



Ministry of Transportation, Ontario

**HIGHWAY 407 TRANSITWAY:  
TRANSPORTATION STUDY FOR PROPOSED BATHURST  
STATION**

---

FINAL REPORT

DECEMBER, 2010





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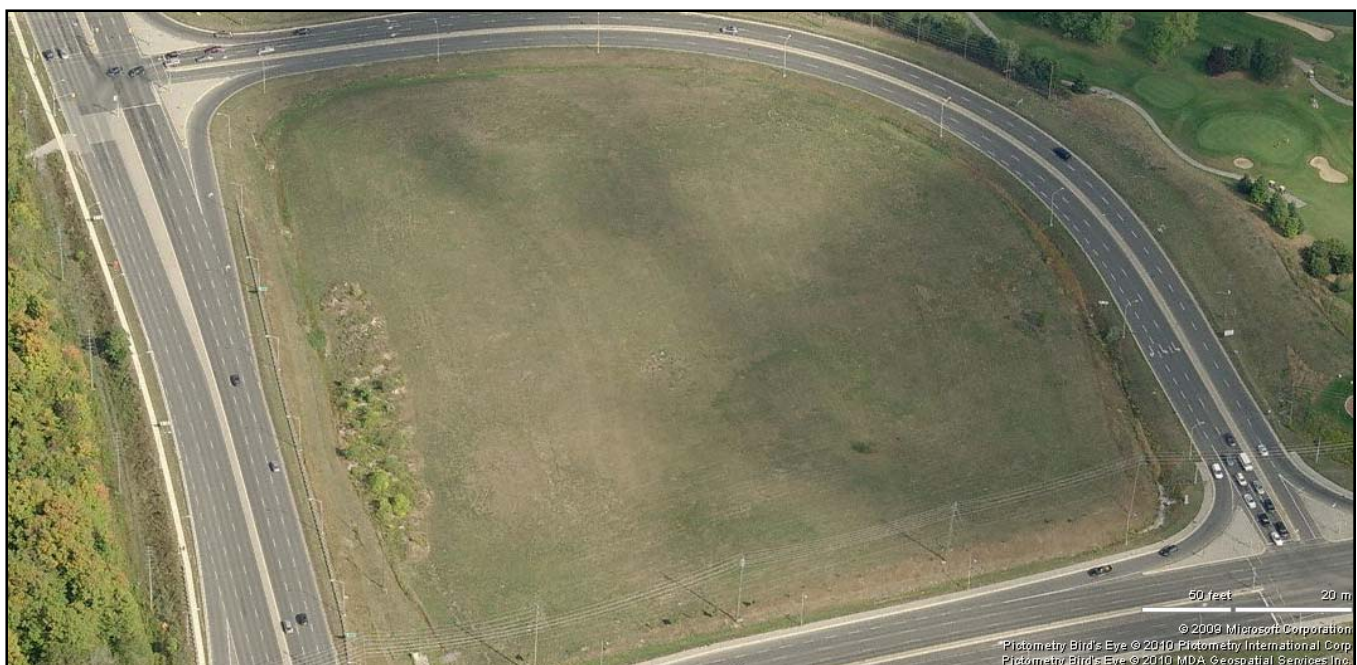
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## 1. INTRODUCTION

This transportation study report presents the preliminary findings of traffic analysis of the proposed 407 Transitway Bathurst Station. While the proposed station platforms will be located on the south side of Highway 7 (just east of the Bathurst Ramp), the main station park-and-ride and bus loop will be located on the north side of Highway 7 on vacant land in the centre of the Bathurst Ramp connection between Highway 7 and Bathurst Street (**Exhibit 1-1**). The analysis assesses the ability of the preferred alternative geometric layouts to accommodate projected traffic volumes, while incorporating the planned Highway 7 corridor transit initiatives for the local transit operations.

**Exhibit 1-1 Aerial View of Proposed Bathurst Station Site**



### 1.1 Report Outline

The subsequent sections of this transportation study report are as follows:

- Section 2 – Summary of the Proposed Development;
- Section 3 – Scope for the Transportation Study;
- Section 4 – Existing Condition (2010) Analysis and Results;
- Section 5 – Future Background Condition (2031) Analysis and Results;
- Section 6 – Proposed Bathurst Station Related Traffic;
- Section 7 – Future Total Condition (2031) Analysis and Results; and
- Section 8 – Summary and Conclusions;

## 1.2 Key Issues

Key issues addressed in this transportation study report include the following:

- The existing and background traffic conditions at Study Area intersections;
- The estimate of traffic generated by the proposed Bathurst Station park-and-ride and transit bus loop;
- The assignment and distribution of site generated traffic;
- The implications of site generated traffic on Study Area intersections, access driveways/roadways and the surrounding road network; and
- Potential site access geometric configurations and other measures to mitigate projected traffic impacts.



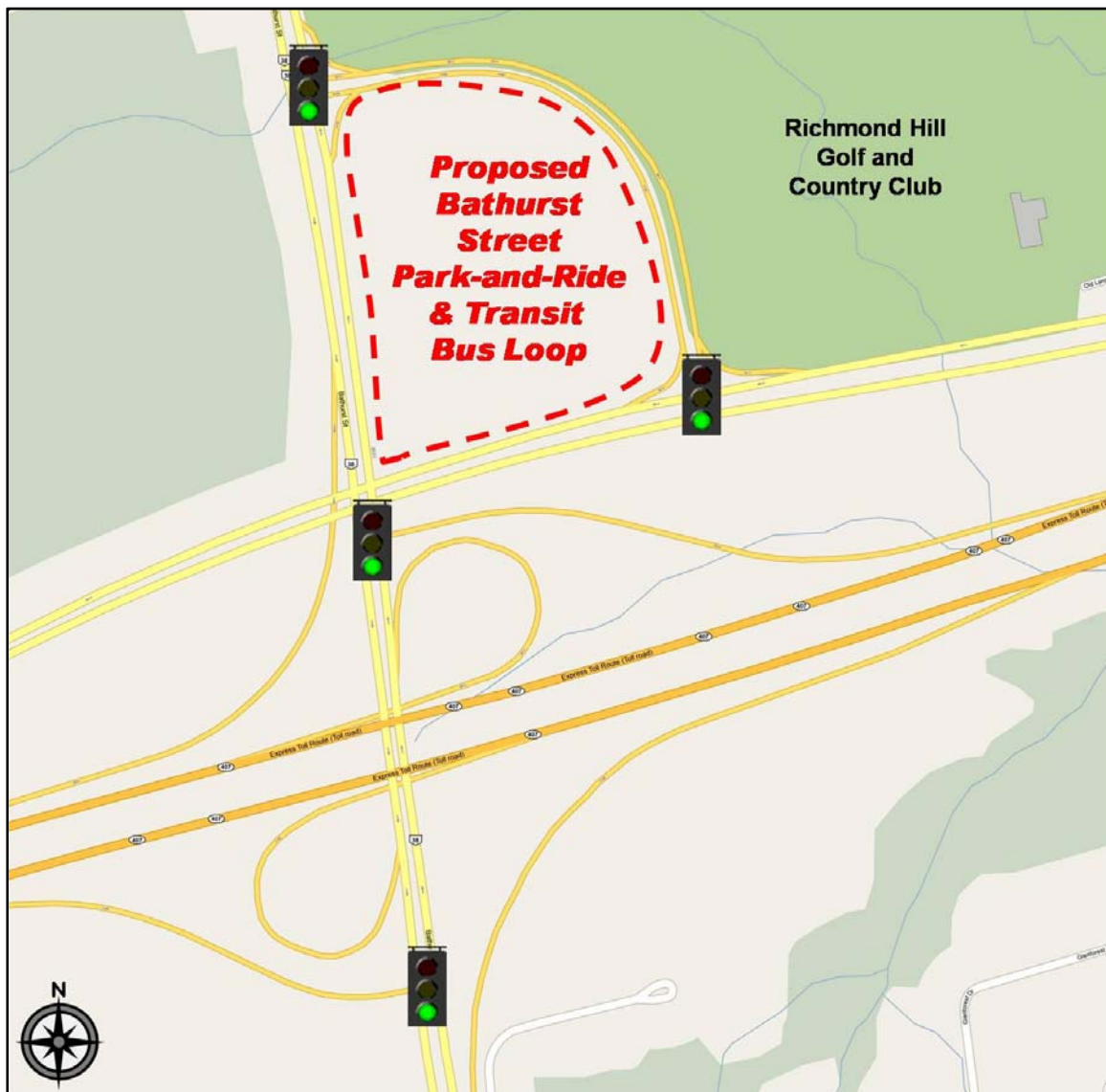
## 2. THE PROPOSED DEVELOPMENT

### 2.1 Station Location

The proposed 407 Transitway Bathurst Station (“Proposed Station”) will be located on a parcel of vacant land (“Subject Site”) on the northeast corner of Bathurst Street and Highway 7 in the centre of the Bathurst Ramp. The Subject Site is located in the Town of Richmond Hill (station platforms in the City of Vaughan) on the west side of the Bathurst Ramp and opposite to the Richmond Hill Golf and Country Club.

A map showing the location of Subject Site and Proposed Development is in **Exhibit 2-1**.

**Exhibit 2-1: Proposed Bathurst Station Site and Vacinity**



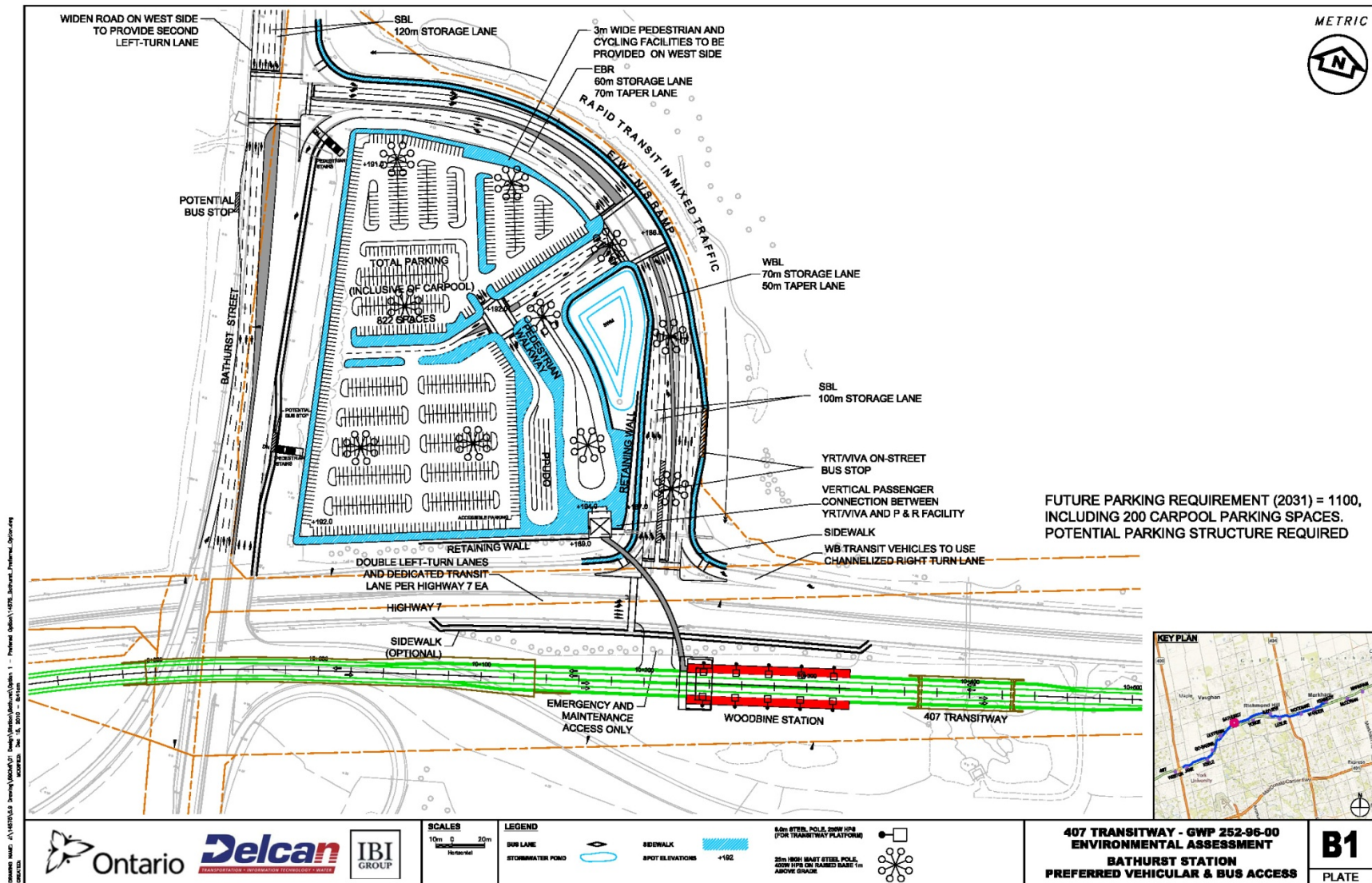
## 2.2 Site Plan

A site plan for the preferred station concept is shown in **Exhibit 2-2**. The proposed Bathurst Station will serve as a regional intermodal station for passengers transferring between the proposed 407 Transitway and other bus services including VIVA and YRT. Bathurst Station is divided into two distinct sites areas: north of Highway 7 and south of Highway 7. The north of Highway 7 site area includes a passenger pick-up and drop-off (PPUDO) area and a bus loop for YRT. It also has two main parking areas referred to in this report as the “407 Transitway” parking lot and the “Carpool” parking lot. The south of Highway 7 site area includes the proposed 407 Transitway platforms, which are located to the south of Highway 7.

Currently, there is a multi-use pathway located west of Bathurst Street. Under the preferred station concept, pedestrian and bike accesses are also planned to connect the proposed Bathurst Station with areas to the north of the Bathurst Ramp. The preferred station concept also recommends an above-grade pedestrian and bicycle walkway across Highway 7, which would establish a direct connection between the north of Highway 7 station area and the 407 Transitway platforms.

According to *Highway 7 Corridor Transit Improvement Report*, a mixed-traffic option is recommended for local transit routes because it avoids the costly reconstruction of existing bridges and the cost of constructing four new structures (separate transitway option). As a result, initial stages of this study examined several transit operation scenarios on the Bathurst Ramp including options with or without exclusive access and on-street VIVA bus stop options. The option with a single shared access to the Bathurst Station was ultimately selected as the preferred alternative.

Exhibit 2-2: Preferred Bathurst Station Concept (December 2010)



### 3. STUDY SCOPE

#### 3.1 Study Area

The Study Area for the transportation study is generally bounded by the Bathurst Ramp to the north and east, Highway 407 to the south and Bathurst Street to the west. A list of all Study Area intersections analyzed in this study is shown in **Exhibit 3-1** and a map of the Bathurst Station Study Area is shown in **Exhibit 3-2**.

**Exhibit 3-1: List of Study Area Intersections**

No.	East-West Street	North-South Street	Intersection Type
1	Bathurst Ramp	Bathurst Street	Signalized
2	Highway 407 Westbound Off-Ramp	Bathurst Street	Signalized
3	Highway 7	Bathurst Ramp	Signalized
4	Station Access Road	Bathurst Ramp	Signalized

#### 3.2 Guidelines and Standards

Guidelines consulted for this study include the *York Region Transportation Impact Study (TIS) Guideline For Development Applications (August 2007)* and the *Ministry of Transportation, Ontario General Guidelines for the Preparation of Traffic Impact Studies (January 2008)*.

This study was carried out according to the accepted documents for geometric design standards outlined in the *York Region Road Design Guidelines*. It also maintains consistency with recommendations described in "Highway 7 Corridor & Vaughan North-South Link Public Transit Improvements" report published in August 2005.

#### 3.3 Horizon Years and Analysis Periods

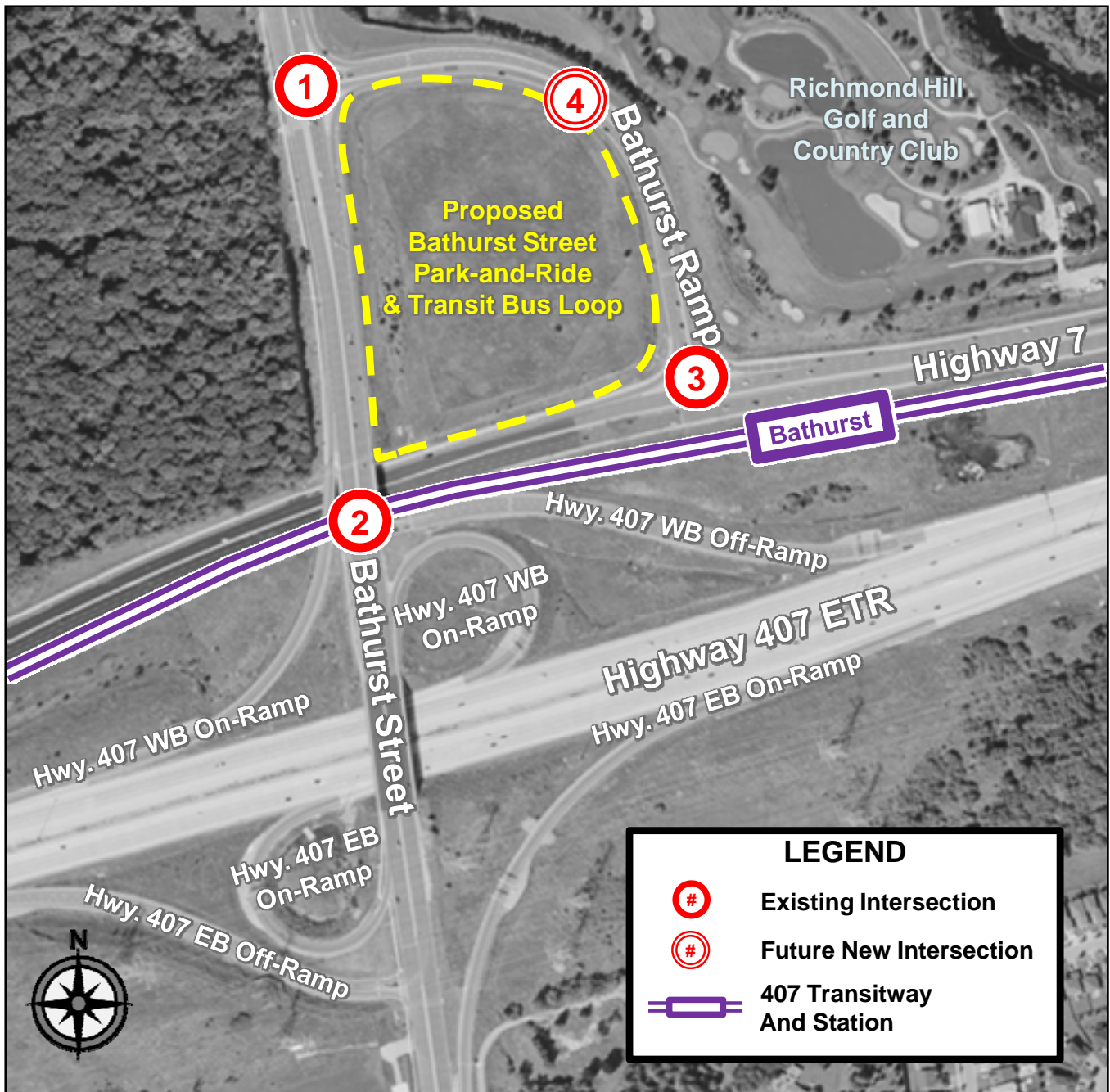
Based on these guidelines and proposed construction and operational dates for the 407 Transitway, the following existing and future horizon periods (conditions) were established as part of this study:

- 2010 (Existing Condition);
- 2031 (Background Condition);
- 2031 (Future Total Condition).

Performance of the road network was assessed during the weekday am peak hour and pm peak hour, which correspond to the peak hours for the proposed Bathurst Station.



**Exhibit 3-2: Study Area of Transportation Study**



## 3.4 Data Collection

### 3.4.1 TURNING MOVEMENT COUNTS

Turning movement counts for all Study Area intersections were obtained from York Region's Transportation Service's Department.

### 3.4.2 SIGNAL TIMING AND INTERSECTION CONFIGURATIONS

Current signal phasing and splits for the signalized study intersections were obtained from York Region's Transportation Service's Department. Intersection configurations were obtained through field studies undertaken by IBI Group staff.

## 3.5 Traffic Analysis Parameters

A Synchro signalized intersection analysis was conducted at all Study Area intersections under the existing, future background and future total traffic conditions. The operational analyses were primarily based on procedures set out in the Highway Capacity Manual (2000) with the assistance of Synchro 6 and Highway Capacity Software 2000. Signal cycle lengths, timing, and phasing currently in effect were obtained from York Region. The critical movements are identified for each time period.

### 3.5.1 CAPACITY AND LEVEL OF SERVICE

An intersection's overall operating conditions are typically characterized by two standard measures: the volume to capacity ratio (V/C) and the level of service (LOS). Taken together, they provide an indication of delay and the number of vehicles that can be accommodated through an intersection.

