Bridge, northern portion of downtown Halifax, Shipyards, etc.)
South	20%	(Downtown Halifax, Dalhousie and St. Mary's, Hospitals, etc.)
West	30%	(Halifax Shopping Centre, Bayers Lake, Highway 102, Armdale roundabout, etc.)

Pass-by site generated trips were assigned to the roadway network based on directional distribution of counted volumes at the Robie Street / Almon Street intersection.

Estimated trips generated by the proposed development have been assigned to Study Area intersections and are shown diagrammatically in Figure A-2 (Boxes A and B), Appendix A.

***Projected 2019 Traffic  
Volumes that Include  
Site Generated Trips***

Trips generated by the proposed development (Figure A-2, Boxes A and B) have been added to the projected 2019 background volumes (Figure A-1, Boxes C and D) to provide projected 2019 AM and PM peak hourly volumes that include site generated trips, illustrated diagrammatically in Figure A-2 (Boxes C and D), Appendix A.

## 4.0 Intersection Performance Analysis

### 4.1 Turn Lane Warrant Analysis

#### **Left-Turn Lane Warrant Analysis**

Left-turn movements on a two lane street may cause both operational and safety problems. Operational problems result as a vehicle stopped waiting for an opportunity to turn across 'heavy' opposing traffic causes a queue of stopped vehicles to form. Safety problems result from rear end collisions when a stopped left-turning vehicle is struck by an advancing vehicle, or from head-on or right angle collisions when a left-turning vehicle is struck by an opposing vehicle.

The Geometric Design Standards for Ontario Highways Manual contains nomographs for left-turn lane analysis for two lane streets at unsignalized intersections. The analysis method, which is normally used by WSP Atlantic to evaluate the need for left-turn lanes, uses a series of nomographs that consider speed, advancing volumes, left-turns as a percentage of advancing volumes, and opposing volumes. A point, based on 'opposing' and 'advancing' volumes, plotted to the right of the 'warrant line' of the appropriate '% left-turns' and 'approach speed' nomograph, indicates that a left-turn lane is warranted for the conditions used in the analysis. Similarly, a point that is plotted to the left of the warrant line indicates that a left-turn lane is not warranted.

Analyses of left-turn lane warrants with projected traffic volumes were completed (Figure A-3, Appendix A) and found the following:

- A northbound left-turn lane on Robie Street at St. Albans Street is expected to be warranted in 2019 without and with the addition of site generated trips.
- A westbound left-turn lane on Almon Street at the Site Access is expected to be warranted in 2019 with the addition of site generated trips.

Almon Street in this area is approximately 12 metres in width. It is anticipated that the westbound left-turn lane (warranted in 2019 with site generated trips) can be installed within the existing road width with the removal of some on-street parking spaces near the proposed driveway.

Robie Street in this area is approximately 10 metres in width and the operating speed is likely less than 50 km/h during peak periods. While the lane widths may be less than desired, HRM could consider installing a northbound left turn lane on Robie Street at St. Albans Street within the existing road width with the removal of parking spaces on Robie Street near the intersection. The lane is warranted with background volume conditions similar to many other left-turn locations along this section of Robie Street.

The proposed development is planned to include 490 onsite parking spaces. With redevelopment of the site, it is anticipated that the demand for on-street parking surrounding this development will be reduced, mitigating the impact of any loss of on-street parking spaces.

## 4.2 Intersection Capacity Analysis

### Intersection Capacity Analysis

Synchro 9.0 software has been used for performance evaluation of Study Area intersections for 2019 AM and PM peak hour volumes without and with site development. Analysis results are included in Appendix B and summarized in Tables 2 to 5 below.

### Summary of Capacity Analysis Results

**Robie Street at Almon Street (Table 2)** – Overall performance at the intersection is expected to be satisfactory both without and with the addition of site generated trips. All movements are expected to operate within HRM acceptable limits.

**Robie Street at St. Albans Street (Table 3, Table 4)** – Overall performance at the intersection is expected to be satisfactory both without and with the addition of site generated trips.

With the addition of a northbound left-turn lane (Table 3), all movements are expected to operate within HRM acceptable limits.

Without the addition of a northbound left-turn lane (Table 4), the northbound approach is expected to operate with a v/c ratio over 0.85 during the PM peak hour without and with the addition of site generated trips. Although this volume to capacity ratio exceeds the HRM acceptable limits for a left / through shared lane, the approach is expected to operate within its capacity.

**Almon Street at Site Access (Table 5)** – Overall performance at the intersection is expected to be satisfactory both without and with the addition of site generated trips. With the addition of a westbound left-turn lane, all movements are expected to operate within HRM acceptable limits.

**Table 2 – 2019 Intersection Capacity Analysis for Robie Street at Almon Street**

Analysis Criteria	Control Delay (sec/veh), v/c Ratio, and 95 <sup>th</sup> Queue (m) by Intersection Movement							Overall Intersection
	EB-L	EB-TR	WB-LTR	NB-LTR	SB-L	SB-T	SB-R	Delay
Weekday AM Peak Hour without Site Development (Page B-1)								
Delay	27.2	26.5	16.8	11.1	10.7	18.9	2.6	16.8
v/c	0.53	0.67	0.30	0.38	0.13	0.73	0.28	
Queue	42.2	82.1	27.0	38.4	9.7	114.7	9.8	
Weekday AM Peak Hour with Site Development (Page B-5)								
Delay	32.8	30.0	20.7	12.7	11.5	19.9	2.3	19.0
v/c	0.58	0.63	0.29	0.35	0.12	0.69	0.28	
Queue	50.9	83.9	27.9	38.4	9.8	121.7	10.2	
Weekday PM Peak Hour without Site Development (Page B-3)								
Delay	24.5	16.7	30.5	23.3	19.6	23.7	3.8	23.5
v/c	0.64	0.35	0.69	0.65	0.16	0.59	0.21	
Queue	37.8	49.9	74.0	87.4	9.0	94.7	10.5	
Weekday PM Peak Hour with Site Development (Page B-8)								
Delay	60.2	17.1	30.9	23.5	19.2	24.8	3.6	27.6
v/c	0.96	0.38	0.70	0.65	0.15	0.63	0.24	
Queue	86.1	54.1	74.6	86.1	8.6	102.3	11.3	



**Table 3 – 2019 Intersection Capacity Analysis for Robie Street at St. Albans Street – with NB LT Lane**

Analysis Criteria	Control Delay (sec/veh), v/c Ratio, and 95% <sup>th</sup> % Queue (m) by Intersection Movement				Overall Intersection
	EB-LR	NB-L	NB-T	SB-TR	Delay
Weekday AM Peak Hour without Site Development (Page B-2)					
Delay	31.0	9.6	0.0	0.0	1.2
v/c	0.26	0.02	0.32	0.43	
Queue	7.7	0.5	0.0	0.0	
Weekday AM Peak Hour with Site Development (Page B-6)					
Delay	36.6	10.0	0.0	0.0	2.3
v/c	0.4	0.07	0.31	0.45	
Queue	13.7	1.7	0.0	0.0	
Weekday PM Peak Hour without Site Development (Page B-4)					
Delay	43.4	8.7	0.0	0.0	2.5
v/c	0.47	0.02	0.50	0.32	
Queue	17.0	0.5	0.0	0.0	
Weekday PM Peak Hour with Site Development (Page B-9)					
Delay	86.5	9.1	0.0	0.0	8.8
v/c	0.86	0.09	0.48	0.34	
Queue	47.5	2.3	0.0	0.0	

**Table 4 – 2019 Intersection Capacity Analysis for Robie Street at St. Albans Street – without NB LT Lane**

Table 1. Level Intersection Capacity Analysis for North Street at Ch. Arizona Street				
Analysis Criteria	Control Delay (sec/veh), v/c Ratio, and 95% <sup>tho</sup> % Queue (m) by Intersection Movement			Overall Intersection
	EB-LR	NB-LT	SB-TR	Delay
Weekday AM Peak Hour without Site Development (Page B-11)				
Delay	31.0	0.5	0.0	1.4
v/c	0.26	0.69	0.43	
Queue	7.7	0.5	0.0	
Weekday AM Peak Hour with Site Development (Page B-13)				
Delay	36.6	1.9	0.0	2.7
v/c	0.4	0.76	0.45	
Queue	13.7	1.7	0.0	
Weekday PM Peak Hour without Site Development (Page B-12)				
Delay	43.4	0.6	0.0	2.7
v/c	0.47	0.86	0.32	
Queue	17.0	0.5	0.0	
Weekday PM Peak Hour with Site Development (Page B-14)				
Delay	86.5	2.4	0.0	9.6
v/c	0.86	0.93	0.34	
Queue	47.5	2.3	0.0	

