Hamilton
Public Works

KING STREET TRANSIT ONLY LANE PILOT PROJECT

Appendix "E"

Cole Engineering - Traffic and Travel Time Monitoring Report King Street Reserved Bus Lane

APPENDIX E

CITY OF HAMILTON

TRAFFIC AND TRAVEL TIME MONITORING REPORT

KING STREET RESERVED BUS LANE

Project No.: TR13-0252

NOVEMBER 2014

COLE ENGINEERING GROUP LTD.

HEAD OFFICE
70 Valleywood Drive
Markham, ON CANADA L3R 4T5
T. 905.940.6161 | 416.987.6161
F. 905.940.2064 | www.ColeEngineering.ca

GTA WEST OFFICE
150 Courtneypark Drive West, Unit C100
Mississauga, ON CANADA L5W 1Y6
T. 905.364.6161
F. 905.364.6162

COLE ENGINEERING

Experience Enhancing Excellence

Date: November 14, 2014
Our Ref: TR13-0252

City of Hamilton
Public Works Department
77 James Street North, Suite 400
Hamilton, ON L8R 2K3

Attention: Mr. Daryl Bender, B.E.S
Project Manager, Alternative Transportation

Dear Mr. Bender:

Re: Traffic and Travel Time Monitoring Report
King Street Reserved Bus Lane

Cole Engineering Group Ltd. Is pleased to submit this report that summarizes the traffic monitoring, travel time monitoring for the implementation of the King Street Reserved Bus Lane.

Yours truly,

COLE ENGINEERING GROUP LTD.

Kamran Shah, P.Eng., PTOE
Transportation Engineer

MC:

Encl.

S:\2013 Projects\TR\TR13-0252 Hamilton_KingStreetBRT-DD\300-Design-Engineering\312-Deliverables\Project Deliverables\Combined Memo\King Street BRT Report v4.doc

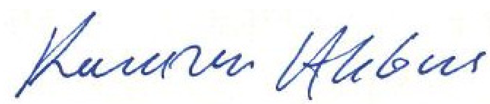
PREPARED BY:

COLE ENGINEERING GROUP LTD.

Matthew Clark
Transport Planner

CHECKED BY:

COLE ENGINEERING GROUP LTD.



Kamran Shah, P.Eng., PTOE
Transportation Engineer

Issues and Revisions Registry

Identification	Date	Description of issued and/or revision
Draft Report	Feb 22, 2012	For internal review
Draft Report	Feb 23, 2012	For client review
Final Report	Nov 14, 2014	Submission

Statement of Conditions

This Report / Study (the "Work") has been prepared at the request of, and for the exclusive use of, the Owner / Client, and its affiliates (the "Intended User"). No one other than the Intended User has the right to use and rely on the Work without first obtaining the written authorization of Cole Engineering Group Ltd. and its Owner. Cole Engineering expressly excludes liability to any party except the intended User for any use of, and/or reliance upon, the work.

Neither possession of the Work, nor a copy of it, carries the right of publication. All copyright in the Work is reserved to Cole Engineering. The Work shall not be disclosed, produced or reproduced, quoted from, or referred to, in whole or in part, or published in any manner, without the express written consent of Cole Engineering and the Owner.

Table of Contents

LIST OF FIGURES

LIST OF TABLES

APPENDICES

1.0 Introduction

1.1. Background

Cole Engineering Group Ltd. (Cole Engineering) was retained by the City of Hamilton (City) to prepare a detailed design and traffic analysis for a 12-month pilot project for the installation of a Reserved Bus Lane (RBL) on King Street between Mary Street and Dundurn Street in the downtown core.

This report compiles both the traffic analysis before the bus lane was implemented (pre-installation) and three and seven months after implementation (post-installation). Also included and summarised in this report is the travel time monitoring undertaken pre-installation and post-installation (after one month, three months and seven months). Finally, a review of similar facilities in North America and a survey of the operators of the facilities were undertaken; the findings are summarised herein. Specific attention was given to the impact of a reserved bus lane on local businesses.

2.0 Traffic Analysis

A traffic model was developed using the Synchro 7 and8 software packages to assess the traffic operations at key intersections along the King Street study corridor for various scenarios. Based on discussions with City staff, the following King Street intersections were identified for analysis:

- Queen Street (signalized)
- Bay Street (signalized)
- MacNab Street (signalized)
- James Street (signalized)
- John Street (signalized)

The signalized intersection operations were assessed using the Synchro 8 software package which utilizes the Highway Capacity Manual 2010 methodologies. In addition, for comparison purposes, the existing signalized intersection operational analyses were also assessed using the Synchro 7 package. The signalized intersection analyses utilizes the following assumptions based on discussions with City staff and the City of Hamilton's ***Guidelines for Synchro Software***:

- Lane utilization based on Synchro default values;
- Saturation flow rate based on Synchro default value of 1,900 (vphpl);
- Lane width of 3.3 m for turning lanes and through lanes;
- Lost time adjustment of 0 seconds; and,
- Peak hour factors based on existing traffic count information.

2.1. Pre-installation Traffic Analysis

The lane configuration for the pre-installation scenario is illustrated in **Figure 1**. Pre-installation weekday peak hour turning movement counts were provided by the City as summarized in **Table 1**. The balanced pre-installation traffic volumes are illustrated in **Figure 2**.

Table 1: Pre-installation Traffic Counts

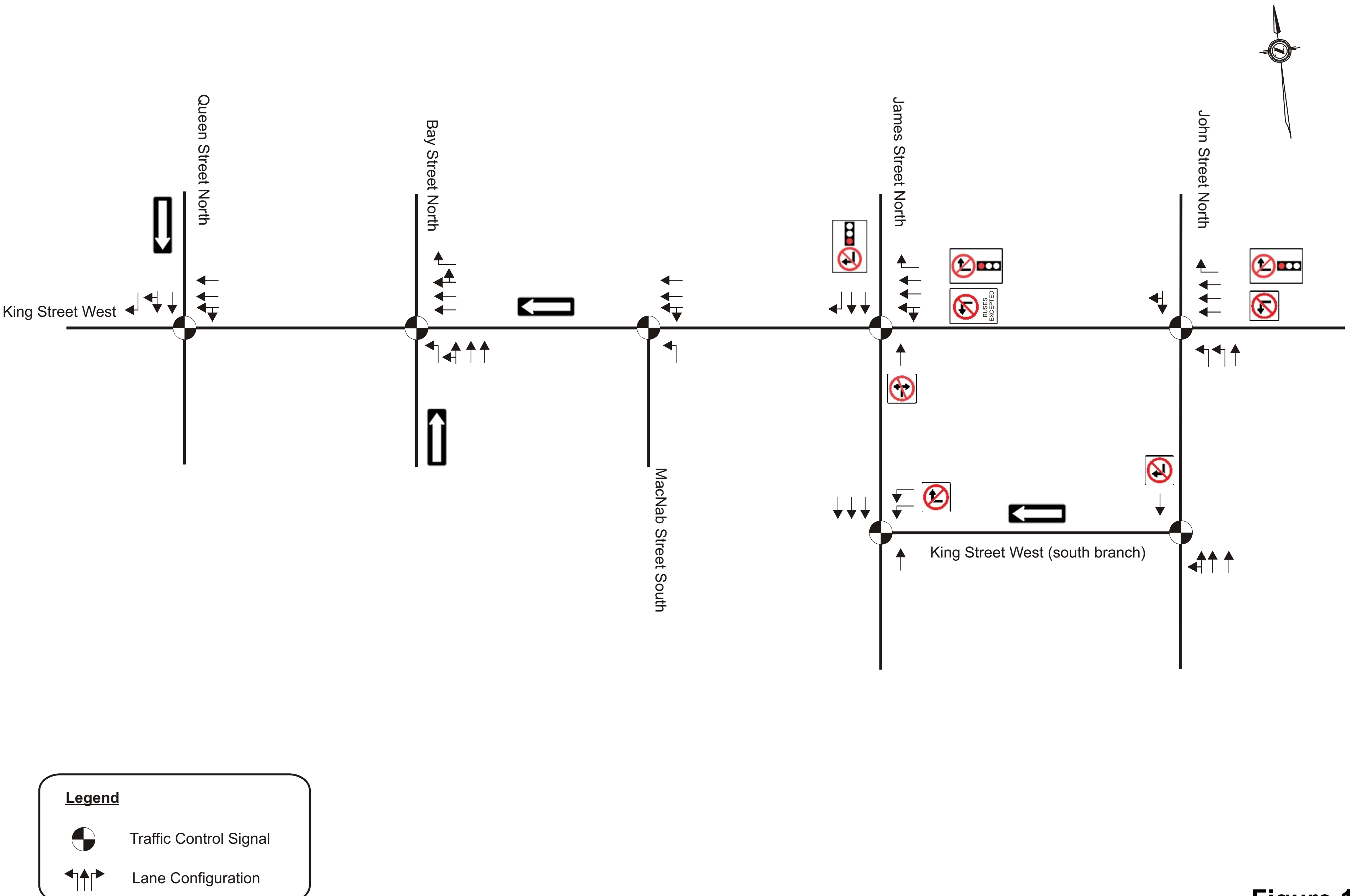
Location	Date
John Street / King Street	May 13, 2013
James Street / King Street	May 14, 2013
MacNab Street / King Street	May 16, 2013
Bay Street / King Street	May 14, 2013
Queen Street / King Street	May 15, 2013

Based on the road network and traffic controls shown in **Figure 1,** the pre-installation (balanced) traffic volumes shown in **Figure 2**, and the signal timings provided by the City, the pre-installation intersection operations and queues are summarized in **Table 2** and **Table 3**, respectively. The Synchro 7 and Synchro 8 outputs are provided in **Appendix A**.

The results of the analysis indicate that the signalized intersections within the study area are operating with residual capacity and acceptable Levels of Service (LOS) during the weekday AM, Midday, and PM peak periods. The results generated by Synchro 7 and Synchro 8 are comparable for all peak hours.

The results for the queuing analysis indicate that pre-installation queues can be accommodated by the available storage during all three peak hours with the exception of:

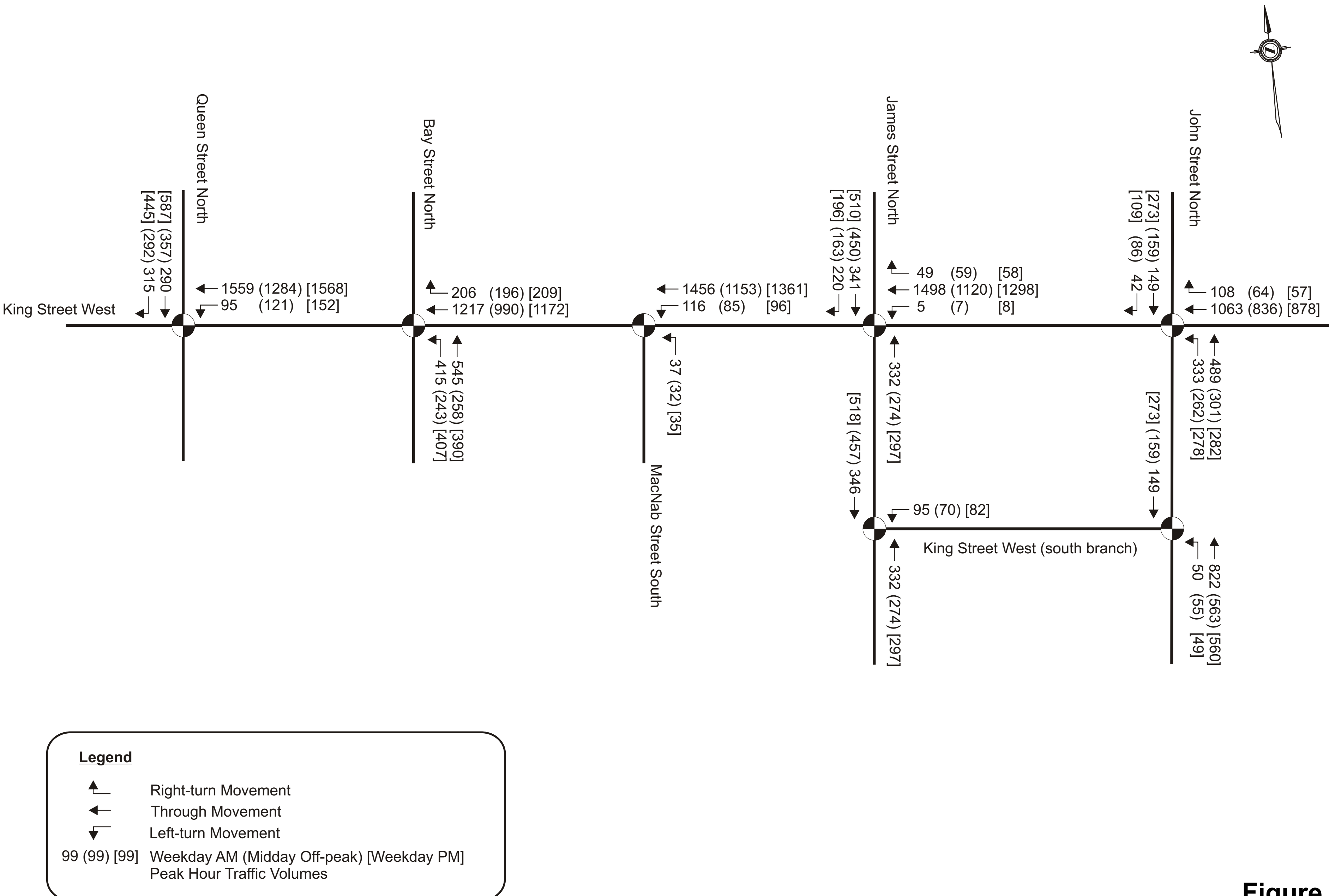
- The southbound through and southbound right-turn movements Queen Street / King Street during the PM peak hour; and,
- The southbound through movement at John Street / King Street during the PM peak hour.



Not to Scale

Figure 1
Pre-Installation Lane Configuration (As Modelled in Synchro)

COLE ENGINEERING



Not to Scale

Figure 2
Pre-Installation Traffic Volumes

Table 2: Pre-installation Intersection Operations

Intersection	Key Movement	AM Peak Hour				Off-Peak Hour				PM Peak Hour			
		LOS		v/c		LOS		v/c		LOS		v/c	
		Synchro 7	Synchro 8	Synchro 7	Synchro 8	Synchro 7	Synchro 8	Synchro 7	Synchro 8	Synchro 7	Synchro 8	Synchro 7	Synchro 8
Queen Street / King Street	Overall	B	B	0.58	0.57	B	B	0.58	0.56	B	B	0.73	0.72
	WB left-through	A	A	0.55	0.55	A	A	0.56	0.55	B	B	0.71	0.71
	SB through-right	C	C	0.64	0.65	C	C	0.57	0.59	C	C	0.72	0.72
	SB right	D	D	0.68	0.65	C	C	0.62	0.58	C	C	0.77	0.74
Bay Street / King Street	Overall	B	B	0.51	0.50	A	A	0.38	0.38	B	B	0.51	0.50
	WB through-right	A	A	0.46	0.46	A	A	0.37	0.37	A	A	0.45	0.44
	WB right	A	A	0.23	0.26	A	A	0.24	0.24	A	A	0.29	0.29
	NB left	C	C	0.63	0.59	C	C	0.34	0.35	C	C	0.65	0.63
	NB left-through	C	C	0.61	0.60	C	C	0.43	0.43	C	C	0.56	0.56
MacNab Street / King Street	Overall	A	A	0.43	0.43	A	A	0.40	0.40	A	A	0.43	0.43
	WB left-through	A	A	0.46	0.46	A	A	0.42	0.42	A	A	0.45	0.45
	NB left	D	D	0.24	0.24	C	C	0.23	0.23	D	D	0.23	0.23
James Street / King Street	Overall	B	B	0.62	0.65	B	B	0.49	0.52	B	B	0.53	0.55
	WB left-through	C	C	0.86	0.86	C	C	0.73	0.73	B	B	0.76	0.76
	WB right	B	B	0.12	0.12	B	B	0.18	0.18	B	B	0.15	0.15
	NB through	A	A	0.42	0.42	A	A	0.33	0.33	A	A	0.34	0.34
	SB through	B	B	0.25	0.25	B	B	0.30	0.30	B	B	0.33	0.33
	SB right	C	C	0.40	0.40	B	B	0.28	0.28	B	B	0.32	0.32
John Street / King Street	Overall	B	B	0.63	0.66	B	B	0.54	0.50	B	B	0.58	0.58
	WB through	B	B	0.52	0.52	B	B	0.44	0.44	B	B	0.41	0.41
	WB right	B	B	0.19	0.19	B	B	0.16	0.16	B	B	0.12	0.12
	NB left	A	A	0.50	0.50	A	A	0.38	0.38	A	A	0.55	0.55
	NB through	A	A	0.75	0.75	A	A	0.45	0.45	A	A	0.41	0.41
	SB through-right	C	C	0.44	0.44	C	C	0.61	0.62	D	D	0.87	0.87

LOS - level of service, v/c - volume to capacity ratio
Syn - Synchro;

Table 3: Pre-installation Queues

Intersection	Key Movement	Available Storage (m)	AM Peak Hour				Off-Peak Hour				PM Peak Hour			
			50th Percentile (m)		95th Percentile (m)		50th Percentile (m)		95th Percentile (m)		50th Percentile (m)		95th Percentile (m)	
			Syn 7	Syn 8	Syn 7	Syn 8	Syn 7	Syn 8	Syn 7	Syn 8	Syn 7	Syn 8	Syn 7	Syn 8
Queen Street / King Street	WB through	103	51	50	59	58	26	17	25	25	66	64	63	63
	SB through	75	36	37	45	45	30	30	36	36	61	62	77	77
	SB right	75	32	29	49	46	26	23	40	37	54	51	85	80
Bay Street / King Street	WB through	160	26	26	17	17	8	8	<7	<7	10	10	<7	<7
	WB right	160	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7
	NB left	58[1]	40	37	57	54	11	11	23	23	36	33	54	51
	NB through	80	43	42	47	46	16	16	21	21	36	35	40	39
MacNab Street / King Street	WB through	85	10	10	<7	<7	<7	<7	10	10	<7	<7	18	18
	NB left	130	<7	<7	13	13	<7	<7	9	9	<7	<7	13	13
James Street / King Street	WB through	87	48	48	69	69	57	57	73	73	42	42	48	48
	WB right	87	<7	<7	10	10	7	7	<7	<7	<7	<7	8	9
	NB through	15	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7
	SB through	80	19	19	28	28	19	19	28	28	29	29	40	40
	SB right	80	25	25	71	71	12	12	50	50	20	20	54	54
John Street / King Street	WB through	90	54	54	67	67	28	28	47	47	39	39	49	49
	WB right	30	12	12	24	24	<7	<7	16	16	<7	<7	13	13
	NB left	20	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7
	NB through	104	<7	<7	86	86	<7	<7	<7	<7	<7	<7	<7	<7
	SB through	85	26	26	45	45	26	26	40	40	59	59	104	104

LOS - level of service, v/c - volume to capacity ratio
Syn - Synchro
1. Average length of dual left turn lanes

2.2. Post-Installation Traffic Analysis (Month 3)

The Post-installation (Month 3) operational analysis was conducted to assess the operations of the general traffic lanes on King Street three months after the implementation of the RBL. The Post-installation (Month 3) weekday turning movement counts, as summarized in **Table 4,** were provided by the City.

Table 4: Post Installation (Month 3) Traffic Counts

Location	Date
John Street / King Street	January 30, 2014
James Street / King Street	February 3, 2014
MacNab Street / King Street	February 4, 2014
Bay Street / King Street	February 7, 2014
Queen Street / King Street	January 29, 2014

Synchro is unable to analyze vehicle-specific lanes such as the RBL. Therefore, the Synchro model provides an assessment of the remaining general purpose lanes only. From the Post-installation (Month 3) turning movement counts the bus volumes in the RBL and the RBL lane are not analyzed in the Synchro model.

However, buses that utilize the general purpose lanes ARE included in the Synchro model. Buses destined for the MacNab Street Terminal are observed to exit the RBL on the approach to James Street in order to weave to the left-turn lane at MacNab Street. Therefore, bus volume in the general purpose lanes are included in the Synchro Model at the intersection of James Street / King Street (as through movements) and at MacNab Street / King Street (as left-turn movements).