The V/C ratio is an indication of the volume of traffic attempting to make a specific movement through an intersection (i.e., northbound left, westbound straight through), versus the theoretical capacity of that movement given the lane configurations, operating conditions and signal timings provided at the intersection. A V/C ratio of 1.0 represents a condition where the theoretical capacity for a particular movement is being fully used.

The level of service (LOS) of the overall intersection of a particular movement is a measure of the average vehicle delay experienced by the motorists attempting to travel through the intersection. LOS is measured from "A" to "F" with peak hour LOS in the "A" to "D" range being considered acceptable by most and a "LOS F" representing unacceptable delays.

York Region's *Transportation Impact Study (TIS) Guidelines Development Applications (August 2007)* and the Ministry of Transportation's *General Guidelines for the Preparation of Traffic Impact Studies (January 2008)* were consulted for the base parameters of this study.

Existing intersection capacity analyses were undertaken using the Highway Capacity Manual (HCM) methodology, and specifically the Synchro 6.0 Traffic Signal Coordination Software package by Trafficware. The analysis reflects the most recently available traffic volumes, current signal timings, and existing lane configurations. Peak hour factors (PHF) at each intersection were calculated using 15-minute and hourly count data.

Critical movements were identified as those operating with a volume-to-capacity (V/C) ratio of 0.85 or higher and/or the poorest level of service (LOS) among all movements.

### 3.5.2 QUEUE LENGTHS

A queue length for a turning movement that exceeds the length of the available storage bay or creates back-ups is a concern, particularly at a signalized intersection. These turning vehicles can potentially block through vehicles during a green light, which reduces the intersection efficiency.

The Synchro 6.0 Traffic Signal Coordination Software measures both the 50th percentile and 95th percentile maximum queue lengths. The 50th percentile queue (the median) is the maximum back of queue length during a typical traffic cycle. The 95th percentile queue is the maximum back of queue length during a typical traffic cycle with 95th percentile traffic volumes. The 95th percentile queue measures the queue length that 95 percent of the sample lies below.

95th percentile critical queue lengths were identified for movements where the queue surpassed the estimated length of the storage bay.

## 4. EXISTING CONDITION

### 4.1 Area Road Network

Major roadways in the Study Area include the following:

- Bathurst Street – Regional (Arterial) Road;
- Highway 7– Regional (Arterial) Road;
- Bathurst Ramp – Regional (Arterial) Road; and
- Highway 407 Westbound Off-Ramp – 400 Series Provincial Highway.

These are described in further detail below.

**Bathurst Street** is a six-lane regional arterial roadway under the jurisdiction of York Region. According to 2003 York Region ATR counts, within the Study Area road network, Bathurst Street accommodates approximately 42,000 vehicles per day. The maximum posted speed on Bathurst Street is 60 km/h.



*Street View of Bathurst Street Looking North*



**Highway 7** is a six-lane regional arterial roadway under the jurisdiction of York Region. According to 2003 York Region ATR counts, within the Study Area road network, Highway 7 accommodates approximately 52,000 vehicles per day. The maximum posted speed on Highway 7 is 70 km/h.



*Street View of Highway 7 Looking East*

**Highway 407 Westbound Off-Ramp** allows westbound Highway 407 vehicles to exit to Bathurst Street. It consists of two westbound left-turn lanes and one westbound right-turn lane.



*Street View of Highway 407 Westbound Off-Ramp Looking West*

**Bathurst Ramp** connects northbound and southbound traffic on Bathurst Street with eastbound and westbound traffic on Highway 7. It consists of two northwest and two southeast travel lanes.



*Street View of Bathurst Ramp Looking South*

## 4.2 Lane Configurations

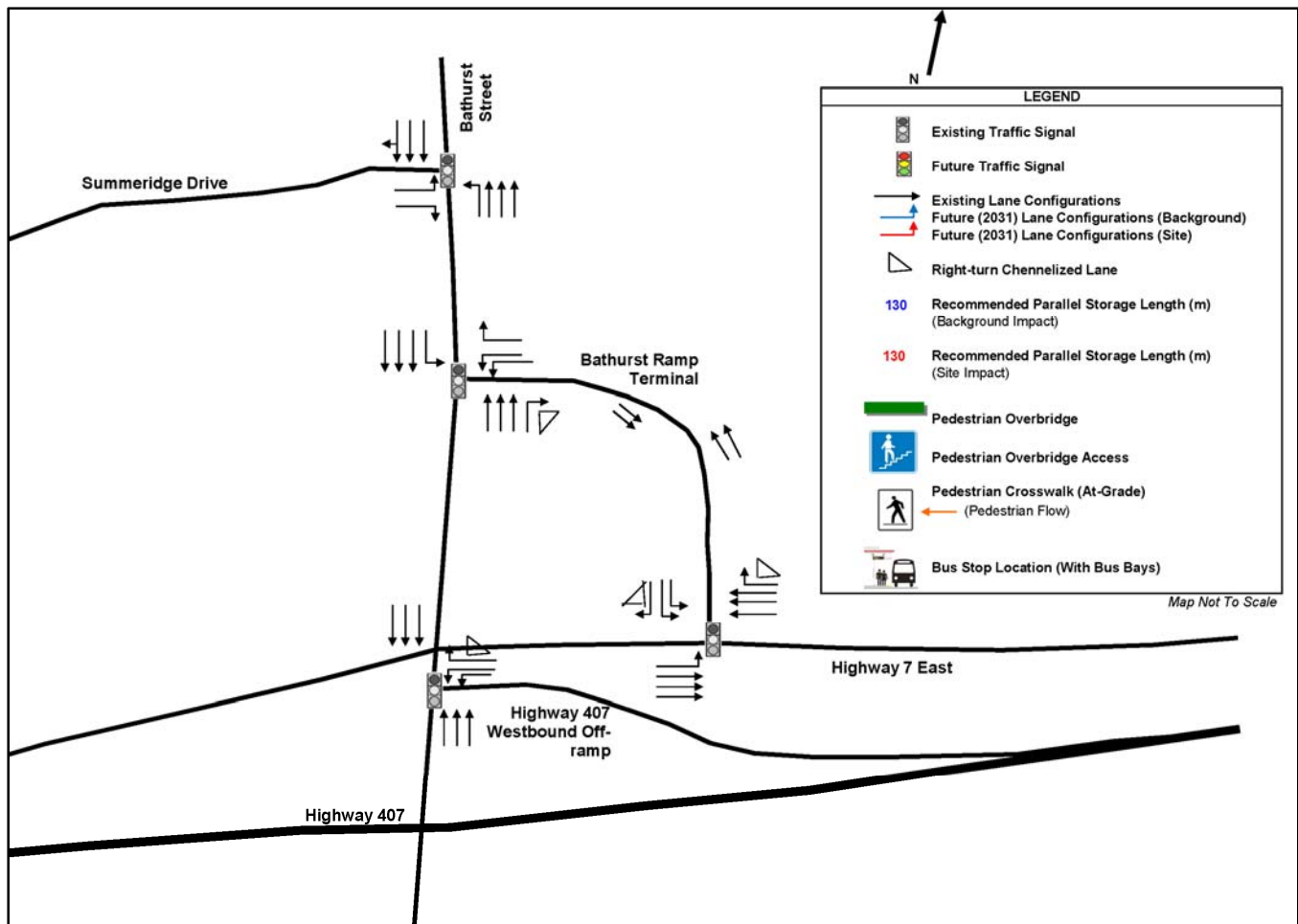
A map shown existing Study Area roadway lane configurations is shown in **Exhibit 4-1**. Through the Study Area, Bathurst Street consists of three northbound and three southbound travel lanes with dedicated left-turn lanes at key signalized intersections. Highway 7 consists of three eastbound and three westbound travel lanes with dedicated left-turn lanes at key signalized intersections. Access between Bathurst Street and Highway 7 is via the Bathurst Ramp, which consists of two northwest and two southeast travel lanes. The Highway 407 Westbound Off-Ramp has three westbound lanes: two left-turns and one right-turn.

## 4.3 Transit Services and Operations

**Exhibit 4-2** shows the existing transit routes in the Study Area. In the vicinity of the Subject Site, the transit operation includes VIVA 'Purple' route, and three YRT bus routes (#23, #87 and #88) on Highway 7 and Bathurst Street.

The peak hour headways of these routes range from 20 to 30 minutes for the YRT local bus routes and 15 minutes for VIVA 'Purple' service. A total of approximately 16 and 6 buses are expected to pass through the Bathurst Ramp and Bathurst Street per hour, respectively, during the weekday am and pm peak hours (one hour between 7:00 to 9:00 am and 4:00 to 6:00 pm).

**Exhibit 4-1: Existing Study Area Lane Configurations**



## 4.4 Existing Condition (2010) Traffic Volumes and Operations

The 2010 Existing Condition traffic volumes, including the weekday am and pm peak hours, are shown in **Exhibit 4-3**. The 2010 Existing Condition intersection capacity analyses were undertaken using the methodology outlined in **Section 3.2**.

**Exhibit 4-2: Transit Services in the Study Area**

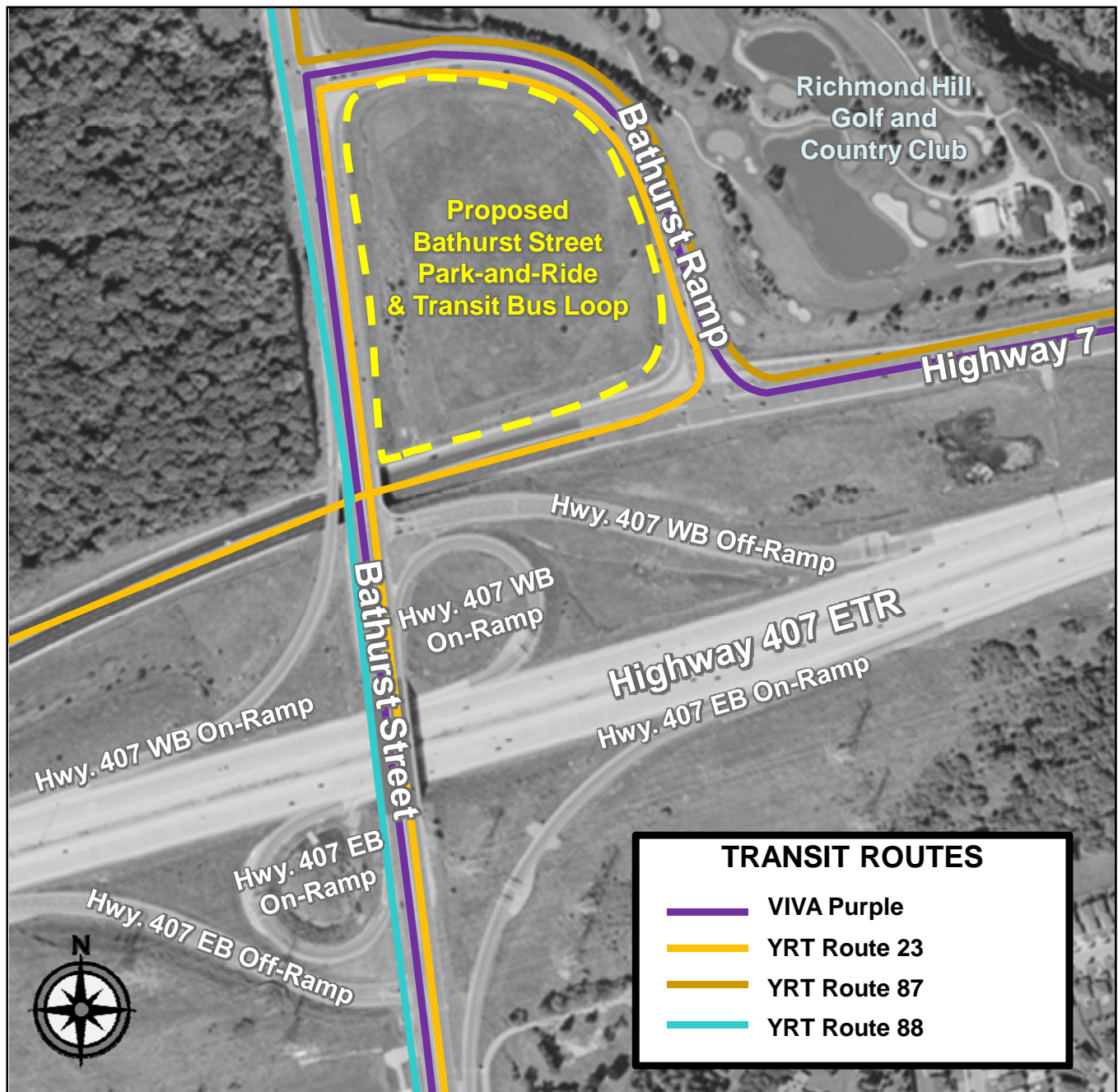
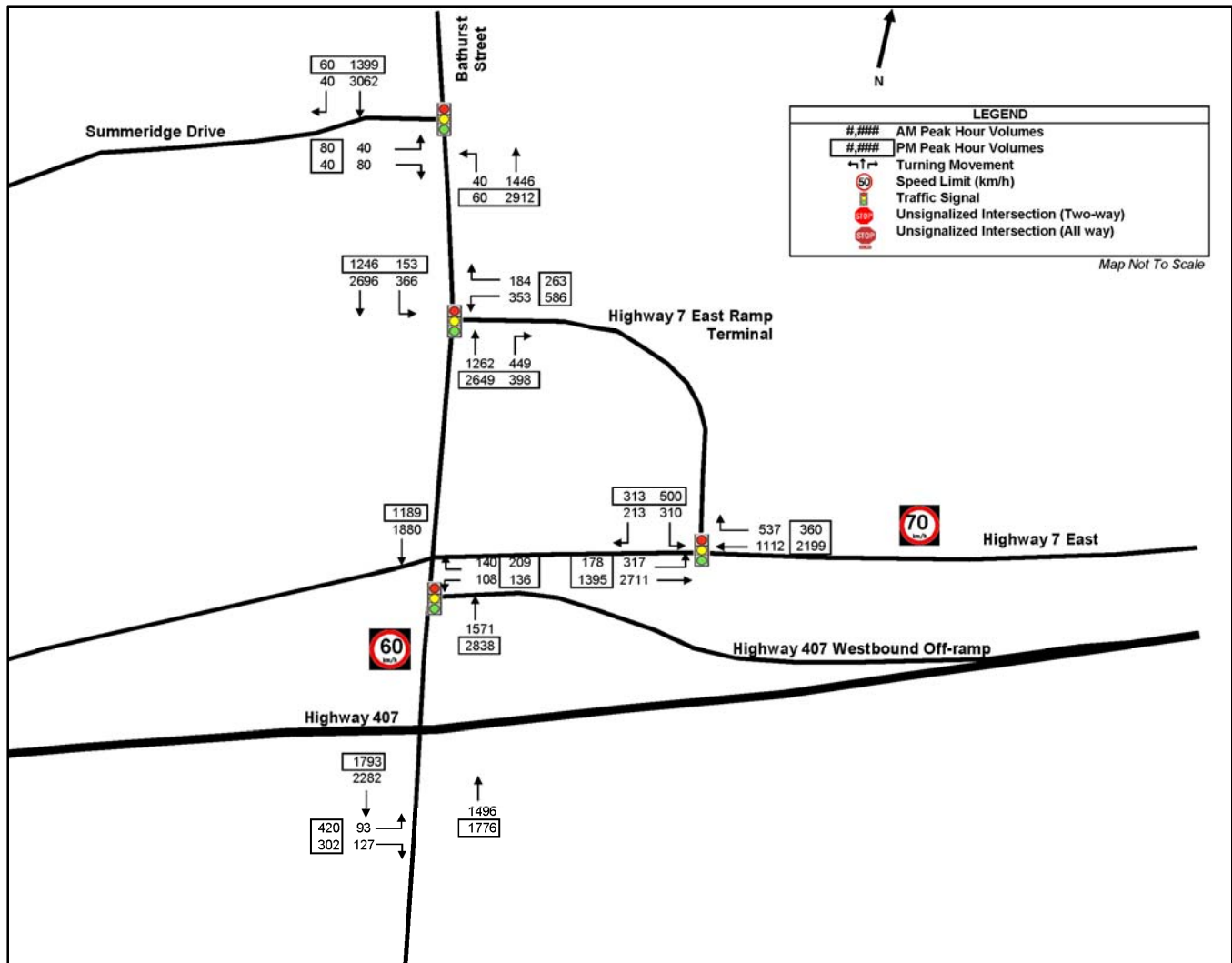




Exhibit 4-3: 2010 Existing Condition Traffic Volumes



#### 4.4.1 CAPACITY AND LEVEL OF SERVICE

The weekday am and pm peak hour existing condition traffic analysis results are included in **Exhibit 4-4**. Existing Condition Synchro traffic analysis reports are included in **Appendix A**.

**Exhibit 4-4: Existing Condition (2010) Intersection Operations**

Intersection		Peak Hour	Movement	Existing Condition (2010)		
				V/C	Delay	LOS
Signalized Intersections						
1	Bathurst Ramp @ Bathurst Street	am	Overall	0.80	16	B
			SBT	0.76	10	B
			SBL	0.85	41	D
		pm	Overall	0.81	16	B
			NBT	0.86	15	B
			WBL	0.77	50	D
2	Highway 407 Westbound Off-Ramp @ Bathurst Street	am	Overall	0.53	7	A
		pm	Overall	0.81	14	B
			NBT	0.82	13	B
3	Highway 7 @ Bathurst Ramp	am	Overall	0.74	26	C
			EBT	0.95	29	C
			EBL	0.91	52	D
		pm	Overall	0.79	26	C
			WBT	0.95	39	D
4	Station Access Road @ Bathurst Ramp	am	Overall	No Intersection Under Existing Condition		
			EBL			
		pm	Overall			
			EBL			

Notes:

Critical movement(s) defined as V/C > 0.85 and/or poorest LOS.

Overall, the three signalized intersections in the Study Area operate at acceptable levels of service (LOS 'C' or better) under the existing weekday am and pm peak hour traffic demands, with the volume to capacity (V/C) ratio below 1.0. Overall V/C ratios range from 0.53 to 0.80 during the weekday am peak hour, and from 0.79 to 0.81 during the weekday pm peak hour.

However, the northbound through movement at the Bathurst Ramp @ Bathurst Street intersection experiences larger delays during the pm peak hour. The eastbound through at the Highway 7 @ Bathurst Ramp also operates at capacity during the weekday am peak hour. Congestion also occurs in the reverse direction during the weekday pm peak hour.

#### 4.4.2 QUEUE LENGTHS

The weekday am and pm peak hour existing condition queue length analysis results are included in **Exhibit 4-5**. Existing Condition Synchro traffic analysis reports are included in **Appendix A**.

**Exhibit 4-5: Existing Condition (2010) Turning Movement Queue Lengths**

Intersection		Peak Hour	Movement	Parallel Lane Storage Length (m)	Existing Condition (2010) Synchro Queues (m)	
					50th Percentile	95th Percentile
Signalized Intersections						
1	Bathurst Ramp @ Bathurst Street	am	WBL <sup>1</sup>	WBL = 200; SBL = 100;	48	62
			SBL <sup>1</sup>		61	132
		pm	WBL <sup>1</sup>		79	96
			SBL <sup>1</sup>		7	16
2	Highway 407 Westbound Off-Ramp @ Bathurst Street	am	WBL	WBL = 400; WBR = 275;	15	22
			WBR		30	50
		pm	WBL		17	25
			WBR		55	77
3	Highway 7 @ Bathurst Ramp	am	EBL <sup>1</sup>	SBL = 250; EBL = 125	52	104
			SBL <sup>1</sup>		31	44
		pm	EBL <sup>1</sup>		27	50
			SBL <sup>1</sup>		57	74
4	Station Access Road @ Bathurst Ramp	am	EBL	-	No Intersection Under Existing Condition	
			NBL			
		pm	EBL			
			NBL			

Notes:

1. Dual left-turn operations either under existing or future traffic conditions. Parallel lane storage length is per lane.

At the Bathurst Ramp @ Bathurst Street intersection, during the am peak hour, the southbound left-turn movement currently experiences queuing spillbacks, where the queued vehicles exceed the available storage space. There are no queuing issues at other Study Area intersection turning movements.

## 5. FUTURE BACKGROUND CONDITION

### 5.1 Proposed Transit Services

Under the *York Region Transportation Master Plan Update Final Report (2009)*, Bathurst Street (from Steeles Avenue north to 19th Avenue) has been identified as a future rapid transit corridor. While the potential on Bathurst Street for future higher order transit such as bus rapid transit exists, there are currently no formal plans or proposals in place regarding any future transit services. Therefore, for this study, no additional transit services have been assumed along Bathurst Street. Future local transit improvements are also proposed along the Highway 7 corridor and have been reflected in this transportation study.

### 5.2 Future Background Traffic Growth

Future background traffic volumes account for general corridor growth on the Study Area road network. This growth was estimated based on the forecasts obtained from the York Region Travel Demand Forecasting Model. For the purposes of this study, existing traffic volumes were factored up by 1.245, representing a compound growth rate of 1% per annum over 21 years, to develop the 2031 base background traffic volumes. These factors were applied to all movements along the Bathurst Street and Highway 7 corridors.