**Table 5 – 2019 Intersection Capacity Analysis for Almon Street at Site Driveway**

Analysis Criteria	Control Delay (sec/veh), v/c Ratio, and 95 <sup>th</sup> % Queue (m) by Intersection Movement					Overall Intersection
	EB-TR	WB-L	WB-T	NB-L	NB-R	Delay
Weekday AM Peak Hour with Site Development (Page B-7)						
Delay	0.0	8.7	0.0	23.2	12.4	1.2
v/c	0.34	0.04	0.28	0.10	0.09	
Queue	0.0	0.9	0.0	2.4	2.1	
Weekday PM Peak Hour with Site Development (Page B-10)						
Delay	0.0	8.7	0.0	54.2	13.5	4.3
v/c	0.31	0.06	0.40	0.51	0.26	
Queue	0.0	1.4	0.0	18.2	7.8	

## 5.0 Summary, Recommendations, and Conclusions

### **Description of the Proposed Development**

1. Plans are being prepared for the development of Midtown North, a multi-use development of 16 parcels at the southwest corner of the intersection of Robie Street at Almon Street in Halifax, NS. The development is planned to include approximately:
  - 311 residential units;
  - 139,000 square feet of leasable retail floor space; and,
  - 68,000 square feet of office floor space.Completion of the development is anticipated by 2019.

### **Proposed Site Access**

2. Vehicular access to the development will be via a driveway onto Almon Street and two driveways to St. Albans Street.

### **Description of Study Area Roads**

3. **Robie Street**, just to the east of the site is a 2-lane arterial roadway. Robie Street is an important north-south corridor on the Halifax Peninsula and serves as a key link for several bus routes.

**Almon Street**, just to the north of the site is a 2-lane major collector roadway.

**St. Albans Street**, just to the south of the site is a 2-lane local east-west roadway.

### **Background Traffic Volumes**

4. Projected 2019 weekday AM and PM peak hour background volumes were calculated using an annual traffic volume growth rate of 0.5%.

### **Estimation of Site Generated Trips**

5. Trip generation estimates, were prepared using rates published in *Trip Generation, 9th Edition* (Institute of Transportation Engineers, Washington, 2012).

During the AM peak hour it is estimated that the multi-use development will generate:

- 204 two-way primary vehicle trips (131 entering and 73 exiting); and,
- 46 two-way pass-by trips (23 entering and 23 exiting).

During the PM peak hour it is estimated that the multi-use development will generate:

- 373 two-way primary vehicle trips (161 entering and 212 exiting); and,
- 180 two way pass-by vehicle trips (90 entering and 90 exiting).

### **Trip Distribution and Assignment**

6. Primary vehicle trips generated by the development have been assigned to study area streets and intersections based on counted volumes and consideration of major trip origins and destinations in the region. Trips were distributed to the north (35%), East (15%), south (20%), and west (30%).

***Trip Distribution and  
Assignment  
(Continued)***

7. Pass-by vehicle trips generated by the development have been assigned to study area streets and intersections based on existing traffic flow at the Robie Street / Almon Street intersection.

***Left-Turn Lane  
Warrant***

8. Analyses of left-turn lane warrants were completed for the following intersections:
  - **Robie Street northbound at St. Albans Street** (Warranted in 2019 without and with site generated trips); and,
  - **Almon Street westbound at site access** (Warranted in 2019 with site generated trips).

***Summary - Level of  
Service Analysis***

9. With the addition of left-turn lanes described above, the intersection level of performance at the study area intersections is expected to be within HRM acceptable limits without and with the addition of site generated trips.
10. Without the installation of a northbound left-turn lane on Robie Street at St. Albans Street, the northbound approach is expected to operate with a v/c ratio of over 0.85 during the PM peak hour without and with the addition of site generated trips. Although this v/c ratio exceeds the HRM acceptable limits for a left / through shared lane, the approach is expected to operate within its capacity.

***Recommendations***

11. It is anticipated that a westbound left-turn lane on Almon Street at the site driveway (warranted in 2019 with site generated trips) could be installed within the existing Almon Street width (approximately 12 metres).
12. While the lane widths may be less than desired, HRM could consider the installation of a northbound left turn lane on Robie Street at St. Albans Street within the existing road width (10 metres). The lane is warranted with background volume conditions similar to many other left-turn locations along this section of Robie Street and would improve the operations of the northbound approach at the intersection.
13. HRM should investigate opportunities to install a receiving lane for southbound transit vehicles south of the Almon Street intersection to add to the planned installation of the Transit Priority Measure for southbound transit vehicles on Robie Street.
14. With the installation of a receiving lane identified in #13, Halifax Transit should consider the relocation of the southbound bus stop and bench on Robie Street from nearside Almon Street to farside Almon Street.

***Conclusions***

15. With implementation of recommended upgrades, site generated trips are not expected to have a significant impact to levels of performance on adjacent intersections or to the regional road network.

## **Appendix A**

**Intersection Turning Movement  
Counts**

**Traffic Volume Diagrams**

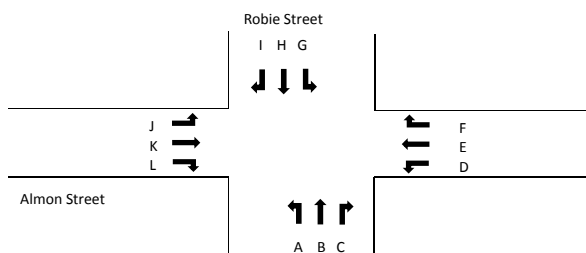
**Left-Turn Lane Warrants**



**Table A-1**

**Robie Street  
@  
Almon Street**

*Halifax, NS*  
Thursday, September 25, 2014

**AM Peak Period Volume Data**

Time		Robie Street Northbound Approach			Almon Street Westbound Approach			Robie Street Southbound Approach			Almon Street Eastbound Approach			Total Vehicles
		A	B	C	D	E	F	G	H	I	J	K	L	
07:00	07:15	1	104	1	6	29	9	17	179	27	27	67	11	478
07:15	07:30	5	86	2	2	30	8	16	171	45	25	75	15	480
07:30	07:45	4	93	5	12	44	9	15	155	48	29	64	19	497
07:45	08:00	3	80	6	4	47	8	9	139	45	33	70	16	460
08:00	08:15	6	112	4	4	42	10	12	159	52	45	64	14	524
08:15	08:30	11	109	4	3	41	16	9	129	52	33	80	13	500
08:30	08:45	4	133	3	2	61	6	9	148	54	41	71	9	541
08:45	09:00	10	111	6	9	53	15	12	149	45	33	76	14	533
<b>AM Peak Hour</b>		<b>31</b>	<b>465</b>	<b>17</b>	<b>18</b>	<b>197</b>	<b>47</b>	<b>42</b>	<b>585</b>	<b>203</b>	<b>152</b>	<b>291</b>	<b>50</b>	<b>2098</b>
<b>07:00</b>	<b>08:00</b>	<b>13</b>	<b>363</b>	<b>14</b>	<b>24</b>	<b>150</b>	<b>34</b>	<b>57</b>	<b>644</b>	<b>165</b>	<b>114</b>	<b>276</b>	<b>61</b>	<b>1915</b>
<b>08:00</b>	<b>09:00</b>	<b>31</b>	<b>465</b>	<b>17</b>	<b>18</b>	<b>197</b>	<b>47</b>	<b>42</b>	<b>585</b>	<b>203</b>	<b>152</b>	<b>291</b>	<b>50</b>	<b>2098</b>

