



644 Main Street West Transportation Impact & Parking Justification Report

Paradigm Transportation Solutions Limited

March 2017

Project Summary



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644 Main Street West

Transportation Impact & Parking Justification Report

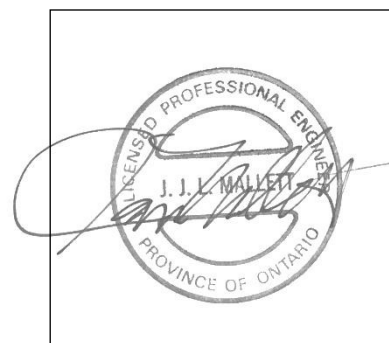
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Signatures and Seals

A handwritten signature in black ink, appearing to be 'S. Manchia', written over a horizontal line.

Signature



Engineer's Seal

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Executive Summary

Content

A new 18-storey residential tower is proposed on the existing site of the Beverly Hills Apartments at 644 Main Street West in Hamilton, Ontario.

Paradigm Transportation Solutions Limited (Paradigm) was retained to undertake this Transportation Impact and Parking Justification Study as a requirement of the development application.

The report documents the additional traffic and parking that is expected to occur because of the development and assesses the impact of the traffic on the surrounding road network and parking needs of the development.

The findings, conclusions and recommendations of this study are summarized below and outlined in detail in the body of the report.

Development Concept

644 Main Street West consists of a 15-storey apartment building containing 281 units. Development plans entail expanding the site to include a second 18-storey apartment building located centrally within the property that will contain 167 units and 96 parking spaces. There are also 5 tandem spaces proposed in the parking garage, however these spaces have not been considered in the parking supply calculations.

Access to 644 Main Street West will be provided via three driveway connections to Carling Street and two connections to Macklin Street South. The connection to Macklin Street South have not been assessed as they primarily serve as access to a small visitor parking area and also serve as a pick-up and drop-off area for residents of the existing building.

Conclusions

Based on the investigations carried out, it is concluded that:

Transportation Overview

- ▶ Under existing conditions, most intersections in the study area are operating at acceptable levels of service during the weekday peak hours. At the intersection of Main Street West and Highway 403 NS Ramp the northbound left turn movement exceeds the theoretical capacity.
- ▶ Under background conditions, most intersections in the study area are forecast to operate at acceptable levels of service during the weekday peak hours. The exception to this is at the intersection of Main Street West and Highway 403 NS Ramp where the northbound left turn movement exceeds the theoretical capacity under all



scenarios and the westbound through movement exceeds theoretical capacity under the 2028 horizon;

- ▶ With full development and occupancy of the property, the subject site is forecast to generate 45 new trips during the weekday AM peak hour and 61 new trips during the weekday PM peak hour.
- ▶ Under total traffic conditions all intersections are forecast to operate with similar operations as noted under the background scenarios.
- ▶ No auxiliary turn lanes are required at the site driveway connections to Carling Street;
- ▶ Limited sight distance is noted to be present to the east along Carling Street. However, as vehicles travelling through the bend in the road they will be negotiating the turn at a lower speed, the available stopping sight distance is sufficient for a design speed of 40 kilometres per hour;

Parking Overview

- ▶ The overall site will encompass 96 parking spaces. This equates to a parking ratio of 0.57 parking space per unit. In addition to the 96 parking spaces, 5 tandem spaces will be provided.
- ▶ The site has been designed to be supportive of measures to reduce the dependency on automobile use by providing and incorporating travel demand management measures consisting of:
 - The owner intends to provide additional bicycle parking spaces within the new single level parking podium, it is unclear as to the amount at this time, however expected to meet demand as dictated by residents of the development.
 - The development will facilitate on-site pedestrian access to the greater sidewalk network, which in turn will provide access to the transit stops.
 - The owner will provide parking as an additional cost in the rental price of a unit. With utilizing this type of parking arrangement, the price of the parking space(s) is separated from the rent or purchase price and allows residents to pay only for parking that they need.
- ▶ Vehicle ownership data indicates that the overall site would require a total of 105 parking (0.63 spaces per unit). Mode split rates further confirm this as the proportion of people in this area of the City who choose to drive for travel purposes is 60 percent of all trips. This rate includes residential requirements.
- ▶ The requirements specified by ITE's Parking Generation with adjustments made to account for vehicle ownership indicates the potential parking demand for the proposed development would be in the order of 120 parking spaces (0.72 spaces per unit). This rate includes residential and visitor requirements.



- ▶ To better understand the actual parking demand that can be expected for a development of this type, a parking utilization survey was undertaken at the existing site and at a secondary site located at 770 Queenston Road. Parking demand from the comparable sites indicates a total of 77 parking spaces (0.46 spaces per unit would be required. This rate includes residential and visitor requirements. The comparable site methodology is the best predictor of the parking demand as this data is representative of demand at local sources.
- ▶ The development is located adjacent to a future LRT line that is anticipated to begin construction in 2019. The site therefore falls within the City's TOD guideline area. The TOD is a high intensive development area within a 400-metre radius to a transit station area that promotes use of existing and future transit infrastructure and discourages auto oriented uses.
- ▶ Within the context of being located in a TOD area, the land use lends itself to being less reliant on auto use where residents and visitors can take advantage of the additional transportation choices such as walking, cycling and transit. It is expected that the land use will generate little resident parking due to the locale in combination with the proposed overall design and marketing strategy of the project.
- ▶ Alternative transportation options provide significant encouragement to residents within the building to explore alternative options given the fact that parking will be at a premium in terms of cost and provided on a limited basis;
- ▶ The current by-law requirements are excessive compared to actual needs. This has been confirmed based on parking demand data collected at comparable sites.
- ▶ Shared parking accommodations could be considered with the existing apartment building located at 644 Main Street West. Results from the parking survey indicate this existing development has well over 100 parking spaces that are not being utilized during peak demand.



Recommendations

Based on the findings of this study, it is recommended that:

- ▶ The City of Hamilton and Ministry of Transportation Ontario recognize the conclusions drawn above;
- ▶ Installations of an Intersection Sign Controlled (WA 13A) sign and a Hidden Intersection tab sign (Wa-18t) should be provided along Carling Street prior to the bend in the roadway to identify the limited sight distance;
- ▶ The signalized intersections along the Main Street West and King Street West corridors be monitored by the City of Hamilton to ensure signal timings are optimized for future traffic conditions and coordination is maintained throughout; and
- ▶ The City of Hamilton support the proposed Zoning By-law variance in order to allow the provision of 96 parking spaces for the overall site.



Contents

1	Introduction	1
1.1	Overview	1
1.2	Purpose and Scope	1
2	Existing Conditions	4
2.1	Existing Roadways	4
2.2	Existing Transit Service	6
2.2.1	Existing Transit	6
2.2.2	Light Rapid Transit.....	8
2.3	Active Transportation	10
2.3.1	Walkability	10
2.3.2	Cycling.....	10
2.4	Existing Traffic Volumes.....	14
2.4.1	Traffic Data	14
2.4.2	Adjustments.....	14
2.5	Traffic Operations.....	17
3	Development Concept	20
3.1	Site Description	20
3.1.1	Existing Development	20
3.1.2	Proposed Development	20
3.2	Development Trip Generation.....	23
3.2.1	Institute of Transportation Engineers (ITE)	23
3.2.2	Trip Generation Estimates	23
3.3	Development Trip Distribution and Assignment.....	24
4	Evaluation of Future Traffic Conditions	27
4.1	Background Traffic Growth.....	27
4.1.1	General Background Growth	27
4.1.2	Background Development	27
4.1.3	Growth Summary.....	29
4.2	Background Traffic Operations	36
4.2.1	Capacity Constraints	36
4.3	Total Traffic Operations	40
4.3.1	Capacity Constraints	40
5	Remedial Measures.....	50
5.1	Sight Distance.....	50
5.2	Auxiliary Turn Lanes	51
5.2.1	Left-Turn Lane Warrants	51
5.2.2	Right-Turn Lane.....	51
5.3	Network Deficiencies	52
5.3.1	Sensitivity Analysis	52