### 5.3 Future Background Developments

A review of York Region, Town of Richmond Hill and City of Vaughan planning documents indicate that no future background developments are proposed in the Study Area. Therefore, no additional background traffic has been added to the road network.

### 5.4 Future Background Volumes

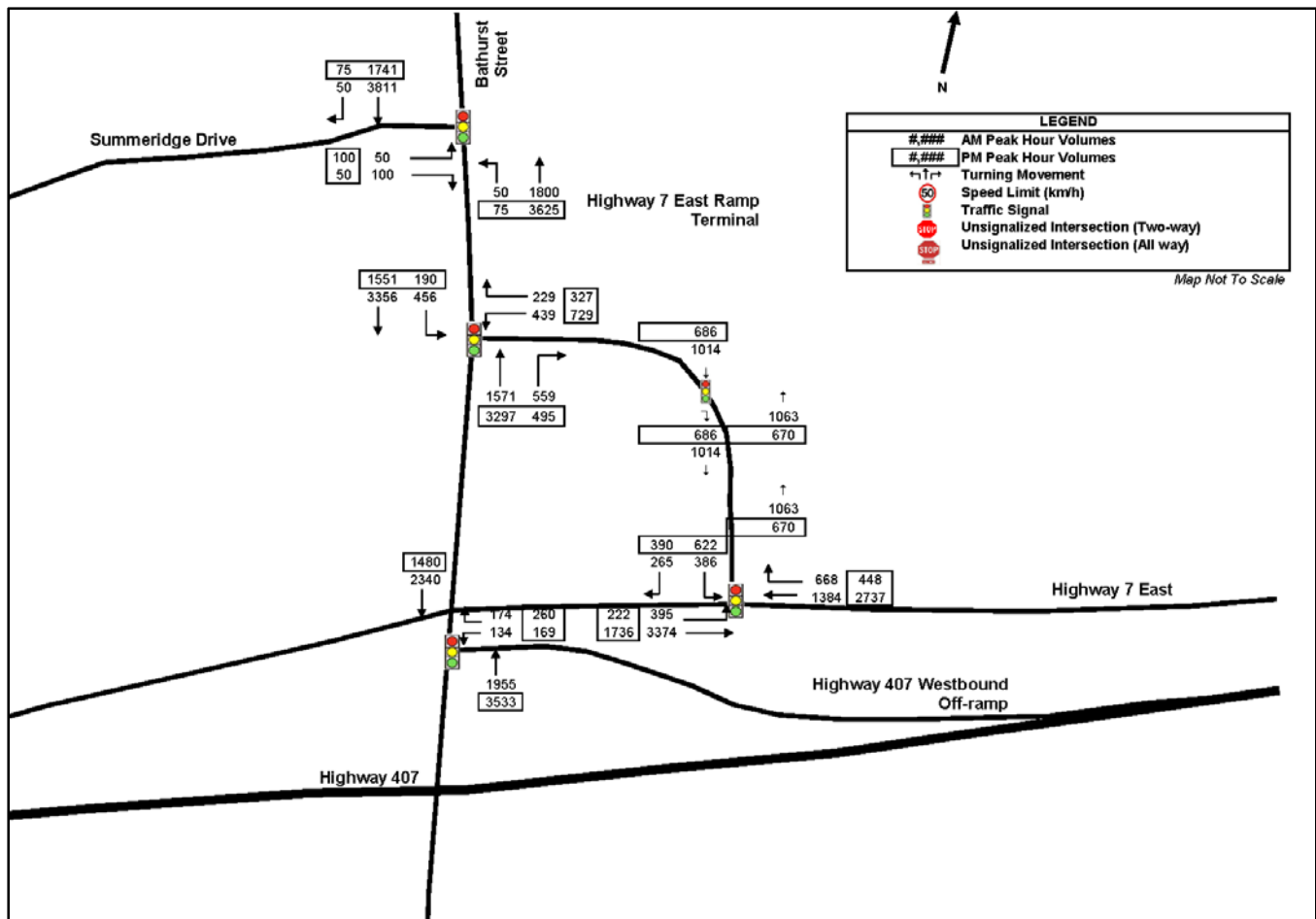
The future (2031) background traffic volumes comprise existing (2010) base traffic volumes shown in **Exhibit 4-3** plus corridor growth traffic to the area surrounding the Subject Site. The resultant future background traffic volumes are illustrated in **Exhibit 5-1** for the weekday am and pm peak hours, respectively.

### 5.5 Future Background Condition (2031) Traffic Operations

The 2031 Background Condition intersection capacity analyses were undertaken using the methodology outlined in **Section 3.2**.



Exhibit 5-1: 2031 Background Condition Traffic Volumes



### 5.5.1 CAPACITY AND LEVEL OF SERVICE

The weekday am and pm peak hour background condition traffic analysis results are included in **Exhibit 5-2**. Full analysis summaries are included in **Appendix B**.

**Exhibit 5-2: Background Condition (2031) Compared with Existing Condition (2010)  
Intersection Operations**

Intersection		Peak Hour	Movement	Existing Condition (2010)			Background Condition (2031)		
				V/C	Delay	LOS	V/C	Delay	LOS
Signalized Intersections									
1	Bathurst Ramp @ Bathurst Street	am	Overall	0.80	16	B	0.93	31	C
			SBT	0.76	10	B	0.99	28	C
			SBL	0.85	41	D	0.87	49	D
		pm	Overall	0.81	16	B	0.98	25	C
			NBT	0.86	15	B	1.00	26	C
			WBL	0.77	50	D	0.96	73	E
2	Highway 407 Westbound Off-Ramp @ Bathurst Street	am	Overall	0.53	7	A	0.68	11	B
		pm	Overall	0.81	14	B	0.91	20	B
			NBT	0.82	13	B	0.94	22	C
3	Highway 7 @ Bathurst Ramp	am	Overall	0.74	26	C	0.85	24	C
			EBT	0.95	29	C	0.95	22	C
			EBL	0.91	52	D	0.96	69	E
		pm	Overall	0.79	26	C	0.91	27	C
			WBT	0.95	39	D	0.97	37	D
4	Station Access Road @ Bathurst Ramp	am	Overall	No Intersection Under Existing Condition			No Intersection Under Background Condition		
			EBL						
		pm	Overall						
			EBL						

Notes:

Critical movement(s) defined as V/C >0.85 and/or poorest LOS.

The future total background traffic analysis results indicate that all the approaches at the signalized intersections will continue to operate satisfactorily at Level of Service (LOS) 'C' (or better) during both the weekday am, and pm peak hours.

However, there is projected to be considerable traffic performance decline at key Study Area intersections. The impact of the additional background traffic is an 11% to 17% increase in the overall V/C ratios at Study Area intersections during the weekday am and pm peak hours. As congested through movements compete with opposing turning movements for a proportion of green time, some intersection approaches will experience over one minute delays per vehicle during the weekday am and pm peak hours.

### 5.5.2 QUEUE LENGTHS

The weekday am and pm peak hour existing condition queue length analysis results are included in **Exhibit 5-3**. Full analysis summaries are included in **Appendix B**.

**Exhibit 5-3: Background Condition (2031) Compared with Existing Condition (2010) Turning Movement Queue Lengths**

Intersection		Peak Hour	Movement	Parallel Lane Storage Length (m)	Existing Condition (2010) Synchro Queues (m)		Background Condition (2031) Synchro Queues (m)	
					50th Percen.	95th Percen.	50th Percen.	95th Percen.
Signalized Intersections								
1	Bathurst Ramp @ Bathurst Street	am	WBL <sup>1</sup>	WBL = 200; SBL = 100;	48	62	60	73
			SBL <sup>1</sup>		61	132	104	187
		pm	WBL <sup>1</sup>		79	96	93	130
			SBL <sup>1</sup>		7	16	38	79
2	Highway 407 Westbound Off-Ramp @ Bathurst Street	am	WBL	WBL = 400; WBR = 275;	15	22	17	25
			WBR		30	50	44	64
		pm	WBL		17	25	20	29
			WBR		55	77	69	95
3	Highway 7 @ Bathurst Ramp	am	EBL <sup>1</sup>	SBL = 250; EBL = 125	52	104	82	144
			SBL <sup>1</sup>		31	44	45	62
		pm	EBL <sup>1</sup>		27	50	41	88
			SBL <sup>1</sup>		57	74	77	99
4	Station Access Road @ Bathurst Ramp	am	EBL	.	No Intersection Under Existing Condition		No Intersection Under Background Condition	
			NBL					
		pm	EBL					
			NBL					

**Notes:**

1. Dual left-turn operations either under existing or future traffic conditions. Parallel lane storage length is per lane.

At the Bathurst Ramp @ Bathurst Street intersection, the southbound left-turn movement is projected to continue to experience queuing issues during the am peak hours. Background traffic growth is also projected to cause eastbound left-turn queuing issues at the Highway 7 @ Bathurst Ramp during the am peak hour. There are no queuing issues at other Study Area intersection turning movements.

## 6. BATHURST STATION RELATED TRAFFIC

### 6.1 Passenger Flow Projections

The preferred station concept shown in **Exhibit 2-2** indicates that the park-and-ride facility will initially include 600 parking spaces for 407 Transitway users and 200 spaces for carpoolers by the year 2031. Access to and from the parking lot will be through a single access point from the Bathurst Ramp.

### 6.2 Bathurst Station Trip Generation

#### 6.2.1 ASSUMPTIONS

The following assumptions were used to establish the increase in site related traffic. The trip generation rates for the subject park-and-ride development were extracted from the *Institute of Transportation Engineers (ITE) Trip Generation Manual, 8th Edition*. The selected trip rates were taken from Land Use Code 090: Park-and-Ride Lot with Bus Service and are summarized in **Exhibit 6-1**.

**Exhibit 6-1: Trips Rates and Splits for Park-and-Ride with PPUDO Facility**

Site Users	No. of Parking Spaces	Am Split		Pm Split		Trip Rates					
						Am Peak Hour			Pm Peak Hour		
		In	Out	In	Out	In	Out	Total	In	Out	Total
407 Transitway	600	81%	19%	23%	77%	0.58	0.14	0.72	0.14	0.48	0.62
Carpool	200	81%	19%	23%	77%	0.58	0.14	0.72	0.14	0.48	0.62

#### 6.2.2 GENERATED TRIPS

The estimated trip generation for the proposed Bathurst Station is summarized in **Exhibit 6-2**. The park-and-ride facility will generate approximately 575 and 500 two-way trips during the am and pm peak hours, respectively.

**Exhibit 6-2: Estimated Trip Generation for Bathurst Station**

Site Users	No. of Parking Spaces	Am Split		Pm Split		Trip Rates					
						Am Peak Hour			Pm Peak Hour		
		In	Out	In	Out	In	Out	Total	In	Out	Total
407 Transitway	600	81%	19%	23%	77%	350	82	432	86	286	372
Carpool	200	81%	19%	23%	77%	117	27	144	28	95	123
<b>Total Trips</b>						<b>467</b>	<b>109</b>	<b>576</b>	<b>114</b>	<b>381</b>	<b>495</b>

## 6.3 Future Bus Transit Volumes

In terms of bus traffic accessing the proposed Bathurst Station, it was assumed the frequency of future local feeder buses including VIVA and YRT would increase by more than 100% and 50%, respectively. Therefore, a total of 18 buses, including approximately 12 VIVA buses will access Bathurst Station from either direction during both the weekday am and pm peak hours.

Based on the data from the *Canadian Capacity Guide for Signalized Intersection (3rd Edition, February 2008)*, for the future condition traffic analysis, each bus is assumed to be equivalent to 2 passenger cars. For the analysis purposes, it is also assumed that existing transit routes would remain unchanged under future conditions.

## 6.4 Trip Distribution

Site generated traffic was assigned to the road network based on the indicated trip generation, trip distribution, and proposed site access parameters. **Exhibit 6-3** summarizes the trip distribution parameters used for this study.

**Exhibit 6-3: Distribution of Park-and-Ride Traffic**

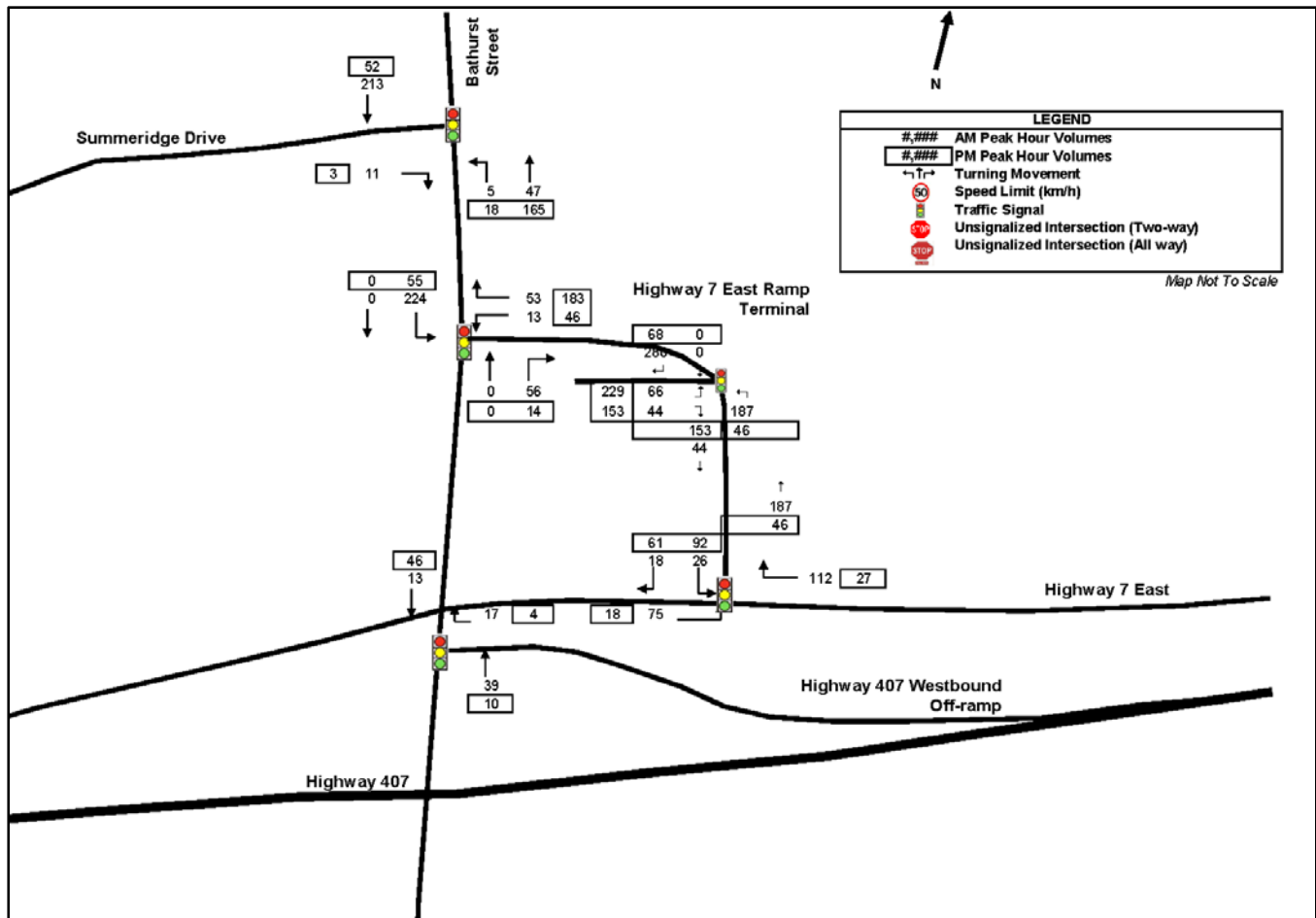
To / From	Am Peak Hour		Pm Peak Hour	
	IN	OUT	IN	OUT
Bathurst Street (North)	46%	43%	46%	43%
Bathurst Street (South)	8%	12%	8%	12%
Highway 7 (West)	16%	16%	16%	16%
Highway 7 (East)	24%	24%	24%	24%
Other	6%	5%	6%	5%
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

The source of the trip distribution is associated with Transportation Tomorrow Survey (TTS) data. As indicated in the TTS data, it is expected that the Bathurst Street north approach will provide the most inbound traffic to the Subject Site during the am and pm peak hours – approximately 43% to 46%. Minor differences for inbound and outbound trips patterns reflect the relative convenience of alternative trip routings afforded by the Study Area and larger regional road network.

## 6.5 Trip Assignment

The site generated trips were assigned to the street network based on the trip distribution percentages discussed above, taking into account the directionality of the trips (inbound vs. outbound). The site generated traffic volumes for the weekday am and pm peak hour are illustrated in **Exhibit 6-4**.

Exhibit 6-4: 2031 Site Generated Traffic Volumes



## 7. FUTURE TOTAL CONDITION

### 7.1 Future Transit Services and Operations

Based on the existing transit route configurations and recommendations from the *Highway 7 Corridor Transit Improvement Report*, the physical location and configuration of future transit operations were evaluated to achieve optimum traffic operations for Study Area intersections.

For future transit operations in the vicinity of Bathurst Station, it was assumed that YRT local transit operations will access the proposed Bathurst Station under a mixed-traffic condition and that VIVA express route operations will utilize on-street stops on the Bathurst Ramp. This assumption is consistent with the *Highway 7 Corridor Transit Improvement Report* recommendations.

As such, providing on-street VIVA bus stops is a cost-effective solution that will reduce the number of transit vehicle movements inside the proposed Bathurst Station thus reducing VIVA running times. This will also reduce turning movement delays at the new signalized site access for other transit vehicles. YRT service configurations on Bathurst Street will remain the same and utilize existing bus stops on both sides of Bathurst Street.

### 7.2 Future Pedestrian / Bicycle Facilities and Operations

In order to ensure the subject site is a complete and sustainable community, it is proposed that walking and cycling infrastructure be built into the site from the outset (See **Exhibit 7-1**). Key features include:

- A multi-use overpass is planned over Highway 7 to facilitate walking and cycling between the park-and-ride and transit bus loop to the 407 Transitway platforms located south of Highway 7. This will eliminate at-grade crossings along the Highway 7 @ Bathurst Ramp intersection and ensure pedestrian safety under future traffic conditions. The approximate distance between the 407 Transitway platforms and Bathurst Street is approximately 350 metres (i.e. less than 7 min walking distance);
- At-grade east-west crosswalks are also recommended for the Highway 7 @ Bathurst Ramp intersection to facilitate VIVA passengers and utilize the pedestrian overpass to access 407 Transitway platforms;
- A pedestrian and bicycle connection to the east side of Bathurst Street to access the existing YRT bus stop;
- A walking path from the park-and-ride area and transit bus bays to access Bathurst Street; and
- Other opportunities to promote walking and cycling including options for bicycle parking, and pedestrian amenities (e.g. benches).

### 7.3 Site Access and Configurations

The total signalized intersection spacing on the Bathurst Ramp is approximately 460 metres. This curved spacing is relatively shorter than desirable distance for the installation of a new signal intersection in this corridor. However, if satisfactory intersection sight lines are maintained, the provision for a mid-block signalized intersection would be acceptable.

The future condition traffic analysis results are based on a new signalized intersection being established on the Bathurst Ramp approximately 240 metres southeast of Bathurst Street and 220 metres northwest of Highway 7. This distance will also ensure that a moderately acceptable distance from the Bathurst Street is maintained to reduce potential interferences with the westbound left-turn movement. However, the selected distance from Highway 7 is considerably shorter to avoid some interference with southbound vehicle queues during the pm. peak hour.

While a northbound left-turn lane could be installed at the Station Access Road @ Bathurst Ramp intersection, it is not recommended due to the substantial curvature and grade variation between the north and south approaches of proposed signalized Station Access Road. As such, it also does not fall within the recommendations documented in *TAC and MTO Geometric Design Guidelines*.

Supplemental improvements at Station Access Road @ Bathurst Ramp intersection beyond those planned will be required to accommodate site generated traffic. These include:

- Signalizing of the new intersection;
- Introducing northbound left-turn and southbound right-turn lanes (i.e. two inbound lanes); and
- Adding three lanes to the eastbound approach to accommodate outbound traffic.

## 7.4 Future Traffic Control and Lane Configurations

Several physical road improvements were recommended in the *Highway 7 Corridor Study* to mitigate the background traffic increases along the Highway 7 corridor. Dual eastbound left-turn lanes were considered for the Highway 7 @ Bathurst Ramp intersection. A southbound dedicated transit left-turn lane is recommended at the same intersection in order to reduce transit delays during commuter rush hours.

A map shown future Study Area roadway lane configurations is shown in **Exhibit 7-1** with recommended future background and site lane configurations and storage lengths shown in blue and red. Other geometrical improvements including pedestrian crossings and pathways are also shown.

## 7.5 Future Total Traffic Volumes

Site traffic volumes were added to future background traffic volumes to obtain the corresponding future total traffic volumes at the study area intersections. The 2031 future total traffic volumes are shown in **Exhibit 7-2**.

