HALIFAX

P.O. Box 1749
Halifax, Nova Scotia
B3J 3A5 Canada

Item No. 11.2
Transportation Standing Committee of Council
December 8, 2016

TO: Chair and Members of Transportation Standing Committee

Original Signed

SUBMITTED BY: ____

Dave Reage, MCIP, LPP, Director, Halifax Transit

Original Signed

SUBMITTED BY: ____

Bruce Zvaniga, P.Eng. Director, Transportation & Public Works

DATE: October 11, 2016

SUBJECT: **Responsibility for Transit Priority Measures**

INFORMATION REPORT

ORIGIN

At the June 14, 2016 meeting of the Transportation Standing Committee, the following motion was approved:

> That the Transportation Standing Committee request a staff report outlining a) The possible transfer of responsibility for Transit Priority Measures (TPM) funding from Halifax Transit to Transportation & Public Works b) A plan to implement the full list of proposed TPM's listed in the Staff Report dated April 18, 2016 during the 2017/18 fiscal year And that this report shall be returned to the committee in sufficient time that it may be considered as a proposal for possible inclusion in the 2017/18 capital budget.

LEGISLATIVE AUTHORITY

Section 69(1) of the Halifax Regional Municipality Charter provides the legislative authority for the municipality to provide a public transportation service. Section 79(1)(o) provides the authority for Council to expend money required by the municipality for public transportation services.

BACKGROUND

Transit Priority Measures (TPMs) are interventions that provide transit vehicles with a competitive time advantage over private vehicles. TPMs can be physical, or policy related, obvious, or subtle, but all work to increase the reliability of transit vehicles by reducing the impact of traffic congestion on transit.

Evaluating and recommending Transit Priority Measures that will have the greatest benefit on the regional transportation system and mobility patterns is carried out jointly by Halifax Transit and Planning and Development Services. Implementing measures is then carried out by either Halifax Transit or Transportation and Public Works as discussed below.

There are a number of TPMs currently in place in Halifax. The majority of the existing TPMs were installed as part of the MetroLink service launch in 2005/2006, and are located on Windmill Road or Portland Street. Other examples of TPMs include the bus only lane entering the Bridge Terminal on Wyse Road, and the entrance to the Fairview Overpass at the end of Main Avenue that can only be utilized by buses. In 2015, a *Transit Priority Measures Study* (Attachment A) was completed, and brought forward to the Transportation Standing Committee in a staff report dated April 18, 2016. The purpose of this study was to develop evaluation criteria for assessing TPMs, and evaluate a short roster of 13 TPMs against the criteria to determine the costs and benefits.

DISCUSSION

a) The possible transfer of responsibility for Transit Priority Measures (TPM) funding from Halifax Transit to Transportation & Public Works

TPMs can vary widely, in physical appearance, cost, and benefits to different road users. In addition to increasing the reliability for transit vehicles, some interventions, such as queue jump lanes, can generally improve the flow of traffic and also provide a measurable benefit for private vehicles. As such, TPMs could be funded as Halifax Transit projects, or as part of roadway or signalization improvements under Transportation & Public Works.

In the past, funding for TPM related initiatives in the municipality has come from a number of sources, based on relationships to other initiatives, and available funds. For example, the *Transit Priority Measures Study* (Attachment A) completed in 2015 was funded by the Planning & Development business unit, with cost sharing by the Province of Nova Scotia's Connect2 program. However, the initial funding for implementation of the measures identified in that study was contained in the 2016/17 Halifax Transit budget. The decision to fund TPM implementation from the Halifax Transit budget was largely due to budget availability, to ensure that the implementation could commence in a timely manner. Implementation of the TPMs is a shared responsibility between Halifax Transit and Transportation & Public Works, as expertise in transit, traffic management, engineering, street design, and construction are all critical components.

It is important to maintain flexibility in the funding source for TPMs. This can allow TPMs to be integrated into initiatives throughout municipal business units. In addition, the TPMs scheduled for implementation in 2016/17 are relatively minor, but it is anticipated that more significant measures will be proposed through the Integrated Mobility Plan and other strategic planning initiatives in the future. The flexibility to fund more significant and costly projects through multiple budgets or reserve accounts may be essential to allow the projects to proceed, and/or permit the flexibility to leverage other sources of funding.

For the fiscal year 2017/18, Halifax Transit has been approved for funding under the Federal Public Transit Infrastructure Fund (PTIF), to cost share both the implementation of TPMs, and to conduct a study related to the development of TPM corridors.

b) A plan to implement the full list of proposed TPM's listed in the Staff Report dated April 18, 2016 during the 2017/18 fiscal year

The *Transit Priority Measures Study* (Attachment A) brought forward to the Transportation Standing Committee in the staff report dated April 18, 2016 included a potential five year implementation plan for the 13 TPMs evaluated.

The 2016/17 Halifax Transit budget included sufficient funding to implement one to three of the TPMs proposed in the study (depending on costs once tendered). However, the municipality also submitted the implementation of TPMs over two years as potential projects for PTIF cost sharing. In August 2016, this funding was approved, as shown in the table below. This additional funding will allow for expedited implementation of the TPMs identified in the report, as all of the necessary funding will be available by fiscal 2017/18.

Transit Priority Measures Implementation Project Account: CM000009			
Year	Halifax Transit Funding	PTIF Funding	Total Funding
2016/17	$200,000	$200,000	$400,000
2017/18	$450,000	$450,000	$900,000

Although it is anticipated that funding will be sufficient to implement all of the TPMs identified in the study by 2017/18 (subject to any unforeseen costs), there are other factors that could impact timelines and project delivery. These include obtaining necessary approvals, and acquiring land. The complete list of TPMs evaluated in the study, along with the implementation status and risk factors are described below.

Transit Priority Measures Implementation			
Location	**Description**	**Implementation Status**	**Risks**
Main Street at Hartlen Avenue	Allow northbound buses to turn left from right turn lane onto Main Street.	This TPM was implemented in December 2015.	None.
Robie Street at Almon Street	Install transit only signal to allow southbound buses to proceed straight from right turn lane.	This TPM has approval from all necessary bodies and is scheduled to be implemented in November 2016.	Implementation scheduled for November 2016. There is a very low level of risk that this will not be completed.
Cobequid Terminal at Cobequid Road	Install left turn only phase at traffic signals to allow vehicles to exit the Cobequid Terminal.	Tentatively scheduled for implementation in 2017/18.	This is considered low risk.
Windmill Road at Seapoint Road (southbound)	Widen road and create southbound queue jump lane	Detailed design work is complete. Completion of land assembling requirements is pending.	Requires completion of land assembly, considered low/medium risk.
Windmill Road at Victoria Road (northbound)	Widen road and create northbound queue jump lane	The detailed design work is scheduled to be complete this winter, allowing for construction in 2017/18.	Requires approval from Halifax Harbour Bridges related to overhead signage, considered low/medium risk.
Windmill Road at Akerley Boulevard	Create southbound transit only lane at traffic signal	Tentatively scheduled for construction in 2017/18.	This is considered medium risk.
Mumford Road at Chebucto Road	Reconfigure lanes and provide transit only signal to allow buses to turn left from right turn lane	Tentatively scheduled for implementation in 2017/18,	This is considered medium risk.

Chebucto Road at Connaught Avenue	Provide queue jump lane for eastbound buses.	Tentatively scheduled for implementation in 2017/18.	This is considered medium risk.
Portland Street at Woodlawn Road	Extend existing transit only lane	Scheduled for implementation in 2017/18, but may be complicated by the need to relocate private driveways.	Implementation may have a negative impact on general vehicle traffic. This has a high risk of not being completed.
Barrington Street at Macdonald Bridge ramp	Reconfigure lanes at bridge approach to reduce merging by transit vehicles	Tentatively scheduled for construction in 2017/18.	Implementation may have a negative impact on general vehicle traffic. This initiative would benefit from being integrated with the bikeways connection project to ensure a complete solution. This has a high risk of not being completed.
Macdonald Bridge at Wyse Road	Convert far right Halifax bound toll lane to transit only	This TPM requires cooperation and coordination with Halifax Harbour Bridges. Staff are currently conducting modelling exercises required to obtain approval.	Requires approval from Halifax Harbour Bridges. This has a high level of risk of not being completed. Alternative TPMs in this location are being considered.
Main Street at Gordon Avenue	Install transit only signal to allow eastbound buses to proceed straight from right turn lane at Gordon Avenue	The benefits of this TPM are marginal without the additional introduction of a receiving lane, which is more challenging. In addition, due to bus stop location changes, this TPM is no longer as beneficial, and will not be pursued at this time.	Deferred
Robie Street at Quinpool Road	Convert southbound curb lane to transit only lane	The study recommended this TPM be deferred until the overall intersection is reviewed; it will not be pursued at this time.	Deferred

Due to the number of risk factors involved, and the timelines required to complete some of the TPMs, it is highly unlikely that all of them will be successfully implemented in 2017/18. However, it is staff's intent to pursue each of the measures (with the exception of the two that are identified as "deferred") and advance any that are approved.

In addition to the 13 TPMs identified in the study, as part of the Integrated Mobility Plan development, staff are compiling an inventory of other possible TPMs. These come from a variety of sources, including the public, staff, Operators, etc. These TPMs will be evaluated based on the cost/benefit formulas developed in the study, and prioritized. Should any of the above measures not receive necessary approvals, and funding is sufficient, it may be possible to pursue alternative TPMs that have been identified through the Integrated Mobility Plan development.

FINANCIAL IMPLICATIONS

There are no financial implications associated with this report.

COMMUNITY ENGAGEMENT

There was no community engagement undertaken as part of this report.

ATTACHMENTS

Attachment A: *Transit Priority Measures Study* – Prepared by WSP Canada Inc., March 2016

A copy of this report can be obtained online at http://www.halifax.ca/commcoun/index.php then choose the appropriate Transportation Standing Committee meeting date, or by contacting the Office of the Municipal Clerk at 902.490.4210, or Fax 902.490.4208.

Report Prepared by: Patricia Hughes, MCIP, LPP, Manager, Planning & Scheduling, 902.490.6287

Comparison of Selected TPM Locations

Transit Priority Measures Study

Halifax Regional Municipality

March 2016

1 Spectacle Lake Drive
Dartmouth, NS
B3B 1X7
Tel: 902-835-9955
Fax: 902-835-1645
www.wspgroup.com

Project #: 151-01704

Table of Contents

Chapter	Contents	Page

1.0 Introduction

One of the main project objectives of the Halifax Transit Priority Measures Study is to evaluate a roster of opportunities for transit priority measures (TPM). Included in the RFP were proposed preliminary opportunity sites identified by HRM as providing opportunity for transit priority benefits. In addition to the seven preliminary opportunity locations, the WSP workplan recommended developing a list of five to ten additional TPM opportunity locations for further consideration. In total, a roster of 19 locations was developed including the original 7 locations from the RFP. WSP staff met with staff from HRM Strategic Transportation Planning, HRM Traffic Management, and Halifax Transit, as well as staff from the Halifax Harbour Bridges to review the roster of 19 locations. During the meeting, the 13 locations numbered in Table 1 were selected for further review and evaluation as part of this project. While the six locations listed at the bottom of Table 1 were not selected for evaluation as part of this Study, they may still offer benefits to HRM and Halifax Transit and may be further considered using the same methodology as outlined in ***Framework for Transit Priority Measure Evaluation*** (WSP, 2015).

Table 1-1 – Selected TPM

Location	Measure
1 Macdonald Bridge @ Wyse Road	Convert far right Halifax-bound toll lane (Lane 10) to Transit only.
2 Windmill Road @ Victoria Road (NB)	Widen road and provide exemption from regulation to create northbound queue jump lane.
3 Windmill Road @ Seapoint Road (SB)	Widen road and provide exemption from regulation to create southbound queue jump lane.
4 Main Street @ Gordon Avenue	Provide exemption from regulation and install transit only phase to permit eastbound buses to proceed from right turn lane at Gordon Avenue.
5 Portland Street @ Woodlawn Road	Extend transit only lane to provide additional queue jump opportunity for westbound buses.
6 Barrington Street @ Macdonald Bridge Ramp	Relocate existing bus stop and reconfigure lanes at bridge approach to reduce merging by transit vehicles.
7 Windmill Road @ Akerley Boulevard	Provide free flow (except pedestrian crossings) transit only lane for southbound buses at traffic signal. Remove southbound transit only phase.
8 Robie Street @ Almon Street	Provide exemption from regulation and install transit only phase to permit southbound buses to proceed from right turn lane at Almon Street.
9 Main Street @ Hartlen Street	Provide exemption from regulation to permit northbound buses to turn left from right turn lane at Main Street.
10 Chebucto Road @ Connaught Avenue	Provide exemption from regulation and install receiving lane for queue jump for eastbound through buses on Chebucto Road
11 Mumford Road @ Chebucto Road	Reconfigure lanes on Mumford Road between Chebucto Road and Leppert Street. Provide exemption from regulation and install transit only phase to permit southbound left turn buses to proceed from right turn lane at Chebucto Road.
12 Robie Street @ Quinpool Road	Reconfigure southbound curb lane on Robie Street as transit only lane, except right turns.
13 Cobequid Terminal @ Cobequid Road	Install eastbound protected/permitted phase for left turning vehicles leaving Cobequid Terminal.
Alderney Drive @ Wyse Road	Widen to provide queue jump lane for right turning buses on Alderney Drive to Wyse Road.
Pleasant Street @ Highway 111	Widen road to provide Transit only lane for left turns onto Highway 111 from Pleasant Street
Highway 111 Exit @ Portland Street	Permit exemption from regulation to permit right turns by buses from the stop bar from Highway 111.
Highway 102 @ North West Arm Drive	Provide exemption from regulation to permit throught movement by transit vehicles to return to Highway 102.
Thistle Street @ Wyse Road	Restrict right turns (except buses) from Thistle Street.
Bayers Road @ Desmond Avenue	Install traffic signals required by Transit

2.0 Net Road User Delay

For each TPM location, WSP obtained the most recent turning movement counts, pedestrian counts, and traffic signal timings from HRM / NSTIR for the AM and PM peak hours as well as the transit ridership and transit vehicle volume data from HRM for the peak hour that was determined to have the most impact. At each TPM location, pedestrian volumes and movements have been considered.

Methodology for determining Net Change in Road User Delay
To provide estimates for delay to Transit and non-transit vehicles, two approaches were used, depending on the TPM and its location:

1. WSP Transportation Engineering staff conducted field measurements on Tuesdays, Wednesdays and Thursdays in September and October 2015 to observe transit delay under existing conditions. Observations measured delay to transit vehicles and estimated the delay savings to each transit vehicle. This provides an estimate of change in transit delay with the implementation of the proposed TPM.
2. Traffic analysis models were developed using Synchro 9.0 with existing intersection configurations and with modified intersection geometry to simulate a transit only lane/phase conducting an otherwise restricted movement from a particular lane. A 1.5% annual growth rate was applied at all locations to obtain an estimate of projected 2016 traffic volumes.

At four of the locations being reviewed (Windmill Road @ Seapoint Road, Robie Street @ Almon Street, Hartlen Street @ Main Street, and Chebucto Road @ Connaught Avenue), there are transit vehicles that service a nearside transit stop from a right-turn only lane before changing lanes into a through or left-turn lane and proceeding along their route. It was observed that the right-turning vehicles using the lane experienced a delay while the transit vehicles serviced the transit stop and while the transit vehicles await opportunities to merge out of the right-turn only lane. In each noted TPM, the transit vehicles will be permitted to conduct their movement from the right-turn lane and will experience a reduction in delay due to the TPM and not being required to change into the through lane. This delay change will reduce the time that the transit vehicle blocks the right-turn lane and will likely reduce the average delay to right turning vehicles at these locations.

The analysis of the peak hour data supplied by HRM yielded net delay changes on per-user and net total user basis. Since many TPM locations considered offer benefits beyond the analyzed peak hour, a Daily Delay Factor is used to estimate the overall daily impact of the TPM. The Daily Delay Factor is used to estimate the daily benefit level experienced with consideration of a potential lower level of benefit during non-analyzed periods of the day. For example, a TPM may provide benefit only during an AM peak period. The analysis determines the benefit during the peak hour, however the remainder of the AM period may also experience benefits but at a reduced level per hour. In this example a Daily Delay Factor of 1.5 may be appropriate where the full benefit is experienced for one hour, and a reduced benefit for an additional hour per day.

Table 2-1 summarizes the net change in delay to Transit and Non-Transit vehicles at each of the 13 evaluated TPM locations. Reductions in delay are reported as negative values, while increases in delay as positive values. Intersection Performance Analyses are included in Appendix C.

Further discussion of the delay estimates for each TPM is included in the subsequent sections.

Table 2-1 - Delay Analysis Results

TPM Location	TPM #	Associated Peak Hour	Daily Delay Factor[1]	Peak Hour Net Transit Vehicle Delay (s/veh)[2, 3]	Peak Hour Net non-Transit Vehicle Delay (s/veh)[2]	Daily Net Transit User Delay (user.hr)	Daily Net non-Transit User Delay (user.hr)	Estimated Daily Net Road User Delay (user.hr)
Macdonald Bridge @ Wyse Road	1	AM	3	-6.3	0.0	-4.4	0.0	**-4.4**
Windmill Road @ Victoria Road (NB)	2	PM	2	-90.0	13.7	-23.4	0.1	**-23.3**
Windmill Road @ Seapoint Road (SB)	3	AM	2	-75.0	0.0	-20.0	0.0	**-20.0**
Main Street @ Gordon Avenue	4	PM	2	-64.0	14.6	-6.8	46.5	**39.7**
Portland Street @ Woodlawn Road	5	AM	2	-17.0	0.0	-3.2	0.0	**-3.2**
Barrington Street @ Macdonald Bridge Ramp	6	PM	2	-30.0	0.0	-3.4	0.0	**-3.4**
Windmill Road @ Akerley Boulevard	7	AM	3	-7.1	0.0	-2.8	0.0	**-2.8**
Robie Street @ Almon Street	8	AM	2	-18.0	0.0	-2.6	0.0	**-2.6**
Main Street @ Hartlen Street	9	AM	2	-49.0	0.0	-2.5	0.0	-2.5
		PM	2	-53.7	0.0	-4.7	0.0	-4.7
					Total	**-7.1**	**0.0**	**-7.1**
Chebucto Road @ Connaught Avenue	10	AM	2	-31.7	0.0	-6.0	0.0	**-6.0**
Mumford Road @ Chebucto Road	11	PM	2	-21.3	4.6	-5.4	5.0	**-0.4**
Robie Street @ Quinpool Road	12	AM	2	-19.0	201.5	-5.9	106.9	**101.0**
Cobequid Terminal @ Cobequid Road	13	PM	1.8	-9.3	6.3	-1.1	5.6	**4.5**

1. Represents a factor to estimate daily delay results from the peak hour.
2. As outlined in *Framework for Transit Priority Measure Evaluation* , movements with a net change in delay of less than 5 seconds are excluded from the analysis. Net Vehicle delay is the average delay change for the remaining movements.
3. Transit vehicle delay was estimated with field measurements during the associated peak period and using Synchro 9 traffic models and calculated using delay calculations described in *Framework for Transit Priority Measure Evaluation* .
4. Non-Transit vehicle delay was estimated using Synchro 9 traffic models and calculated using delay calculations described in *Framework for Transit Priority Measure Evaluation* .

2.1 Macdonald Bridge @ Wyse Road

This TPM (Figure A-1, Appendix A) involves reallocating the usage of rightmost toll lane (Lane 10) for the westbound (to Halifax) approach to the Macdonald Bridge and reserving its use for Transit vehicles only. This option builds on the success of the transit only northbound left turn lane from Wyse Road to the Macdonald Bridge, and reduces the merging requirements for these transit vehicles.

To estimate the delay changes with this TPM, site visits were conducted during the AM peak period, Macdonald Bridge toll lane volume usage, and video of the toll lanes observed. Data acquisition and delay analysis methods for this TPM are summarized in Table 2-2.

Table 2-2 – TPM #1 Analysis Methods

Delay Measurement	Delay Acquisition/Analysis Method
Non Transit User Delay Without and With TPM	During field investigations, it was observed that the loss of a single toll lane to general traffic will not significantly alter traffic delay at the approach to the Macdonald Bridge. During one of the field investigations, a toll lane was closed during the AM peak period (See Photo 1) and no resulting change in delay to non-transit vehicles would be realized if the closed lane were to be used by transit-vehicles only. It was noted that any observed delay at the tolls results from the requirement to merge into the one or two lanes and spillback of queuing on the bridge itself. Any increase in delay to non-Transit vehicles from this TPM is estimated at less than 5 seconds and would be too low to be noticeable by non-Transit users. Traffic data showing the volume for each Halifax bound toll lane was collected by Halifax Harbour Bridges for the week of November 16 to November 20, 2015 and provided for review. A review of the data finds that there is sufficient residual capacity in the toll lanes to accommodate the closure of one westbound toll lane to non-Transit Vehicles. Video of the toll lanes recorded by HHB supports the analysis that there is sufficient capacity in the remaining toll lanes. To further assess the delay and throughput of traffic without and with a transit only lane, Synchro/SimTraffic models for the AM and PM peak hour conditions without and with the TPM were developed. The results of five one-hour SimTraffic runs for each of the AM and PM peak hours were reviewed.
Transit User Delay Without and With TPM	WSP conducted field investigations during the AM peak period to determine the impacts to delay of Transit vehicles. The field investigation involved the collection of transit vehicle travel time through the proposed length of the transit only lane under existing conditions. The free-flow time through the road segment was also recorded to develop transit delay estimations both without and with the proposed TPM. With this field data, the change in delay for transit vehicles with this TPM was estimated.

Review of HHB Data:

Traffic count data were obtained for the AM and PM peak periods during the week of November 16 to November 20, 2015 that show the hourly traffic volumes through each of the westbound (to Halifax) toll lanes. Analysis of the data indicates the following:

- During a typical weekday there are approximately 5,300 vehicles that cross the Macdonald Bridge to Halifax between 6 AM and 9 AM;
- During the peak one hour period (7 AM to 8 AM) there are approximately 2,100 vehicles crossing to Halifax;
- Traffic volumes per toll lane during the AM peak hour range from 321 to 566 vehicles;
- Although approximately 25% of the AM peak hour traffic chooses to use Lane 10 during typical AM peak periods, the closure of Lane 7 during the AM peak period on November 17, 2015 shows a more balanced use of each toll lane that remained open;
- The closure of Lane 7 in the supplied data set shows that Lane 9 (an exact change lane) can accommodate 26% of the traffic volumes and that the change lane (Lane 8) can accommodate 21% of the traffic volume; and,
- The balanced volume during the data set with a toll lane closure indicate that there is sufficient remaining capacity in Lanes 7, 8, and 9 during a typical AM peak hour to accommodate the closure of Lane 10 to non-Transit Vehicles.

Video of the westbound toll lanes at the Macdonald Bridge was recorded in the peak periods on three weekdays in February 2016. A review of this video finds that although there are heavily used toll lanes, there is very often capacity in adjacent toll lanes during the morning and afternoon peak period. This residual capacity in adjacent toll lanes indicates that traffic can be accommodated by the remaining toll lanes with the closure of toll Lane 10 to non-Transit vehicles. Video review suggests that the constraint to more toll lane throughput is the capacity of the bridge link and resulting merge activity beyond the toll lanes.

SimTraffic Modelling:

SimTraffic microsimulation modelling software was used to model the AM and PM peak hours without and with the proposed TPM. Without the TPM and under existing lane configurations, traffic traveling on the Macdonald Bridge toward Halifax is required to merge from five lanes to two in the AM and from five lanes to one in the PM during typical weekdays. This merging creates delay and conflict points for non-Transit and Transit vehicles alike. The SimTraffic models for the AM and PM peak hours found that with the TPM, there is reduced delay through the tolls to non-transit vehicles due to reduced merging and removal of transit vehiclers from the remaining toll lanes. The reduction of one toll lane to non-Transit vehicles reduces the storage at the bridge west of the intersection at Wyse Road by approximately 6 non-Transit vehicles, however the reduction in merging delay offsets this loss. Overall, the SimTraffic modelling results showed no loss of throughput of vehicles on the bridge in the AM or PM peak periods with this proposed TPM. Table 2-3 provides a summary of the SimTraffic Analysis. Modelling indicated no overall significant change to total throughput at the tolls. Modelling also shows potential reductions in overall toll delay possibly resulting from a simplified merge and separation of transit vehicles from the remaining toll lanes, however, overall delay to vehciles crossing the bridge is no expected to change.

Table 2-3 – Summary of SimTraffic Review of Toll Lanes

	AM Peak Hour		PM Peak Hour	
	Without TPM	With TPM	Without TPM	With TPM
Average Delay to Non-Transit Vehicles (s/veh)	66.7	45.5	46.0	44.4
Average Delay to Transit Vehicles (s/veh)	66.7	34.0	46.0	33.3
Total Throughput (vehicles per hour)	3329	3443	3395	3447

Field Investigations:

The field investigation found a range of anticipated transit vehicle delay reductions of between 0 seconds and 45 seconds per transit vehicle during the AM peak. The observed average delay reduction was 6.3 seconds. No transit vehicles were expected to be delayed as a result of the TPM. The wide range of measured delay reductions indicates improved travel time predictability through the toll area and improved schedule adherence for these routes with the TPM; however schedule adherence was not directly considered in the analysis.

With sustained merging delay throughout the day on the Macdonald Bridge approach, although reduced from the AM peak hour, the daily benefit is estimated to be about 3 times the AM peak hour benefit. A Daily Delay Factor of 3.0 was used.

Based on field observations and considering the above data analysis and review, the high number of transit vehicles and high transit vehicle occupancy at this location the TPM is estimated to reduce the delay per bus by 6.3 seconds and reduce the daily noticeable net road user delay by 4.4 user hours per day as outlined in Table D-1, Appendix D.

Photo 1 - Looking west on October 6, 2015 toward Macdonald bridge toll lanes from Wyse Road (The centre toll lane is closed)

2.2 Windmill Road @ Victoria Road (Northbound)

This TPM (Figure A-2, Appendix A) involves road widening for the northbound direction on Windmill Road, north of the intersection with Victoria Road. An exemption from regulation is required to permit transit vehicles to use the existing northbound right turn lane on Victoria Road (into the Ford Dealership driveway) and proceed through into the newly created lane. A transit only phase is not required at this location.

To determine the delay changes with this TPM, field measurements of delay during the PM peak period were conducted and traffic models were developed using Synchro 9.0. Data acquisition and delay analysis methods for this TPM are summarized in Table 2-4.

Table 2-4 – TPM #2 Analysis Methods

Delay Measurement	Delay Acquisition/Analysis Method
Non Transit Delay Without TPM	The signalized intersection of Windmill Road @ Victoria Road was modelled using Synchro 9.0 with 2016 forecasted traffic volumes and existing signal timings. The results of the modelling are included in Appendix C (Page C-1).
Non Transit Delay With TPM	A separate model was created to model the network with the addition of the transit only lane, using a new northeastbound movement to model a transit only through movement from the curb lane. The results of the modelling are included in Appendix C (Page C-2).
Transit delay Without and With TPM	WSP conducted field investigation during the PM peak period. The field investigation involved the collection of travel times for transit vehicles through the limits of additional transit lane (shown diagrammatically in Figure A-2). This time was compared to the estimated time for a transit vehicle to cover the distance with the lane as transit only, including modelled signal delay at Victoria Road. From this information, the change in delay for transit vehicles with this TPM was obtained.

Since the TPM will reduce the delay of transit vehicles not only at the intersection but also between Victoria Road and the limits of widening, the delay to Transit before and after the TPM is the total delay through the segment. Delay to Non-Transit Vehicles is intersection delay only.

The field investigation found a range of anticipated transit vehicle delay reductions of between 71 seconds and 152 seconds per transit vehicle. The observed average delay reduction was 90 seconds. No transit vehicles were expected to be delayed as a result of the TPM.

This TPM results in a very high benefit to transit users and the transit agency, with a low disbenefit to non-transit vehicles. This disbenefit is felt by northbound right-turning vehicles (Victoria Road into Ford dealership). This movement may notice an increase of 13.7 seconds per vehicle for the 15 vehicles in the PM peak hour however, through traffic may experience a slight improvement in operation as transit vehicles have been removed from these lanes.

The majority of the change to delay would be experienced during the PM peak period when delay and queuing on Victoria Road / Windmill Road northbound is longest. Outside of the PM peak hour, delay benefits are reduced and a Daily Delay Factor of 2.0 was used in the analysis.

A review of the results of the delay model finds that the TPM will have a daily noticeable net benefit to the road user of 23.3 user hours per day as outlined in Table D-2, Appendix D, and will save an estimated 90 seconds per transit vehicle during the PM peak hour.

2.3 Windmill Road @ Seapoint Road (Southbound)

This TPM (Figure A-3, Appendix A) involves road widening for the southbound direction on Windmill Road, between the intersections at Seapoint Road and Bancroft Lane. An exemption from regulation is required to permit transit vehicles to use the existing southbound right turn lane on Windmill Road at Seapoint Road and proceed through into the newly created lane. Transit vehicles would continue to be exempt from the requirement to turn right onto Bancroft Lane. There is an existing transit only phase at the intersection of Windmill Road and Bancroft Lane and this phase would continue to be required with the proposed TPM.

To determine the delay changes with this TPM, field measurements of delay during the AM peak period were conducted traffic models were developed using Synchro 9.0. Data acquisition and delay analysis methods for this TPM are summarized in Table 2-5.

Table 2-5 – TPM #3 Analysis Methods

Delay Measurement	Delay Acquisition/Analysis Method
Non Transit Delay Without TPM	The signalized intersections of Windmill Road @ Seapoint Road and Windmill Road @ Wright Avenue were modelled using Synchro 9.0 with 2016 forecasted traffic volumes and existing signal timings. The results of the modelling are included in Appendix C (Pages C-3, C-4).
Non Transit Delay With TPM	A separate model was created to model the network with the addition of the transit only lane, using a new southwestbound movement to model a transit only through movement from the curb lane. The results of the modelling are included in Appendix C (Pages C-5, C-6).
Transit delay Without and With TPM	WSP conducted field investigations during the AM peak period to determine the impacts to delay of Transit vehicles. The field investigation involved the collection of the time it took for transit vehicles to travel from the start of the existing right turn lane for southbound vehicles at Seapoint Road to the point where they entered the intersection at Bancroft Lane. This time was compared to the estimated time for a transit vehicle to cover the distance with the lane as transit only, including signal delay at Seapoint Road. From this information, the change in delay for transit vehicles with this TPM was obtained.

Since the TPM will reduce the delay of transit vehicles not only at the intersection but will also reduce the queue delay between Seapoint Road and Bancroft Lane, the delay to Transit before and after the TPM is the total delay through the segment. Delay to Non-Transit Vehicles is intersection delay only.

The field investigation found a range of anticipated transit vehicle delay reductions of between 10 seconds and 173 seconds per transit vehicle. The observed average delay reduction was 75 seconds. No transit vehicles were observed to be expected to be delayed as a result of the TPM. The range of delays is due to the location of the nearside transit stop north of the intersection with Bancroft Lane. Transit vehicles were observed to pass through the intersection at Seapoint Road and reach the transit stop within the same phase but departed the stop with a red signal on Windmill Road. These individual transit vehicles had to wait at the red signal until the following phase and are estimated to have little delay reduction resulting from the TPM. The wide range in delay indicates improved schedule adherence resulting from this TPM; however schedule adherence was not directly considered in the analysis.

The majority of the change to delay would be experienced during the AM peak period when delay and queuing on Windmill Road is greatest. Outside of the AM peak hour, delay benefits are reduced and a Daily Delay Factor of 2.0 was used in the analysis.

A review of the results of the delay model finds that the TPM will have a daily noticeable net benefit to the road user of 20.0 user hours per day as outlined in Table D-3, Appendix D, and results in an estimated savings of 75 seconds per transit vehicle. This TPM results in a very high noticeable benefit to transit users and the transit agency and no noticeable disbenefit to non-transit users.

2.4 Main Street @ Gordon Avenue

This TPM (Figure A-4, Appendix A) involves an exemption from regulation to permit eastbound transit vehicles to proceed through from the curb lane on Main Street at Gordon Avenue. As there is currently no third receiving lane, a transit only phase is also required to accommodate this permitted movement.

To determine the delay changes with this TPM, field measurements of delay during the PM peak period were conducted and traffic models were developed using Synchro 9.0. Data acquisition and delay analysis methods for this TPM are summarized in Table 2-6.

Table 2-6 – TPM #4 Analysis Methods

Delay Measurement	Delay Acquisition/Analysis Method
Non Transit Delay Without TPM	The signalized intersection of Main Street @ Gordon Avenue was modelled using Synchro 9.0 with 2016 forecasted traffic volumes and existing signal timings. The results of the modelling are included in Appendix C (Page C-7).
Non Transit Delay With TPM	A separate model was created to model the network with the addition of the transit only lane, using a new southeastbound movement to model a transit only through movement from the curb lane. An 8-10 second signal phase was added to accommodate the movement. The results of the modelling are included in Appendix C (Page C-8).
Transit delay Without and With TPM	WSP conducted field investigations during the PM peak period to estimate the impacts to delay of Transit vehicles. The field investigation involved the collection of the time it took for transit vehicles to travel the distance of the right turn lane for eastbound vehicles at Gordon Avenue to the point where they entered the intersection. While onsite, the free-flow time through the road segment and intersection delay were also recorded. This time was compared to the estimated time for a transit vehicle to cover the distance with the lane as transit only, including signal delay at Gordon Avenue to develop transit delay estimations both without and with the proposed TPM. From this information, the change in delay for transit vehicles with this TPM was obtained.

Since the TPM would allow the transit vehicle to bypass much of the queue, the delay reduction to transit considers the queue delays. As the queue delay for non-transit vehicles will remain unchanged, delay to non-transit vehicles only considers modeled intersection delay.