The Post-installation (Month 3) bus volumes in the King Street corridor are shown in

Figure 3. The Post-installation (Month 3) general purpose traffic volumes are illustrated in **Figure 4.** The Post-installation lane configuration is shown in

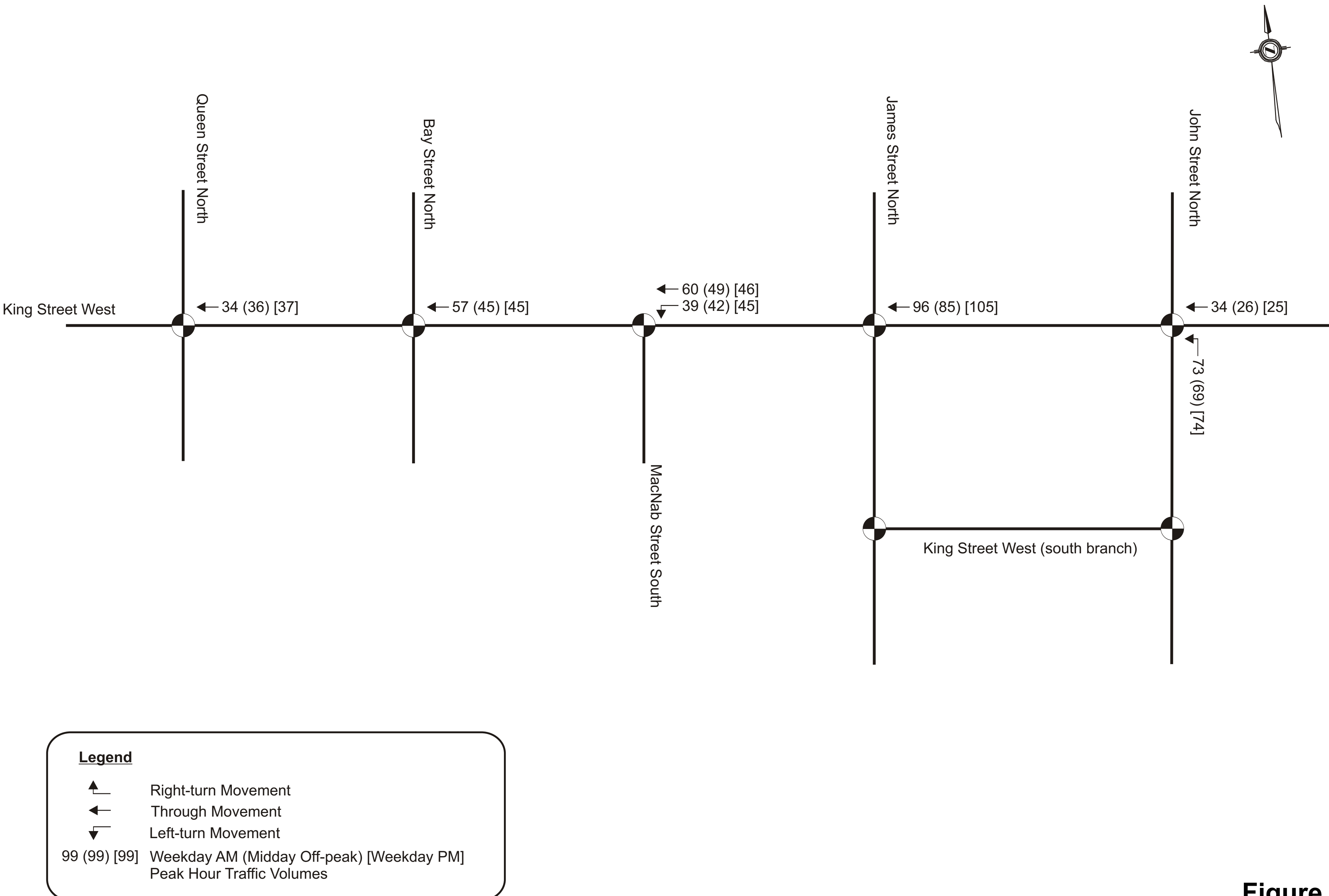
Figure 5. The lane configuration modelled in Synchro is shown in

Figure 6 (i.e. excluding the RBL which Synchro cannot model).

Three analysis scenarios were developed to assess the impacts of the RBL:

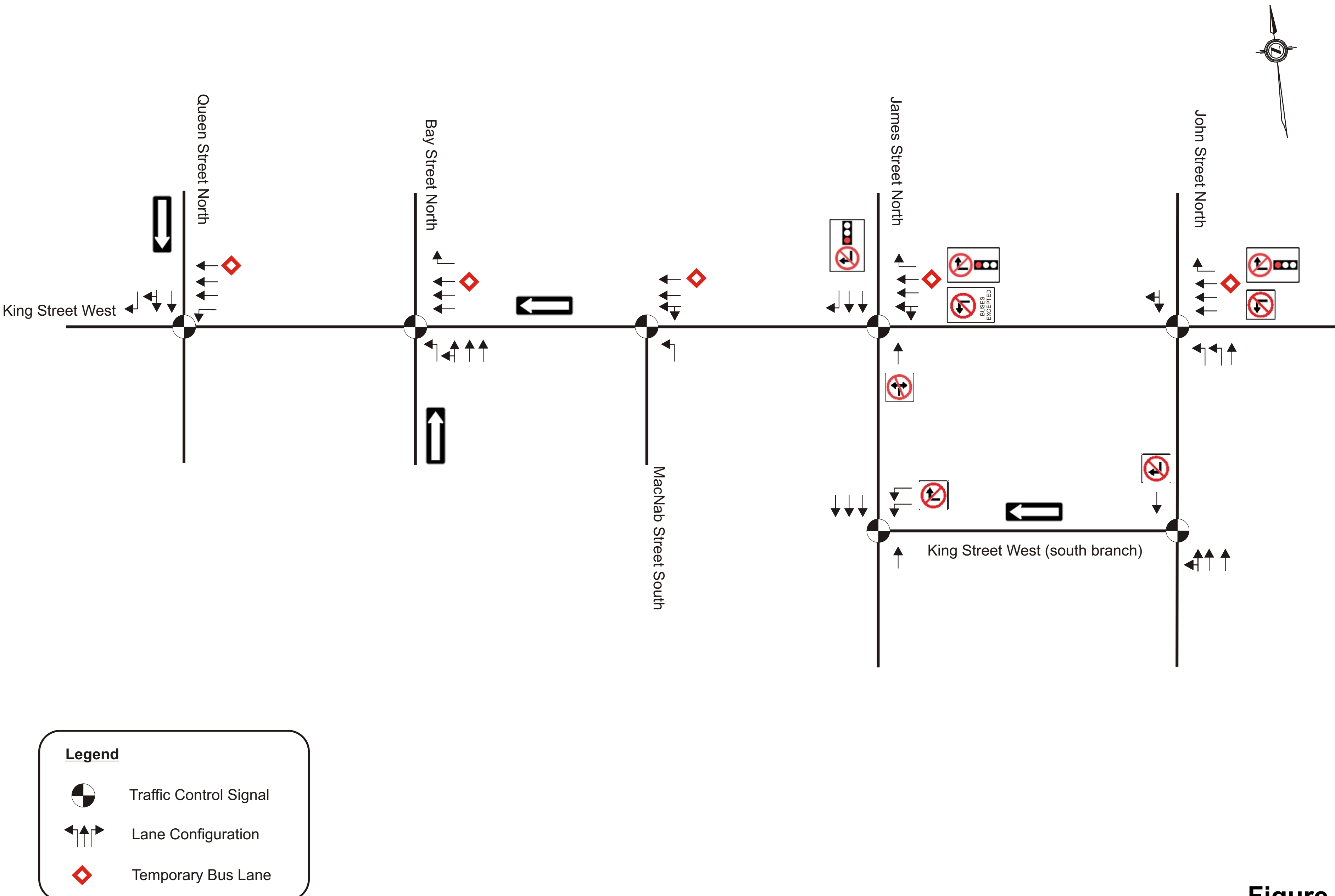
- **Scenario 1 –** pre-installation signal timing splits (provided by City staff)
- **Scenario 2** - modified signal timing splits
- **Scenario 3** - modified signal timing splits with transit signal priority (westbound left to MacNab Street Terminal)

Transit signal priority phasing at the intersection of James Street / King Street was not considered in Scenario 3 as this location has substantial pedestrian volumes. Another reason transit signal priority phasing was not considered at this location was that bus movements from the RBL into the general purpose lanes to make the westbound left turn into MacNab Street could not be guaranteed due to the queues of westbound through traffic on King Street.



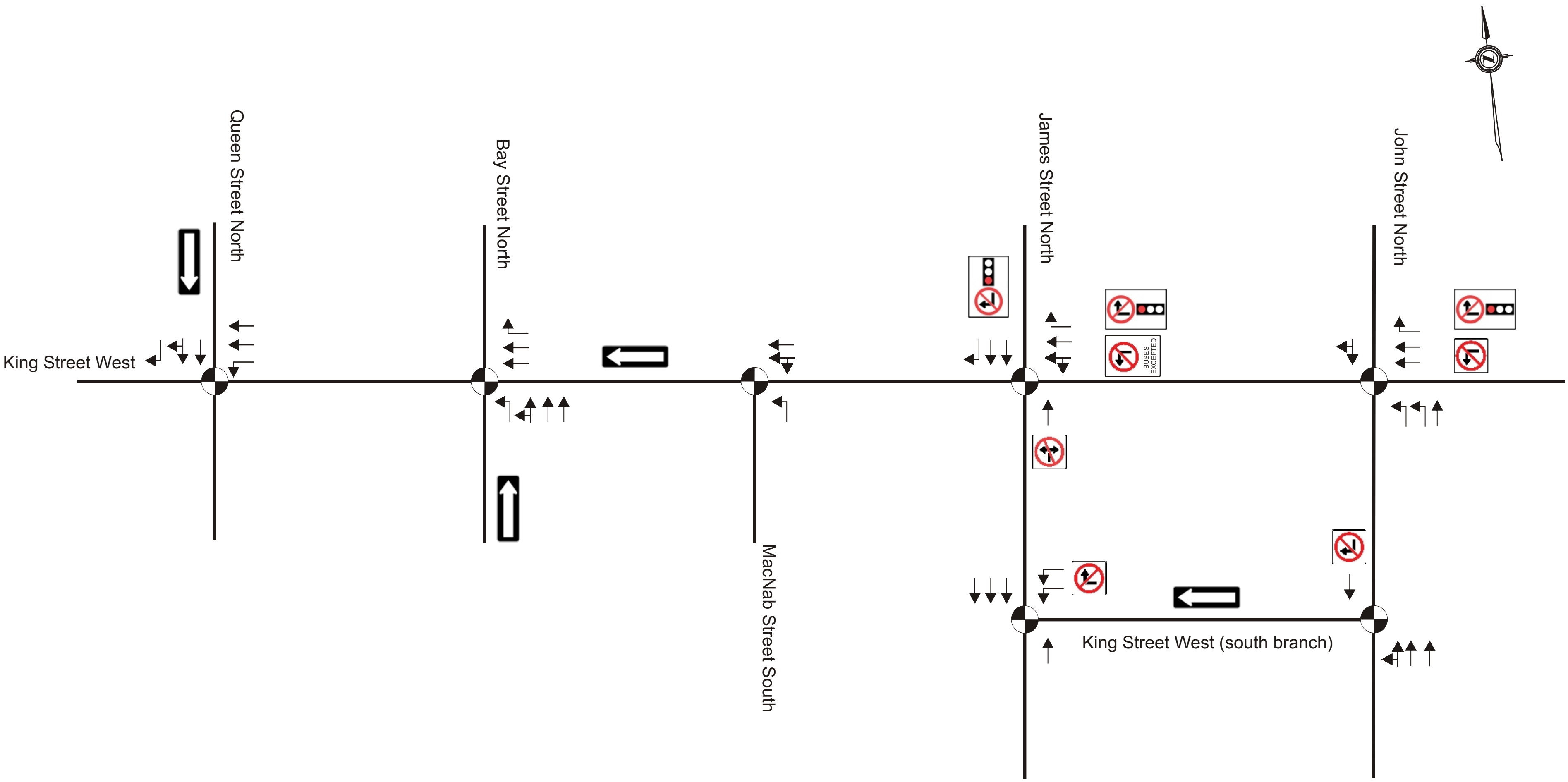
Not to Scale

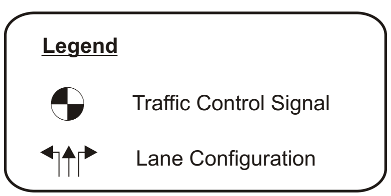
Figure 3
Post-Installation (Month 3) Bus Volumes



Not to Scale

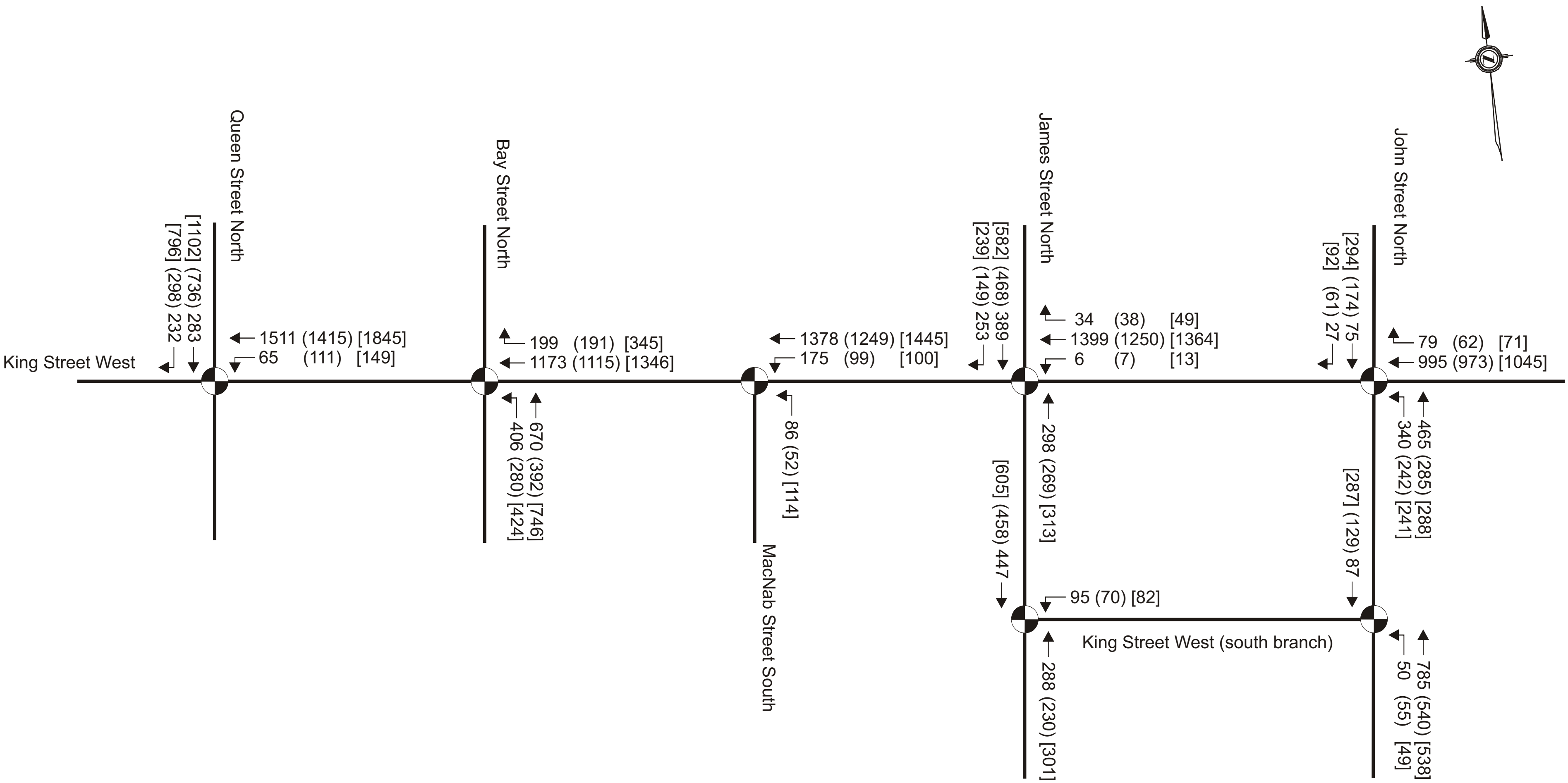
Figure 5
Post-Installation (Month 3) Lane Configurations





Not to Scale

Figure 6
Post-Installation (Month 3) Lane Configuration (As Modelled in Synchro)



Legend

- Right-turn Movement
- Through Movement
- Left-turn Movement

99 (99) [99] Weekday AM (Midday Off-peak) [Weekday PM] Peak Hour Traffic Volumes

Not to Scale

Figure 4
Post-Installation (Month 3) General Purpose Traffic Volumes

2.2.1. Traffic Operations

The results of the Post-installation (Month 3) intersection operations using Synchro 7 and Synchro 8 are summarized in **Table 5** and **Table 6**, respectively. The corresponding 50th and 90th percentile queues are provided in **Table 7** and **Table 8**, respectively. The Synchro 7 and Synchro 8 outputs are provided in **Appendix B**.

The results of the traffic analysis indicate that the intersections within the study area are operating with residual capacity and at acceptable LOS during the weekday AM, Midday and PM peak hours, with the exception of the westbound left-through movement at James Street / King Street, which operates with capacity constraints during all peak hours in Scenario 1. However, capacity issues at the intersection of James Street / King Street can be mitigated by improving the existing signal timing splits and increasing the cycle length in the AM peak to 100 seconds (see results for Scenario 2). The results of the Synchro analysis are summarized in **Table 5** and **Table 6.** The results generated by Synchro 7 and Synchro 8 are comparable for all peak hours.

It should be noted that the January 29, 2014, turning movement count for the intersection of Queen Street / King Street during the PM peak hour appears to be considerably higher than the previous count dated May 15, 2013. This may suggest traffic is diverting to avoid congestion and returning to King Street at Queen Street. **Section 2.4** discusses traffic diversion to parallel streets.

Table 5: Post-Installation (Month 3) Intersection Operations (Synchro 7)

Intersection	Movement	AM Peak Hour						Off Peak Hour						PM Peak Hour					
		LOS			v/c			LOS			v/c			LOS			v/c		
		Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3
Queen Street / King Street (Signalized)	Overall	C	B	B	0.85	0.83	0.83	B	B	B	0.80	0.80	0.80	F	F	F	1.14	1.14	1.14
	WBL	A	A	A	0.07	0.07	0.07	A	A	A	0.10	0.10	0.10	B	B	B	0.18	0.18	0.18
	WBT	B	B	B	0.91	0.86	0.86	B	B	B	0.87	0.87	0.87	F	E	E	1.15	1.12	1.12
	SBTR	C	D	D	0.62	0.67	0.67	C	C	C	0.70	0.70	0.70	E	F	F	1.08	1.12	1.12
	SBR	D	D	D	0.68	0.74	0.74	C	C	C	0.62	0.62	0.62	F	F	F	1.12	1.15	1.15
Bay Street / King Street (Signalized)	Overall	B	C	C	0.63	0.61	0.61	B	B	B	0.55	0.55	0.55	B	B	B	0.74	0.74	0.74
	WBTR	A	C	C	0.62	0.59	0.59	A	A	A	0.56	0.56	0.56	A	A	A	0.73	0.72	0.72
	WBR	A	B	B	0.28	0.27	0.27	A	A	A	0.26	0.26	0.26	B	B	B	0.62	0.61	0.61
	NBL	C	D	D	0.64	0.67	0.67	C	C	C	0.52	0.52	0.52	C	D	D	0.76	0.78	0.78
	NBLT	C	C	C	0.61	0.65	0.65	C	C	C	0.52	0.52	0.52	C	C	C	0.60	0.62	0.62
MacNab Street / King Street (Signalized)	Overall	A	A	B	0.64	0.63	0.68	A	A	B	0.58	0.58	0.64	A	A	C	0.65	0.65	0.73
	WBL[1]	-	-	F	-	-	0.73	-	-	D	-	-	0.53	-	-	D	-	-	0.57
	WBLT	A	A	B	0.68	0.66	0.74	A	A	B	0.63	0.63	0.73	A	A	C	0.69	0.69	0.80
	NBL	D	D	D	0.44	0.48	0.41	C	C	C	0.27	0.27	0.25	D	D	D	0.46	0.46	0.46
James Street / King Street [2] (Signalized)	Overall	D	C	C	0.77	0.76	0.74	D	C	C	0.65	0.65	0.63	C	C	C	0.69	0.69	0.68
	WBLT	F	D	D	**1.11**	0.99	0.96	E	D	D	**1.07**	**1.03**	0.99	D	D	D	**1.04**	0.99	0.98
	WBR	B	B	B	0.09	0.08	0.08	A	A	A	0.11	0.11	0.11	B	B	B	0.12	0.12	0.12
	NBT	A	A	A	0.47	0.51	0.51	A	A	A	0.33	0.34	0.34	A	A	A	0.38	0.39	0.39
	SBT	B	B	B	0.28	0.31	0.31	B	B	B	0.32	0.33	0.33	B	B	B	0.39	0.40	0.40
	SBR	C	C	C	0.46	0.50	0.50	B	B	B	0.27	0.28	0.28	C	C	C	0.42	0.43	0.43
John Street / King Street (Signalized)	Overall	B	B	B	0.66	0.65	0.65	B	B	B	0.70	0.70	0.70	C	C	C	0.76	0.76	0.76
	WBT	B	B	B	0.62	0.59	0.59	C	C	C	0.72	0.72	0.72	C	C	C	0.72	0.73	0.73
	WBR	B	B	B	0.12	0.12	0.12	B	B	B	0.15	0.15	0.15	B	B	B	0.14	0.14	0.14
	NBL	A	A	A	0.49	0.50	0.50	A	A	A	0.38	0.38	0.38	A	A	A	0.61	0.59	0.59
	NBT	A	A	A	0.72	0.73	0.73	A	A	A	0.43	0.43	0.43	A	A	A	0.44	0.44	0.44
	SBTR	C	C	C	0.22	0.22	0.22	C	C	C	0.61	0.61	0.61	D	D	D	0.88	0.86	0.86

LOS - level of service, v/c - volume to capacity ratio
Sc 1 - Existing signal timings; Sc 2 - Optimized signal timings; Sc 3 - Transit signal priority (westbound left to MacNab Street Terminal)
[1] Transit-Only lane
[2] Results for the AM peak hour in scenarios 2 and 3 are based on 100 seconds cycle length