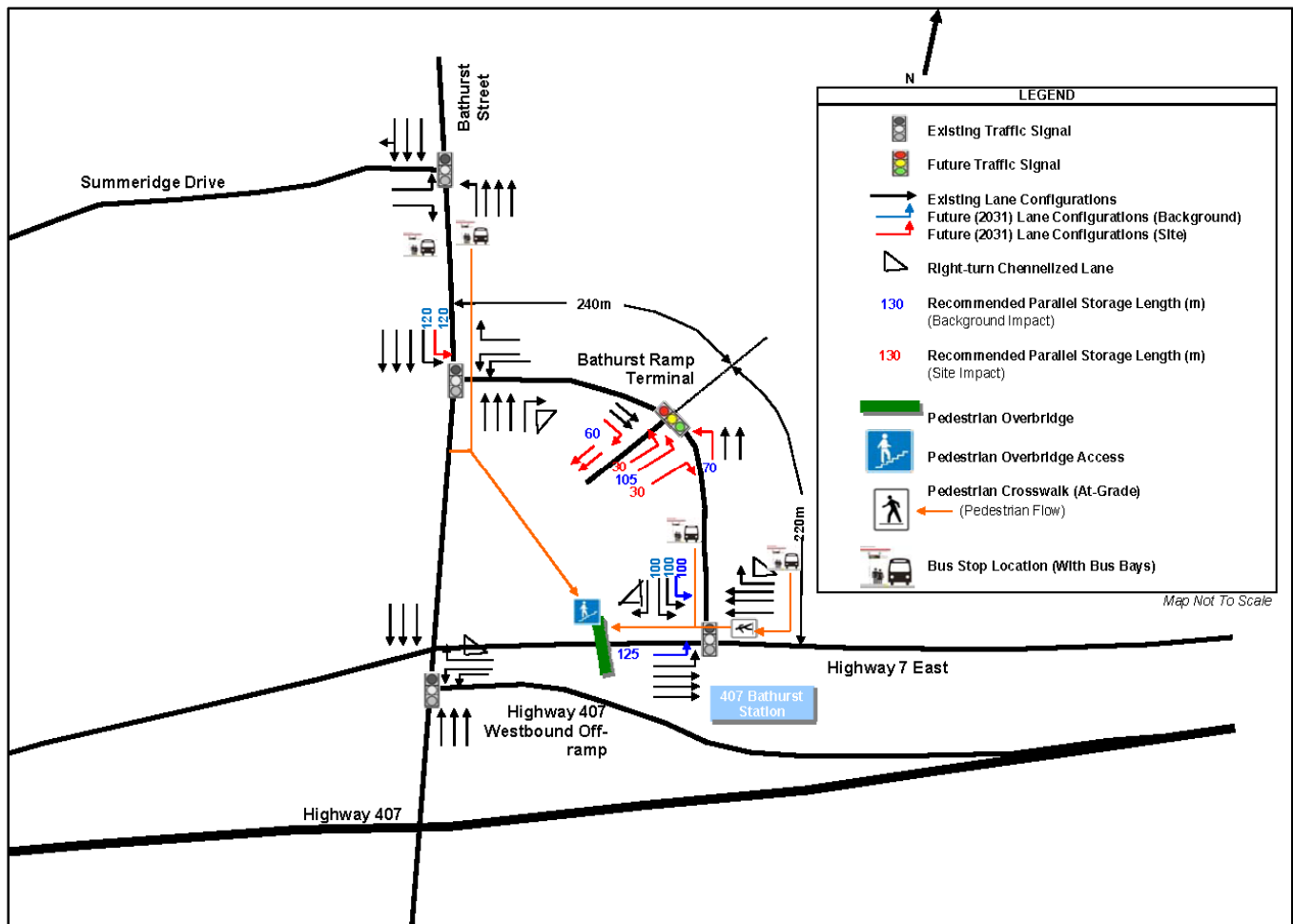
## 7.6 Future Total Condition (2031) Traffic Operations

### 7.6.1 CAPACITY AND LEVEL OF SERVICE

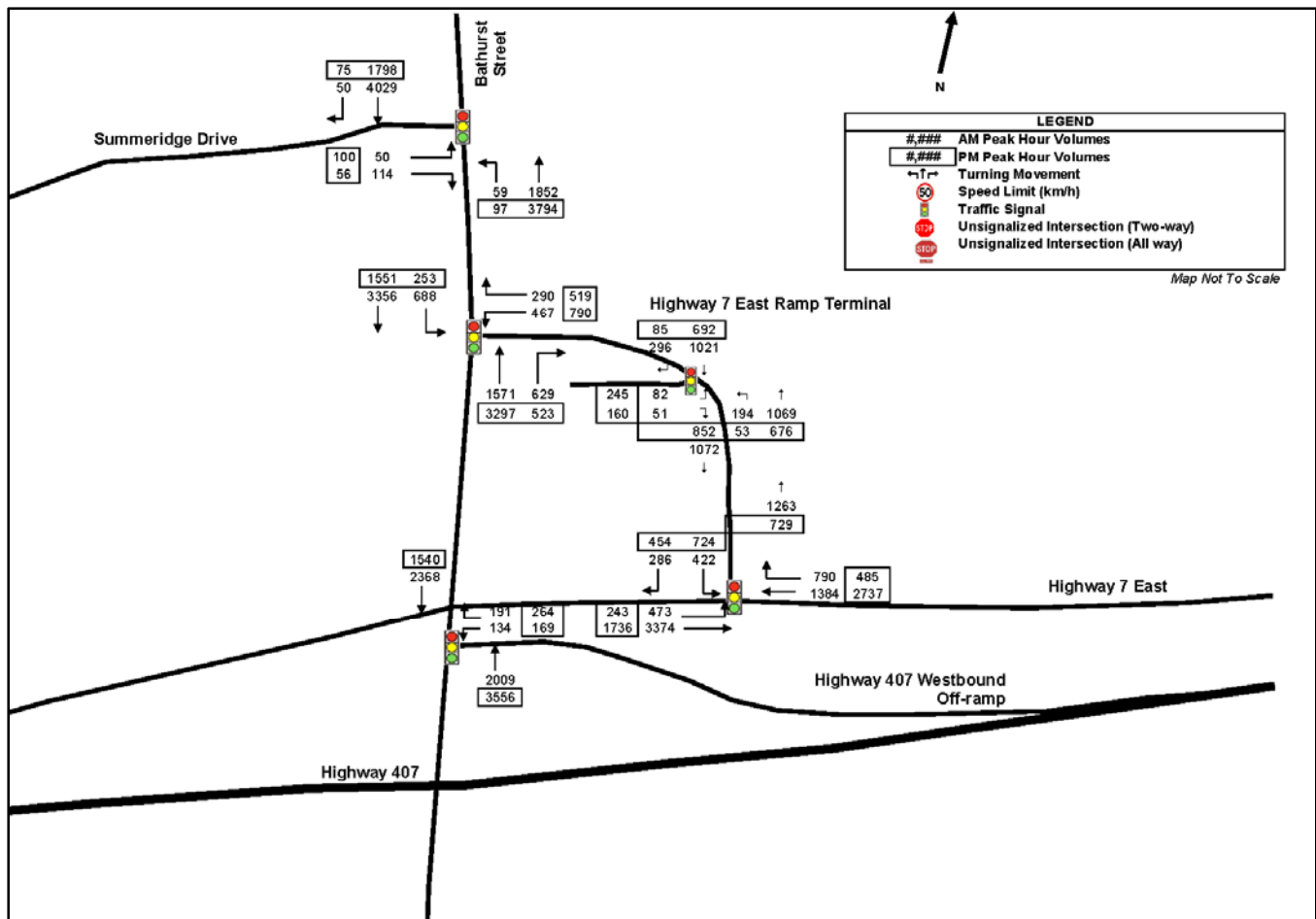
The weekday am and pm peak hour traffic analysis results are included in **Exhibit 7-3**. Full analysis summaries are included in **Appendix C**.



**Exhibit 7-1: Future Study Area Recommended Lane and Geometrical Configurations**



**Exhibit 7-2: 2031 Future Total Traffic Volumes**



**Exhibit 7-3: Future Total Condition (2031) Compared with Background Condition (2031)  
Intersection Operations**

Intersection		Peak Hour	Movement	Background Condition (2031)			Future Total Condition (2031)		
				V/C	Delay	LOS	V/C	Delay	LOS
Signalized Intersections									
1	Bathurst Ramp @ Bathurst Street	am	Overall	0.93	31	C	0.94	31	C
			SBT	0.99	28	C	1.00	33	C
			SBL	0.87	49	D	0.89	52	D
		pm	Overall	0.98	25	C	0.96	23	C
			NBT	1.00	26	C	1.00	23	C
			WBL	0.96	73	E	0.97	73	E
2	Highway 407 Westbound Off-Ramp @ Bathurst Street	am	Overall	0.68	11	B	0.70	11	B
		pm	Overall	0.91	20	B	0.92	21	C
			NBT	0.94	22	C	0.95	23	C
3	Highway 7 @ Bathurst Ramp	am	Overall	0.85	24	C	0.89	41	D
			EBT	0.95	22	C	1.07	59	E
			EBL	0.96	69	E	0.80	40	D
		pm	Overall	0.91	27	C	0.80	32	C
			WBT	0.97	37	D	1.02	50.4	D
4	Station Access Road @ Bathurst Ramp	am	Overall	No Intersection Under Background Condition			0.47	7	A
			EBL				0.30	51	D
		pm	Overall				0.32	13	B
			EBL				0.54	48	D

Notes:

Critical movement(s) defined as V/C > 0.85 and/or poorest LOS.

The addition of site generated traffic is projected to moderately affect future operations at all Study Area intersections, except at the signalized Site Access Road @ Bathurst Ramp intersection. Overall satisfactory level-of-service will be maintained under future traffic conditions (LOS 'D' or better).

During the am peak hour, the addition of park-and-ride and bus transit traffic to the signalized Bathurst Ramp @ Bathurst Street intersection, along with the background traffic increase is projected to impact the southbound approach. V/C ratios are projected to increase significantly and create 'over capacity' conditions. Dual left-turn lanes have been included for the Future Total Conditions to accommodate the future projected traffic volumes for the southbound approach.

It should be noted that the projected southbound left-turn volumes at the signalized Bathurst Ramp @ Bathurst Street intersection under future background condition will be approximately 450 vehicles per hour. Most municipal guidelines, including York Region's suggest that left-turn volumes over 300 vehicles per hour warrant the installation of dual left-turn lanes.

### 7.6.2 QUEUE LENGTHS

The weekday am and pm peak hour existing condition queue length analysis results are included in **Exhibit 7-4**. Full analysis summaries are included in **Appendix C**.

**Exhibit 7-4: Future Total Condition (2031) Compared With Background Condition (2031)  
Intersection Operations**

Intersection		Peak Hour	Movement	Parallel Lane Storage Length (m)	Background Condition (2031) Synchro Queues (m)		Future Total Condition (2031) Synchro Queues (m)	
					50th Percen.	95th Percen.	50th Percen.	95th Percen.
Signalized Intersections								
1	Bathurst Ramp @ Bathurst Street	am	WBL <sup>1</sup>	WBL = 200; SBL = 100;	60	73	63	77
			SBL <sup>1</sup>		104	187	77	111
		pm	WBL <sup>1</sup>		93	130	101	139
			SBL <sup>1</sup>		38	79	20	35
2	Highway 407 Westbound Off-Ramp @ Bathurst Street	am	WBL	WBL = 400; WBR = 275;	17	25	17	25
			WBR		44	64	49	70
		pm	WBL		20	29	20	29
			WBR		69	95	70	97
3	Highway 7 @ Bathurst Ramp	am	EBL <sup>1</sup>	SBL = 250; EBL= 125	82	144	44	61
			SBL <sup>1</sup>		45	62	30	39
		pm	EBL <sup>1</sup>		41	88	17	38
			SBL <sup>1</sup>		77	99	44	53
4	Station Access Road @ Bathurst Ramp	am	EBL	.	No Intersection Under Background Condition		11	18
			NBL				7	23
		pm	EBL				31	42
			NBL				3	7

Notes:

1. Dual left-turn operations either under existing or future traffic conditions. Parallel lane storage length is per lane.

The additional of dual left-turn lanes at the southbound approach of the signalized Bathurst Ramp @ Bathurst Street intersection and at the eastbound approach of the signalized Highway 7 @ Bathurst Ramp intersection is projected to improve queue spillbacks. At the signalized Bathurst Ramp @ Bathurst Street intersection, the southbound left-turn movement is projected to continue to experience minor queue spillbacks during the am peak hour. There are no queuing issues at other Study Area intersection turning movements.

## 8. SUMMARY AND CONCLUSIONS

Based on the analysis presented above, the following have been concluded / recommended:

- A single consolidated signalized Station Access Road is proposed to provide general vehicular and local transit access to Bathurst Station. In order to avoid potential interference with traffic operations at all Study Area intersections, the new traffic signal should be installed at least 240 meters east of Bathurst Street;
- A multi-use overpass is planned across Highway 7 in conjunction with at grade crossings at the Highway 7 @ Bathurst Ramp to facilitate passenger transfers between VIVA and YRT transit services and the 407 Transitway;
- Further investigation is required regarding the sight-line requirements of new signalized Station Access Road @ Bathurst Ramp intersection in order to achieve satisfactory intersection sight triangles and address grade variation issues;
- The preliminary traffic analysis projects that the signalized Bathurst Ramp @ Bathurst Street intersection will operate with relatively low delays and acceptable levels of service if dual left-turn lanes are installed at the southbound approach; and
- On-street VIVA bus operation is desirable in order to mitigate constraints of intersection geometric configurations and to reduce the number of transit vehicles entering and exiting the proposed Bathurst Station during peak hours. As a result, a satisfactory balance for new signalized traffic approaches can be achieved through the selection of acceptable geometric configurations and optimum traffic control elements.



## APPENDIX A

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### 2010 EXISTING CONDITION SYNCHRO SUMMARY OUTPUTS





2010 Existing - Weekday AM Peak Hour  
1: Bathurst Ramp & Bathurst Street

Queues  
Highway 407 Transitway: Bathurst Station

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰↰	↰	↑↑↑	↰	↰	↑↑↑
Volume (vph)	353	184	1262	449	366	2696
Lane Group Flow (vph)	384	200	1372	488	398	2930
Turn Type	Free		Free pm+pt			
Protected Phases	8		2		1	6
Permitted Phases		Free		Free	6	
Detector Phases	8		2		1	6
Minimum Initial (s)	10.0		25.0		7.0	25.0
Minimum Split (s)	32.0		32.0		11.0	32.0
Total Split (s)	40.0	0.0	74.0	0.0	16.0	90.0
Total Split (%)	30.8%	0.0%	56.9%	0.0%	12.3%	69.2%
Yellow Time (s)	5.0		5.0		3.0	5.0
All-Red Time (s)	2.0		2.0		1.0	2.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None		C-Max		None C-Max	
v/c Ratio	0.67	0.13	0.51	0.31	0.85	0.76
Control Delay	56.0	0.2	17.6	0.5	41.9	10.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	56.0	0.2	17.6	0.5	41.9	10.8
Queue Length 50th (m)	47.9	0.0	65.6	0.0	60.3	133.1
Queue Length 95th (m)	61.5	0.0	71.5	0.0	#131.5	180.1
Internal Link Dist (m)	184.0		312.0			92.3
Turn Bay Length (m)		90.0		85.0	100.0	
Base Capacity (vph)	913	1493	2682	1551	471	3847
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.42	0.13	0.51	0.31	0.85	0.76

Intersection Summary

Cycle Length: 130

Actuated Cycle Length: 130

Offset: 125 (96%), Referenced to phase 2:NBT and 6:SBTL, Start of Green

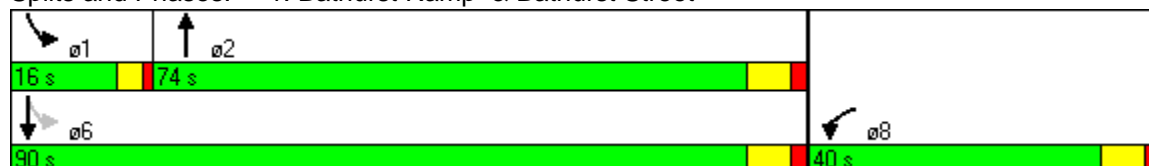
Natural Cycle: 90

Control Type: Actuated-Coordinated

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


Queue shown is maximum after two cycles.

Splits and Phases: 1: Bathurst Ramp & Bathurst Street



2010 Existing - Weekday AM Peak Hour  
1: Bathurst Ramp & Bathurst Street

HCM Signalized Intersection Capacity Analysis  
Highway 407 Transitway: Bathurst Station

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↔↔	↔	↔↔↔	↔	↔	↔↔↔
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.91	1.00	1.00	0.91
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3298	1493	4980	1551	1733	5029
Flt Permitted	0.95	1.00	1.00	1.00	0.13	1.00
Satd. Flow (perm)	3298	1493	4980	1551	232	5029
Volume (vph)	353	184	1262	449	366	2696
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	384	200	1372	488	398	2930
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	384	200	1372	488	398	2930
Heavy Vehicles (%)	5%	7%	3%	3%	3%	2%
Turn Type	Free		Free pm+pt			
Protected Phases	8		2		1	6
Permitted Phases		Free		Free		6
Actuated Green, G (s)	19.6	130.0	67.0	130.0	96.4	96.4
Effective Green, g (s)	22.6	130.0	70.0	130.0	99.4	99.4
Actuated g/C Ratio	0.17	1.00	0.54	1.00	0.76	0.76
Clearance Time (s)	7.0		7.0		4.0	7.0
Vehicle Extension (s)	3.0		6.0		3.0	6.0
Lane Grp Cap (vph)	573	1493	2682	1551	471	3845
v/s Ratio Prot	c0.12		0.28		c0.17	0.58
v/s Ratio Perm		0.13		0.31	c0.48	
v/c Ratio	0.67	0.13	0.51	0.31	0.85	0.76
Uniform Delay, d1	50.2	0.0	19.1	0.0	27.8	8.6
Progression Factor	1.00	1.00	0.88	1.00	1.00	1.00
Incremental Delay, d2	3.1	0.2	0.6	0.5	13.1	1.5
Delay (s)	53.3	0.2	17.4	0.5	40.9	10.1
Level of Service	D	A	B	A	D	B
Approach Delay (s)	35.1		13.0			13.8
Approach LOS	D		B			B
<b>Intersection Summary</b>						
HCM Average Control Delay			15.7		HCM Level of Service	B
HCM Volume to Capacity ratio			0.80			
Actuated Cycle Length (s)			130.0		Sum of lost time (s)	8.0
Intersection Capacity Utilization			68.8%		ICU Level of Service	C
Analysis Period (min)			15			
c Critical Lane Group						



Lane Group	WBL	WBR	NBT	SBT
Lane Configurations	↰↰	↱	↑↑↑	↑↑↑
Volume (vph)	108	140	1571	1880
Lane Group Flow (vph)	117	152	1708	2043
Turn Type	Perm			
Protected Phases	8		2	6
Permitted Phases		8		
Detector Phases	8	8	2	6
Minimum Initial (s)	10.0	10.0	15.0	15.0
Minimum Split (s)	33.0	33.0	30.0	23.0
Total Split (s)	40.0	40.0	90.0	90.0
Total Split (%)	30.8%	30.8%	69.2%	69.2%
Yellow Time (s)	4.0	4.0	5.0	5.0
All-Red Time (s)	2.0	2.0	2.0	2.0
Lead/Lag				
Lead-Lag Optimize?				
Recall Mode	None	None	C-Max	C-Max
v/c Ratio	0.28	0.67	0.44	0.51
Control Delay	50.5	55.3	4.8	3.3
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	50.5	55.3	4.8	3.3
Queue Length 50th (m)	14.1	29.5	39.9	33.8
Queue Length 95th (m)	21.8	49.4	63.0	53.1
Internal Link Dist (m)	447.2		464.1	312.0
Turn Bay Length (m)	290.0			
Base Capacity (vph)	848	422	3875	3988
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.14	0.36	0.44	0.51