The majority of the change to delay would be experienced during the PM peak period when eastbound traffic queues are longest and most impede transit vehicles. Outside of the PM peak hour, delay benefits are reduced and a Daily Delay Factor of 2.0 was used in the analysis.

A review of the results of the delay model finds that the TPM will have a daily noticeable net disbenefit to the road user of 39.7 user hours per day as outlined in Table D-4, Appendix D. The high delay increase to non-transit users results from the requirement to include a transit phase with the TPM at this location. This increases the cycle length and decreases the capacity of the intersection. The northbound left turn (Gordon Avenue turning left onto Main Street) and the eastbound through movements are expected to operate at or over capacity during the 2016 PM peak hour without the proposed TPM. The reallocation of even a small amount a green time to accommodate the proposed phase compounds this delay.

The TPM can be expected to save over one minute per bus, however, with the high eastbound right turning volume (522 vehicles in the PM peak), it is possible that the transit vehicles will be queued when the transit phase is active and will miss the phase opportunity.

If a receiving lane could be added on Main Street then this would remove the need for the transit signal phase and would significantly reduce the impact on non-Transit vehicles and would very likely improve the operations of this proposed TPM. It is also likely that providing a receiving lane would provide additional benefit to transit vehicles and transit users.

2.5 Portland Street @ Woodlawn Road

This TPM (Figure A-5, Appendix A) involves an extension of the existing transit lane to enable access to the lane by transit vehicles from further back in the queue. No change to existing signal timings is required. To accommodate the elongated lane without road widening, access changes are proposed at Bruce Street and at Boston Pizza.

To determine the delay changes with this TPM, field measurements of delay during the AM peak period were conducted and traffic models were developed using Synchro 9.0. Data acquisition and delay analysis methods for this TPM are summarized in Table 2-7.

Table 2-7 – TPM #5 Analysis Methods

Delay Measurement	Delay Acquisition/Analysis Method
Non Transit Delay Without TPM	The signalized intersection of Portland Street @ Woodlawn Road / Baker Drive was modelled using Synchro 9.0 with 2016 forecasted traffic volumes and existing signal timings. The results of the modelling are included in Appendix C (Page C-9).
Non Transit Delay With TPM	The tradeoff of this TPM is the reduced access at Bruce Street, however, with increased access at Boston Pizza, no change in non-Transit delay is anticipated. With a low peak period volume of westbound left turning traffic from Portland Street to Baker Drive (14 in AM peak hour, 11 in PM peak hour), the queue of left turning vehicles is not expected to impede access to the transit lane.
Transit delay Without and With TPM	WSP conducted site visits during the AM peak to determine the impacts to delay of Non-Transit and Transit vehicles. The field investigation involved the review of time it took for transit vehicles to travel from the development of the proposed extension of the transit lane to the point where they entered the existing transit lane at Woodlawn Road. While onsite, the free-flow time through the road segment and intersection delay were also recorded to develop transit delay estimations with and without the proposed TPM.

The field investigation found a range of anticipated transit vehicle delay reductions of between 0 seconds and 60 seconds per transit vehicle. The observed average delay reduction was 17 seconds. No transit vehicles were expected to be delayed as a result of the TPM.

The majority of the change to delay would be experienced during the AM peak period when westbound queues on Portland Street impede access to the existing transit lane. Outside of the AM peak hour, delay benefits are reduced and a Daily Delay Factor of 2.0 was used in the analysis.

A review of the delay results finds that the TPM will have a daily noticeable net benefit to the road user of 3.2 user hours per day as outlined in Table D-5, Appendix D. Although the TPM indicates an overall benefit, further investigation into the removal of the left turn lane to Bruce Street is required.

2.6 Barrington Street at Macdonald Bridge Ramp

This TPM (Figure A-6A, Appendix A) involves relocating the transit stop and restriping the northbound lanes to restrict the curb lane to right-turning traffic (only traffic proceeding to the bridge). Additional lane configuration changes could be considered at the intersection of Barrington Street and North Street to assist with lane balancing; however these additional lane use changes are not necessary to implement this TPM.

To determine the delay changes with this TPM, field measurements of delay during the PM peak period were conducted and traffic models were developed using Synchro 9.0. Data acquisition and delay analysis methods for this TPM are summarized in Table 2-8.

Table 2-8 – TPM #6 Analysis Methods

Delay Measurement	Delay Acquisition/Analysis Method
Non Transit Delay Without TPM	The intersection of Barrington Street with the Macdonald Bridge Ramp was modeled in the PM peak hour using Synchro 9.0.The results of the modelling are included in Appendix C (Page C-10).
Non Transit Delay With TPM	A separate model was created to analyze the network with the reconfigured lane use on Barrington Street at the approach to the Macdonald Bridge Ramp (Page C-11). The results of the modelling find that the individual lanes on Barrington Street operate under capacity and that the queuing on Barrington Street is due to queuing at the traffic signals at the Bridge approach. Lane configurations in this scenario past the ramp better reflect the defacto lane configurations on Barrington Street during the PM peak. Since the initial TPM scenario will not alter the operations of the signals at North Street, no change to non-Transit user delay is anticipated. This conclusion is confirmed by the field observation conducted by WSP.
Transit delay Without and With TPM	WSP staff conducted field investigation during the PM peak period to measure the delay to transit vehicles and estimate the delay reduction to transit vehicles that would be experienced with the implementation of the TPM. Transit delay included a measurement of queuing delay in the curb lane relative to the leftmost northbound lane (average of 20 seconds) and the delay to transit vehicles leaving the transit stop and merging in to mixed traffic to proceed north on Barrington Street (average of 10 seconds). The delay estimate only considered transit vehicles that stop at the transit stop that would be relocated. All transit vehicles running routes that do not stop at the transit stop would not be impacted by the proposed relocation. Therefore, a delay reduction of 30 seconds per vehicle to 7 transit vehicles in the PM peak is estimated.

The majority of the change to delay would be experienced during the PM peak period when northbound traffic volumes are highest. Outside of these times the delay is expected to be significantly reduced and a Daily Delay Factor of 2.0 was used in the analysis.

A review of the results of the delay model finds that the TPM will have a daily noticeable net benefit to the road user of 3.4 user hours per day as outlined in Table D-6, Appendix D.

<u>Alternate Lane Configurations north of TPM:</u>
Further analysis of the intersection of Barrington Street at North Street was completed to determine whether modifying the lane configurations could improve lane balance and traffic flow on Barrington Street. The lane configuration alternatives used in the analysis were:

- Existing lane configurations and signal timings;
- Reassigning one of the southbound lanes as left turn only lanes; and,
- Reassigning one of the northbound lanes as left turn only lanes.

A review of the Synchro 9.0 modeling of the intersection of Barrington Street and North Street (Table 2-9) determined:

- Although there is benefit to reallocating a northbound through lane in the AM peak hour, the PM peak hour of the northbound through movement is expected to operate with a volume to capacity (v/c) of 1.01. The reallocation of a northbound lane is not recommended.

- There is overall benefit to reallocating one of the southbound lanes on Barrington Street as a southbound left turn lane north of the intersection and as a northbound left turn lane south of the intersection. Analysis indicates that this would provide overall benefit to traffic operations in the PM peak period, sufficient to offset the slight increase in delay in the AM peak period.

In the AM peak hour with one southbound through lane, the southbound protected / permitted left turn phase was removed. By providing the left turn lane to the high volume southbound left turn movement, the advanced phase was found to no longer be required. To accommodate the high southbound through volume in the single approach lane, the cycle length for the AM peak hour was increased to 100 seconds, coinciding with the cycle length at the intersection with Cornwallis Street.

Modifying these lanes as described above, although not required for the proposed TPM, would increase the benefit of the proposed TPM by providing an additional northbound lane north of the Macdonald Bridge ramp and maintain lane balance through the corridor with the addition of the TPM (Figure A-6B, Appendix A).

Table 2-9 – Barrington Street @ North Street Analysis Results

LOS Criteria	Control Delay (sec/veh), LOS, v/c Ratio, and 95th% Queue (m) by Intersection Movement									Overall Intersection	
	EB-L	EB-T	EB-R	WB-L	WB-TR	NB-L	NB-TR	SB-L	SB-TR	Delay	LOS
2016 AM Peak Hour - Existing Lane Configuration, Signal Timings (Page C-12)											
Delay	25.2	36.1	0.4	25.4	0.4	22.1		13.1		15.3	B
v/c	0.19	0.66	0.27	0.22	0.09	0.52		0.72			
Queue	13.8	52.4	0.0	19.1	0.0	40.8		90.9			
2016 AM Peak Hour - Modified to 2 Northbound through lanes, 1 Southbound through lane (Page C-13)											
Delay	37.5	58.5	0.4	38.5	12.2	27.8	7.1	10.0	19.3	17.3	B
v/c	0.23	0.8	0.27	0.30	0.12	0.86	0.31	0.42	0.85		
Queue	19.2	80.3	0.0	27.0	8.2	7.8	17.5	28.6	237.1		
2016 AM Peak Hour - Modified to 1 Northbound through lane, 2 Southbound through lanes (Page C-14)											
Delay	25.2	36.1	0.4	25.4	6.9	17.4	13.7	23.7	9.4	13.2	B
v/c	0.19	0.66	0.27	0.22	0.10	0.47	0.66	0.63	0.49		
Queue	13.8	52.4	0.0	19.1	5.5	30.3	129.3	56.3	70.2		
2016 PM Peak Hour - Existing Lane Configuration, Signal Timings (Page C-15)											
Delay	25.1	20.9	0.4	30.2	34.6	23.0		8.5		18.5	B
v/c	0.24	0.04	0.27	0.52	0.74	0.88		0.34			
Queue	15.2	6.1	0.0	42.1	55.5	163.6		37.3			
2016 PM Peak Hour - Modified to 2 Northbound through lanes, 1 Southbound through lane (Page C-16)											
Delay	25.1	20.9	0.4	30.2	34.6	13.0	11.9	10.6	12.2	14.0	B
v/c	0.24	0.04	0.27	0.52	0.74	0.38	0.61	0.12	0.55		
Queue	15.2	6.1	0.0	42.1	55.5	27.6	93.9	5.4	91.8		
2016 PM Peak Hour - Modified to 1 Northbound through lane, 2 Southbound through lanes (Page C-17)											
Delay	44.6	33.9	0.4	52.0	54.3	7.6	28.0	17.3	5.5	23.0	C
v/c	0.39	0.05	0.27	0.70	0.87	0.28	1.01	0.28	0.25		
Queue	22.1	8.5	0.0	60.6	81.5	6.6	86.7	7.0	27.1		

Beyond the TPM modifications considered in Figure A-6A, Appendix A, HRM should consider lane reconfigurations at the North Street intersection as shown in Figure A-6B and analyzed on pages C-13 and C-16, Appendix C.

2.7 Windmill Road @ Akerley Boulevard

This TPM (Figure A-7, Appendix A) involves the installation of physical separation to eliminate conflicts between southbound through transit vehicles on Windmill Road and left turning vehicles from Akerley Boulevard onto Windmill Road. This would allow for southbound transit vehicles to experience free flow at the traffic signals except when there is a pedestrian crossing Windmill Road. This TPM was considered for review since there are low pedestrian volumes crossing the intersection (8 pedestrians crossed Windmill Road during the AM peak hour), which would provide nearly free flow for transit vehicles in the lane. The existing southbound transit only phase could be eliminated as it would no longer be required.

To determine the delay changes with this TPM, traffic models using Synchro 9.0 were developed. Data acquisition and delay analysis methods for this TPM are summarized in Table 2-10.

Table 2-10 – TPM #7 Analysis Methods

Delay Measurement	Delay Acquisition/Analysis Method
Non Transit Delay Without TPM	The signalized intersections of Windmill Road @ Akerley Boulevard was modelled using Synchro 9.0 with 2016 forecasted traffic volumes and existing signal timings. The results of the modelling are included in Appendix C (Page C-18).
Non Transit Delay With TPM	A separate model was created to model the network without the existing transit only phase and removing the southbound transit vehicles from the intersection. The results of the modelling are included in Appendix C (Page C-19).
Transit delay Without and With TPM	The Synchro models were used to determine the impacts to transit vehicles that would result from the implementation of the TPM.

The highest flow of the southbound traffic occurs during the AM peak period; however, this is also when the signals provide the majority of the green time to southbound vehicles. A review of the PM signal timings and traffic volumes indicate potential delay reductions to Transit during the PM peak. Considering the reduced ridership in this direction during the PM peak, a Daily Delay Factor of 3.0 was used in the analysis.

A review of the results of the delay model finds that the TPM will have a daily noticeable net benefit of 2.8 user hours per day as outlined in Table D-7, Appendix D. This TPM results in a small reduction (7.1 seconds) of delay per transit vehicle and no noticeable reduction in delay to non-transit users. The existing signal timings in the AM peak hour provide the majority of the green time to southbound vehicles and with the existing transit signal phase the southbound transit vehicles experience only a small intersection delay under existing conditions.

2.8 Robie Street @ Almon Street

This TPM (Figure A-8, Appendix A) involves an exemption from regulation to permit southbound transit vehicles to proceed through from the curb lane on Robie Street @ Almon Street. As there is currently no receiving lane, a transit only phase is also required to accommodate this transit movement.

To determine the delay changes with this TPM, field measurements of delay during the AM peak period were conducted and traffic models were developed using Synchro 9.0. Data acquisition and delay analysis methods for this TPM are summarized in Table 2-11.

Table 2-11 – TPM #8 Analysis Methods

Delay Measurement	Delay Acquisition/Analysis Method
Non Transit Delay Without TPM	The signalized intersection of Robie Street @ Almon Street was modelled using Synchro 9.0 with 2016 forecasted traffic volumes and existing signal timings. The results of the modelling are included in Appendix C (Page C-20).
Non Transit Delay With TPM	A separate model was created to model the network with the addition of the transit only movement, using a new southwestbound movement to model a transit only through movement from the curb lane. An 8-10 second transit signal phase was added to accommodate the movement. The results of the modelling are included in Appendix C (Page C-21).
Transit delay Without and With TPM	WSP conducted transit delay field measurements during the AM peak period to determine the impacts to the delay of Transit vehicles. The field investigation noted that each southbound bus traveled in the curb lane, boarded/alighted passengers at the bus stop immediately north of Almon Street, and had to merge into the through lane. The investigation collected the time it took the transit vehicles to depart the bus stop and proceed through the signals at Robie Street. While onsite, the free-flow time through the road segment and intersection delay were also recorded to develop transit delay estimations both with and without the proposed TPM.

The field investigation found a range of anticipated transit vehicle delay reductions of between 0 seconds and 30 seconds per transit vehicle. The observed average delay reduction was 18 seconds. No transit vehicles were expected to be delayed as a result of the TPM.

The majority of the change to delay would be experienced during the AM peak period when the southbound volumes on Robie Street are highest. Outside of the AM peak period, delay benefits are reduced and a Daily Delay Factor of 2.0 was used in the analysis.

A review of the results of the delay model finds that the TPM will have a daily noticeable net benefit of 2.6 user hours per day as outlined in Table D-8, Appendix D.

2.9 Main Street @ Hartlen Street

This TPM (Figure A-9, Appendix A) involves an exemption from regulation to permit northbound transit vehicles to turn left onto Main Street from the curb lane on Hartlen Street. As there is already a second receiving lane for the left-turn movement, a transit only phase is not required to accommodate this TPM.

To determine the delay changes with this TPM, traffic models for the AM and PM peak periods were developed using Synchro 9.0. Data acquisition and delay analysis methods for this TPM are summarized in Table 2-12.

Table 2-12 – TPM #9 Analysis Methods

Delay Measurement	Delay Acquisition/Analysis Method
Non Transit Delay Without TPM	The signalized intersection of Main Street @ Hartlen Street was modelled using Synchro 9.0 with 2016 forecasted traffic volumes and existing signal timings. The results of the modelling are included in Appendix C (Pages C-22, C-23).
Non Transit Delay With TPM	A separate model was created to model the network with the addition of the transit only lane. This was done by modeling the intersection with a northbound through lane with a volume equal to the number of transit vehicles provided by HRM. The results of the modelling are included in Appendix C (Pages C-24, C-25).
Transit delay Without and With TPM	The Synchro models were used to determine the impacts to transit vehicles that would result from the implementation of the TPM.

The majority of the change to delay would be experienced during the PM peak period however, there are significant improvements to transit that can be expected in the AM peak period as well. A Daily Delay Factor of 2.0 was applied to the results from each peak hour and the results summed to determine the benefits associated with this TPM.

A review of the results of the delay model finds that the TPM will reduce delay to transit vehicles by 49 and 54 seconds per vehicle in the AM and PM peak hours, respectively, and will have a daily noticeable net benefit to the road user of 7.1 user hours per day as outlined in Table D-9, Appendix D. Additionally, the model does not consider bus blockages under current conditions where right turning traffic can be clocked by transit vehicles departing the transit stop in the curb lane and trying to merge to the left turn lane under existing conditions. It is possible that with this TPM, the overall net benefits to road users may be higher than shown in the model.

2.10 Chebucto Road @ Connaught Avenue

This TPM (Figure A-10, Appendix A) involves an exemption from regulation to permit eastbound transit vehicles to proceed through from the curb lane on Chebucto Road @ Connaught Avenue. As part of this TPM, the size of the existing channelized island will be reduced and an additional receiving lane will be created to accommodate this movement. With the additional receiving lane, a transit only phase is not required. The net user delay for this location was also assessed without the installation of the receiving lane and with a transit only phase.

To determine the delay changes with this TPM, field measurements of delay during the AM peak period were conducted and traffic models were developed using Synchro 9.0. Data acquisition and delay analysis methods for this TPM are summarized in Table 2-13.

Table 2-13 – TPM #10 Analysis Methods

Delay Measurement	Delay Acquisition/Analysis Method
Non Transit Delay Without TPM	The signalized intersection of Chebucto Road @ Connaught Avenue was modelled using Synchro 9.0 with 2016 forecasted traffic volumes and existing signal timings. The results of the modelling are included in Appendix C (PageC-26).
Non Transit Delay With TPM	A separate model was created to model the network with the addition of the transit only movement, using a new southeastbound movement to model a transit only through movement from the curb lane. The results of the modelling are included in Appendix C (Pages C-27, C-28).
Transit delay Without and With TPM	WSP conducted site visits during the AM peak period to determine the impacts to the delay of Transit vehicles. The field investigation noted that many of the eastbound transit vehicles traveled in the curb lane, boarded or alighted passengers at the bus stop immediately west of Connaught Avenue, and had to merge into the through lane. The investigation therefore collected the time it took a transit vehicle in the through lane to reach and enter the intersection, as well as the time it took a through transit vehicle from the curb lane to depart the bus stop merge into the through lane and enter the intersection. While onsite, the free-flow time through the road segment and intersection delay were also recorded to develop transit delay estimations both with and without the proposed TPM.

This TPM was assessed for the net user delay both without and with the installation of the additional transit only receiving lane. In the scenario without a receiving lane, the TPM requires the installation of a transit signal phase.

The majority of the change to delay would be experienced during the AM peak period due to the significant eastbound through volume on Chebucto Road. Outside of the AM peak period, delay benefits are reduced and a Daily Delay Factor of 2.0 was used in the analysis.

<u>Without a receiving lane:</u>
A review of the results of the delay model, confirmed by the field investigation, shows a small reduction in the delay to transit vehicles. Under existing conditions, transit vehicles departing the nearside transit stop merge into mixed traffic before entering the intersection. This TPM without a receiving lane at this location would move the merge point into the intersection or farside the

intersection for some transit vehicles, however, the TPM would not affect any transit vehicle that did not arrive at the intersection on a red signal, or missed the transit only phase as they were blocked by right turning vehicles not able to turn on the preceding red phase.

With a receiving lane:
A review of the results of the delay model finds that the TPM will have a daily noticeable net benefit to the road user of 6.0 user hours per day as outlined in Table D-10, Appendix D. Further review finds that the model shows no noticeable increase in delay to non-transit vehicles (maximum of 3.5 seconds per vehicle) but will save approximately 32 seconds per transit vehicle in the AM peak hour.

Since the scenario without a receiving lane has a low net benefit to transit and increased non-transit vehicle delay, the TPM cost estimate and evaluation was only continued with the installation of the receiving lane.

2.11 Mumford Road @ Chebucto Road

This TPM (Figure A-11, Appendix A) involves restriping the lanes on Mumford Road at the intersection with Chebucto Road to provide a third (transit only) left turn lane from Mumford Road onto Chebucto Road with the reduction to a single northbound lane on Mumford Road. A transit only phase is required to accommodate this TPM.

To determine the delay changes with this TPM, traffic models were developed using Synchro 9.0. Data acquisition and delay analysis methods for this TPM are summarized in Table 2-14.

Table 2-14 – TPM #11 Analysis Methods

Delay Measurement	Delay Acquisition/Analysis Method
Non Transit Delay Without TPM	The signalized intersection of Mumford Road @ Chebucto Road was modelled using Synchro 9.0 with 2016 forecasted traffic volumes and existing signal timings. The results of the modelling are included in Appendix C (Page C-29).
Non Transit Delay With TPM	A separate model was created to model the network with the addition of the transit only movement, using a new southwestbound movement to model a transit only left turn movement from the curb lane. The results of the modelling are included in Appendix C (Page C-30).
Transit delay Without and With TPM	The above mentioned Synchro models were used to determine the impacts to transit vehicles that would result from the implementation of the TPM.

The majority of the change to delay would be experienced during the PM peak period. Outside of the PM peak period, delay benefits are reduced and a Daily Delay Factor of 2.0 was used in the analysis.

A review of the results of the delay model finds that the TPM will have a daily noticeable net benefit to the road user of 0.4 user hours per day as outlined in Table D-11, Appendix D.

2.12 Robie Street @ Quinpool Road

This TPM (Figure A-12, Appendix A) involves restriping the southbound lanes on Robie Street at Quinpool Road to restrict the curb lane to transit vehicles and right turning vehicles only. Since there is a southbound receiving lane, a transit only phase is not required.

To determine the delay changes with this TPM, traffic models were developed using Synchro 9.0. Data acquisition and delay analysis methods for this TPM are summarized in Table 2-15.

Table 2-15 – TPM #12 Analysis Methods

Delay Measurement	Delay Acquisition/Analysis Method
Non Transit Delay Without TPM	The signalized intersection of Robie Street @ Quinpool Road / Cogswell Street / Bell Road (Willow Tree) was modelled using Synchro 9.0 with 2016 forecasted traffic volumes and existing signal timings. The results of the modelling are included in Appendix C (Page C-31).
Non Transit Delay With TPM	A separate model was created to model the network with the addition of the transit only through lane, using a new southwestbound movement to model a transit only through movement from the curb lane. The results of the modelling are included in Appendix C (Page C-32).
Transit delay Without and With TPM	The Synchro models were used to determine the impacts to transit vehicles that would result from the implementation of the TPM.

The majority of the change to delay would be experienced during the AM peak period when stopping is not permitted in the curb lane on Robie Street in existing conditions. Outside of the AM peak period, delay benefits and disbenefits are reduced and a Daily Delay Factor of 2.0 was used in the analysis.

A review of the results of the delay model finds that the TPM will have a daily noticeable net disbenefit to road users of 101 user hours per day as outlined in Table D-12, Appendix D. Further analysis finds that the restriping of an existing southbound through lane as transit only will decrease the capacity of Robie Street southbound at the intersection for non-transit vehicles to an extent where through volume exceeds capacity. Average delay to southbound through vehicles will increase from 63 seconds to an estimated 278 seconds. The TPM saves an estimated 20 seconds per transit vehicle.

2.13 Cobequid Terminal @ Cobequid Road

This TPM (Figure A-13, Appendix A) involves installing a protected / permitted phase for westbound left turning vehicles (vehicles leaving the Cobequid Terminal and turning left onto Cobequid Road). No lane modifications are required and no exclusive transit phase is required.

To determine the delay changes with this TPM, traffic models were developed using Synchro 9.0. Data acquisition and delay analysis methods for this TPM are summarized in Table 2-16.

Table 2-16 – TPM #12 Analysis Methods

Delay Measurement	Delay Acquisition/Analysis Method
Non Transit Delay Without TPM	The signalized intersection of Cobequid Road @ Legacy Court / Fultz House Lane was modelled using Synchro 9.0 with 2016 forecasted traffic volumes and existing signal timings. The results of the modelling are included in Appendix C (Page C-33).
Non Transit Delay With TPM	A separate model was created to model the network with the addition of the protected/permissive movement. The results of the modelling are included in Appendix C (Page C-34).
Transit delay Without and With TPM	The Synchro models were used to determine the impacts to transit vehicles that would result from the implementation of the TPM.

The implementation of this TPM is expected to be in effect only during the PM peak. Recognizing that the non-peak hour experiences reduced volumes to the peak hour, a Daily Delay Factor of 1.8 was used.

A review of the results of the delay model finds that the TPM will have a daily noticeable net disbenefit to the road user of 4.5 user hours per day as outlined in Table D-13, Appendix D. Further review finds that the reallocation of green time from traffic on Cobequid Road and vehicles coming from the Bedford By-pass will result in an increase in delay for those movements. The highest delay increase being 21 seconds per vehicle for left turning vehicles from Fultz House Lane to Cobequid Road, with the movement approaching capacity (v/c=0.93).

3.0 TPM Financial Costs, Benefits, and Payback Period

For each of the 13 TPM being evaluated, functional layout plans have been prepared and included in Appendix A. Functional layouts were used to determine order of magnitude cost estimates for each proposed TPM. The Estimated Capital Costs, Estimated Annual cost change, Payback Period to the Transit Agency, and Overall Payback Period, are summarized in Table 3-1 with details shown in Appendix B.

Determination of Capital Costs:
Each of the cost estimates presented in this analysis and evaluation are order of magnitude costs only. The requirement for property acquisition was noted where required (TPM # 7), but the cost of the acquisition was not considered. The cost of upgrading signal poles, signal controllers, and vehicle detection was not included and costs of relocating underground infrastructure were not considered. Where signs were required, costs include the installation of posts. Costs do not include HST.

Where TPM projects indicated the potential for Integration with Capital Works Projects, the TPM cost estimate was reduced to account for Integration as follows:

- The cost estimate for TPM # 3 (Windmill Road at Seapoint Road) does not include the installation of sidewalk, but does include road widening, curb relocation, and utility pole relocation; and,
- The cost estimate for TPM # 11 (Mumford Road at Chebucto Road) does not include removal of existing pavement markings as the integration opportunity includes a resurfacing of Mumford Road.

In Table 3-1, negative payback periods (TPM # 4, 12, 13) indicate annual benefits are negative and that the capital costs will never be recovered by overall savings to transit, road users, and change in maintenance costs.

Table 3-1 - Cost Summary Table

TPM Location	TPM #	Estimated Capital Cost[1]	Annual Change in Cost to Transit Agency[2]	Annual Change in Cost to road users (including Transit Riders)	Estimated Annual Maintenance Costs	Payback Period to the Transit Agency (years)[3]	Overall Payback Period (years)
Macdonald Bridge @ Wyse Road	1	$12,000	-$2,800	-$25,100	$0	4.3	0.4
Windmill Road @ Victoria Road (NB)	2	$299,000	-$15,200	-$132,700	$800	18.7	2.0
Windmill Road @ Seapoint Road (SB)	3	$276,000	-$14,100	-$114,000	$800	18.5	2.2
Main Street @ Gordon Avenue	4	$4,000	-$7,200	$260,900	$0	0.6	(0.02)
Portland Street @ Woodlawn Road	5	$68,000	-$3,200	-$18,200	$0	21.3	3.2
Barrington Street @ Macdonald Bridge Ramp	6	$83,000	-$2,000	-$19,400	$0	41.5	3.9
Windmill Road @ Akerley Boulevard	7	$332,000	-$1,500	-$16,000	$300	184.4	19.3
Robie Street @ Almon Street	8	$6,000	-$2,000	-$14,800	$0	3.0	0.4
Main Street @ Hartlen Street	9	$4,000	-$10,700	-$40,500	$0	0.4	0.08
Chebucto Road @ Connaught Avenue	10	$99,000	-$3,600	-$34,200	$300	25.4	2.6
Mumford Road @ Chebucto Road	11	$10,000	-$3,800	$1,400	$0	2.6	4.2
Robie Street @ Quinpool Road	12	$20,000	-$3,200	$655,400	$0	6.3	(0.03)
Cobequid Terminal @ Cobequid Road	13	$4,000	-$1,400	$29,900	$0	2.9	(0.1)

1. This estimate of probable construction cost is approximate only. Actual cost may vary significantly from this estimate due to market conditions. Details for each shown in Appendix B.
2. Annual Change in Cost to the Transit Agency does not include Change in Cost of ridership delay.
3. The Payback Period to the Transit Agency is the Capital Cost divided by the Annual Savings to Transit minus the Annual Maintenance. This does not include time savings to transit riders.

4.0 Comparison Between TPM Locations

The results of the delay and financial analyses for each TPM were compared to determine the Priority ranking and create a five year implementation plan for the TPM.

4.1 TPM Summary Matrix and Overall Evaluation

The results of the evaluations of the individual TPM locations have been compiled and are summarized in the Evaluation Matrix (Table 4-1). The Evaluation Matrix indicates that many of the TPM locations provide delay reductions to overall users while providing strong financial benefits to transit and overall road users.

Table 4-2 ranks the 13 TPM by Overall Evaluation Score and can be used a comparison tool assist with determining an implementation schedule of the TPM's.

This Section was Intentionally Left Blank

Table 4-1 - TPM Summary Evaluation Matrix

		1- Macdonald Bridge @Wyse Road	2- Windmill Road @ Victoria Road	3- Windmill Road @ Seapoint Road	4- Main Street @ Gordon Avenue	5- Portland Street @ Woodlawn Road	6- Barrington Street @ Macdonald Bridge Ramp	7- Windmill Road @ Akerley Boulevard	8- Robie Street @ Almon Street	9- Main Street @ Hartlen Street	10- Chebucto Road @ Connaught Avenue	11- Mumford Road @ Chebucto Road	12- Robie Street @ Quinpool Road	13- Cobequid Terminal @ Cobequid Road
Net Transit User Delay		-4.4 pass.hr	-23.4 pass.hr	-20.0 pass.hr	-6.8 pass.hr	-3.2 pass hr	-3.4 pass.hr	-2.8 pass.hr	-2.6 pass.hr	-7.0 pass.hr	-6.0 pass.hr	-5.4 pass.hr	-5.9 pass.hr	-1.1 pass.hr
Payback Period to Transit		4.3 years	18.7 years	18.5 years	0.6 years	21.3 years	41.5 years	184.4.4 years	3.0 years	0.4 years	25.4 years	2.6 years	6.3 years	2.9 years
Net Change in Road User Delay[1]		-4.4 pass.hr **2**	-23.3 pass.hr **5**	-20.0 pass.hr **5**	+39.7 pass.hr **0**	-3.2 pass.hr **2**	-3.4 pass.hr **2**	-2.8 pass.hr **1**	-2.6 pass.hr **1**	-7.0 pass.hr **2**	-6.0 pass.hr **2**	-0.4 pass.hr **1**	+101.0 pass.hr **0**	+4.5 pass.hr **0**
Payback Period[2]		0.4 years **5**	2.0 years **4**	2.2 years **4**	-0.02 years **0**	3.2 years **3**	3.9 years **3**	19.3 years **1**	0.4 years **5**	0.08 years **5**	2.6 years **4**	4.2 years **3**	-0.03 years **0**	-0.1 years **0**
Other Key Factors[3]	**Score for Other Factors**	**2**	**1**	**4**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**0**
	Safety Considerations	+Reduced merging by Transit Vehicles	None	None	None	None	+Reduced merging by Transit Vehicles	+Better separation of transit vehicles	None	None	None	-Transit vehicles merging beyond intersection	+Currently Transit vehicles have to merge around parked vehicles	None
	Impact to Other Users	+Slight improvement for emergency vehicles	+Improvement for emergency vehicles	+Impovement for Emergency Vehicles	None	Impacts to adjacent properties with reduced access at Bruce Street, increased access at Boston Pizza	+Locates bus stops closer to crosswalks	+Improved pedestrian crossing -Property acquisition	None	-Additional conflict to pedestrians crossing during a permitted dual left	None	Reduced length of left turn availability to Leppert Street	-Removal of parking +Improvement for Emergency Vehicles	None
	Project Integration	No HRM Projects, Bridge Redecking, possible toll changes	None	++Potential New Sidewalk Seapoint to Bancroft, 2016/2017	None	None	None	None	None	None	None	++Potential overlay on Chebucto Road and Mumford Road, 2016/2017	None	None
	TPM Enforcement Requirements	-Enforcement of Exclusive Lane	-Enforcement of Transit only movement	-Enforcement of Transit phase/Transit only movement	-Enforcement of Transit only movement	None	None	-Enforcement of Exclusive Lane	-Enforcement of Transit phase/Transit only movement	None	-Enforcement of Transit only movement	-Enforcement of Transit only lane	--Significant enforcement of parking restrictions, Transit only movement	None
	Issues to Implementation	-Requires endorsement by HHB	-Removal of existing sign structure is required	N/A	N/A	Requires further investigation of left turns to Bruce Street	N/A	-Property Acquisition Required	N/A	N/A	N/A	N/A	N/A	-Intersection is under NSTIR Jurisdiction
	Promotion of Transit	+Good Promotion of Transit	+Good Promotion of Transit	+Good Promotion of Transit	+Good Promotion of Transit	Continues on existing promotion of Transit	None	++Great Promotion of Transit	+Good Promotion of Transit	+Good Promotion of Transit	+Good Promotion of Transit	+Good Promotion of Transit	++Great Promotion of Transit	None
	Schedule Adherence	+Improved schedule adherence	+Improved schedule adherence	+Improved schedule adherence	+Improved schedule adherence	+Improved schedule adherence	None	None	+Improved schedule adherence	+Improved schedule adherence	+Improved schedule adherence	+Improved schedule adherence	+Improved schedule adherence	None
Overall Evaluation		**9**	**10**	**13**	**1**	**6**	**7**	**3**	**7**	**8**	**7**	**5**	**2**	**0**

NOTES: 1. Scored on a scale of 0 to 5. Max score assigned for overall delay savings greater than 15 net Road user hours.
2. Scored on a scale of 0 to 5. Max score assigned for payback period less than 1 year.
3. Scored by combining each of the scores for the subcategories.