6	Parking Supply Management	54
6.1	Zoning By-Law Requirements	54
6.1.1	Zoning By-Law 6593.....	54
6.1.2	Evolution of Parking Ratios.....	55
6.1.3	Applicability of Zoning By-Law 6593	55
6.1.4	New Zoning By-Law 05-200	56
6.2	Site Specific – Methodology for Reduction.....	57
6.2.1	Area-Specific Mode Choice.....	57
6.2.2	Area-Specific Mode Share.....	58
6.2.3	Area-Specific Recognition	61
6.3	Industry Standard – Methodology for Reduction.....	62
6.3.1	ITE Parking Standards	62
6.3.2	Adjusted for Vehicle Ownership.....	63
6.4	Comparable Sites – Methodology for Reduction.....	64
6.4.1	Beverly Hills Apartment (644 Main Street West, Hamilton).....	64
6.4.2	Tiara (770 Queenston Road, Hamilton)	64
6.4.3	Calculated Design Value (CDV)	66
6.5	Urban Hamilton Official Plan.....	67
6.6	Transit Oriented Guidelines	68
6.7	Visitor Parking.....	68
6.8	Shared Parking Arrangement	68
6.9	Summary of Parking Demand.....	69
6.10	Property Design Elements	71
6.10.1	Secure Bicycle Parking.....	71
6.10.2	Transit Supportive	71
6.10.3	Parking Management.....	71
6.10.4	Summary	72
7	Conclusions and Recommendations	73
7.1	Conclusions	73
7.2	Recommendations.....	75



Appendices

Appendix A	Terms of Reference
Appendix B	Traffic Data
Appendix C	Base Year Traffic Operations Reports
Appendix D	Approved Developments Trip Generation & Projections
Appendix E	Background Traffic Operations Reports
Appendix F	Total Traffic Operations Reports
Appendix G	Sensitivity Analysis Operations Reports
Appendix H	Zoning By-law 6593
Appendix I	Zoning By-law 05-200
Appendix J	Comparable Sites - Parking Survey Data



Figures

Figure 1.1:	Location of Subject Site & Study Area.....	3
Figure 2.1:	Existing Lane Configuration & Traffic Control	5
Figure 2.2:	Existing Transit Network	7
Figure 2.3:	Proposed LRT And GO Network	9
Figure 2.4:	Existing Cycling Network.....	12
Figure 2.5:	Bike Share Stations.....	13
Figure 2.6A:	Base Year AM Peak Hour Traffic Volumes	15
Figure 2.6B:	Base Year PM Peak Hour Traffic Volumes	16
Figure 3.1:	Site Plan.....	22
Figure 3.2A:	Site Generated AM Peak Hour Forecasts.....	25
Figure 3.2B:	Site Generated PM Peak Hour Forecasts.....	26
Figure 4.1:	WHID Lands	28
Figure 4.2A:	2018 Background AM Peak Hour Forecasts	30
Figure 4.2B:	2018 Background PM Peak Hour Forecasts.....	31
Figure 4.3A:	2023 Background AM Peak Hour Forecasts	32
Figure 4.3B:	2023 Background PM Peak Hour Forecasts.....	33
Figure 4.4A:	2028 Background AM Peak Hour Forecasts	34
Figure 4.4B:	2028 Background PM Peak Hour Forecasts.....	35
Figure 4.5A:	2018 Total AM Peak Hour Forecasts.....	41
Figure 4.5B:	2018 Total PM Peak Hour Forecasts.....	42
Figure 4.6A:	2023 Total AM Peak Hour Forecasts.....	43
Figure 4.6B:	2023 Total PM Peak Hour Forecasts.....	44
Figure 4.7A:	2028 Total AM Peak Hour Forecasts.....	45
Figure 4.7B:	2028 Total PM Peak Hour Forecasts.....	46



Tables

Table 2.1:	Vehicle Level of Service Definitions	17
Table 2.2:	Base Year Peak Hour Traffic Volumes.....	19
Table 3.1:	Trip Generation Estimates.....	23
Table 3.2:	Trip Distribution.....	24
Table 4.1:	2018 Background Operations Summary.....	37
Table 4.2:	2023 Background Operations Summary.....	38
Table 4.3:	2028 Background Operations Summary.....	39
Table 4.4:	2018 Total Operations Summary.....	47
Table 4.5:	2023 Total Operations Summary.....	48
Table 4.6:	2028 Total Operations Summary.....	49
Table 5.1:	Sight Distance Requirements.....	50
Table 5.2:	Sight Distance Measurements	50
Table 5.3:	2028 AM Peak Hour Total TraffSensitivity Analysis	53
Table 6.1:	Zoning Requirements.....	54
Table 6.2:	Zoning By-Law 05-200 Parking Requirements.....	56
Table 6.3:	Vehicles Per Household (2011 TTS)	57
Table 6.4:	Vehicles Per Household (2001 TTS)	58
Chart 6.5:	Commuting Trips In The Study Area.....	60
Table 6.6:	Parking Demand Based on Vehicle Ownership.....	61
Table 6.7:	ITE Parking Requirements.....	62
Table 6.8:	ITE Parking Requirements – Adjusted	63
Chart 6.9:	644 Main Street West (Beverly) Parking Demand Trend..	65
Chart 6.10:	770 Queenston Road (Tiara) Parking Demand Trend	65
Table 6.11:	Design Value Estimated Demand.....	66



1 Introduction

1.1 Overview

Paradigm Transportation Solutions Limited (Paradigm) was retained to conduct this Transportation Impact and Parking Justification Study for a new 18-storey residential tower proposed on the existing site of the Beverly Hills Apartments at 644 Main Street West in Hamilton, Ontario.

Figure 1.1 illustrates the location of the development.

1.2 Purpose and Scope

The scope of the transportation component includes determination of the current traffic and site conditions near the proposed development, additional traffic that will be generated by the proposed development, analyses of the impact that this traffic may have on the adjacent roadway network and recommendations with regard to any necessary remedial measures required to mitigate the site generated traffic in a satisfactory manner.

The scope of the parking component is to assess the adequacy of the parking supply being proposed for the development and to provide a plan to ensure that the parking is accommodated and managed in a manner that is consistent with the development's needs.

More specifically, the purpose of this study is to:

- ▶ Forecast traffic from the proposed redevelopment;
- ▶ Assign the projected volumes to the surrounding road network based on the existing traffic patterns at the driveway connections;
- ▶ Assess future total traffic within the study area. The following horizons have been considered: Opening Day, 5 years from Opening Day and 10 year from Opening Day;
- ▶ Identify operational or safety concerns and any mitigation measures that may be required to improve operations;
- ▶ Review the City of Hamilton's Zoning By-Law requirements;
- ▶ Provide a technical analysis using secondary source and local parking survey information to estimate the potential parking demand; and
- ▶ Review the adequacy of the proposed parking supply.

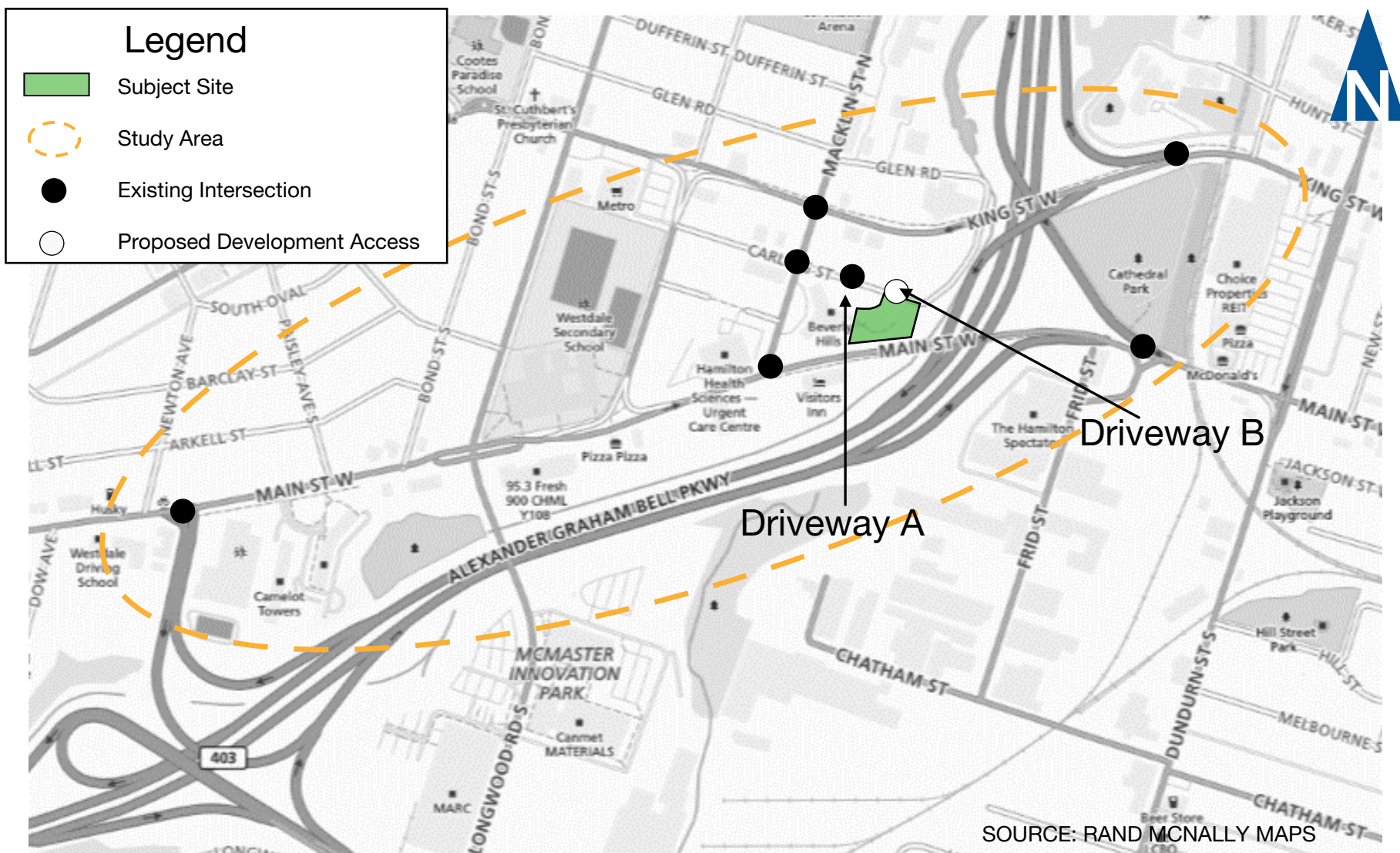
Pre-study consultation with the City of Hamilton and Ministry of Transportation via e-mail in October 2016, yielded a terms of reference for this study. **Appendix A** contains correspondence regarding establishing the terms of reference.