**Intersection Summary**

Cycle Length: 130

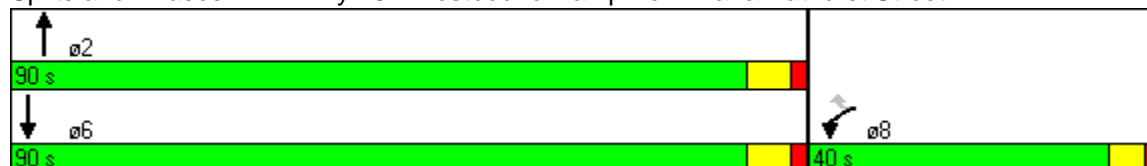
Actuated Cycle Length: 130

Offset: 15 (12%), Referenced to phase 2:NBT and 6:SBT, Start of Green

Natural Cycle: 65

Control Type: Actuated-Coordinated

Splits and Phases: 2: Hwy 407 Westbound Ramp Terminal &amp; Bathurst Street





Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰↰	↰	↰↰↰			↰↰↰
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0			4.0
Lane Util. Factor	0.97	1.00	0.91			0.91
Frt	1.00	0.85	1.00			1.00
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3064	1439	4839			4980
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3064	1439	4839			4980
Volume (vph)	108	140	1571	0	0	1880
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	117	152	1708	0	0	2043
RTOR Reduction (vph)	0	28	0	0	0	0
Lane Group Flow (vph)	117	124	1708	0	0	2043
Heavy Vehicles (%)	13%	11%	6%	0%	0%	3%
Turn Type	Perm					
Protected Phases	8		2			6
Permitted Phases	8					
Actuated Green, G (s)	15.9	15.9	101.1			101.1
Effective Green, g (s)	17.9	17.9	104.1			104.1
Actuated g/C Ratio	0.14	0.14	0.80			0.80
Clearance Time (s)	6.0	6.0	7.0			7.0
Vehicle Extension (s)	3.0	3.0	7.0			7.0
Lane Grp Cap (vph)	422	198	3875			3988
v/s Ratio Prot	0.04		0.35			c0.41
v/s Ratio Perm	c0.09					
v/c Ratio	0.28	0.62	0.44			0.51
Uniform Delay, d1	50.3	52.9	4.0			4.4
Progression Factor	1.00	1.00	1.00			0.61
Incremental Delay, d2	0.4	6.0	0.4			0.3
Delay (s)	50.6	58.9	4.4			3.0
Level of Service	D	E	A			A
Approach Delay (s)	55.3		4.4			3.0
Approach LOS	E		A			A
<b>Intersection Summary</b>						
HCM Average Control Delay			7.1		HCM Level of Service	A
HCM Volume to Capacity ratio			0.53			
Actuated Cycle Length (s)			130.0		Sum of lost time (s)	8.0
Intersection Capacity Utilization			51.3%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

2010 Existing - Weekday AM Peak Hour  
3: Highway 7 & Bathurst Ramp

Queues  
Highway 407 Transitway: Bathurst Station



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑↑↑	↑↑↑	↰	↰↰	↰
Volume (vph)	317	2711	1112	537	310	213
Lane Group Flow (vph)	345	2947	1209	584	337	232
Turn Type	pm+pt			Free		Free
Protected Phases	7	4	8		6	
Permitted Phases	4			Free		Free
Detector Phases	7	4	8		6	
Minimum Initial (s)	7.0	22.0	22.0		10.0	
Minimum Split (s)	11.0	29.0	29.0		23.0	
Total Split (s)	23.0	78.0	55.0	0.0	42.0	0.0
Total Split (%)	19.2%	65.0%	45.8%	0.0%	35.0%	0.0%
Yellow Time (s)	3.0	5.0	5.0		5.0	
All-Red Time (s)	1.0	2.0	2.0		2.0	
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Recall Mode	None	None	None	C-Max		
v/c Ratio	0.92	0.95	0.57	0.38	0.32	0.16
Control Delay	54.2	29.9	27.1	0.7	32.3	0.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	54.2	29.9	27.1	0.7	32.3	0.2
Queue Length 50th (m)	51.6	220.4	78.0	0.0	31.0	0.0
Queue Length 95th (m)#104.0	248.5	92.4	0.0	43.3	0.0	
Internal Link Dist (m)		86.1	503.7		103.8	
Turn Bay Length (m)	125.0			85.0		115.0
Base Capacity (vph)	387	3101	2133	1536	1044	1493
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.89	0.95	0.57	0.38	0.32	0.16

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 2 (2%), Referenced to phase 2: and 6:SBL, Start of Green

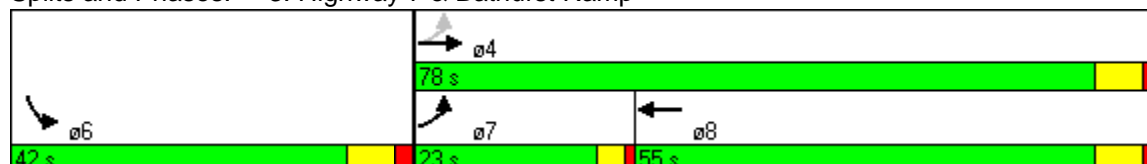
Natural Cycle: 70

Control Type: Actuated-Coordinated

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

Queue shown is maximum after two cycles.

Splits and Phases: 3: Highway 7 & Bathurst Ramp



2010 Existing - Weekday AM Peak Hour  
3: Highway 7 & Bathurst Ramp

HCM Signalized Intersection Capacity Analysis  
Highway 407 Transitway: Bathurst Station



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.91	0.91	1.00	0.97	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1750	5029	4932	1536	3298	1493
Flt Permitted	0.13	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	245	5029	4932	1536	3298	1493
Volume (vph)	317	2711	1112	537	310	213
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	345	2947	1209	584	337	232
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	345	2947	1209	584	337	232
Heavy Vehicles (%)	2%	2%	4%	4%	5%	7%
Turn Type	pm+pt		Free		Free	
Protected Phases	7	4	8		6	
Permitted Phases	4			Free		Free
Actuated Green, G (s)	71.0	71.0	48.9	120.0	35.0	120.0
Effective Green, g (s)	74.0	74.0	51.9	120.0	38.0	120.0
Actuated g/C Ratio	0.62	0.62	0.43	1.00	0.32	1.00
Clearance Time (s)	4.0	7.0	7.0		7.0	
Vehicle Extension (s)	3.0	5.0	5.0		3.0	
Lane Grp Cap (vph)	378	3101	2133	1536	1044	1493
v/s Ratio Prot	0.14	c0.59	0.25		0.10	
v/s Ratio Perm	0.43			c0.38		0.16
v/c Ratio	0.91	0.95	0.57	0.38	0.32	0.16
Uniform Delay, d1	26.5	21.3	25.6	0.0	31.2	0.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	25.7	7.8	0.6	0.7	0.8	0.2
Delay (s)	52.2	29.1	26.2	0.7	32.0	0.2
Level of Service	D	C	C	A	C	A
Approach Delay (s)		31.5	17.9		19.1	
Approach LOS		C	B		B	


Intersection Summary

HCM Average Control Delay	26.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	4.0
Intersection Capacity Utilization	67.9%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

2010 Existing - Weekday PM Peak Hour  
1: Bathurst Ramp & Bathurst Street

Queues  
Highway 407 Transitway: Bathurst Station

						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰↰	↰	↑↑↑	↰	↰↰	↑↑↑
Volume (vph)	586	263	2649	398	153	1246
Lane Group Flow (vph)	637	286	2879	433	166	1354
Turn Type	Free		Free pm+pt			
Protected Phases	8		2		1	6
Permitted Phases		Free		Free	6	
Detector Phases	8		2		1	6
Minimum Initial (s)	10.0		25.0		7.0	25.0
Minimum Split (s)	32.0		32.0		11.0	32.0
Total Split (s)	40.0	0.0	70.0	0.0	20.0	90.0
Total Split (%)	30.8%	0.0%	53.8%	0.0%	15.4%	69.2%
Yellow Time (s)	5.0		5.0		3.0	5.0
All-Red Time (s)	2.0		2.0		1.0	2.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None		C-Max		None C-Max	
v/c Ratio	0.77	0.18	0.86	0.28	0.50	0.39
Control Delay	52.2	0.3	16.4	0.3	15.8	9.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	52.2	0.3	16.4	0.3	15.8	9.0
Queue Length 50th (m)	78.1	0.0	201.1	0.0	6.4	49.0
Queue Length 95th (m)	95.1	0.0	195.1	m0.0	15.7	63.2
Internal Link Dist (m)	184.0		312.0			92.3
Turn Bay Length (m)		90.0		85.0	100.0	
Base Capacity (vph)	950	1551	3366	1536	519	3501
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.67	0.18	0.86	0.28	0.32	0.39

Intersection Summary

Cycle Length: 130

Actuated Cycle Length: 130

Offset: 81 (62%), Referenced to phase 2:NBT and 6:SBTL, Start of Green

Natural Cycle: 90

Control Type: Actuated-Coordinated













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

Splits and Phases: 1: Bathurst Ramp & Bathurst Street



2010 Existing - Weekday PM Peak Hour  
1: Bathurst Ramp & Bathurst Street

HCM Signalized Intersection Capacity Analysis  
Highway 407 Transitway: Bathurst Station

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	*1.00	1.00	0.97	0.91
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3429	1551	5581	1536	3298	5029
Flt Permitted	0.95	1.00	1.00	1.00	0.05	1.00
Satd. Flow (perm)	3429	1551	5581	1536	169	5029
Volume (vph)	586	263	2649	398	153	1246
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	637	286	2879	433	166	1354
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	637	286	2879	433	166	1354
Heavy Vehicles (%)	1%	3%	1%	4%	5%	2%
Turn Type	Free		Free pm+pt			
Protected Phases	8		2		1	6
Permitted Phases	Free		Free			
Actuated Green, G (s)	28.5	130.0	75.4	130.0	87.5	87.5
Effective Green, g (s)	31.5	130.0	78.4	130.0	90.5	90.5
Actuated g/C Ratio	0.24	1.00	0.60	1.00	0.70	0.70
Clearance Time (s)	7.0		7.0		4.0	7.0
Vehicle Extension (s)	3.0		6.0		3.0	6.0
Lane Grp Cap (vph)	831	1551	3366	1536	313	3501
v/s Ratio Prot	c0.19		c0.52		c0.03	0.27
v/s Ratio Perm		0.18		0.28	0.34	
v/c Ratio	0.77	0.18	0.86	0.28	0.53	0.39
Uniform Delay, d1	45.8	0.0	21.2	0.0	24.9	8.2
Progression Factor	1.00	1.00	0.65	1.00	1.00	1.00
Incremental Delay, d2	4.3	0.3	1.7	0.3	1.7	0.3
Delay (s)	50.1	0.3	15.4	0.3	26.6	8.5
Level of Service	D	A	B	A	C	A
Approach Delay (s)	34.7		13.4			10.5
Approach LOS	C		B			B
Intersection Summary						
HCM Average Control Delay			16.0	HCM Level of Service		B
HCM Volume to Capacity ratio			0.81			
Actuated Cycle Length (s)			130.0	Sum of lost time (s)		12.0
Intersection Capacity Utilization			83.7%	ICU Level of Service		E
Analysis Period (min)			15			
c Critical Lane Group						





Lane Group	WBL	WBR	NBT	SBT
Lane Configurations	↰↰	↰	↑↑↑	↑↑↑
Volume (vph)	136	209	2838	1189
Lane Group Flow (vph)	148	227	3085	1292
Turn Type	Perm			
Protected Phases	8		2	6
Permitted Phases		8		
Detector Phases	8	8	2	6
Minimum Initial (s)	10.0	10.0	15.0	15.0
Minimum Split (s)	33.0	33.0	30.0	23.0
Total Split (s)	40.0	40.0	90.0	90.0
Total Split (%)	30.8%	30.8%	69.2%	69.2%
Yellow Time (s)	4.0	4.0	5.0	5.0
All-Red Time (s)	2.0	2.0	2.0	2.0
Lead/Lag				
Lead-Lag Optimize?				
Recall Mode	None	None	C-Max	C-Max
v/c Ratio	0.22	0.75	0.82	0.34
Control Delay	43.7	63.6	14.4	3.9
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	43.7	63.6	14.4	3.9
Queue Length 50th (m)	16.7	55.0	165.6	22.1
Queue Length 95th (m)	24.1	76.7	241.5	32.0
Internal Link Dist (m)	447.2		464.1	312.0
Turn Bay Length (m)	290.0			
Base Capacity (vph)	959	439	3757	3757
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.15	0.52	0.82	0.34

**Intersection Summary**

Cycle Length: 130

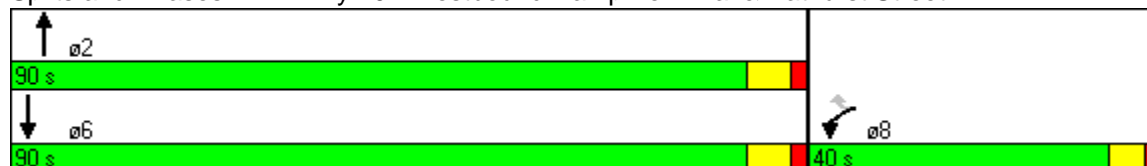
Actuated Cycle Length: 130











Offset: 44 (34%), Referenced to phase 2:NBT and 6:SBT, Start of Green

Natural Cycle: 90

Control Type: Actuated-Coordinated

Splits and Phases: 2: Hwy 407 Westbound Ramp Terminal &amp; Bathurst Street



						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0			4.0
Lane Util. Factor	0.97	1.00	0.91			0.91
Frt	1.00	0.85	1.00			1.00
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3463	1581	5029			5029
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3463	1581	5029			5029
Volume (vph)	136	209	2838	0	0	1189
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	148	227	3085	0	0	1292
RTOR Reduction (vph)	0	2	0	0	0	0
Lane Group Flow (vph)	148	225	3085	0	0	1292
Heavy Vehicles (%)	0%	1%	2%	0%	0%	2%
Turn Type	Perm					
Protected Phases	8		2			6
Permitted Phases	8					
Actuated Green, G (s)	22.9	22.9	94.1			94.1
Effective Green, g (s)	24.9	24.9	97.1			97.1
Actuated g/C Ratio	0.19	0.19	0.75			0.75
Clearance Time (s)	6.0	6.0	7.0			7.0
Vehicle Extension (s)	3.0	3.0	7.0			7.0
Lane Grp Cap (vph)	663	303	3756			3756
v/s Ratio Prot	0.04		c0.61			0.26
v/s Ratio Perm	c0.14					
v/c Ratio	0.22	0.74	0.82			0.34
Uniform Delay, d1	44.4	49.5	10.8			5.6
Progression Factor	1.00	1.00	1.00			0.60
Incremental Delay, d2	0.2	9.5	2.1			0.2
Delay (s)	44.6	59.0	12.9			3.6
Level of Service	D	E	B			A
Approach Delay (s)	53.3		12.9			3.6
Approach LOS	D		B			A
Intersection Summary						
HCM Average Control Delay			13.6	HCM Level of Service		B
HCM Volume to Capacity ratio			0.81			
Actuated Cycle Length (s)			130.0	Sum of lost time (s)		8.0
Intersection Capacity Utilization			74.4%	ICU Level of Service		D
Analysis Period (min)			15			
c Critical Lane Group						

2010 Existing - Weekday PM Peak Hour  
3: Highway 7 & Bathurst Ramp

Queues  
Highway 407 Transitway: Bathurst Station



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑↑↑	↑↑↑	↰	↰↰	↰
Volume (vph)	178	1395	2199	360	500	313
Lane Group Flow (vph)	193	1516	2390	391	543	340
Turn Type	pm+pt			Free		Free
Protected Phases	7	4	8		6	
Permitted Phases	4			Free		Free
Detector Phases	7	4	8		6	
Minimum Initial (s)	7.0	22.0	22.0		10.0	
Minimum Split (s)	11.0	29.0	29.0		23.0	
Total Split (s)	23.0	82.0	59.0	0.0	38.0	0.0
Total Split (%)	19.2%	68.3%	49.2%	0.0%	31.7%	0.0%
Yellow Time (s)	3.0	5.0	5.0		5.0	
All-Red Time (s)	1.0	2.0	2.0		2.0	
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Recall Mode	None	None	None		C-Max	
v/c Ratio	0.68	0.47	0.95	0.25	0.56	0.22
Control Delay	36.8	11.1	40.0	0.4	39.3	0.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	36.8	11.1	40.0	0.4	39.3	0.3
Queue Length 50th (m)	26.7	60.6	192.4	0.0	56.1	0.0
Queue Length 95th (m)	50.0	70.6	#248.2	0.0	73.5	0.0
Internal Link Dist (m)		86.1	503.7		103.8	
Turn Bay Length (m)	125.0			85.0		115.0
Base Capacity (vph)	339	3237	2504	1536	972	1581
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.57	0.47	0.95	0.25	0.56	0.22

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

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

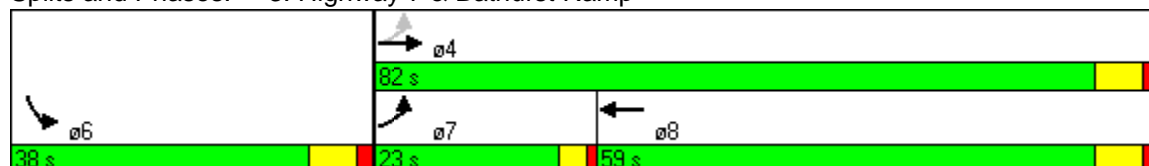
Natural Cycle: 75

Control Type: Actuated-Coordinated

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

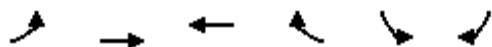
Queue shown is maximum after two cycles.

Splits and Phases: 3: Highway 7 & Bathurst Ramp



2010 Existing - Weekday PM Peak Hour  
3: Highway 7 & Bathurst Ramp

HCM Signalized Intersection Capacity Analysis  
Highway 407 Transitway: Bathurst Station



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.91	0.91	1.00	0.97	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1750	4980	5079	1536	3429	1581
Flt Permitted	0.06	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	117	4980	5079	1536	3429	1581
Volume (vph)	178	1395	2199	360	500	313
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	193	1516	2390	391	543	340
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	193	1516	2390	391	543	340
Heavy Vehicles (%)	2%	3%	1%	4%	1%	1%
Turn Type	pm+pt		Free		Free	
Protected Phases	7	4	8		6	
Permitted Phases	4			Free		Free
Actuated Green, G (s)	75.0	75.0	56.2	120.0	31.0	120.0
Effective Green, g (s)	78.0	78.0	59.2	120.0	34.0	120.0
Actuated g/C Ratio	0.65	0.65	0.49	1.00	0.28	1.00
Clearance Time (s)	4.0	7.0	7.0		7.0	
Vehicle Extension (s)	3.0	5.0	5.0		3.0	
Lane Grp Cap (vph)	277	3237	2506	1536	972	1581
v/s Ratio Prot	c0.09	0.30	c0.47		c0.16	
v/s Ratio Perm	0.37			0.25		0.22
v/c Ratio	0.70	0.47	0.95	0.25	0.56	0.22
Uniform Delay, d1	34.2	10.6	29.1	0.0	36.6	0.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.4	0.2	9.6	0.4	2.3	0.3
Delay (s)	41.6	10.8	38.7	0.4	38.9	0.3
Level of Service	D	B	D	A	D	A
Approach Delay (s)		14.3	33.3		24.1	
Approach LOS		B	C		C	
<b>Intersection Summary</b>						
HCM Average Control Delay			25.7		HCM Level of Service	C
HCM Volume to Capacity ratio			0.79			
Actuated Cycle Length (s)			120.0		Sum of lost time (s)	12.0
Intersection Capacity Utilization			76.6%		ICU Level of Service	D
Analysis Period (min)			15			
c Critical Lane Group						

## APPENDIX B












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### 2031 BACKGROUND CONDITION SYNCHRO SUMMARY OUTPUTS



2031 Background - Weekday AM Peak Hour  
1: Bathurst Ramp & Bathurst Street

Queues  
Highway 407 Transitway: Bathurst Station

						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	439	229	1571	559	456	3356
Lane Group Flow (vph)	477	249	1708	608	496	3648
Turn Type	Free		Free		pm+pt	
Protected Phases	8		2		1	6
Permitted Phases	Free		Free		6	
Detector Phases	8		2		1	6
Minimum Initial (s)	10.0		25.0		7.0	25.0
Minimum Split (s)	32.0		32.0		11.0	32.0
Total Split (s)	40.0	0.0	57.0	0.0	33.0	90.0
Total Split (%)	30.8%	0.0%	43.8%	0.0%	25.4%	69.2%
Yellow Time (s)	5.0		5.0		3.0	5.0
All-Red Time (s)	2.0		2.0		1.0	2.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None		C-Max		None	C-Max
v/c Ratio	0.71	0.17	0.84	0.39	0.87	0.99
Control Delay	54.2	0.2	39.6	0.6	51.6	29.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	54.2	0.2	39.6	0.6	51.6	29.2
Queue Length 50th (m)	59.3	0.0	111.9	0.0	103.4	290.1
Queue Length 95th (m)	72.7	0.0	153.0	0.0	#186.2	#395.1
Internal Link Dist (m)	184.0		312.0			92.3
Turn Bay Length (m)	90.0		85.0		100.0	
Base Capacity (vph)	913	1493	2030	1551	571	3701
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.52	0.17	0.84	0.39	0.87	0.99

Intersection Summary

Cycle Length: 130

Actuated Cycle Length: 130

Offset: 125 (96%), Referenced to phase 2:NBT and 6:SBTL, Start of Green

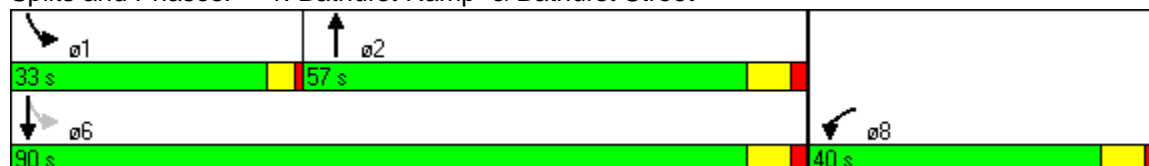
Natural Cycle: 130

Control Type: Actuated-Coordinated

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













Queue shown is maximum after two cycles.