Table 4-2 - TPM Overall Evaluation

Rank	TPM #	TPM Location	Overall Evaluation
1	3	Windmill Road @ Seapoint Road (SB)	13
2	2	Windmill Road @ Victoria Road (NB)	10
3	1	Macdonald Bridge @ Wyse Road	9
4	9	Main Street @ Hartlen Street	8
5	8	Robie Street @ Almon Street	7
6	10	Chebucto Road @ Connaught Avenue	7
7	6	Barrington Street @ Macdonald Bridge Ramp	7
8	5	Portland Street @ Woodlawn Road	6
9	11	Mumford Road @ Chebucto Road	5
10	7	Windmill Road @ Akerley Boulevard	3
11	12	Robie Street @ Quinpool Road	2
12	4	Main Street @ Gordon Avenue	1
13	13	Cobequid Terminal @ Cobequid Road	0

5.0 Summary & Recommended Five-Year Implementation Plan

5.1 Summary

One of the main project objectives of the Halifax Transit Priority Measures Study is to evaluate a roster of intersection opportunities for transit priority measures (TPM). In total, a roster of 19 locations was developed for initial screening (***Selection of TPM Locations,*** WSP July 2015) and the 13 locations detailed in this report were selected for further review and evaluation.

Each of the 13 TPM locations has been individually assessed to determine the expected impacts to delay for transit and non-transit vehicles, as well as to consider any other site specific key factors associated with the proposed TPM. Order of magnitude cost estimates have been prepared for each TPM and compared to the expected cost savings to Halifax Transit resulting from reduced transit vehicle running time as well as cost savings to the public resulting from changes in delay. Payback Periods were determined for each TPM based on the project costs and savings. The results found that all 13 TPMs are expected to yield delay reductions for transit vehicles during the associated peak hour but that there are varying delay results expected for non-transit vehicles. The implementation cost estimates for installation of the 13 proposed TPM ranged from $4,000 to over $300,000.

Each TPM was given an overall evaluation score to facilitate direct comparisons between differing opportunities. Overall, there were high rankings for a mix of large and small scale TPM opportunities. This indicates that a small project can compare favourably to a large scale project in the right scenario and may be easier to budget for and implement in the near term versus larger scale opportunities that require more detailed design and budgeting for higher capital costs.

The Summary Comparison Matrix provides a tool for comparative analysis of the candidate TPM sites by combining multiple variables into a single measure to assist decision making. The Matrix has allowed a ranking of the locations to be considered for implementation by Halifax Transit. It is important to keep in mind that multiple criteria analysis is a tool that aids in decision making, and that rankings alone should not be used to deem locations suitable or unsuitable or to provide an absolute order of which locations should be considered for implementation.

Using the results of the comparative analysis and the estimated capital costs, a recommended five-year implementation plan was developed for the TPMs.

5.2 Recommended Five-Year Implementation Plan

Using the TPM Summary Evaluation Matrix (Table 4-1) and Estimated Capital Costs (Table 3-1) from this report, a recommended five-year implementation plan was developed. The implementation of TPM #4 will cost more than estimated if the installation of a receiving lane on Main Street is included. Staff from Halifax Transit have indicated that they intend to implement TPM #8 (Robie Street @ Almon Street) and TPM #9 (Main Street @ Hartlen Street) within the short term. Table 5-1 shows the recommended Five-Year Implementation Plan for the TPM evaluated in this report with the implementation of TPM at locations 8 and 9 shown in the current year for reference. If TPMs 8 and 9 cannot be implemented in 2016 they should both be completed in 2017 with preference to TPM #9 with its improved delay reduction and lower cost when compared to TPM #8. Included in the schedule is accommodation for detailed design.

The Summary Comparison Matrix provides a tool for comparative analysis of the candidate TPM sites by combining multiple variables into a single measure to assist decision making. The Matrix has allowed a ranking of the locations to be considered for implementation by Halifax Transit. It is important to keep in mind that multiple criteria analysis is a tool that aids in decision making, and that rankings alone should not be used to deem locations suitable or unsuitable or to provide an absolute order of which locations should be considered for implementation.

Table 5-1 – Proposed Five-year TPM Implementation Plan

TPM Location[1]	TPM #	Estimated Capital Cost[2]	Implementation Year					
			2016	2017	2018	2019	2020	2021
MacDonald Bridge @ Wyse Road[3]	1	$12,000		Design	Construct			
Windmill Road @ Victoria Road (NB)	2	$299,000			Design	Construct		
Windmill Road @ Seapoint Road (SB)[4]	3	$276,000	Design	Construct				
Main Street @ Gordon Avenue[5]	4	$4,000			Design	Design	Construct	
Portland Street @ Woodlawn Road	5	$68,000				Design	Construct	
Barrington Street @ MacDonald Bridge Ramp[3]	6	$83,000		Design	Construct			
Windmill Road @ Akerley Boulevard	7	$332,000				Design	Design	Construct
Robie Street @ Almon Street	8	$6,000	Construct					
Main Street @ Hartlen Street	9	$4,000	Construct					
Chebucto Road @ Connaught Avenue	10	$99,000		Design	Construct			
Mumford Road @ Chebucto Road[4]	11	$10,000	Design	Construct				
Robie Street @ Quinpool Road[6]	12	$20,000				Planning		
Cobequid Terminal @ Cobequid Road[7]	13	$4,000				Design	Construct	
Total Cost[8]		**$1,217,000**	**$ 10,000**	**$ 286,000**	**$ 194,000**	**$ 299,000**	**$ 96,000**	**$ 332,000**

1. In addition to the TPM locations assessed in this report, there may be additional TPM opportunities that are developed during the five-year implementation plan that warrant implementation before some of the 13 locations.
2. This estimate of probable construction cost is approximate only. Includes 35% contingency, excludes HST and property acquisition, details shown in Appendix B.
3. The completion of TPM #1 and TPM #6 in 2017 would coincide with the anticipated completion of The Big Lift.
4. TPM #3 and TPM #11 should be integrated with upcoming Capital Works Projects, with both projects anticipated for the 2016/17 Budget Year. Any delay in these Capital Works Projects should also delay the installation of the TPM.
5. TPM #4 should be designed with consideration to adding a receiving lane on Main Street east of Gordon Avenue. The installation of a receiving lane would increase the capital cost.
6. Defer TPM at this location until the overall intersection is further reviewed.
7. Consider for actuation of the left turn phase by Transit vehicles only.
8. Total project cost for each budget year assumes that the full capital cost is realized in the Construction year.

Table 5-1 considers the integration opportunities of TPM #3 and TPM #11 with scheduled Capital Works Projects at these locations. With the redecking of the Macdonald Bridge currently underway and its anticipated completion in Fall 2017, it is recommended that TPM #1 and TPM #6 be completed in 2017. Although this is not truly an integration opportunity, it is expected that there would be reduced impact to drivers and cost savings if the projects could be completed together, possibly during a scheduled bridge closure, and would mean that Macdonald Bridge users would become familiar with the new lane use restrictions of each TPM upon completion of the combined projects.

Halifax Transit staff should review the recommended five-year implementation plan and if necessary, seek additional capital funding for planning and implementation of the most beneficial locations over the next five years. The following are specific items to individual TPM locations that should be considered when planning for their implementation:

1. TPM at the intersection of Chebucto Road and Connaught Avenue in the eastbound direction should be accompanied by the installation of an eastbound receiving lane.

2. TPM on northbound Barrington Street at the approach to the Macdonald Bridge ramp should:
   a. Reassign a southbound through lane as left turn lanes at the intersection with North Street, as shown in Figure A-6B; and,
   b. Consider the additional relocation of the nearside bus stop south of North Street to the new stop location.

3. Before considering implementation of the TPM on Main Street at Gordon Avenue HRM should seek opportunities to install a short receiving lane on Main Street east of Gordon Avenue.

4. The modifications to the Toll lane at the Macdonald Bridge TPM could be implemented as a pilot project and further reviewed to provide information on how the lane usage change would impact actual operations in the merge area past the toll lanes to the bridge.

5. TPM at the intersection of Robie Street at Quinpool Road should be deferred until the overall intersection is further reviewed.

6. TPM at the intersection of the Cobequid Terminal at Cobequid Road should include a left turn phase that is activated by transit vehicles only.

Appendix A

Conceptual Layouts

LEGEND

PROPERTY BOUNDARY
PROPOSED SIGN
PAVEMENT ARROW
TRAFFIC SIGNAL MODIFICATIONS

Notes:

1. All property boundaries shown are approximate only.
2. Proposed changes are conceptual and representative only.
3. Background aerial photography is for information purposes only and does not necessarily reflect the current existing condition.

Drawn: P. NICKERSON

Engineer: G. O'BRIEN

TRANSIT PRIORITY STUDY

MACDONALD BRIDGE AT WYSE ROAD

FIGURE A-1

HALIFAX

MARCH 2016

WSP
1 SPECTACLE LAKE DRIVE
DARTMOUTH, NOVA SCOTIA CANADA, B3B 1X7
PHONE: 902 835-9955 - FAX: 902 835-1645 - WWW.WSPGROUP.COM

FILE: K:\DARTMOUTH\2015\151-01704 HALIFAX_TRANSIT PRIORITIES MEASURES\11_DWG\11.7_TRAFFIC\151-01704 - FUNCTIONAL DESIGNS\V2.DWG
Sheet: 1

LEGEND

- PROPERTY BOUNDARY
- PROPOSED SIGN
- PAVEMENT ARROW
- TRAFFIC SIGNAL MODIFICATIONS

Notes:

1. All property boundaries shown are approximate only.
2. Proposed changes are conceptual and representative only.
3. Background aerial photography is for information purposes only and does not necessarily reflect the existing condition.

Drawn: P. NICKERSON

Engineer: G. O'BRIEN

TRANSIT PRIORITY STUDY

WINDMILL ROAD AT VICTORIA ROAD

FIGURE A-2

HALIFAX

MARCH 2016

WSP

1 SPECTACLE LAKE DRIVE
DARTMOUTH, NOVA SCOTIA CANADA, B3B 1X7
PHONE: 902 835-9955 - FAX: 902 835-1645 - WWW.WSPGROUP.COM

FILE: K:\DARTMOUTH\2015\151-01704 HALIFAX_TRANSIT PRIORITIES MEASURES\11_ DWG\11.7_TRAFFIC\151-01704 - FUNCTIONAL DESIGNSV2.DWG Sheet:2

LEGEND

- PROPERTY BOUNDARY
- PROPOSED SIGN
- PAVEMENT ARROW
- TRAFFIC SIGNAL MODIFICATIONS

Notes:

1. All property boundaries shown are approximate only.
2. Proposed changes are conceptual and representative only.
3. Background aerial photography is for information purposes only and does not necessarily reflect the current existing condition.

Drawn: P. NICKERSON

Engineer: G. O'BRIEN

TRANSIT PRIORITY STUDY

WINDMILL ROAD AT SEAPOINT ROAD

FIGURE A-3

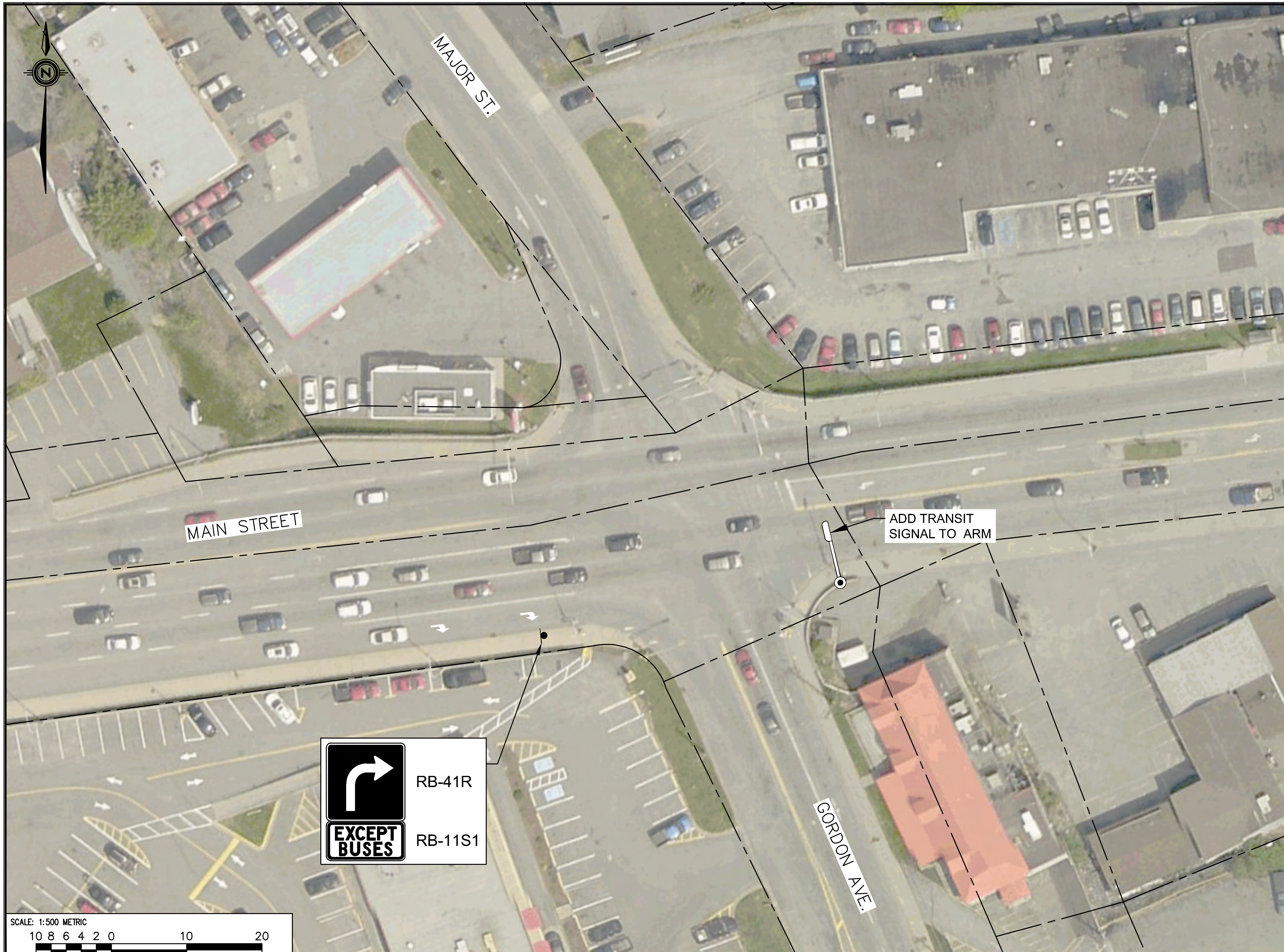
HALIFAX

MARCH 2016

WSP

1 SPECTACLE LAKE DRIVE
DARTMOUTH, NOVA SCOTIA CANADA, B3B 1X7
PHONE: 902 835-9955 - FAX: 902 835-1645 - WWW.WSPGROUP.COM

FILE: K:\DARTMOUTH\2015\151-01704 HALIFAX_TRANSIT PRIORITIES MEASURES\11_ DWG\11.7_TRAFFIC\151-01704 - FUNCTIONAL DESIGNSV2.DWG Sheet:3



LEGEND

- PROPERTY BOUNDARY
- PROPOSED SIGN
- PAVEMENT ARROW
- TRAFFIC SIGNAL MODIFICATIONS

Notes:

1. All property boundaries shown are approximate only.
2. Proposed changes are conceptual and representative only.
3. Background aerial photography is for information purposes only and does not necessarily reflect the current existing condition.

Drawn: P. NICKERSON

Engineer: G. O'BRIEN

TRANSIT PRIORITY STUDY

MAIN STREET AT GORDON AVENUE

FIGURE A-4

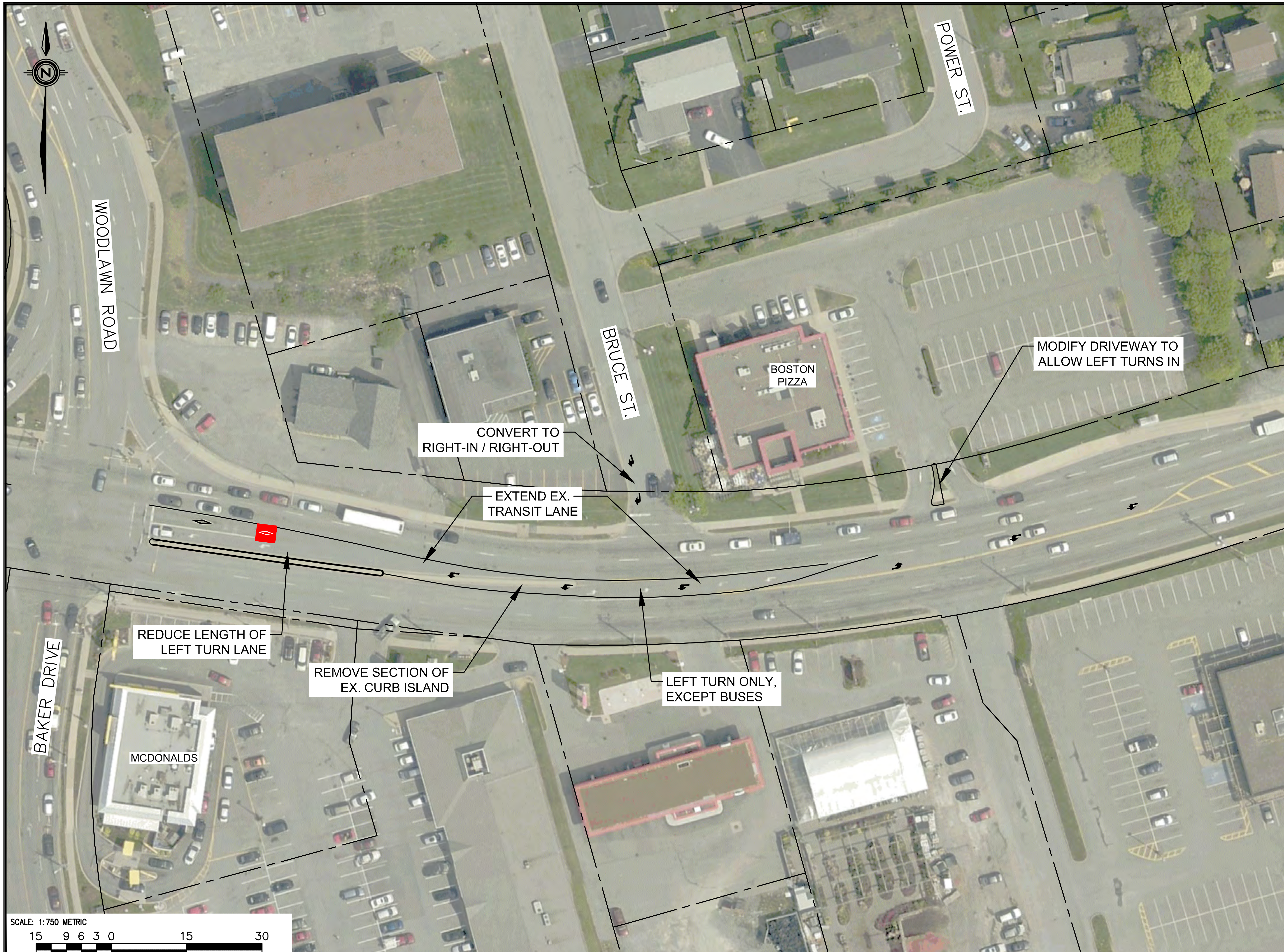
HALIFAX

MARCH 2016

WSP

1 SPECTACLE LAKE DRIVE
DARTMOUTH, NOVA SCOTIA CANADA, B3B 1X7
PHONE: 902 835-9955 - FAX: 902 835-1645 - WWW.WSPGROUP.COM

FILE: K:\DARTMOUTH\2015\151-01704 HALIFAX_TRANSIT PRIORITIES MEASURES\11_ DWG\11.7_TRAFFIC\151-01704 - FUNCTIONAL DESIGNSV2.DWG Sheet:4



LEGEND

- PROPERTY BOUNDARY
- PROPOSED SIGN
- PAVEMENT ARROW
- TRAFFIC SIGNAL MODIFICATIONS

Notes:

1. All property boundaries shown are approximate only.
2. Proposed changes are conceptual and representative only.
3. Background aerial photography is for information purposes only and does not necessarily reflect the current existing condition.

Drawn: P. NICKERSON

Engineer: G. O'BRIEN

TRANSIT PRIORITY STUDY

PORTLAND STREET AT WOODLAWN ROAD

FIGURE A-5

HALIFAX

MARCH 2016

WSP
1 SPECTACLE LAKE DRIVE
DARTMOUTH, NOVA SCOTIA CANADA, B3B 1X7
PHONE: 902 835-9955 - FAX: 902 835-1645 - WWW.WSPGROUP.COM

FILE: K:\DARTMOUTH\2015\151-01704 HALIFAX_TRANSIT PRIORITY MEASURES\11_DWG\11.7_TRAFFIC\151-01704 - FUNCTIONAL DESIGNSV2.DWG Sheet:5

LEGEND

- PROPERTY BOUNDARY
- PROPOSED SIGN
- PAVEMENT ARROW
- TRAFFIC SIGNAL MODIFICATIONS

Notes:

1. All property boundaries shown are approximate only.
2. Proposed changes are conceptual and representative only.
3. Background aerial photography is for information purposes only and does not necessarily reflect the current existing condition.

Drawn: P. NICKERSON

Engineer: G. O'BRIEN

TRANSIT PRIORITY STUDY

BARRINGTON ST. AT MACDONALD BRIDGE RAMP

FIGURE A-6A

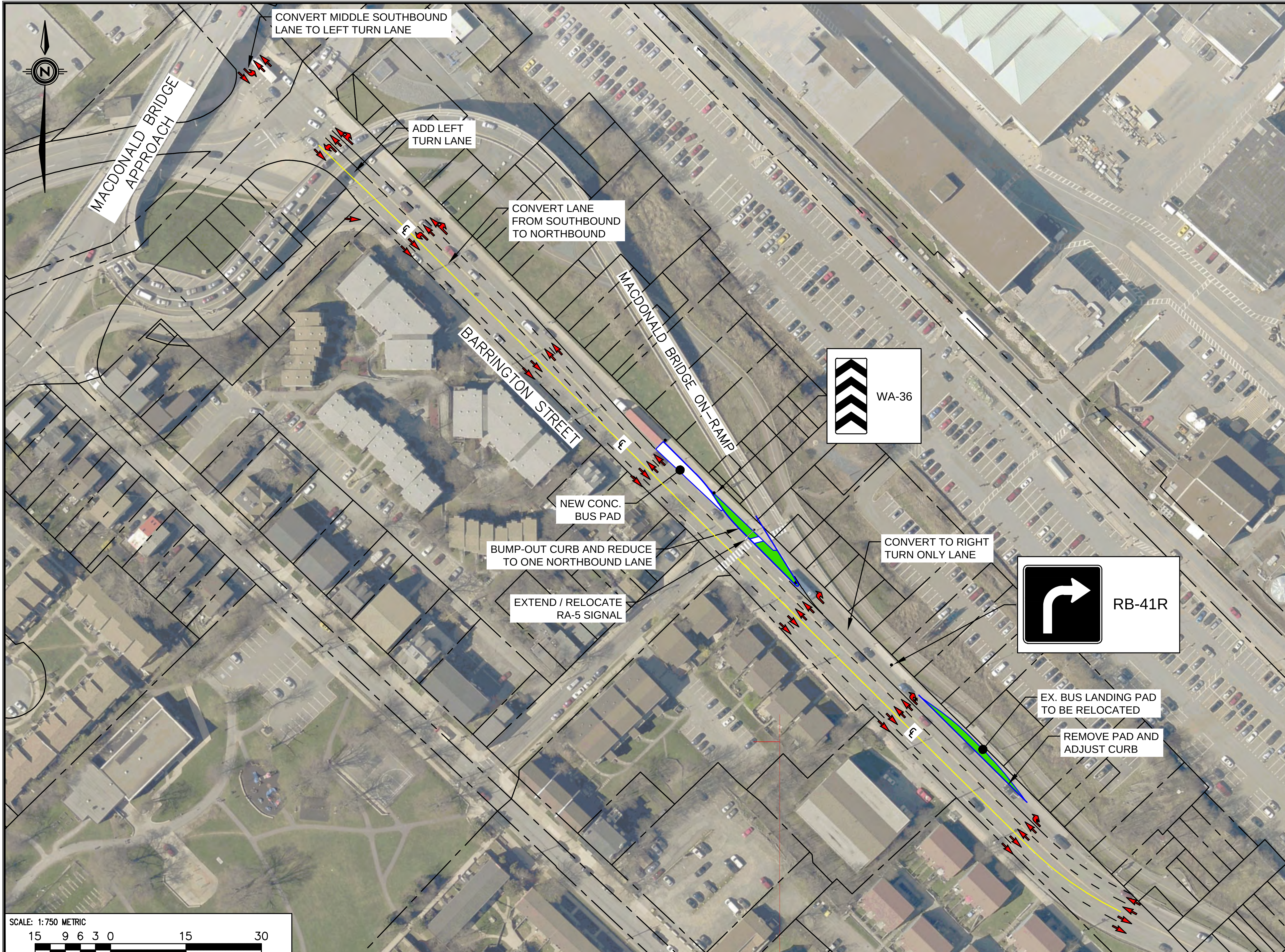
HALIFAX

MARCH 2016

SCALE: 1:750

WSP

1 SPECTACLE LAKE DRIVE
DARTMOUTH, NOVA SCOTIA CANADA, B3B 1X7
PHONE: 902 835-9955 - FAX: 902 835-1645 - WWW.WSPGROUP.COM



LEGEND

- PROPERTY BOUNDARY
- PROPOSED SIGN
- PAVEMENT ARROW
- TRAFFIC SIGNAL MODIFICATIONS

Notes:

1. All property boundaries shown are approximate only.
2. Proposed changes are conceptual and representative only.
3. Background aerial photography is for information purposes only and does not necessarily reflect the current existing condition.

Drawn: P. NICKERSON

Engineer: G. O'BRIEN

TRANSIT PRIORITY STUDY

BARRINGTON ST. AT MACDONALD BRIDGE RAMP

FIGURE A-6B

HALIFAX

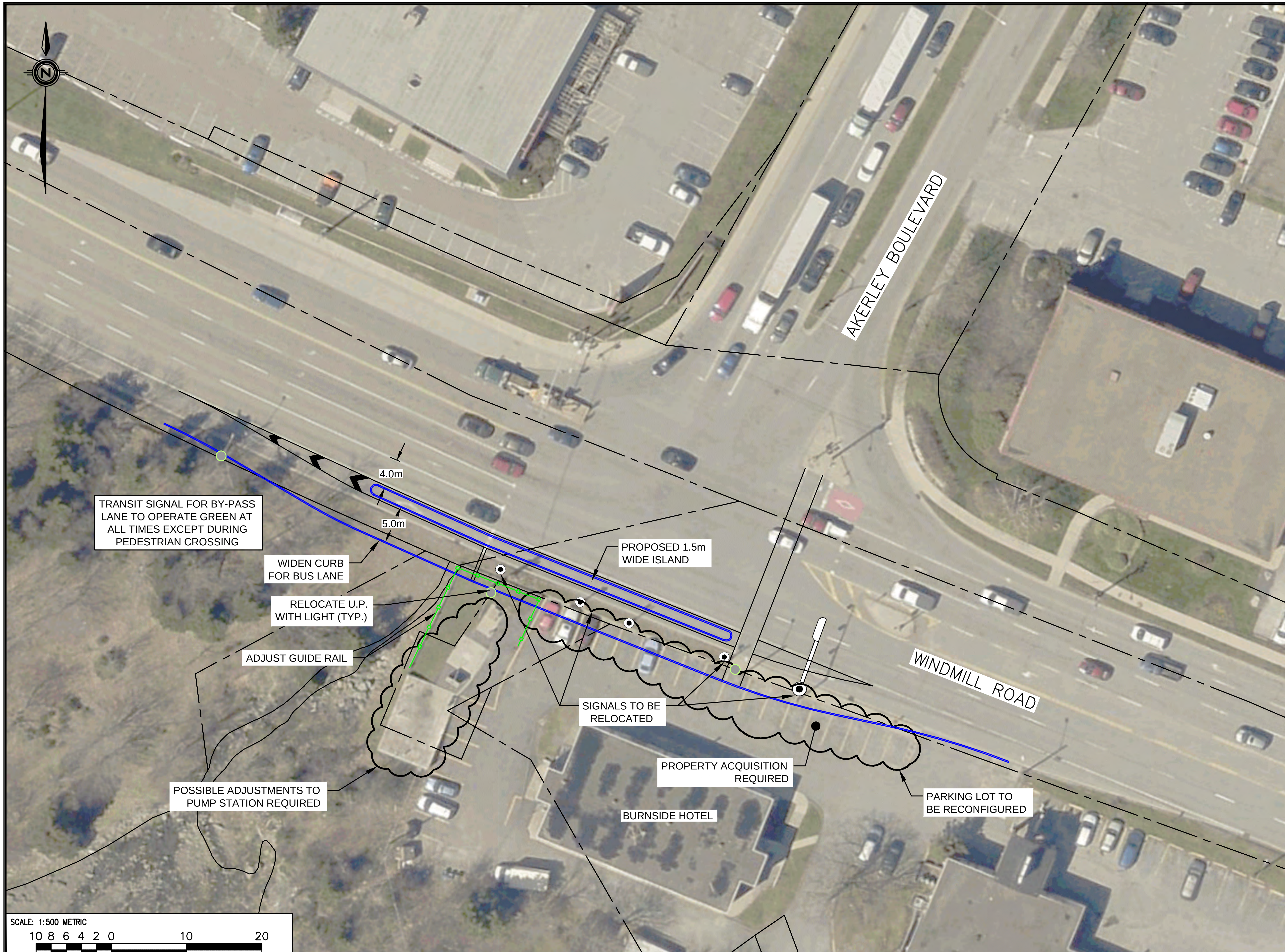
MARCH 2016

SCALE: NOT TO SCALE

WSP

1 SPECTACLE LAKE DRIVE
DARTMOUTH, NOVA SCOTIA CANADA, B3B 1X7
PHONE: 902 835-9955 - FAX: 902 835-1645 - WWW.WSPGROUP.COM

FILE: K:\DARTMOUTH\2015\151-01704 HALIFAX_TRANSIT PRIORITIES MEASURES\11_ DWG\11.7_TRAFFIC\151-01704 - FUNCTIONAL DESIGNSV2.DWG Sheet:6B



LEGEND

- PROPERTY BOUNDARY
- PROPOSED SIGN
- PAVEMENT ARROW
- TRAFFIC SIGNAL MODIFICATIONS

Notes:

1. All property boundaries shown are approximate only.
2. Proposed changes are conceptual and representative only.
3. Background aerial photography is for information purposes only and does not necessarily reflect the current existing condition.

Drawn: P. NICKERSON

Engineer: G. O'BRIEN

TRANSIT PRIORITY STUDY

WINDMILL ROAD AT AKERLEY BOULEVARD

FIGURE A-7

HALIFAX

MARCH 2016

SCALE: 1:500

WSP

1 SPECTACLE LAKE DRIVE
DARTMOUTH, NOVA SCOTIA CANADA, B3B 1X7
PHONE: 902 835-9955 - FAX: 902 835-1645 - WWW.WSPGROUP.COM

FILE: K:\DARTMOUTH\2015\151-01704 HALIFAX_TRANSIT PRIORITIES MEASURES\11_DWG\11.7_TRAFFIC\151-01704 - FUNCTIONAL DESIGNS\V2.DWG

Sheet 7

LEGEND

- PROPERTY BOUNDARY
- PROPOSED SIGN
- PAVEMENT ARROW
- TRAFFIC SIGNAL MODIFICATIONS

Notes:

1. All property boundaries shown are approximate only.
2. Proposed changes are conceptual and representative only.
3. Background aerial photography is for information purposes only and does not necessarily reflect the current existing condition.

Drawn: P. NICKERSON

Engineer: G. O'BRIEN

TRANSIT PRIORITY STUDY

ROBIE STREET BETWEEN ALMON ST. AND YOUNG ST.