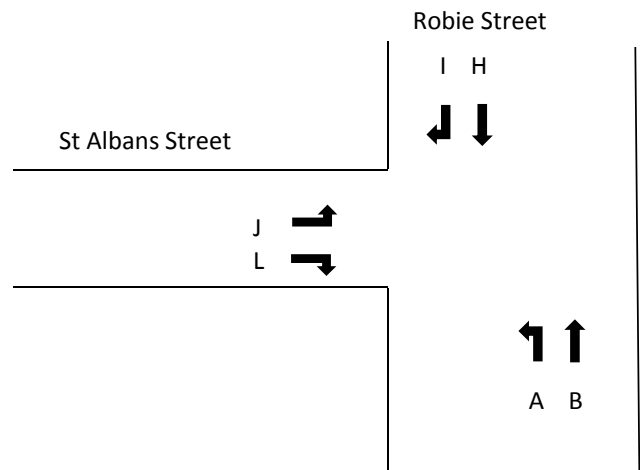
**PM Peak Period Volume Data**

Time		Robie Street Northbound Approach			Almon Street Westbound Approach			Robie Street Southbound Approach			Almon Street Eastbound Approach			Total Vehicles
		A	B	C	D	E	F	G	H	I	J	K	L	
16:00	16:15	7	172	0	3	125	36	7	115	38	57	48	13	621
16:15	16:30	9	188	6	5	111	28	4	108	29	41	54	12	595
16:30	16:45	8	213	2	2	122	32	5	71	33	47	44	19	598
16:45	17:00	6	186	3	6	113	28	6	84	30	45	50	14	571
17:00	17:15	7	197	1	5	115	20	10	102	16	51	59	12	595
17:15	17:30	7	184	5	7	95	25	5	80	22	51	50	14	545
17:30	17:45	7	174	7	12	74	16	13	120	39	27	45	13	547
17:45	18:00	7	154	3	2	51	25	13	128	42	52	46	14	537
<b>PM Peak Hour</b>		<b>30</b>	<b>759</b>	<b>11</b>	<b>16</b>	<b>471</b>	<b>124</b>	<b>22</b>	<b>378</b>	<b>130</b>	<b>190</b>	<b>196</b>	<b>58</b>	<b>2385</b>
<b>16:00</b>	<b>17:00</b>	<b>30</b>	<b>759</b>	<b>11</b>	<b>16</b>	<b>471</b>	<b>124</b>	<b>22</b>	<b>378</b>	<b>130</b>	<b>190</b>	<b>196</b>	<b>58</b>	<b>2385</b>
<b>17:00</b>	<b>18:00</b>	<b>28</b>	<b>709</b>	<b>16</b>	<b>26</b>	<b>335</b>	<b>86</b>	<b>41</b>	<b>430</b>	<b>119</b>	<b>181</b>	<b>200</b>	<b>53</b>	<b>2224</b>

\* Count completed by HRM Traffic Management

**Table A-2**  
**Robie Street**  
**@**  
**St Albans Street**

*Halifax, NS*  
Tuesday, November 25, 2014



### AM Peak Period Volume Data

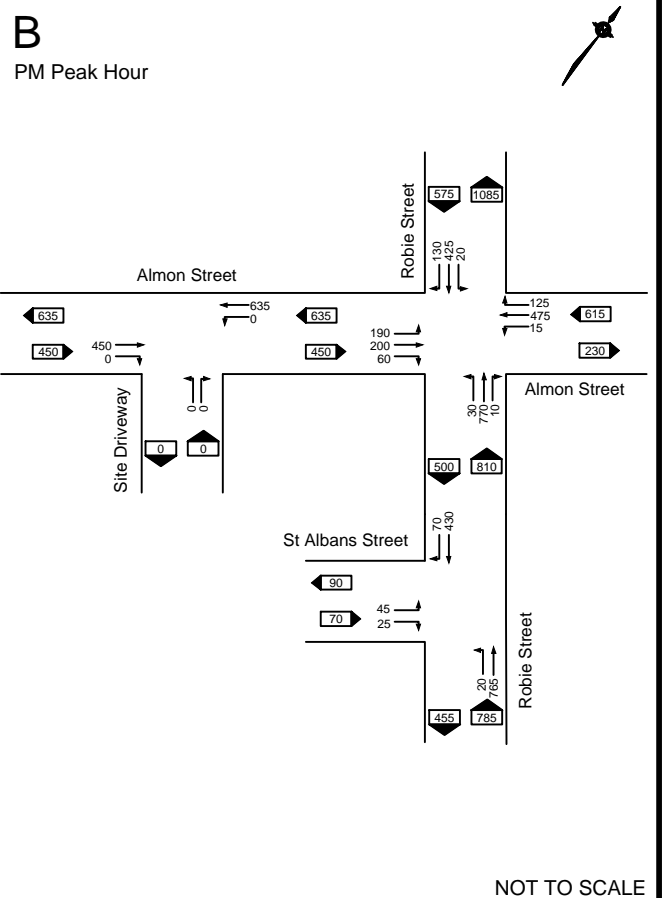
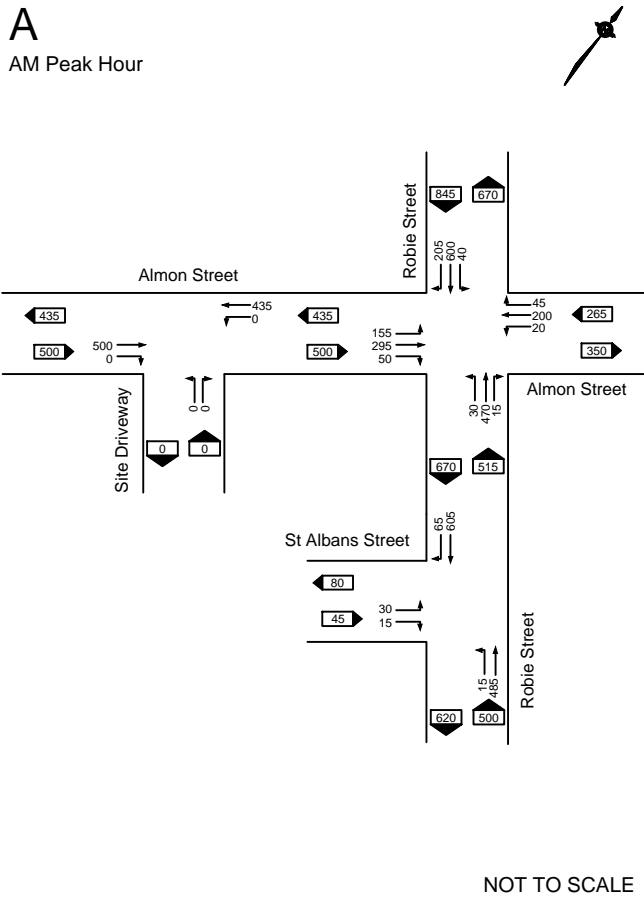
Time	Robie Street Northbound Approach		Robie Street Southbound Approach		St Albans Street Eastbound Approach		Total Vehicles
	A	B	H	I	J	L	
07:00 07:15	3	87	175	14	2	3	284
07:15 07:30	2	105	198	10	9	2	326
07:30 07:45	2	91	166	12	5	3	279
07:45 08:00	4	95	170	15	8	4	296
08:00 08:15	1	126	153	12	6	2	300
08:15 08:30	5	119	147	17	5	5	298
08:30 08:45	6	113	140	13	15	1	288
08:45 09:00	5	129	173	21	5	5	338
<b>AM Peak Hour</b>	<b>17</b>	<b>487</b>	<b>613</b>	<b>63</b>	<b>31</b>	<b>13</b>	<b>1224</b>
<b>07:00 08:00</b>	<b>11</b>	<b>378</b>	<b>709</b>	<b>51</b>	<b>24</b>	<b>12</b>	<b>1185</b>
<b>08:00 09:00</b>	<b>17</b>	<b>487</b>	<b>613</b>	<b>63</b>	<b>31</b>	<b>13</b>	<b>1224</b>