Table 6: Post Installation (Month 3) Intersection Operations (Synchro 8)

Intersection	Movement	AM Peak Hour						Off Peak Hour						PM Peak Hour					
		LOS			v/c			LOS			v/c			LOS			v/c		
		Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3
Queen Street / King Street (Signalized)	Overall	C	B	B	0.83	0.82	0.82	B	B	B	0.80	0.80	0.80	F	F	F	1.13	1.13	1.13
	WBL	A	A	A	0.07	0.07	0.07	A	A	A	0.10	0.10	0.10	B	B	B	0.17	0.17	0.17
	WBT	B	B	B	0.90	0.86	0.86	B	B	B	0.87	0.87	0.87	F	E	E	1.15	1.12	1.12
	SBTR	C	D	D	0.64	0.69	0.69	C	C	C	0.70	0.70	0.70	E	F	F	1.08	1.11	1.11
	SBR	D	D	D	0.64	0.70	0.70	C	C	C	0.58	0.58	0.58	F	F	F	1.11	1.14	1.14
Bay Street / King Street (Signalized)	Overall	B	C	C	0.62	0.61	0.61	B	B	B	0.55	0.55	0.55	B	B	B	0.73	0.73	0.73
	WBTR	A	C	C	0.62	0.59	0.59	A	A	A	0.56	0.56	0.56	A	A	A	0.72	0.71	0.71
	WBR	A	B	B	0.27	0.26	0.26	A	A	A	0.25	0.25	0.25	A	A	A	0.59	0.58	0.58
	NBL	C	D	D	0.62	0.67	0.67	C	C	C	0.50	0.50	0.50	C	D	D	0.74	0.76	0.76
	NBLT	C	C	C	0.61	0.65	0.65	C	C	C	0.52	0.52	0.52	C	C	C	0.60	0.62	0.62
MacNab Street / King Street (Signalized)	Overall	A	A	B	0.64	0.63	0.63	A	A	B	0.58	0.58	0.56	A	A	C	0.65	0.65	0.65
	WBL[1]	-	-	F	-	-	0.75	-	-	D	-	-	0.52	-	-	D	-	-	0.57
	WBLT	A	A	B	0.68	0.66	0.74	A	A	B	0.63	0.63	0.73	A	A	C	0.69	0.69	0.80
	NBL	D	D	D	0.44	0.48	0.41	C	C	C	0.27	0.27	0.25	D	D	D	0.46	0.46	0.46
James Street / King Street [2] (Signalized)	Overall	D	C	C	0.80	0.78	0.77	D	C	C	0.68	0.68	0.67	C	C	C	0.72	0.72	0.71
	WBLT	F	D	D	**1.11**	0.99	0.96	E	D	D	**1.07**	**1.03**	0.99	D	D	D	**1.04**	0.99	0.98
	WBR	B	B	B	0.09	0.08	0.08	A	A	A	0.11	0.11	0.11	B	B	B	0.12	0.12	0.12
	NBT	A	A	A	0.47	0.51	0.51	A	A	A	0.33	0.34	0.34	A	A	A	0.38	0.39	0.39
	SBT	B	B	B	0.28	0.31	0.31	B	B	B	0.32	0.33	0.33	B	B	B	0.39	0.40	0.40
	SBR	C	C	C	0.46	0.50	0.50	B	B	B	0.27	0.28	0.28	C	C	C	0.42	0.43	0.43
John Street / King Street (Signalized)	Overall	B	B	B	0.69	0.67	0.67	B	B	B	0.64	0.64	0.64	C	C	C	0.76	0.76	0.76
	WBT	B	B	B	0.62	0.59	0.59	C	C	C	0.72	0.72	0.72	C	C	C	0.72	0.73	0.73
	WBR	B	B	B	0.12	0.12	0.12	B	B	B	0.15	0.15	0.15	B	B	B	0.14	0.14	0.14
	NBL	A	A	A	0.49	0.50	0.50	A	A	A	0.38	0.38	0.38	A	A	A	0.61	0.59	0.59
	NBT	A	A	A	0.72	0.73	0.73	A	A	A	0.43	0.43	0.43	A	A	A	0.44	0.44	0.44
	SBTR	C	C	C	0.22	0.22	0.22	C	C	C	0.61	0.61	0.61	D	D	D	0.88	0.86	0.86

LOS - level of service, v/c - volume to capacity ratio
Sc 1 - Existing signal timings; Sc 2 - Optimized signal timings; Sc 3 - Transit signal priority (westbound left to MacNab Street Terminal)
[1] Transit-Only lane
[2] Results for the AM peak hour in scenarios 2 and 3 are based on 100 seconds cycle length

Table 7: Post Installation (Month 3) 50th Percentile Queues

Intersection	Key Movement	Available Storage Length (m)	50th Percentile Queue Length (m)																	
			AM Peak Hour						Off Peak Hour						PM Peak Hour					
			Synchro 7			Synchro 8			Synchro 7			Synchro 8			Synchro 7			Synchro 8		
			Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3
Queen Street / King Street (Signalized)	WBL	30	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	11	10	10	10	9	9
	WBT	103	120	66	66	103	61	61	53	50	50	52	50	50	206	202	202	206	202	202
	SBT	75	40	45	45	41	45	45	47	47	47	47	47	47	149	153	153	147	151	151
	SBR	75	35	39	39	31	36	36	31	31	31	28	28	28	133	136	136	130	132	132
Bay Street / King Street (Signalized)	WBT	160	43	94	94	43	94	94	< 7	< 7	< 7	< 7	< 7	< 7	32	32	32	32	32	32
	WBR	30	7	24	24	< 7	23	23	< 7	< 7	< 7	< 7	< 7	< 7	15	16	16	13	13	13
	NBL	58[1]	44	49	49	42	49	49	20	20	20	18	18	18	48	48	48	45	45	45
	NBT	80	48	54	54	47	54	54	24	24	24	23	23	23	48	48	48	47	48	48
MacNab Street / King Street (Signalized)	WBL[2]	85	-	-	8	-	-	23	-	-	7	-	-	7	-	-	8	-	-	8
	WBT	85	20	67	111	20	67	111	11	11	85	11	11	85	< 7	< 7	126	< 7	< 7	126
	NBL	130	15	17	17	15	17	17	7	7	8	7	7	8	20	20	20	20	20	20
James Street / King Street (Signalized)	WBT	87	152	161	157	152	161	157	107	103	98	107	103	98	76	69	67	76	70	67
	WBR	87	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7
	NBT	15	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7
	SBT	80	23	28	28	23	28	28	20	21	21	20	21	21	35	36	36	35	36	36
	SBR	80	30	37	37	30	36	37	11	12	12	12	12	12	26	28	28	26	28	28
John Street / King Street (Signalized)	WBT	90	69	74	74	69	74	74	56	56	56	56	56	56	83	85	85	83	85	85
	WBR	30	8	9	9	8	9	9	< 7	< 7	< 7	< 7	< 7	< 7	8	8	8	8	8	8
	NBL	20	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7
	NBT	104	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7
	SBT	85	12	13	13	12	13	13	27	27	27	27	27	27	64	63	63	64	63	63

LOS - level of service, v/c - volume to capacity ratio

Sc 1 - Existing signal timings; Sc 2 - Optimized signal timings; Sc 3 - Transit signal priority (westbound left to MacNab Street Terminal)

[1] Average length of dual left turn lanes

[2] Transit-Only lane

Table 8: Post Installation (Month 3) 95th Percentile Queues

Intersection	Key Movement	Available Storage Length (m)	95th Percentile Queue Length (m)																	
			AM Peak Hour						Off Peak Hour						PM Peak Hour					
			Synchro 7			Synchro 8			Synchro 7			Synchro 8			Synchro 7			Synchro 8		
			Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3
Queen Street / King Street (Signalized)	WBL	30	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	18	17	17	17	16	16
	WBT	103	186	99	99	179	99	99	140	140	140	140	140	140	247	243	243	247	243	243
	SBT	75	39	48	48	40	48	48	64	64	64	64	64	64	192	195	195	190	194	194
	SBR	75	42	51	51	39	47	47	54	54	54	50	50	50	202	205	205	199	202	202
Bay Street / King Street (Signalized)	WBT	160	68	84	84	68	84	84	13	13	13	13	13	13	82	63	63	82	64	64
	WBR	30	13	35	35	< 7	33	33	< 7	< 7	< 7	< 7	< 7	< 7	51	39	39	21	19	19
	NBL	58[1]	65	75	75	62	74	74	35	35	35	34	34	34	79	83	83	75	78	78
	NBT	80	53	62	62	53	62	62	29	29	29	29	29	29	58	60	60	57	59	59
MacNab Street / King Street (Signalized)	WBL[2]	85	-	-	23	-	-	23	-	-	25	-	-	25	-	-	27	-	-	27
	WBT	85	7	54	120	7	54	120	11	13	148	11	13	148	26	169	130	26	169	130
	NBL	130	25	29	29	25	29	29	13	13	15	13	13	15	32	32	32	32	32	32
James Street / King Street (Signalized)	WBT	87	196	204	195	197	204	195	146	143	136	147	142	136	178	170	165	178	170	166
	WBR	87	8	< 7	< 7	8	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	8	7	7	8	7	8
	NBT	15	7	9	9	8	9	9	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7
	SBT	80	33	39	39	33	39	39	29	30	30	29	30	30	48	49	49	48	49	49
	SBR	80	88	98	99	88	98	99	45	48	49	45	48	49	76	83	80	76	83	80
John Street / King Street (Signalized)	WBT	90	97	103	103	97	103	103	109	109	109	109	109	109	108	110	110	108	110	110
	WBR	30	18	19	19	18	19	19	16	16	16	16	16	16	17	17	17	17	17	17
	NBL	20	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7
	NBT	104	72	82	82	73	82	82	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7
	SBT	85	23	25	25	23	25	25	41	41	41	41	41	41	112	108	108	112	108	108

LOS - level of service, v/c - volume to capacity ratio
Sc 1 - Existing signal timings; Sc 2 - Optimized signal timings; Sc 3 - Transit signal priority (westbound left to MacNab Street Terminal)
[1] Average length of dual left turn lanes
[2] Transit-Only lane

2.2.2. Queuing

The results for the 50th percentile (average queue) queuing analysis indicate that, in general, the queues for all movements will be accommodated in the available storage during the weekday AM peak, Midday and PM peak hours, with the exception of the following movements detailed below in **Table 9**.

Table 9: Post Installation (Month 3) 50th Percentile Queuing Issues

Month 3 Analysis - 50th Percentile Queuing	
Scenario 1	**Confirmed Obs and Notes**
@ Queen St – WBT: AM pk hr & PM pk hr – LOS B & LOS F	Occasionally
@ Queen St – SBTR & SBR: PM pk hr – LOS E & LOS F	Confirmed
@ James St – WBT: AM pk hr &: Off pk hr – LOS F & LOS E	Confirmed
Scenario 2	**Confirmed Obs and Notes**
@ Queen St – WBT: PM pk hr – LOS E	N/A
@ Queen St – SBTR & SBR: PM pk hr – LOS F & LOS F	N/A
@ James St – WBT: AM pk hr &: Off pk hr – LOS D & LOS D	N/A
Scenario 3	**Confirmed Obs and Notes**
@ Queen St – WBT: PM pk hr – LOS E	N/A
@ Queen St – SBTR & SBR: PM pk hr – LOS F & LOS F	N/A
@ MacNab St – WBT: AM pk hr & PM pk hr – LOS B & LOS C	N/A
@ James St – WBT: AM pk hr &: Off pk hr – LOS D & LOS D	N/A

The results for the 95th percentile (maximum queues) queuing analysis indicate that the queues for several movements will exceed the available storage during the weekday AM, Midday and PM peak hours. These movements are detailed below in **Table 10**.

Table 10: Post Installation (Month 3) 95th Percentile Queuing Issues

Month 3 Analysis - 95th Percentile Queuing	
Scenario 1	**Confirmed Obs and Notes**
@ Queen St – WBT: AM pk hr, Off pk hr & PM pk hr – LOS B , LOS B & LOS F	Occasionally
@ Queen St – SBTR & SBR: PM pk hr – LOS E & LOS F	Confirmed
@ Bay St – NBL: AM pk hr & PM pk hr – LOS C & LOS C	Occasionally
@ James St – WBT: AM pk hr, Off pk hr & PM pk hr – LOS F , LOS E & LOS D	Confirmed
@ James St – SBR: AM pk hr – LOS C	Occasionally
@ John St – WBT: AM pk hr, Off pk hr & PM pk hr – LOS B , LOS C & LOS C	Confirmed
@ John St – SBT: PM pk hr – LOS D	Occasionally
Scenario 2	**Confirmed Obs and Notes**
@ Queen St – WBT: AM pk hr, Off pk hr & PM pk hr – LOS B , LOS B & LOS E	N/A
@ Queen St – SBTR & SBR: PM pk hr – LOS F & LOS F	N/A

Month 3 Analysis - 95th Percentile Queuing	
@ Bay St – NBL: AM pk hr & PM pk hr – LOS D & LOS D	N/A
@ Bay St – WBR: AM pk hr & PM pk hr – LOS B & LOS B	N/A
@ MacNab St – WBT: PM pk hr – LOS A	N/A
@ James St – WBT: AM pk hr, Off pk hr & PM pk hr – LOS D , LOS D & LOS D	N/A
@ James St – SBR: AM pk hr & PM pk hr – LOS C & LOC C	N/A
@ John St – WBT: AM pk hr, Off pk hr & PM pk hr – LOS B , LOS C & LOS C	N/A
@ John St – SBT: PM pk hr – LOS D	N/A
Scenario 3	**Confirmed Obs and Notes**
@ Queen St – WBT: AM pk hr, Off pk hr & PM pk hr – LOS B , LOS B & LOS E	N/A
@ Queen St – SBTR & SBR: PM pk hr – LOS F & LOS F	N/A
@ Bay St – NBL: AM pk hr & PM pk hr – LOS D & LOS D	N/A
@ Bay St – WBR: AM pk hr & PM pk hr – LOS B & LOS B	N/A
@ MacNab St – WBT: AM pk hr, OFF pk hr & PM pk hr – LOS B, LOS B & LOS C	N/A
@ James St – WBT: AM pk hr, Off pk hr & PM pk hr – LOS D , LOS D & LOS D	N/A
@ James St – SBR: AM pk hr – LOS C	N/A
@ John St – WBT: AM pk hr, Off pk hr & PM pk hr – LOS B , LOS C & LOS C	N/A
@ John St – SBT: PM pk hr – LOS D	N/A

N/A – Not Applicable

Note, the LOS values for above noted movements in **Table 9** and **Table 10** are based on Synchro 7 results (**Table 5**). However, there is minimal or no difference in the LOS values between Synchro 7 and Synchro 8 results.

2.3. Post-Installation Traffic Analysis (Month 7)

The Post-installation (Month 7) operational analysis assessed the operations of the general purpose traffic lanes on King Street seven months after the implementation of the RBL. Post-Installation (Month 7) weekday turning movement counts, as summarized in **Table 11,** were provided by the City.

Table 11: Post Installation (Month 7) Traffic Counts

Location	Date
John Street / King Street	May 12, 2014
James Street / King Street	May 13, 2014
MacNab Street / King Street	May 12, 2014
Bay Street / King Street	May 14, 2014
Queen Street / King Street	May 15, 2014

The approach and methodology for the Post-installation (Month 7) traffic analysis is consistent with the analysis undertaken for the Post-installation (Month 3), i.e. only general purpose traffic lanes are assessed given the limitations of Synchro to model transit-only lanes.

The Post-installation (Month 7) bus volumes in the King Street corridor are shown in **Figure 7**. The Post-installation (Month 7) general purpose traffic volumes are illustrated in **Figure 8**. The Post-installation lane configuration is shown in

Figure 5. The lane configuration modelled in Synchro is shown in **Figure 6** (i.e. excluding the RBL which Synchro cannot model).

The three analysis scenarios to assess Post-installation (Month 7) impacts are:

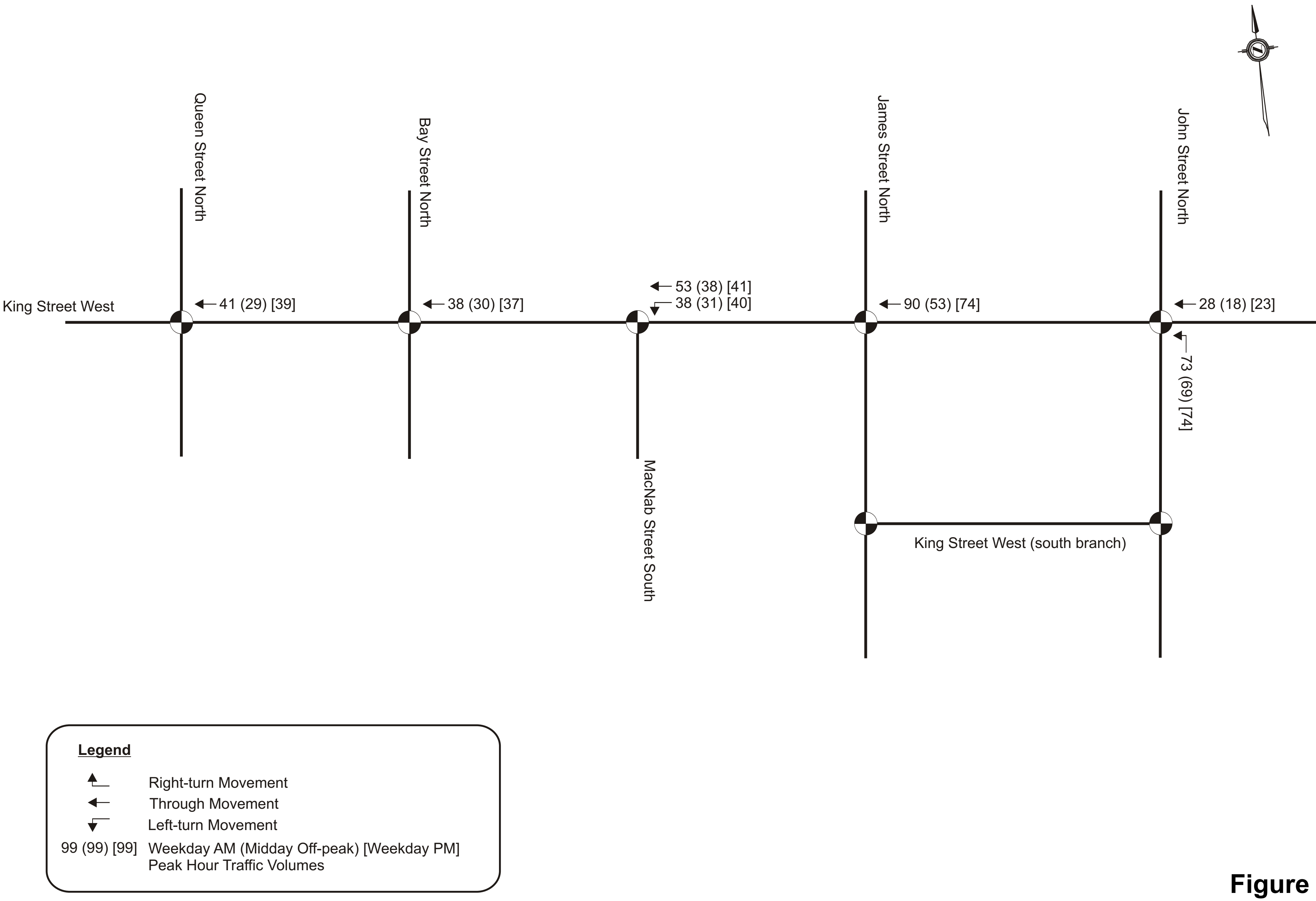
- **Scenario 1 –** pre-installation signal timing splits (provided by City staff)
- **Scenario 2** - modified signal timing splits
- **Scenario 3** - modified signal timing splits with transit signal priority (westbound left to MacNab Street Terminal)

Transit signal priority phasing at the intersection of James Street / King Street was not considered in Scenario 3 as this location has substantial pedestrian volumes. Another reason transit signal priority phasing was not considered at this location was that bus movements from the RBL into the general purpose lanes to make the westbound left turn into MacNab Street could not be guaranteed due to the queues of westbound through traffic on King Street.