FIGURE A-8

HALIFAX

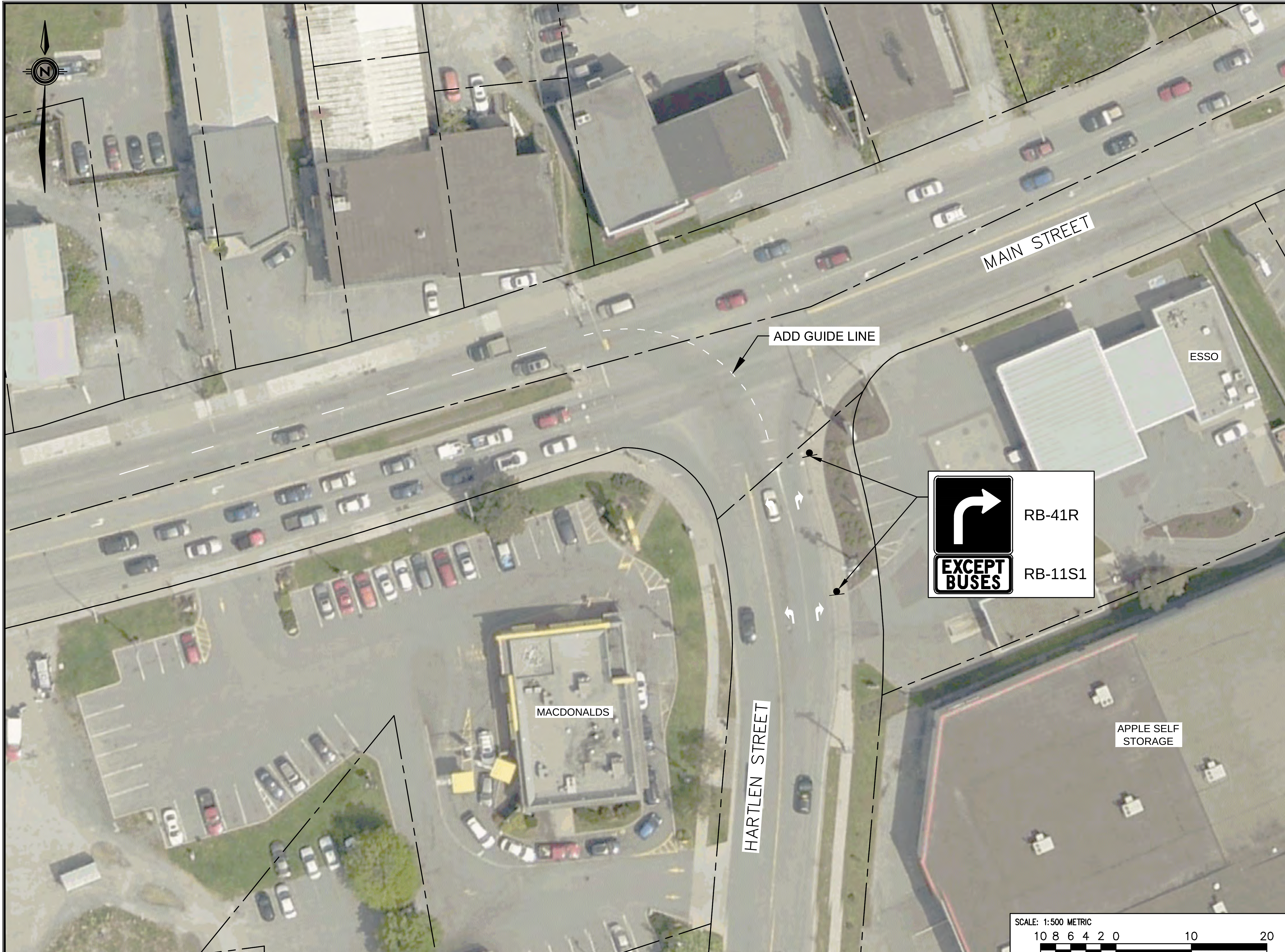
MARCH 2016

SCALE: 1:500

WSP

1 SPECTACLE LAKE DRIVE
DARTMOUTH, NOVA SCOTIA CANADA, B3B 1X7
PHONE: 902 835-9955 - FAX: 902 835-1645 - WWW.WSPGROUP.COM

FILE: K:\DARTMOUTH\2015\151-01704 HALIFAX_TRANSIT PRIORITIES MEASURES\11_ DWG\11.7_TRAFFIC\151-01704 - FUNCTIONAL DESIGNSV2.DWG Sheet:8



LEGEND

- PROPERTY BOUNDARY
- PROPOSED SIGN
- PAVEMENT ARROW
- TRAFFIC SIGNAL MODIFICATIONS

Notes:

1. All property boundaries shown are approximate only.
2. Proposed changes are conceptual and representative only.
3. Background aerial photography is for information purposes only and does not necessarily reflect the current existing condition.

Drawn: P. NICKERSON

Engineer: G. O'BRIEN

TRANSIT PRIORITY STUDY

HARTLEN ST. AT MAIN ST.

FIGURE A-9

HALIFAX

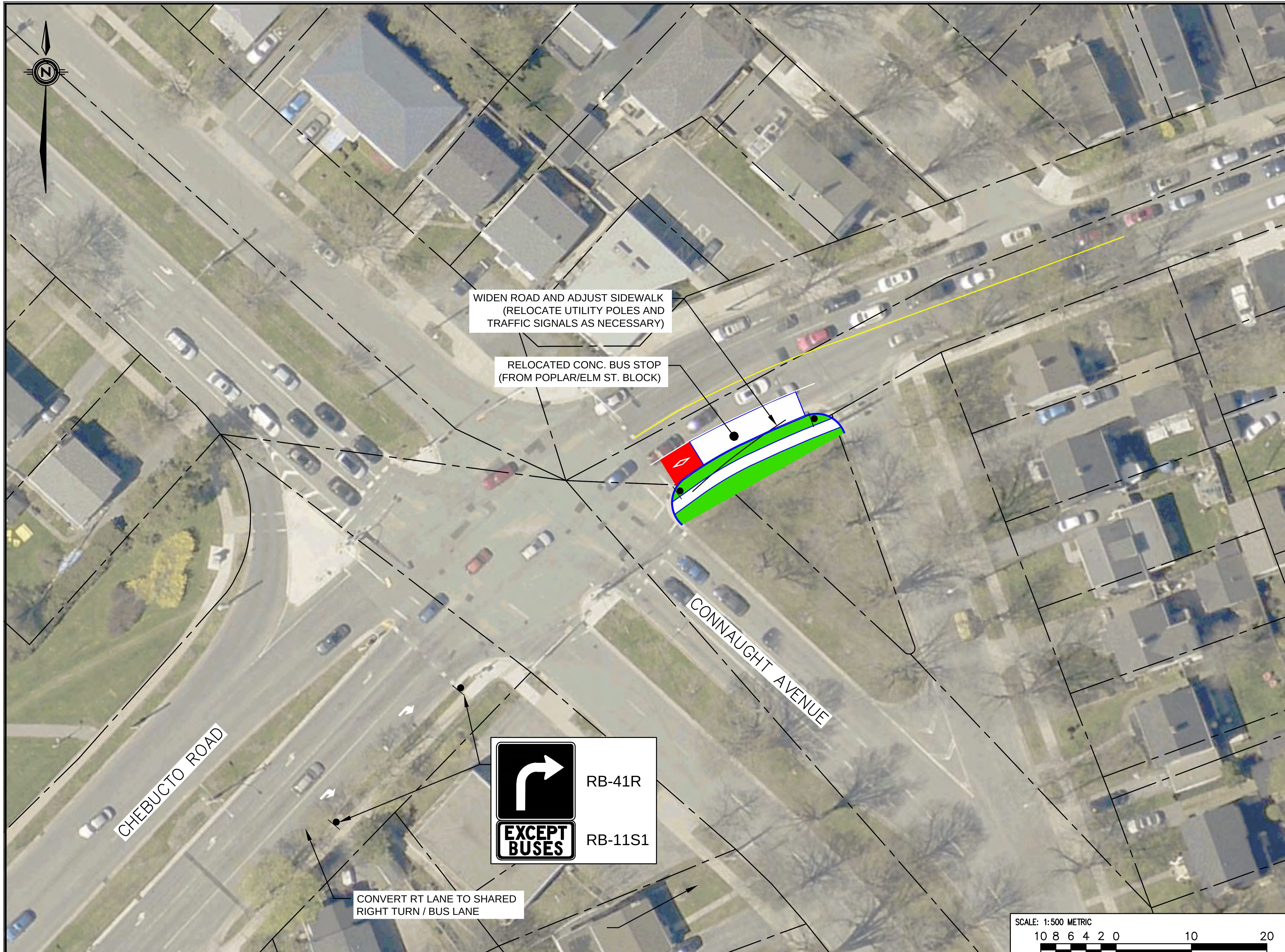
MARCH 2016

SCALE: 1:500

WSP

1 SPECTACLE LAKE DRIVE
DARTMOUTH, NOVA SCOTIA CANADA, B3B 1X7
PHONE: 902 835-9955 - FAX: 902 835-1645 - WWW.WSPGROUP.COM

FILE: K:\DARTMOUTH\2015\151-01704 HALIFAX_TRANSIT PRIORITIES MEASURES\11_ DWG\11.7_TRAFFIC\151-01704 - FUNCTIONAL DESIGNSV2.DWG Sheet:9



LEGEND

- PROPERTY BOUNDARY
- PROPOSED SIGN
- PAVEMENT ARROW
- TRAFFIC SIGNAL MODIFICATIONS

Notes:

1. All property boundaries shown are approximate only.
2. Proposed changes are conceptual and representative only.
3. Background aerial photography is for information purposes only and does not necessarily reflect the current existing condition.

Drawn: P. NICKERSON

Engineer: G. O'BRIEN

TRANSIT PRIORITY STUDY

CHEBUCTO ROAD AT CONNAUGHT AVENUE

FIGURE A-10

HALIFAX

MARCH 2016

SCALE: 1:500

WSP

1 SPECTACLE LAKE DRIVE
DARTMOUTH, NOVA SCOTIA CANADA, B3B 1X7
PHONE: 902 835-9955 - FAX: 902 835-1645 - WWW.WSPGROUP.COM

FILE: K:\DARTMOUTH\2015\151-01704 HALIFAX_TRANSIT PRIORITIES MEASURES\11_DWG\11.7_TRAFFIC\151-01704 - FUNCTIONAL DESIGNSV2.DWG

Sheet:10

LEGEND

PROPERTY BOUNDARY

PROPOSED SIGN

PAVEMENT ARROW

TRAFFIC SIGNAL MODIFICATIONS

Notes:

1. All property boundaries shown are approximate only.
2. Proposed changes are conceptual and representative only.
3. Background aerial photography is for information purposes only and does not necessarily reflect the current existing condition.

Drawn: P. NICKERSON

Engineer: G. O'BRIEN

TRANSIT PRIORITY STUDY

MUMFORD ROAD AT CHEBUCTO ROAD

FIGURE A-11

HALIFAX

MARCH 2016

SCALE: 1:500

WSP

1 SPECTACLE LAKE DRIVE
DARTMOUTH, NOVA SCOTIA CANADA, B3B 1X7
PHONE: 902 835-9955 - FAX: 902 835-1645 - WWW.WSPGROUP.COM

FILE: K:\DARTMOUTH\2015\151-01704 HALIFAX_TRANSIT PRIORITIES MEASURES\11_ DWG\11.7_TRAFFIC\151-01704 - FUNCTIONAL DESIGNSV2.DWG

Sheet:11

LEGEND

PROPERTY BOUNDARY
PROPOSED SIGN
PAVEMENT ARROW
TRAFFIC SIGNAL MODIFICATIONS

Notes:

1. All property boundaries shown are approximate only.
2. Proposed changes are conceptual and representative only.
3. Background aerial photography is for information purposes only and does not necessarily reflect the current existing condition.

Drawn: P. NICKERSON

Engineer: G. O'BRIEN

TRANSIT PRIORITY STUDY

ROBIE STREET AT QUINPOOL ROAD

FIGURE A-12

HALIFAX

MARCH 2016

SCALE: 1:500

WSP

1 SPECTACLE LAKE DRIVE
DARTMOUTH, NOVA SCOTIA CANADA, B3B 1X7
PHONE: 902 835-9955 - FAX: 902 835-1645 - WWW.WSPGROUP.COM

FILE: K:\DARTMOUTH\2015\151-01704 HALIFAX_TRANSIT PRIORITIES MEASURES\11_ DWG\11.7_TRAFFIC\151-01704 - FUNCTIONAL DESIGNSV2.DWG Sheet:12

LEGEND

- PROPERTY BOUNDARY
- PROPOSED SIGN
- PAVEMENT ARROW
- TRAFFIC SIGNAL MODIFICATIONS

Notes:

1. All property boundaries shown are approximate only.
2. Proposed changes are conceptual and representative only.
3. Background aerial photography is for information purposes only and does not necessarily reflect the current existing condition.

Drawn: P. NICKERSON

Engineer: G. O'BRIEN

TRANSIT PRIORITY STUDY

COBEQUID ROAD AT COBEQUID TERMINAL

FIGURE A-13

HALIFAX

MARCH 2016

SCALE: 1:500

WSP

1 SPECTACLE LAKE DRIVE
DARTMOUTH, NOVA SCOTIA CANADA, B3B 1X7
PHONE: 902 835-9955 - FAX: 902 835-1645 - WWW.WSPGROUP.COM

FILE: K:\DARTMOUTH\2015\151-01704 HALIFAX_TRANSIT PRIORITIES MEASURES\11_ DWG\11.7_TRAFFIC\151-01704 - FUNCTIONAL DESIGNSV2.DWG Sheet:13

Appendix B

Estimated TPM Costs

HRM TRANSIT PRIORITIES
HIGH LEVEL ESTIMATE OF PROBABLE COSTS

PROJECT NO. 151-01704
DATE: Oct. 16, 2015
CLIENT: HRM
CONSULTANT: WSP
UNIT PRICE SOURCE: WSP
NOTE: HST NOT INCLUDED IN INDICATED UNIT PRICES AND TOTALS.

This estimate of probable construction cost is approximate only. Actual cost may vary significantly from this estimate due to market conditions such as material and labour costs, time of year, industry workload, competition, etc. This estimate has been prepared based on our experience with similar projects. This estimate has not been prepared by obtaining any estimates or quotes from contractors. Due to the uncertainties of what contractors bid, WSP cannot make any assurances that this estimate will be within a reasonable range of the tendered low bid. When assessing this project for business feasibility purposes this estimate should not be relied upon without considering these factors.

				SITE LOCATION (See Description Below)											
				#1		#2		#3[3]		#4		#5		#6	
ITEM	DESCRIPTION	UNITS	UNIT PRICE	QNTY.	COST	QNTY.	COST	QNTY.	COST	QNTY.	COST	QNTY.	COST	QNTY.	COST
1	Land Acquisition Anticipated?	-	-	No		No		No		No		No		No	
2	Street Widening	m2	$100			600	$60,000	900	$90,000			60	$6,000		
3	Street Removal	m2	$10											280	$2,800
4	Curbs	m	$100			250	$25,000	235	$23,500			125	$12,500	150	$15,000
5	Curb Removal	m	$25			250	$6,250	235	$5,875			210	$5,250	150	$3,750
6	Sidewalks	m2	$100											5	$500
7	Sidewalk Removal	m2	$20												
8	Bus Pad	m2	$150											90	$13,500
9	Signs (Landscape)	each	$600			3	$1,800					2	$1,200	1	$600
10	Signs (Concrete)	each	$1,000	1	$1,000					1	$1,000	1	$1,000	3	$3,000
11	Landscaping	m2	$12			300	$3,600	365	$4,380			300	$3,600	180	$2,160
12	Pavement Markings	LS		1	$250	1	$2,000	1	$1,500	1	$250	1	$7,500	1	$2,500
13	In-Lay Reserved Lane Symbol	each	$5,000	1	$5,000							1	$5,000		
14	Add Transit Priority Signal	each	$2,000							1	$2,000				
15	Signal/Light Relocation	each	$10,000			4	$40,000							1	$10,000
16	Power Pole Relocation	each	$7,500			2	$15,000	9	$67,500						
17	Catchbasin Relocation	each	$8,000			2	$16,000	1	$8,000			1	$8,000	1	$8,000
19	Transit Bench/Pad Relocation	each	$1,500			1	$1,500								
20	Guard Rail Replacement	m	$120												
21	Removable Delineators	each	$750	4	$3,000										
22	Fencing	m	$100					35	$3,500						
24	Add Left Turn Signal Phase	LS	$3,000												
25	Misc Costs[1,2]	LS				1	$50,000								

	#1	#2	#3	#4	#5	#6
Sub-Total	**$9,250**	**$221,150**	**$204,255**	**$3,250**	**$50,050**	**$61,810**
Contingency (35%)	**$3,238**	**$77,403**	**$71,489**	**$1,138**	**$17,518**	**$21,634**
ESTIMATED COST (excl. HST)	**$12,000**	**$299,000**	**$276,000**	**$4,000**	**$68,000**	**$83,000**

SITE LOCATIONS

#1	MacDonald Bridge @ Wyse Road
#2	Windmill Road @ Victoria Road (NB)
#3	Windmill Road @ Seapoint Road (SB)
#4	Main Street @ Gordon Avenue
#5	Portland Street @ Woodlawn Road
#6	Barrington Street @ MacDonald Bridge Ramp

1. Allowance for removal/relocation of truss sign structure, TPM #2
2. Allowance for parking lot adjustments, Burnside Hotel, TPM #7
3. TPM #3 (Windmill @ Seapoint) can be integrated with sidewalk installation on Windmill Road. Cost of sidewalk was not included in the estimate.
4. TPM #11 (Mumford @ Chebucto) can be integrated with resurfacing of Mumford Road. Costs for slight modifications to pavement markings was not included in the estimate.

HRM TRANSIT PRIORITIES
HIGH LEVEL ESTIMATE OF PROBABLE COSTS

PROJECT NO.	151-01704
DATE:	Oct. 16, 2015
CLIENT:	HRM
CONSULTANT:	WSP
UNIT PRICE SOURCE:	WSP

NOTE: HST NOT INCLUDED IN INDICATED UNIT PRICES AND TOTALS.

This estimate of probable construction cost is approximate only. Actual cost may vary significantly from this estimate due to market conditions such as material and labour costs, time of year, industry workload, competition, etc. This estimate has been prepared based on our experience with similar projects. This estimate has not been prepared by obtaining any estimates or quotes from contractors. Due to the uncertainties of what contractors bid, WSP cannot make any assurances that this estimate will be within a reasonable range of the tendered low bid. When assessing this project for business feasibility purposes this estimate should not be relied upon without considering these factors.

				SITE LOCATION (See Description Below)													
				#7		#8		#9		#10		#11		#12		#13	
ITEM	DESCRIPTION	UNITS	UNIT PRICE	QNTY.	COST	QNTY.	COST	QNTY.	COST	QNTY.	COST	QNTY.	COST	QNTY.	COST	QNTY.	COST
1	Land Acquisition Anticipated?	-	-	Yes		No		No		No		No		No		No	
2	Street Widening	m2	$100	400	$40,000					40	$4,000						
3	Street Removal	m2	$10	150	$1,500												
4	Curbs	m	$100	250	$25,000					35	$3,500						
5	Curb Removal	m	$25	150	$3,750					35	$875						
6	Sidewalks	m2	$100	50	$5,000					40	$4,000						
7	Sidewalk Removal	m2	$20	50	$1,000					40	$800						
8	Bus Pad	m2	$150							55	$8,250						
9	Signs (Landscape)	each	$600							4	$2,400	1	$600				
10	Signs (Concrete)	each	$1,000	1	$1,000	2	$2,000	2	$2,000					2	$2,000		
11	Landscaping	m2	$12	300	$3,600					80	$960						
12	Pavement Markings	LS		1	$7,500	1	$500	1	$1,000	1	$500			1	$7,500		
13	In-Lay Reserved Lane Symbol	each	$5,000	1	$5,000					1	$5,000	1	$5,000	1	$5,000		
14	Add Transit Priority Signal	each	$2,000			1	$2,000					1	$2,000				
15	Signal/Light Relocation	each	$10,000	5	$50,000					2	$20,000						
16	Power Pole Relocation	each	$7,500	3	$22,500					2	$15,000						
17	Catchbasin Relocation	each	$8,000	2	$16,000					1	$8,000						
19	Transit Bench/Pad Relocation	each	$1,500														
20	Guard Rail Replacement	m	$120	35	$4,200												
21	Removable Delineators	each	$750														
22	Fencing	m	$100														
24	Add Left Turn Signal Phase	LS	$3,000													1	$3,000
25	Misc Costs[1,2]	LS		1	$60,000												

	#7	#8	#9	#10	#11	#12	#13
Sub-Total	**$246,050**	**$4,500**	**$3,000**	**$73,285**	**$7,600**	**$14,500**	**$3,000**
Contingency (35%)	**$86,118**	**$1,575**	**$1,050**	**$25,650**	**$2,660**	**$5,075**	**$1,050**
ESTIMATED COST (excl. HST)	**$332,000**	**$6,000**	**$4,000**	**$99,000**	**$10,000**	**$20,000**	**$4,000**

SITE LOCATIONS

#7	Windmill Road @ Akerley Boulevard
#8	Robie Street @ Almon Street
#9	Main Street @ Hartlen Street
#10	Chebucto Road @ Connaught Avenue
#11	Mumford Road @ Chebucto Road
#12	Robie Street @ Quinpool Road
#13	Cobequid Terminal @ Cobequid Road

1. Allowance for removal/relocation of truss sign structure, TPM #2
2. Allowance for parking lot adjustments, Burnside Hotel, TPM #7
3. TPM #3 (Windmill @ Seapoint) can be integrated with sidewalk installation on Windmill Road. Cost of sidewalk was not included in the estimate.
4. TPM #11 (Mumford @ Chebucto) can be integrated with resurfacing of Mumford Road. Costs for slight modifications to pavement markings was not included in the estimate.

Appendix C

Intersection Performance Analyses

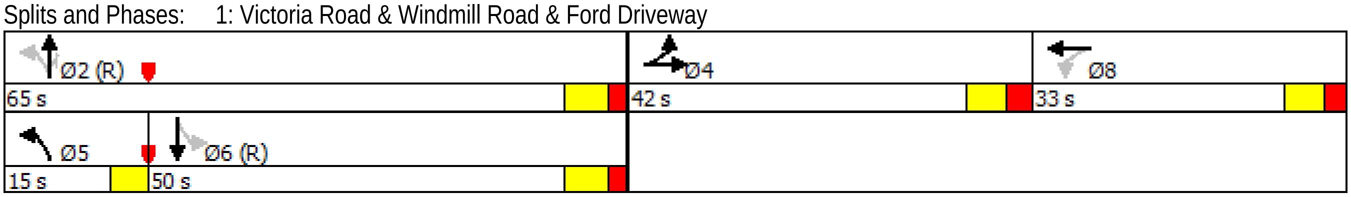
March 2016

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	420	1	70	13	3	7	50	1378	15	4	986	0
Future Volume (vph)	420	1	70	13	3	7	50	1378	15	4	986	0
Satd. Flow (prot)	1700	1654	0	0	1754	0	1789	3579	1601	1789	3579	0
Flt Permitted	0.950	0.966			0.680		0.180			0.119		
Satd. Flow (perm)	1700	1654	0	0	1226	0	339	3579	1601	224	3579	0
Satd. Flow (RTOR)		14			8				81			
Lane Group Flow (vph)	270	264	0	0	25	0	54	1498	16	4	1072	0
Turn Type	Split	NA		Perm	NA		pm+pt	NA	Perm	Perm	NA	
Protected Phases	4	4			8		5	2			6	
Permitted Phases				8			2		2	6		
Total Split (s)	42.0	42.0		33.0	33.0		15.0	65.0	65.0	50.0	50.0	
Total Lost Time (s)	6.7	6.7			6.7		4.0	6.6	6.6	6.6	6.6	
Act Effct Green (s)	27.6	27.6			8.0		92.5	89.9	89.9	80.4	80.4	
Actuated g/C Ratio	0.20	0.20			0.06		0.66	0.64	0.64	0.57	0.57	
v/c Ratio	0.81	0.78			0.32		0.18	0.65	0.02	0.03	0.52	
Control Delay	71.3	66.2			58.8		13.0	19.7	0.0	22.8	16.9	
Queue Delay	0.0	0.0			0.0		0.0	0.0	0.0	0.0	0.0	
Total Delay	71.3	66.2			58.8		13.0	19.7	0.0	22.8	16.9	
LOS	E	E			E		B	B	A	C	B	
Approach Delay		68.8			58.8			19.3			16.9	
Approach LOS		E			E			B			B	
Queue Length 50th (m)	75.3	69.6			4.6		5.5	141.4	0.0	0.2	38.4	
Queue Length 95th (m)	102.3	96.7			14.2		13.3	200.7	0.0	m1.3	120.8	
Internal Link Dist (m)		24.9			43.8			305.5			102.9	
Turn Bay Length (m)							40.0		40.0	30.0		
Base Capacity (vph)	428	427			236		338	2297	1056	128	2055	
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	0.63	0.62			0.11		0.16	0.65	0.02	0.03	0.52	

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green, Master Intersection
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.81
Intersection Signal Delay: 27.0 Intersection LOS: C
Intersection Capacity Utilization 72.8% ICU Level of Service C
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Victoria Road & Windmill Road & Ford Driveway

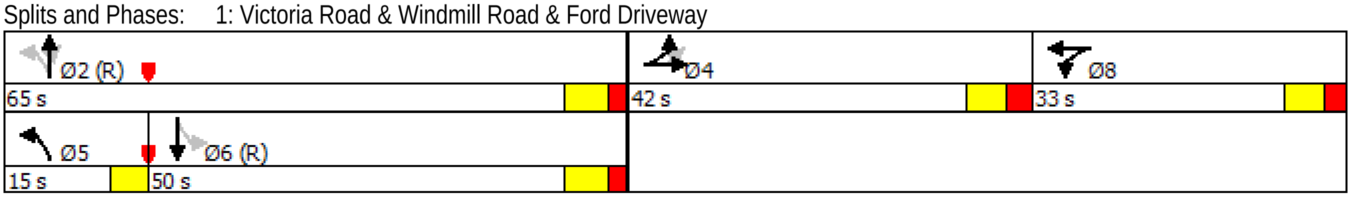


Lane Group	EBL2	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	NBR2	SBL	SBT
Lane Configurations												
Traffic Volume (vph)	420	1	70	13	3	7	50	1360	18	15	4	986
Future Volume (vph)	420	1	70	13	3	7	50	1360	18	15	4	986
Satd. Flow (prot)	1700	1654	0	0	1754	0	1789	3579	1054	0	1789	3579
Flt Permitted	0.950	0.966			0.972		0.169				0.112	
Satd. Flow (perm)	1700	1654	0	0	1754	0	318	3579	1054	0	211	3579
Satd. Flow (RTOR)		14										
Lane Group Flow (vph)	277	272	0	0	26	0	56	1523	37	0	4	1104
Turn Type	Split	NA		Split	NA		pm+pt	NA	Perm		Perm	NA
Protected Phases	4	4		8	8		5	2				6
Permitted Phases							2		2		6	
Total Split (s)	42.0	42.0		33.0	33.0		15.0	65.0	65.0		50.0	50.0
Total Lost Time (s)	6.7	6.7			6.7		4.0	6.6	6.6		6.6	6.6
Act Effct Green (s)	28.1	28.1			8.0		92.0	89.4	89.4		79.9	79.9
Actuated g/C Ratio	0.20	0.20			0.06		0.66	0.64	0.64		0.57	0.57
v/c Ratio	0.81	0.80			0.26		0.19	0.67	0.06		0.03	0.54
Control Delay	71.7	66.8			69.1		13.3	20.3	13.7		23.2	17.2
Queue Delay	0.0	0.0			0.0		0.0	0.0	0.0		0.0	0.0
Total Delay	71.7	66.8			69.1		13.3	20.3	13.7		23.2	17.2
LOS	E	E			E		B	C	B		C	B
Approach Delay		69.3			69.1			19.9				17.2
Approach LOS		E			E			B				B
Queue Length 50th (m)	77.2	71.8			7.1		5.8	148.4	4.1		0.2	58.0
Queue Length 95th (m)	105.1	100.0			16.8		13.5	205.5	10.7		m1.4	124.7
Internal Link Dist (m)		24.9			43.8			305.5				102.9
Turn Bay Length (m)							40.0		40.0		30.0	
Base Capacity (vph)	428	427			329		324	2285	672		120	2041
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	0.65	0.64			0.08		0.17	0.67	0.06		0.03	0.54

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green, Master Intersection
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.81
Intersection Signal Delay: 27.6 Intersection LOS: C
Intersection Capacity Utilization 74.6% ICU Level of Service D
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Victoria Road & Windmill Road & Ford Driveway

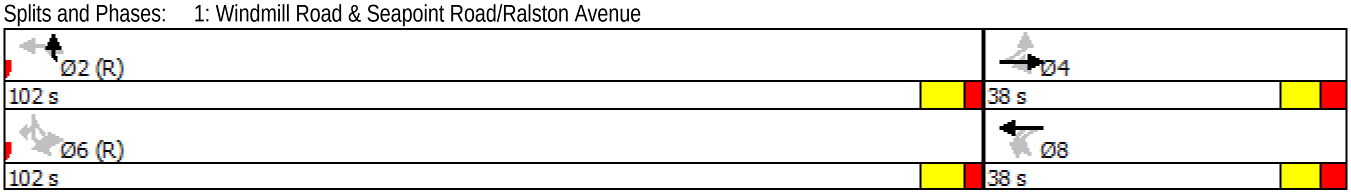


Lane Group	EBL	EBT	EBR	WBL2	WBT	WBR	SBL2	SBL	SBR	NWL	NWR	NWR2
Lane Configurations												
Traffic Volume (vph)	17	12	30	11	2	26	42	2012	24	20	1073	10
Future Volume (vph)	17	12	30	11	2	26	42	2012	24	20	1073	10
Satd. Flow (prot)	0	1831	1601	0	1690	0	1789	3471	1601	1789	2818	1601
Flt Permitted		0.797			0.892		0.211	0.955		0.068		
Satd. Flow (perm)	0	1501	1601	0	1529	0	397	3489	1601	128	2818	1601
Satd. Flow (RTOR)					28				31			31
Lane Group Flow (vph)	0	31	33	0	42	0	46	2187	26	22	1166	11
Turn Type	Perm	NA	Perm	Perm	NA		Perm	Perm	Perm	Perm	Prot	Perm
Protected Phases		4			8						2	
Permitted Phases	4		4	8			6	6	6	2		2
Total Split (s)	38.0	38.0	38.0	38.0	38.0		102.0	102.0	102.0	102.0	102.0	102.0
Total Lost Time (s)		7.0	7.0		7.0		6.6	6.6	6.6	6.6	6.6	6.6
Act Effct Green (s)		8.7	8.7		8.7		121.8	121.8	121.8	121.8	121.8	121.8
Actuated g/C Ratio		0.06	0.06		0.06		0.87	0.87	0.87	0.87	0.87	0.87
v/c Ratio		0.33	0.33		0.35		0.13	0.72	0.02	0.20	0.48	0.01
Control Delay		72.0	71.3		37.4		3.2	6.1	0.6	8.3	8.8	0.1
Queue Delay		0.0	0.0		0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		72.0	71.3		37.4		3.2	6.1	0.6	8.3	8.8	0.1
LOS		E	E		D		A	A	A	A	A	A
Approach Delay		71.6			37.4					8.7		
Approach LOS		E			D					A		
Queue Length 50th (m)		8.4	9.0		3.8		1.7	101.4	0.0	0.6	57.6	0.0
Queue Length 95th (m)		18.7	19.8		15.6		4.9	144.2	1.3	m0.4	71.1	m0.0
Internal Link Dist (m)		139.1			195.9					324.4		
Turn Bay Length (m)			30.0				23.0	23.0	25.0	23.0		
Base Capacity (vph)		332	354		360		345	3036	1397	111	2452	1397
Starvation Cap Reductn		0	0		0		0	0	0	0	0	0
Spillback Cap Reductn		0	0		0		0	0	0	0	0	0
Storage Cap Reductn		0	0		0		0	0	0	0	0	0
Reduced v/c Ratio		0.09	0.09		0.12		0.13	0.72	0.02	0.20	0.48	0.01

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 109 (78%), Referenced to phase 2:NWL and 6:SBL, Start of Green
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.72
Intersection Signal Delay: 8.5 Intersection LOS: A
Intersection Capacity Utilization 93.5% ICU Level of Service F
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Windmill Road & Seapoint Road/Ralston Avenue

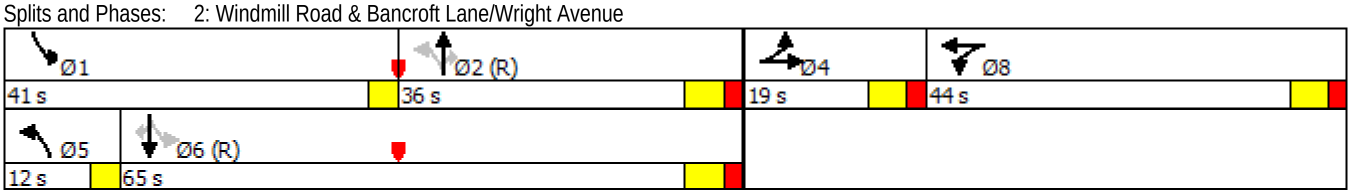


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	44	47	54	263	12	146	50	1036	340	290	1620	72
Future Volume (vph)	44	47	54	263	12	146	50	1036	340	290	1620	72
Satd. Flow (prot)	1789	1733	0	1700	1578	0	1789	3579	1601	1789	3579	1601
Flt Permitted	0.950			0.950	0.989		0.066			0.109		
Satd. Flow (perm)	1789	1733	0	1700	1578	0	124	3579	1601	205	3579	1601
Satd. Flow (RTOR)		33			90				224			95
Lane Group Flow (vph)	48	110	0	237	221	0	54	1126	370	315	1761	78
Turn Type	Split	NA		Split	NA		pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases							2		2	6		6
Total Split (s)	19.0	19.0		44.0	44.0		12.0	36.0	36.0	41.0	65.0	65.0
Total Lost Time (s)	6.1	6.1		6.1	6.1		3.0	6.1	6.1	3.0	6.1	6.1
Act Effct Green (s)	10.6	10.6		25.3	25.3		70.7	60.4	60.4	88.9	77.3	77.3
Actuated g/C Ratio	0.08	0.08		0.18	0.18		0.50	0.43	0.43	0.64	0.55	0.55
v/c Ratio	0.36	0.68		0.77	0.62		0.36	0.73	0.45	0.82	0.89	0.08
Control Delay	67.8	64.4		70.7	37.4		25.2	38.3	18.6	47.2	34.5	5.7
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	67.8	64.4		70.7	37.4		25.2	38.3	18.6	47.2	34.5	5.7
LOS	E	E		E	D		C	D	B	D	C	A
Approach Delay		65.4			54.6			33.1			35.3	
Approach LOS		E			D			C			D	
Queue Length 50th (m)	12.7	20.8		66.7	35.5		4.4	99.5	15.8	68.2	181.3	0.0
Queue Length 95th (m)	25.7	40.5		90.3	59.4		m18.9	#239.3	89.5	103.3	#332.3	m6.1
Internal Link Dist (m)		86.9			194.0			241.5			324.4	
Turn Bay Length (m)							35.0			70.0		35.0
Base Capacity (vph)	164	189		460	492		171	1544	818	560	1975	926
Starvation Cap Reductn	0	0		0	0		0	0	0	0	0	0
Spillback Cap Reductn	0	0		0	0		0	0	0	0	0	0
Storage Cap Reductn	0	0		0	0		0	0	0	0	0	0
Reduced v/c Ratio	0.29	0.58		0.52	0.45		0.32	0.73	0.45	0.56	0.89	0.08