### PM Peak Period Volume Data

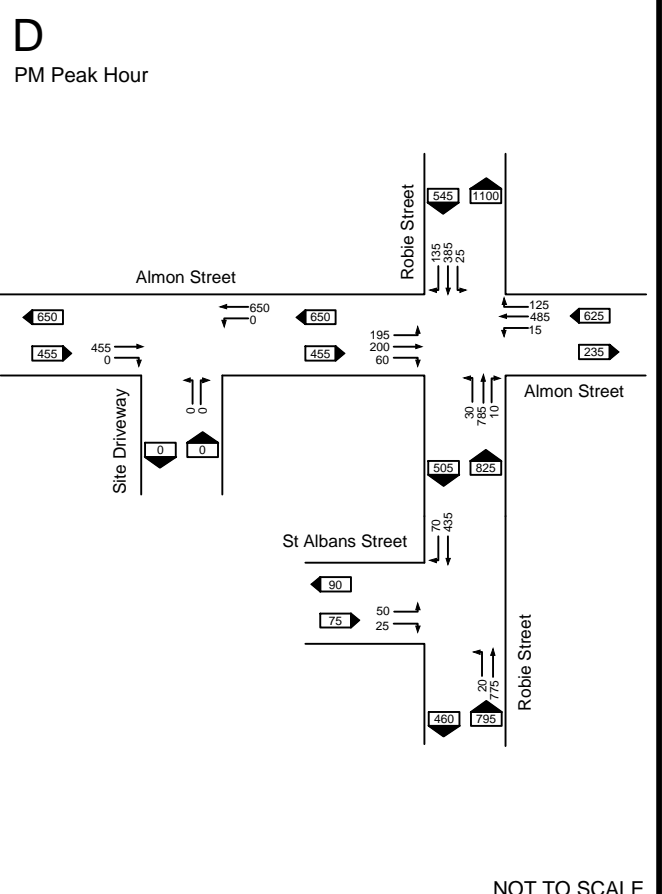
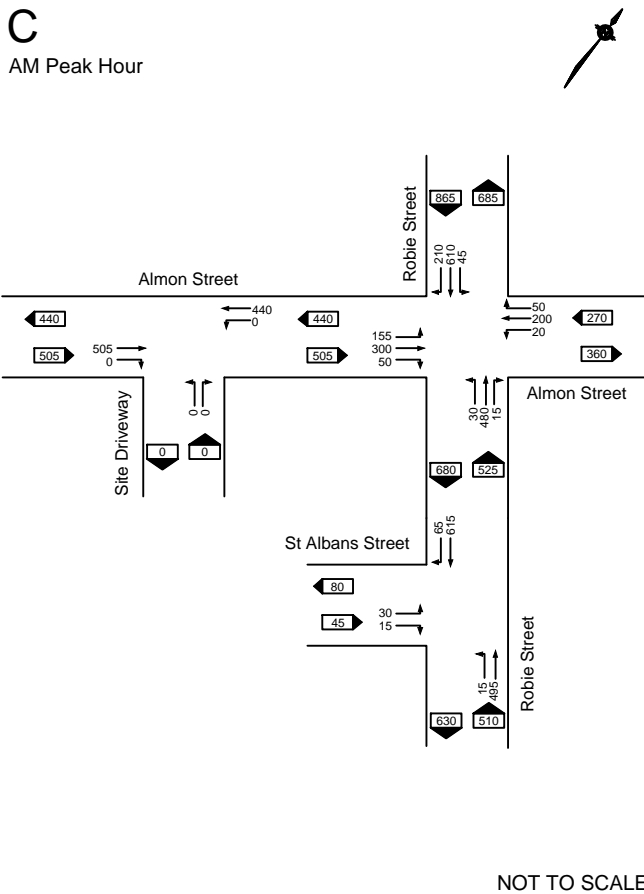
Time	Robie Street Northbound Approach		Robie Street Southbound Approach		St Albans Street Eastbound Approach		Total Vehicles
	A	B	H	I	J	L	
15:30 15:45	5	173	118	19	11	9	335
15:45 16:00	3	187	112	15	11	4	332
16:00 16:15	8	206	129	18	15	9	385
16:15 16:30	5	192	120	16	10	2	345
16:30 16:45	2	191	93	8	18	5	317
16:45 17:00	4	182	128	6	12	4	336
17:00 17:15	7	187	125	5	12	2	338
17:15 17:30	3	151	102	4	4	1	265
<b>PM Peak Hour</b>	<b>21</b>	<b>758</b>	<b>479</b>	<b>68</b>	<b>47</b>	<b>24</b>	<b>1397</b>
<b>15:30 16:30</b>	<b>21</b>	<b>758</b>	<b>479</b>	<b>68</b>	<b>47</b>	<b>24</b>	<b>1397</b>
<b>16:30 17:30</b>	<b>16</b>	<b>711</b>	<b>448</b>	<b>23</b>	<b>46</b>	<b>12</b>	<b>1256</b>

\* Count completed by HRM Traffic Management

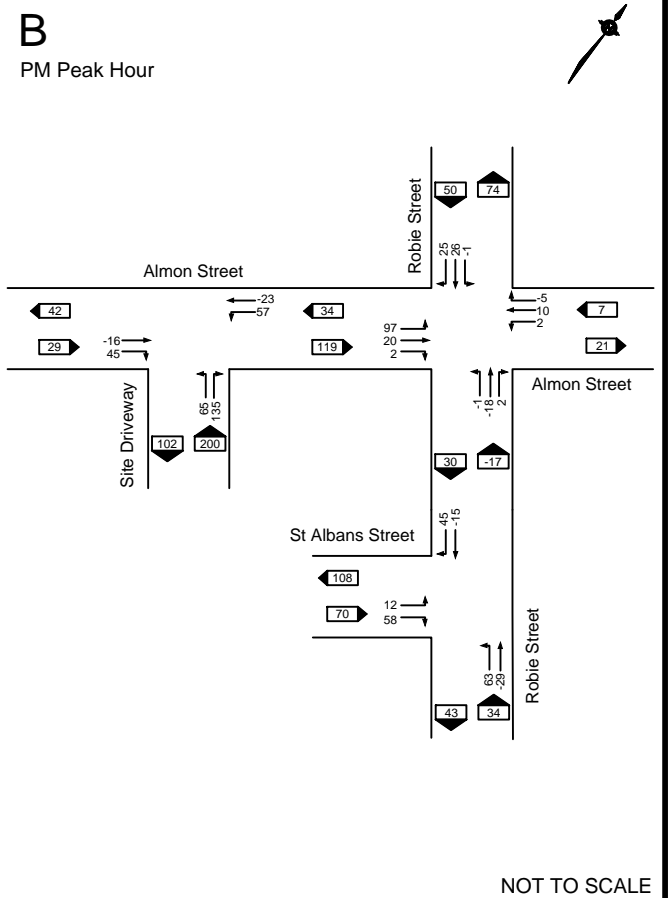
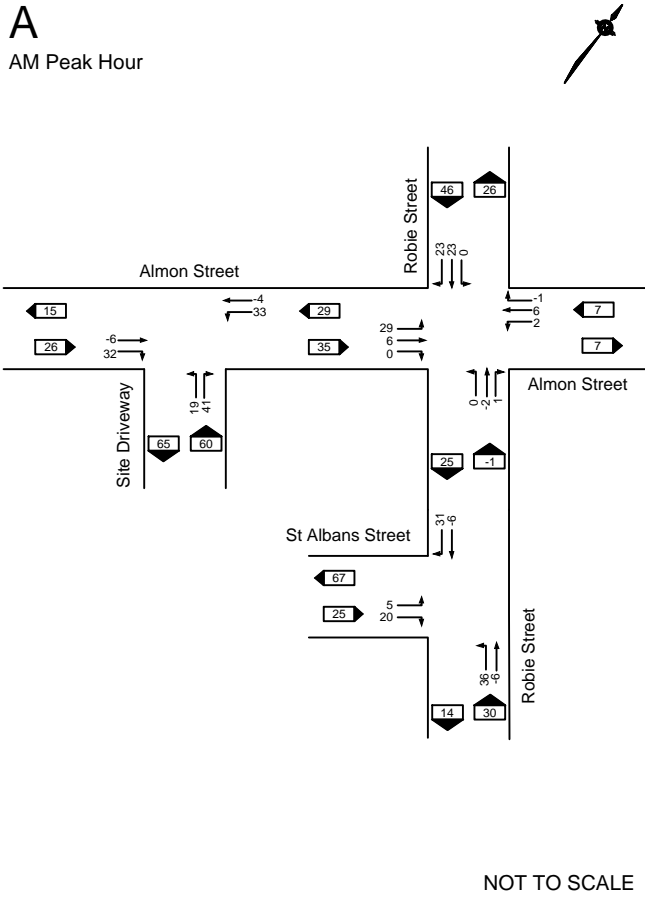
2016 AM and PM Peak Hour  
Background Volumes Without Site Development