2.3.1. Traffic Operations

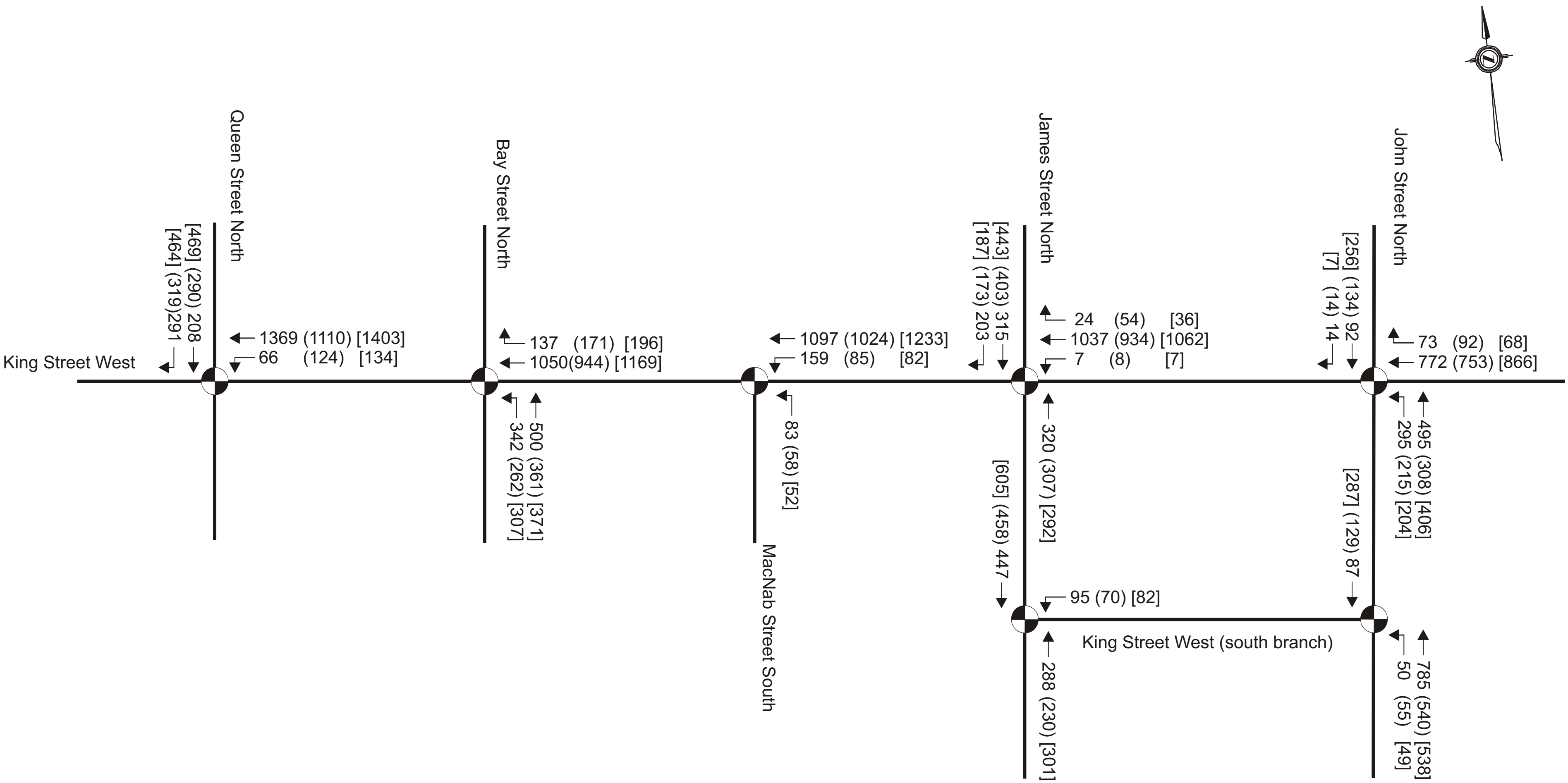
The results of the Post-installation (Month 7) intersection operations using Synchro 7 and Synchro 8 are summarized in **Table 12** and **Table 13,** respectively. The corresponding 50th and 90th percentile queues are provided in **Table 14** and **Table 15**, respectively. The Synchro 7 and Synchro 8 outputs are provided in **Appendix C**.

The results of the traffic analysis indicate that most movements within the study area are operating at acceptable LOS during the peak periods analyzed except for some movements at James Street and at Queen Street. The results generated by Synchro 7 and Synchro 8 are comparable for all peak hours.



Not to Scale

Figure 7
Post-Installation (Month 7) Bus Volumes



Legend

Right-turn Movement

Through Movement

Left-turn Movement

99 (99) [99] Weekday AM (Midday Off-peak) [Weekday PM] Peak Hour Traffic Volumes

Not to Scale

Figure 8
Post- Installation (Month 7) General Purpose Traffic Volumes

COLE ENGINEERING

Table 12: Post-Installation (Month 7) Intersection Operations (Synchro 7)

Intersection	Movement	AM Peak Hour						Off Peak Hour						PM Peak Hour					
		LOS			v/c			LOS			v/c			LOS			v/c		
		Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3
Queen Street / King Street	Overall	B	B	B	0.78	0.78	0.78	B	B	B	0.56	0.56	0.56	B	B	B	0.73	0.72	0.72
	WBL	A	A	A	0.07	0.07	0.07	A	A	A	0.09	0.09	0.09	A	A	A	0.12	0.11	0.11
	WBT	B	A	B	0.82	0.81	0.80	A	A	A	0.57	0.57	0.57	B	B	B	0.74	0.71	0.71
	SBTR	C	C	C	0.63	0.65	0.66	C	C	C	0.56	0.56	0.56	C	C	C	0.68	0.73	0.73
	SBR	D	D	D	0.68	0.70	0.71	C	C	C	0.56	0.55	0.55	C	D	D	0.69	0.73	0.73
Bay Street / King Street	Overall	B	C	B	0.53	0.53	0.53	B	B	B	0.47	047	047	B	B	B	0.55	0.55	0.55
	WBTR	A	B	A	0.50	0.50	0.50	A	A	A	0.46	0.46	0.46	A	A	A	0.53	0.52	0.52
	WBR	A	A	A	0.17	0.17	0.17	A	A	A	0.22	0.22	0.22	A	A	A	0.28	0.29	0.29
	NBL	C	C	C	0.60	0.58	0.58	C	C	C	0.46	0.45	0.45	D	D	D	0.63	0.61	0.61
	NBLT	C	C	C	0.59	0.59	0.59	C	C	C	0.49	0.49	0.49	C	C	C	0.53	0.53	0.53
MacNab Street / King Street	Overall	A	A	B	0.53	0.53	0.60	A	A	B	0.49	0.49	0.54	A	A	C	0.52	0.52	0.60
	WBL[1]	-	-	E	-	-	0.70	-	-	D	-	-	0.59	-	-	D	-	-	0.55
	WBLT	A	A	B	0.54	0.55	0.63	A	A	B	0.53	0.52	0.59	A	A	C	0.54	0.54	0.66
	NBL	D	D	D	0.43	0.43	0.43	C	C	C	0.30	0.30	0.27	D	D	D	0.34	0.34	0.27
James Street / King Street[2]	Overall	B	C	C	0.65	0.65	0.64	B	B	B	0.56	0.57	0.55	B	B	B	0.57	0.57	0.55
	WBLT	C	C	C	0.86	0.86	0.84	C	C	C	0.83	0.84	0.81	C	C	C	0.84	0.84	0.82
	WBR	B	B	B	0.07	0.07	0.07	B	B	B	0.17	0.10	0.17	B	B	B	0.10	0.10	0.10
	NBT	A	A	A	0.49	0.49	0.49	A	A	A	0.36	0.35	0.36	A	A	A	0.34	0.35	0.34
	SBT	B	B	B	0.22	0.22	0.22	B	B	B	0.27	0.29	0.27	B	B	B	0.28	0.29	0.28
	SBR	B	C	B	0.35	0.36	0.35	B	B	B	0.30	0.31	0.30	B	B	B	0.31	0.31	0.31
John Street / King Street	Overall	B	B	B	0.61	0.61	0.61	B	B	B	0.51	0.51	0.51	B	B	B	0.62	0.62	0.62
	WBT	B	B	B	0.49	0.49	0.49	B	B	B	0.52	0.52	0.52	B	B	B	0.56	0.56	0.56
	WBR	B	B	B	0.12	0.12	0.12	B	B	B	0.22	0.22	0.22	B	B	B	0.12	0.12	0.12
	NBL	A	A	A	0.41	0.41	0.41	A	A	A	0.34	0.34	0.34	A	A	A	0.45	0.45	0.45
	NBT	A	A	A	0.74	0.74	0.74	A	A	A	0.50	0.50	0.50	A	A	A	0.69	0.69	0.69
	SBTR	C	C	C	0.24	0.24	0.24	C	C	C	0.44	0.44	0.44	D	D	D	0.67	0.67	0.67

LOS - level of service, v/c - volume to capacity ratio
Sc 1 - Existing signal timings; Sc 2 - Optimized signal timings; Sc 3 - Transit signal priority (westbound left to MacNab Street Terminal)
[1] Transit-Only lane

Table 13: Post-Installation (Month 7) Intersection Operations (Synchro 8)

Intersection	Movement	AM Peak Hour						Off Peak Hour						PM Peak Hour					
		LOS			v/c			LOS			v/c			LOS			v/c		
		Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3
Queen Street / King Street	Overall	B	B	B	0.78	0.77	0.77	B	B	B	0.56	0.56	0.56	B	B	B	0.73	0.72	0.72
	WBL	A	A	A	0.07	0.07	0.07	A	A	A	0.09	0.09	0.09	A	A	A	0.12	0.11	0.11
	WBT	B	A	B	0.82	0.80	0.80	A	A	A	0.57	0.57	0.57	B	B	B	0.74	0.71	0.71
	SBTR	C	C	C	0.63	0.67	0.67	C	C	C	0.56	0.56	0.56	C	C	C	0.68	0.73	0.73
	SBR	D	D	D	0.68	0.67	0.77	C	C	C	0.56	0.55	0.55	C	D	D	0.69	0.73	0.73
Bay Street / King Street	Overall	B	C	B	0.53	0.53	0.53	B	B	B	0.47	047	047	B	B	B	0.55	0.55	0.55
	WBTR	A	B	A	0.50	0.50	0.50	A	A	A	0.46	0.46	0.46	A	A	A	0.53	0.52	0.52
	WBR	A	A	A	0.17	0.16	0.16	A	A	A	0.22	0.22	0.22	A	A	A	0.28	0.29	0.29
	NBL	C	C	C	0.60	0.59	0.59	C	C	C	0.46	0.45	0.45	D	D	D	0.63	0.61	0.61
	NBLT	C	C	C	0.59	0.59	0.59	C	C	C	0.49	0.49	0.49	C	C	C	0.53	0.53	0.53
MacNab Street / King Street	Overall	A	A	B	0.53	0.53	0.55	A	A	B	0.49	0.49	0.54	A	A	C	0.52	0.52	0.60
	WBL[1]	-	-	E	-	-	0.70	-	-	D	-	-	0.59	-	-	D	-	-	0.55
	WBLT	A	A	B	0.54	0.55	0.63	A	A	B	0.53	0.52	0.59	A	A	C	0.54	0.54	0.66
	NBL	D	D	D	0.43	0.43	0.43	C	C	C	0.30	0.30	0.27	D	D	D	0.34	0.34	0.27
James Street / King Street[2]	Overall	B	C	C	0.68	0.68	0.67	B	B	B	0.59	0.59	0.55	B	B	B	0.59	0.59	0.55
	WBLT	C	C	C	0.86	0.86	0.84	C	C	C	0.83	0.83	0.81	C	C	C	0.84	0.84	0.82
	WBR	B	B	B	0.07	0.07	0.07	B	B	B	0.17	0.16	0.17	B	B	B	0.10	0.10	0.10
	NBT	A	A	A	0.49	0.49	0.49	A	A	A	0.36	0.37	0.36	A	A	A	0.34	0.35	0.34
	SBT	B	B	B	0.22	0.22	0.22	B	B	B	0.27	0.27	0.27	B	B	B	0.28	0.29	0.28
	SBR	B	C	B	0.35	0.36	0.35	B	B	B	0.30	0.31	0.30	B	B	B	0.31	0.31	0.31
John Street / King Street)	Overall	B	B	B	0.61	0.63	0.63	B	B	B	0.51	0.51	0.51	B	B	B	0.62	0.62	0.62
	WBT	B	B	B	0.49	0.49	0.49	B	B	B	0.52	0.52	0.52	B	B	B	0.56	0.56	0.56
	WBR	B	B	B	0.12	0.12	0.12	B	B	B	0.22	0.22	0.22	B	B	B	0.12	0.12	0.12
	NBL	A	A	A	0.41	0.41	0.41	A	A	A	0.34	0.34	0.34	A	A	A	0.45	0.45	0.45
	NBT	A	A	A	0.74	0.75	0.75	A	A	A	0.50	0.50	0.50	A	A	A	0.69	0.69	0.69
	SBTR	C	C	C	0.24	0.24	0.24	C	C	C	0.44	0.44	0.44	D	D	D	0.67	0.67	0.67

LOS - level of service, v/c - volume to capacity ratio

Sc 1 - Existing signal timings; Sc 2 - Optimized signal timings; Sc 3 - Transit signal priority (westbound left to MacNab Street Terminal)

[1] Transit-Only lane

[2] Results for the AM peak hour in scenarios 2 and 3 are based on 100 seconds cycle length

Table 14: Post-Installation (Month 7) 50th Percentile Intersection Queues

Intersection	Key Movement	Available Storage Length (m)	50th Percentile Queue Length (m)																	
			AM Peak Hour						Off Peak Hour						PM Peak Hour					
			Synchro 7			Synchro 8			Synchro 7			Synchro 8			Synchro 7			Synchro 8		
			Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3
Queen Street / King Street	WBL	30	<7	<7	< 7	<7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	<7	<7	<7	<7	<7	<7
	WBT	103	86	31	95	85	21	96	19	18	22	19	18	22	70	39	31	74	39	31
	SBT	75	38	37	38	38	38	38	27	27	27	27	27	27	54	54	54	55	54	54
	SBR	75	35	34	34	31	31	31	22	22	22	21	21	21	47	46	46	45	45	45
Bay Street / King Street	WBT	160	19	66	36	19	66	36	<7	<7	31	<7	<7	31	17	15	111	17	15	105
	WBR	30	< 7	13	<7	< 7	12	<7	< 7	< 7	8	< 7	< 7	7	<7	<7	28	<7	<7	26
	NBL	58[1]	34	33	33	33	33	33	15	15	15	15	15	15	28	27	27	26	26	26
	NBT	80	38	38	38	38	38	38	21	20	20	21	20	20	30	30	30	30	30	30
MacNab Street / King Street	WBL[2]	85	-	-	7	-	-	7	-	-	<7	-	-	<7	-	-	7	-	-	7
	WBT	85	17	47	91	17	47	91	13	13	61	13	13	61	7	7	105	7	7	105
	NBL	130	14	14	14	14	14	14	7	7	9	7	7	9	9	9	9	9	9	9
James Street / King Street	WBT	87	51	107	102	51	107	102	70	67	66	70	70	66	39	37	37	39	39	38
	WBR	87	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7
	NBT	15	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7
	SBT	80	18	18	18	18	18	18	16	16	20	16	16	20	25	25	25	25	25	25
	SBR	80	23	23	23	23	23	23	13	13	0	13	13	0	20	20	20	20	20	20
John Street / King Street	WBT	90	51	51	51	51	51	51	35	35	35	35	35	35	59	59	59	59	59	59
	WBR	30	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
	NBL	20	<7	<7	< 7	< 7	< 7	< 7	<7	< 7	< 7	< 7	< 7	<7	<7	<7	<7	<7	<7	<7
	NBT	104	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7
	SBT	85	13	13	13	13	13	13	18	18	18	18	18	18	44	44	44	44	44	44

LOS - level of service, v/c - volume to capacity ratio
Sc 1 - Existing signal timings; Sc 2 - Optimized signal timings; Sc 3 - Transit signal priority (westbound left to MacNab Street Terminal)
[1] Average length of dual left turn lanes
[2]Transit-Only lane

Table 15: Post-Installation (Month 7) 95th Percentile Intersection Queues

Intersection	Key Movement	Available Storage Length (m)	95th Percentile Queue Length (m)																	
			AM Peak Hour						Off Peak Hour						PM Peak Hour					
			Synchro 7			Synchro 8			Synchro 7			Synchro 8			Synchro 7			Synchro 8		
			Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3	Sc 1	Sc 2	Sc 3
Queen Street / King Street	WBL	30	<7	<7	<7	<7	<7	7	<7	<7	<7	<7	<7	<7	13	10	<7	13	10	<7
	WBT	103	138	100	112	131	100	112	41	41	67	42	42	66	113	67	42	112	67	42
	SBT	75	37	40	40	38	40	40	32	32	32	32	32	32	64	71	71	64	71	71
	SBR	75	41	44	44	38	41	41	34	34	34	33	33	33	69	75	75	66	74	74
Bay Street / King Street	WBT	160	27	67	57	27	67	7	<7	<7	58	<7	<7	58	12	8	138	13	9	138
	WBR	30	<7	22	18	<7	20	17	<7	< 7	21	< 7	< 7	20	<7	<7	56	<7	< 7	54
	NBL	58[1]	51	50	50	51	50	50	30	30	30	30	30	30	45	44	44	42	42	42
	NBT	80	43	43	43	43	43	43	26	26	26	26	26	26	35	35	35	34	34	34
MacNab Street / King Street	WBL[2]	85	-	-	20	-	-	20	-	-	18	-	-	18	-	-	24	-	-	24
	WBT	85	8	52	114	8	52	115	20	20	104	21	21	104	29	29	128	29	29	128
	NBL	130	24	24	24	24	24	24	14	14	16	14	14	16	17	17	17	17	17	17
James Street / King Street	WBT	87	74	133	128	75	133	128	94	58	31	94	75	31	64	60	61	64	64	61
	WBR	87	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7
	NBT	15	8	8	7	8	8	<7	10	10	11	10	10	11	<7	<7	10	<7	<7	10
	SBT	80	26	26	26	26	26	27	16	25	29	25	25	29	35	35	35	35	35	35
	SBR	80	64	64	64	64	64	64	54	54	<7	54	54	<7	53	53	53	53	53	53
John Street / King Street	WBT	90	70	70	70	70	70	70	68	68	68	68	68	68	86	86	86	86	86	86
	WBR	30	16	16	16	16	16	16	21	21	21	21	21	21	16	16	16	16	16	16
	NBL	20	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	< 7	<7	<7	<7	<7	<7	<7
	NBT	104	80	80	80	80	80	80	<7	<7	<7	<7	<7	<7	85	85	85	85	85	85
	SBT	85	25	25	25	25	25	25	27	27	27	27	27	27	65	65	65	65	65	65

LOS - level of service, v/c - volume to capacity ratio

Sc 1 - Existing signal timings; Sc 2 - Optimized signal timings; Sc 3 - Transit signal priority (westbound left to MacNab Street Terminal)

[1] Average length of dual left turn lanes

[2] Transit-Only lane

2.3.2. Queuing

The results for the 50th percentile (average queue) queuing analysis indicate that, in general, the queues for all movements will be accommodated in the available storage during the weekday AM, Midday and PM peak hours, with the exception of the movements detailed in **Table 16**.

Table 16: Post Installation (Month 7) 50th Percentile Queuing Issues

Month 7 Analysis - 50th Percentile Queuing	
Scenario 1	**Confirmed Obs and Notes**
No Queuing Storage Issues Identified	Field observations indicate issues at John St. during all three time periods and James St. during PM peak.
Scenario 2	**Confirmed Obs and Notes**
@ James St – WBT: AM pk hr – LOS C	N/A
Scenario 3	**Confirmed Obs and Notes**
@ MacNab St – WBT: AM pk hr & PM pk hr – LOS B & LOS C	N/A
@ James St – WBT: AM pk hr – LOS C	N/A

The results for the 95th percentile (maximum queue) queuing analysis indicate that the queues for several movements will exceed the available storage during the weekday AM, Midday and PM peak hours. These movements are detailed in **Table 17**.

Table 17: Post Installation (Month 7) 95th Percentile Queuing Issues

Month 7 Analysis - 95th Percentile Queuing	
Scenario 1	**Confirmed Obs and Notes**
@ Queen St – WBT: AM pk hr & PM pk hr – LOS B & LOS B	Field observations indicate issues at John St. during all three time periods and James St. during PM peak.
Scenario 2	**Confirmed Obs and Notes**
@ James St – WBT: AM pk hr – LOS C	N/A
Scenario 3	**Confirmed Obs and Notes**
@ Bay St – WBR: PM pk hr – LOS A	N/A
@ MacNab St – WBT: AM pk hr, OFF pk hr & PM pk hr – LOS B, LOS B & LOS C	N/A
@ James St – WBT: AM pk hr – LOS C	N/A

N/A – Not Applicable

Note, the LOS values for above noted movements in **Table 16** and **Table 17** are based on Synchro 7 (**Table 12**) results. However, there is minimal or no difference in the LOS values between Synchro 7 and Synchro 8 results.

2.4. Traffic Volumes Comparison

Month 3 traffic volumes on King Street indicate a slight reduction from Pre-Installation volumes. Month 7 Post-installation traffic volumes on King Street indicate more notable decrease in the AM peak period traffic volumes of 200 to 400 vehicles per hour in westbound direction. The parallel street traffic volumes were assessed by comparing Post-installation (Month 3) and (Month 7) AM, Midday and PM peak hour turning movement counts at the following intersections provided by the City:

- Cannon Street / John Street;
- Wilson Street / John Street;
- Hunter Street / John Street;
- Cannon Street / Bay Street; and
- Hunter Street / Bay Street.

There are some variations in the turning movements observed on the parallel streets to King Street however no definitive re-assignment of traffic can be traced or attributed to the installation of the RBL on King Street. As no pre-installation traffic data was provided for the parallel streets a conclusive comparison or analysis cannot be made.

2.5. Summary of Traffic Analysis

The analysis of the pre-installation conditions show that intersections within the study area are operating with residual capacity and acceptable LOS during the weekday AM, Midday and PM peak periods. Generally, queuing in the study corridor can be accommodated within the available storage.

The Post-installation (Month 3) operational analysis of the corridor indicate that the intersections within the study area for Scenarios 1, 2 and 3 are operating with residual capacity and at acceptable LOS during the weekday AM, Midday and PM peak hours, with the exception of the westbound left-through movement at the intersection of James Street / King Street that operates with capacity constraints during all peak hours for Scenario 1. The intersection is also over capacity in Scenario 2 Midday peak. Some queuing issues are experienced for the westbound through movements on King Street in all scenarios tested.