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green, Master Intersection
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.89
Intersection Signal Delay: 37.7 Intersection LOS: D
Intersection Capacity Utilization 85.4% ICU Level of Service E
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Windmill Road & Bancroft Lane/Wright Avenue

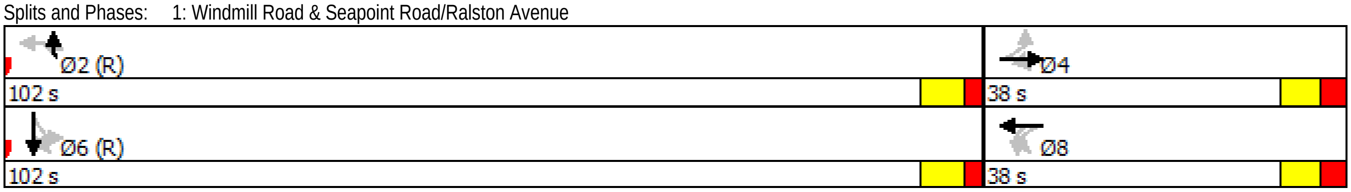


Lane Group	EBL	EBT	EBR	WBL2	WBT	SBL2	SBL	SBT	NWL	NWR	NWR2
Lane Configurations											
Traffic Volume (vph)	17	12	30	11	2	42	1992	20	20	1073	10
Future Volume (vph)	17	12	30	11	2	42	1992	20	20	1073	10
Lane Group Flow (vph)	0	31	33	0	42	46	2165	48	22	1166	11
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	Perm	Prot	Perm
Protected Phases		4			8			6		2	
Permitted Phases	4		4	8		6	6		2		2
Detector Phase	4	4	4	8	8	6	6	6	2	2	2
Switch Phase											
Minimum Initial (s)	7.0	7.0	7.0	7.0	7.0	15.0	15.0	15.0	15.0	15.0	15.0
Minimum Split (s)	37.0	37.0	37.0	37.0	37.0	27.6	27.6	27.6	27.6	27.6	27.6
Total Split (s)	38.0	38.0	38.0	38.0	38.0	102.0	102.0	102.0	102.0	102.0	102.0
Total Split (%)	27.1%	27.1%	27.1%	27.1%	27.1%	72.9%	72.9%	72.9%	72.9%	72.9%	72.9%
Yellow Time (s)	4.1	4.1	4.1	4.1	4.1	4.6	4.6	4.6	4.6	4.6	4.6
All-Red Time (s)	2.9	2.9	2.9	2.9	2.9	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)		7.0	7.0		7.0	6.6	6.6	6.6	6.6	6.6	6.6
Lead/Lag											
Lead-Lag Optimize?											
Recall Mode	None	None	None	None	None	C-Min	C-Min	C-Min	C-Min	C-Min	C-Min
Act Effct Green (s)		8.7	8.7		8.7	121.8	121.8	121.8	121.8	121.8	121.8
Actuated g/C Ratio		0.06	0.06		0.06	0.87	0.87	0.87	0.87	0.87	0.87
v/c Ratio		0.33	0.33		0.35	0.13	0.71	0.03	0.19	0.48	0.01
Control Delay		72.0	71.3		37.4	3.2	6.0	1.2	6.3	6.1	0.0
Queue Delay		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		72.0	71.3		37.4	3.2	6.0	1.2	6.3	6.1	0.0
LOS		E	E		D	A	A	A	A	A	A
Approach Delay		71.6			37.4			5.8	6.1		
Approach LOS		E			D			A	A		
Queue Length 50th (m)		8.4	9.0		3.8	1.7	99.0	0.8	0.3	13.7	0.0
Queue Length 95th (m)		18.7	19.8		15.6	4.9	140.1	2.9	m0.4	71.1	m0.0
Internal Link Dist (m)		139.1			195.9			495.7	324.4		
Turn Bay Length (m)			30.0			23.0	23.0		23.0		
Base Capacity (vph)		332	354		360	345	3036	1510	115	2452	1397
Starvation Cap Reductn		0	0		0	0	0	0	0	0	0
Spillback Cap Reductn		0	0		0	0	0	0	0	0	0
Storage Cap Reductn		0	0		0	0	0	0	0	0	0
Reduced v/c Ratio		0.09	0.09		0.12	0.13	0.71	0.03	0.19	0.48	0.01

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 109 (78%), Referenced to phase 2:NWL and 6:SBTL, Start of Green
Natural Cycle: 110
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.71
Intersection Signal Delay: 7.5 — Intersection LOS: A
Intersection Capacity Utilization 95.1% — ICU Level of Service F
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Windmill Road & Seapoint Road/Ralston Avenue

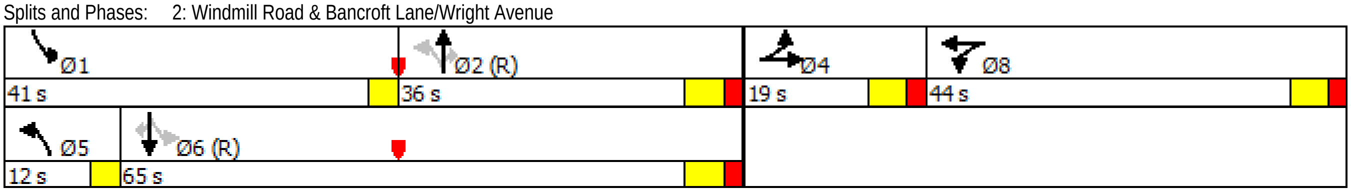


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations										
Traffic Volume (vph)	44	47	263	12	50	1036	340	290	1620	72
Future Volume (vph)	44	47	263	12	50	1036	340	290	1620	72
Lane Group Flow (vph)	48	108	237	221	54	1126	370	315	1761	78
Turn Type	Split	NA	Split	NA	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	4	4	8	8	5	2		1	6	
Permitted Phases					2		2	6		6
Detector Phase	4	4	8	8	5	2	2	1	6	6
Switch Phase										
Minimum Initial (s)	5.0	5.0	7.0	7.0	5.0	15.0	15.0	5.0	15.0	15.0
Minimum Split (s)	19.0	19.0	42.1	42.1	8.0	31.1	31.1	13.1	38.1	38.1
Total Split (s)	19.0	19.0	44.0	44.0	12.0	36.0	36.0	41.0	65.0	65.0
Total Split (%)	13.6%	13.6%	31.4%	31.4%	8.6%	25.7%	25.7%	29.3%	46.4%	46.4%
Yellow Time (s)	4.1	4.1	4.1	4.1	3.0	4.1	4.1	3.0	4.1	4.1
All-Red Time (s)	2.0	2.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.1	6.1	6.1	6.1	3.0	6.1	6.1	3.0	6.1	6.1
Lead/Lag					Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?					Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	C-Min	C-Min	None	C-Min	C-Min
Act Effct Green (s)	10.6	10.6	25.3	25.3	70.8	60.5	60.5	88.9	77.3	77.3
Actuated g/C Ratio	0.08	0.08	0.18	0.18	0.51	0.43	0.43	0.64	0.55	0.55
v/c Ratio	0.36	0.68	0.77	0.62	0.36	0.73	0.45	0.82	0.89	0.08
Control Delay	68.0	64.3	70.7	37.4	25.3	37.8	18.1	41.3	39.0	6.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	68.0	64.3	70.7	37.4	25.3	37.8	18.1	41.3	39.0	6.7
LOS	E	E	E	D	C	D	B	D	D	A
Approach Delay		65.4		54.6		32.6			38.2	
Approach LOS		E		D		C			D	
Queue Length 50th (m)	12.8	20.5	66.7	35.5	4.3	98.0	14.7	60.1	209.2	0.6
Queue Length 95th (m)	25.7	40.5	90.3	59.4	m18.7	#238.6	88.1	103.1	#331.8	m6.2
Internal Link Dist (m)		86.9		194.0		241.5			324.4	
Turn Bay Length (m)					35.0			70.0		
Base Capacity (vph)	164	188	460	492	171	1545	818	560	1977	926
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.29	0.57	0.52	0.45	0.32	0.73	0.45	0.56	0.89	0.08

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 140
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green, Master Intersection
Natural Cycle: 140
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.89
Intersection Signal Delay: 38.9 Intersection LOS: D
Intersection Capacity Utilization 85.3% ICU Level of Service E
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Windmill Road & Bancroft Lane/Wright Avenue

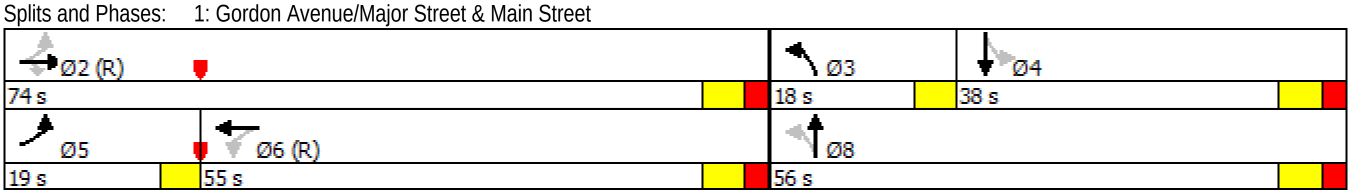


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	214	2023	522	29	945	37	336	143	134	104	69	155
Future Volume (vph)	214	2023	522	29	945	37	336	143	134	104	69	155
Satd. Flow (prot)	1789	3579	1601	1789	3552	0	1789	1715	0	1789	1671	0
Flt Permitted	0.146			0.067			0.226			0.577		
Satd. Flow (perm)	275	3579	1509	126	3552	0	425	1715	0	1069	1671	0
Satd. Flow (RTOR)			311		3			3			82	
Lane Group Flow (vph)	233	2199	567	32	1067	0	365	301	0	113	243	0
Turn Type	pm+pt	NA	Perm	Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases	5	2			6		3	8			4	
Permitted Phases	2		2	6			8			4		
Total Split (s)	19.0	74.0	74.0	55.0	55.0		18.0	56.0		38.0	38.0	
Total Lost Time (s)	4.0	6.5	6.5	6.5	6.5		4.0	6.7		6.7	6.7	
Act Effct Green (s)	82.1	79.6	79.6	60.1	60.1		39.9	37.2		19.2	19.2	
Actuated g/C Ratio	0.63	0.61	0.61	0.46	0.46		0.31	0.29		0.15	0.15	
v/c Ratio	0.66	1.00	0.54	0.55	0.65		1.32	0.61		0.72	0.77	
Control Delay	22.8	45.9	8.9	66.0	26.5		199.0	44.5		75.9	50.2	
Queue Delay	0.0	11.8	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	22.8	57.7	8.9	66.0	26.5		199.0	44.5		75.9	50.2	
LOS	C	E	A	E	C		F	D		E	D	
Approach Delay		45.7			27.6			129.2			58.4	
Approach LOS		D			C			F			E	
Queue Length 50th (m)	23.6	~282.6	32.0	5.0	90.4		~97.4	66.2		28.0	40.6	
Queue Length 95th (m)	51.3	#385.4	73.6	#26.3	158.8		#142.0	86.5		45.2	64.1	
Internal Link Dist (m)		377.2			274.1			160.3			189.3	
Turn Bay Length (m)	57.0			35.0			50.0			23.0		
Base Capacity (vph)	370	2192	1044	58	1643		277	652		257	464	
Starvation Cap Reductn	0	0	0	0	0		0	0		0	0	
Spillback Cap Reductn	0	77	0	0	0		0	0		0	0	
Storage Cap Reductn	0	0	0	0	0		0	0		0	0	
Reduced v/c Ratio	0.63	1.04	0.54	0.55	0.65		1.32	0.46		0.44	0.52	

Intersection Summary

Cycle Length: 130
Actuated Cycle Length: 130
Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green, Master Intersection
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.32
Intersection Signal Delay: 53.6 Intersection LOS: D
Intersection Capacity Utilization 114.2% ICU Level of Service H
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Gordon Avenue/Major Street & Main Street

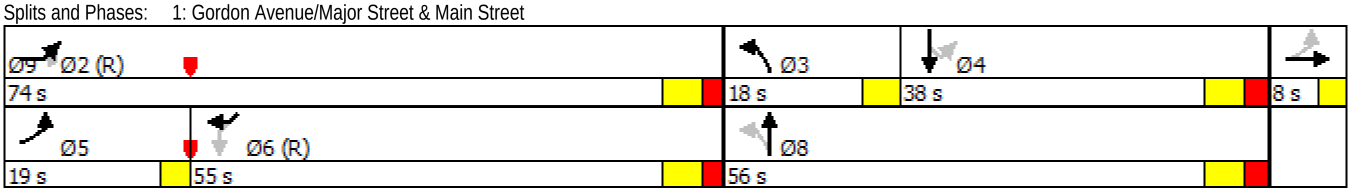


Lane Group	EBL2	EBL	EBT	NBL	NBT	SBL2	SBT	SWL	SWR
Lane Configurations									
Traffic Volume (vph)	214	2011	12	336	143	104	69	29	945
Future Volume (vph)	214	2011	12	336	143	104	69	29	945
Lane Group Flow (vph)	233	2186	580	365	301	113	243	32	1067
Turn Type	pm+pt	Prot	NA	pm+pt	NA	Perm	NA	Perm	Prot
Protected Phases	5	2	9	3	8		4		6
Permitted Phases	9		2	8		4		6	
Detector Phase	5	2	9	3	8	4	4	6	6
Switch Phase									
Minimum Initial (s)	7.0	7.0	5.0	7.0	7.0	7.0	7.0	7.0	7.0
Minimum Split (s)	13.1	30.5	8.0	11.0	37.7	37.7	37.7	30.5	30.5
Total Split (s)	19.0	74.0	8.0	18.0	56.0	38.0	38.0	55.0	55.0
Total Split (%)	13.8%	53.6%	5.8%	13.0%	40.6%	27.5%	27.5%	39.9%	39.9%
Yellow Time (s)	3.0	4.1	3.0	4.0	4.1	4.1	4.1	4.1	4.1
All-Red Time (s)	0.0	2.4	0.0	0.0	2.6	2.6	2.6	2.4	2.4
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	3.0	6.5	3.0	4.0	6.7	6.7	6.7	6.5	6.5
Lead/Lag	Lead			Lead		Lag	Lag	Lag	Lag
Lead-Lag Optimize?	Yes			Yes		Yes	Yes	Yes	Yes
Recall Mode	None	C-Min	None	None	None	None	None	C-Min	C-Min
Act Effct Green (s)	23.3	76.4	90.3	40.7	38.0	20.0	20.0	57.5	57.5
Actuated g/C Ratio	0.17	0.55	0.65	0.29	0.28	0.14	0.14	0.42	0.42
v/c Ratio	0.89	1.14	0.49	1.41	0.64	0.73	0.79	0.59	0.86
Control Delay	89.1	99.3	2.6	241.4	49.6	80.9	56.3	81.3	42.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	89.1	99.3	2.6	241.4	49.6	80.9	56.3	81.3	42.4
LOS	F	F	A	F	D	F	E	F	D
Approach Delay			79.8		154.7		64.1	43.5	
Approach LOS			E		F		E	D	
Queue Length 50th (m)	58.8	~355.9	1.2	~111.4	72.5	29.9	45.2	6.8	139.6
Queue Length 95th (m)	#110.4	#429.4	16.3	#158.4	93.7	47.5	69.6	#27.6	#206.7
Internal Link Dist (m)			377.2		160.3		189.3	274.1	
Turn Bay Length (m)	57.0	57.0		50.0		23.0		35.0	
Base Capacity (vph)	273	1920	1185	258	612	242	437	54	1236
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.85	1.14	0.49	1.41	0.49	0.47	0.56	0.59	0.86

Intersection Summary

Cycle Length: 138
Actuated Cycle Length: 138
Offset: 0 (0%), Referenced to phase 2:EBTL and 6:SWL, Start of Green, Master Intersection
Natural Cycle: 145
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.41
Intersection Signal Delay: 80.7 Intersection LOS: F
Intersection Capacity Utilization 127.8% ICU Level of Service H
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Gordon Avenue/Major Street & Main Street



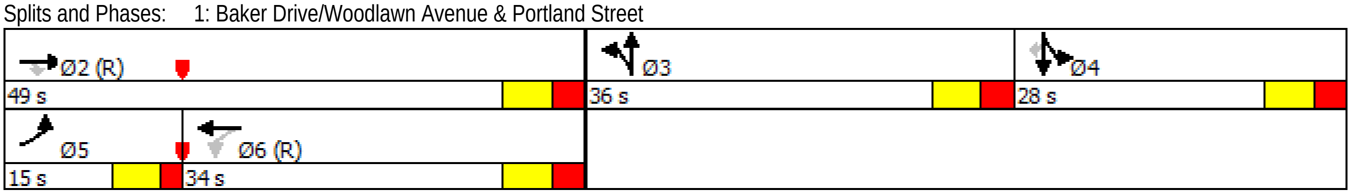
1: Baker Drive/Woodlawn Avenue & Portland Street

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	129	585	292	14	1454	8	462	53	5	43	90	641
Future Volume (vph)	129	585	292	14	1454	8	462	53	5	43	90	641
Satd. Flow (prot)	3471	3579	1601	1789	3575	0	1700	1718	0	1789	1585	1521
Flt Permitted	0.950			0.410			0.950	0.963		0.950		
Satd. Flow (perm)	3471	3579	1601	772	3575	0	1700	1718	0	1789	1585	1521
Satd. Flow (RTOR)			317					1				
Lane Group Flow (vph)	140	636	317	15	1589	0	281	284	0	47	405	390
Turn Type	Prot	NA	Perm	Perm	NA		Split	NA		Split	NA	Perm
Protected Phases	5	2			6		3	3		4	4	
Permitted Phases			2	6								4
Total Split (s)	15.0	49.0	49.0	34.0	34.0		36.0	36.0		28.0	28.0	28.0
Total Lost Time (s)	6.0	7.1	7.1	7.1	7.1		7.0	7.0		7.0	7.0	7.0
Act Effct Green (s)	8.6	41.9	41.9	27.3	27.3		23.7	23.7		26.3	26.3	26.3
Actuated g/C Ratio	0.08	0.37	0.37	0.24	0.24		0.21	0.21		0.23	0.23	0.23
v/c Ratio	0.53	0.48	0.40	0.08	1.84		0.79	0.79		0.11	1.10	1.10
Control Delay	57.8	28.7	4.3	35.0	410.2		57.7	57.2		38.0	118.8	121.1
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	57.8	28.7	4.3	35.0	410.2		57.7	57.2		38.0	118.8	121.1
LOS	E	C	A	C	F		E	E		D	F	F
Approach Delay		25.4			406.7			57.4			115.4	
Approach LOS		C			F			E			F	
Queue Length 50th (m)	15.5	55.9	0.0	2.6	~281.9		61.6	62.1		8.3	~110.0	~106.2
Queue Length 95th (m)	25.6	72.5	17.4	8.3	#324.1		88.6	88.9		19.3	#186.9	#181.5
Internal Link Dist (m)		268.6			94.7			154.7			75.8	
Turn Bay Length (m)	45.0									40.0		
Base Capacity (vph)	276	1327	793	186	863		436	441		415	368	353
Starvation Cap Reductn	0	0	0	0	0		0	0		0	0	0
Spillback Cap Reductn	0	0	0	0	0		0	0		0	0	0
Storage Cap Reductn	0	0	0	0	0		0	0		0	0	0
Reduced v/c Ratio	0.51	0.48	0.40	0.08	1.84		0.64	0.64		0.11	1.10	1.10

Intersection Summary

Cycle Length: 113
Actuated Cycle Length: 113
Offset: 13.1 (12%), Referenced to phase 2:EBT and 6:WBTL, Start of Green
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.84
Intersection Signal Delay: 197.3 Intersection LOS: F
Intersection Capacity Utilization 100.2% ICU Level of Service G
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Baker Drive/Woodlawn Avenue & Portland Street



Movement	NBT	NBR	SBL	SBT	SWL	SWR
Lane Configurations						
Traffic Volume (veh/h)	1301	825	0	539	0	0
Future Volume (Veh/h)	1301	825	0	539	0	0
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)	1457	924	0	603	0	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)				269		
pX, platoon unblocked						
vC, conflicting volume			2381		2220	1190
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			2381		2220	1190
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			200		37	180

Direction, Lane #	NB 1	NB 2	SB 1	SB 2
Volume Total	971	1410	302	302
Volume Left	0	0	0	0
Volume Right	0	924	0	0
cSH	1700	1700	1700	1700
Volume to Capacity	0.57	0.83	0.18	0.18
Queue Length 95th (m)	0.0	0.0	0.0	0.0
Control Delay (s)	0.0	0.0	0.0	0.0
Lane LOS				
Approach Delay (s)	0.0		0.0	
Approach LOS				

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	67.6%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	NBT	NBR	SBL	SBT	SWL	SWR
Lane Configurations						
Traffic Volume (veh/h)	1301	825	0	539	0	0
Future Volume (Veh/h)	1301	825	0	539	0	0
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)	1457	924	0	603	0	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)				269		
pX, platoon unblocked						
vC, conflicting volume			2381		1758	1457
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			2381		1758	1457
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			200		76	119

Direction, Lane #	NB 1	NB 2	SB 1	SB 2
Volume Total	1457	924	302	302
Volume Left	0	0	0	0
Volume Right	0	924	0	0
cSH	1700	1700	1700	1700
Volume to Capacity	0.86	0.54	0.18	0.18
Queue Length 95th (m)	0.0	0.0	0.0	0.0
Control Delay (s)	0.0	0.0	0.0	0.0
Lane LOS				
Approach Delay (s)	0.0		0.0	
Approach LOS				

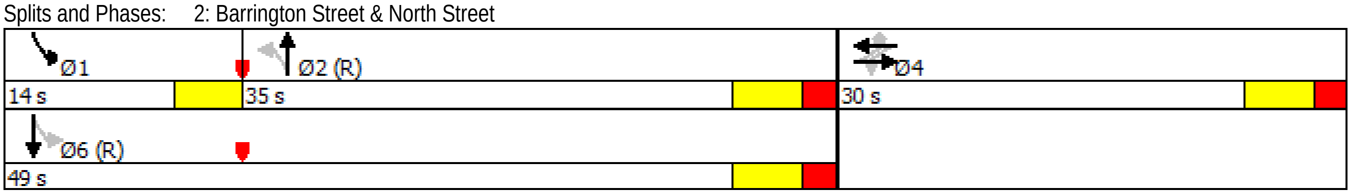
Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	73.9%	ICU Level of Service	D
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	48	238	400	8	67	34	56	341	20	174	1000	30
Future Volume (vph)	48	238	400	8	67	34	56	341	20	174	1000	30
Satd. Flow (prot)	1789	1883	1601	0	1874	1601	0	3529	0	0	3539	0
Flt Permitted	0.704				0.948			0.666			0.725	
Satd. Flow (perm)	1326	1883	1601	0	1786	1601	0	2367	0	0	2584	0
Satd. Flow (RTOR)			435			99		7			5	
Lane Group Flow (vph)	52	259	435	0	82	37	0	454	0	0	1309	0
Turn Type	Perm	NA	Free	Perm	NA	Perm	Perm	NA		pm+pt	NA	
Protected Phases		4			4			2		1	6	
Permitted Phases	4		Free	4		4	2			6		
Total Split (s)	30.0	30.0		30.0	30.0	30.0	35.0	35.0		14.0	49.0	
Total Lost Time (s)	6.1	6.1			6.1	6.1		6.2			6.2	
Act Effct Green (s)	16.5	16.5	79.0		16.5	16.5		28.8			50.2	
Actuated g/C Ratio	0.21	0.21	1.00		0.21	0.21		0.36			0.64	
v/c Ratio	0.19	0.66	0.27		0.22	0.09		0.52			0.72	
Control Delay	25.2	36.1	0.4		25.4	0.4		22.1			13.1	
Queue Delay	0.0	0.0	0.0		0.0	0.0		0.0			0.0	
Total Delay	25.2	36.1	0.4		25.4	0.4		22.1			13.1	
LOS	C	D	A		C	A		C			B	
Approach Delay		14.5			17.6			22.1			13.1	
Approach LOS		B			B			C			B	
Queue Length 50th (m)	6.5	36.1	0.0		10.3	0.0		27.1			51.5	
Queue Length 95th (m)	13.8	52.4	0.0		19.1	0.0		40.8			#90.9	
Internal Link Dist (m)		103.7			19.5			192.7			164.9	
Turn Bay Length (m)	10.0		50.0									
Base Capacity (vph)	401	569	1601		540	553		867			1825	
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	0.13	0.46	0.27		0.15	0.07		0.52			0.72	

Intersection Summary

Cycle Length: 79
Actuated Cycle Length: 79
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.72
Intersection Signal Delay: 15.3 Intersection LOS: B
Intersection Capacity Utilization 73.3% ICU Level of Service D
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 2: Barrington Street & North Street

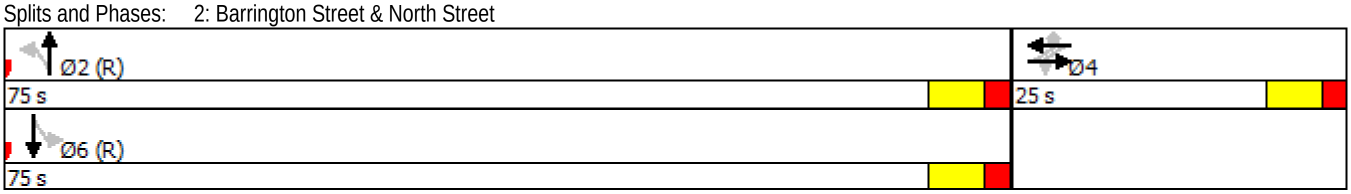


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	48	238	400	8	67	34	56	341	20	174	1000	30
Future Volume (vph)	48	238	400	8	67	34	56	341	20	174	1000	30
Satd. Flow (prot)	1789	1883	1601	0	1874	1601	1789	3550	0	1789	1876	0
Flt Permitted	0.704				0.845		0.107			0.342		
Satd. Flow (perm)	1326	1883	1601	0	1592	1601	202	3550	0	644	1876	0
Satd. Flow (RTOR)			328			37		13			4	
Lane Group Flow (vph)	52	259	435	0	82	37	122	784	0	189	1120	0
Turn Type	Perm	NA	Free	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		4			4			2			6	
Permitted Phases	4		Free	4		4	2			6		
Total Split (s)	25.0	25.0		25.0	25.0	25.0	75.0	75.0		75.0	75.0	
Total Lost Time (s)	6.1	6.1			6.1	6.1	6.2	6.2		6.2	6.2	
Act Effct Green (s)	17.2	17.2	100.0		17.2	17.2	70.5	70.5		70.5	70.5	
Actuated g/C Ratio	0.17	0.17	1.00		0.17	0.17	0.70	0.70		0.70	0.70	
v/c Ratio	0.23	0.80	0.27		0.30	0.12	0.86	0.31		0.42	0.85	
Control Delay	37.5	58.5	0.4		38.5	12.2	27.8	7.1		10.0	19.3	
Queue Delay	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	37.5	58.5	0.4		38.5	12.2	27.8	7.1		10.0	19.3	
LOS	D	E	A		D	B	C	A		A	B	
Approach Delay		23.2			30.3			9.9			18.0	
Approach LOS		C			C			A			B	
Queue Length 50th (m)	8.6	47.7	0.0		13.7	0.0	18.5	33.7		14.3	147.4	
Queue Length 95th (m)	19.2	#80.3	0.0		27.0	8.2	m7.8	m17.5		28.6	#237.1	
Internal Link Dist (m)		103.7			19.5			192.7			164.9	
Turn Bay Length (m)	10.0		50.0									
Base Capacity (vph)	250	355	1601		300	332	142	2505		454	1323	
Starvation Cap Reductn	0	0	0		0	0	0	0		0	0	
Spillback Cap Reductn	0	0	0		0	0	0	0		0	0	
Storage Cap Reductn	0	0	0		0	0	0	0		0	0	
Reduced v/c Ratio	0.21	0.73	0.27		0.27	0.11	0.86	0.31		0.42	0.85	

Intersection Summary

Cycle Length: 100
Actuated Cycle Length: 100
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.86
Intersection Signal Delay: 17.3 Intersection LOS: B
Intersection Capacity Utilization 88.6% ICU Level of Service E
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Barrington Street & North Street

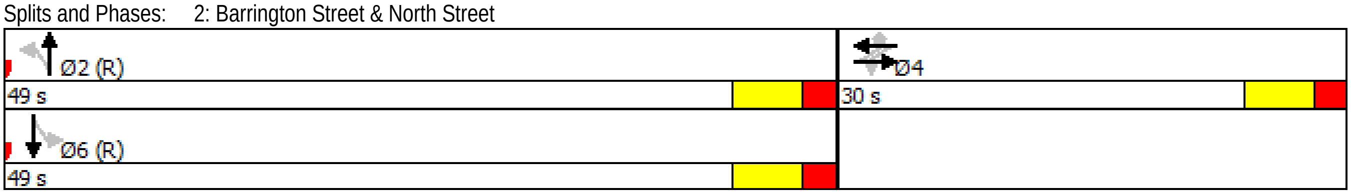


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	48	238	400	8	67	34	56	341	20	174	1000	30
Future Volume (vph)	48	238	400	8	67	34	56	341	20	174	1000	30
Satd. Flow (prot)	1789	1883	1601	0	1874	1601	1789	1868	0	1789	3564	0
Flt Permitted	0.704				0.948		0.215			0.251		
Satd. Flow (perm)	1326	1883	1601	0	1786	1601	405	1868	0	473	3564	0
Satd. Flow (RTOR)			425			44		6			6	
Lane Group Flow (vph)	52	259	435	0	82	37	122	784	0	189	1120	0
Turn Type	Perm	NA	Free	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		4			4			2			6	
Permitted Phases	4		Free	4		4	2			6		
Total Split (s)	30.0	30.0		30.0	30.0	30.0	49.0	49.0		49.0	49.0	
Total Lost Time (s)	6.1	6.1			6.1	6.1	6.2	6.2		6.2	6.2	
Act Effct Green (s)	16.5	16.5	79.0		16.5	16.5	50.2	50.2		50.2	50.2	
Actuated g/C Ratio	0.21	0.21	1.00		0.21	0.21	0.64	0.64		0.64	0.64	
v/c Ratio	0.19	0.66	0.27		0.22	0.10	0.47	0.66		0.63	0.49	
Control Delay	25.2	36.1	0.4		25.4	6.9	17.4	13.7		23.7	9.4	
Queue Delay	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	25.2	36.1	0.4		25.4	6.9	17.4	13.7		23.7	9.4	
LOS	C	D	A		C	A	B	B		C	A	
Approach Delay		14.5			19.7			14.2			11.4	
Approach LOS		B			B			B			B	
Queue Length 50th (m)	6.5	36.1	0.0		10.3	0.0	8.3	63.3		14.9	40.4	
Queue Length 95th (m)	13.8	52.4	0.0		19.1	5.5	30.3	129.3		#56.3	70.2	
Internal Link Dist (m)		103.7			19.5			192.7			164.9	
Turn Bay Length (m)	10.0		50.0									
Base Capacity (vph)	401	569	1601		540	515	257	1188		300	2265	
Starvation Cap Reductn	0	0	0		0	0	0	0		0	0	
Spillback Cap Reductn	0	0	0		0	0	0	0		0	0	
Storage Cap Reductn	0	0	0		0	0	0	0		0	0	
Reduced v/c Ratio	0.13	0.46	0.27		0.15	0.07	0.47	0.66		0.63	0.49	

Intersection Summary

Cycle Length: 79
Actuated Cycle Length: 79
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.66
Intersection Signal Delay: 13.3 Intersection LOS: B
Intersection Capacity Utilization 75.9% ICU Level of Service D
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 2: Barrington Street & North Street

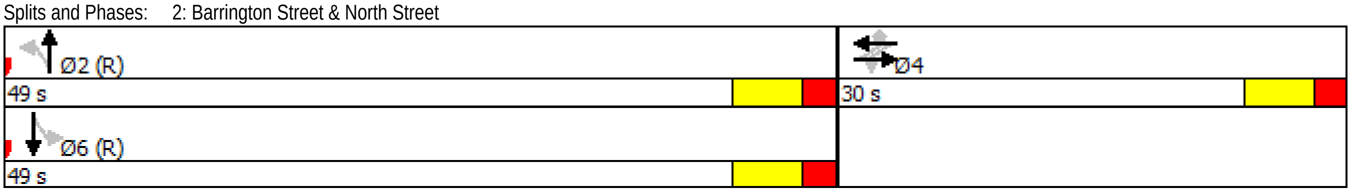


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	53	16	400	42	147	272	138	1230	1	19	512	67
Future Volume (vph)	53	16	400	42	147	272	138	1230	1	19	512	67
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	10.0		50.0	0.0		0.0	0.0		0.0	0.0		0.0
Storage Lanes	1		1	0		1	0		0	0		0
Taper Length (m)	15.0			15.0			15.0			15.0		
Satd. Flow (prot)	1789	1883	1601	0	1863	1601	0	3561	0	0	3511	0
Flt Permitted	0.567				0.925			0.766			0.874	
Satd. Flow (perm)	1068	1883	1601	0	1742	1601	0	2741	0	0	3074	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			435			44					27	
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		127.7			43.5			165.8			188.9	
Travel Time (s)		9.2			3.1			11.9			13.6	
Lane Group Flow (vph)	58	17	435	0	206	296	0	1488	0	0	651	0
Turn Type	Perm	NA	Free	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		4			4			2			6	
Permitted Phases	4		Free	4		4	2			6		
Total Split (s)	30.0	30.0		30.0	30.0	30.0	49.0	49.0		49.0	49.0	
Total Lost Time (s)	6.1	6.1			6.1	6.1		6.2			6.2	
Act Effct Green (s)	18.1	18.1	79.0		18.1	18.1		48.6			48.6	
Actuated g/C Ratio	0.23	0.23	1.00		0.23	0.23		0.62			0.62	
v/c Ratio	0.24	0.04	0.27		0.52	0.74		0.88			0.34	
Control Delay	25.1	20.9	0.4		30.2	34.6		23.0			8.5	
Queue Delay	0.0	0.0	0.0		0.0	0.0		0.0			0.0	
Total Delay	25.1	20.9	0.4		30.2	34.6		23.0			8.5	
LOS	C	C	A		C	C		C			A	
Approach Delay		3.9			32.8			23.0			8.5	
Approach LOS		A			C			C			A	
Queue Length 50th (m)	7.0	2.0	0.0		26.7	34.8		90.8			21.8	
Queue Length 95th (m)	15.2	6.1	0.0		42.1	55.5		#163.6			37.3	
Internal Link Dist (m)		103.7			19.5			141.8			164.9	
Turn Bay Length (m)	10.0		50.0									
Base Capacity (vph)	323	569	1601		527	515		1684			1899	
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	0.18	0.03	0.27		0.39	0.57		0.88			0.34	