The intersections evaluated within this study that are most likely to be impacted by the development, as identified by the City and Ministry are:

- ▶ King Street and Macklin Street South;
- ▶ Macklin Street South and Carling Street;
- ▶ Main Street West and Macklin Street South;
- ▶ Carling Street and Driveway A;
- ▶ Carling Street and Driveway B;
- ▶ Main Street West and Highway 403 SE Ramp;
- ▶ Main Street West and Highway 403 NE Ramp;
- ▶ Main Street West and Highway 403 NS Ramp;
- ▶ King Street West and Highway 403 NW Ramp; and
- ▶ King Street West and Highway 403 SW Ramp.





2 Existing Conditions

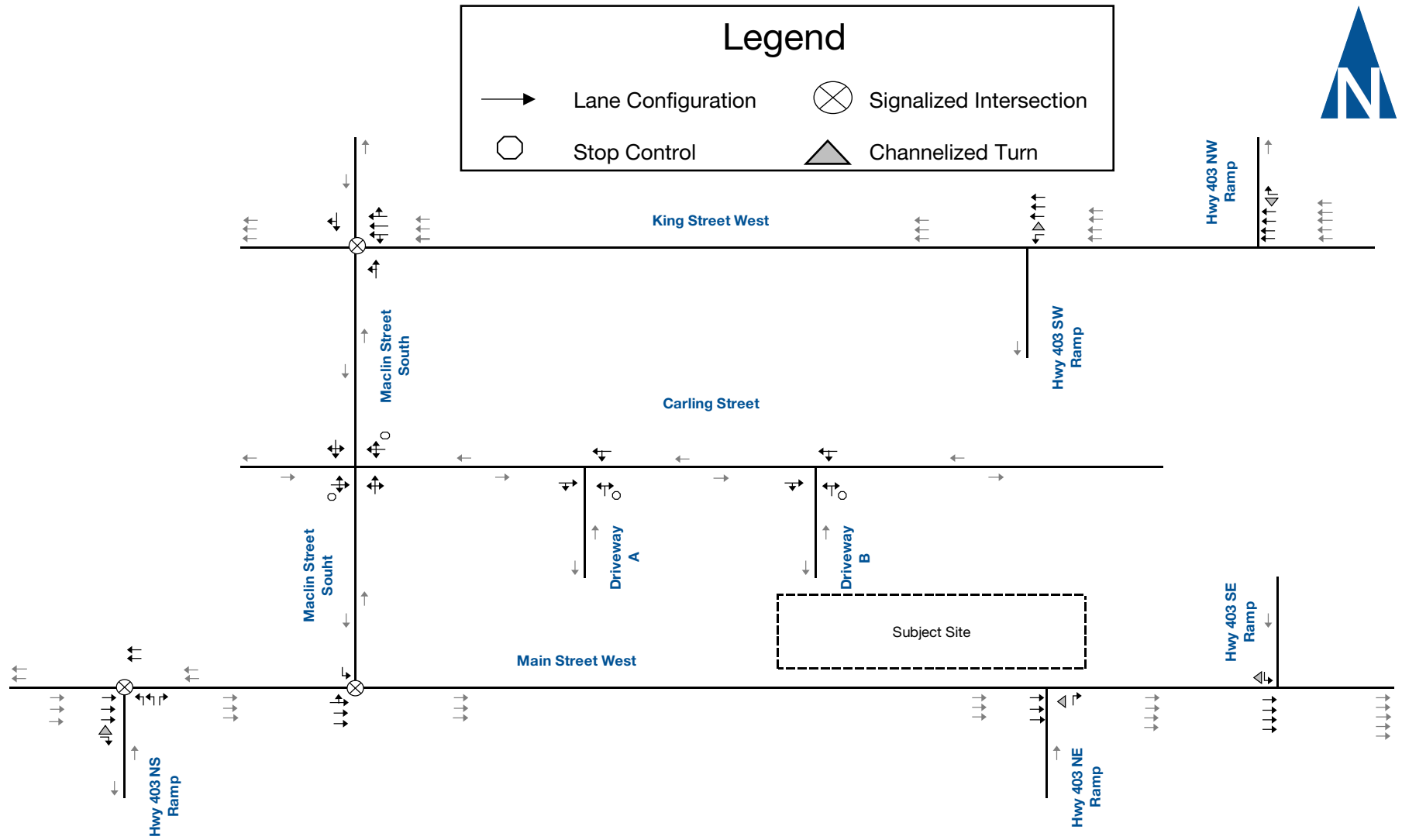
This section of the report provides an overview of the existing conditions on the roadways in the study area.

2.1 Existing Roadways

Figure 2.1 displays the existing lane configurations and traffic control provisions at the study area intersections. The roadways that form the study area include:

- ▶ **Main Street West** is a major arterial running east-west within the study area. The roadway operates with one-way operation in the eastbound direction with an urban cross-section, three travel lanes with a posted speed limit of 60 kilometres per hour. Sidewalks are provided on both sides of the roadway and an on-street cycling track is provided on the south side of the roadway. On-street parking is not permitted on either side of the roadway.
- ▶ **King Street West** is a major arterial running east-west within the study area. The roadway operates with one-way operation in the westbound direction with an urban cross-section, three travel lanes with a posted speed limit of 50 kilometres per hour. Sidewalks are provided on both sides of the roadway however discontinue over the Highway 403 bridge network; approximately 140 metres east of Macklin Street South. On-street parking is not permitted on either side of the roadway.
- ▶ **Macklin Street South** is a collector road running north-south within the study area. The roadway has an urban cross-section with a single travel lane in each direction and an assumed speed limit is 50 kilometres per hour (as no speed limit sign could be located). Sidewalks are located on both sides of the roadway, on-street bicycle lanes are not provided and on-street parking is not permitted on either side of the road.
- ▶ **Carling Street** is a local road running east-west within the study area. The roadway has an urban cross-section with a single travel lane in each direction with an assumed speed limit of 50 kilometres per hour (as no speed limit sign could be located). Sidewalks are provided on both sides of the roadway, on-street parking is permitted on at least one side of the roadway and on-street bicycle lanes are not provided.
- ▶ **Highway 403** is a major controlled access highway under the jurisdiction of the MTO. It connects Woodstock and the Greater Toronto Area (GTA). The King Street West interchanges provide access to Highway 403 whereas Main Street West provides access from Highway 403. Highway 403 has a four-lane cross section with a posted speed limit of 100 kilometres per hour.





2.2 Existing Transit Service

Hamilton Street Railway (HSR) owns and operates the public transit system in Hamilton, Ontario.