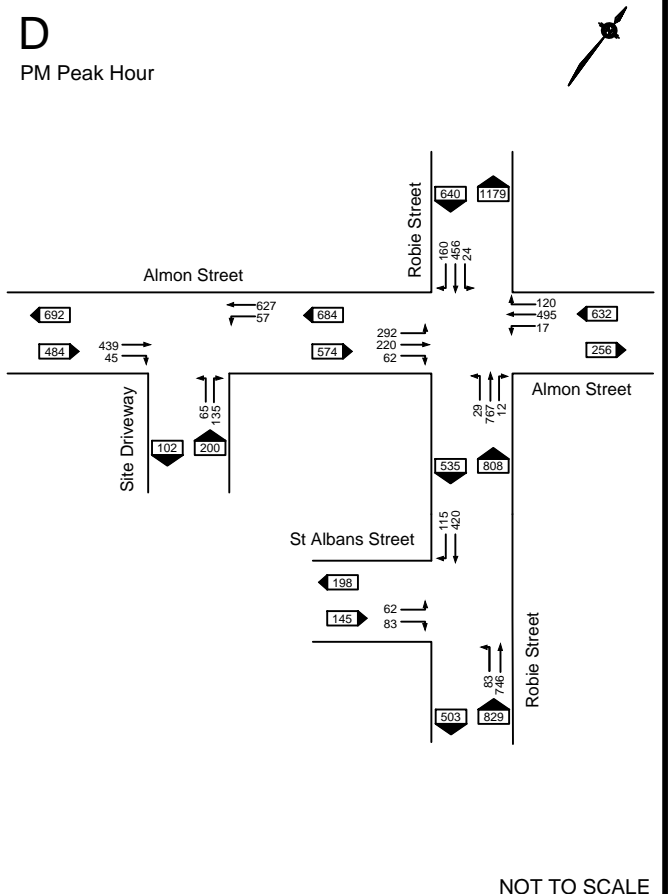
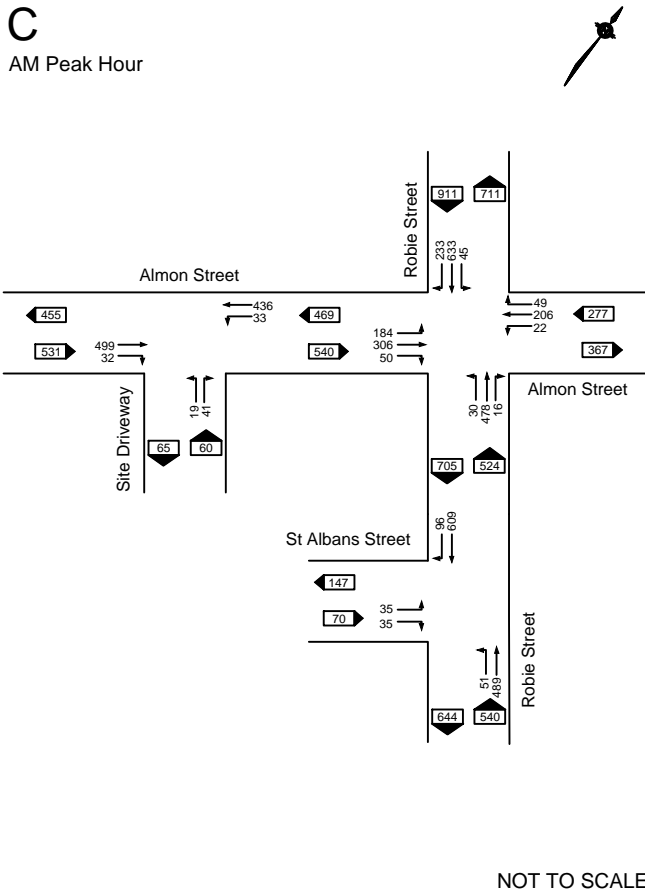
2019 AM and PM Peak Hour  
Background Volumes Without Site Development



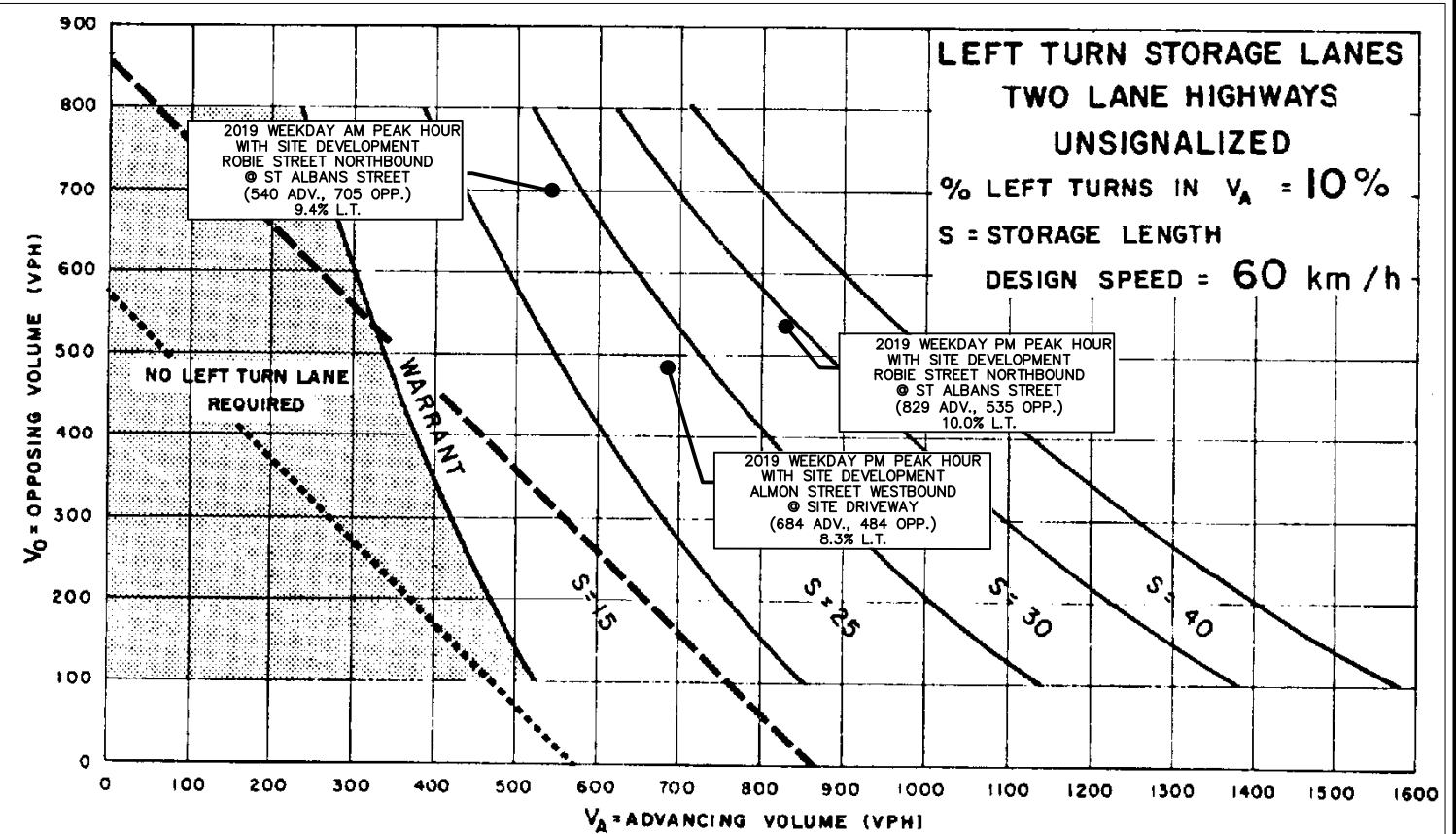
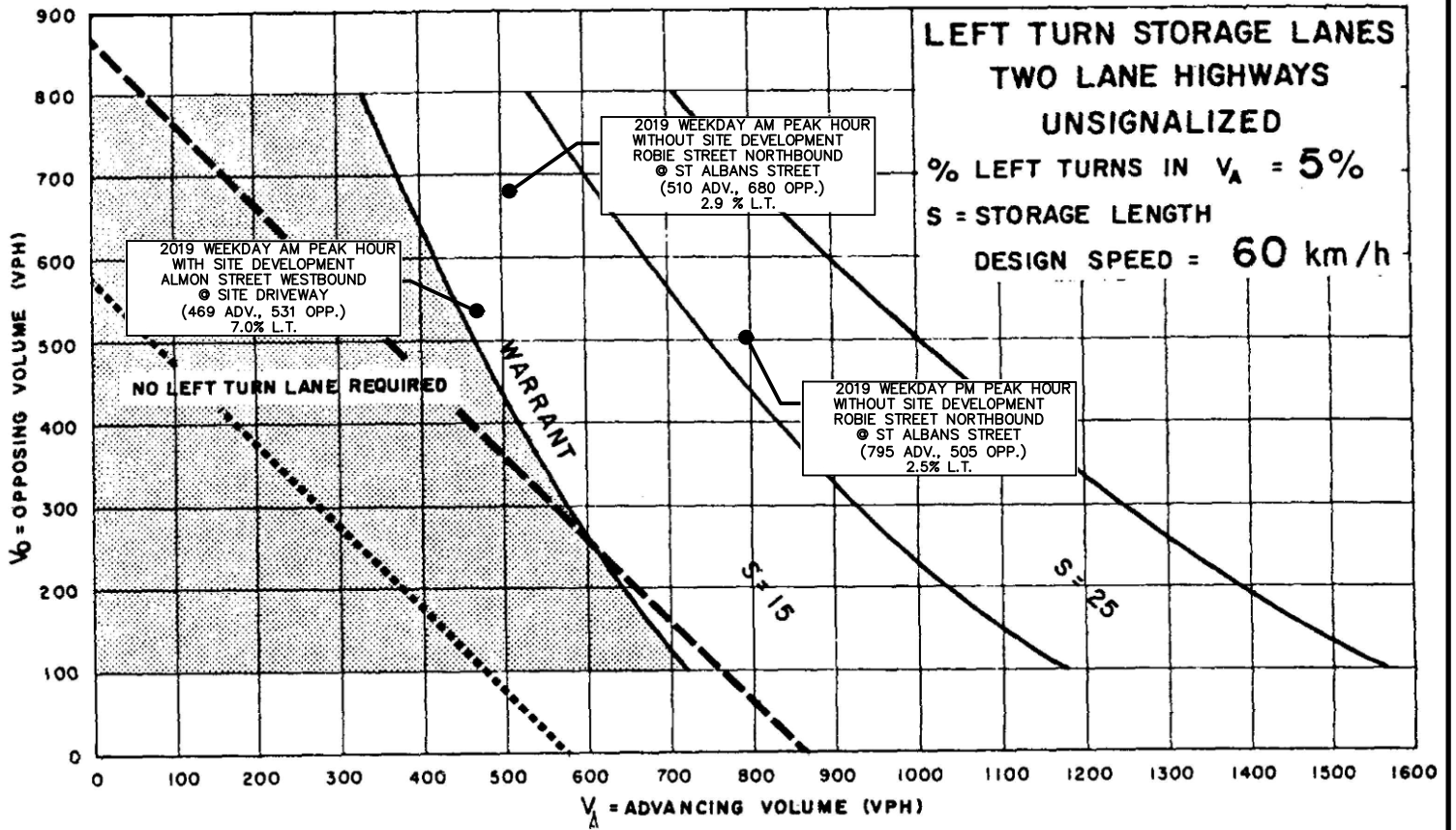
Estimated Site Generated Trips