Intersection Summary

Area Type: Other
Cycle Length: 79
Actuated Cycle Length: 79
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.88
Intersection Signal Delay: 18.5 — Intersection LOS: B
Intersection Capacity Utilization 91.3% — ICU Level of Service F
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 2: Barrington Street & North Street

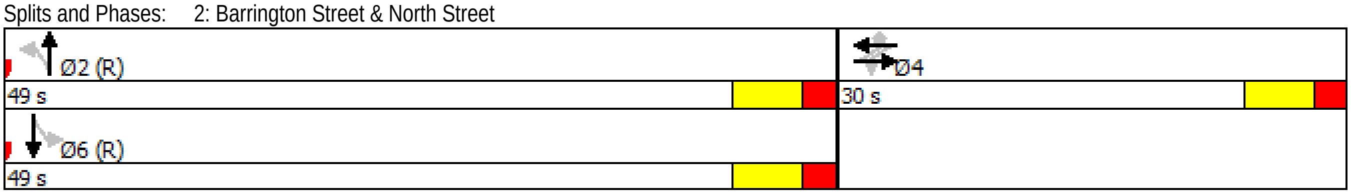


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	53	16	400	42	147	272	138	1230	1	19	512	67
Future Volume (vph)	53	16	400	42	147	272	138	1230	1	19	512	67
Satd. Flow (prot)	1789	1883	1601	0	1863	1601	1789	3579	0	1789	1851	0
Flt Permitted	0.567				0.925		0.337			0.148		
Satd. Flow (perm)	1068	1883	1601	0	1742	1601	635	3579	0	279	1851	0
Satd. Flow (RTOR)			435			44					13	
Lane Group Flow (vph)	58	17	435	0	206	296	150	1338	0	21	630	0
Turn Type	Perm	NA	Free	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		4			4			2			6	
Permitted Phases	4		Free	4		4	2			6		
Total Split (s)	30.0	30.0		30.0	30.0	30.0	49.0	49.0		49.0	49.0	
Total Lost Time (s)	6.1	6.1			6.1	6.1	6.2	6.2		6.2	6.2	
Act Effct Green (s)	18.1	18.1	79.0		18.1	18.1	48.6	48.6		48.6	48.6	
Actuated g/C Ratio	0.23	0.23	1.00		0.23	0.23	0.62	0.62		0.62	0.62	
v/c Ratio	0.24	0.04	0.27		0.52	0.74	0.38	0.61		0.12	0.55	
Control Delay	25.1	20.9	0.4		30.2	34.6	13.0	11.9		10.6	12.2	
Queue Delay	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	25.1	20.9	0.4		30.2	34.6	13.0	11.9		10.6	12.2	
LOS	C	C	A		C	C	B	B		B	B	
Approach Delay		3.9			32.8			12.0			12.1	
Approach LOS		A			C			B			B	
Queue Length 50th (m)	7.0	2.0	0.0		26.7	34.8	10.4	59.6		1.2	49.4	
Queue Length 95th (m)	15.2	6.1	0.0		42.1	55.5	27.6	93.9		5.4	91.8	
Internal Link Dist (m)		103.7			19.5			192.7			164.9	
Turn Bay Length (m)	10.0		50.0									
Base Capacity (vph)	323	569	1601		527	515	390	2200		171	1142	
Starvation Cap Reductn	0	0	0		0	0	0	0		0	0	
Spillback Cap Reductn	0	0	0		0	0	0	0		0	0	
Storage Cap Reductn	0	0	0		0	0	0	0		0	0	
Reduced v/c Ratio	0.18	0.03	0.27		0.39	0.57	0.38	0.61		0.12	0.55	

Intersection Summary

Cycle Length: 79
Actuated Cycle Length: 79
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.74
Intersection Signal Delay: 14.0 — Intersection LOS: B
Intersection Capacity Utilization 76.3% — ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 2: Barrington Street & North Street



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	53	16	400	42	147	272	138	1230	1	19	512	67
Future Volume (vph)	53	16	400	42	147	272	138	1230	1	19	512	67
Satd. Flow (prot)	1789	1883	1601	0	1863	1601	1789	1883	0	1789	3518	0
Flt Permitted	0.458				0.919		0.410			0.057		
Satd. Flow (perm)	863	1883	1601	0	1731	1601	772	1883	0	107	3518	0
Satd. Flow (RTOR)			435			82					33	
Lane Group Flow (vph)	58	17	435	0	206	296	150	1338	0	21	630	0
Turn Type	Perm	NA	Free	Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		4			4			2			6	
Permitted Phases	4		Free	4		4	2			6		
Total Split (s)	25.0	25.0		25.0	25.0	25.0	75.0	75.0		75.0	75.0	
Total Lost Time (s)	6.1	6.1			6.1	6.1	6.2	6.2		6.2	6.2	
Act Effct Green (s)	17.0	17.0	100.0		17.0	17.0	70.7	70.7		70.7	70.7	
Actuated g/C Ratio	0.17	0.17	1.00		0.17	0.17	0.71	0.71		0.71	0.71	
v/c Ratio	0.39	0.05	0.27		0.70	0.87	0.28	1.01		0.28	0.25	
Control Delay	44.6	33.9	0.4		52.0	54.3	7.6	28.0		17.3	5.5	
Queue Delay	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	44.6	33.9	0.4		52.0	54.3	7.6	28.0		17.3	5.5	
LOS	D	C	A		D	D	A	C		B	A	
Approach Delay		6.6			53.4			26.0			5.8	
Approach LOS		A			D			C			A	
Queue Length 50th (m)	9.9	2.7	0.0		37.1	40.4	11.9	~278.7		1.4	20.1	
Queue Length 95th (m)	22.1	8.5	0.0		60.6	#81.5	m6.6	m86.7		7.0	27.1	
Internal Link Dist (m)		103.7			19.5			192.7			164.9	
Turn Bay Length (m)	10.0		50.0									
Base Capacity (vph)	163	355	1601		327	369	545	1330		75	2496	
Starvation Cap Reductn	0	0	0		0	0	0	0		0	0	
Spillback Cap Reductn	0	0	0		0	0	0	0		0	0	
Storage Cap Reductn	0	0	0		0	0	0	0		0	0	
Reduced v/c Ratio	0.36	0.05	0.27		0.63	0.80	0.28	1.01		0.28	0.25	

Intersection Summary

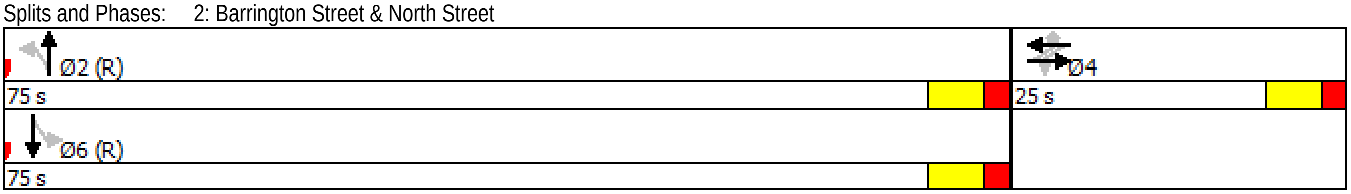
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.01
Intersection Signal Delay: 23.0 Intersection LOS: C
Intersection Capacity Utilization 107.0% ICU Level of Service G
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

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

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Barrington Street & North Street

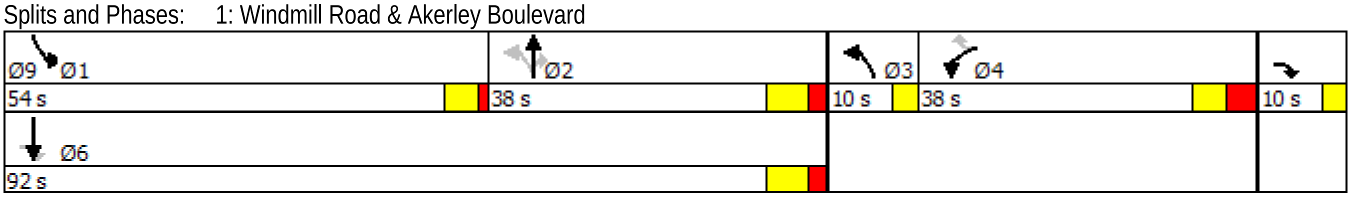


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	15	161	0	464	15	705	331	1197	1898	0
Future Volume (vph)	0	0	15	161	0	464	15	705	331	1197	1898	0
Satd. Flow (prot)	0	0	831	1789	0	2818	1789	3579	1601	3471	3579	0
Flt Permitted				0.950			0.128			0.950		
Satd. Flow (perm)	0	0	831	1789	0	2818	241	3579	1601	3471	3579	0
Satd. Flow (RTOR)						504			298			
Lane Group Flow (vph)	0	0	16	175	0	504	16	766	360	1301	2063	0
Turn Type			custom	Prot		Perm	pm+pt	NA	Perm	Prot	NA	
Protected Phases			9	4			3	2		1	6	
Permitted Phases			6			4	2		2			
Total Split (s)			10.0	38.0		38.0	10.0	38.0	38.0	54.0	92.0	
Total Lost Time (s)			3.0	7.3		7.3	3.0	6.9	6.9	5.0	6.9	
Act Effct Green (s)			93.1	30.8		30.8	40.7	31.2	31.2	49.2	85.5	
Actuated g/C Ratio			0.68	0.22		0.22	0.30	0.23	0.23	0.36	0.62	
v/c Ratio			0.03	0.44		0.49	0.12	0.94	0.61	1.05	0.93	
Control Delay			8.2	51.5		5.6	42.3	72.5	14.8	81.3	32.8	
Queue Delay			0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay			8.2	51.5		5.6	42.3	72.5	14.8	81.3	32.8	
LOS			A	D		A	D	E	B	F	C	
Approach Delay		8.2			17.4			53.9			51.6	
Approach LOS		A			B			D			D	
Queue Length 50th (m)			1.2	38.2		0.0	2.8	100.6	12.7	169.8	211.0	
Queue Length 95th (m)			4.2	69.9		15.7	9.2	#165.8	49.4	#270.9	#373.4	
Internal Link Dist (m)		75.2			202.7			495.7			182.1	
Turn Bay Length (m)										100.0		
Base Capacity (vph)			562	401		1023	153	813	593	1243	2225	
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			0.03	0.44		0.49	0.10	0.94	0.61	1.05	0.93	

Intersection Summary

Cycle Length: 150
Actuated Cycle Length: 137.4
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 1.05
Intersection Signal Delay: 47.5 Intersection LOS: D
Intersection Capacity Utilization 78.0% ICU Level of Service D
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Windmill Road & Akerley Boulevard

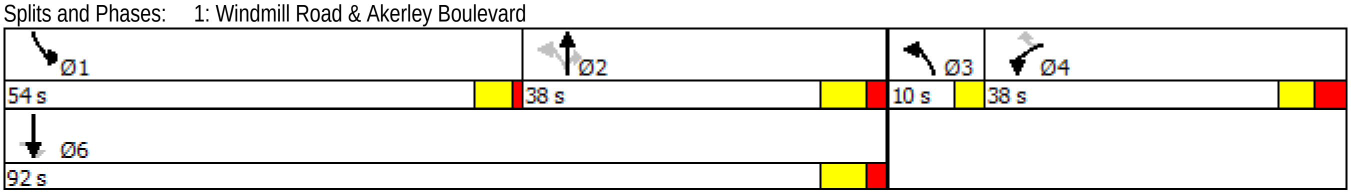


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	161	0	464	15	705	331	1197	1898	0
Future Volume (vph)	0	0	0	161	0	464	15	705	331	1197	1898	0
Satd. Flow (prot)	0	0	961	1789	0	2818	1789	3579	1601	3471	3579	0
Flt Permitted				0.950			0.128			0.950		
Satd. Flow (perm)	0	0	961	1789	0	2818	241	3579	1601	3471	3579	0
Satd. Flow (RTOR)						509			324			
Lane Group Flow (vph)	0	0	0	177	0	509	16	774	363	1314	2084	0
Turn Type			Perm	Prot		Perm	pm+pt	NA	Perm	Prot	NA	
Protected Phases				4			3	2		1	6	
Permitted Phases			6			4	2		2			
Total Split (s)			92.0	38.0		38.0	10.0	38.0	38.0	54.0	92.0	
Total Lost Time (s)			6.9	7.3		7.3	3.0	6.9	6.9	5.0	6.9	
Act Effct Green (s)				30.7		30.7	40.5	31.1	31.1	49.0	85.2	
Actuated g/C Ratio				0.23		0.23	0.30	0.23	0.23	0.37	0.64	
v/c Ratio				0.43		0.49	0.12	0.93	0.58	1.03	0.91	
Control Delay				48.4		5.3	38.3	68.1	11.4	74.5	28.9	
Queue Delay				0.0		0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay				48.4		5.3	38.3	68.1	11.4	74.5	28.9	
LOS				D		A	D	E	B	E	C	
Approach Delay					16.4			49.8			46.5	
Approach LOS					B			D			D	
Queue Length 50th (m)				38.7		0.0	2.8	101.9	7.9	~173.8	215.6	
Queue Length 95th (m)				65.4		15.1	8.7	#150.7	38.8	#246.5	#316.1	
Internal Link Dist (m)		75.2			202.7			495.7			182.1	
Turn Bay Length (m)										100.0		
Base Capacity (vph)				412		1040	157	835	621	1276	2285	
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				0.43		0.49	0.10	0.93	0.58	1.03	0.91	

Intersection Summary

Cycle Length: 140
Actuated Cycle Length: 133.4
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 1.03
Intersection Signal Delay: 43.3 Intersection LOS: D
Intersection Capacity Utilization 78.6% ICU Level of Service D
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Windmill Road & Akerley Boulevard

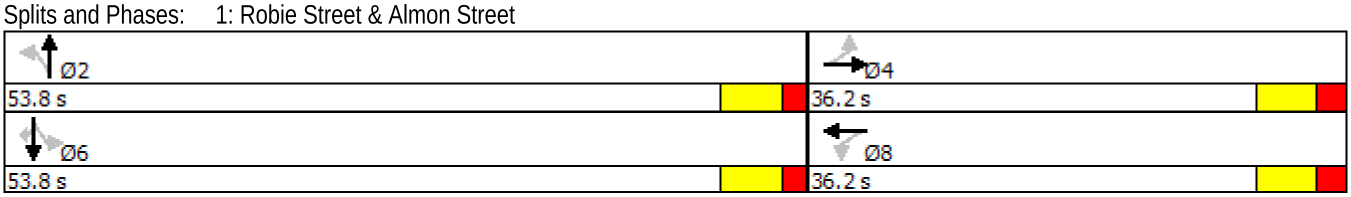


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	157	300	52	19	203	47	32	479	18	43	597	209
Future Volume (vph)	157	300	52	19	203	47	32	479	18	43	597	209
Satd. Flow (prot)	1789	1828	0	0	3439	0	0	3545	0	1789	1883	1601
Flt Permitted	0.573				0.910			0.869		0.411		
Satd. Flow (perm)	1049	1828	0	0	3139	0	0	3088	0	767	1883	1534
Satd. Flow (RTOR)		10			30			6				227
Lane Group Flow (vph)	171	383	0	0	293	0	0	576	0	47	649	227
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		6
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	0.49	0.62			0.27			0.35		0.11	0.65	0.25
Control Delay	29.7	29.8			20.5			12.7		11.4	18.7	2.2
Queue Delay	0.0	0.0			0.0			0.0		0.0	0.0	0.0
Total Delay	29.7	29.8			20.5			12.7		11.4	18.7	2.2
LOS	C	C			C			B		B	B	A
Approach Delay		29.8			20.5			12.7			14.3	
Approach LOS		C			C			B			B	
Queue Length 50th (m)	23.3	53.6			17.2			28.0		3.8	75.3	0.0
Queue Length 95th (m)	42.7	83.0			27.1			38.7		9.4	111.3	9.8
Internal Link Dist (m)		61.8			24.3			159.5			371.1	
Turn Bay Length (m)										45.0		
Base Capacity (vph)	349	616			1066			1649		409	1004	924
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	0.49	0.62			0.27			0.35		0.11	0.65	0.25

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 90
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.65
Intersection Signal Delay: 18.3 Intersection LOS: B
Intersection Capacity Utilization 119.8% ICU Level of Service H
Analysis Period (min) 15

Splits and Phases: 1: Robie Street & Almon Street

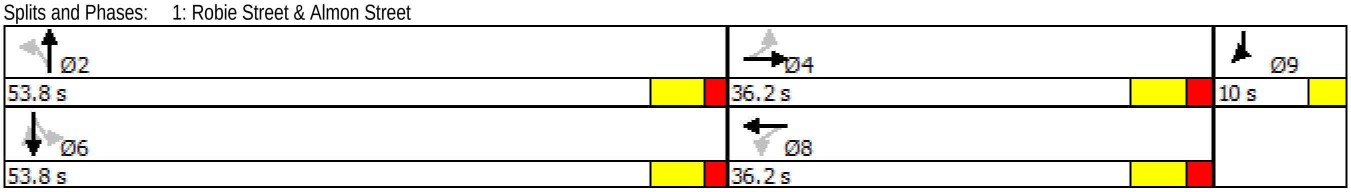


Lane Group	EBL	EBT	WBL2	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations									
Traffic Volume (vph)	157	300	19	203	32	479	43	585	12
Future Volume (vph)	157	300	19	203	32	479	43	585	12
Lane Group Flow (vph)	171	383	0	294	0	576	47	636	240
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA	custom
Protected Phases		4		8		2		6	9
Permitted Phases	4		8		2		6		6
Detector Phase	4	4	8	8	2	2	6	6	9
Switch Phase									
Minimum Initial (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	5.0
Minimum Split (s)	36.2	36.2	36.2	36.2	53.8	53.8	53.8	53.8	8.0
Total Split (s)	36.2	36.2	36.2	36.2	53.8	53.8	53.8	53.8	10.0
Total Split (%)	36.2%	36.2%	36.2%	36.2%	53.8%	53.8%	53.8%	53.8%	10.0%
Yellow Time (s)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	3.0
All-Red Time (s)	2.1	2.1	2.1	2.1	1.7	1.7	1.7	1.7	0.0
Lost Time Adjust (s)	0.0	0.0		0.0		0.0	0.0	0.0	0.0
Total Lost Time (s)	6.2	6.2		6.2		5.8	5.8	5.8	3.0
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max	None
Act Effct Green (s)	30.0	30.0		30.0		48.0	48.0	48.0	57.0
Actuated g/C Ratio	0.30	0.30		0.30		0.48	0.48	0.48	0.57
v/c Ratio	0.54	0.70		0.32		0.41	0.13	0.70	0.25
Control Delay	36.4	38.6		25.4		17.5	15.7	25.1	2.0
Queue Delay	0.0	0.0		0.0		0.0	0.0	0.0	0.0
Total Delay	36.4	38.6		25.4		17.5	15.7	25.1	2.0
LOS	D	D		C		B	B	C	A
Approach Delay		38.0		25.4		17.5		18.7	
Approach LOS		D		C		B		B	
Queue Length 50th (m)	27.1	64.4		20.5		35.4	4.8	91.0	0.9
Queue Length 95th (m)	49.1	97.9		32.0		49.6	11.8	134.2	9.7
Internal Link Dist (m)		61.8		24.3		159.5		371.1	
Turn Bay Length (m)							45.0		
Base Capacity (vph)	318	549		933		1411	355	911	991
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	0.54	0.70		0.32		0.41	0.13	0.70	0.24

Intersection Summary

Cycle Length: 100
Actuated Cycle Length: 99.2
Natural Cycle: 100
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.70
Intersection Signal Delay: 23.8 Intersection LOS: C
Intersection Capacity Utilization 122.2% ICU Level of Service H
Analysis Period (min) 15

Splits and Phases: 1: Robie Street & Almon Street

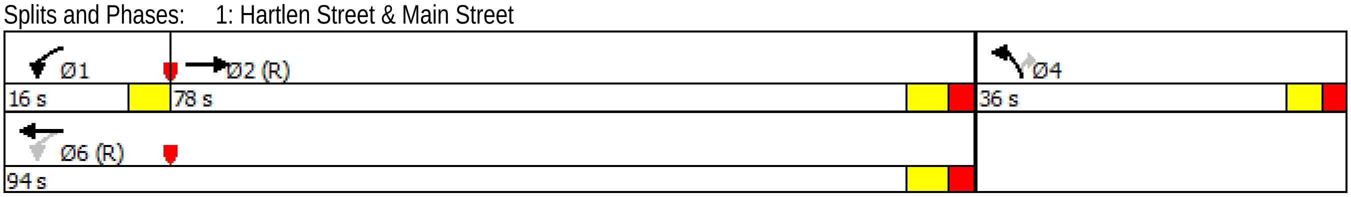


Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	984	58	97	1542	118	48
Future Volume (vph)	984	58	97	1542	118	48
Satd. Flow (prot)	3550	0	1789	3579	1789	1601
Flt Permitted			0.198		0.950	
Satd. Flow (perm)	3550	0	373	3579	1789	1601
Satd. Flow (RTOR)	7					54
Lane Group Flow (vph)	1167	0	109	1726	132	54
Turn Type	NA		pm+pt	NA	Prot	Perm
Protected Phases	2		1	6	4	
Permitted Phases			6			4
Total Split (s)	78.0		16.0	94.0	36.0	36.0
Total Lost Time (s)	6.7		4.0	6.7	6.0	6.0
Act Effct Green (s)	90.9		105.1	102.4	14.9	14.9
Actuated g/C Ratio	0.70		0.81	0.79	0.11	0.11
v/c Ratio	0.47		0.28	0.61	0.64	0.23
Control Delay	5.6		4.9	7.2	68.9	14.9
Queue Delay	0.0		0.0	0.0	0.0	0.0
Total Delay	5.6		4.9	7.2	68.9	14.9
LOS	A		A	A	E	B
Approach Delay	5.6			7.1	53.2	
Approach LOS	A			A	D	
Queue Length 50th (m)	17.1		4.6	80.2	32.8	0.0
Queue Length 95th (m)	140.1		10.3	119.6	51.4	11.8
Internal Link Dist (m)	274.1			312.5	162.8	
Turn Bay Length (m)			50.0			25.0
Base Capacity (vph)	2483		432	2819	412	411
Starvation Cap Reductn	0		0	0	0	0
Spillback Cap Reductn	0		0	0	0	0
Storage Cap Reductn	0		0	0	0	0
Reduced v/c Ratio	0.47		0.25	0.61	0.32	0.13

Intersection Summary

Cycle Length: 130
Actuated Cycle Length: 130
Offset: 46.2 (36%), Referenced to phase 2:EBT and 6:WBTL, Start of Green
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.64
Intersection Signal Delay: 9.2 Intersection LOS: A
Intersection Capacity Utilization 61.2% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 1: Hartlen Street & Main Street

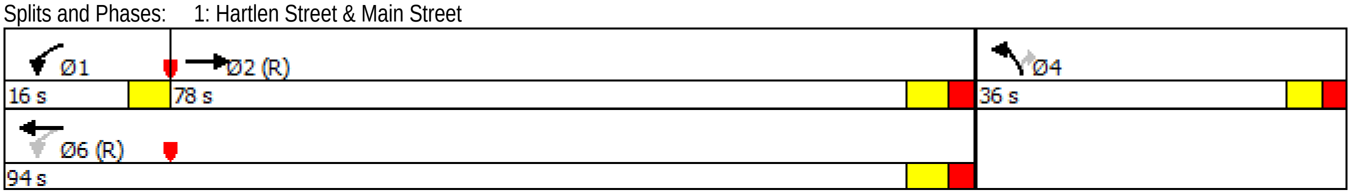


Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	1881	114	114	702	139	87
Future Volume (vph)	1881	114	114	702	139	87
Satd. Flow (prot)	3546	0	1789	3579	1789	1601
Flt Permitted			0.044		0.950	
Satd. Flow (perm)	3546	0	83	3579	1789	1601
Satd. Flow (RTOR)	7					95
Lane Group Flow (vph)	2169	0	124	763	151	95
Turn Type	NA		pm+pt	NA	Prot	Perm
Protected Phases	2		1	6	4	
Permitted Phases			6			4
Total Split (s)	78.0		16.0	94.0	36.0	36.0
Total Lost Time (s)	6.7		4.0	6.7	6.0	6.0
Act Effct Green (s)	87.2		103.7	101.0	16.3	16.3
Actuated g/C Ratio	0.67		0.80	0.78	0.13	0.13
v/c Ratio	0.91		0.64	0.27	0.68	0.34
Control Delay	7.7		38.6	4.7	68.8	12.4
Queue Delay	0.4		0.0	0.0	0.0	0.0
Total Delay	8.1		38.6	4.7	68.8	12.4
LOS	A		D	A	E	B
Approach Delay	8.1			9.4	47.1	
Approach LOS	A			A	D	
Queue Length 50th (m)	35.1		14.5	24.7	37.5	0.0
Queue Length 95th (m)	m#313.3		35.0	38.7	57.0	14.8
Internal Link Dist (m)	274.1			312.5	145.4	
Turn Bay Length (m)			50.0		25.0	
Base Capacity (vph)	2379		231	2781	412	442
Starvation Cap Reductn	32		0	0	0	0
Spillback Cap Reductn	0		0	0	0	0
Storage Cap Reductn	0		0	0	0	0
Reduced v/c Ratio	0.92		0.54	0.27	0.37	0.21

Intersection Summary

Cycle Length: 130
Actuated Cycle Length: 130
Offset: 17 (13%), Referenced to phase 2:EBT and 6:WBTL, Start of Green
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.91
Intersection Signal Delay: 11.4 Intersection LOS: B
Intersection Capacity Utilization 83.6% ICU Level of Service E
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Hartlen Street & Main Street

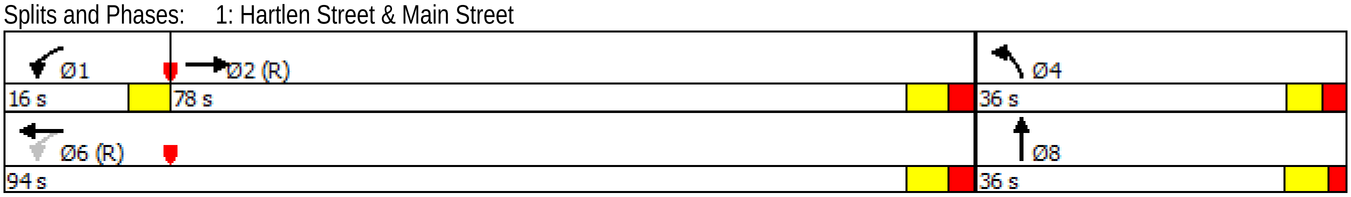


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	984	58	97	1542	0	108	10	48	0	0	0
Future Volume (vph)	0	984	58	97	1542	0	108	10	48	0	0	0
Satd. Flow (prot)	0	3550	0	1789	3579	0	1789	1648	0	0	0	0
Flt Permitted				0.199			0.950					
Satd. Flow (perm)	0	3550	0	375	3579	0	1789	1648	0	0	0	0
Satd. Flow (RTOR)		7						54				
Lane Group Flow (vph)	0	1167	0	109	1726	0	121	65	0	0	0	0
Turn Type		NA		pm+pt	NA		Prot	NA				
Protected Phases		2		1	6		4	8				
Permitted Phases				6								
Total Split (s)		78.0		16.0	94.0		36.0	36.0				
Total Lost Time (s)		6.7		4.0	6.7		6.0	6.1				
Act Effct Green (s)		91.7		105.9	103.2		14.1	14.0				
Actuated g/C Ratio		0.71		0.81	0.79		0.11	0.11				
v/c Ratio		0.47		0.28	0.61		0.62	0.29				
Control Delay		5.2		4.6	6.9		68.7	19.9				
Queue Delay		0.0		0.0	0.0		0.0	0.0				
Total Delay		5.2		4.6	6.9		68.7	19.9				
LOS		A		A	A		E	B				
Approach Delay		5.2			6.7			51.7				
Approach LOS		A			A			D				
Queue Length 50th (m)		17.7		4.4	77.2		30.1	2.6				
Queue Length 95th (m)		137.1		9.9	115.2		48.0	15.7				
Internal Link Dist (m)		274.1			312.5			162.8			43.0	
Turn Bay Length (m)				50.0			25.0					
Base Capacity (vph)		2506		436	2840		412	420				
Starvation Cap Reductn		0		0	0		0	0				
Spillback Cap Reductn		0		0	0		0	0				
Storage Cap Reductn		0		0	0		0	0				
Reduced v/c Ratio		0.47		0.25	0.61		0.29	0.15				

Intersection Summary

Cycle Length: 130
Actuated Cycle Length: 130
Offset: 46.2 (36%), Referenced to phase 2:EBT and 6:WBTL, Start of Green
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.62
Intersection Signal Delay: 8.8 Intersection LOS: A
Intersection Capacity Utilization 60.6% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 1: Hartlen Street & Main Street

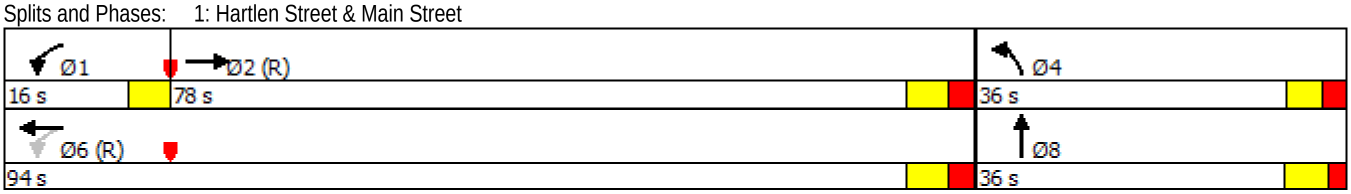


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1881	114	114	702	0	139	12	87	0	0	0
Future Volume (vph)	0	1881	114	114	702	0	139	12	87	0	0	0
Satd. Flow (prot)	0	3546	0	1789	3579	0	1789	1635	0	0	0	0
Flt Permitted				0.044			0.950					
Satd. Flow (perm)	0	3546	0	83	3579	0	1789	1635	0	0	0	0
Satd. Flow (RTOR)		7						95				
Lane Group Flow (vph)	0	2169	0	124	763	0	151	108	0	0	0	0
Turn Type		NA		pm+pt	NA		Prot	NA				
Protected Phases		2		1	6		4	8				
Permitted Phases				6								
Total Split (s)		78.0		16.0	94.0		36.0	36.0				
Total Lost Time (s)		6.7		4.0	6.7		6.0	6.1				
Act Effct Green (s)		87.2		103.7	101.0		16.3	16.2				
Actuated g/C Ratio		0.67		0.80	0.78		0.13	0.12				
v/c Ratio		0.91		0.64	0.27		0.68	0.38				
Control Delay		7.7		38.6	4.7		68.8	16.1				
Queue Delay		0.4		0.0	0.0		0.0	0.0				
Total Delay		8.1		38.6	4.7		68.8	16.1				
LOS		A		D	A		E	B				
Approach Delay		8.1			9.4			46.8				
Approach LOS		A			A			D				
Queue Length 50th (m)		35.1		14.5	24.7		37.5	3.0				
Queue Length 95th (m)		m#313.3		35.0	38.7		57.0	18.8				
Internal Link Dist (m)		274.1			312.5			145.4			37.2	
Turn Bay Length (m)				50.0			25.0					
Base Capacity (vph)		2379		231	2781		412	449				
Starvation Cap Reductn		32		0	0		0	0				
Spillback Cap Reductn		0		0	0		0	0				
Storage Cap Reductn		0		0	0		0	0				
Reduced v/c Ratio		0.92		0.54	0.27		0.37	0.24				

Intersection Summary

Cycle Length: 130
Actuated Cycle Length: 130
Offset: 17 (13%), Referenced to phase 2:EBT and 6:WBTL, Start of Green
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.91
Intersection Signal Delay: 11.5 Intersection LOS: B
Intersection Capacity Utilization 83.6% ICU Level of Service E
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Hartlen Street & Main Street