2.2.1 Existing Transit

Currently, HSR operates four routes within the study area:

- ▶ **Route 1 (King):** This route operates between the Eastgate Terminal and the McMaster Medical Centre in an east-west direction. Monday to Sunday service is operated with headways between 10 and 30 minutes.
- ▶ **Route 5 (Delaware):** This route operates in an east-west direction between Lower Hamilton, Dundas, Ancaster and Stoney Creek. Monday to Sunday service is operated from early morning until after midnight with headways between 60 and 30 minutes.
- ▶ **Route 6 (Aberdeen):** This route operates in an east-west and north-south direction between downtown and the south-west end of Hamilton. Monday to Sunday service is operated from early morning until after midnight with headways between 60 and 20 minutes.
- ▶ **Route 7 (Locke):** This route operates in a north-south direction between downtown and the south-west end of Hamilton. Monday to Sunday service is operated from early morning until after midnight with headways between 60 and 20 minutes.
- ▶ **Route 10 (B-Line Express):** This route operates between the Eastgate Terminal and University Plaza in an east-west direction. Monday to Friday service is operated with headway between 10 and 20 minutes. There is no Weekend or Holiday service.
- ▶ **Route 51 (University):** This route operates between the downtown Hamilton GO Station and the west Hamilton loop in an east-west direction. Monday to Saturday service is operated with headways between 10 and 30 minutes. There is no Sunday or Holiday service.

All HSR transit routes are noted to be Accessible Low Floor (ALF) as the buses serve riders with at-grade entry/exit. Regularly scheduled public transit services are available for users of wheelchairs, scooters, walkers and are equipped with a front bumper bicycle racks.

Figure 2.2 illustrates the existing transit network.



Legend

Subject Site



Existing Transit Network

2.2.2 Light Rapid Transit

Future transit plans for the City include the implementation of rapid transit corridors throughout the City. A total of five corridors are proposed that will form Hamilton's "B-L-A-S-T" network:

- ▶ B-Line – McMaster University to Eastgate Square;
- ▶ L-Line – Downtown to Waterdown;
- ▶ A-Line – Downtown to Airport;
- ▶ S-Line – Centennial to Ancaster Business Park; and
- ▶ T-Line – Mohawk to Meadowlands.

The B-Line was identified in The Big Move, a Regional Transportation Plan, as a Metrolinx "priority" project. The project envisions rapid transit between Eastgate Square and McMaster University via Downtown Hamilton along the Main Street/King Street corridor.

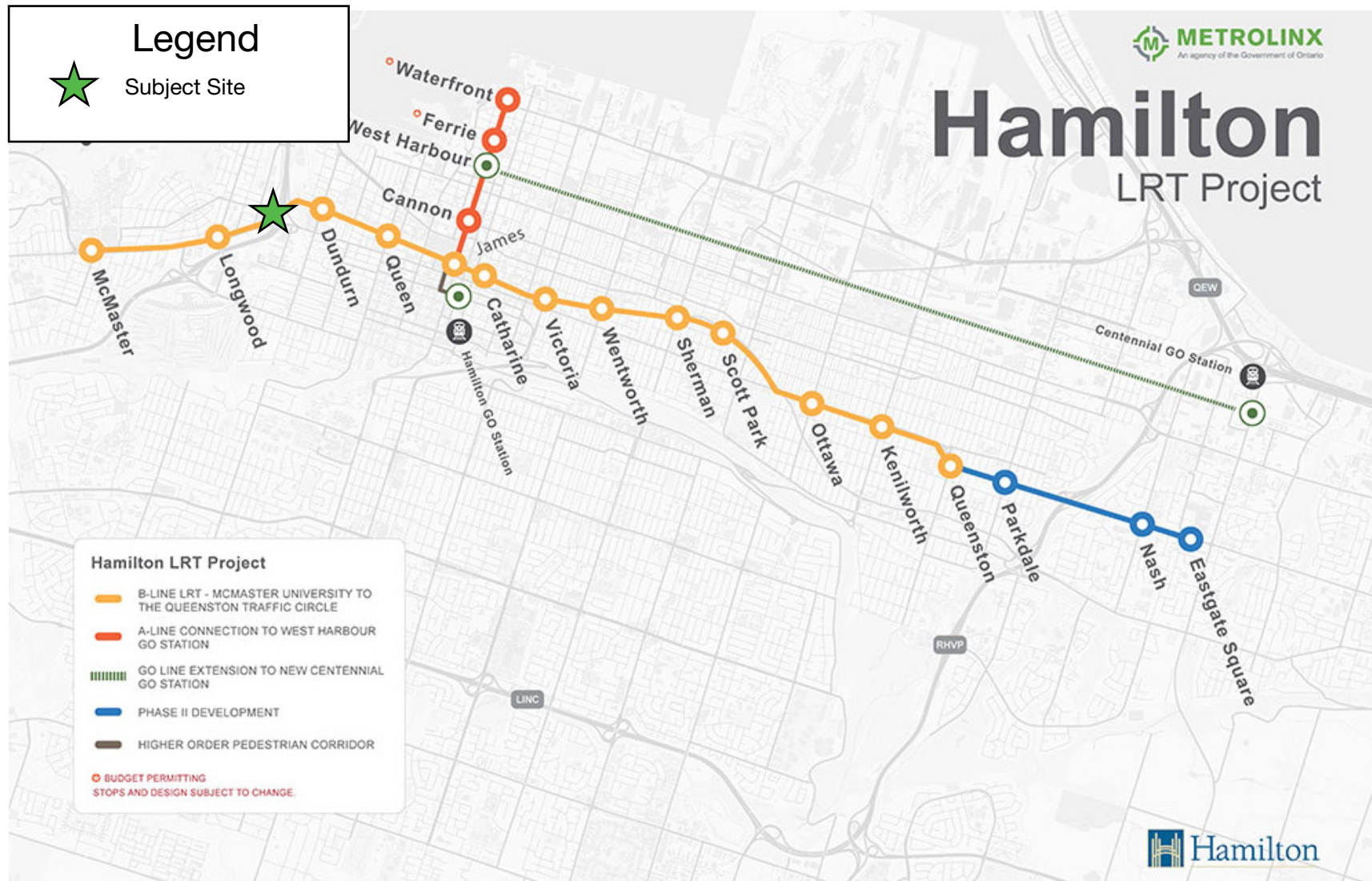
The Benefits Case Analysis (BCA) demonstrates this line will generate positive benefits for Hamilton and the region and will accommodate long-term travel demand growth in the corridor.

The first phase of the line will run from the McMaster University to the Queenston Traffic Circle. The second phase will see the line extend to the Eastgate Terminal with direct connection provided to HSR routes within the east end of Hamilton. In total, 16 stops will be provided, with a stop located less than 600 metres away from the proposed development at the intersection of King Street West and Longwood Road South.

The proposed LRT line will link to GO Transit, VIA Rail services as well as walking and cycling trails to help provide sustainable transportation choices to residents of Hamilton.

Figure 2.3 illustrates the LRT in relation to the proposed development.





Proposed LRT And GO Network

2.3 Active Transportation

2.3.1 Walkability

Pedestrian sidewalks are provided along both sides of roadways through the majority of the study area. Crosswalks, pedestrian pushbuttons, and indicators are provided for all approaches at the signalized intersections within the study area.

The site is located within walking distance of numerous and significant employment, retail, cultural and recreational opportunities providing for a range of destinations for prospective residents of the proposed building that can be readily accessed without the use of a car. The proximity of the site to such a range of amenities and destinations within walking distance serves to reduce the need for residents of the building to travel on a regular basis using a car.

Walk Score is an online tool that assigns a numerical walkability score between 0 and 100 for addresses in Australia, Canada, United States, and New Zealand. Walk Score ranks communities nationwide based on how many businesses, parks, theatres, schools and other common destinations are within walking distance of any given address. The subject site is noted to have a Walk Score of 79 and is considered a “Very Walkable” location which means most daily errands can be accomplished on foot without the need of a personal vehicle¹.

2.3.2 Cycling

The City’s cycling infrastructure consists of on-street and off-street facilities. On-street routes are comprised of bicycle lanes, signed bicycle routes and paved shoulders. Off-street facilities are in the form of multi-use paths. On-road cycling lanes are currently provided along King Street West and Main Street West via a cycling track.

The City’s Shifting Gears² identifies the cycling master plan envisioned for the City over the next 13 years. The City’s vision is to have a transportation system that offers a choice of integrated travel modes, emphasizing active transportation (walking and cycling), public transit and carpooling. A review of this report identified that improvement to the on-road bicycle facilities are proposed along both the Main Street West and King Street West corridors to work towards completing the network.

Figure 2.4 illustrates the existing cycling network within the study area.

¹ <http://www.walkscore.com/score/644-main-st-w-hamilton-on-canada>

² Hamilton’s Cycling Master Plan 2009, Prepared by for City of Hamilton, 2009.