The results of the traffic analysis indicate that most movements within the study area are operating at acceptable LOS during the peak periods analyzed except for some movements at James Street and at Queen Street.

Pre installation, the intersection of Queen Street / King Street operates well within capacity with v/c ratios less than 0.90 and some minor queue storage issues for the southbound through and southbound right-turn movements. Post-installation (Month 7), this intersection experiences its greatest increase in v/c ratio in the AM peak for all analysis scenarios – the westbound through movement experiences an increase in v/c ratio and 95th percentile queues that exceed available storage.

Pre installation, the intersection of Bay Street / King Street operates well within capacity with v/c ratios less than 0.90 and no queue storage issues. Post-installation (Month 7), this intersection experiences its greatest increase in v/c ratio in the Midday peak for all analysis scenarios. In Scenario 3 of the PM peak, the westbound right-turn has a 95th percentile queue that exceeds available storage.

Pre installation, the intersection of MacNab Street / King Street operates well within capacity with v/c ratios less than 0.90 and no queue storage issues. Post-installation (Month 7), the intersection continues to operate with v/c ratios less 0.90 during the AM, Midday and PM peaks. The 50th and 95th percentile queue for the westbound through movement exceeds available storage in Scenario 3 mainly as a result of green time that has been taken away from the westbound through movement to facilitate the left-turn transit priority signal.

Pre installation, the intersection of James Street / King Street operates well within capacity with v/c ratios less than 0.90 and no queue storage issues. The overall intersection v/c ratio Post installation (Month 7) for the AM, Midday and PM peak hours are in a similar range to those experienced pre installation of the RBL. The westbound through-left movement experiences the greatest increase in v/c ratio during the Midday and PM peaks for all analysis scenarios. In the AM peak, the westbound through-left queues (50th and 95th percentile) in Scenarios 2 and 3 exceed available storage.

Pre installation, the intersection of John Street / King Street operates well within capacity with v/c ratios less than 0.90 but with southbound right queues (95th percentile) that exceed available storage. The intersection continues to operate with v/c ratios less than 0.90. The 95th percentile queues indicate near capacity conditions.

3.0 Travel Speed and Travel Time Runs

3.1. Pre-Installation and Post-Installation Travel Time

Travel speed and delay runs were conducted by Accu-Traffic Inc. during the weekday AM, Midday and PM peak periods before the RBL implementation on Thursday May 16, 2013 and for four periods following the installation of the RBL.

After implementation travel time runs for the one month monitoring interval were conducted during the AM, Midday and PM peak periods on Tuesday November 5, 2013. Concurrent with the implementation and opening of the RBL, unrelated construction activities were taking place on King Street which adversely affected the operations on King Street. Since construction activities occurred during the Midday hours on November 5, 2013, the after speed survey for the Midday peak period was redone on Thursday November 7, 2013 to obtain representative data.

It should be noted that, as of Thursday November 7, No Stopping regulation from 4:00 PM to 6:00 PM on the south side of King Street between Locke Street and Dundurn Street was implemented and on street parking will no longer be permitted during this time period.

The runs for the three month monitoring interval were conducted during the AM, Midday, and PM peak periods on Thursday January 30, 2014.

The runs for the seven month monitoring interval were conducted during the AM, Midday, and PM peak periods on Wednesday May 14, 2014. The travel time data collection dates are summarised in **Table 18** below.

Table 18: AM Peak Period Travel Time and Speed (Before and After Conditions Comparison)

Monitoring Period	Survey Date
Pre Installation of RBL	Thursday May 16 2013
Post installation (Month 1)	Tuesday November 5 and Thursday November 7 2013
Post installation (Month 3)	Thursday January 30 2014
Post installation (Month 7)	Wednesday May 14 2014

These surveys capture the typical automobile speed on King Street and the time to travel the King Street RBL. In addition the data also includes Wellington Street to Mary Street to capture queuing on the approach to the RBL. The findings from the before and after travel time surveys are summarized in **Table 19** to **Table 21**.

Detailed travel time plots for the before and after conditions are provided in **Appendices D** to **G**.

The survey results indicate that the average travel time has generally increased with a corresponding decrease in the average speed during the AM, Midday and PM peak periods one month after the RBL implementation. The increase in average travel times for the one month monitoring interval is 3 minutes 24 seconds during the AM peak period, 1 minute 34 seconds during the Midday peak period and 1 minute and 11 seconds during the PM peak period. With all periods resulting in similar travel times of approx 8-9 minutes

The survey results for the three month monitoring interval show average travel time's improvements during the AM and Midday peak periods compared to the pre installation runs. The decrease in average travel times observed for the 3 month monitoring interval is 32 seconds during the AM peak period and 1 minute 52 seconds during the Midday peak period. For the PM peak period, an increase of 1 minute 4 seconds in average travel time was observed. This is due to diverting traffic and abuse of the RBL.

The survey results for the seven month monitoring interval compared to pre installation show average travel times have generally increased with a corresponding decrease in the average speed during the AM, Midday and PM peak periods seven months after the RBL implementation. The increase in average travel times for the seven month monitoring interval is 1 minutes 43 seconds during the AM peak period, 2 minute 24 seconds during the Midday peak period and 5 minute and 19 seconds during the PM peak period.

Table 19: AM Peak Period Travel Time and Speed (Before and After Conditions Comparison)

Run	King Street WB AM Peak (Pre-Installation Runs)					King Street WB AM Peak (Post-Installation Runs - Month 1)					King Street WB AM Peak (Post-Installation Runs - Month 3)					King Street WB AM Peak (Post-Installation Runs - Month 7)				
	Average Speed (km/h)	Travel Time (min)	No. of Stops	Stopped Time (min)	Congested Time (min)	Average Speed (km/h)	Travel Time (min)	No. of Stops	Stopped Time (min)	Congested Time (min)	Average Speed (km/h)	Travel Time (min)	No. of Stops	Stopped Time (min)	Congested Time (min)	Average Speed (km/h)	Travel Time (min)	No. of Stops	Stopped Time (min)	Congested Time (min)
1	42.2	4.37	1	0.53	0.85	28.9	7.77	4	2.16	3.96	36.2	4.85	1	0.73	1.02	34.08	5.40	2	1	1.45
2	32.5	6.10	4	1.53	2.26	32.5	9.23	11	3.70	5.99	33.6	5.15	2	0.73	1.18	37.65	5.26	2	0.90	1.58
3	32.0	6.38	4	1.79	2.44	26.8	9.39	10	3.31	5.73	35.6	5.04	2	0.84	1.13	39.17	4.96	3	1.11	2
4	35.6	6.70	3	2.12	2.95	26.5	10.68	9	4.17	7.17	32.7	4.87	3	1.45	2.19	31.94	7.84	6	2.08	4.20
5	33.5	6.43	5	1.86	2.60	29.6	7.85	9	2.59	4.03	45.6	4.06	1	0.73	0.83	32.06	8.34	7	2.88	4.63
6	43.9	3.88	1	0.33	0.44	25.1	7.75	5	2.24	3.17	38.5	5.04	3	1.27	2.05	26.59	10.77	13	4.76	7.42
7	38.5	4.83	1	0.63	0.86	-	-	-	-	-	-	-	-	-	-					
8	37.8	4.69	2	0.68	0.98	-	-	-	-	-	-	-	-	-	-					
9	36.1	5.04	2	0.84	1.05	-	-	-	-	-	-	-	-	-	-					
Avg.	36.9	5.38	3	1.15	1.60	28.2	8.78	8	3.03	5.01	37.0	4.84	2	0.96	1.40	33.58	7.10	5.50	2.12	3.55

Note 1: Travel time surveys were conducted along King Street from east of Wellington Street to west of Dundurn Street.
Note 2: Congested time represents the time on each interval the vehicles spent at or below the 20 km/h speed limit. This also includes the stopped time.

Table 20: Midday Peak Period Travel Time and Speed (Before and After Conditions Comparison)

Run	King Street WB Midday Peak (Pre-Installation Runs)					King Street WB Midday Peak (Post-Installation Runs - Month 1)					King Street WB Midday Peak (Post-Installation Runs - Month 3)					King Street WB Midday Peak (Post-Installation Runs - Month 7)				
	Average Speed (km/h)	Travel Time (min)	No. of Stops	Stopped Time (min)	Congested Time (min)	Average Speed (km/h)	Travel Time (min)	No. of Stops	Stopped Time (min)	Congested Time (min)	Average Speed (km/h)	Travel Time (min)	No. of Stops	Stopped Time (min)	Congested Time (min)	Average Speed (km/h)	Travel Time (min)	No. of Stops	Stopped Time (min)	Congested Time (min)
1	30.6	6.69	4	1.32	2.57	22.8	9.51	11	3.18	5.67	30.9	5.87	3	1.31	1.64	31.86	8.08	8	2.63	4.64
2	28.1	6.96	4	1.59	2.56	28.7	7.25	5	2.16	3.02	34.8	5.20	2	1.02	1.33	28.74	8.47	7	2.72	4.71
3	26.2	7.94	5	1.99	3.65	31.6	6.00	4	1.57	1.92	31.7	5.88	2	1.34	1.84	28.73	8.99	8	4.26	6.04
4	28.9	8.07	6	2.12	4.40	25.8	10.50	11	4.93	6.72	33.0	5.83	3	1.40	2.04	25.76	11.51	13	5.09	7.80
5	27.7	8.48	8	2.84	4.41	22.1	11.70	15	5.27	8.27	31.2	5.69	3	1.00	1.58	31.19	12.40	16	6.09	9.37
6	31.6	7.06	8	1.83	3.13	24.6	9.63	14	3.31	6.42	32.9	5.52	2	1.05	1.50	33.57	10.18	12	4.79	6.79
Avg.	28.9	7.53	6	1.95	3.45	25.9	9.10	10	3.40	5.34	32.4	5.67	3	1.19	1.66	29.98	9.94	10.67	4.26	6.56

Note 1: Travel time surveys were conducted along King Street from east of Wellington Street to west of Dundurn Street.
Note 2: Congested time represents the time on each interval the vehicles spent at or below the 20 km/h speed limit. This also includes the stopped time.

Table 21: PM Peak Period Travel Time and Speed (Before and After Conditions Comparison)

Run	King Street WB PM Peak (Pre-Installation Runs)					King Street WB PM Peak (Post-Installation Runs - Month 1)					King Street WB PM Peak (Post-Installation Runs - Month 3)					King Street WB PM Peak (Post-Installation Runs - Month 7)				
	Average Speed (km/h)	Travel Time (min)	No. of Stops	Stopped Time (min)	Congested Time (min)	Average Speed (km/h)	Travel Time (min)	No. of Stops	Stopped Time (min)	Congested Time (min)	Average Speed (km/h)	Travel Time (min)	No. of Stops	Stopped Time (min)	Congested Time (min)	Average Speed (km/h)	Travel Time (min)	No. of Stops	Stopped Time (min)	Congested Time (min)
1	32.4	6.15	4	1.14	2.15	27.0	7.91	5	2.38	3.47	31.2	5.82	2	0.79	1.67	17.93	14.98	20	6.56	11.73
2	30.8	6.81	3	1.83	2.39	21.8	12.15	13	6.22	8.39	25.0	9.73	10	3.79	6.22	21.07	12.47	13	5.53	8.35
3	25.9	8.52	8	2.56	4.47	29.5	9.06	8	3.75	5.25	21.2	11.92	18	5.30	8.11	22.57	11.97	11	4.93	8.08
4	24.8	9.47	13	3.08	7.04	27.4	7.76	6	2.48	3.64	29.7	6.18	2	1.17	2.11	21.43	12.72	11	5.61	8.73
5	39.2	6.01	3	1.91	2.38	32.3	6.00	3	1.45	2.08	23.1	8.67	4	2.56	4.37	21.07	11.38	11	3.91	7.49
Avg.	30.6	7.39	7	2.10	3.69	27.6	8.58	7	3.26	4.57	26.0	8.50	7	2.70	4.50	20.81	12.70	13.20	5.31	8.88

Note 1: Travel time surveys were conducted along King Street from east of Wellington Street to west of Dundurn Street.
Note 2: Congested time represents the time on each interval the vehicles spent at or below the 20 km/h speed limit. This also includes the stopped time.

The Post installation (Month 1) travel times and average speeds on King Street indicate that the worst conditions were experienced during the Midday peak. The congested time experienced is 5.34 minutes. Further details are provided in **Appendices E**.

The Post installation (Month 3) travel times and average speeds on King Street indicate that the worst conditions were experienced during the PM peak The congested time experienced is 4.50 minutes. Further details are provided in **Appendices F**.

The Post installation (Month 7) travel times and average speeds on King Street indicate that the worst conditions were experienced during the PM peak. The congested time experienced is 8.88 minutes. Further details are provided in **Appendices G**.

The travel time data collected throughout the pilot study of RBL on King Street shows that the operation of the RBL impacts the average speed and travel time of general purpose traffic due to increases in stopped and congested time during the AM, Midday and PM peak hours.

3.2. Google Maps Monitoring

Post-installation traffic flow monitoring along the King Street study segment was supplemented using the Google Maps online “live traffic feature”. Google Maps monitoring was conducted during the weekday AM, Midday and PM peak periods at one month, three months and seven months post installation. The King Street study segment extended from east of Wellington Street to west of Dundurn Street.

Google Maps is untested data intended to ensure a breadth of data for comparison purposes. The methodology is uncertain and the data should be used with caution.

The travel times from Google Maps “live traffic feature” are shown in **Table 22**. Detailed travel time screenshots from Google Maps are provided in **Appendix H**.

Based on the results in **Table 22**, the travel times recorded using Google Maps show fairly consistent patterns during the weekday AM, Midday and PM peak periods with the exception of the November 2013 travel times recorded during temporary construction activities on the King Street corridor as noted above. During the January 2014 PM peak period, one high travel time was recorded; however, the cause of congestion is not known.

The uncongested travel time in Google Maps along the King Street West study segment is 5 minutes. However, it should be noted that the uncongested travel time is for off peak time periods rather than pre-installation peak periods travel time. The results indicate that the average post RBL implementation travel times during the three peak periods are generally 2 to 3 minutes higher compared to the off peak travel time of 5 minutes.

Table 22: Google Maps Monitored Travel Time

Time	Travel Time from Google Maps (minutes)														
	Post –installation Month 1 (2013) – 30 minute interval					Post –installation Month 3 (2014) – 60 minute interval					Post –installation Month 7 (2014) – 60 minute interval				
	Nov 1	Nov 4	Nov 5	Nov 6	Nov 7	Jan 27	Jan 28	Jan 29	Jan 30	Jan 31	May 12	May 13	May 14	May 15	May 16
AM Peak Period															
8:00	6	6	6	6	6	6	6	7	6	6	6	6	7	6	6
8:30	6	6	8	6	7	-	-	-	-	-					
9:00	6	7	7	7	6	7	7	6	6	8	7	8	10	9	5
9:30	6	6	6	6	6	-	-	-	-	-					
Average	6	6.25	6.75	6.25	6.25	6.50	6.50	6.50	6	7	6.5	7	8.5	7.5	5.5
Midday Peak Period															
11:00	-	-	-	-	-	6	10	6	7	6	7	6	7	8	7
12:00	7	6	10*	7	7	7	7	7	7	8	8	8	9	11	8
12:30	8	6	12*	7	7	-	-	-	-	-					
13:00	8	7	8	7	7	7	7	7	8	8	7	15	9	9	11
13:30	7	7	7	7	8	-	-	-	-	-					
14:00	8	7	7	7	7	-	-	-	-	-					
Average	7.60	6.60	7.33	7.00	7.20	6.67	8.00	6.67	7.33	7.33	7.33	9.66	8.33	9.33	8.66
PM Peak Period															
15:00	-	-	-	-	-	6	7	9	7	8	10	9	9	10	11
16:00	9	6	7	7	7	6	6	7	6	8	8	8	11	9	10
16:30	8	6	7	8	7	-	-	-	-	-					
17:00	8	6	8	8	7	7	7	15**	9	8	9	8	9	12	10
17:30	7	6	7	9	7	-	-	-	-	-					
18:00	6	6	6	6	6	6	6	7	6	7	7	6	8	12	9
Average	7.60	6.00	7.00	7.60	6.80	6.25	6.50	9.50	7.00	7.75	8.5	7.75	9.25	10.75	10

*Travel times recorded during construction activities along the King Street corridor not included in average travel time calculation

** Travel time congestion cause not known (occurred during 2-hour period from 16:00 to 18:00) and included in average travel time calculation

3.3. Queue Observation

Queue clearance observations during the weekday AM and PM peak periods were conducted by City staff following the implementation of the RBL in the segment of King Street between Mary Street and James Street, where queues appeared to be most problematic. The observations were conducted during three monitoring periods – Post-install Month 1, Post-install Month 3, and Post-install Month 7. As noted previously, the RBL was opened on Wednesday October 23, 2013. The queue clearance observations recorded what percent of traffic in a queue did not clear the intersection on the first cycle of green time. The dates of the queue observations are summarized in **Table 23**. Some of the latter observations also included notes regarding the level of adherence to the RBL by drivers. This additional data is also summarized in this Section.

Table 23: Queue Observation Dates

Segment	Monitoring Period	Survey Date
King Street (between Mary Street and James Street)	Post –Installation Month 1	Friday October 25, 2013
		Monday October 28, 2013
		Tuesday October 29, 2013
		Monday November 4, 2013
		Tuesday November 5, 2013
	Post –Installation Month 3	Wednesday February 19, 2014
		Monday February 24, 2014
		Monday February 25, 2014
		Monday February 26, 2014
	Post –Installation Month 7	Monday June 16, 2014
		Tuesday June 17, 2014
		Thursday July 24, 2014

Queues were observed at the westbound approaches for each of the five signalized intersections between Mary Street and James Street. At each of these intersections, approximately 10% of queues were observed during the peak periods when the data was being collected as the person collecting the data circulated between the five intersections. Additionally, the northbound approach at John Street was also surveyed. A summary of the queue observations is provided in **Table 24**,
Table 25 and **Table 26**.

Table 24: Queue Observation Summary – Post-Installation Month 1

Intersection at King Street	AM Peak Period Queues			PM Peak Period Queues		
	Total Cycles	No. of Cycles with Residual Queues	% of Cycles with Residual Queues	Total Cycles	No. of Cycles with Residual Queues	% of Cycles with Residual Queues
Catherine Street	67	21	31%	86	33	38%
Hughson Street	64	10	16%	88	13	15%
James Street	32	3	9%	44	8	18%
John Street	68	32	47%	88	60	68%
John Street NB	68	1	1%	88	1	1%
Mary Street	42	13	31%	50	19	38%
Grand Total	341	80	23%	444	134	30%

Table 25: Queue Observation Summary – Post-Installation Month 3

Intersection at King Street	AM Peak Period Queues			PM Peak Period Queues		
	Total Cycles	No. of Cycles with Residual Queues	% of Cycles with Residual Queues	Total Cycles	No. of Cycles with Residual Queues	% of Cycles with Residual Queues
Catherine Street	28	0	0%	29	0	0%
Hughson Street	26	0	0%	31	1	3%
James Street	14	0	0%	16	0	0%
John Street	28	0	0%	35	1	3%
John Street NB	14	0	0%	16	0	0%
Mary Street	16	0	0%	19	0	0%
Grand Total	126	0	0%	146	2	1%

Table 26: Queue Observation Summary – Post-Installation Month 7

Intersection at King Street	AM Peak Period Queues			Midday Peak Period Queues			PM Peak Period Queues		
	Total Cycles	No. of Cycles with Residual Queues	% of Cycles with Residual Queues	Total Cycles	No. of Cycles with Residual Queues	% of Cycles with Residual Queues	Total Cycles	No. of Cycles with Residual Queues	% of Cycles with Residual Queues
Catherine Street	16	2	13%	14	0	0%	18	0	0%
Hughson Street	16	2	13%	14	0	0%	18	1	6%
James Street	16	0	0%	15	0	0%	20	5	25%
John Street	16	5	31%	14	6	43%	18	12	67%
John Street NB	16	0	0%	14	0	0%	18	0	0%
Mary Street	8	1	11%	8	0	8%	10	0	0%
Grand Total	88	10	11%	79	6	0%	102	18	18%

Post-installation (Month 1) observations had the highest rates of residual queues, thus they demonstrated the largest delays to auto traffic. It is expected that the largest delays would be during the initial installation period as auto traffic has not yet had an opportunity to rebalance itself through the network, adjusting times and routing of trips to avoid congestion. The highest rate observed was for westbound traffic approaching John St, with 47% of queues not clearing on the first cycle during the AM peak hour and 68% of queues not clearing on the first cycle during the PM peak hour. Other notable residual queues of 30% to 40% were noted during both the AM and PM peak periods at Catharine Street and Mary Street, demonstrating that the John Street intersection was a critical bottleneck. No data was collected regarding adherence, but it was noted that adherence to the RBL regulations appeared to be good.

Post-installation (Month 3) observations had the lowest rates of residual queues, thus they demonstrated minimal delays to auto traffic. It is recognized that residual queues were lowest during this monitoring period due to rebalanced auto traffic (adjusting times and routing of trips to avoid congestion) combined with the faded pavement markings. It is suggested that the faded pavement markings resulted in drivers adhering to the RBL regulations less strictly. Virtually zero residual queues were noted – only two queues of the over 300 queues observed. Observations of adherence to RBL regulations show that adherence was low. Of the 53 AM queues observed, 68% had auto traffic in the RBL and during the PM, 91% of the 32 queues observed included auto traffic in the RBL. Many of these queues in the RBL, approximately 30%, were three or more vehicles in length.