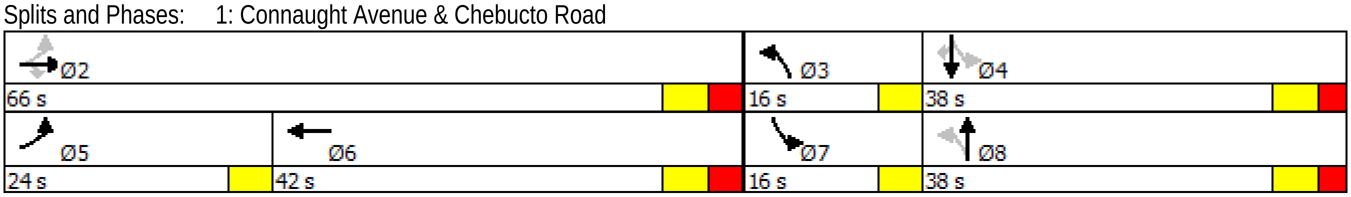


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	380	756	680	0	376	76	87	249	0	287	611	166
Future Volume (vph)	380	756	680	0	376	76	87	249	0	287	611	166
Satd. Flow (prot)	1789	1883	1601	0	3480	0	1789	3579	0	1789	3579	1601
Flt Permitted	0.338						0.276			0.492		
Satd. Flow (perm)	635	1883	1527	0	3480	0	519	3579	0	927	3579	1569
Satd. Flow (RTOR)			326		20							158
Lane Group Flow (vph)	413	822	739	0	492	0	95	271	0	312	664	180
Turn Type	pm+pt	NA	Perm		NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases	5	2			6		3	8		7	4	
Permitted Phases	2		2				8			4		4
Total Split (s)	24.0	66.0	66.0		42.0		16.0	38.0		16.0	38.0	38.0
Total Lost Time (s)	4.0	7.2	7.2		7.2		4.0	6.8		4.0	6.8	6.8
Act Effct Green (s)	56.8	53.5	53.5		30.3		34.8	22.5		40.4	28.6	28.6
Actuated g/C Ratio	0.53	0.50	0.50		0.28		0.33	0.21		0.38	0.27	0.27
v/c Ratio	0.76	0.87	0.80		0.49		0.34	0.36		0.69	0.69	0.34
Control Delay	27.1	36.5	20.2		33.1		25.5	37.4		35.3	41.6	9.6
Queue Delay	0.0	0.0	0.0		0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	27.1	36.5	20.2		33.1		25.5	37.4		35.3	41.6	9.6
LOS	C	D	C		C		C	D		D	D	A
Approach Delay		28.4			33.1			34.3			34.9	
Approach LOS		C			C			C			C	
Queue Length 50th (m)	53.1	154.4	76.8		45.1		13.6	26.9		51.1	72.6	3.8
Queue Length 95th (m)	#89.2	#250.2	146.0		64.4		24.6	38.7		75.2	95.7	21.5
Internal Link Dist (m)		447.1			23.4			68.6			658.9	
Turn Bay Length (m)							40.0			40.0		50.0
Base Capacity (vph)	559	1064	1005		1178		329	1073		450	1073	581
Starvation Cap Reductn	0	0	0		0		0	0		0	0	0
Spillback Cap Reductn	0	0	0		0		0	0		0	0	0
Storage Cap Reductn	0	0	0		0		0	0		0	0	0
Reduced v/c Ratio	0.74	0.77	0.74		0.42		0.29	0.25		0.69	0.62	0.31

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 106.9
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.87
Intersection Signal Delay: 31.4 Intersection LOS: C
Intersection Capacity Utilization 78.4% ICU Level of Service D
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Connaught Avenue & Chebucto Road

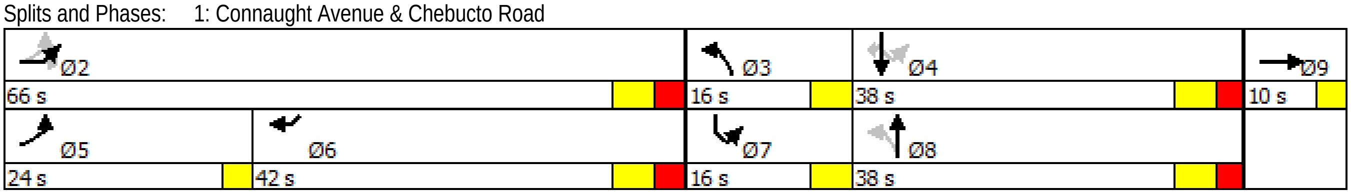


Lane Group	EBL2	EBL	EBT	EBR	NBL	NBT	SBL2	SBT	SBR	SWR	SWR2
Lane Configurations											
Traffic Volume (vph)	380	739	17	680	87	249	287	611	166	376	76
Future Volume (vph)	380	739	17	680	87	249	287	611	166	376	76
Satd. Flow (prot)	1789	1789	1497	0	1789	3579	1789	3579	1601	2818	0
Flt Permitted	0.307	0.950			0.184		0.503				
Satd. Flow (perm)	577	1789	1497	0	346	3579	947	3579	1601	2818	0
Satd. Flow (RTOR)			321						142		
Lane Group Flow (vph)	413	803	757	0	95	271	312	664	180	492	0
Turn Type	custom	Prot	NA		pm+pt	NA	pm+pt	NA	Perm	Prot	
Protected Phases	5	2	9		3	8	7	4		6	
Permitted Phases	2		2		8		4		4		
Total Split (s)	24.0	66.0	10.0		16.0	38.0	16.0	38.0	38.0	42.0	
Total Lost Time (s)	3.0	7.2	3.0		4.0	6.8	4.0	6.8	6.8	7.2	
Act Effct Green (s)	62.4	58.2	72.4		38.4	25.9	42.9	28.3	28.3	34.7	
Actuated g/C Ratio	0.50	0.47	0.58		0.31	0.21	0.35	0.23	0.23	0.28	
v/c Ratio	0.84	0.96	0.75		0.43	0.36	0.76	0.82	0.38	0.63	
Control Delay	38.9	55.8	16.7		33.1	43.2	46.3	54.7	13.2	44.1	
Queue Delay	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	38.9	55.8	16.7		33.1	43.2	46.3	54.7	13.2	44.1	
LOS	D	E	B		C	D	D	D	B	D	
Approach Delay			37.2			40.6		46.0			
Approach LOS			D			D		D			
Queue Length 50th (m)	66.6	193.7	82.7		15.7	30.2	59.0	82.1	7.5	62.1	
Queue Length 95th (m)	#104.4	#286.6	144.4		27.7	42.8	#87.6	105.8	27.0	84.3	
Internal Link Dist (m)			447.1			68.6		658.9			
Turn Bay Length (m)					40.0		40.0		50.0		
Base Capacity (vph)	495	849	1006		253	901	408	901	509	791	
Starvation Cap Reductn	0	0	0		0	0	0	0	0	0	
Spillback Cap Reductn	0	0	0		0	0	0	0	0	0	
Storage Cap Reductn	0	0	0		0	0	0	0	0	0	
Reduced v/c Ratio	0.83	0.95	0.75		0.38	0.30	0.76	0.74	0.35	0.62	

Intersection Summary

Cycle Length: 130
Actuated Cycle Length: 124.2
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.96
Intersection Signal Delay: 40.9 Intersection LOS: D
Intersection Capacity Utilization 89.4% ICU Level of Service E
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Connaught Avenue & Chebucto Road

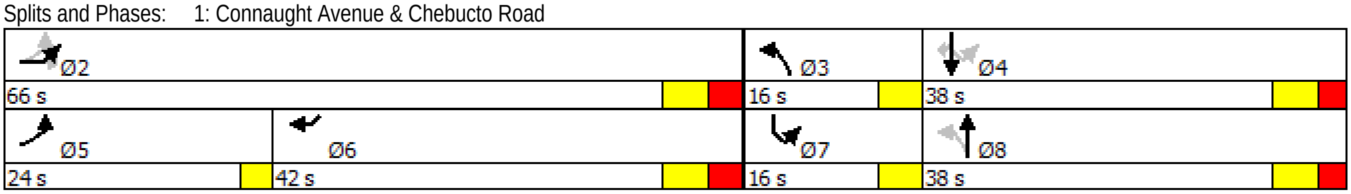


Lane Group	EBL2	EBL	EBT	EBR	NBL	NBT	SBL2	SBT	SBR	SWR	SWR2
Lane Configurations											
Traffic Volume (vph)	380	739	17	680	87	249	287	611	166	376	76
Future Volume (vph)	380	739	17	680	87	249	287	611	166	376	76
Satd. Flow (prot)	1789	1789	1502	0	1789	3579	1789	3579	1601	2818	0
Flt Permitted	0.329	0.950			0.268		0.489				
Satd. Flow (perm)	619	1789	1502	0	504	3579	921	3579	1601	2818	0
Satd. Flow (RTOR)			328						158		
Lane Group Flow (vph)	413	803	757	0	95	271	312	664	180	492	0
Turn Type	custom	Prot	NA		pm+pt	NA	pm+pt	NA	Perm	Prot	
Protected Phases	5	2			3	8	7	4		6	
Permitted Phases	2		2		8		4		4		
Total Split (s)	24.0	66.0	66.0		16.0	38.0	16.0	38.0	38.0	42.0	
Total Lost Time (s)	3.0	7.2	7.2		4.0	6.8	4.0	6.8	6.8	7.2	
Act Effct Green (s)	59.2	54.9	54.9		34.9	22.6	40.4	28.5	28.5	32.5	
Actuated g/C Ratio	0.55	0.51	0.51		0.32	0.21	0.37	0.26	0.26	0.30	
v/c Ratio	0.76	0.89	0.82		0.35	0.36	0.71	0.70	0.33	0.58	
Control Delay	25.9	38.3	21.8		25.9	37.8	36.3	42.4	9.6	36.6	
Queue Delay	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	25.9	38.3	21.8		25.9	37.8	36.3	42.4	9.6	36.6	
LOS	C	D	C		C	D	D	D	A	D	
Approach Delay			29.4			34.7		35.7			
Approach LOS			C			C		D			
Queue Length 50th (m)	52.0	154.2	83.3		13.6	26.9	51.1	72.6	3.8	52.9	
Queue Length 95th (m)	#84.4	#251.7	#160.1		24.6	38.7	75.2	95.7	21.4	75.9	
Internal Link Dist (m)			447.1			68.6		658.9			
Turn Bay Length (m)					40.0		40.0		50.0		
Base Capacity (vph)	570	994	981		321	1056	442	1056	583	932	
Starvation Cap Reductn	0	0	0		0	0	0	0	0	0	
Spillback Cap Reductn	0	0	0		0	0	0	0	0	0	
Storage Cap Reductn	0	0	0		0	0	0	0	0	0	
Reduced v/c Ratio	0.72	0.81	0.77		0.30	0.26	0.71	0.63	0.31	0.53	

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 108.2
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.89
Intersection Signal Delay: 32.6 Intersection LOS: C
Intersection Capacity Utilization 92.1% ICU Level of Service F
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Connaught Avenue & Chebucto Road

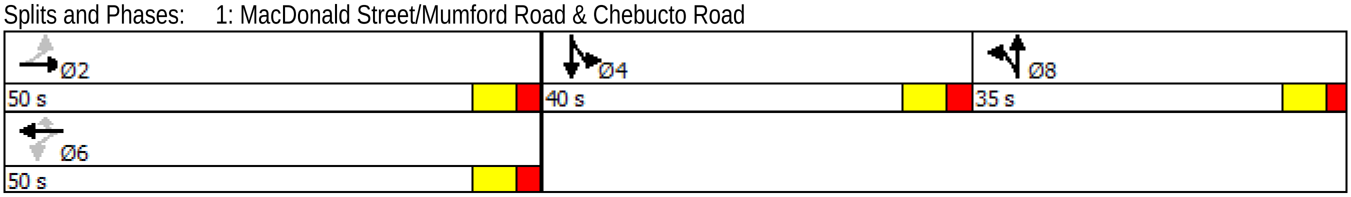


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	85	408	2	20	664	892	20	206	14	479	46	78
Future Volume (vph)	85	408	2	20	664	892	20	206	14	479	46	78
Satd. Flow (prot)	1789	3574	0	0	3575	1601	0	1854	0	1700	1671	0
Flt Permitted	0.268				0.930			0.996		0.950	0.972	
Satd. Flow (perm)	503	3574	0	0	3325	1559	0	1853	0	1700	1671	0
Satd. Flow (RTOR)						683		2			14	
Lane Group Flow (vph)	92	445	0	0	744	970	0	261	0	333	323	0
Turn Type	Perm	NA		Perm	NA	Perm	Split	NA		Split	NA	
Protected Phases		2			6		8	8		4	4	
Permitted Phases	2			6		6						
Total Split (s)	50.0	50.0		50.0	50.0	50.0	35.0	35.0		40.0	40.0	
Total Lost Time (s)	6.4	6.4			6.5	6.5		6.1		6.5	6.5	
Act Effct Green (s)	43.6	43.6			43.5	43.5		20.6		26.6	26.6	
Actuated g/C Ratio	0.40	0.40			0.40	0.40		0.19		0.24	0.24	
v/c Ratio	0.46	0.31			0.57	0.94		0.75		0.81	0.78	
Control Delay	38.4	25.7			30.0	28.4		56.9		56.2	51.7	
Queue Delay	0.0	0.0			0.0	0.0		0.0		0.0	0.0	
Total Delay	38.4	25.7			30.0	28.4		56.9		56.2	51.7	
LOS	D	C			C	C		E		E	D	
Approach Delay		27.8			29.1			56.9			54.0	
Approach LOS		C			C			E			D	
Queue Length 50th (m)	14.9	35.3			66.8	78.0		54.2		71.4	65.8	
Queue Length 95th (m)	37.0	56.5			101.4	#204.1		85.6		114.5	107.5	
Internal Link Dist (m)		413.1			143.4			344.1			683.0	
Turn Bay Length (m)	10.0											
Base Capacity (vph)	202	1436			1333	1034		495		524	525	
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	0.46	0.31			0.56	0.94		0.53		0.64	0.62	

Intersection Summary

Cycle Length: 125
Actuated Cycle Length: 110.1
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.94
Intersection Signal Delay: 36.3 Intersection LOS: D
Intersection Capacity Utilization 103.8% ICU Level of Service G
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: MacDonald Street/Mumford Road & Chebucto Road

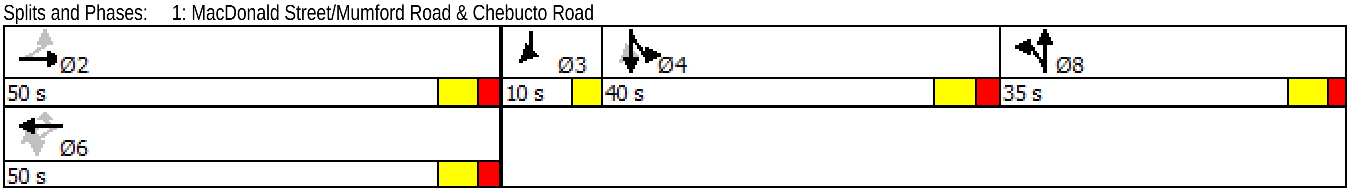


Lane Group	EBL	EBT	WBL2	WBT	WBR	NBT	SBL	SBT	SBR
Lane Configurations									
Traffic Volume (vph)	85	408	20	664	892	206	460	46	19
Future Volume (vph)	85	408	20	664	892	206	460	46	19
Lane Group Flow (vph)	92	445	0	744	970	261	275	275	106
Turn Type	Perm	NA	Perm	NA	Perm	NA	Split	NA	custom
Protected Phases		2		6		8	4	4	3
Permitted Phases	2		6		6				4
Detector Phase	2	2	6	6	6	8	4	4	3
Switch Phase									
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	7.0	7.0	7.0	5.0
Minimum Split (s)	27.4	27.4	27.5	27.5	27.5	30.1	30.5	30.5	8.0
Total Split (s)	50.0	50.0	50.0	50.0	50.0	35.0	40.0	40.0	10.0
Total Split (%)	37.0%	37.0%	37.0%	37.0%	37.0%	25.9%	29.6%	29.6%	7.4%
Yellow Time (s)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	3.0
All-Red Time (s)	2.3	2.3	2.4	2.4	2.4	2.0	2.4	2.4	0.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.4	6.4		6.5	6.5	6.1	6.5	6.5	3.0
Lead/Lag							Lag	Lag	Lead
Lead-Lag Optimize?							Yes	Yes	Yes
Recall Mode	Min	Min	None	None	None	None	None	None	None
Act Effct Green (s)	43.8	43.8		43.7	43.7	21.4	24.5	24.5	38.1
Actuated g/C Ratio	0.37	0.37		0.37	0.37	0.18	0.21	0.21	0.32
v/c Ratio	0.53	0.34		0.61	0.95	0.78	0.79	0.78	0.25
Control Delay	47.6	30.0		35.2	29.2	63.5	61.9	61.0	32.2
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	47.6	30.0		35.2	29.2	63.5	61.9	61.0	32.2
LOS	D	C		D	C	E	E	E	C
Approach Delay		33.0		31.8		63.5		56.7	
Approach LOS		C		C		E		E	
Queue Length 50th (m)	17.0	39.7		75.1	77.7	58.5	64.6	64.5	18.3
Queue Length 95th (m)	#44.3	63.2		113.4	#206.0	93.2	101.7	101.4	34.6
Internal Link Dist (m)		413.1		143.4		344.1		681.7	
Turn Bay Length (m)	10.0								
Base Capacity (vph)	174	1324		1228	1025	456	483	489	431
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	0.53	0.34		0.61	0.95	0.57	0.57	0.56	0.25

Intersection Summary

Cycle Length: 135
Actuated Cycle Length: 119
Natural Cycle: 110
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.95
Intersection Signal Delay: 39.8 Intersection LOS: D
Intersection Capacity Utilization 102.2% ICU Level of Service G
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: MacDonald Street/Mumford Road & Chebucto Road

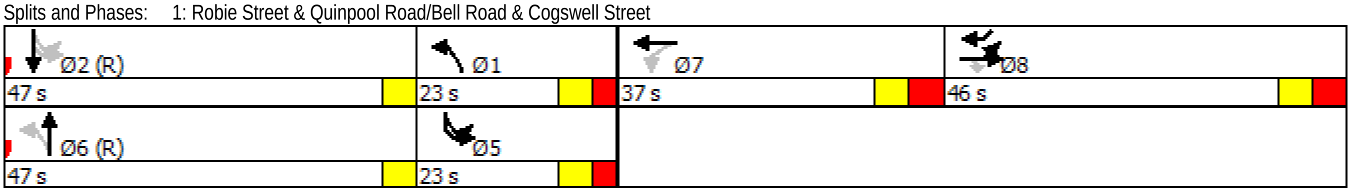


Lane Group	EBL	EBT	EBR	WBT	NBL	NBT	SBL2	SBL	SBT	SWR
Lane Configurations										
Traffic Volume (vph)	423	482	414	253	153	418	70	247	753	210
Future Volume (vph)	423	482	414	253	153	418	70	247	753	210
Lane Group Flow (vph)	460	524	450	394	166	493	0	344	868	261
Turn Type	Split	NA	Perm	NA	pm+pt	NA	pm+pt	pm+pt	NA	Over
Protected Phases	8	8		7	1	6	5	5	2	8
Permitted Phases			8		6		2	2		
Minimum Split (s)	46.0	46.0	46.0	37.0	23.0	47.0	23.0	23.0	47.0	46.0
Total Split (s)	46.0	46.0	46.0	37.0	23.0	47.0	23.0	23.0	47.0	46.0
Total Split (%)	30.1%	30.1%	30.1%	24.2%	15.0%	30.7%	15.0%	15.0%	30.7%	30.1%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	4.0	4.0	4.0	4.0	3.0	0.0	3.0	3.0	0.0	4.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	8.0	8.0	8.0	8.0	7.0	4.0		7.0	4.0	8.0
Lead/Lag	Lag	Lag	Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Act Effct Green (s)	38.0	38.0	38.0	29.0	56.0	43.0		56.0	43.0	38.0
Actuated g/C Ratio	0.25	0.25	0.25	0.19	0.37	0.28		0.37	0.28	0.25
v/c Ratio	1.04	1.12	0.93	0.61	0.72	0.51		1.08	0.87	0.33
Control Delay	107.1	130.5	60.8	61.4	74.6	48.3		123.6	63.0	27.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	107.1	130.5	60.8	61.4	74.6	48.3		123.6	63.0	27.2
LOS	F	F	E	E	E	D		F	E	C
Approach Delay		101.1		61.4		54.9			80.2	
Approach LOS		F		E		D			F	
Queue Length 50th (m)	~149.7	~182.6	91.0	58.3	32.5	66.3		~85.1	132.8	20.2
Queue Length 95th (m)	#217.6	#253.1	#157.2	76.2	#64.3	84.3		#154.5	159.3	34.4
Internal Link Dist (m)		508.7		335.1		282.7			389.0	
Turn Bay Length (m)			40.0							
Base Capacity (vph)	444	467	486	647	232	966		318	996	785
Starvation Cap Reductn	0	0	0	0	0	0		0	0	0
Spillback Cap Reductn	0	0	0	0	0	0		0	0	0
Storage Cap Reductn	0	0	0	0	0	0		0	0	0
Reduced v/c Ratio	1.04	1.12	0.93	0.61	0.72	0.51		1.08	0.87	0.33

Intersection Summary

Cycle Length: 153
Actuated Cycle Length: 153
Offset: 79.1 (52%), Referenced to phase 2:SBTL and 6:NBTL, Start of Green
Natural Cycle: 155
Control Type: Pretimed
Maximum v/c Ratio: 1.12
Intersection Signal Delay: 78.2 Intersection LOS: E
Intersection Capacity Utilization 134.7% ICU Level of Service H
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Robie Street & Quinpool Road/Bell Road & Cogswell Street



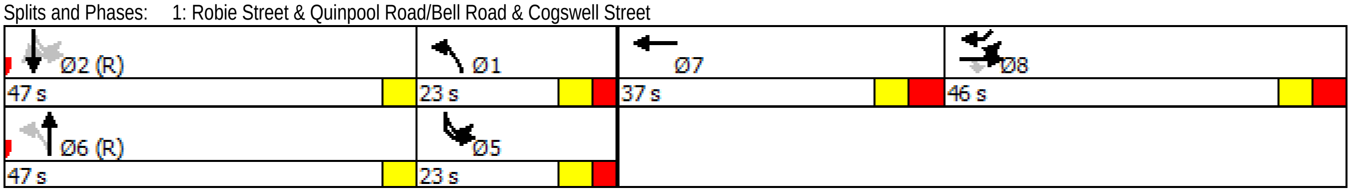
Lane Group	EBL	EBT	EBR	WBT	NBL	NBT	SBL2	SBL	SBT	SBR	SWR
Lane Configurations											
Traffic Volume (vph)	423	482	414	253	153	418	70	247	737	18	210
Future Volume (vph)	423	482	414	253	153	418	70	247	737	18	210
Lane Group Flow (vph)	460	524	450	394	166	493	0	344	801	70	261
Turn Type	Split	NA	Perm	NA	pm+pt	NA	pm+pt	pm+pt	NA	Perm	Over
Protected Phases	8	8		7	1	6	5	5	2		8
Permitted Phases			8		6		2	2		2	
Minimum Split (s)	46.0	46.0	46.0	37.0	23.0	47.0	23.0	23.0	47.0	47.0	46.0
Total Split (s)	46.0	46.0	46.0	37.0	23.0	47.0	23.0	23.0	47.0	47.0	46.0
Total Split (%)	30.1%	30.1%	30.1%	24.2%	15.0%	30.7%	15.0%	15.0%	30.7%	30.7%	30.1%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	4.0	4.0	4.0	4.0	3.0	0.0	3.0	3.0	0.0	0.0	4.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Total Lost Time (s)	8.0	8.0	8.0	8.0	7.0	4.0		7.0	4.0	4.0	8.0
Lead/Lag	Lag	Lag	Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Act Effct Green (s)	38.0	38.0	38.0	29.0	56.0	43.0		56.0	43.0	43.0	38.0
Actuated g/C Ratio	0.25	0.25	0.25	0.19	0.37	0.28		0.37	0.28	0.28	0.25
v/c Ratio	1.04	1.12	1.25	0.61	0.72	0.51		1.08	1.51	0.16	0.33
Control Delay	107.1	130.5	179.7	61.4	74.6	48.3		123.6	278.4	42.6	27.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Total Delay	107.1	130.5	179.7	61.4	74.6	48.3		123.6	278.4	42.6	27.2
LOS	F	F	F	E	E	D		F	F	D	C
Approach Delay		138.5		61.4		54.9			221.0		
Approach LOS		F		E		D			F		
Queue Length 50th (m)	~149.7	~182.6	~169.8	58.3	32.5	66.3		~85.1	~337.6	16.1	20.2
Queue Length 95th (m)	#217.6	#253.1	#237.1	76.2	#64.3	84.3		#154.5	#415.0	29.3	34.4
Internal Link Dist (m)		508.7		335.1		282.7			389.0		
Turn Bay Length (m)			40.0								
Base Capacity (vph)	444	467	360	647	232	966		318	529	449	785
Starvation Cap Reductn	0	0	0	0	0	0		0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0		0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0		0	0	0	0
Reduced v/c Ratio	1.04	1.12	1.25	0.61	0.72	0.51		1.08	1.51	0.16	0.33

Intersection Summary

Cycle Length: 153
Actuated Cycle Length: 153
Offset: 79.1 (52%), Referenced to phase 2:SBTL and 6:NBTL, Start of Green
Natural Cycle: 155
Control Type: Pretimed
Maximum v/c Ratio: 1.51
Intersection Signal Delay: 134.9 Intersection LOS: F
Intersection Capacity Utilization 117.7% ICU Level of Service H
Analysis Period (min) 15

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

Splits and Phases: 1: Robie Street & Quinpool Road/Bell Road & Cogswell Street

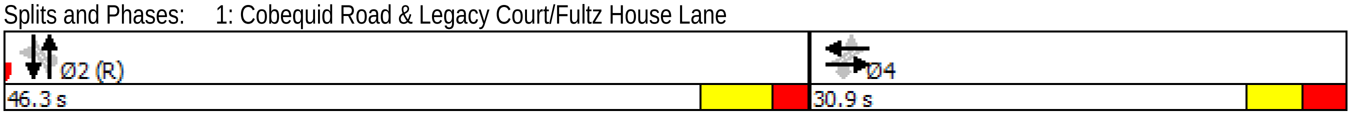


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	60	0	42	329	22	412	52	410	3	7	593	41
Future Volume (vph)	60	0	42	329	22	412	52	410	3	7	593	41
Satd. Flow (prot)	0	1789	1601	1789	1616	0	0	3554	0	0	3539	0
Flt Permitted		0.243		0.715				0.809			0.949	
Satd. Flow (perm)	0	458	1601	1347	1616	0	0	2892	0	0	3362	0
Satd. Flow (RTOR)			47		358			1			14	
Lane Group Flow (vph)	0	65	46	358	472	0	0	506	0	0	698	0
Turn Type	Perm	NA	Perm	Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4		4	4			2			2		
Total Split (s)	30.9	30.9	30.9	30.9	30.9		46.3	46.3		46.3	46.3	
Total Lost Time (s)		5.9	5.9	5.9	5.9			6.3			6.3	
Act Effct Green (s)		25.0	25.0	25.0	25.0			40.0			40.0	
Actuated g/C Ratio		0.32	0.32	0.32	0.32			0.52			0.52	
v/c Ratio		0.44	0.08	0.82	0.62			0.34			0.40	
Control Delay		31.9	6.4	41.9	9.6			11.6			11.9	
Queue Delay		0.0	0.0	0.0	0.0			0.0			0.0	
Total Delay		31.9	6.4	41.9	9.6			11.6			11.9	
LOS		C	A	D	A			B			B	
Approach Delay		21.3			23.5			11.6			11.9	
Approach LOS		C			C			B			B	
Queue Length 50th (m)		7.4	0.0	47.6	12.0			21.2			29.7	
Queue Length 95th (m)		19.7	6.4	#91.5	38.8			30.9			41.5	
Internal Link Dist (m)		22.9			35.3			162.2			145.3	
Turn Bay Length (m)												
Base Capacity (vph)		148	550	436	765			1498			1748	
Starvation Cap Reductn		0	0	0	0			0			0	
Spillback Cap Reductn		0	0	0	0			0			0	
Storage Cap Reductn		0	0	0	0			0			0	
Reduced v/c Ratio		0.44	0.08	0.82	0.62			0.34			0.40	

Intersection Summary

Cycle Length: 77.2
Actuated Cycle Length: 77.2
Offset: 0 (0%), Referenced to phase 2:NBSB and 6:, Start of Green
Control Type: Pretimed
Maximum v/c Ratio: 0.82
Intersection Signal Delay: 16.8 Intersection LOS: B
Intersection Capacity Utilization 83.6% ICU Level of Service E
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Cobequid Road & Legacy Court/Fultz House Lane

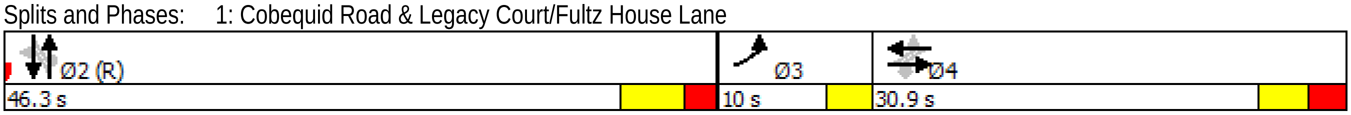


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	60	0	42	329	22	412	52	410	3	7	593	41
Future Volume (vph)	60	0	42	329	22	412	52	410	3	7	593	41
Satd. Flow (prot)	0	1789	1601	1789	1616	0	0	3554	0	0	3539	0
Flt Permitted		0.173		0.715				0.801			0.949	
Satd. Flow (perm)	0	326	1601	1347	1616	0	0	2864	0	0	3362	0
Satd. Flow (RTOR)			79		332			1			11	
Lane Group Flow (vph)	0	65	46	358	472	0	0	506	0	0	698	0
Turn Type	pm+pt	NA	Perm	Perm	NA		Perm	NA		Perm	NA	
Protected Phases	3	4			4			2			2	
Permitted Phases	4		4	4			2			2		
Total Split (s)	10.0	30.9	30.9	30.9	30.9		46.3	46.3		46.3	46.3	
Total Lost Time (s)		5.9	5.9	5.9	5.9			6.3			6.3	
Act Effct Green (s)		29.1	25.0	25.0	25.0			40.0			40.0	
Actuated g/C Ratio		0.33	0.29	0.29	0.29			0.46			0.46	
v/c Ratio		0.37	0.09	0.93	0.67			0.39			0.45	
Control Delay		22.6	2.5	63.3	13.7			16.6			17.0	
Queue Delay		0.0	0.0	0.0	0.0			0.0			0.0	
Total Delay		22.6	2.5	63.3	13.7			16.6			17.0	
LOS		C	A	E	B			B			B	
Approach Delay		14.3			35.1			16.6			17.0	
Approach LOS		B			D			B			B	
Queue Length 50th (m)		6.6	0.0	57.9	18.2			28.1			39.6	
Queue Length 95th (m)		14.3	3.3	#108.6	51.6			39.9			53.6	
Internal Link Dist (m)		22.9			35.3			162.2			145.3	
Turn Bay Length (m)												
Base Capacity (vph)		177	515	386	700			1314			1548	
Starvation Cap Reductn		0	0	0	0			0			0	
Spillback Cap Reductn		0	0	0	0			0			0	
Storage Cap Reductn		0	0	0	0			0			0	
Reduced v/c Ratio		0.37	0.09	0.93	0.67			0.39			0.45	

Intersection Summary

Cycle Length: 87.2
Actuated Cycle Length: 87.2
Offset: 0 (0%), Referenced to phase 2:NBSB and 6:, Start of Green
Control Type: Pretimed
Maximum v/c Ratio: 0.93
Intersection Signal Delay: 23.7 Intersection LOS: C
Intersection Capacity Utilization 83.6% ICU Level of Service E
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Cobequid Road & Legacy Court/Fultz House Lane



Appendix D

Delay Calculations

WSP

March 2016

Using the Net User Delay Methodology developed in the Evaluation Report, and the Transit ridership data obtained for each location it is possible to calculate the net road user delay during the subject peak hour.

$$\text{Net Change in Road User Delay} = \text{Net Transit User Delay} + \text{Net Non Transit User Delay}$$

Where:

$$\text{Net Change in Transit User Delay} \\ = \text{Delay/Transit Vehicle} \times \#\ \text{Transit Vehicles} \times \text{Average Ridership per Transit Vehicle}$$

And,

$$\text{Net Change in Non Transit User Delay} \\ = \text{Delay/Non Transit Vehicle} \times \#\ \text{Non Transit Vehicles} \times \text{Average Vehicle Occupancy}$$

Note: Delay reductions will be a negative value while delay increases will be a positive value.

$$\text{Daily Change in Cost to Transit} \\ = \text{Average Change in Delay/Transit Vehicle} \times \#\ \text{Transit Vehicles} \times \text{Cost/hour for Transit Vehicle}$$

$$\text{Annual Change in Cost to Transit} = \text{Daily Change in Cost to Transit} \times \text{Days/Year TPM is in Use}$$

$$\text{Daily Change in Cost to Public} \\ = \text{Daily Change in Person Cost} + \text{Daily Change in nonTransit Vehicle Cost}$$

Where

$$\text{Daily Change in Person Cost} \\ = \text{Net Change in Road User Delay} \times \#\ \text{hours TPM will be in effect per day} \times \text{Cost/hour for Road User}$$

$$\text{Daily Change in nonTransit Vehicle Cost} \\ = \text{Average delay change per nonTransit user} \times \#\ \text{of NonTransit vehicles} \times \text{Cost /hour for nonTransit Vehicle}$$

$$\text{Annual Change in Cost to Public} = \text{Daily Change in Cost to Public} \times \text{Days/Year TPM is in Use}$$

$$\text{Payback Period} \\ = \frac{\text{TPM Capital Cost}}{\text{Annual Cost Savings to Transit} + \text{Annual Cost Savings to Public} - \text{Annual Change in Operating Cost}}$$