2019 AM and PM Peak Hour Background Traffic  
with Added Site Generated Trips




























## **Appendix B**

### **Intersection Performance Analyses**

# Midtown North Traffic Impact Study

## 1: Robie Street & Almon Street

Page B-1  
2019 AM Future Background





												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					 			 				
Traffic Volume (vph)	155	300	50	20	200	50	30	480	15	45	610	210
Future Volume (vph)	155	300	50	20	200	50	30	480	15	45	610	210
Satd. Flow (prot)	1789	1829	0	0	3425	0	0	3549	0	1789	1883	1601
Flt Permitted	0.573				0.906			0.875		0.431		
Satd. Flow (perm)	1043	1829	0	0	3112	0	0	3111	0	802	1883	1463
Satd. Flow (RTOR)		10			32			5				228
Lane Group Flow (vph)	168	380	0	0	293	0	0	571	0	49	663	228
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	Perm
Protected Phases		8			4			6			2	
Permitted Phases	8			4			6			2		2
Total Split (s)	36.2	36.2		36.2	36.2		53.8	53.8		53.8	53.8	53.8
Total Lost Time (s)	6.2	6.2			6.2			5.8		5.8	5.8	5.8
Act Effct Green (s)	19.0	19.0			19.0			29.8		29.8	29.8	29.8
Actuated g/C Ratio	0.31	0.31			0.31			0.48		0.48	0.48	0.48
v/c Ratio	0.53	0.67			0.30			0.38		0.13	0.73	0.28
Control Delay	27.2	26.5			16.8			11.1		10.7	18.9	2.6
Queue Delay	0.0	0.0			0.0			0.0		0.0	0.0	0.0
Total Delay	27.2	26.5			16.8			11.1		10.7	18.9	2.6
LOS	C	C			B			B		B	B	A
Approach Delay		26.7			16.8			11.1			14.5	
Approach LOS		C			B			B			B	
Queue Length 50th (m)	15.0	34.9			11.2			19.0		2.7	53.4	0.0
Queue Length 95th (m)	42.2	82.1			27.0			38.4		9.7	114.7	9.8
Internal Link Dist (m)		62.6			24.3			46.1			173.6	
Turn Bay Length (m)										45.0		
Base Capacity (vph)	555	979			1672			2474		637	1497	1210
Starvation Cap Reductn	0	0			0			0		0	0	0
Spillback Cap Reductn	0	0			0			0		0	0	0
Storage Cap Reductn	0	0			0			0		0	0	0
Reduced v/c Ratio	0.30	0.39			0.18			0.23		0.08	0.44	0.19

### Intersection Summary

Cycle Length: 90  
Actuated Cycle Length: 62  
Control Type: Semi Act-Uncoord  
Maximum v/c Ratio: 0.73  
Intersection Signal Delay: 16.8  
Intersection Capacity Utilization 90.7%  
Analysis Period (min) 15











Intersection LOS: B  
ICU Level of Service E

Splits and Phases: 1: Robie Street & Almon Street

 Ø2	 Ø4
53.8 s	36.2 s
 Ø6	 Ø8
53.8 s	36.2 s

# Midtown North Traffic Impact Study




















## 2: Robie Street & St Albans Street

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	30	15	15	495	615	65
Future Volume (Veh/h)	30	15	15	495	615	65
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	33	16	16	538	668	71
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (m)					150	
pX, platoon unblocked	0.69	0.69	0.69			
vC, conflicting volume	1274	704	739			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1173	350	401			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	77	97	98			
cM capacity (veh/h)	144	480	802			
Direction, Lane #	EB 1	NB 1	NB 2	SB 1		
Volume Total	49	16	538	739		
Volume Left	33	16	0	0		
Volume Right	16	0	0	71		
cSH	187	802	1700	1700		
Volume to Capacity	0.26	0.02	0.32	0.43		
Queue Length 95th (m)	7.7	0.5	0.0	0.0		
Control Delay (s)	31.0	9.6	0.0	0.0		
Lane LOS	D	A				
Approach Delay (s)	31.0	0.3		0.0		
Approach LOS	D					
Intersection Summary						
Average Delay			1.2			
Intersection Capacity Utilization			46.3%	ICU Level of Service		A
Analysis Period (min)			15			

# Midtown North Traffic Impact Study

## 1: Robie Street & Almon Street

Page B-3  
2019 PM Future Background

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	195	200	60	15	485	125	30	785	10	25	430	135
Future Volume (vph)	195	200	60	15	485	125	30	785	10	25	430	135
Satd. Flow (prot)	1789	1793	0	0	3421	0	0	3562	0	1789	1883	1601
Flt Permitted	0.222				0.943			0.916		0.212		
Satd. Flow (perm)	412	1793	0	0	3227	0	0	3265	0	396	1883	1451
Satd. Flow (RTOR)		19			32			2				147
Lane Group Flow (vph)	212	282	0	0	679	0	0	897	0	27	467	147
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	Perm
Protected Phases	3	8			4			6			2	
Permitted Phases	8			4			6			2		2
Total Split (s)	13.0	49.2		36.2	36.2		50.8	50.8		50.8	50.8	50.8
Total Lost Time (s)	4.0	6.2			6.2			5.8		5.8	5.8	5.8
Act Effct Green (s)	41.3	39.1			26.2			37.1		37.1	37.1	37.1
Actuated g/C Ratio	0.47	0.44			0.30			0.42		0.42	0.42	0.42
v/c Ratio	0.64	0.35			0.69			0.65		0.16	0.59	0.21
Control Delay	24.5	16.7			30.5			23.3		19.6	23.7	3.8
Queue Delay	0.0	0.0			0.0			0.0		0.0	0.0	0.0
Total Delay	24.5	16.7			30.5			23.3		19.6	23.7	3.8
LOS	C	B			C			C		B	C	A
Approach Delay		20.0			30.5			23.3			18.9	
Approach LOS		C			C			C			B	
Queue Length 50th (m)	20.2	27.4			49.7			60.3		2.7	57.6	0.0
Queue Length 95th (m)	#37.8	49.9			74.0			87.4		9.0	94.7	10.5
Internal Link Dist (m)		62.6			24.3			46.1			173.6	
Turn Bay Length (m)										45.0		
Base Capacity (vph)	333	885			1120			1669		202	962	813
Starvation Cap Reductn	0	0			0			0		0	0	0
Spillback Cap Reductn	0	0			0			0		0	0	0
Storage Cap Reductn	0	0			0			0		0	0	0
Reduced v/c Ratio	0.64	0.32			0.61			0.54		0.13	0.49	0.18