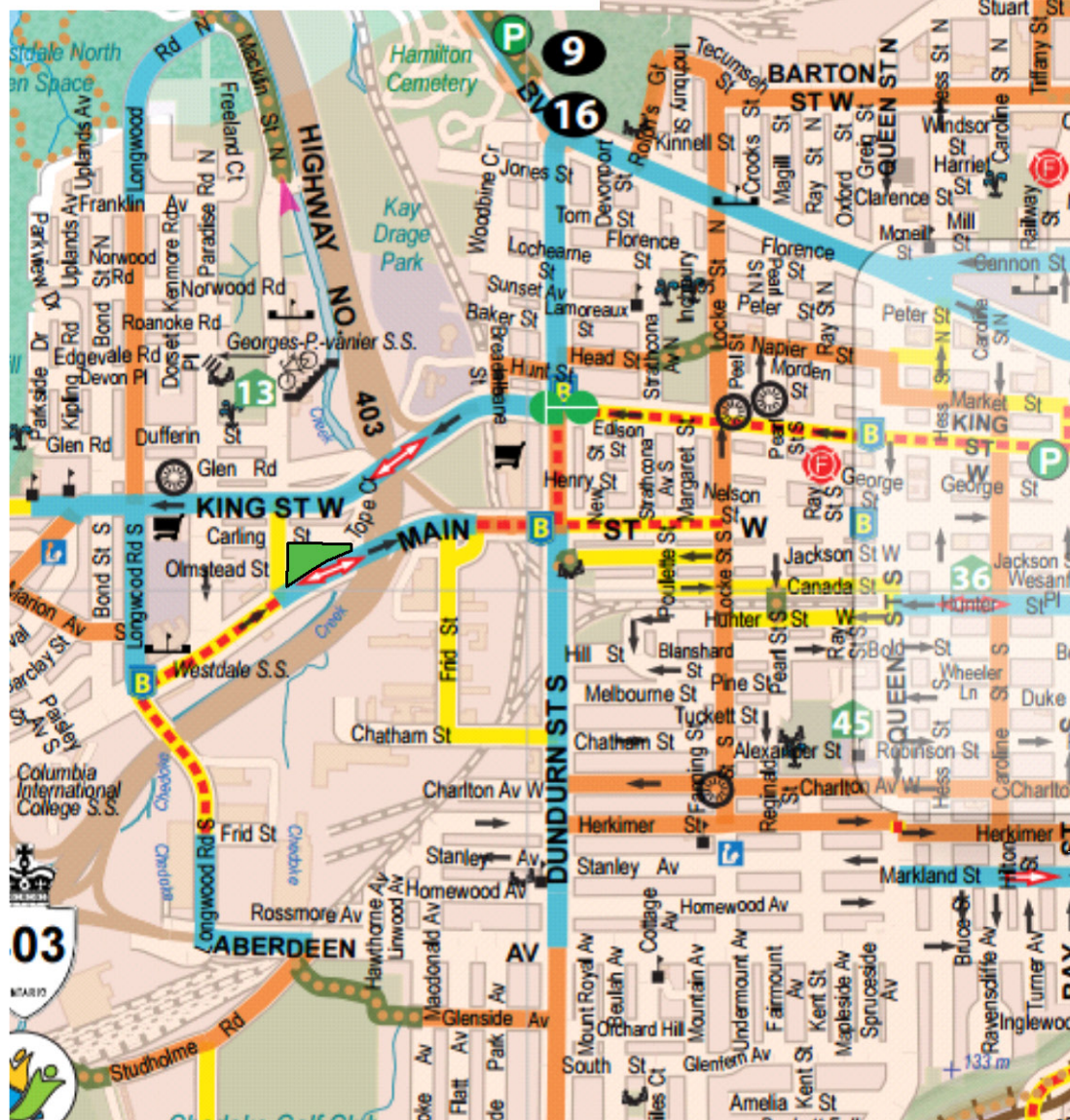
The City of Hamilton, in partnership with Social Bicycles, has implemented a bike share program. The bike share program provides bicycles at a number of locations across the downtown area, including the vicinity of the site, for use by members of the program on a short-term rental basis. Members are able to pick up and drop off bicycles at different bike share station, as desired, providing convenient and ready access to an increasingly well used non-automotive travel mode.

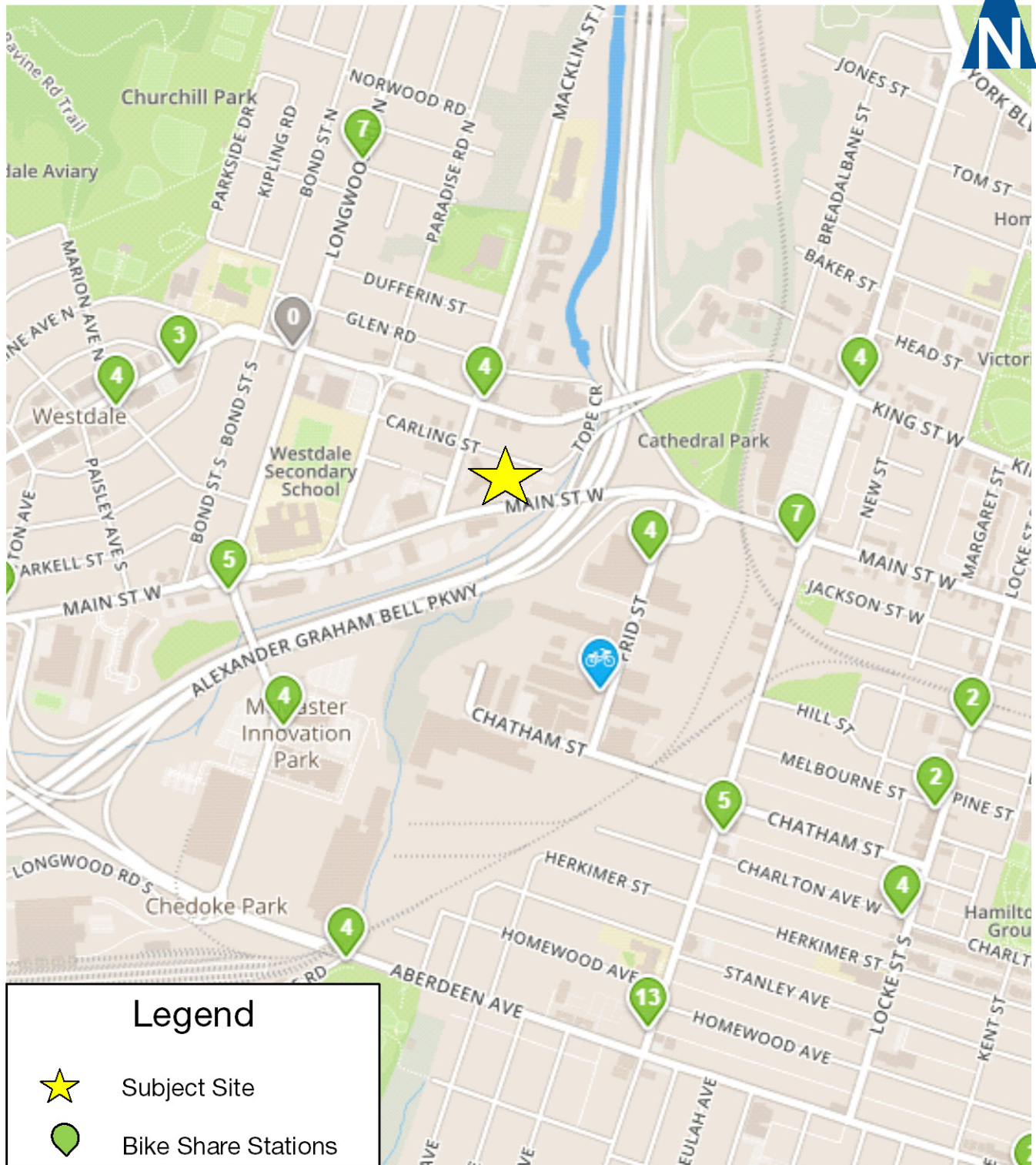
Figure 2.5 illustrates the bike share stations located near the proposed development.





-  Walking or Hiking Trail
-  Paved Multi-Use Trail
(shared with pedestrians)
-  Unpaved Multi-Use Trail
(shared with pedestrians)
-  Designated Bike Lane
-  Paved Shoulder
-  Signed On-Street Bike Route
(on streets with mostly low traffic volume)
-  Cautionary Un-Signed Bike Route
(on streets with low to moderate traffic volume)





Existing Bike Share Locations

2.4 Existing Traffic Volumes

To assess intersection operation, turning movement counts are used to quantify the movement of vehicles through the area. Existing traffic data at an intersection or on a road section forms the foundation for analysis. The counts are usually taken during peak periods at an intersection to complete level of service analysis.

2.4.1 Traffic Data

The City of Hamilton and MTO provided existing count data at the following intersections:

- ▶ King Street West and Macklin Street South (May 2015);
- ▶ Main Street West and Highway 403 West Ramp (November 2014).