Table D-1 - Wyse Road @ Macdonald Bridge (32 Transit veh/hr x Daily Delay Factor of 3 hr/day)

$$\text{Daily Net Change in Transit User Delay} = \frac{-6.3\text{ seconds x }96\text{ vehicles x }26\text{ users/veh}}{3600\text{ sec/hr}}$$

$$\mathbf{Daily\ Net\ Change\ in\ Transit\ User\ Delay = \ -4.4\ user\ hours/day}$$

$$\text{Daily Net Change in Non Transit User Delay} = \frac{0\text{ seconds x }6921\text{ vehicles x }1.22\text{ users/veh}}{3600\text{ sec/hr}}$$

$$\mathbf{Daily\ Net\ Change\ in\ Non\ Transit\ User\ Delay = 0\ user\ hours/day}$$

$$\text{Daily Net Change in Road User Delay } = -4.4\text{ user hours} + 0\text{ user hours}$$

$$\mathbf{Daily\ Net\ Change\ in\ Road\ User\ Delay\ = -4.4\ user\ hours/day}$$

$$\text{Daily Change in Cost to Transit} = \frac{-6.3\text{ sec/ veh x }96\text{ vehicles x }65.14\$/\text{hr}}{3600\text{ sec/hr}}$$

$$\text{Daily Change in Cost to Transit} = -\$10.94$$

$$\text{Annual Change in Cost to Transit } = -10.94\ \$/\text{day x }260\text{ days/year}$$

$$\mathbf{Annual\ Change\ in\ Cost\ to\ Transit\ = -\$2,800}$$

$$\text{Daily Change in Person Cost} = \ -4.4\text{ user hours/day x }21.92\$/\text{hr}$$

$$\text{Daily Change in Person Cost} = \ -\$96.45$$

$$\text{Daily Change in nonTransit Vehicle Cost} = 0\text{ sec/veh x }6921\text{ veh/day x }3.50\ \$/\text{hr}$$

$$\text{Daily Change in nonTransit Vehicle Cost} = \$0$$

$$\text{Daily Change in Cost to Public} = -\$96.45 + \$0$$

$$\text{Daily Change in Cost to Public} = -\$96.45$$

$$\text{Annual Change in Cost to Public } = -96.45\ \$/\text{day x }260\text{ days/year}$$

$$\mathbf{Annual\ Change\ in\ Cost\ to\ Public\ = -\$25,100}$$

$$\text{Payback Period} = \frac{\$12{,}000}{\$2{,}800 + \$25{,}100 - \$0}$$

$$\mathbf{Payback\ Period = \ 0.4\ years}$$

Table D-2 - Windmill Road @ Victoria Road (NB) (18 Transit veh/hr x Daily Delay Factor of 2 hr/day)

$$\text{Daily Net Change in Transit User Delay} = \frac{-90 \text{ seconds x } 36 \text{ vehicles x } 26 \text{ users/veh}}{3600 \text{ sec/hr}}$$

$$\textbf{Daily Net Change in Transit User Delay} = \mathbf{-23.4 \text{ user hours/day}}$$

$$\text{Daily Net Change in Non Transit User Delay} = \frac{13.7 \text{ seconds x } 30 \text{ vehicles x } 1.22 \text{ users/veh}}{3600 \text{ sec/hr}}$$

$$\textbf{Daily Net Change in Non Transit User Delay} = \mathbf{+0.1 \text{ user hours/day}}$$

$$\text{Daily Net Change in Road User Delay} = -23.4 \text{ user hours} + 0.1 \text{ user hours}$$

$$\textbf{Daily Net Change in Road User Delay} = \mathbf{-23.3 \text{ user hours/day}}$$

$$\text{Daily Change in Cost to Transit} = \frac{-90 \text{ sec/ veh x } 36 \text{ vehicles x } 65.14\$/\text{hr}}{3600 \text{ sec/hr}}$$

$$\text{Daily Change in Cost to Transit} = -\$58.63$$

$$\text{Annual Change in Cost to Transit} = -58.63 \text{ \$/day x } 260 \text{ days/year}$$

$$\textbf{Annual Change in Cost to Transit} = \mathbf{-\$15,200}$$

$$\text{Daily Change in Person Cost} = -23.3 \text{ user hours/day x } 21.92\$/\text{hr}$$

$$\text{Daily Change in Person Cost} = -\$510.74$$

$$\text{Daily Change in nonTransit Vehicle Cost} = \frac{13.7 \text{ sec/veh x } 30 \text{ veh/day x } 3.50 \text{ \$/hr}}{3600 \text{ sec/hr}}$$

$$\text{Daily Change in nonTransit Vehicle Cost} = \$0.40$$

$$\text{Daily Change in Cost to Public} = -\$510.74 + \$0.40$$

$$\text{Daily Change in Cost to Public} = -\$510.34$$

$$\text{Annual Change in Cost to Public} = -510.34 \text{ \$/day x } 260 \text{ days/year}$$

$$\textbf{Annual Change in Cost to Public} = \mathbf{-\$132,700}$$

$$\text{Payback Period} = \frac{\$299{,}000}{\$15{,}200 + \$132{,}700 - \$800}$$

$$\textbf{Payback Period} = \mathbf{2.0 \text{ years}}$$

Table D-3 - Windmill Road @ Seapoint Road (SB) (20 Transit veh/hr x Daily Delay Factor of 2 hr/day)

$$\text{Daily Net Change in Transit User Delay} = \frac{-75 \text{ seconds x } 40 \text{ vehicles x } 24 \text{ users/veh}}{3600 \text{ sec/hr}}$$

$$\textbf{Daily Net Change in Transit User Delay} = \mathbf{-20.0 \text{ user hours/day}}$$

$$\text{Daily Net Change in Non Transit User Delay} = \frac{0 \text{ seconds x } 6516 \text{ vehicles x } 1.22 \text{ users/veh}}{3600 \text{ sec/hr}}$$

$$\textbf{Daily Net Change in Non Transit User Delay} = \mathbf{+0 \text{ user hours/day}}$$

$$\text{Daily Net Change in Road User Delay} = -20.0 \text{ user hours} + 0 \text{ user hours}$$

$$\textbf{Daily Net Change in Road User Delay} = \mathbf{-20.0 \text{ user hours/day}}$$

$$\text{Daily Change in Cost to Transit} = \frac{-75 \text{ sec/ veh x } 40 \text{ vehicles x } 65.14\$/\text{hr}}{3600 \text{ sec/hr}}$$

$$\text{Daily Change in Cost to Transit} = -\$54.28$$

$$\text{Annual Change in Cost to Transit} = -54.28\$/\text{day x } 260 \text{ days/year}$$

$$\textbf{Annual Change in Cost to Transit} = \mathbf{-\$14,100}$$

$$\text{Daily Change in Person Cost} = -20.0 \text{ user hours/day x } 21.92\$/\text{hr}$$

$$\text{Daily Change in Person Cost} = -\$438.40$$

$$\text{Daily Change in nonTransit Vehicle Cost} = \frac{0 \text{ sec/veh x } 6516 \text{ veh/day x } 3.50 \ \$/\text{hr}}{3600 \text{ sec/hr}}$$

$$\text{Daily Change in nonTransit Vehicle Cost} = \$0$$

$$\text{Daily Change in Cost to Public} = -\$438.40 + \$0$$

$$\text{Daily Change in Cost to Public} = -\$438.40$$

$$\text{Annual Change in Cost to Public} = -438.40 \ \$/\text{day x } 260 \text{ days/year}$$

$$\textbf{Annual Change in Cost to Public} = \mathbf{-\$114,000}$$

$$\text{Payback Period} = \frac{\$276,000}{\$14,100 + \$114,000 - \$800}$$

$$\textbf{Payback Period} = \mathbf{2.2 \text{ years}}$$

Table D-4 - Main Street @ Gordon Street (12 Transit veh/hr x Daily Delay Factor of 2 hr/day)

$$\text{Daily Net Change in Transit User Delay} = \frac{-64 \text{ seconds x } 24 \text{ vehicles x } 16 \text{ users/veh}}{3600 \text{ sec/hr}}$$

$$\textbf{Daily Net Change in Transit User Delay} = \mathbf{-6.8 \text{ user hours/day}}$$

$$\text{Daily Net Change in Non Transit User Delay} = \frac{14.6 \text{ seconds x } 9398 \text{ vehicles x } 1.22 \text{ users/veh}}{3600 \text{ sec/hr}}$$

$$\textbf{Daily Net Change in Non Transit User Delay} = \mathbf{+46.5 \text{ user hours/day}}$$

$$\text{Daily Net Change in Road User Delay} = -6.8 \text{ user hours} + 46.5 \text{ user hours}$$

$$\textbf{Daily Net Change in Road User Delay} = \mathbf{+39.7 \text{ user hours/day}}$$

$$\text{Daily Change in Cost to Transit} = \frac{-64 \text{ sec/ veh x } 24 \text{ vehicles x } 65.14\$/\text{hr}}{3600 \text{ sec/hr}}$$

$$\text{Daily Change in Cost to Transit} = -\$27.80$$

$$\text{Annual Change in Cost to Transit} = -27.80\$/\text{day x } 260 \text{ days/year}$$

$$\textbf{Annual Change in Cost to Transit} = \mathbf{-\$7,200}$$

$$\text{Daily Change in Person Cost} = +39.7 \text{ user hours/day x } 21.92\$/\text{hr}$$

$$\text{Daily Change in Person Cost} = +\$870.22$$

$$\text{Daily Change in nonTransit Vehicle Cost} = \frac{14.6 \text{ sec/veh x } 9398 \text{ veh/day x } 3.50 \ \$/\text{hr}}{3600 \text{ sec/hr}}$$

$$\text{Daily Change in nonTransit Vehicle Cost} = \$133.40$$

$$\text{Daily Change in Cost to Public} = \$870.22 + \$133.40$$

$$\text{Daily Change in Cost to Public} = \$1003.62$$

$$\text{Annual Change in Cost to Public} = 1003.62 \ \$/\text{day x } 260 \text{ days/year}$$

$$\textbf{Annual Change in Cost to Public} = \mathbf{\$260,900}$$

$$\text{Payback Period} = \frac{\$4,000}{\$7,200 - \$260,900 - \$0}$$

$$\textbf{Payback Period} = \mathbf{-0.02 \text{ years}}$$

Table D-5 - Portland Street @ Woodlawn Road (20 Transit veh/hr x Daily Delay Factor of 2 hr/day)

$$\text{Daily Net Change in Transit User Delay} = \frac{-17 \text{ seconds x } 40 \text{ vehicles x } 17 \text{ users/veh}}{3600 \text{ sec/hr}}$$

$$\mathbf{Daily\ Net\ Change\ in\ Transit\ User\ Delay = \ -3.2\ user\ hours/day}$$

$$\text{Daily Net Change in Non Transit User Delay} = \frac{0 \text{ seconds x } 0 \text{ vehicles x } 1.22 \text{ users/veh}}{3600 \text{ sec/hr}}$$

$$\mathbf{Daily\ Net\ Change\ in\ Non\ Transit\ User\ Delay = +0\ user\ hours/day}$$

$$\text{Daily Net Change in Road User Delay } = -3.2 \text{ user hours} + 0 \text{ user hours}$$

$$\mathbf{Daily\ Net\ Change\ in\ Road\ User\ Delay\ = -3.2\ user\ hours/day}$$

$$\text{Daily Change in Cost to Transit} = \frac{-17 \text{ sec/ veh x } 40 \text{ vehicles x } 65.14\$/\text{hr}}{3600 \text{ sec/hr}}$$

$$\text{Daily Change in Cost to Transit} = -\$12.30$$

$$\text{Annual Change in Cost to Transit } = -12.30\$/\text{day x } 260 \text{ days/year}$$

$$\mathbf{Annual\ Change\ in\ Cost\ to\ Transit\ = -\$3,200}$$

$$\text{Daily Change in Person Cost} = \ -3.2 \text{ user hours/day x } 21.92\$/\text{hr}$$

$$\text{Daily Change in Person Cost} = \ -\$70.14$$

$$\text{Daily Change in nonTransit Vehicle Cost} = \frac{0 \text{ sec/veh x } 0 \text{ veh/day x } 3.50 \ \$/\text{hr}}{3600 \text{ sec/hr}}$$

$$\text{Daily Change in nonTransit Vehicle Cost} = \$0$$

$$\text{Daily Change in Cost to Public} = -\$70.14 + \$0$$

$$\text{Daily Change in Cost to Public} = \$70.14$$

$$\text{Annual Change in Cost to Public } = -70.14 \ \$/\text{day x } 260 \text{ days/year}$$

$$\mathbf{Annual\ Change\ in\ Cost\ to\ Public\ = -\$18,200}$$

$$\text{Payback Period} = \frac{\$68{,}000}{\$3{,}200 + \$18{,}200 - \$0}$$

$$\mathbf{Payback\ Period = \ 3.2\ years}$$

Table D-6 - Barrington Street @ Macdonald Bridge Ramp (7 Transit veh/hr x Daily Delay Factor of 2 hr/day)

$$\text{Daily Net Change in Transit User Delay} = \frac{-30 \text{ seconds x } 14 \text{ vehicles x } 29 \text{ users/veh}}{3600 \text{ sec/hr}}$$

$$\textbf{Daily Net Change in Transit User Delay} = -\mathbf{3.4} \textbf{ user hours/day}$$

$$\text{Daily Net Change in Non Transit User Delay} = \frac{0 \text{ seconds x } 0 \text{ vehicles x } 1.22 \text{ users/veh}}{3600 \text{ sec/hr}}$$

$$\textbf{Daily Net Change in Non Transit User Delay} = +\mathbf{0} \textbf{ user hours/day}$$

$$\text{Daily Net Change in Road User Delay} = -3.4 \text{ user hours} + 0 \text{ user hours}$$

$$\textbf{Daily Net Change in Road User Delay} = -\mathbf{3.4} \textbf{ user hours/day}$$

$$\text{Daily Change in Cost to Transit} = \frac{-30 \text{ sec/ veh x } 14 \text{ vehicles x } 65.14\$/\text{hr}}{3600 \text{ sec/hr}}$$

$$\text{Daily Change in Cost to Transit} = -\$7.60$$

$$\text{Annual Change in Cost to Transit} = -7.60\$/\text{day x } 260 \text{ days/year}$$

$$\textbf{Annual Change in Cost to Transit} = -\$\mathbf{2,000}$$

$$\text{Daily Change in Person Cost} = -3.4 \text{ user hours/day x } 21.92\$/\text{hr}$$

$$\text{Daily Change in Person Cost} = -\$74.53$$

$$\text{Daily Change in nonTransit Vehicle Cost} = \frac{0 \text{ sec/veh x } 0 \text{ veh/day x } 3.50 \text{ \$/hr}}{3600 \text{ sec/hr}}$$

$$\text{Daily Change in nonTransit Vehicle Cost} = \$0$$

$$\text{Daily Change in Cost to Public} = -\$74.53 + \$0$$

$$\text{Daily Change in Cost to Public} = -\$74.53$$

$$\text{Annual Change in Cost to Public} = -74.53 \text{ \$/day x } 260 \text{ days/year}$$

$$\textbf{Annual Change in Cost to Public} = -\$\mathbf{19,400}$$

$$\text{Payback Period} = \frac{\$83,000}{\$2,000 + \$19,400 - \$0}$$

$$\textbf{Payback Period} = \mathbf{3.9} \textbf{ years}$$

Table D-7 - Windmill Road @ Akerley Boulevard (15 Transit veh/hr x Daily Delay Factor of 3 hr/day)

$$\text{Daily Net Change in Transit User Delay} = \frac{-7.1 \text{ seconds x } 45 \text{ vehicles x } 31 \text{ users/veh}}{3600 \text{ sec/hr}}$$

$$\textbf{Daily Net Change in Transit User Delay} = \mathbf{-2.8 \text{ user hours/day}}$$

$$\text{Daily Net Change in Non Transit User Delay} = \frac{0 \text{ seconds x } 14358 \text{ vehicles x } 1.22 \text{ users/veh}}{3600 \text{ sec/hr}}$$

$$\textbf{Daily Net Change in Non Transit User Delay} = \mathbf{+0 \text{ user hours/day}}$$

$$\text{Daily Net Change in Road User Delay} = -2.8 \text{ user hours} + 0 \text{ user hours}$$

$$\textbf{Daily Net Change in Road User Delay} = \mathbf{-2.8 \text{ user hours/day}}$$

$$\text{Daily Change in Cost to Transit} = \frac{-7.1 \text{sec/ veh x } 45 \text{ vehicles x } 65.14\$/\text{hr}}{3600 \text{ sec/hr}}$$

$$\text{Daily Change in Cost to Transit} = -\$5.80$$

$$\text{Annual Change in Cost to Transit} = -5.80\$/\text{day x } 260 \text{ days/year}$$

$$\textbf{Annual Change in Cost to Transit} = \mathbf{-\$1,500}$$

$$\text{Daily Change in Person Cost} = -2.8 \text{ user hours/day x } 21.92\$/\text{hr}$$

$$\text{Daily Change in Person Cost} = -\$61.38$$

$$\text{Daily Change in nonTransit Vehicle Cost} = \frac{0 \text{ sec/veh x } 14358 \text{ veh/day x } 3.50 \text{ \$/hr}}{3600 \text{ sec/hr}}$$

$$\text{Daily Change in nonTransit Vehicle Cost} = \$0$$

$$\text{Daily Change in Cost to Public} = -\$61.38 + \$0$$

$$\text{Daily Change in Cost to Public} = -\$61.38$$

$$\text{Annual Change in Cost to Public} = -61.38 \text{ \$/day x } 260 \text{ days/year}$$

$$\textbf{Annual Change in Cost to Public} = \mathbf{-\$16,000}$$

$$\text{Payback Period} = \frac{\$332{,}000}{\$1{,}500 + \$16{,}000 - \$300}$$

$$\textbf{Payback Period} = \mathbf{19.3 \text{ years}}$$

Table D-8 - Robie Street @ Almon Street (12 Transit veh/hr x Daily Delay Factor of 2 hr/day)

$$\text{Daily Net Change in Transit User Delay} = \frac{-18 \text{ seconds x } 24 \text{ vehicles x } 22 \text{ users/veh}}{3600 \text{ sec/hr}}$$

$$\textbf{Daily Net Change in Transit User Delay} = \mathbf{-2.6 \text{ user hours/day}}$$

$$\text{Daily Net Change in Non Transit User Delay} = \frac{0 \text{ seconds x } 4290 \text{ vehicles x } 1.22 \text{ users/veh}}{3600 \text{ sec/hr}}$$

$$\textbf{Daily Net Change in Non Transit User Delay} = \mathbf{+0 \text{ user hours/day}}$$

$$\text{Daily Net Change in Road User Delay} = -2.6 \text{ user hours} + 0 \text{ user hours}$$

$$\textbf{Daily Net Change in Road User Delay} = \mathbf{-2.6 \text{ user hours/day}}$$

$$\text{Daily Change in Cost to Transit} = \frac{-18 \text{ sec/ veh x } 24 \text{ vehicles x } 65.14\$/\text{hr}}{3600 \text{ sec/hr}}$$

$$\text{Daily Change in Cost to Transit} = -\$7.82$$

$$\text{Annual Change in Cost to Transit} = -7.82\$/\text{day x } 260 \text{ days/year}$$

$$\textbf{Annual Change in Cost to Transit} = \mathbf{-\$2,000}$$

$$\text{Daily Change in Person Cost} = -2.6 \text{ user hours/day x } 21.92\$/\text{hr}$$

$$\text{Daily Change in Person Cost} = -\$56.99$$

$$\text{Daily Change in nonTransit Vehicle Cost} = \frac{0 \text{ sec/veh x } 4290 \text{ veh/day x } 3.50 \text{ \$/hr}}{3600 \text{ sec/hr}}$$

$$\text{Daily Change in nonTransit Vehicle Cost} = \$0$$

$$\text{Daily Change in Cost to Public} = -\$56.99 + \$0$$

$$\text{Daily Change in Cost to Public} = -\$56.99$$

$$\text{Annual Change in Cost to Public} = -56.99 \text{ \$/day x } 260 \text{ days/year}$$

$$\textbf{Annual Change in Cost to Public} = \mathbf{-\$14,800}$$

$$\text{Payback Period} = \frac{\$6,000}{\$2,000 + \$14,800 - \$0}$$

$$\textbf{Payback Period} = \mathbf{0.4 \text{ years}}$$

Table D-9 - Main Street @ Hartlen Street AM and PM each (10 AM Transit veh/hr x Daily Delay Factor of 2 hr/day and 12 PM Transit veh/h x Daily Delay Factor of 2hr/day)

AM

$$\text{Daily Net Change in Transit User Delay} = \frac{-49 \text{ seconds x } 20 \text{ vehicles x } 9 \text{ users/veh}}{3600 \text{ sec/hr}}$$

$$\mathbf{AM\ Net\ Change\ in\ Transit\ User\ Delay} = \mathbf{-2.45\ user\ hours/day}$$

PM

$$\text{Daily Net Change in Transit User Delay} = \frac{-53.7 \text{ seconds x } 24 \text{ vehicles x } 13 \text{ users/veh}}{3600 \text{ sec/hr}}$$

$$\mathbf{PM\ Net\ Change\ in\ Transit\ User\ Delay} = \mathbf{-4.65\ user\ hours/day}$$

$$\text{Daily Net Change in Transit User Delay} = -4.65 \text{ user hours} - 2.45 \text{ user hours}$$

$$\mathbf{Daily\ Net\ Change\ in\ Transit\ User\ Delay} = \mathbf{-7.1\ user\ hours/day}$$

$$\text{Daily Net Change in Non Transit User Delay} = \frac{0 \text{ seconds x } 12{,}430 \text{ vehicles x } 1.22 \text{ users/veh}}{3600 \text{ sec/hr}}$$

$$\mathbf{Daily\ Net\ Change\ in\ Non\ Transit\ User\ Delay} = \mathbf{+0\ user\ hours/day}$$

$$\text{Daily Net Change in Road User Delay} = -7.1 \text{ user hours} + 0 \text{ user hours}$$

$$\mathbf{Daily\ Net\ Change\ in\ Road\ User\ Delay} = \mathbf{-7.1\ user\ hours/day}$$

$$\text{Daily Change in Cost to Transit} = \frac{-49 \text{ sec/ veh x } 20 \text{ veh x } 65.14\$/\text{hr} - 53.7 \text{ sec/veh x } 24 \text{ veh x} 65.14\$/\text{hr}}{3600 \text{ sec/hr}}$$

$$\text{Daily Change in Cost to Transit} = -\$41.05$$

$$\text{Annual Change in Cost to Transit} = -41.05\$/\text{day x } 260 \text{ days/year}$$

$$\mathbf{Annual\ Change\ in\ Cost\ to\ Transit} = \mathbf{-\$10,700}$$

$$\text{Daily Change in Person Cost} = -7.1 \text{ user hours/day x } 21.92\$/\text{hr}$$

$$\text{Daily Change in Person Cost} = -\$155.63$$

$$\text{Daily Change in nonTransit Vehicle Cost} = \frac{0 \text{ sec/veh x} 12{,}430 \text{ veh/day x } 3.50 \text{ \$/hr}}{3600 \text{ sec/hr}}$$

$$\text{Daily Change in nonTransit Vehicle Cost} = \$0$$

$$\text{Daily Change in Cost to Public} = -\$155.63 + \$0$$

$$\text{Daily Change in Cost to Public} = -\$155.63$$

$$\text{Annual Change in Cost to Public } = -155.63 \text{ \$/day x } 260 \text{ days/year}$$

$$\textbf{Annual Change in Cost to Public } = -\$\mathbf{40,500}$$

$$\text{Payback Period} = \frac{\$4{,}000}{\$10{,}700 + \$40{,}500 - \$0}$$

$$\textbf{Payback Period} = \mathbf{0.08} \textbf{ years}$$

Table D-10 - Chebucto Road @ Connaught Avenue (17 Transit veh/hr x Daily Delay Factor of 2 hr/day)

$$\text{Daily Net Change in Transit User Delay} = \frac{-31.7\text{ seconds x }34\text{ vehicles x }20\text{ users/veh}}{3600\text{ sec/hr}}$$

$$\mathbf{Daily\ Net\ Change\ in\ Transit\ User\ Delay} = \mathbf{-6.0\ user\ hours/day}$$

$$\text{Daily Net Change in Non Transit User Delay} = \frac{0\text{ seconds x }7302\text{ vehicles x }1.22\text{ users/veh}}{3600\text{ sec/hr}}$$

$$\mathbf{Daily\ Net\ Change\ in\ Non\ Transit\ User\ Delay} = \mathbf{+0\ user\ hours/day}$$

$$\text{Daily Net Change in Road User Delay} = -6.0\text{ user hours} + 0\text{ user hours}$$

$$\mathbf{Daily\ Net\ Change\ in\ Road\ User\ Delay} = \mathbf{-6.0\ user\ hours/day}$$

$$\text{Daily Change in Cost to Transit} = \frac{-31.7\text{ sec/ veh x }24\text{ vehicles x }65.14\$/\text{hr}}{3600\text{ sec/hr}}$$

$$\text{Daily Change in Cost to Transit} = -\$13.77$$

$$\text{Annual Change in Cost to Transit} = -13.77\$/\text{day x }260\text{ days/year}$$

$$\mathbf{Annual\ Change\ in\ Cost\ to\ Transit} = \mathbf{-\$3,600}$$

$$\text{Daily Change in Person Cost} = -6.0\text{ user hours/day x }21.92\$/\text{hr}$$

$$\text{Daily Change in Person Cost} = -\$131.52$$

$$\text{Daily Change in nonTransit Vehicle Cost} = \frac{0\text{ sec/veh x }7302\text{ veh/day x }3.50\ \$/\text{hr}}{3600\text{ sec/hr}}$$

$$\text{Daily Change in nonTransit Vehicle Cost} = \$0$$

$$\text{Daily Change in Cost to Public} = -\$131.52 + \$0$$

$$\text{Daily Change in Cost to Public} = -\$131.52$$

$$\text{Annual Change in Cost to Public} = -131.52\ \$/\text{day x }260\text{ days/year}$$

$$\mathbf{Annual\ Change\ in\ Cost\ to\ Public} = \mathbf{-\$34,200}$$

$$\text{Payback Period} = \frac{\$99,000}{\$3,600 + \$34,200 - \$300}$$

$$\mathbf{Payback\ Period} = \mathbf{2.6\ years}$$

Table D-11 - Mumford Road @ Chebucto Road (19 Transit veh/hr x Daily Delay Factor of 2 hr/day)

$$\text{Daily Net Change in Transit User Delay} = \frac{-21.3 \text{ seconds x } 38 \text{ vehicles x } 24 \text{ users/veh}}{3600 \text{ sec/hr}}$$

$$\textbf{Daily Net Change in Transit User Delay} = -\mathbf{5.4} \textbf{ user hours/day}$$

$$\text{Daily Net Change in Non Transit User Delay} = \frac{4.6 \text{ seconds x } 3186 \text{ vehicles x } 1.22 \text{ users/veh}}{3600 \text{ sec/hr}}$$

$$\textbf{Daily Net Change in Non Transit User Delay} = +\mathbf{5.0} \textbf{ user hours/day}$$

$$\text{Daily Net Change in Road User Delay} = -5.4 \text{ user hours} + 5.0 \text{ user hours}$$

$$\textbf{Daily Net Change in Road User Delay} = -\mathbf{0.4} \textbf{ user hours/day}$$

$$\text{Daily Change in Cost to Transit} = \frac{-21.3 \text{ sec/ veh x } 38 \text{ vehicles x } 65.14\$/\text{hr}}{3600 \text{ sec/hr}}$$

$$\text{Daily Change in Cost to Transit} = -\$14.65$$

$$\text{Annual Change in Cost to Transit} = -14.65\$/\text{day x } 260 \text{ days/year}$$

$$\textbf{Annual Change in Cost to Transit} = -\$\mathbf{3,800}$$

$$\text{Daily Change in Person Cost} = -0.4 \text{ user hours/day x } 21.92\$/\text{hr}$$

$$\text{Daily Change in Person Cost} = -\$8.77$$

$$\text{Daily Change in nonTransit Vehicle Cost} = \frac{4.6 \text{ sec/veh x } 3186 \text{ veh/day x } 3.50 \text{ \$/hr}}{3600 \text{ sec/hr}}$$

$$\text{Daily Change in nonTransit Vehicle Cost} = \$14.25$$

$$\text{Daily Change in Cost to Public} = -\$8.77 + \$14.25$$

$$\text{Daily Change in Cost to Public} = \$5.48$$

$$\text{Annual Change in Cost to Public} = 5.48\$/\text{day x } 260 \text{ days/year}$$

$$\textbf{Annual Change in Cost to Public} = \$\mathbf{1,400}$$

$$\text{Payback Period} = \frac{\$10{,}000}{\$3{,}800 - \$1{,}400 - \$0}$$

$$\textbf{Payback Period} = \mathbf{4.2} \textbf{ years}$$

Table D-12 - Robie Street @ Quinpool Road (18 Transit veh/hr x Daily Delay Factor of 2 hr/day)

$$\text{Daily Net Change in Transit User Delay} = \frac{-19.0 \text{ seconds x } 36 \text{ vehicles x } 31 \text{ users/veh}}{3600 \text{ sec/hr}}$$

$$\textbf{Daily Net Change in Transit User Delay} = \mathbf{-5.9 \text{ user hours/day}}$$

$$\text{Daily Net Change in Non Transit User Delay} = \frac{201.5 \text{ seconds x } 1566 \text{ vehicles x } 1.22 \text{ users/veh}}{3600 \text{ sec/hr}}$$

$$\textbf{Daily Net Change in Non Transit User Delay} = \mathbf{+106.9 \text{ user hours/day}}$$

$$\text{Daily Net Change in Road User Delay} = -5.9 \text{ user hours} + 106.9 \text{ user hours}$$

$$\textbf{Daily Net Change in Road User Delay} = \mathbf{101.0 \text{ user hours/day}}$$

$$\text{Daily Change in Cost to Transit} = \frac{-19 \text{ sec/ veh x } 36 \text{ vehicles x } 65.14\$/\text{hr}}{3600 \text{ sec/hr}}$$

$$\text{Daily Change in Cost to Transit} = -\$12.38$$

$$\text{Annual Change in Cost to Transit} = -12.38\$/\text{day x } 260 \text{ days/year}$$

$$\textbf{Annual Change in Cost to Transit} = \mathbf{-\$3,200}$$

$$\text{Daily Change in Person Cost} = 101.0 \text{ user hours/day x } 21.92\$/\text{hr}$$

$$\text{Daily Change in Person Cost} = \$2214$$

$$\text{Daily Change in nonTransit Vehicle Cost} = \frac{201.5 \text{ sec/veh x } 1566 \text{ veh/day x } 3.50 \text{ \$/hr}}{3600 \text{ sec/hr}}$$

$$\text{Daily Change in nonTransit Vehicle Cost} = \$306.78$$

$$\text{Daily Change in Cost to Public} = \$2214 + \$306.78$$

$$\text{Daily Change in Cost to Public} = \$2520.78$$

$$\text{Annual Change in Cost to Public} = 2520.78\$/\text{day x } 260 \text{ days/year}$$

$$\textbf{Annual Change in Cost to Public} = \mathbf{\$655,400}$$

$$\text{Payback Period} = \frac{\$20,000}{\$3,200 - \$655,400 - \$0}$$

$$\textbf{Payback Period} = \mathbf{-0.03 \text{ years}}$$

Table D-13 - Cobequid Terminal @ Cobequid Road (17 Transit veh/hr x Daily Delay Factor of 1.8 hr/day)

$$\text{Daily Net Change in Transit User Delay} = \frac{-9.3 \text{ seconds x } 31 \text{ vehicles x } 14 \text{ users/veh}}{3600 \text{ sec/hr}}$$

$$\textbf{Daily Net Change in Transit User Delay} = \mathbf{-1.1 \text{ user hours/day}}$$

$$\text{Daily Net Change in Non Transit User Delay} = \frac{6.3 \text{ seconds x } 2660 \text{ vehicles x } 1.22 \text{ users/veh}}{3600 \text{ sec/hr}}$$

$$\textbf{Daily Net Change in Non Transit User Delay} = \mathbf{+5.6 \text{ user hours/day}}$$

$$\text{Daily Net Change in Road User Delay} = -1.1 \text{ user hours} + 5.6 \text{ user hours}$$

$$\textbf{Daily Net Change in Road User Delay} = \mathbf{4.5 \text{ user hours/day}}$$

$$\text{Daily Change in Cost to Transit} = \frac{-9.3 \text{ sec/ veh x } 31 \text{ vehicles x } 65.14\$/\text{hr}}{3600 \text{ sec/hr}}$$

$$\text{Daily Change in Cost to Transit} = -\$5.22$$

$$\text{Annual Change in Cost to Transit} = -5.22\$/\text{day x } 260 \text{ days/year}$$

$$\textbf{Annual Change in Cost to Transit} = \mathbf{-\$1,400}$$

$$\text{Daily Change in Person Cost} = 4.5 \text{ user hours/day x } 21.92\$/\text{hr}$$

$$\text{Daily Change in Person Cost} = \$98.64$$

$$\text{Daily Change in nonTransit Vehicle Cost} = \frac{6.3 \text{ sec/veh x } 2660 \text{ veh/day x } 3.50 \text{ \$/hr}}{3600 \text{ sec/hr}}$$

$$\text{Daily Change in nonTransit Vehicle Cost} = \$16.29$$

$$\text{Daily Change in Cost to Public} = \$98.64 + \$16.29$$

$$\text{Daily Change in Cost to Public} = \$114.93$$

$$\text{Annual Change in Cost to Public} = 114.93\$/\text{day x } 260 \text{ days/year}$$

$$\textbf{Annual Change in Cost to Public} = \mathbf{\$29,900}$$

$$\text{Payback Period} = \frac{\$4,000}{\$1,400 - \$29,900 - \$0}$$

$$\textbf{Payback Period} = \mathbf{-0.1 \text{ years}}$$