### Intersection Summary

Cycle Length: 100

Actuated Cycle Length: 88.2

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.69

Intersection Signal Delay: 23.5

Intersection Capacity Utilization 100.8%

Analysis Period (min) 15






# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Intersection LOS: C

ICU Level of Service G











Splits and Phases: 1: Robie Street & Almon Street

		
Ø2	Ø3	Ø4
50.8 s	13 s	36.2 s
		
Ø6	Ø8	
50.8 s	49.2 s	

# Midtown North Traffic Impact Study

## 2: Robie Street & St Albans Street

Page B-4  
2019 PM Future Background




















						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	50	25	20	775	435	70
Future Volume (Veh/h)	50	25	20	775	435	70
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)	54	27	22	842	473	76
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (m)					150	
pX, platoon unblocked	0.80	0.80	0.80			
vC, conflicting volume	1397	511	549			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1371	265	312			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	57	96	98			
cM capacity (veh/h)	126	620	999			
Direction, Lane #	EB 1	NB 1	NB 2	SB 1		
Volume Total	81	22	842	549		
Volume Left	54	22	0	0		
Volume Right	27	0	0	76		
cSH	172	999	1700	1700		
Volume to Capacity	0.47	0.02	0.50	0.32		
Queue Length 95th (m)	17.0	0.5	0.0	0.0		
Control Delay (s)	43.4	8.7	0.0	0.0		
Lane LOS	E	A				
Approach Delay (s)	43.4	0.2		0.0		
Approach LOS	E					
Intersection Summary						
Average Delay			2.5			
Intersection Capacity Utilization			51.8%	ICU Level of Service		A
Analysis Period (min)			15			



# Midtown North Traffic Impact Study

## 1: Robie Street & Almon Street

Page B-5  
2019 AM Peak Hour with Site Generated Trips





												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	184	306	50	22	206	49	30	478	16	45	633	233
Future Volume (vph)	184	306	50	22	206	49	30	478	16	45	633	233
Satd. Flow (prot)	1789	1831	0	0	3439	0	0	3549	0	1789	1883	1601
Flt Permitted	0.568				0.900			0.856		0.414		
Satd. Flow (perm)	1040	1831	0	0	3104	0	0	3045	0	772	1883	1489
Satd. Flow (RTOR)		10			30			5				253
Lane Group Flow (vph)	200	387	0	0	301	0	0	570	0	49	688	253
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	Perm
Protected Phases		8			4			6			2	
Permitted Phases	8			4			6			2		2
Total Split (s)	36.2	36.2		36.2	36.2		53.8	53.8		53.8	53.8	53.8
Total Lost Time (s)	6.2	6.2			6.2			5.8		5.8	5.8	5.8
Act Effct Green (s)	30.0	30.0			30.0			48.0		48.0	48.0	48.0
Actuated g/C Ratio	0.33	0.33			0.33			0.53		0.53	0.53	0.53
v/c Ratio	0.58	0.63			0.29			0.35		0.12	0.69	0.28
Control Delay	32.8	30.0			20.7			12.7		11.5	19.9	2.3
Queue Delay	0.0	0.0			0.0			0.0		0.0	0.0	0.0
Total Delay	32.8	30.0			20.7			12.7		11.5	19.9	2.3
LOS	C	C			C			B		B	B	A
Approach Delay		30.9			20.7			12.7			15.0	
Approach LOS		C			C			B			B	
Queue Length 50th (m)	28.2	54.3			17.8			27.7		4.0	82.4	0.0
Queue Length 95th (m)	50.9	83.9			27.9			38.4		9.8	121.7	10.2
Internal Link Dist (m)		62.6			24.3			46.1			173.6	
Turn Bay Length (m)										45.0		
Base Capacity (vph)	346	617			1054			1626		411	1004	912
Starvation Cap Reductn	0	0			0			0		0	0	0
Spillback Cap Reductn	0	0			0			0		0	0	0
Storage Cap Reductn	0	0			0			0		0	0	0
Reduced v/c Ratio	0.58	0.63			0.29			0.35		0.12	0.69	0.28

### Intersection Summary

Cycle Length: 90  
Actuated Cycle Length: 90  
Control Type: Semi Act-Uncoord  
Maximum v/c Ratio: 0.69  
Intersection Signal Delay: 19.0  
Intersection Capacity Utilization 119.8%  
Analysis Period (min) 15

Intersection LOS: B  
ICU Level of Service H











Splits and Phases: 1: Robie Street & Almon Street

 Ø2	 Ø4
53.8 s	36.2 s
 Ø6	 Ø8
53.8 s	36.2 s

# Midtown North Traffic Impact Study

## 2: Robie Street & St Albans Street












Page B-6  
2019 AM Peak Hour with Site Generated Trips

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	35	35	51	489	609	96
Future Volume (Veh/h)	35	35	51	489	609	96
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)	38	38	55	532	662	104
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (m)					150	
pX, platoon unblocked	0.71	0.71	0.71			
vC, conflicting volume	1356	714	766			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1297	390	464			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	68	92	93			
cM capacity (veh/h)	118	466	777			
Direction, Lane #	EB 1	NB 1	NB 2	SB 1		
Volume Total	76	55	532	766		
Volume Left	38	55	0	0		
Volume Right	38	0	0	104		
cSH	188	777	1700	1700		
Volume to Capacity	0.40	0.07	0.31	0.45		
Queue Length 95th (m)	13.7	1.7	0.0	0.0		
Control Delay (s)	36.6	10.0	0.0	0.0		
Lane LOS	E	A				
Approach Delay (s)	36.6	0.9		0.0		
Approach LOS	E					
Intersection Summary						
Average Delay			2.3			
Intersection Capacity Utilization			53.1%	ICU Level of Service		A
Analysis Period (min)			15			

# Midtown North Traffic Impact Study

## 3: Site Driveway & Almon Street



























Page B-7  
2019 AM Peak Hour with Site Generated Trips

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	499	32	33	436	19	41
Future Volume (Veh/h)	499	32	33	436	19	41
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	542	35	36	474	21	45
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)				154		
pX, platoon unblocked					0.93	
vC, conflicting volume			577		1106	560
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			577		1075	560
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			96		90	91
cM capacity (veh/h)			996		217	528
Direction, Lane #	EB 1	WB 1	WB 2	NB 1	NB 2	
Volume Total	577	36	474	21	45	
Volume Left	0	36	0	21	0	
Volume Right	35	0	0	0	45	
cSH	1700	996	1700	217	528	
Volume to Capacity	0.34	0.04	0.28	0.10	0.09	
Queue Length 95th (m)	0.0	0.9	0.0	2.4	2.1	
Control Delay (s)	0.0	8.7	0.0	23.3	12.4	
Lane LOS		A		C	B	
Approach Delay (s)	0.0	0.6		15.9		
Approach LOS				C		
Intersection Summary						
Average Delay			1.2			
Intersection Capacity Utilization			38.2%		ICU Level of Service	A
Analysis Period (min)			15			