Post-installation (Month 7) observations demonstrate that auto traffic is rebalancing itself (adjusting times and routing of trips to avoid congestion). Midday queue data was also collected to further investigate the King Street traffic operations. John Street continues to be the intersection approach (westbound) with the highest rates of residual queues. These rates are 31% during the AM peak, 43% during the Midday peak, and 67% during the PM peak period. James Street westbound queues are also significant during the PM peak period, with 25% of queues observed having a residual queue that did not clear the intersection during the first green phase. All other rates were observed to be less than 15%.

Post-installation (Month 7) observations of adherence to the RBL regulations were much reduced from Post-installation (Month 3) observations. Auto traffic in Month 3 was observed violating the RBL regulation in 19% of AM queues, 14% of Midday queues, and 19% of PM queues. The Post-installation (Month 7) observations of autos queues in the RBL (violations) of three or more vehicles in length was only 1% of all queue observations.

3.4. Summary of Findings

Travel time and average speed data recorded on King Street during the AM, Midday and PM peak periods shows travel time increases of between 2 to 5 minutes and average speeds dropping as low as 20 km/hr.

As previously stated the Google Maps data and methodology is untested and should be used cautiously, however it does show the King Street corridor experiencing delay during the AM, Midday and PM peak periods.

The queuing observations data collection post install month 1, 3 and 7 shows that residual queuing was present after the install of the RBL, the lowest level of residual queuing was recorded 3 months after the install however driver adherence to the RBL was low during this period. The post install month 7 queue observations note residual queuing occurring at King Street and John / James Street intersections. RBL violation was recorded to be far less than recorded post install month and 3.

4.0 Literature Review - North American Transit Only Lanes

An online literature review was conducted to identify any associated impact to existing businesses post implementation of a transit only lane (TOL) through a commercial area. The review focused on projects where mixed traffic lanes were converted to dedicated bus lanes through the downtown of North American municipalities rather than a widening of the roadway to create an additional lane for transit only.

This online review was conducted using various sources including the Transportation Research Board's (TRB) Transportation Research International Documentation (TRID). TRID is an integrated database that contains records from both TRB and International Transport Research Documentation (ITRD). The search also looked at the National BRT Institute (www.nbrti.org) and the Center for Urban Transportation Research (CUTR) and www.cutr.usf.edu.

The online search revealed that numerous evaluation studies were completed which measure transit performance such as travel time and reliability; however, limited publications were sourced from the online search where the economic impact of the TOL on local businesses in a commercial area was evaluated.

The key findings from the online literature are documented below.

4.1. Schaller et al. (2013), The Economic Benefit of Sustainable Streets

A study by Schaller et al. (2013) developed a methodology to evaluate the economic impact of street design improvements including transit only lanes on neighbourhoods in New York City. The study was commissioned by the New York City Department of Transportation (DOT) with input from the New York City Department of Finance (DOF).

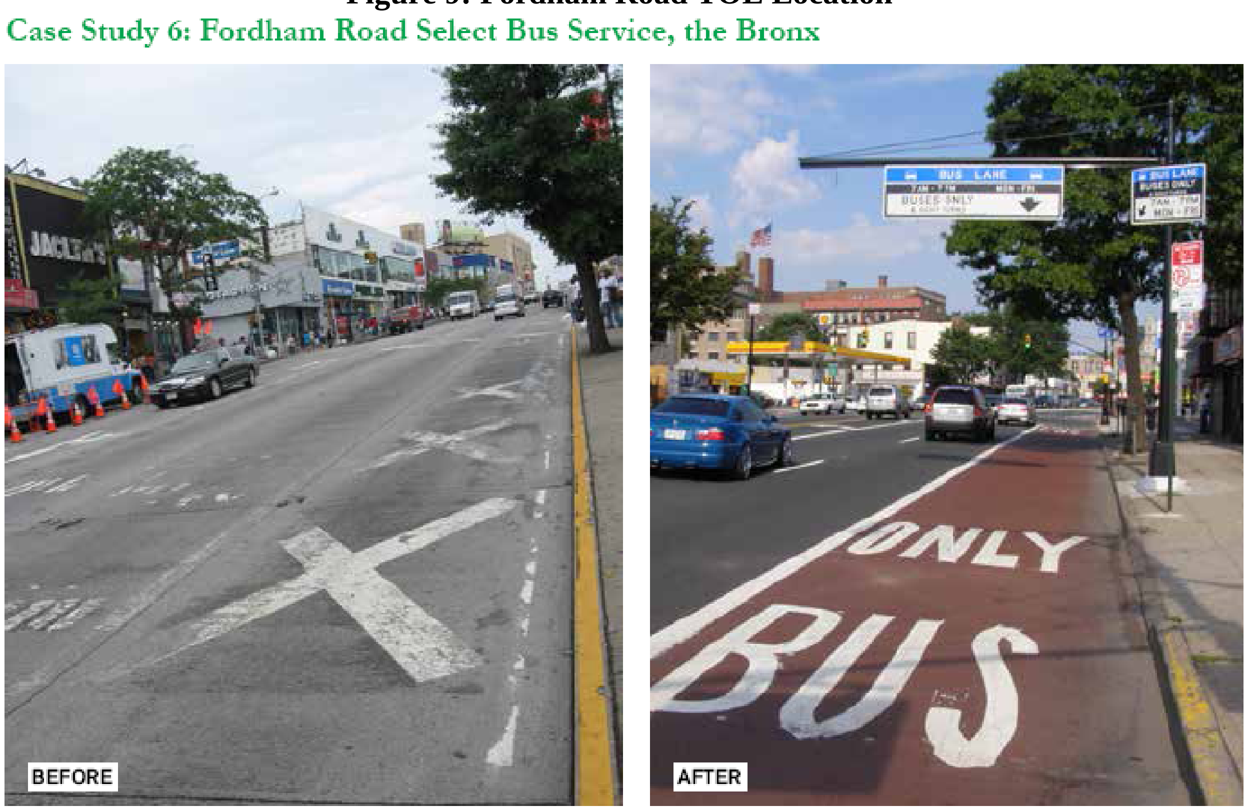
The project team considered several data sources to evaluate economic impact to businesses and found that retail sales to be the most reliable and direct indicator. Retail sales data for street-level retail and restaurant/food service businesses was obtained from New York sales tax data provided by the DOF. The DOF is responsible for the collection of sales tax in New York City. A majority of the businesses included in the analysis are local small stores (mom-and-pop stores) and independently operated franchises.

To evaluate the impact to businesses using retail sales data sales, businesses impacted by the street design improvements were identified along with businesses from comparison sites. The comparison sites chosen have similar characteristics to the impacted/improvement site. It is important that the comparison sites have similar characteristics to the improvement site since this will isolate site-specific differences.

The changes in retail sales before and after implementation were compared for the improvement site and the comparison sites. The evaluation time periods for the improvement sites (and their comparison sites) were identified based on the dates of project implementation. A baseline ("before") period was considered to be the four quarters (one year) prior to the implementation while the post-improvement ("after") period was defined to be the twelve quarters (three years) after the improvement was implemented.

The study documented several case studies which evaluated the impact of street design improvements on the economic health of local businesses. The Fordham Road Select Bus Service case study is the most relevant, since the street design improvement provided a dedicated bus lane from the Inwood neighbourhood in Manhattan to Co-Op City in the Bronx. **Figure 9** shows the urban make up of the corridor around the Fordham Road route similar to that found in Hamilton.

Figure 9: Fordham Road TOL Location



Source: Schaller et al. (2013)

Given the size of the Fordham Road Select Bus Service route, the analysis focused on a dense retail corridor along a five block segment between two busy north/south avenues. Changes in retail sales for the improvement site were compared to changes recorded at four comparison sites.

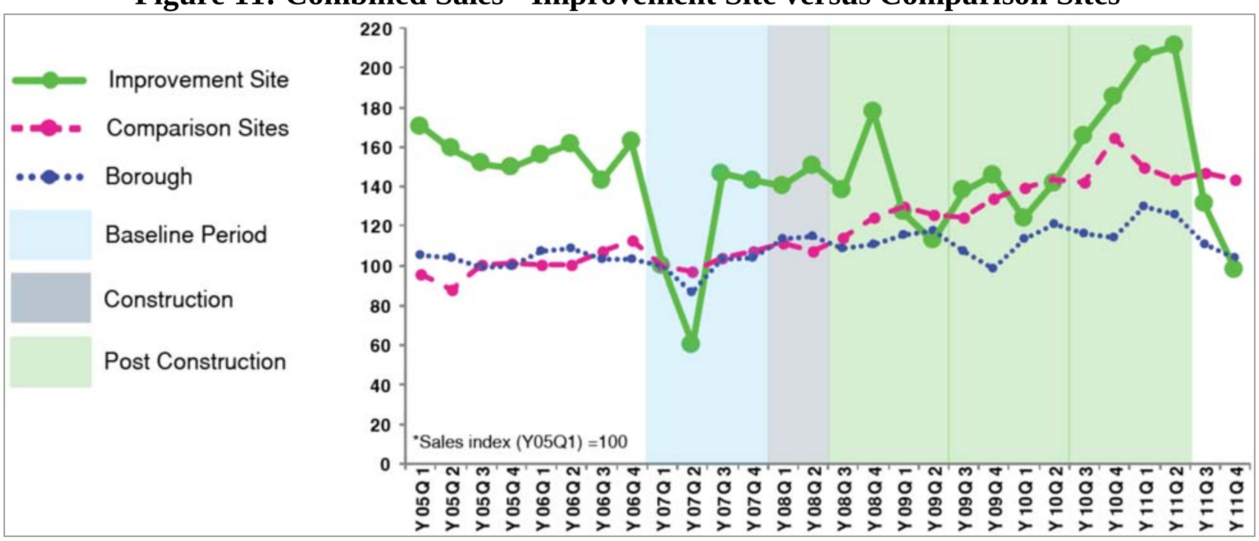
The results from the business sales analysis indicated that the improvement site showed strong performance where sales rose consistently in each of the three years post implementation of the dedicated transit only lane. In the third year post implementation business sales increased by 71% compared to the baseline. The recorded increases in retail sales occurred even though parking was prohibited during peak periods; a major issue for local businesses before implementation. It is noted that there was a decline in sales during the baseline period and at the end of the 3 year post implementation period; however, in general, the improvement site performed better than three of the four comparison sites as shown in **Figure 10**. A combined sales comparison between the improvement site, Bronx Borough and the comparison sites is illustrated in **Figure 11**.

Figure 10: Changes in Baseline and Post Improvement Sales

Area	Baseline Quarterly Sales	Δ Sales Post-Improvement		
Improvement Site		1st Year	2nd Year	3rd Year
Bx12	$ 7,439,735	24%	22%	71%
Borough				
Bronx	$ 362,097,700	15%	12%	23%
Neighborhood Comparisons				
Average	$ 1,328,357	16%	25%	38%
Kingsbridge	$ 2,735,121	-24%	-36%	-34%
Grand Concourse	$ 661,370	22%	43%	51%
Jerome	$ 504,943	46%	71%	96%
Webster	$ 1,411,994	21%	24%	39%

Source: Schaller et al. (2013)

Figure 11: Combined Sales - Improvement Site versus Comparison Sites



Source: Schaller et al. (2013)

4.2. NCHRP Research Results Digest 336 (2009)

The NCHRP Research Results Digest 336 (2009) documents the findings from Task 21 of NCHRP Project 20-65. Task 21 researched the cost benefit of converting a mixed flow travel lane to a lane for bus rapid transit (BRT).

The research comprised of a detailed literature review of BRT projects to identify candidate projects, evaluation criteria for BRT proposals, and benefit/cost approaches. The research team also conducted interviews with BRT project representatives.

Based on a review of BRT systems worldwide, the research team identified thirty-eight (38) BRT projects of significance. However, the team noted that converting mixed-flow traffic lanes for exclusive transit use was not the norm and the list was reduced to six (6) locations where a mixed-flow traffic lane was converted to transit only lane. All other locations added new lanes or used parking lanes during peak period travel to accommodate BRT.

Interviews conducted with the agencies of the shortlisted six locations confirmed that only two (2) locations converted a mixed-flow traffic lane to transit only lane for BRT. These two locations were: Cleveland, OH (operational in 2008) and Eugene, OR (operational in 2007).

The study noted that increased economic activity resulting from the conversion of a mixed-flow traffic lane to BRT only is considered an indirect benefit and may be omitted from the evaluation process by agencies since it is often difficult to measure. The impact on adjacent mixed-flow lanes traffic operations due to the conversion is an important consideration for most agencies.

Cleveland, OH conducted an evaluation study for the mixed-flow lane conversion to BRT only. The evaluation study included forecasts for economic developments and land use analysis. The results show that redevelopment targets were surpassed at the time of evaluation and developments in some areas were stabilised; however, a breakdown for the downtown core is not provided in the literature.

Eugene, OR reported that impacts to surrounding development did not meet the levels anticipated since developers were a bit nervous to invest as BRT ridership is less certain than rail. The study did not specify the location of the developments.

4.3. Nelson et al. (2013), Bus Rapid Transit and Economic Development: Case Study of the Eugene-Springfield BRT System

Nelson et al. (2013) conducted a study to evaluate economic performance in metropolitan Eugene-Springfield, OR following the implementation of a BRT system. The study looked at change in share of jobs in an urban area and determined if there is a relationship between this change and the implementation of a BRT system.

The analysis using employment data covered a three year period before and after implementation of the BRT system. The construction for the BRT system called EmX started in 2004 and began operation in 2007. The first EmX route connected downtown Eugene with Springfield, Oregon and converted mixed-flow traffic lane to BRT only lane.

The EmX BRT system was evaluated based on its economic development outcomes in terms of employment change within 0.25 and 0.50 miles (400 and 800 m) of BRT stations. The employment data came from the Local Employment Dynamics (LED) database. LED data are assembled by the Census Bureau through a voluntary partnership among 45 states. The data provide details about jobs, workers, and the structure of local economies.

The study found that jobs stayed around the same level between 400 and 800 metres from BRT station areas. Jobs increased by around 10% within 400 metres from BRT stations while jobs beyond 800 metres from stations fell about 5%.

While some job types increased more than others closer to BRT station locations, the study could not conclude that there is a cause-and-effect relationship between station proximity and job types. The study did not provide a breakdown for the downtown core.

4.4. Schimek et al. (2005), Boston Silver Line Washington Street BRT Demonstration Project Evaluation

The Schimek et al. (2005) report provides a detailed evaluation of the first phase of Silver Line Washington Street BRT which began operation in July 2002. The BRT was evaluated based on the system performance including travel time, reliability, identity and image, safety and security, and capacity. The report also assessed system benefits including higher ridership, capital costs effectiveness, operating cost efficiency, transit-supportive land development, and environmental quality. It is indicated in the report that one of the BRT initiative's goals is to provide positive impacts on local businesses. However, the report does not evaluate any impacts on businesses specifically.

4.5. Summary of Literature Review Findings

The majority of the available online literature for transit only lane post implementation evaluation do not consider economic impact as a direct measure due to difficulty in quantifying this impact in a robust and defendable manner. Most studies will measure improvements in transit travel time and reliability and congestion impacts to mixed-flow traffic lanes.

The most robust study to measure economic impact on businesses through a downtown core was conducted by Schaller et al. (2013) for the New York City Department of Transportation. This study used sales tax data to evaluate the economic impact on businesses and concluded that the conversion of a mixed-flow traffic lane transit only lane resulted in sales growth over a three year post implementation period.

Nelson et al. (2013) concluded that BRT through a metropolitan area resulted in job growth, including a 4% growth in the retail sector, for areas within 400 m (walking distance) from BRT stations.

Other studies reviewed looked at the impact of transit only lanes attracting development to transit oriented development (TOD) and not at the impact on existing businesses.

It is recommended that a survey be conducted for transit agencies which converted mixed-traffic flow lane to transit only lane through a commercial corridor for additional information on the impact to businesses and results are in section 4.7.

4.6. Other Studies

The literature review looked at several other studies (listed in **Section 5.3)**. These studies did not evaluate impacts of BRT on local businesses. Topics discussed in these studies include information regarding the design, change in ridership and travel time before and after, enforcement, and system costs.

5.0 North American Transit Agency and City Survey

Based on the literature review, several potential North American transit agencies were identified for a telephone survey to obtain additional information on the impact on transit only lanes to businesses in a downtown core. A list of the potential transit agencies and the corresponding transit project recommended for the telephone survey is provided in **Table 27**.

Table 27: North American Transit Agencies for Survey

Agency	Transit Project
City of Toronto	W.R. Allen Road RBL and Various Streetcar routes
City of Ottawa	Albert Street, Slater Street, Rideau Street and Montreal Road
Greater Cleveland Regional Transit Authority	HealthLine (Euclid Corridor, Cleveland, OH)
Lane Transit District (Eugene, OR)	EmX Line (Franklin Corridor, Eugene, OR)
Tri Met (Portland, OR)	The Portland Transit Mall (downtown Portland, OR)
Metropolitan Transit Authority of Harris County (Houston, TX)	Downtown Transit Route, Houston, TX
City of Seattle	Downtown Seattle, WA
Translink (Vancouver, BC)	Marine Drive Bus Lane, West Vancouver, BC
Edmonton Transit System	Various Bus lanes, Edmonton, AB
San Francisco Municipal Transport Agency	Various Bus lanes, San Francisco, CA

5.1. North American Transit Agency and City Survey

A survey was developed for the North American transit agencies that operate a similar facility to what the city is piloting. The survey is aimed at obtaining additional information regarding the impact on existing businesses from converting a mixed-flow traffic lane to transit only lane through a downtown core.

The survey was sent to the transit agencies via email with responses to the questions below being sent back via email. The questions are:

a) Can you please confirm that you have a transit route through a commercial area which operates on a transit only lane?

b) Did you convert a mixed-flow traffic lane to become a transit only lane? Or did you provide an additional lane for transit (construct a new lane or convert a parking lane to transit lane during peak periods?)

c) Were parking spaces and/or loading areas reduced, relocated or modified due to the implementation of the transit only lane?

d) Did you evaluate the impact to existing businesses following the implementation of the transit only lane? If yes, did you carry out a formal data driven analysis (e.g. using sales data, business closures and economic transition data) or was a survey of business owners conducted?

e) Can you please provide a brief summary of your findings regarding the impact to existing businesses?

5.2. North American Transit Agency and City Survey Findings

Table 28 below summarizes the transit agencies responses to the survey in a matrix form with further details summarized beyond this table and **Appendix I** along with transit agency contact information.

Table 28: North American Transit Agencies Answers Matrix

	Toronto, ON	Ottawa, ON	Cleveland, OH	Eugene, OR	Portland, OR	Seattle, WA	Vancouver, BC	Edmonton, AB	San Francisco, CA
a) Can you please confirm that you have a transit route through a commercial area which operates on a transit only lane?	Y	Y	Y	Y	Y	Y	Y	Y	Y
b) Did you convert a mixed-flow traffic lane to become a transit only lane? Or did you provide an additional lane for transit (construct a new lane or convert a parking lane to transit lane during peak periods?)	Y	Y	Y	Y	Y	Y	Y	Y	Y
c) Were parking spaces and/or loading areas reduced, relocated or modified due to the implementation of the transit only lane?	N	Y	Y	Y	Y	Y	N	Y	Y
d) Did you evaluate the impact to existing businesses following the implementation of the transit only lane? If yes, did you carry out a formal data driven analysis (e.g. using sales data, business closures and economic transition data) or was a survey of business owners conducted?	N	N	N	Y	Y	N	N	N	Y
e) Can you please provide a brief summary of your findings regarding the impact to existing businesses?	N	N	N	Y	Y	N	N	N	Y

City of Toronto, Nazzareno Capano, Manager of Transportation Infrastructure Management – Operational Planning and Policy.

The City of Toronto operates a number of transit only facilities within the City:

- Allen Road Bus Only Lane;
- Spadina Avenue Streetcar;
- St Clair Avenue Streetcar; and
- Queens Quay Streetcar;

An HOV lane was converted to create the Bus Only Lane. A general purpose traffic lane was converted to provide the streetcars with their own dedicated ROW. Parking was restricted during the construction of the dedicated ROW. Businesses were impacted during the construction of the dedicated ROWs but everything returned to normal activity once construction was complete.

City of Ottawa, Colin Leech, Senior Engineer, Transit Priority

Ottawa has two locations where in the downtown-commercial area Rideau Street / Montreal Road and Albert / Slater Street. Other Bus Only Lanes exist on suburban arterials and highways. Theses bus lanes were created through lane conversation, with many areas of parking/loading reduced or modified to accommodate the bus lanes. In Vanier bus lanes operate in the peak direction allowing the public to park in the off peak direction to access shops and local businesses.

Greater Cleveland Regional Transit Authority, Michael Schipper

The Healthline BRT runs in the center of the street downtown on Euclid Avenue, a general purpose traffic lane was converted. On street parking was reorganized and grouped to maintain most of the existing parking allocation whilst also creating larger sidewalks for outdoor dining. The downtown transit zone has a 24 hours day bus only lane on Superior Avenue with a general purpose traffic lane being converted and parking reorganized in the vicinity of hotels, a peak hour bus lane on St Clair was.