City of Hamilton and MTO traffic count data was either dated or unavailable for the remainder of the study area intersections. Accordingly, Paradigm conducted weekday turning movement counts in November 2016 at:

- ▶ Macklin Street South and Carling Street;
- ▶ Main Street West and Macklin Street South;
- ▶ Carling Street and Driveway A;
- ▶ Carling Street and Driveway B;
- ▶ Main Street West and Highway 403 Off Ramp Terminals; and
- ▶ King Street West and Highway 403 On Ramp Terminals.

Appendix B contains the traffic data utilized in this report.

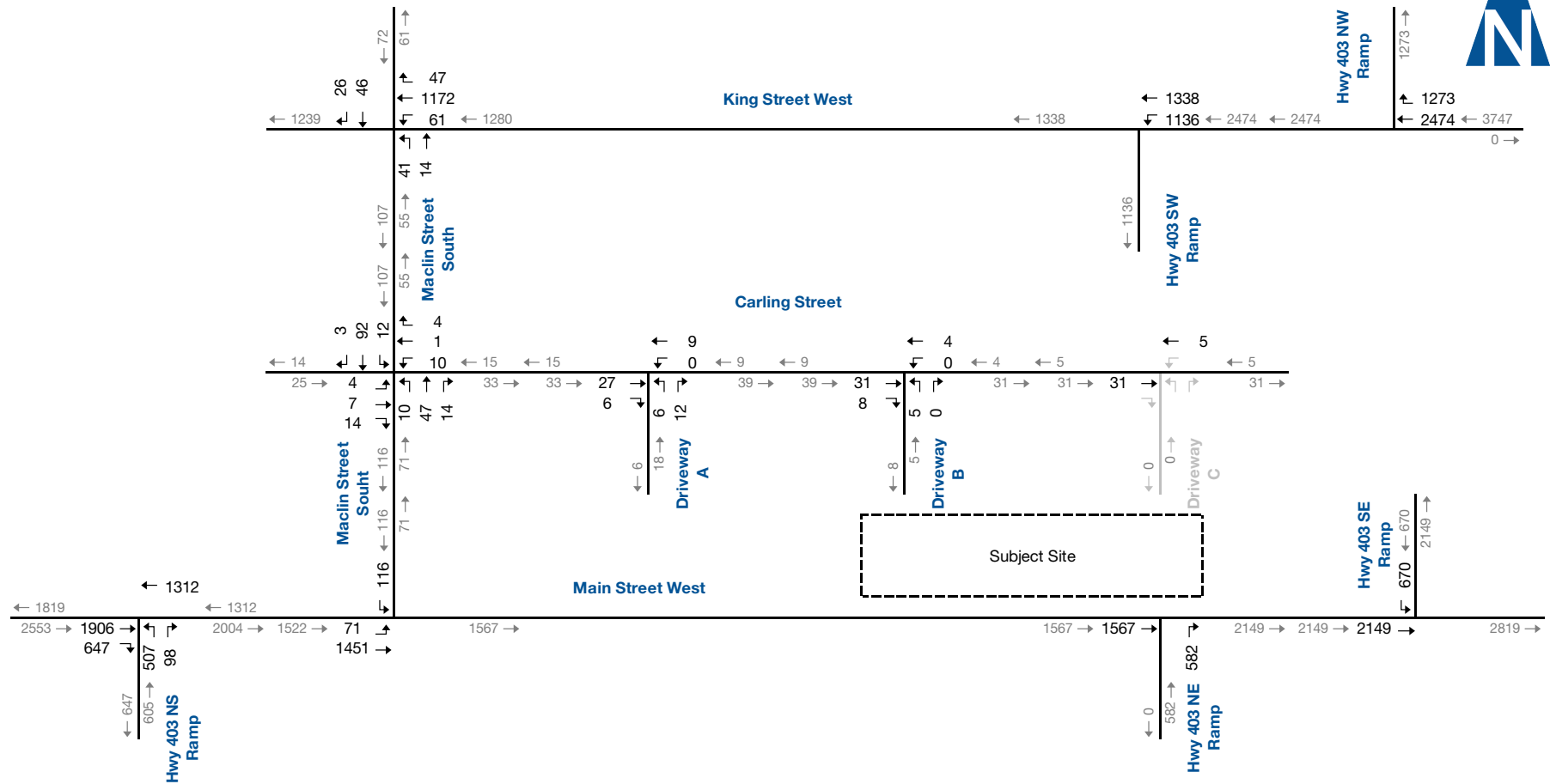
2.4.2 Adjustments

The counts conducted in year 2014 and 2015 have been factored to 2016 volumes using a 0.5% per annum growth rate.

As no major intersections or access points are provided between the area intersections; with the exception to the intersections of Main Street West and Highway 403 West Ramp, and King Street West and Macklin Street South, volume balancing has been applied to the traffic volumes to ensure reasonable upstream and downstream flow was maintained at the study area intersections. The intersection of Main Street West and Macklin Street South has been used as the reference intersection.

Figure 2.6A and **Figure 2.6B** illustrate the base year traffic volumes.





Base Year PM Peak Hour Traffic Volumes

2.5 Traffic Operations

Intersection level of service (LOS) is a recognized method of quantifying the delay experienced by drivers at intersections. The term “Level of Service” denotes how well a traffic movement operates under given traffic demands, lane arrangements, and traffic controls. Each level is determined by the average amount of control delay per vehicle. Control delay is the total delay associated with stopping for a signal or stop sign, and includes four components; deceleration delay, stopped delay, queue move up time and final acceleration delay.

Table 2.1 contains the level of service criteria for signalized and stop-controlled intersections. As shown, LOS A indicates small average control delays (less than 10 second per vehicle) whereas LOS F indicates intersection failure, which results in extensive vehicular queues and long delays (over 50 seconds per vehicle at an unsignalized intersection, and over 80 seconds per vehicle at a signalized intersection). LOS D is typically considered acceptable peak-hour performance in an urban setting, and lower LOS values are tolerable for short term time periods during peak hours when heavier traffic volumes are expected.

TABLE 2.1: VEHICLE LEVEL OF SERVICE DEFINITIONS

Level of Service	Signalized Intersections Average Total Delay (sec/veh)	Unsignalized Intersections Average Total Delay (sec/veh)
A	≤ 10	≤ 10
B	$> 10 \text{ \& } \leq 20$	$> 10 \text{ \& } \leq 15$
C	$> 20 \text{ \& } \leq 35$	$> 15 \text{ \& } \leq 25$
D	$> 35 \text{ \& } \leq 55$	$> 25 \text{ \& } \leq 35$
E	$> 55 \text{ \& } \leq 80$	$> 35 \text{ \& } \leq 50$
F	> 80	> 50

The operations of the intersections in the study area were evaluated using Synchro 9.1 with HCM 2000 procedures and SimTraffic for the weekday AM and PM peak hour conditions. SimTraffic was used to provide simulation statistics in the assessment of interchange performance based on the total delay per vehicle parameter as Synchro is unable to model these types of intersections with free-flow characteristics.

Table 2.2 displays a summary of the existing traffic operations and the following is noted:

- ▶ Main Street West and Highway 403 NS Ramp northbound left turn movement is operating at level of service E with a volume to capacity ratio greater than 1.00.
- ▶ Main Street West and Macklin Street South is operating with acceptable level of service during the weekday peak hours;



- ▶ Highway 403 NE Ramp and Main Street West is operating with acceptable level of service during the weekday peak hours;
- ▶ Highway 403 SE Ramp and Main Street West is operating with acceptable level of service during the weekday peak hours;
- ▶ Highway 403 NW Ramp and King Street West is operating with acceptable level of service during the weekday peak hours;
- ▶ Highway 403 SW Ramp and King Street West is operating with acceptable level of service during the weekday peak hours;
- ▶ King Street West and Macklin Street South is operating with acceptable level of service during the weekday peak hours;
- ▶ Macklin Street South and Carling Street is operating with acceptable level of service during the weekday peak hours;
- ▶ Carling Street and Driveway A is operating with acceptable level of service during the weekday peak hours; and
- ▶ Carling Street and Driveway B is operating with acceptable level of service during the weekday peak hours.

Appendix C contains the detailed Synchro reports.