# Midtown North Traffic Impact Study

## 1: Robie Street & Almon Street

Page B-8  
2019 PM Peak Hour With Site Generated Trips

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					  			  			 	  
Traffic Volume (vph)	292	220	62	17	495	120	29	767	12	24	456	160
Future Volume (vph)	292	220	62	17	495	120	29	767	12	24	456	160
Satd. Flow (prot)	1789	1798	0	0	3431	0	0	3562	0	1789	1883	1601
Flt Permitted	0.219				0.940			0.898		0.219		
Satd. Flow (perm)	406	1798	0	0	3226	0	0	3203	0	409	1883	1511
Satd. Flow (RTOR)		18			29			2				174
Lane Group Flow (vph)	317	306	0	0	686	0	0	879	0	26	496	174
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	Perm
Protected Phases	3	8			4			6			2	
Permitted Phases	8			4			6			2		2
Total Split (s)	13.0	49.2		36.2	36.2		50.8	50.8		50.8	50.8	50.8
Total Lost Time (s)	4.0	6.2			6.2			5.8		5.8	5.8	5.8
Act Effct Green (s)	41.5	39.3			26.3			37.0		37.0	37.0	37.0
Actuated g/C Ratio	0.47	0.45			0.30			0.42		0.42	0.42	0.42
v/c Ratio	0.96	0.38			0.70			0.65		0.15	0.63	0.24
Control Delay	60.2	17.1			30.9			23.5		19.2	24.8	3.6
Queue Delay	0.0	0.0			0.0			0.0		0.0	0.0	0.0
Total Delay	60.2	17.1			30.9			23.5		19.2	24.8	3.6
LOS	E	B			C			C		B	C	A
Approach Delay		39.0			30.9			23.5			19.3	
Approach LOS		D			C			C			B	
Queue Length 50th (m)	32.4	30.5			50.7			59.1		2.6	62.6	0.0
Queue Length 95th (m)	#86.1	54.1			74.6			86.1		8.6	102.3	11.3
Internal Link Dist (m)		62.6			24.3			46.1			173.6	
Turn Bay Length (m)										45.0		
Base Capacity (vph)	331	886			1117			1635		209	961	856
Starvation Cap Reductn	0	0			0			0		0	0	0
Spillback Cap Reductn	0	0			0			0		0	0	0
Storage Cap Reductn	0	0			0			0		0	0	0
Reduced v/c Ratio	0.96	0.35			0.61			0.54		0.12	0.52	0.20

### Intersection Summary

Cycle Length: 100

Actuated Cycle Length: 88.3

Control Type: Semi Act-Uncoord

Maximum v/c Ratio: 0.96

Intersection Signal Delay: 27.6

Intersection Capacity Utilization 99.6%

Analysis Period (min) 15






# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Intersection LOS: C

ICU Level of Service F











Splits and Phases: 1: Robie Street & Almon Street

		
Ø2	Ø3	Ø4
50.8 s	13 s	36.2 s
		
Ø6	Ø8	
50.8 s	49.2 s	

# Midtown North Traffic Impact Study

## 2: Robie Street & St Albans Street












Page B-9  
2019 PM Peak Hour With Site Generated Trips

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	62	83	83	746	420	115
Future Volume (Veh/h)	62	83	83	746	420	115
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)	67	90	90	811	457	125
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (m)					150	
pX, platoon unblocked		0.78	0.78			
vC, conflicting volume	1510	520	582			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1513	247	327			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	28	85	91			
cM capacity (veh/h)	94	620	965			
Direction, Lane #	EB 1	NB 1	NB 2	SB 1		
Volume Total	157	90	811	582		
Volume Left	67	90	0	0		
Volume Right	90	0	0	125		
cSH	182	965	1700	1700		
Volume to Capacity	0.86	0.09	0.48	0.34		
Queue Length 95th (m)	47.5	2.3	0.0	0.0		
Control Delay (s)	86.5	9.1	0.0	0.0		
Lane LOS	F	A				
Approach Delay (s)	86.5	0.9		0.0		
Approach LOS	F					
Intersection Summary						
Average Delay			8.8			
Intersection Capacity Utilization			54.5%	ICU Level of Service		A
Analysis Period (min)			15			

# Midtown North Traffic Impact Study

## 3: Site Driveway & Almon Street

Page B-10  
2019 PM Peak Hour With Site Generated Trips










						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	439	45	57	627	65	135
Future Volume (Veh/h)	439	45	57	627	65	135
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	477	49	62	682	71	147
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)				154		
pX, platoon unblocked					0.79	
vC, conflicting volume			526		1308	502
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			526		1257	502
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			94		49	74
cM capacity (veh/h)			1041		141	570
Direction, Lane #	EB 1	WB 1	WB 2	NB 1	NB 2	
Volume Total	526	62	682	71	147	
Volume Left	0	62	0	71	0	
Volume Right	49	0	0	0	147	
cSH	1700	1041	1700	141	570	
Volume to Capacity	0.31	0.06	0.40	0.51	0.26	
Queue Length 95th (m)	0.0	1.4	0.0	18.2	7.8	
Control Delay (s)	0.0	8.7	0.0	54.2	13.5	
Lane LOS		A		F	B	
Approach Delay (s)	0.0	0.7		26.8		
Approach LOS				D		
Intersection Summary						
Average Delay			4.3			
Intersection Capacity Utilization			43.3%	ICU Level of Service		A
Analysis Period (min)			15			



# Midtown North Traffic Impact Study

## 2: Robie Street & St Albans Street










Page B-11  
2019 AM Future Background - no NBL Robie Street

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	30	15	15	495	615	65
Future Volume (Veh/h)	30	15	15	495	615	65
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	33	16	16	538	668	71
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (m)					150	
pX, platoon unblocked	0.69	0.69	0.69			
vC, conflicting volume	1274	704	739			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1173	350	401			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	77	97	98			
cM capacity (veh/h)	144	480	802			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	49	554	739			
Volume Left	33	16	0			
Volume Right	16	0	71			
cSH	187	802	1700			
Volume to Capacity	0.26	0.02	0.43			
Queue Length 95th (m)	7.7	0.5	0.0			
Control Delay (s)	31.0	0.5	0.0			
Lane LOS	D	A				
Approach Delay (s)	31.0	0.5	0.0			
Approach LOS	D					
Intersection Summary						
Average Delay			1.4			
Intersection Capacity Utilization			48.1%	ICU Level of Service		A
Analysis Period (min)			15			

# Midtown North Traffic Impact Study

## 2: Robie Street & St Albans Street

Page B-12  
2019 PM Future Background - no NBL Robie Street










						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	50	25	20	775	435	70
Future Volume (Veh/h)	50	25	20	775	435	70
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)	54	27	22	842	473	76
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (m)					150	
pX, platoon unblocked	0.80	0.80	0.80			
vC, conflicting volume	1397	511	549			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1371	265	312			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	57	96	98			
cM capacity (veh/h)	126	620	999			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	81	864	549			
Volume Left	54	22	0			
Volume Right	27	0	76			
cSH	172	999	1700			
Volume to Capacity	0.47	0.02	0.32			
Queue Length 95th (m)	17.0	0.5	0.0			
Control Delay (s)	43.4	0.6	0.0			
Lane LOS	E	A				
Approach Delay (s)	43.4	0.6	0.0			
Approach LOS	E					
Intersection Summary						
Average Delay			2.7			
Intersection Capacity Utilization			67.8%	ICU Level of Service		C
Analysis Period (min)			15			

# Midtown North Traffic Impact Study

## 2: Robie Street & St Albans Street

Page B-13

2019 AM Peak Hour with Site Generated Trips - no NBL Robie Street










						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	35	35	51	489	609	96
Future Volume (Veh/h)	35	35	51	489	609	96
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)	38	38	55	532	662	104
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (m)					150	
pX, platoon unblocked	0.71	0.71	0.71			
vC, conflicting volume	1356	714	766			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1297	390	464			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	68	92	93			
cM capacity (veh/h)	118	466	777			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	76	587	766			
Volume Left	38	55	0			
Volume Right	38	0	104			
cSH	188	777	1700			
Volume to Capacity	0.40	0.07	0.45			
Queue Length 95th (m)	13.7	1.7	0.0			
Control Delay (s)	36.6	1.9	0.0			
Lane LOS	E	A				
Approach Delay (s)	36.6	1.9	0.0			
Approach LOS	E					
Intersection Summary						
Average Delay			2.7			
Intersection Capacity Utilization			79.0%	ICU Level of Service		D
Analysis Period (min)			15			

# Midtown North Traffic Impact Study

## 2: Robie Street & St Albans Street

Page B-14

2019 PM Peak Hour With Site Generated Trips - no NBL Robie Street

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	62	83	83	746	420	115
Future Volume (Veh/h)	62	83	83	746	420	115
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)	67	90	90	811	457	125
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (m)					150	
pX, platoon unblocked		0.78	0.78			
vC, conflicting volume	1510	520	582			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1513	247	327			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	28	85	91			
cM capacity (veh/h)	94	620	965			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	157	901	582			
Volume Left	67	90	0			
Volume Right	90	0	125			
cSH	182	965	1700			
Volume to Capacity	0.86	0.09	0.34			
Queue Length 95th (m)	47.5	2.3	0.0			
Control Delay (s)	86.5	2.4	0.0			
Lane LOS	F	A				
Approach Delay (s)	86.5	2.4	0.0			
Approach LOS	F					
Intersection Summary						
Average Delay			9.6			
Intersection Capacity Utilization			91.5%	ICU Level of Service		F
Analysis Period (min)			15			