There was no formal study into business impact on Euclid Avenue, local businesses reported that during construction they lost up to 30% of there gross sales. The Healthline has seen over $5 billion of construction along its entire length since it opened.

Lane Transit District (LTD), Dan Tutt, Planning and Development Department

LTD's EmX has a BRT system that operates in general purpose traffic lanes and a variety of lane types including transitways, curbed lanes which are not traversable by general traffic. The EmX also runs in exclusive curb side and median transit lanes which are traversable. The EmX also runs in BAT Lanes (Business Access and Transit) accommodating right and left turning general traffic. Parking has been replaced by the transit lanes in certain areas, as part of the environmental review process parking utilization studies was undertaken and the removal of parking has been strategic in lower demand areas were other parking is available.

Trimet, Alan Lehto, Director of Planning and Policy

Trimet operates transit only lanes SW 5th and SW 6th Avenues serving north-south through the heart of downtown business district. Two general purpose traffic lanes were converted to create the transit only lanes. Parking was reduced from most curbs with exceptions to area where businesses (such as hotels) needed short term parking. Over the past five years since construction work has been completed on the transit mall substantial new development and redevelopment has occurred. Construction is always an impact to businesses; we have provided programs and small business assistance to minimize impacts.

Metropolitan Transit Authority of Harris County

A response to the survey was not received from the Metropolitan Transit Authority of Harris County.

City of Seattle Department of Transportation, Bill Bryant, Manager Transit System Development

The City of Seattle confirmed that they have several transit only lanes in commercial areas. These lanes were provided by converting a general purpose lane or provide an additional lane through new construction or peak hour parking restrictions. Parking spaces and / or loading areas were reduced, relocated or modified to facilitate the implementation of the transit only lanes. The City of Seattle did not evaluate the impact to local businesses before or after the implementation of the transit only lanes.

Translink, South Coast British Columbia Transportation Authority, Rachel Jamieson, Senior Transportation Engineer

The Marine Drive bus lanes are a queue jumper to the Lions Gate bridge from both the east and west, and a bus lane in front of a shopping mall with off street parking. We converted a right turn only lane to a right turn and bus lane and widened the street to provide a bus queue jump lane and a transit priority signal at a busy intersection approaching the Lion's Gate Bridge from the west. We removed a left turn lane, banned left turns and restriped Marine Drive on a section approaching the Lions Gate Bridge from the east. The local businesses have off street parking.

City of Edmonton, Jim Bryant, General Supervisor of Development and Technical Review, Edmonton Transit

Edmonton operates Bus Only Lanes on Jasper Avenue, 109 Street and 97 Street in the downtown area. Edmonton has converted general purpose traffic lanes and where feasible they add an additional lane. Parking spaces and / or loading areas were reduced, relocated or modified in the west downtown area. No significant business impact analysis was performed as our main objective was to address bus delays due to traffic congestion. The impact to parking was not considered of great impact as parking capacity was still maintained during off-peak time periods. Edmonton transit plans to engage the public over future bus lane plans in more mature areas of the city.

City of San Francisco, Lulu Feliciano, Outreach Manager, San Francisco Municipal Transportation Agency (SFMTA)

SFMTA runs a transit only lane on Market Street which forms the backbone of the city's transit network. Geary Boulevard also operates a transit only lane which has a different surface color (Red) to the other general purpose traffic lanes to remind the public it is transit only. SFMTA has not recently converted a general purpose traffic lane and plans to construct an additional lane for the Van Ness rapid transit. Parking spaces and / or loading areas were reduced, relocated or modified for the Van Ness rapid transit. An evaluation of impact to existing businesses was carried out in the planning and EIR phase.

Transit Survey Records and Contact Lists are provided in **Appendix I**.

5.3. North American Literature Review References

Agrawal, A. W., Goldman, T. and Hannaford, N., *Shared-Use Bus Priority Lanes on City Streets: Case Studies in Design and Management*, Report 11-10, Mineta Transportation Institute, San Jose State University, CA, April 2012. Website accessed February 2014, http://transweb.sjsu.edu/PDFs/research/2606-shared-use-bus-priority-lanes-city-streets.pdf

American Association of State Highway and Transportation Officials (AASHTO), *Effective Practices for Congestion Management: Final Report*, Cambridge Systematics, Inc., NCHRP Project 20-24A, Task 63, MA, November 2008. Website accessed 2014, http://onlinepubs.trb.org/onlinepubs/archive/NotesDocs/20-24(63)_FR.pdf

Ffrench, K., Pessaro, B., Dowell, M., Gonzales, M. and Danaher, A. R., *Bus Rapid Transit Applications Phase 2*, Florida Department of Transportation, District IV, December 2011. Website accessed February 2014, http://www.nbrti.org/docs/pdf/BRT_Applications_PhaseII_Report_Final12-08-2011.pdf

Hillsman, E. L., Hendricks, S., Fiebe, J. K., Volinski, J., Winters, P. L., O'Hagan, D. C. and Koos, M., *A Summary of Design, Policies and Operational Characteristics for Shared Bicycle/Bus Lanes*, Florida Department of Transportation Research Centre, Tallahassee, FL, July 2012. Website accessed February 2014, http://www.nctr.usf.edu/wp-content/uploads/2012/11/77937.pdf

Hook, W., Lotshaw, S. and Weinstock, A., *More Development for Your Transit Dollar – An Analysis of 21 North American Transit Corridors*, Institute for Transportation and Development Policy (ITDP), New York, NY. Website accessed February 2014, http://www.itdp.org/documents/ITDP_MORE_DEVELOPMENT_924.pdf

Li, Y. I., Li, J., Miller, M. A. and Zhang, W., Assess the Trade-Offs between People Through-put and Level of Service Degradation in the Conversion of a Mixed Flow Lane to a Bus Only Lane on US 101, California Path Program, Institute of Transportation Studies, University of California, Berkeley, May 2011. Website accessed February 2014, http://www.path.berkeley.edu/PATH/Publications/PDF/PRR/2011/PRR-2011-03.pdf

Miller, M. A., *Bus Lanes/Bus Rapid Transit Systems on Highways: Review of the Literature*, Institute of Transportation Studies, California Path Program, University of California, Berkeley, January 2009. Website accessed February 2014, http://www.path.berkeley.edu/PATH/Publications/PDF/PWP/2009/PWP-2009-01.pdf

National Cooperative Highway Research Program (NCHRP) – Research Results Digest 336, *Benefit/Cost Analysis of Converting a Lane for Bus Rapid Transit*, Transportation Research Board (TRB), Washington, DC, June 2009. Website accessed February 2014, http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rrd_336.pdf

National Cooperative Highway Research Program (NCHRP) – Research Results Digest 352, *Benefit/Cost Analysis of Converting a Lane for Bus Rapid Transit – Phase II Evaluation and*

Methodology, Transportation Research Board (TRB), Washington, DC, April 2011. Website accessed February 2014. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rrd_352.pdf

Nelson, A. C, Appleyard, B., Kannan, S., Ewing, R., Miller, M. and Eskic, D., *Bus Rapid Transit and Economic Development: Case Study of the Eugene-Springfield BRT System*, Metropolitan Research Center, University of Utah, 2013. Website accessed February 2014, http://www.arch.utah.edu/cgi-bin/wordpress-metroresearch/wp-content/uploads/2012/publications/reports/Nelson_final.pdf

Schaller, B., Maguire, T., Flynn, M., Quinn, S., Nedeljkovic, I., DeCrescenzo, E., Barber, G., Lee, E. S., Sprung, B., Stefanik, S., Lau, M., Schlain, K., Robinson, S. and Sukach, L., *The Economic Benefits of Sustainable Streets*, New York City and Bennett Midland, New York City Department of Transportation (NY DOT), 2013. Website accessed February 2014, http://www.infrastructureusa.org/the-economic-benefits-of-sustainable-streets/

Schimek, P., Darido, G. and Schneck, D., Boston Silver Line Washington Street BRT Demonstration Project Evaluation, Federal Transit Administration, U.S. Department of Transportation, Washington, DC, September 2005. Website accessed February 2014, www.nbrti.org (report saved under Evaluate link)

6.0 Conclusion and Recommendations

- This report summarizes the traffic and travel time monitoring analysis undertaken as part of the implementation of a Reserved Bus Lane on King Street in the City of Hamilton as a one year pilot project.
- The results of the traffic analysis indicate that most movements within the study area are operating at acceptable LOS during the peak periods analyzed except for some movements at James Street and at Queen Street.
- Post-installation (Month 7) observations demonstrate that auto traffic is rebalancing itself (adjusting times and routing of trips to avoid congestion). John Street continues to be the intersection approach (westbound) with the highest rates of residual queues at all time periods and James Street westbound queues are also significant during the PM peak period.
- The deployment of scenario 3 benefits public transit riders and may also improve conditions for vehicles in the general purpose through lanes at King Street and James Street as buses will not be required to weave from the RBL to position themselves to successfully turn into MacNab transit terminal.
- The travel time analysis and monitoring confirms that implementation of the RBL has increased travel times along King Street corridor by approximately 2 minutes during AM and Midday peak periods and by approximately 5 minutes in PM peak period. This should be compared to potentially improved transit times experienced by services that use the RBL given the significant transit ridership along King Street corridor.
- There are a number of similar facilities in operation across North America, some have been in place for many years and others installed more recently. The literature review indicates existing RBLs across North America with minimal documentation of impacts to adjacent businesses.

APPENDIX A
Existing Operational Analysis

<u>NOTE:</u>

APPENDIX NOT INCLUDED DUE TO VOLUME

APPENDIX B
Month Three Operational Analysis

NOTE:

APPENDIX NOT INCLUDED DUE TO VOLUME

APPENDIX C
Month Seven Operational Analysis

NOTE:

APPENDIX NOT INCLUDED DUE TO VOLUME

APPENDIX D
Travel Time Runs Existing

NOTE:

APPENDIX NOT INCLUDED DUE TO VOLUME

APPENDIX E
Travel Time Runs Month One

NOTE:

APPENDIX NOT INCLUDED DUE TO VOLUME

APPENDIX F
Travel Time Runs Month Three

NOTE:

APPENDIX NOT INCLUDED DUE TO VOLUME

APPENDIX G
Travel Time Runs Month Seven

NOTE:

APPENDIX NOT INCLUDED DUE TO VOLUME

APPENDIX H
Google Maps Travel Time Monitoring

NOTE:

APPENDIX NOT INCLUDED DUE TO VOLUME

APPENDIX I
Transit Agency Surveys And Contacts

North American Transit Agency Survey Responses and Contact Details

1.Can you please confirm that you have a transit route through a commercial area which operates on a transit only lane?

2.Did you convert a mixed-flow traffic lane to become a transit only lane? Or did you provide an additional lane for transit (construct a new lane or convert a parking lane to transit lane during peak periods)?

3.Were parking spaces and/or loading areas reduced, relocated or modified due to the implementation of the transit only lane?

4.Did you evaluate the impact to existing businesses following the implementation of the transit only lane? If yes, did you carry out a formal data driven analysis (e.g. using sales data, business closures and economic transition data) or was a survey of business owners conducted?

5.Can you please provide a brief summary of your findings regarding the impact to existing businesses?

City of Toronto

Nazzareno Capano, Manager of Transportation Infrastructure Management – Operational Planning & Policy, ncapano@toronto.ca , 416 392 5348

The city of Toronto has a number of transit only facilities.

Bus Only Lane Allen Road northbound north of Sheppard Avenue to just north Finch Avenue were it meets the York University Busway
St Clair Avenue Streetcar
Spadina Avenue Streetcar
Queens Quay Streetcar

Bus Only Lane on Allen Road North was converted from a HOV Lane

Streetcars went from mixed flow lanes to dedicated ROW's

Parking was restricted during the construction of the dedicated streetcar ROW's

No evaluation of business impacts

During construction businesses were impacted but once construction was finished business as usual.

City of Ottawa

City of Ottawa, Colin Leech, Colin.Leech@Ottawa.ca Senior Engineer, Transit Priority

Question 1:

Yes, we do have two locations where bus lanes are in operation on streets in a "downtown-commercial" context: Rideau St./Montreal Road, and Albert/Slater St. We also have several bus lanes on suburban arterial roads and on highways. The context of each is as follows:

Rideau St. is a traditional "main street" arterial in the core of downtown Ottawa with individual stores facing the street as well as larger developments. Rideau St. continues east of the Rideau River as Montreal Road where the street serves a similar function as the core of the former City of Vanier. These streets are generally two lanes in each direction with additional left turn lanes at some cross-streets. There are very high transit volumes on Rideau St. (by traditional standards) which taper off to lower volumes on Montreal Road as various routes diverge onto other streets. The bus lanes are curbside and they end just west of St. Laurent Blvd.

The bus lanes are in operation 24/7 for several blocks of Rideau St. in the heart of downtown. The eastern section of Rideau St. has peak-period bus lanes in both directions which are used for on-street parking off-peak. Montreal Road currently has peak-period bus lanes only in the peak direction. Many years ago the peak period bus lanes operated in both directions during both peaks on Montreal Road.

Rideau St., full-time bus lanes: http://goo.gl/maps/oDioP
Montreal Road, peak-period bus lanes: http://goo.gl/maps/RjAt1

Albert and Slater Streets are a one-way pair in downtown Ottawa which form the central portion of the Transitway. Bus volumes are up to 180 buses/hr/direction. The adjacent development generally consists of large office buildings and hotels with very few individual stores. The streets are four lanes each with the bus lane being the second lane from the right curb. The right curb lane is used for activities such as loading zones, taxi zones, right turn lanes, larger platform areas at bus stations/stops, and full-time parking. This leaves two lanes available for general traffic during peak periods. Off-peak perking is allowed in the left curb lane. Due to the (lack of) connectivity at each end, Albert/Slater are not as important for E-W vehicular traffic as one might initially assume.

In the 1990s, New York City Transit analyzed many different types of bus lanes and stated a conclusion which was familiar to us from our experience on Albert/Slater, but which I don't think was ever documented in Ottawa. There are many legitimate users of the road space such as kiss&ride, taxis, loading, turns, etc. If you don't provide suitable space for these activities to occur, they will occur in places where you don't want them (i.e. in the bus lane) and they are very difficult/expensive to control. By providing space for these activities in the curb lanes, the bus lanes are effectively self-enforcing. (Except in NYC where double-parking is practically a national sport.)

Albert St.: bus lane with right turn lane beside it (the white STO bus is turning right): http://goo.gl/maps/TyyRk
Albert St.: bulbout in curb lane for station platform, with parking (and RT entrance into a parking garage) in the curb lane beyond the bus stop: http://goo.gl/maps/2s7QN

Unfortunately, the bus lanes on Rideau/Montreal were created in approximately 1973 and various different kinds of bus lanes were tried on Albert/Slater during the 1970s and 1980s, so any impact studies done at the time are no longer available.

King Edward Ave. is a long-standing political hot potato in downtown Ottawa. It is a six-lane arterial that feeds the Macdonald-Cartier Bridge and Autoroute 5 in Gatineau QC and is a major route for heavy truck traffic. The surrounding community has lobbied for decades for the street to become four lanes and have truck traffic banned, but the alternatives are extremely limited until such time as a new interprovincial bridge is constructed. A new interprovincial bridge is studied approximately every decade, but political wrangling inevitably bogs down the process and it is highly unlikely that anything will change in the next 5-10 years.

There is currently a SB bus lane on King Edward Ave. during the PM peak period that benefits STO (Société de transport de l'Outaouais) buses. In my opinion, this lane is ideally suited to multiple usage: traffic capacity during the AM peak when it is most required (and when benefits to STO would be small), off-peak parking, and STO bus lane during the PM peak when they most need it (when SB traffic volumes don't really require the extra lane). There are not many businesses along King Edward Ave. so the demand for parking is not comparable to the commercial areas along Rideau/Montreal.

Question 2 (and part of Question 3):

I believe the bus lanes on Albert, Slater, and Rideau were created through lane conversions since road widening is not feasible in the context of the surrounding environment. A long-retired transportation planner once told me that (at least part of) Montreal Road used to be somewhat nebulous, i.e. perhaps more of a shoulder than a travel lane, so there was no loss of traffic capacity when the road was rebuilt and the bus lanes formalized. Grainy air photos from 1965 are consistent with this but not conclusive. In practice, I think the situation has been similar for decades: both Rideau St. and Montreal Road have effectively only had one full-time travel lane in each direction along most of their length as the curb lanes functioned for parking and/or bus lanes.

Question 3:

Modifications to parking and loading definitely would have occurred on Albert and Slater as several different types of bus lane arrangements were tried before the current arrangement was implemented.

As noted above, I believe that parking has been a core use of the curb lanes on Rideau/Montreal for many decades. Therefore, the main questions with respect to bus lanes are the hours of operation for buses and for parking, but not really a question of affecting traffic capacity.

Many (about 20?) years ago the merchants in Vanier requested additional parking so the bi-directional bus lanes were reduced to operate only in the peak direction with the non-peak direction available for parking.

We are currently considering extending the hours of operation of the peak-period bus lanes on Rideau/Montreal. This information is not yet public and we have not consulted either the businesses or the local city councillor. Since we know that parking will be a major issue for the businesses, we have conducted a parking study along Rideau/Montreal and the adjacent side streets to determine availability and usage during the time periods which might be impacted.

Questions 4 and 5:

Due to the age of the bus lanes, I do not have access to any reports or analyses that may have been done at the time they were created.

Beyond the formal questionnaire, I can provide the following information based on past experience.

In an urban downtown context, often the two largest objections you'll get to implementation of a bus lane are traffic capacity and parking/loading. There are many traditional tools to deal with the traffic capacity issue (eg. diversion to other nearby streets, long-term modal split objectives (i.e. moving more people per lane via bus/HOV than via SOV), etc.) If your bus volumes are high enough and buses are stopping frequently, the loss of traffic capacity from restricting other vehicles is minimal since the other vehicles are caught behind the buses anyway.

Parking will often be perceived by nearby businesses as a larger issue than what your data actually show it to be, so consultation and communication becomes vital to ensure that it doesn't become a huge political issue. I would note that many businesses in traditional "main street" settings aren't even open before 9:00 am so the PM should be more problematic than the AM (although perception doesn't always match reality).

There are many legitimate uses of road space (pedestrians, cyclists, transit, auto traffic, parking, loading, etc.) that are often competing for a limited amount of available space in urban environments, and it is important to look at the larger picture when attempting to make trade-offs among uses. Since you generally won't be able to provide superior facilities for all modes on every street, it is often appropriate to consider prioritizing transit, cycling, traffic, etc. on different nearby streets. We need to optimize the use of the existing limited infrastructure by prioritising the sustainable transportation modes (pedestrians, cycling, transit) that use less space per person, while recognizing that cars also have an important and legitimate role in the transportation mix.

Curbside lanes that are used for transit during peak periods and parking off-peak are often an appropriate joint-use of available space, but it depends on the context. If transit volumes are high off-peak, and/or if the City's Transportation Master Plan prioritises transit use, then full-time bus lanes are certainly appropriate for achieving these goals. Loading zones can easily be incorporated into off-peak parking but they become more problematic with full-time bus lanes. In the case of the Spadina LRT in Toronto, TTC built (or was planning to build) an off-street parking garage to accommodate on-street parking that was eliminated by the redesign of the road (Spadina previously had angle parking which accommodates more cars than parallel parking).

As one time I had data to show that bus travel times were faster on Montreal Road during peak periods than they were during off-peaks, despite much higher passenger loads and traffic. The reason is that the off-peak parking effectively turned every bus stop into a bus bay, from which buses would be delayed when they tried to re-enter the traffic stream, whereas the continuous bus lanes eliminated this delay during peak periods.

It is important to consider the locations of bus stops as part of the transit improvements. Often there are too many stops located in the wrong places. I know that the transportation planners of the era worked with the adjacent landowners along Albert/Slater so that large stations/stops could be located in suitable places that minimized the impact on businesses and non-transit pedestrians, and where proper amenities (large shelters etc.) could be provided.

A recent example from Ottawa which may be much more useful to you than a bus lane example is the segregated bike lanes on Laurier Ave. downtown which were implemented a couple of years ago. See, for example: http://goo.gl/maps/4PFQf. A four-lane road with off-peak parking was converted into two traffic lanes plus two segregated cycling lanes, with left turn lanes, loading zones, and full-time parking wherever possible in the remaining space. Changes to the parking and loading zones were very controversial in certain areas with the adjacent businesses and residents. In some cases more parking spaces were created on nearby streets than the number of spaces removed from Laurier itself, but it can be difficult to overcome the perception of the usefulness of a parking space right in front of a business even though the reality is that it can only be occupied by one car at a time and all the other customers must walk a block or two anyway. Loading zones become very important when permanent full-time changes are being considered for a roadway.

The Laurier segregated bike lanes were the subject of extensive public consultation and analysis before and after their implementation. See: http://ottawa.ca/en/city-hall/public-consultations/segregated-bike-lane-pilot-project. If you require more information than what is available on that website, you could contact Colin Simpson at Colin.Simpson@Ottawa.ca or 613-580-2424, ext. 27881. Segregated cycling lanes and cycle tracks have been a hot topic in many cities in recent years and I'm sure that other cities must have done similar consultations and analyses. In particular, New York City and Montreal have aggressively expanded their cycling facilities in recent years.

I hope this information has been helpful. If I can be of further assistance, please don't hesitate to call or e-mail me.