TABLE 2.2: BASE YEAR PEAK HOUR TRAFFIC VOLUMES

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach															
				Eastbound				Westbound				Northbound				Southbound			
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach
AM Peak Hour	1 - Highway 403 NS Ramp & Main Street West	TCS	LOS Delay V/C Queue	C 25 0.82 122	B 17 0.31 19	C 23		D 43				E 56 1.01 130	B 19 0.36 35	D 50					
	2 - Main Street West & Macklin Street South	TCS	LOS Delay V/C Queue	B 16 0.65 101	B 16 0.65 101	B 16										C 27 0.22 35			C 27
	3 - Highway 403 NE Ramp & Main Street West	TWSC	LOS Delay V/C Queue	A 1 - -	A 1 - -	A 1						A 1 - -	A 1 - -						
	4 - Highway 403 SE Ramp & Main Street West	TWSC	LOS Delay V/C Queue	A 1 - -	A 1 - -	A 1										A 1 - -			A 1
	5 - Highway 403 NW Ramp & King Street West	TWSC	LOS Delay V/C Queue					A 0 - -	A 3 - -	A 1									
	6 - Highway 403 SW Ramp & King Street West	TWSC	LOS Delay V/C Queue					A 3 - -	A 0 - -	A 1									
	7 - King Street West & Macklin Street South	TCS	LOS Delay V/C Queue					A 6 0.37 39	A 3 0 - -	A 6		D 36 0.13 15	D 36			C 34 0.22 27			C 34
	8 - Macklin Street South & Carling Street	TWSC	LOS Delay V/C Queue	A 9 0.02 1	A 9 0.02 1	A 9		A 10 0.05 1	A 10 0.05 1	A 10		A 1 0.00 0	A 1 0.00 0	A 1 0.00 0	A 1	A 0 0.00 0	A 0 0.00 0	A 0 0.00 0	A 0
	9 - Carling Street & Driveway A	TWSC	LOS Delay V/C Queue	A 0 0.01 0	A 0 0.01 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0		A 9 0.01 0	A 9 0.01 0	A 9					
	10 - Carling Street & Driveway B	TWSC	LOS Delay V/C Queue	A 0 0.01 0	A 0 0.01 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0		A 9 0.02 0	A 9 0.02 0	A 9					
PM Peak Hour	1 - Highway 403 NS Ramp & Main Street West	TCS	LOS Delay V/C Queue	C 28 0.88 139	C 21 0.53 42	C 26		C 30				C 22 0.62 54	B 16 0.21 22	C 21					
	2 - Main Street West & Macklin Street South	TCS	LOS Delay V/C Queue	B 13 0.32 83	B 13 0.32 83	B 13										C 33 0.24 38			C 33
	3 - Highway 403 NE Ramp & Main Street West	TWSC	LOS Delay V/C Queue	A 3 - -	A 3 - -	A 3						A 1 - -	A 1 - -						
	4 - Highway 403 SE Ramp & Main Street West	TWSC	LOS Delay V/C Queue	A 1 - -	A 1 - -	A 1										A 1 - -			A 1
	5 - Highway 403 NW Ramp & King Street West	TWSC	LOS Delay V/C Queue					A 2 - -	A 6 - -	A 3									
	6 - Highway 403 SW Ramp & King Street West	TWSC	LOS Delay V/C Queue					A 5 - -	A 0 - -	A 2									
	7 - King Street West & Macklin Street South	TCS	LOS Delay V/C Queue					A 6 0.38 40	A 6 0.20 21	A 6		C 34 0.20 21	C 34			C 33 0.15 20			C 33
	8 - Macklin Street South & Carling Street	TWSC	LOS Delay V/C Queue	A 10 0.03 1	A 10 0.03 1	A 10		A 10 0.02 1	A 10 0.02 1	A 10		A 1 0.01 0	A 1 0.01 0	A 1 0.01 0	A 1	A 1 0.01 0	A 1 0.01 0	A 1 0.01 0	A 1
	9 - Carling Street & Driveway A	TWSC	LOS Delay V/C Queue	A 0 0.02 0	A 0 0.02 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0		A 9 0.02 1	A 9 0.02 1	A 9					
	10 - Carling Street & Driveway B	TWSC	LOS Delay V/C Queue	A 0 0.03 0	A 0 0.03 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0		A 9 0.01 0	A 9 0.01 0	A 9					

AWSC - All-Way Stop Control
 TWSC - Two-Way Stop Control
 TCS - Traffic Control TCS

RBT - Roundabout

MOE - Measure of Effectiveness
 LOS - Level of Service
 Delay - Average Delay per Vehicle in Seconds

V/C - Volume to Capacity Ratio
 Queue (m) - 95th Percentile Queue Length



3 Development Concept

3.1 Site Description

3.1.1 Existing Development

644 Main Street West consists of a 15-storey apartment building containing 281 units. Residential parking is provided through a two-level podium parking garage that contains 299 parking spaces and 15 on-site surface parking spaces along the frontage to Carling Street. Visitor parking is currently provided through 11 on-site surface parking spaces along the frontage to Macklin Street South. Access to 644 Main Street West is currently provided via three driveway connections:

- ▶ **Macklin Street South Connections** – Two connections are provided to Macklin Street South that provide access to the 11 visitor parking spaces and facilitate drop-offs at the main building entrance. The two connections are separate approximately 70 metres and function with all-directional movements with a single inbound and outbound travel lane.
- ▶ **Driveway A** – is located approximately 75 metres east of the Macklin Street South and Carling Street intersection (centreline to centreline) and operates with all movements permitted with a single inbound and outbound travel lane. This connection provides access to the two-level podium parking garages second level and can only be accessed by residents of the building that have a garage door opener.
- ▶ **Driveway B** – is located approximately 115 metres east of the Macklin Street South and Carling Street intersection (centreline to centreline) and operates with all movements permitted with a single inbound and outbound travel lane. This connection provides access to the two-level podium parking garages first level and can only be accessed by residents of the building that have a garage door opener. This connection also provides access to the 15 surface parking spaces.

3.1.2 Proposed Development

Development plans entail expanding the site to include a second 18-storey apartment building located centrally within the property that will contain 167 units. The residential units are comprised of 48 units less than 50 square metres and 119 units greater than 50 square metres. In accommodating the new building, the 15-on-site residential surface parking spaces along the frontage to Carling Street will be removed.

Vehicular access to the new building pad is proposed via existing driveway connections to Carling Street (Driveway B and Driveway C). Driveway C is described as follows:



- ▶ **Driveway C** – is located approximately 170 metres east of the Macklin Street South and Carling Street intersection (centreline to centreline) and will operate with all movements permitted with a single inbound and outbound travel lane. This connection will provide access to a surface parking area.

Parking for the new building will be accommodated in two ways:

- ▶ **Single Level Podium Parking** - A new ramp in the location of the existing one via Driveway B would be built to include a landing. Cars will access the new parking garage via this ramp. Once inside the garage they are taken into a one-way parking layout with double loaded parking aisles that will contain 73 parking spaces and 5 tandem parking spaces for use by residents.
- ▶ **Surface Parking Area** - A new surface parking area will be constructed at the eastern portion of the site with a new driveway connection provided to Carling Street (Driveway C). This parking area will contain 23 parking spaces for use by visitors.