Splits and Phases: 1: Bathurst Ramp & Bathurst Street



2031 Background - Weekday AM Peak Hour  
1: Bathurst Ramp & Bathurst Street

HCM Signalized Intersection Capacity Analysis  
Highway 407 Transitway: Bathurst Station

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.91	1.00	1.00	0.91
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3298	1493	4980	1551	1733	5029
Flt Permitted	0.95	1.00	1.00	1.00	0.07	1.00
Satd. Flow (perm)	3298	1493	4980	1551	128	5029
Volume (vph)	439	229	1571	559	456	3356
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	477	249	1708	608	496	3648
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	477	249	1708	608	496	3648
Heavy Vehicles (%)	5%	7%	3%	3%	3%	2%
Turn Type	Free		Free pm+pt			
Protected Phases	8		2		1	6
Permitted Phases		Free		Free	6	
Actuated Green, G (s)	23.3	130.0	50.0	130.0	92.7	92.7
Effective Green, g (s)	26.3	130.0	53.0	130.0	95.7	95.7
Actuated g/C Ratio	0.20	1.00	0.41	1.00	0.74	0.74
Clearance Time (s)	7.0		7.0		4.0	7.0
Vehicle Extension (s)	3.0		6.0		3.0	6.0
Lane Grp Cap (vph)	667	1493	2030	1551	572	3702
v/s Ratio Prot	c0.14		0.34		0.26	c0.73
v/s Ratio Perm		0.17		0.39	0.38	
v/c Ratio	0.72	0.17	0.84	0.39	0.87	0.99
Uniform Delay, d1	48.4	0.0	34.7	0.0	36.3	16.5
Progression Factor	1.00	1.00	1.03	1.00	1.00	1.00
Incremental Delay, d2	3.6	0.2	3.6	0.6	13.1	11.8
Delay (s)	52.0	0.2	39.3	0.6	49.4	28.2
Level of Service	D	A	D	A	D	C
Approach Delay (s)	34.3		29.1			30.8
Approach LOS	C		C			C
<b>Intersection Summary</b>						
HCM Average Control Delay			30.6		HCM Level of Service	C
HCM Volume to Capacity ratio			0.93			
Actuated Cycle Length (s)			130.0		Sum of lost time (s)	8.0
Intersection Capacity Utilization			84.0%		ICU Level of Service	E
Analysis Period (min)			15			
c Critical Lane Group						





Lane Group	WBL	WBR	NBT	SBT
Lane Configurations	↰↰	↰	↑↑↑	↑↑↑
Volume (vph)	134	174	1955	2340
Lane Group Flow (vph)	146	189	2125	2543
Turn Type	Perm			
Protected Phases	8		2	6
Permitted Phases		8		
Detector Phases	8	8	2	6
Minimum Initial (s)	10.0	10.0	15.0	15.0
Minimum Split (s)	33.0	33.0	30.0	23.0
Total Split (s)	40.0	40.0	90.0	90.0
Total Split (%)	30.8%	30.8%	69.2%	69.2%
Yellow Time (s)	4.0	4.0	5.0	5.0
All-Red Time (s)	2.0	2.0	2.0	2.0
Lead/Lag				
Lead-Lag Optimize?				
Recall Mode	None	None	C-Max	C-Max
v/c Ratio	0.28	0.73	0.57	0.67
Control Delay	46.4	62.6	7.8	9.2
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	46.4	62.6	7.8	9.2
Queue Length 50th (m)	16.9	43.3	71.5	115.9
Queue Length 95th (m)	24.6	64.0	109.5	163.9
Internal Link Dist (m)	447.2		464.1	312.0
Turn Bay Length (m)	290.0			
Base Capacity (vph)	848	408	3704	3812
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.17	0.46	0.57	0.67

**Intersection Summary**

Cycle Length: 130

Actuated Cycle Length: 130

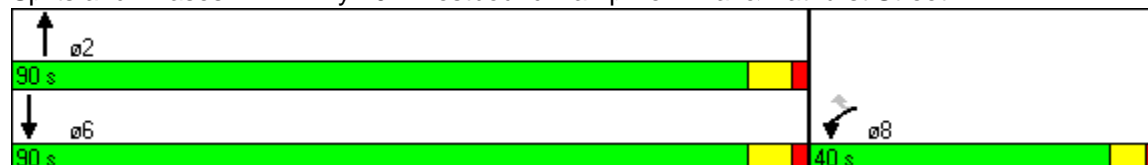
Offset: 15 (12%), Referenced to phase 2:NBT and 6:SBT, Start of Green

Natural Cycle: 80











Control Type: Actuated-Coordinated

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

Splits and Phases: 2: Hwy 407 Westbound Ramp Terminal &amp; Bathurst Street



2031 Background - Weekday AM Peak Hour HCM Signalized Intersection Capacity Analysis  
 2: Hwy 407 Westbound Ramp Terminal & Bathurst Street Highway 407 Transitway: Bathurst Station

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0			4.0
Lane Util. Factor	0.97	1.00	0.91			0.91
Frt	1.00	0.85	1.00			1.00
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3064	1439	4839			4980
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3064	1439	4839			4980
Volume (vph)	134	174	1955	0	0	2340
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	146	189	2125	0	0	2543
RTOR Reduction (vph)	0	11	0	0	0	0
Lane Group Flow (vph)	146	178	2125	0	0	2543
Heavy Vehicles (%)	13%	11%	6%	0%	0%	3%
Turn Type	Perm					
Protected Phases	8		2			6
Permitted Phases	8					
Actuated Green, G (s)	20.5	20.5	96.5			96.5
Effective Green, g (s)	22.5	22.5	99.5			99.5
Actuated g/C Ratio	0.17	0.17	0.77			0.77
Clearance Time (s)	6.0	6.0	7.0			7.0
Vehicle Extension (s)	3.0	3.0	7.0			7.0
Lane Grp Cap (vph)	530	249	3704			3812
v/s Ratio Prot	0.05		0.44			c0.51
v/s Ratio Perm	c0.12					
v/c Ratio	0.28	0.72	0.57			0.67
Uniform Delay, d1	46.7	50.7	6.4			7.3
Progression Factor	1.00	1.00	1.00			1.08
Incremental Delay, d2	0.3	9.4	0.7			0.3
Delay (s)	47.0	60.1	7.0			8.2
Level of Service	D	E	A			A
Approach Delay (s)	54.4		7.0			8.2
Approach LOS	D		A			A
<b>Intersection Summary</b>						
HCM Average Control Delay			10.8		HCM Level of Service	B
HCM Volume to Capacity ratio			0.68			
Actuated Cycle Length (s)			130.0		Sum of lost time (s)	8.0
Intersection Capacity Utilization			60.2%		ICU Level of Service	B
Analysis Period (min)			15			
c Critical Lane Group						

2031 Background - Weekday AM Peak Hour  
3: Highway 7 & Bathurst Ramp

Queues  
Highway 407 Transitway: Bathurst Station



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑↑↑	↑↑↑	↰	↰↰	↰
Volume (vph)	395	3374	1384	668	386	265
Lane Group Flow (vph)	429	3667	1504	726	420	288
Turn Type	pm+pt			Free		Free
Protected Phases	7	4	8		6	
Permitted Phases	4			Free		Free
Detector Phases	7	4	8		6	
Minimum Initial (s)	7.0	22.0	22.0		10.0	
Minimum Split (s)	11.0	29.0	29.0		23.0	
Total Split (s)	30.0	88.0	58.0	0.0	32.0	0.0
Total Split (%)	25.0%	73.3%	48.3%	0.0%	26.7%	0.0%
Yellow Time (s)	3.0	5.0	5.0		5.0	
All-Red Time (s)	1.0	2.0	2.0		2.0	
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Recall Mode	None	None	None		C-Max	
v/c Ratio	0.97	0.95	0.67	0.47	0.55	0.19
Control Delay	69.1	23.2	27.7	1.0	43.5	0.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	69.1	23.2	27.7	1.0	43.5	0.3
Queue Length 50th (m)	81.8	230.5	100.4	0.0	45.0	0.0
Queue Length 95th (m)#144.0	255.5	117.0	0.0	61.1	0.0	
Internal Link Dist (m)		86.1	503.7		103.8	
Turn Bay Length (m)	125.0			85.0		115.0
Base Capacity (vph)	450	3868	2236	1536	770	1493
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.95	0.95	0.67	0.47	0.55	0.19

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 2 (2%), Referenced to phase 2: and 6:SBL, Start of Green

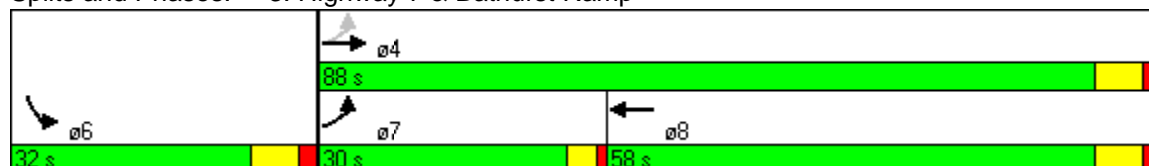
Natural Cycle: 90

Control Type: Actuated-Coordinated

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

Queue shown is maximum after two cycles.

Splits and Phases: 3: Highway 7 & Bathurst Ramp



2031 Background - Weekday AM Peak Hour  
3: Highway 7 & Bathurst Ramp













HCM Signalized Intersection Capacity Analysis  
Highway 407 Transitway: Bathurst Station



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	*1.00	0.91	1.00	0.97	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1750	5526	4932	1536	3298	1493
Flt Permitted	0.08	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	150	5526	4932	1536	3298	1493
Volume (vph)	395	3374	1384	668	386	265
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	429	3667	1504	726	420	288
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	429	3667	1504	726	420	288
Heavy Vehicles (%)	2%	2%	4%	4%	5%	7%
Turn Type	pm+pt		Free		Free	
Protected Phases	7	4	8		6	
Permitted Phases	4			Free		Free
Actuated Green, G (s)	81.0	81.0	51.4	120.0	25.0	120.0
Effective Green, g (s)	84.0	84.0	54.4	120.0	28.0	120.0
Actuated g/C Ratio	0.70	0.70	0.45	1.00	0.23	1.00
Clearance Time (s)	4.0	7.0	7.0		7.0	
Vehicle Extension (s)	3.0	5.0	5.0		3.0	
Lane Grp Cap (vph)	446	3868	2236	1536	770	1493
v/s Ratio Prot	0.21	c0.66	0.30		c0.13	
v/s Ratio Perm	c0.47			0.47		0.19
v/c Ratio	0.96	0.95	0.67	0.47	0.55	0.19
Uniform Delay, d1	35.9	16.1	25.8	0.0	40.4	0.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	32.8	6.3	1.1	1.0	2.8	0.3
Delay (s)	68.7	22.3	26.9	1.0	43.2	0.3
Level of Service	E	C	C	A	D	A
Approach Delay (s)		27.2	18.5		25.7	
Approach LOS		C	B		C	
<b>Intersection Summary</b>						
HCM Average Control Delay			24.3		HCM Level of Service	C
HCM Volume to Capacity ratio			0.85			
Actuated Cycle Length (s)			120.0		Sum of lost time (s)	8.0
Intersection Capacity Utilization			82.9%		ICU Level of Service	E
Analysis Period (min)			15			
c Critical Lane Group						

2031 Background - Weekday PM Peak Hour  
1: Bathurst Ramp & Bathurst Street

Queues  
Highway 407 Transitway: Bathurst Station

						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	729	327	3297	495	190	1551
Lane Group Flow (vph)	729	355	3297	538	207	1633
Turn Type	Free		Free pm+pt			
Protected Phases	8		2		1	6
Permitted Phases		Free		Free	6	
Detector Phases	8		2		1	6
Minimum Initial (s)	10.0		25.0		7.0	25.0
Minimum Split (s)	32.0		32.0		11.0	32.0
Total Split (s)	32.0	0.0	80.0	0.0	18.0	98.0
Total Split (%)	24.6%	0.0%	61.5%	0.0%	13.8%	75.4%
Yellow Time (s)	5.0		5.0		3.0	5.0
All-Red Time (s)	2.0		2.0		1.0	2.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None		C-Max		None C-Max	
v/c Ratio	0.96	0.23	1.00	0.35	0.87	0.45
Control Delay	74.3	0.3	27.0	0.2	68.3	7.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	74.3	0.3	27.0	0.2	68.3	7.8
Queue Length 50th (m)	93.0	0.0	~300.1	0.0	37.4	56.1
Queue Length 95th (m)#	129.4	0.0	#319.0	m0.0	#78.7	64.2
Internal Link Dist (m)	184.0		312.0			92.3
Turn Bay Length (m)		90.0		85.0	100.0	
Base Capacity (vph)	761	1551	3295	1536	247	3636
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.96	0.23	1.00	0.35	0.84	0.45

Intersection Summary

Cycle Length: 130

Actuated Cycle Length: 130

Offset: 81 (62%), Referenced to phase 2:NBT and 6:SBTL, Start of Green

Natural Cycle: 120

Control Type: Actuated-Coordinated

~ Volume exceeds capacity, queue is theoretically infinite.

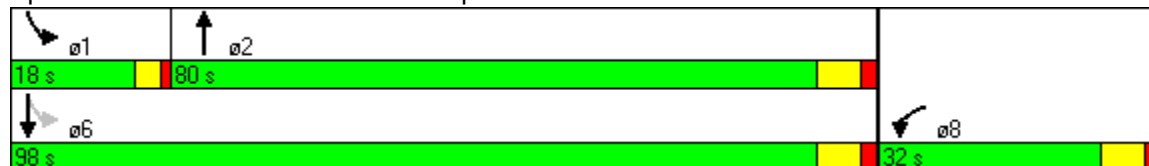
Queue shown is maximum after two cycles.

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

Queue shown is maximum after two cycles.













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

Splits and Phases: 1: Bathurst Ramp & Bathurst Street



2031 Background - Weekday PM Peak Hour  
1: Bathurst Ramp & Bathurst Street

HCM Signalized Intersection Capacity Analysis  
Highway 407 Transitway: Bathurst Station

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	*1.00	1.00	*1.00	1.00	1.00	0.91
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	1.00	1.00
Satd. Flow (prot)	3535	1551	5581	1536	1789	5029
Flt Permitted	0.95	1.00	1.00	1.00	0.05	1.00
Satd. Flow (perm)	3535	1551	5581	1536	89	5029
Volume (vph)	729	327	3297	495	190	1551
Peak-hour factor, PHF	1.00	0.92	1.00	0.92	0.92	0.95
Adj. Flow (vph)	729	355	3297	538	207	1633
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	729	355	3297	538	207	1633
Heavy Vehicles (%)	1%	3%	1%	4%	5%	2%
Turn Type	Free		Free pm+pt			
Protected Phases	8		2		1	6
Permitted Phases		Free		Free	6	
Actuated Green, G (s)	25.0	130.0	73.7	130.0	91.0	91.0
Effective Green, g (s)	28.0	130.0	76.7	130.0	94.0	94.0
Actuated g/C Ratio	0.22	1.00	0.59	1.00	0.72	0.72
Clearance Time (s)	7.0		7.0		4.0	7.0
Vehicle Extension (s)	3.0		6.0		3.0	6.0
Lane Grp Cap (vph)	761	1551	3293	1536	238	3636
v/s Ratio Prot	c0.21		c0.59		c0.09	0.32
v/s Ratio Perm		0.23		0.35	0.54	
v/c Ratio	0.96	0.23	1.00	0.35	0.87	0.45
Uniform Delay, d1	50.4	0.0	26.6	0.0	46.2	7.4
Progression Factor	1.00	1.00	0.62	1.00	1.00	1.00
Incremental Delay, d2	22.6	0.3	9.7	0.2	26.9	0.4
Delay (s)	73.0	0.3	26.1	0.2	73.1	7.8
Level of Service	E	A	C	A	E	A
Approach Delay (s)	49.2		22.5			15.1
Approach LOS	D		C			B
<b>Intersection Summary</b>						
HCM Average Control Delay			24.8		HCM Level of Service	C
HCM Volume to Capacity ratio			0.98			
Actuated Cycle Length (s)			130.0		Sum of lost time (s)	12.0
Intersection Capacity Utilization			105.0%		ICU Level of Service	G
Analysis Period (min)			15			
c Critical Lane Group						



Lane Group	WBL	WBR	NBT	SBT
Lane Configurations	↰↰	↱	↑↑↑	↑↑↑
Volume (vph)	169	260	3533	1480
Lane Group Flow (vph)	184	283	3719	1558
Turn Type	Perm			
Protected Phases	8		2	6
Permitted Phases		8		
Detector Phases	8	8	2	6
Minimum Initial (s)	10.0	10.0	15.0	15.0
Minimum Split (s)	33.0	33.0	30.0	23.0
Total Split (s)	40.0	40.0	90.0	90.0
Total Split (%)	30.8%	30.8%	69.2%	69.2%
Yellow Time (s)	4.0	4.0	5.0	5.0
All-Red Time (s)	2.0	2.0	2.0	2.0
Lead/Lag				
Lead-Lag Optimize?				
Recall Mode	None	None	C-Max	C-Max
v/c Ratio	0.24	0.80	0.94	0.43
Control Delay	40.9	64.4	23.4	5.3
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	40.9	64.4	23.4	5.3
Queue Length 50th (m)	19.9	68.6	254.0	33.5
Queue Length 95th (m)	28.1	94.9	#353.7	m44.6
Internal Link Dist (m)	447.2		464.1	312.0
Turn Bay Length (m)	290.0			
Base Capacity (vph)	959	438	3952	3597
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.19	0.65	0.94	0.43

**Intersection Summary**

Cycle Length: 130

Actuated Cycle Length: 130

Offset: 44 (34%), Referenced to phase 2:NBT and 6:SBT, Start of Green

Natural Cycle: 110

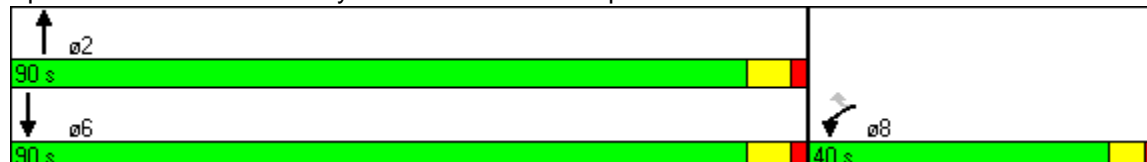
Control Type: Actuated-Coordinated

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











Queue shown is maximum after two cycles.

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

Splits and Phases: 2: Hwy 407 Westbound Ramp Terminal &amp; Bathurst Street



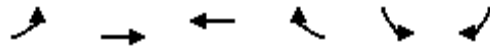
2031 Background - Weekday PM Peak Hour HCM Signalized Intersection Capacity Analysis  
 2: Hwy 407 Westbound Ramp Terminal & Bathurst Street Highway 407 Transitway: Bathurst Station

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0			4.0
Lane Util. Factor	0.97	1.00	*1.00			0.91
Frt	1.00	0.85	1.00			1.00
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3463	1581	5526			5029
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3463	1581	5526			5029
Volume (vph)	169	260	3533	0	0	1480
Peak-hour factor, PHF	0.92	0.92	0.95	0.92	0.92	0.95
Adj. Flow (vph)	184	283	3719	0	0	1558
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	184	283	3719	0	0	1558
Heavy Vehicles (%)	0%	1%	2%	0%	0%	2%
Turn Type	Perm					
Protected Phases	8		2			6
Permitted Phases	8					
Actuated Green, G (s)	27.0	27.0	90.0			90.0
Effective Green, g (s)	29.0	29.0	93.0			93.0
Actuated g/C Ratio	0.22	0.22	0.72			0.72
Clearance Time (s)	6.0	6.0	7.0			7.0
Vehicle Extension (s)	3.0	3.0	7.0			7.0
Lane Grp Cap (vph)	773	353	3953			3598
v/s Ratio Prot	0.05		c0.67			0.31
v/s Ratio Perm	c0.18					
v/c Ratio	0.24	0.80	0.94			0.43
Uniform Delay, d1	41.4	47.8	16.1			7.6
Progression Factor	1.00	1.00	1.00			0.60
Incremental Delay, d2	0.2	12.3	5.9			0.3
Delay (s)	41.6	60.1	22.0			4.9
Level of Service	D	E	C			A
Approach Delay (s)	52.8		22.0			4.9
Approach LOS	D		C			A
<b>Intersection Summary</b>						
HCM Average Control Delay			19.9		HCM Level of Service	B
HCM Volume to Capacity ratio			0.91			
Actuated Cycle Length (s)			130.0		Sum of lost time (s)	8.0
Intersection Capacity Utilization			91.0%		ICU Level of Service	F
Analysis Period (min)			15			
c Critical Lane Group						



2031 Background - Weekday PM Peak Hour  
3: Highway 7 & Bathurst Ramp

Queues  
Highway 407 Transitway: Bathurst Station



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑↑↑	↑↑↑	↰	↰↰	↰
Volume (vph)	222	1736	2737	448	622	390
Lane Group Flow (vph)	241	1887	2881	487	676	424
Turn Type	pm+pt			Free		Free
Protected Phases	7	4	8		6	
Permitted Phases	4			Free		Free
Detector Phases	7	4	8		6	
Minimum Initial (s)	7.0	22.0	22.0		10.0	
Minimum Split (s)	11.0	29.0	29.0		23.0	
Total Split (s)	18.0	86.0	68.0	0.0	34.0	0.0
Total Split (%)	15.0%	71.7%	56.7%	0.0%	28.3%	0.0%
Yellow Time (s)	3.0	5.0	5.0		5.0	
All-Red Time (s)	1.0	2.0	2.0		2.0	
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Recall Mode	None	None	None		C-Max	
v/c Ratio	0.91	0.55	0.97	0.32	0.79	0.27
Control Delay	68.2	10.5	37.9	0.5	49.7	0.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	68.2	10.5	37.9	0.5	49.7	0.4
Queue Length 50th (m)	40.9	75.2	209.7	0.0	76.9	0.0
Queue Length 95th (m)	#87.9	86.1	#251.6	0.0	98.3	0.0
Internal Link Dist (m)		86.1	503.7		103.8	
Turn Bay Length (m)	125.0			85.0		115.0
Base Capacity (vph)	266	3403	2977	1536	857	1581
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.91	0.55	0.97	0.32	0.79	0.27

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

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

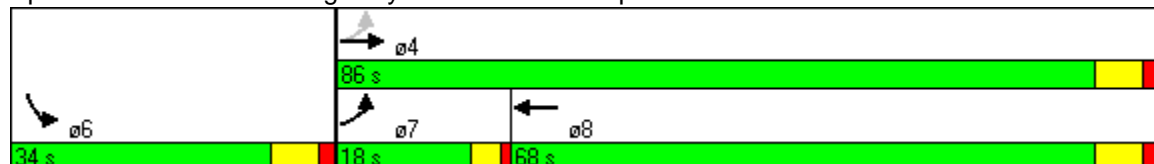
Natural Cycle: 90

Control Type: Actuated-Coordinated

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

Queue shown is maximum after two cycles.