Greater Cleveland Transit Authority

Michael Schipper, MSCHIPPER@gcrta.org

When we built the HealthLIne BRT on Euclid Avenue we did include a Bus Only BRT lane in the center of the street in downtown that replaced a general use automobile lane. In this section we also reconfigured and grouped the on-street parallel parking. By organizing the parking we actually maintained most of the parking and created some zones with larger sidewalks for outdoor dining with no parking.

We also constructed a downtown Transit Zone as part of the project and created a 24/7 Bus Only lane on Superior Avenue. It also replaced a lane of general use traffic. We also organized some parking and valet zones in front of a couple of hotels.

We also created a peak hour Bus Only lane on St. Clair which for the most part was used for parking. Now the parking is restricted in the morning and afternoon peak periods for a couple of hours.

All three of these streets basically run east-west through our downtown.

On impact to businesses. On Euclid there was a not a formal study on business activity. We had reports that many businesses lost about 30% of there gross sales during the time that we were working in there block. Only three businesses closed and they were in bad shape before the project started. For the most part we tried to restrict that period to one construction season. On the other two streets the work was less extensive and had minimal impact.

On Euclid we also had a number of properties with no business activity during the construction. Many of these have now been renovated and contain thriving businesses. Others are being planned for future renovation. We have documented over $5 Billion of construction along the entire length of the HealthLine since it has opened.

Lane Transit District (Eugene)

Dan Tutt, Planning and Development Department, Dan.Tutt@ltd.org

See attached Bus only lane 05-27-14.pdf and EmX Handout (whole document).pdf

1. Can you please confirm that you have a transit route through a commercial area which operates on a transit only lane?
    - LTD's EmX BRT system operates in mixed traffic and a variety of lane types including
    - Transitways, curbed lanes. Not traversable by traffic.

- 

- Transit lanes, traversable, curb side and median, but not shared with other vehicles.
- 

- 

- BAT Lanes, Business Access & Transit, traversable, used by bus and right or left turning vehicles depending on which side of the street the BAT lane is on.

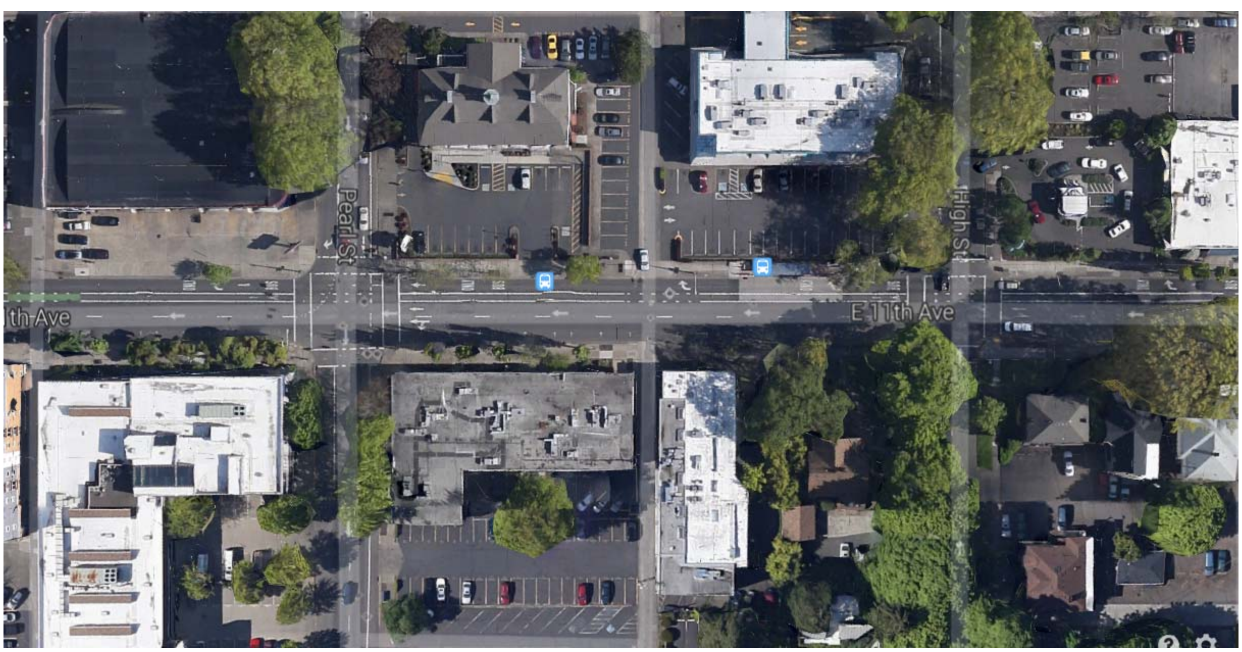
- 

BAT lane traffic sign

- 

- BAT lane, downtown Eugene. Used by EmX <u>and</u> fixed route service approaching Eugene Station. 3 ½ blocks on E 11th Ave. Through travel lane was converted to a BAT lane.

- When LTD constructs bus lanes as part of our EmX system, we build them out of concrete. The exception is this section where a general purpose travel lane was converted to a BAT lane. We did construct a concrete pad for the EmX station in the BAT lane. See stop on right side of image.

- 

2. Did you convert a mixed-flow traffic lane to become a transit only lane? Or did you provide an additional lane for transit (construct a new lane or convert a parking lane to transit lane during peak periods)?
   - We have done both.
   - Our transit lanes have replaced on street parking in certain sections. Bus lanes are dedicated to buses all day, not just at peak periods. You may have to talk to other cities that use only "peak hour bus lanes" to see how they perform.

3. Were parking spaces and/or loading areas reduced, relocated or modified due to the implementation of the transit only lane?
   - Parking utilization studies were conducted as part of the environmental review process.
   - In the image below, the loading area was inset to accommodate the convenience store.

   - Parking removal has been strategic, in lower use areas with alternative parking available.

4. Did you evaluate the impact to existing businesses following the implementation of the transit only lane? If yes, did you carry out a formal data driven analysis (e.g. using sales data, business closures and economic transition data) or was a survey of business owners conducted?
   - No.
   - Our transit only lanes, with the exception of the BAT lane approaching the Eugene Station, are part of our Bus Rapid Transit System (EmX).

5. Can you please provide a brief summary of your findings regarding the impact to existing businesses?

Below is a link to the environmental documents for our third corridor, West Eugene EmX Extension. It contains extensive review of property and business impacts.
Link:
http://www.ltd.org/search/showresult.html?versionthread=5846cd084b147a3da05d11d5fa2c4eff

This is kind of a tough question to summarize because it depends on your definition of “impact”. If the impact is property acquisition, then the first two EmX corridors had little impact to existing businesses.
The type of acquisition is usually a narrow strip of property to accommodate the expansion of the roadway for the EmX lane or EmX stations. Where on-street parking has been removed to accommodate the EmX lane, it is in areas of relatively low utilization with alternative parking available across the street or on cross streets.
Since EmX began operations in 2007 there have been business closings along the route as well as business openings. We opened just before the great recession, which we are still slowly recovering from and small businesses have had a rough time. I don’t believe any business closed as a result of the EmX project.
Businesses, in general, are concerned with the impacts of construction. We are frequently asked if we will compensate a business for lost revenue during construction. We cannot. We do have a robust business outreach program during construction. We commit to always keeping business access open during construction. We provide advance communications about construction in specific locations. We provide business signage to direct customers to a location or entrance. We have a dedicated staff person who works directly with the business community and construction company to assure we have the best communications and information available. For our next corridor we are offering business assistance classes for businesses on the corridor. We also build sections in short 2-3 block increments to minimize the disruption for businesses.
In my opinion, once construction is complete and a corridor is open, it’s pretty hard to remember what it was like prior to the corridor being developed. People and businesses adjust and life goes on, but with better transit service.
It should be noted that many businesses are resistant to change. They have been at their location for a long time. Many do not see transit users as their customers and consider increased transit investment as a boondoggle. However, organizations that are forward thinking recognize the changing demographics like aging and reduced mobility, young people not married to the automobile and looking for communities that have excellent transit systems, those concerned with climate change and sustainability, those organizations recognize the benefit of developing a system like our EmX.
Also, companies that recognize these trends are seeking development opportunities adjacent to developed or developing corridors. Existing businesses also have started marketing that they are next to an EmX line or station, especially to college students.

Our first EmX corridor opened in 2007. The second corridor opened in 2011. These two corridors operate as one continuous route and today represent 25% of LTD’s ridership (boardings).

To get the full picture of our Bus Rapid Transit system, please go to LTD’s web site and click on the EmX link on the main page. You will find that it is much more than just exclusive lanes.
Link: www.ltd.org

Tri Met (Portland)

Alan Lehto, Director of Planning & Policy, LehtoA@trimet.org

See attached Portland Mall Sidewalk and Lane Widths evolution 1978-2009.pdf

Yes. We have transit only lanes on SW 5th and SW 6th Avenues serving generally north-south through the heart of our downtown business district. Though the details vary depending on exactly where it is along the 1.5 mile stretch, the general configuration is that there are wide sidewalks on both sides, two transit lanes on the right (one for serving passengers on the curb and one for passing) and a single mixed-traffic lane on the left. A little history on the Mall is available at http://trimet.org/about/history/portlandmall.htm
More details on the architectural design at http://www.asla.org/2011awards/091.html

Yes, two lanes were converted, but the original conversion was completed in 1978 as part of an overall vision of downtown revitalization. In 2009, we reopened the Mall after two years of construction with both light rail and buses operating in two transit-only lanes.

Parking was reduced from most curbs to specific locations that most needed it (for businesses that needed short-term parking like hotels)

Only anecdotally. In the five years since the final conversion, there has been substantial development along the transit mall, including both new stores and renovation of existing stores to have more visibility from the street.

Construction is always an impact, but we have provided programs and small business assistance to minimize the impacts and help businesses stay in business and be ready for the increased interest in the long run. However, the benefits come as part of the package – it isn't just the increased transit access, it is also the sidewalk improvements that make a difference at the individual property level.

City of Seattle

City of Seattle Department of Transportation, Bill Bryant, Manager Transit System Development, Bill.Bryant@seattle.gov

1. Can you please confirm that you have a transit route through a commercial area which operates on a transit only lane?
   Yes, several.

2. Did you convert a mixed-flow traffic lane to become a transit only lane? Or did you provide an additional lane for transit (construct a new lane or convert a parking lane to transit lane during peak periods)?
   Both.

3. Were parking spaces and/or loading areas reduced, relocated or modified due to the implementation of the transit only lane?
   Yes.

4. Did you evaluate the impact to existing businesses following the implementation of the transit only lane? If yes, did you carry out a formal data driven analysis (e.g. using sales data, business closures and economic transition data) or was a survey of business owners conducted?
   No.

5. Can you please provide a brief summary of your findings regarding the impact to existing businesses?
   No before/after analysis that I'm aware of.

Translink (BC)

Rachel Jamieson, Senior Transportation Engineer, Bicycle & Road Network Initiatives, Rachel.Jamieson@translink.ca

The Marine Drive bus lanes are a queue jumper to the Lions Gate bridge from both the east and west, and a bus lane in front of a shopping mall with off street parking.

We converted a right turn only lane to a right turn and bus lane and widened the street to provide a bus queue jump lane and a transit priority signal at a busy intersection approaching the Lion's Gate bridge from the west. We removed a left turn lane, banned left turns and restriped Marine Drive on a section approaching the Lions Gate Bridge from the east.

No parking spaces and/or loading areas reduced, relocated or modified

No evaluation of business impacts

The businesses nearby have off-street parking.

Edmonton Transit System

Jim Bryant, General Supervisor of Development & Technical Review, Edmonton Transit, jim.bryant@edmonton.ca

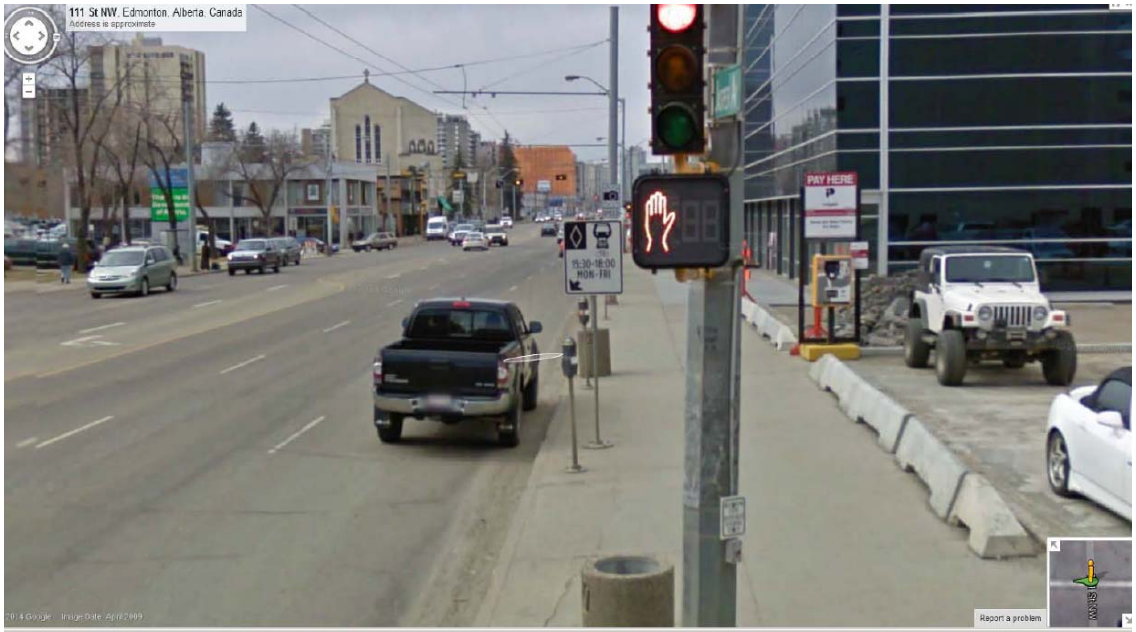
1. Can you please confirm that you have a transit route through a commercial area which operates on a transit only lane? Yes, for example, bus lanes are operational along Jasper Avenue in Oliver (west downtown), along 109 Street northbound between Whyte Avenue and the river and along 97 Street north of Yellowhead Trail. There are also several other bus lanes that do not operate through a commercial area.

2. Did you convert a mixed-flow traffic lane to become a transit only lane? Or did you provide an additional lane for transit (construct a new lane or convert a parking lane to transit lane during peak periods)? Both; usually add an additional lane where feasible. Some peak bus lanes allow for parking during off-peak hours.

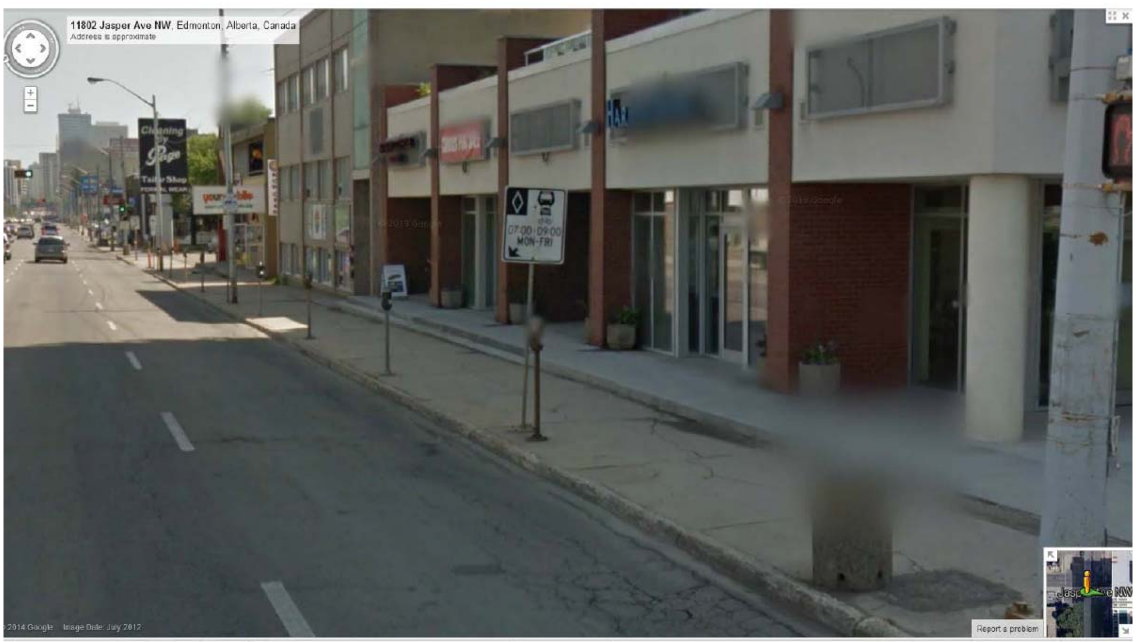
3. Were parking spaces and/or loading areas reduced, relocated or modified due to the implementation of the transit only lane? Yes, in Oliver (west downtown).

4. Did you evaluate the impact to existing businesses following the implementation of the transit only lane? If yes, did you carry out a formal data driven analysis (e.g. using sales data, business closures and economic transition data) or was a survey of business owners conducted? No significant analysis was performed as our main objective was to address bus delays due to traffic congestion. The impact to parking was not considered of great impact as parking capacity was still maintained during off-peak time periods.

5. Can you please provide a brief summary of your findings regarding the impact to existing businesses? Parking issues have been recently emergent in Edmonton. Some opposition due to loss of parking availability in areas of high utilization as occurred in recent years. When Edmonton Transit proposes future bus lanes in mature areas, we will most likely undertake extensive public consultation and review prior to implementation.
6.

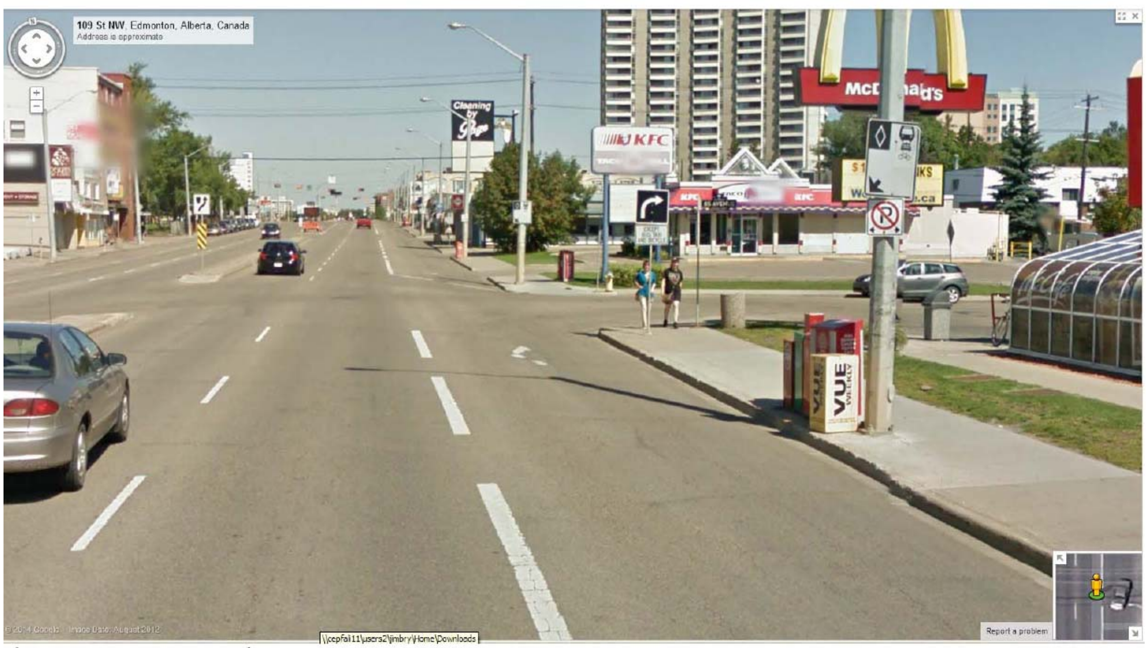


Edmonton Bus Lanes Example – Jasper Avenue Bus Lane WB for PM Peak



Edmonton Bus Lanes Example – Jasper Ave Bus Lane EB for AM Peak

Edmonton Bus Lanes Example – 97 Street Bus Lane NB for PM Peak



Edmonton Bus Lanes Example – 109 Street Bus Lane NB

San Francisco Municipal Transport Agency

City of San Francisco, Lulu Feliciano, Outreach Manager, San Francisco Municipal Transportation Agency, Lulu.Feliciano@sfmta.com

1. Can you please confirm that you have a transit route through a commercial area which operates on a transit only lane?
   We have several routes that operate on transit only lanes –
   Market Street is the backbone of our surface transit service and has a dedicated transit only lane.
   Geary Blvd, from downtown to Van Ness, also operates on transit only lanes (in fact we just applied a red surface treatment to remind auto drivers that this lane is for public transit only)

2. Did you convert a mixed-flow traffic lane to become a transit only lane? Not recently. Or did you provide an additional lane for transit (construct a new lane – this application will be utilized for Van Ness Ave corridor when we build and implement the rapid transit service or convert a parking lane to transit lane during peak periods)?

3. Were parking spaces and/or loading areas reduced, relocated or modified due to the implementation of the transit only lane? Yes, for the Van Ness Bus rapid transit

4. Did you evaluate the impact to existing businesses following the implementation of the transit only lane? This analysis was completed during the planning and EIR phase. If yes, did you carry out a formal data driven analysis (e.g. using sales data, business closures and economic transition data) or was a survey of business owners conducted?

5. Can you please provide a brief summary of your findings regarding the impact to existing businesses?