Splits and Phases: 3: Highway 7 & Bathurst Ramp



2031 Background - Weekday PM Peak Hour  
3: Highway 7 & Bathurst Ramp

HCM Signalized Intersection Capacity Analysis  
Highway 407 Transitway: Bathurst Station



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.91	*1.00	1.00	0.97	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1750	4980	5581	1536	3429	1581
Flt Permitted	0.06	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	108	4980	5581	1536	3429	1581
Volume (vph)	222	1736	2737	448	622	390
Peak-hour factor, PHF	0.92	0.92	0.95	0.92	0.92	0.92
Adj. Flow (vph)	241	1887	2881	487	676	424
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	241	1887	2881	487	676	424
Heavy Vehicles (%)	2%	3%	1%	4%	1%	1%
Turn Type	pm+pt			Free		Free
Protected Phases	7	4	8		6	
Permitted Phases	4			Free		Free
Actuated Green, G (s)	79.0	79.0	61.0	120.0	27.0	120.0
Effective Green, g (s)	82.0	82.0	64.0	120.0	30.0	120.0
Actuated g/C Ratio	0.68	0.68	0.53	1.00	0.25	1.00
Clearance Time (s)	4.0	7.0	7.0		7.0	
Vehicle Extension (s)	3.0	5.0	5.0		3.0	
Lane Grp Cap (vph)	265	3403	2977	1536	857	1581
v/s Ratio Prot	c0.11	0.38	c0.52		c0.20	
v/s Ratio Perm	0.51			0.32		0.27
v/c Ratio	0.91	0.55	0.97	0.32	0.79	0.27
Uniform Delay, d1	40.4	9.7	27.0	0.0	42.0	0.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	32.1	0.3	10.2	0.5	7.3	0.4
Delay (s)	72.5	10.0	37.2	0.5	49.3	0.4
Level of Service	E	B	D	A	D	A
Approach Delay (s)		17.1	31.9		30.5	
Approach LOS		B	C		C	
<b>Intersection Summary</b>						
HCM Average Control Delay			26.9		HCM Level of Service	C
HCM Volume to Capacity ratio			0.91			
Actuated Cycle Length (s)			120.0		Sum of lost time (s)	12.0
Intersection Capacity Utilization			92.9%		ICU Level of Service	F
Analysis Period (min)			15			
c Critical Lane Group						

## APPENDIX C







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### 2031 FUTURE CONDITION SYNCHRO SUMMARY OUTPUTS



2031 Future - Weekday AM Peak Hour  
1: Bathurst Ramp & Bathurst Street

Queues  
Highway 407 Transitway: Bathurst Station

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	467	290	1571	629	688	3356
Lane Group Flow (vph)	508	315	1708	684	748	3648
Turn Type	Free		Free		pm+pt	
Protected Phases	8		2		1	6
Permitted Phases	Free		Free		6	
Detector Phases	8		2		1	6
Minimum Initial (s)	10.0		25.0		7.0	25.0
Minimum Split (s)	32.0		32.0		11.0	32.0
Total Split (s)	38.0	0.0	59.0	0.0	33.0	92.0
Total Split (%)	29.2%	0.0%	45.4%	0.0%	25.4%	70.8%
Yellow Time (s)	5.0		5.0		3.0	5.0
All-Red Time (s)	2.0		2.0		1.0	2.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None		C-Max		None	C-Max
v/c Ratio	0.72	0.21	0.72	0.44	0.88	1.00
Control Delay	53.6	0.3	32.8	0.7	48.2	33.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	53.6	0.3	32.8	0.7	48.2	33.3
Queue Length 50th (m)	62.9	0.0	109.6	0.0	76.1	304.5
Queue Length 95th (m)	76.7	0.0	153.4	0.0	#110.1	#400.0
Internal Link Dist (m)	185.3		312.0			92.3
Turn Bay Length (m)	90.0		85.0		100.0	
Base Capacity (vph)	863	1493	2383	1551	898	3650
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.59	0.21	0.72	0.44	0.83	1.00

Intersection Summary

Cycle Length: 130

Actuated Cycle Length: 130

Offset: 125 (96%), Referenced to phase 2:NBT and 6:SBTL, Start of Green

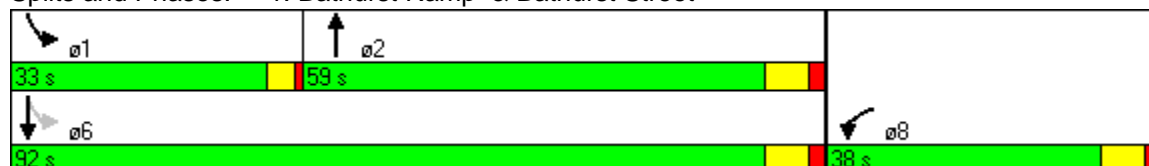
Natural Cycle: 130

Control Type: Actuated-Coordinated

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


Queue shown is maximum after two cycles.

Splits and Phases: 1: Bathurst Ramp & Bathurst Street



2031 Future - Weekday AM Peak Hour  
1: Bathurst Ramp & Bathurst Street

HCM Signalized Intersection Capacity Analysis  
Highway 407 Transitway: Bathurst Station

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↔↔	↔	↔↔↔	↔	↔↔	↔↔↔
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.91	1.00	0.97	0.91
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3298	1493	4980	1551	3362	5029
Flt Permitted	0.95	1.00	1.00	1.00	0.06	1.00
Satd. Flow (perm)	3298	1493	4980	1551	214	5029
Volume (vph)	467	290	1571	629	688	3356
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	508	315	1708	684	748	3648
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	508	315	1708	684	748	3648
Heavy Vehicles (%)	5%	7%	3%	3%	3%	2%
Turn Type	Free		Free pm+pt			
Protected Phases	8		2		1	6
Permitted Phases		Free		Free		6
Actuated Green, G (s)	24.7	130.0	59.2	130.0	91.3	91.3
Effective Green, g (s)	27.7	130.0	62.2	130.0	94.3	94.3
Actuated g/C Ratio	0.21	1.00	0.48	1.00	0.73	0.73
Clearance Time (s)	7.0		7.0		4.0	7.0
Vehicle Extension (s)	3.0		6.0		3.0	6.0
Lane Grp Cap (vph)	703	1493	2383	1551	836	3648
v/s Ratio Prot	c0.15		0.34		0.19	c0.73
v/s Ratio Perm		0.21		0.44	0.46	
v/c Ratio	0.72	0.21	0.72	0.44	0.89	1.00
Uniform Delay, d1	47.6	0.0	26.9	0.0	40.1	17.9
Progression Factor	1.00	1.00	1.10	1.00	1.00	1.00
Incremental Delay, d2	3.7	0.3	1.5	0.7	12.0	14.9
Delay (s)	51.3	0.3	31.1	0.7	52.2	32.8
Level of Service	D	A	C	A	D	C
Approach Delay (s)	31.8		22.4			36.1
Approach LOS	C		C			D
<b>Intersection Summary</b>						
HCM Average Control Delay			31.3		HCM Level of Service	C
HCM Volume to Capacity ratio			0.94			
Actuated Cycle Length (s)			130.0		Sum of lost time (s)	8.0
Intersection Capacity Utilization			84.8%		ICU Level of Service	E
Analysis Period (min)			15			
c Critical Lane Group						



Lane Group	WBL	WBR	NBT	SBT
Lane Configurations	↰↰	↰	↑↑↑	↑↑↑
Volume (vph)	134	191	2009	2368
Lane Group Flow (vph)	146	208	2184	2574
Turn Type	Perm			
Protected Phases	8		2	6
Permitted Phases		8		
Detector Phases	8	8	2	6
Minimum Initial (s)	10.0	10.0	15.0	15.0
Minimum Split (s)	33.0	33.0	30.0	23.0
Total Split (s)	40.0	40.0	90.0	90.0
Total Split (%)	30.8%	30.8%	69.2%	69.2%
Yellow Time (s)	4.0	4.0	5.0	5.0
All-Red Time (s)	2.0	2.0	2.0	2.0
Lead/Lag				
Lead-Lag Optimize?				
Recall Mode	None	None	C-Max	C-Max
v/c Ratio	0.26	0.75	0.60	0.69
Control Delay	44.7	62.8	8.9	8.8
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	44.7	62.8	8.9	8.8
Queue Length 50th (m)	16.6	48.1	80.6	109.4
Queue Length 95th (m)	24.1	69.8	121.3m	165.6
Internal Link Dist (m)	447.2		464.1	312.0
Turn Bay Length (m)	290.0			
Base Capacity (vph)	848	407	3639	3745
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.17	0.51	0.60	0.69

**Intersection Summary**

Cycle Length: 130

Actuated Cycle Length: 130

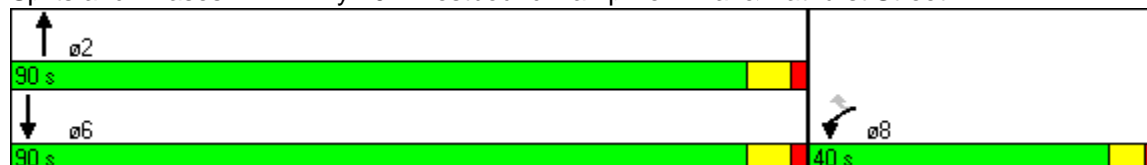
Offset: 15 (12%), Referenced to phase 2:NBT and 6:SBT, Start of Green

Natural Cycle: 80

Control Type: Actuated-Coordinated

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

Splits and Phases: 2: Hwy 407 Westbound Ramp Terminal &amp; Bathurst Street





Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰↰	↰	↰↰↰			↰↰↰
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0			4.0
Lane Util. Factor	0.97	1.00	0.91			0.91
Frt	1.00	0.85	1.00			1.00
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3064	1439	4839			4980
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3064	1439	4839			4980
Volume (vph)	134	191	2009	0	0	2368
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	146	208	2184	0	0	2574
RTOR Reduction (vph)	0	10	0	0	0	0
Lane Group Flow (vph)	146	198	2184	0	0	2574
Heavy Vehicles (%)	13%	11%	6%	0%	0%	3%
Turn Type	Perm					
Protected Phases	8		2			6
Permitted Phases	8					
Actuated Green, G (s)	22.2	22.2	94.8			94.8
Effective Green, g (s)	24.2	24.2	97.8			97.8
Actuated g/C Ratio	0.19	0.19	0.75			0.75
Clearance Time (s)	6.0	6.0	7.0			7.0
Vehicle Extension (s)	3.0	3.0	7.0			7.0
Lane Grp Cap (vph)	570	268	3640			3746
v/s Ratio Prot	0.05		0.45			c0.52
v/s Ratio Perm	c0.14					
v/c Ratio	0.26	0.74	0.60			0.69
Uniform Delay, d1	45.2	49.9	7.3			8.3
Progression Factor	1.00	1.00	1.00			0.92
Incremental Delay, d2	0.2	10.2	0.7			0.3
Delay (s)	45.4	60.1	8.0			7.9
Level of Service	D	E	A			A
Approach Delay (s)	54.1		8.0			7.9
Approach LOS	D		A			A
<b>Intersection Summary</b>						
HCM Average Control Delay			11.1		HCM Level of Service	B
HCM Volume to Capacity ratio			0.70			
Actuated Cycle Length (s)			130.0		Sum of lost time (s)	8.0
Intersection Capacity Utilization			60.8%		ICU Level of Service	B
Analysis Period (min)			15			

c Critical Lane Group



2031 Future - Weekday AM Peak Hour  
3: Highway 7 & Bathurst Ramp

Queues  
Highway 407 Transitway: Bathurst Station



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR	ø5
Lane Configurations	↰↰	↑↑↑	↑↑↑	↰	↰↰↰	↰	
Volume (vph)	473	3374	1384	790	422	286	
Lane Group Flow (vph)	514	3667	1504	859	459	311	
Turn Type	pm+pt			Free		Free	
Protected Phases	7	4	8		6		5
Permitted Phases	4			Free		Free	
Detector Phases	7	4	8		6		
Minimum Initial (s)	7.0	22.0	22.0		10.0		6.0
Minimum Split (s)	11.0	36.0	36.0		34.0		10.0
Total Split (s)	28.0	80.0	52.0	0.0	32.0	0.0	10.0
Total Split (%)	23.0%	65.6%	42.6%	0.0%	26.2%	0.0%	8%
Yellow Time (s)	3.0	5.0	5.0		5.0		3.0
All-Red Time (s)	1.0	2.0	2.0		2.0		1.0
Lead/Lag	Lead		Lag		Lag		Lead
Lead-Lag Optimize?	Yes		Yes		Yes		Yes
Recall Mode	None	None	None		C-Max		None
v/c Ratio	0.80	1.07	0.69	0.56	0.31	0.21	
Control Delay	38.9	60.1	30.3	1.5	32.7	0.3	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	38.9	60.1	30.3	1.5	32.7	0.3	
Queue Length 50th (m)	43.9	~323.2	104.5	0.0	29.6	0.0	
Queue Length 95th (m)	60.4	#343.2	132.3	0.0	38.9	0.0	
Internal Link Dist (m)		86.1	503.7		104.9		
Turn Bay Length (m)	125.0			85.0		115.0	
Base Capacity (vph)	785	3442	2171	1536	1493	1493	
Starvation Cap Reductn	0	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	0	
Reduced v/c Ratio	0.65	1.07	0.69	0.56	0.31	0.21	

Intersection Summary

Cycle Length: 122

Actuated Cycle Length: 122

Offset: 2 (2%), Referenced to phase 2: and 6:SBL, Start of Green

Natural Cycle: 135

Control Type: Actuated-Coordinated

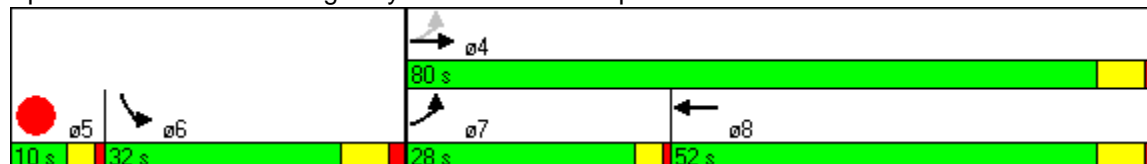
~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

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

Queue shown is maximum after two cycles.

Splits and Phases: 3: Highway 7 & Bathurst Ramp



2031 Future - Weekday AM Peak Hour  
3: Highway 7 & Bathurst Ramp

HCM Signalized Intersection Capacity Analysis  
Highway 407 Transitway: Bathurst Station



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰↰	↑↑↑	↑↑↑	↰	↰↰↰	↰
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	*1.00	0.91	1.00	0.94	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3395	5526	4932	1536	4794	1493
Flt Permitted	0.08	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	276	5526	4932	1536	4794	1493
Volume (vph)	473	3374	1384	790	422	286
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	514	3667	1504	859	459	311
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	514	3667	1504	859	459	311
Heavy Vehicles (%)	2%	2%	4%	4%	5%	7%
Turn Type	pm+pt		Free		Free	
Protected Phases	7	4	8		6	
Permitted Phases	4			Free		Free
Actuated Green, G (s)	73.0	73.0	50.7	122.0	35.0	122.0
Effective Green, g (s)	76.0	76.0	53.7	122.0	38.0	122.0
Actuated g/C Ratio	0.62	0.62	0.44	1.00	0.31	1.00
Clearance Time (s)	4.0	7.0	7.0		7.0	
Vehicle Extension (s)	3.0	5.0	5.0		3.0	
Lane Grp Cap (vph)	640	3442	2171	1536	1493	1493
v/s Ratio Prot	0.12	c0.66	0.30		0.10	
v/s Ratio Perm	0.38			c0.56		0.21
v/c Ratio	0.80	1.07	0.69	0.56	0.31	0.21
Uniform Delay, d1	32.8	23.0	27.5	0.0	32.0	0.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.2	36.3	1.2	1.5	0.5	0.3
Delay (s)	40.0	59.3	28.7	1.5	32.5	0.3
Level of Service	D	E	C	A	C	A
Approach Delay (s)		56.9	18.8		19.5	
Approach LOS		E	B		B	
<b>Intersection Summary</b>						
HCM Average Control Delay			40.7		HCM Level of Service	D
HCM Volume to Capacity ratio			0.89			
Actuated Cycle Length (s)			122.0		Sum of lost time (s)	4.0
Intersection Capacity Utilization			80.2%		ICU Level of Service	D
Analysis Period (min)			15			

c Critical Lane Group

2031 Future - Weekday AM Peak Hour  
4: P&R Access & Bathurst Ramp

Queues  
Highway 407 Transitway: Bathurst Station

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	ø3
Lane Configurations							
Volume (vph)	82	51	194	1069	1021	296	
Lane Group Flow (vph)	89	55	211	1162	1110	322	
Turn Type	pm+ov		pm+pt		pm+ov		
Protected Phases	4	5	5	2	6	4	3
Permitted Phases		4	2			6	
Detector Phases	4	5	5	2	6	4	
Minimum Initial (s)	4.0	7.0	7.0	20.0	20.0	4.0	6.0
Minimum Split (s)	33.0	11.0	11.0	27.0	27.0	33.0	10.0
Total Split (s)	33.0	11.0	11.0	77.0	66.0	33.0	10.0
Total Split (%)	27.5%	9.2%	9.2%	64.2%	55.0%	27.5%	8%
Yellow Time (s)	5.0	3.0	3.0	5.0	5.0	5.0	3.0
All-Red Time (s)	2.0	1.0	1.0	2.0	2.0	2.0	1.0
Lead/Lag	Lag	Lead	Lead		Lag	Lag	Lead
Lead-Lag Optimize?	Yes	Yes	Yes		Yes	Yes	Yes
Recall Mode	None	None	None	C-Max	C-Max	None	None
v/c Ratio	0.30	0.15	0.61	0.41	0.45	0.24	
Control Delay	52.6	10.0	11.4	3.0	8.3	0.6	
Queue Delay	0.0	0.0	0.0	0.2	0.0	0.0	
Total Delay	52.6	10.0	11.4	3.1	8.3	0.6	
Queue Length 50th (m)	10.2	0.0	7.0	26.7	51.1	0.0	
Queue Length 95th (m)	18.0	9.9	22.1	38.5	75.6	4.1	
Internal Link Dist (m)	55.0			90.3	185.3		
Turn Bay Length (m)			50.0			50.0	
Base Capacity (vph)	728	360	347	2869	2454	1501	
Starvation Cap Reductn	0	0	0	697	0	0	
Spillback Cap Reductn	0	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	0	
Reduced v/c Ratio	0.12	0.15	0.61	0.53	0.45	0.21	

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

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

Natural Cycle: 85

Control Type: Actuated-Coordinated

Splits and Phases: 4: P&R Access & Bathurst Ramp

77 s		10 s	
11 s		33 s	

2031 Future - Weekday AM Peak Hour  
4: P&R Access & Bathurst Ramp

HCM Signalized Intersection Capacity Analysis  
Highway 407 Transitway: Bathurst Station

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	←←	→	←	→→	→→	←
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	3011	1452	1700	3433	3433	1521
Flt Permitted	0.95	1.00	0.21	1.00	1.00	1.00
Satd. Flow (perm)	3011	1452	375	3433	3433	1521
Volume (vph)	82	51	194	1069	1021	296
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	89	55	211	1162	1110	322
RTOR Reduction (vph)	0	45	0	0	0	60
Lane Group Flow (vph)	89	10	211	1162	1110	262
Heavy Vehicles (%)	15%	10%	5%	4%	4%	5%
Turn Type	pm+ov		pm+pt		pm+ov	
Protected Phases	4	5	5	2	6	4
Permitted Phases		4	2			6
Actuated Green, G (s)	8.7	19.2	97.3	97.3	82.8	91.5
Effective Green, g (s)	11.7	22.2	100.3	100.3	85.8	97.5
Actuated g/C Ratio	0.10	0.18	0.84	0.84	0.71	0.81
Clearance Time (s)	7.0	4.0	4.0	7.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	294	317	429	2869	2455	1287
v/s Ratio Prot	c0.03	0.00	c0.04	0.34	0.32	0.02
v/s Ratio Perm		0.00	c0.37			0.15
v/c Ratio	0.30	0.03	0.49	0.41	0.45	0.20
Uniform Delay, d1	50.4	40.1	3.9	2.4	7.2	2.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.6	0.0	0.8	0.4	0.6	0.1
Delay (s)	50.9	40.1	4.7	2.8	7.8	2.6
Level of Service	D	D	A	A	A	A
Approach Delay (s)	46.8			3.1	6.6	
Approach LOS	D			A	A	
<b>Intersection Summary</b>						
HCM Average Control Delay			7.0		HCM Level of Service	A
HCM Volume to Capacity ratio			0.47			
Actuated Cycle Length (s)			120.0		Sum of lost time (s)	8.0
Intersection Capacity Utilization			52.3%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

2031 Future - Weekday PM Peak Hour  
1: Bathurst Ramp & Bathurst Street

Queues  
Highway 407 Transitway: Bathurst Station

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↙↘	↗	↑↑↑	↗	↙↘	↑↑↑
Volume (vph)	790	519	3297	536	253	1551
Lane Group Flow (vph)	790	564	3297	583	275	1633
Turn Type	Free		Free		pm+pt	
Protected Phases	8		2		1	6
Permitted Phases	Free		Free		6	
Detector Phases	8		2		1	6
Minimum Initial (s)	10.0		25.0		7.0	25.0
Minimum Split (s)	32.0		32.0		11.0	32.0
Total Split (s)	34.0	0.0	79.0	0.0	17.0	96.0
Total Split (%)	26.2%	0.0%	60.8%	0.0%	13.1%	73.8%
Yellow Time (s)	5.0		5.0		3.0	5.0
All-Red Time (s)	2.0		2.0		1.0	2.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None		C-Max		None	C-Max
v/c Ratio	0.97	0.36	1.00	0.38	0.71	0.46
Control Delay	74.2	0.7	24.5	0.2	35.5	8.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	74.2	0.7	24.5	0.2	35.5	8.7
Queue Length 50th (m)	100.9	0.0	~281.1	0.0	19.8	59.7
Queue Length 95th (m)#	138.9	0.0	#319.5	m0.0	34.2	68.5
Internal Link Dist (m)	184.0		312.0			92.3
Turn Bay Length (m)	90.0		85.0		100.0	
Base Capacity (vph)	816	1551	3309	1536	437	3559
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.97	0.36	1.00	0.38	0.63	0.46

Intersection Summary

Cycle Length: 130

Actuated Cycle Length: 130

Offset: 81 (62%), Referenced to phase 2:NBT and 6:SBTL, Start of Green

Natural Cycle: 110

Control Type: Actuated-Coordinated

~ Volume exceeds capacity, queue is theoretically infinite.

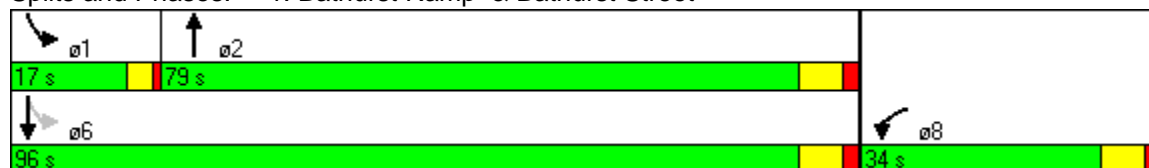
Queue shown is maximum after two cycles.

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

Queue shown is maximum after two cycles.


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

Splits and Phases: 1: Bathurst Ramp & Bathurst Street



2031 Future - Weekday PM Peak Hour  
1: Bathurst Ramp & Bathurst Street

HCM Signalized Intersection Capacity Analysis  
Highway 407 Transitway: Bathurst Station

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↔↔	↔	↔↔↔	↔	↔↔	↔↔↔
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	*1.00	1.00	*1.00	1.00	0.97	0.91
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3535	1551	5581	1536	3298	5029
Flt Permitted	0.95	1.00	1.00	1.00	0.05	1.00
Satd. Flow (perm)	3535	1551	5581	1536	171	5029
Volume (vph)	790	519	3297	536	253	1551
Peak-hour factor, PHF	1.00	0.92	1.00	0.92	0.92	0.95
Adj. Flow (vph)	790	564	3297	583	275	1633
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	790	564	3297	583	275	1633
Heavy Vehicles (%)	1%	3%	1%	4%	5%	2%
Turn Type	Free		Free pm+pt			
Protected Phases	8		2		1	6
Permitted Phases		Free		Free	6	
Actuated Green, G (s)	27.0	130.0	74.1	130.0	89.0	89.0
Effective Green, g (s)	30.0	130.0	77.1	130.0	92.0	92.0
Actuated g/C Ratio	0.23	1.00	0.59	1.00	0.71	0.71
Clearance Time (s)	7.0		7.0		4.0	7.0
Vehicle Extension (s)	3.0		6.0		3.0	6.0
Lane Grp Cap (vph)	816	1551	3310	1536	383	3559
v/s Ratio Prot	c0.22		c0.59		c0.06	0.32
v/s Ratio Perm		0.36		0.38	0.45	
v/c Ratio	0.97	0.36	1.00	0.38	0.72	0.46
Uniform Delay, d1	49.5	0.0	26.3	0.0	41.4	8.2
Progression Factor	1.00	1.00	0.56	1.00	1.00	1.00
Incremental Delay, d2	23.7	0.7	8.3	0.2	6.3	0.4
Delay (s)	73.2	0.7	23.1	0.2	47.8	8.7
Level of Service	E	A	C	A	D	A
Approach Delay (s)	43.0		19.7			14.3
Approach LOS	D		B			B
<b>Intersection Summary</b>						
HCM Average Control Delay			22.7		HCM Level of Service	C
HCM Volume to Capacity ratio			0.96			
Actuated Cycle Length (s)			130.0		Sum of lost time (s)	12.0
Intersection Capacity Utilization			103.5%		ICU Level of Service	G
Analysis Period (min)			15			
c Critical Lane Group						



Lane Group	WBL	WBR	NBT	SBT
Lane Configurations	↰↰	↰	↰↰↰	↰↰↰
Volume (vph)	169	264	3556	1540
Lane Group Flow (vph)	184	287	3743	1621
Turn Type	Perm			
Protected Phases	8		2	6
Permitted Phases		8		
Detector Phases	8	8	2	6
Minimum Initial (s)	10.0	10.0	15.0	15.0
Minimum Split (s)	33.0	33.0	30.0	23.0
Total Split (s)	40.0	40.0	90.0	90.0
Total Split (%)	30.8%	30.8%	69.2%	69.2%
Yellow Time (s)	4.0	4.0	5.0	5.0
All-Red Time (s)	2.0	2.0	2.0	2.0
Lead/Lag				
Lead-Lag Optimize?				
Recall Mode	None	None	C-Max	C-Max
v/c Ratio	0.24	0.80	0.95	0.45
Control Delay	40.7	64.4	24.6	5.2
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	40.7	64.4	24.6	5.2
Queue Length 50th (m)	19.8	69.5	262.4	34.7
Queue Length 95th (m)	28.1	96.5	#358.0	m45.1
Internal Link Dist (m)	447.2		464.1	312.0
Turn Bay Length (m)	290.0			
Base Capacity (vph)	959	438	3939	3585
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.19	0.66	0.95	0.45

### Intersection Summary

Cycle Length: 130

Actuated Cycle Length: 130

Offset: 44 (34%), Referenced to phase 2:NBT and 6:SBT, Start of Green

Natural Cycle: 110

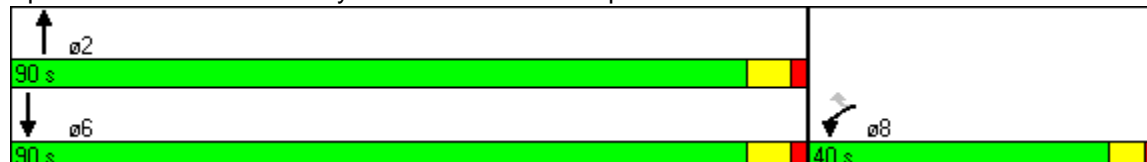
Control Type: Actuated-Coordinated

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

Queue shown is maximum after two cycles.

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

Splits and Phases: 2: Hwy 407 Westbound Ramp Terminal &amp; Bathurst Street





Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰↰	↰	↰↰↰			↰↰↰
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0			4.0
Lane Util. Factor	0.97	1.00	*1.00			0.91
Frt	1.00	0.85	1.00			1.00
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3463	1581	5526			5029
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3463	1581	5526			5029
Volume (vph)	169	264	3556	0	0	1540
Peak-hour factor, PHF	0.92	0.92	0.95	0.92	0.92	0.95
Adj. Flow (vph)	184	287	3743	0	0	1621
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	184	287	3743	0	0	1621
Heavy Vehicles (%)	0%	1%	2%	0%	0%	2%
Turn Type	Perm					
Protected Phases	8		2			6
Permitted Phases		8				
Actuated Green, G (s)	27.3	27.3	89.7			89.7
Effective Green, g (s)	29.3	29.3	92.7			92.7
Actuated g/C Ratio	0.23	0.23	0.71			0.71
Clearance Time (s)	6.0	6.0	7.0			7.0
Vehicle Extension (s)	3.0	3.0	7.0			7.0
Lane Grp Cap (vph)	781	356	3940			3586
v/s Ratio Prot	0.05		c0.68			0.32
v/s Ratio Perm		c0.18				
v/c Ratio	0.24	0.81	0.95			0.45
Uniform Delay, d1	41.2	47.7	16.6			7.9
Progression Factor	1.00	1.00	1.00			0.58
Incremental Delay, d2	0.2	12.5	6.7			0.3
Delay (s)	41.3	60.2	23.3			4.9
Level of Service	D	E	C			A
Approach Delay (s)	52.8		23.3			4.9
Approach LOS	D		C			A
<b>Intersection Summary</b>						
HCM Average Control Delay			20.5		HCM Level of Service	C
HCM Volume to Capacity ratio			0.92			
Actuated Cycle Length (s)			130.0		Sum of lost time (s)	8.0
Intersection Capacity Utilization			91.7%		ICU Level of Service	F
Analysis Period (min)			15			

c Critical Lane Group



2031 Future - Weekday PM Peak Hour  
3: Highway 7 & Bathurst Ramp

Queues  
Highway 407 Transitway: Bathurst Station



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR	ø5
Lane Configurations	↰↰	↑↑↑	↑↑↑	↰	↰↰↰	↰	
Volume (vph)	243	1736	2737	485	724	454	
Lane Group Flow (vph)	264	1887	2881	527	787	493	
Turn Type	pm+pt			Free		Free	
Protected Phases	7	4	8		6		5
Permitted Phases	4			Free		Free	
Detector Phases	7	4	8		6		
Minimum Initial (s)	7.0	22.0	22.0		10.0		6.0
Minimum Split (s)	11.0	36.0	36.0		34.0		10.0
Total Split (s)	11.0	76.0	65.0	0.0	34.0	0.0	10.0
Total Split (%)	9.2%	63.3%	54.2%	0.0%	28.3%	0.0%	8%
Yellow Time (s)	3.0	5.0	5.0		5.0		3.0
All-Red Time (s)	1.0	2.0	2.0		2.0		1.0
Lead/Lag	Lead		Lag		Lag		Lead
Lead-Lag Optimize?	Yes		Yes		Yes		Yes
Recall Mode	None	None	None		C-Max		None
v/c Ratio	0.83	0.63	1.02	0.34	0.47	0.31	
Control Delay	42.3	16.7	50.5	0.6	30.5	0.5	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	42.3	16.7	50.5	0.6	30.5	0.5	
Queue Length 50th (m)	16.3	98.7	~229.4	0.0	43.2	0.0	
Queue Length 95th (m)	#37.5	113.1	#263.0	0.0	53.0	0.0	
Internal Link Dist (m)		86.1	503.7		103.8		
Turn Bay Length (m)	125.0			85.0		115.0	
Base Capacity (vph)	318	2988	2837	1536	1661	1581	
Starvation Cap Reductn	0	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	0	
Reduced v/c Ratio	0.83	0.63	1.02	0.34	0.47	0.31	

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

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

Natural Cycle: 115

Control Type: Actuated-Coordinated

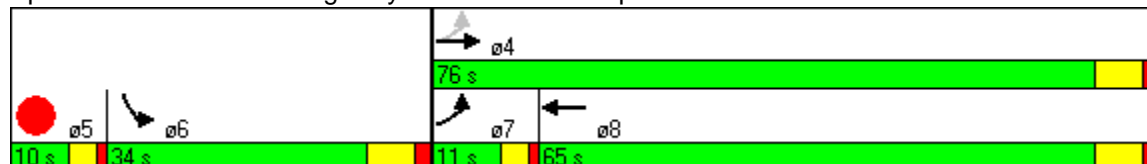
~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

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

Queue shown is maximum after two cycles.

Splits and Phases: 3: Highway 7 & Bathurst Ramp



2031 Future - Weekday PM Peak Hour  
3: Highway 7 & Bathurst Ramp

HCM Signalized Intersection Capacity Analysis  
Highway 407 Transitway: Bathurst Station



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰↰	↑↑↑	↑↑↑	↰	↰↰↰	↰
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.91	*1.00	1.00	0.94	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3395	4980	5581	1536	4984	1581
Flt Permitted	0.06	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	220	4980	5581	1536	4984	1581
Volume (vph)	243	1736	2737	485	724	454
Peak-hour factor, PHF	0.92	0.92	0.95	0.92	0.92	0.92
Adj. Flow (vph)	264	1887	2881	527	787	493
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	264	1887	2881	527	787	493
Heavy Vehicles (%)	2%	3%	1%	4%	1%	1%
Turn Type	pm+pt			Free		Free
Protected Phases	7	4	8		6	
Permitted Phases	4			Free		Free
Actuated Green, G (s)	69.0	69.0	58.0	120.0	37.0	120.0
Effective Green, g (s)	72.0	72.0	61.0	120.0	40.0	120.0
Actuated g/C Ratio	0.60	0.60	0.51	1.00	0.33	1.00
Clearance Time (s)	4.0	7.0	7.0		7.0	
Vehicle Extension (s)	3.0	5.0	5.0		3.0	
Lane Grp Cap (vph)	317	2988	2837	1536	1661	1581
v/s Ratio Prot	c0.05	0.38	c0.52		c0.16	
v/s Ratio Perm	0.45			0.34		0.31
v/c Ratio	0.83	0.63	1.02	0.34	0.47	0.31
Uniform Delay, d1	57.7	15.5	29.5	0.0	31.7	0.0
Progression Factor	1.00	1.00	1.00	1.00	0.93	1.00
Incremental Delay, d2	16.8	0.6	20.9	0.6	1.0	0.5
Delay (s)	74.5	16.1	50.4	0.6	30.4	0.5
Level of Service	E	B	D	A	C	A
Approach Delay (s)		23.2	42.7		18.9	
Approach LOS		C	D		B	
<b>Intersection Summary</b>						
HCM Average Control Delay			32.1		HCM Level of Service	C
HCM Volume to Capacity ratio			0.80			
Actuated Cycle Length (s)			120.0		Sum of lost time (s)	12.0
Intersection Capacity Utilization			83.6%		ICU Level of Service	E
Analysis Period (min)			15			
c Critical Lane Group						

2031 Future - Weekday PM Peak Hour  
4: P&R Access & Bathurst Ramp

Queues  
Highway 407 Transitway: Bathurst Station

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	ø3
Lane Configurations							
Volume (vph)	245	160	53	676	692	85	
Lane Group Flow (vph)	266	174	58	735	752	92	
Turn Type	Perm		Perm		pm+ov		
Protected Phases	4			2	6	4	3
Permitted Phases		4	2			6	
Detector Phases	4	4	2	2	6	4	
Minimum Initial (s)	10.0	10.0	20.0	20.0	20.0	10.0	6.0
Minimum Split (s)	27.0	27.0	27.0	27.0	33.0	27.0	10.0
Total Split (s)	30.0	30.0	80.0	80.0	80.0	30.0	10.0
Total Split (%)	25.0%	25.0%	66.7%	66.7%	66.7%	25.0%	8%
Yellow Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	1.0
Lead/Lag	Lag	Lag				Lag	Lead
Lead-Lag Optimize?	Yes	Yes				Yes	Yes
Recall Mode	None	None	C-Max	C-Max	C-Max	None	None
v/c Ratio	0.54	0.46	0.13	0.27	0.28	0.07	
Control Delay	50.9	10.3	4.1	3.8	4.2	0.1	
Queue Delay	0.0	0.0	0.0	0.2	0.0	0.0	
Total Delay	50.9	10.3	4.1	4.0	4.2	0.1	
Queue Length 50th (m)	30.3	0.0	2.5	19.1	21.1	0.0	
Queue Length 95th (m)	41.7	18.5	6.6	28.2	33.3	0.0	
Internal Link Dist (m)	39.8			94.6	184.0		
Turn Bay Length (m)			50.0			50.0	
Base Capacity (vph)	708	472	436	2714	2688	1376	
Starvation Cap Reductn	0	0	0	1126	0	0	
Spillback Cap Reductn	0	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	0	
Reduced v/c Ratio	0.38	0.37	0.13	0.46	0.28	0.07	

Intersection Summary

Cycle Length: 120

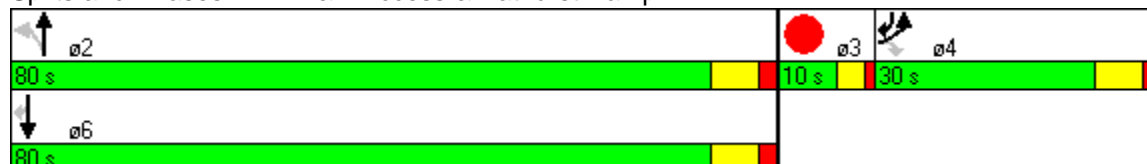
Actuated Cycle Length: 120

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

Natural Cycle: 70

Control Type: Actuated-Coordinated

Splits and Phases: 4: P&R Access & Bathurst Ramp



2031 Future - Weekday PM Peak Hour  
4: P&R Access & Bathurst Ramp

HCM Signalized Intersection Capacity Analysis  
Highway 407 Transitway: Bathurst Station

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	←←	→	←	→→	→→	←
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	3267	1551	1623	3466	3433	1377
Flt Permitted	0.95	1.00	0.35	1.00	1.00	1.00
Satd. Flow (perm)	3267	1551	603	3466	3433	1377
Volume (vph)	245	160	53	676	692	85
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	266	174	58	735	752	92
RTOR Reduction (vph)	0	148	0	0	0	6
Lane Group Flow (vph)	266	26	58	735	752	86
Heavy Vehicles (%)	6%	3%	10%	3%	4%	16%
Turn Type	Perm		Perm	pm+ov		
Protected Phases	4			2	6	4
Permitted Phases		4	2			6
Actuated Green, G (s)	15.0	15.0	91.0	91.0	91.0	106.0
Effective Green, g (s)	18.0	18.0	94.0	94.0	94.0	112.0
Actuated g/C Ratio	0.15	0.15	0.78	0.78	0.78	0.93
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	490	233	472	2715	2689	1377
v/s Ratio Prot	c0.08			0.21	c0.22	0.01
v/s Ratio Perm		0.02	0.10			0.05
v/c Ratio	0.54	0.11	0.12	0.27	0.28	0.06
Uniform Delay, d1	47.2	44.1	3.1	3.6	3.6	0.3
Progression Factor	1.00	1.00	0.90	0.92	1.00	1.00
Incremental Delay, d2	1.2	0.2	0.5	0.2	0.3	0.0
Delay (s)	48.4	44.3	3.3	3.5	3.9	0.3
Level of Service	D	D	A	A	A	A
Approach Delay (s)	46.8			3.5	3.5	
Approach LOS	D			A	A	
<b>Intersection Summary</b>						
HCM Average Control Delay			12.7		HCM Level of Service	B
HCM Volume to Capacity ratio			0.32			
Actuated Cycle Length (s)			120.0		Sum of lost time (s)	8.0
Intersection Capacity Utilization			54.1%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						