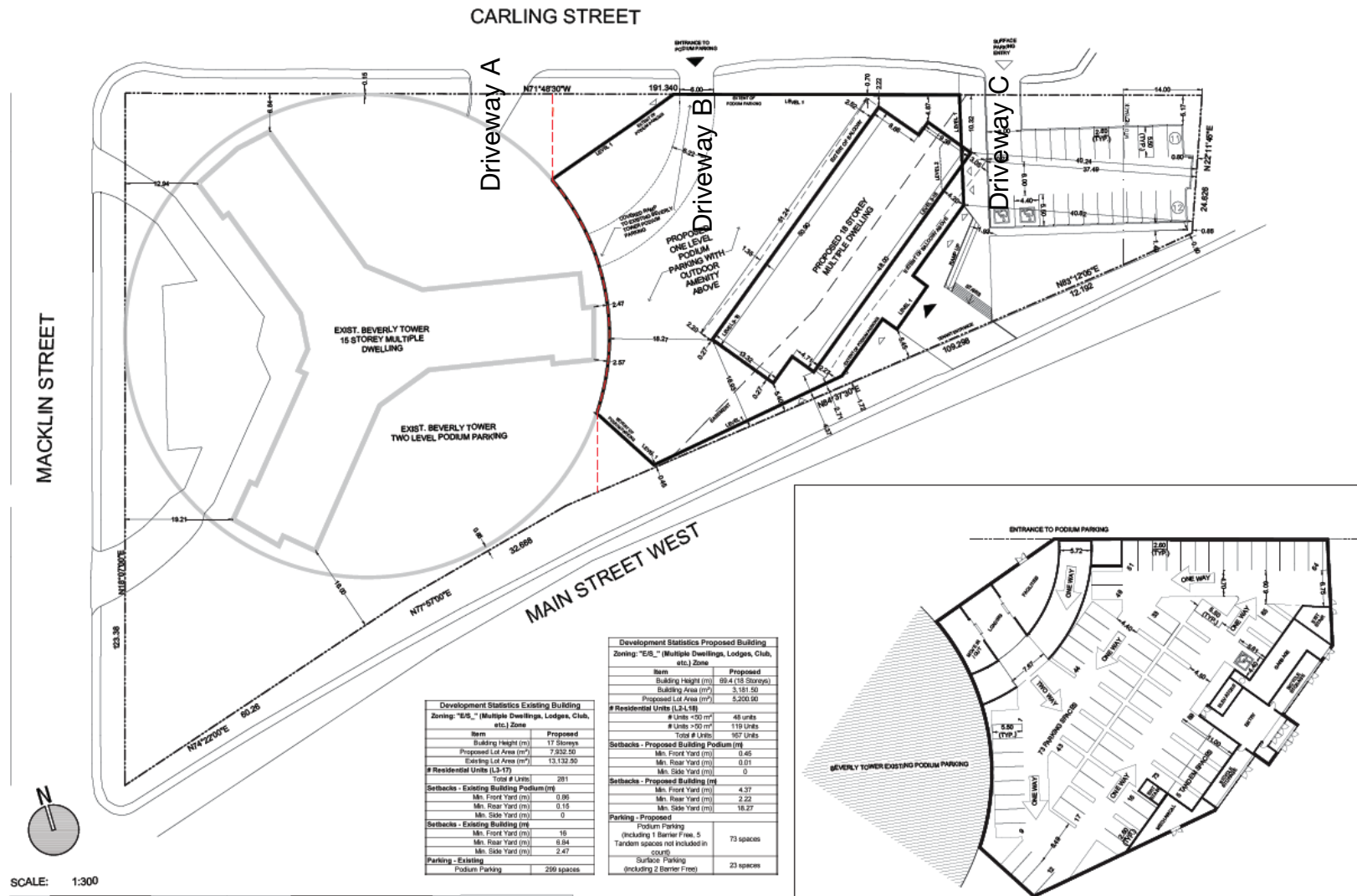
Based on the above, a total of 96 new parking spaces will be provided on-site for residents and visitors with construction of the new tower. There are also 5 tandem spaces proposed in the parking garage, however these spaces have not been considered in the parking supply calculations.

The provision of a loading space adjacent to the single level podium parking area will be provided to accommodate garbage collection, loading and service activities of the development. Access to the loading facilities will be provided via Driveway B.

The build-out of the development is anticipated to occur in one phase, and is anticipated to be fully constructed and occupied by Year 2018.

Figure 3.1 illustrates the conceptual layout of the ground floor of the development.





3.2 Development Trip Generation

Trip generation information is used to forecast the anticipated level of traffic activity forecast to occur as a result development of the site.

Trip generation was estimated for each land use type in the proposed development. Morning and afternoon peak-hour trip generation for each land use type were then summed to establish total site trip generation. The following sub-sections provides the methodology used.

3.2.1 Institute of Transportation Engineers (ITE)

Trips estimated to be generated by the proposed development for the weekday AM and PM peak hours were developed using data from Trip Generation³. The following land use codes has been utilized for estimating the trip generation for the development:

- ▶ **LUC 222 (High-Rise Apartment).** This land use code is described as units located in buildings that have three or more levels. Both condos and towns are included in this land use.

Data for the peak hour of adjacent street traffic were used to estimated trip generation. Fitted curve equations with satisfactory R² values were applied. If no equations were available, the average rates have been applied.

3.2.2 Trip Generation Estimates

Table 3.2 summarizes the trip generation estimates for the weekday AM and PM peak hours. These estimates consider the reductions noted above.

A total of 45 AM and 61 PM peak hour new vehicle trips are forecast to be added to the area roadways.

TABLE 3.1: TRIP GENERATION ESTIMATES

Land Use Code	Units	Trips	AM Peak Hour				PM Peak Hour			
			Rate	In	Out	Total	Rate	In	Out	Total
223 - High-Rise Apartment (Units)	167	Total	eq.	11	34	45	eq.	37	24	61
Total Trip Generation	167	Total	-	11	34	45	-	37	24	61

³ Trip Generation Ninth Edition, Institute of Transportation Engineers, Washington D.C., 2012



3.3 Development Trip Distribution and Assignment

The 2011 Transportation Tomorrow Survey (TTS) data for the City of Hamilton was used to determine the trip distribution for the proposed development. The TTS was examined for the weekday peak hours.

The weekday survey was run for trips originating within Ward 1 of Hamilton corresponding to when residents would be leaving home for the day. Likewise, the survey was also ran for trips originating with a destination that ended in Ward 1 of Hamilton corresponding to when residents would be coming home for the day.

The estimated trip distribution for the development is outlined in **Table 3.2**. The following is noted with regard to the assignment:

- ▶ No trips have been assigned to travel east via Carling Street, north via Macklin Street South as these routes do not provide any connection to the external roadway network.

Table 3.2 details the estimated trip distribution for the development

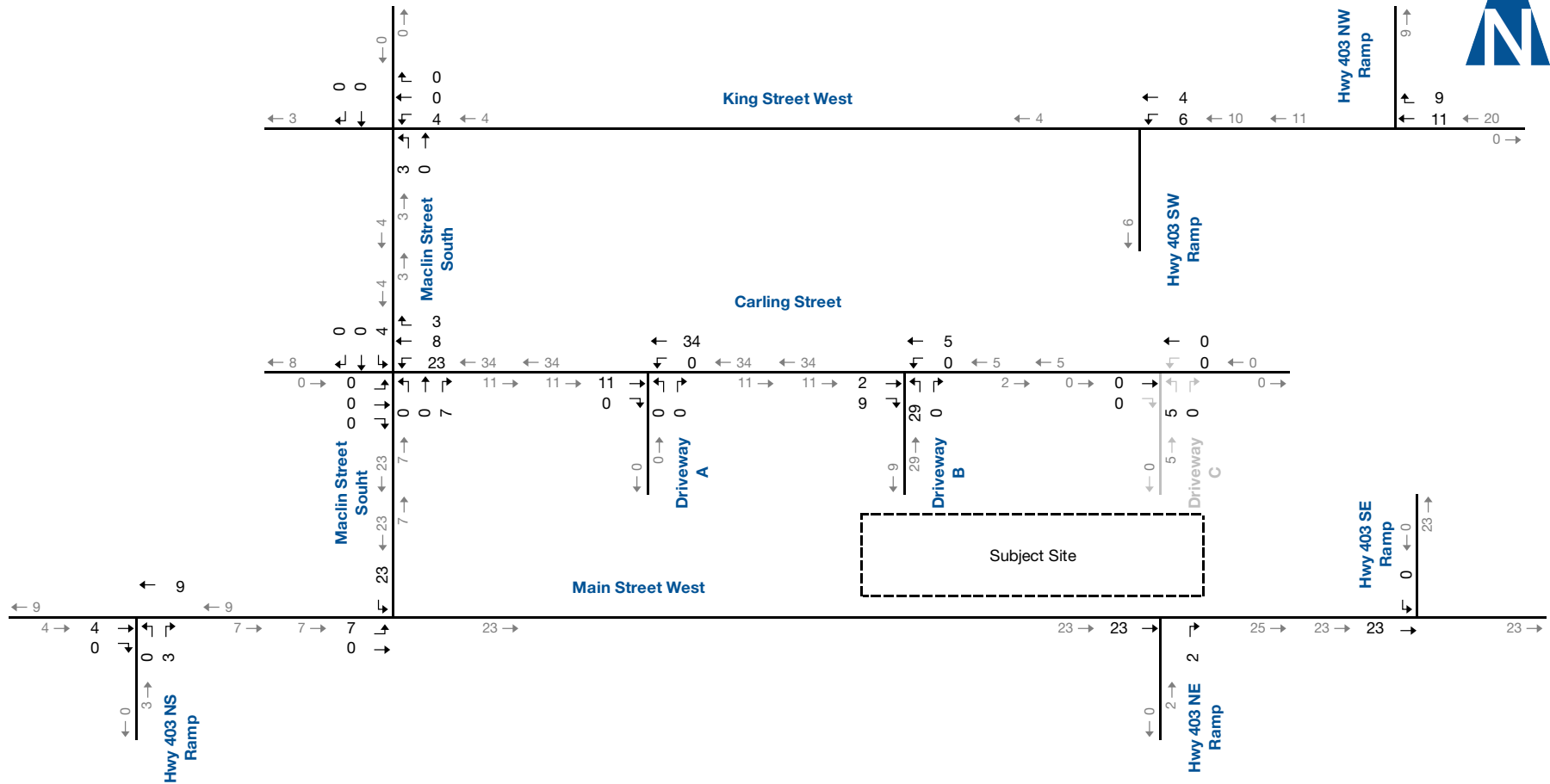
TABLE 3.2: TRIP DISTRIBUTION

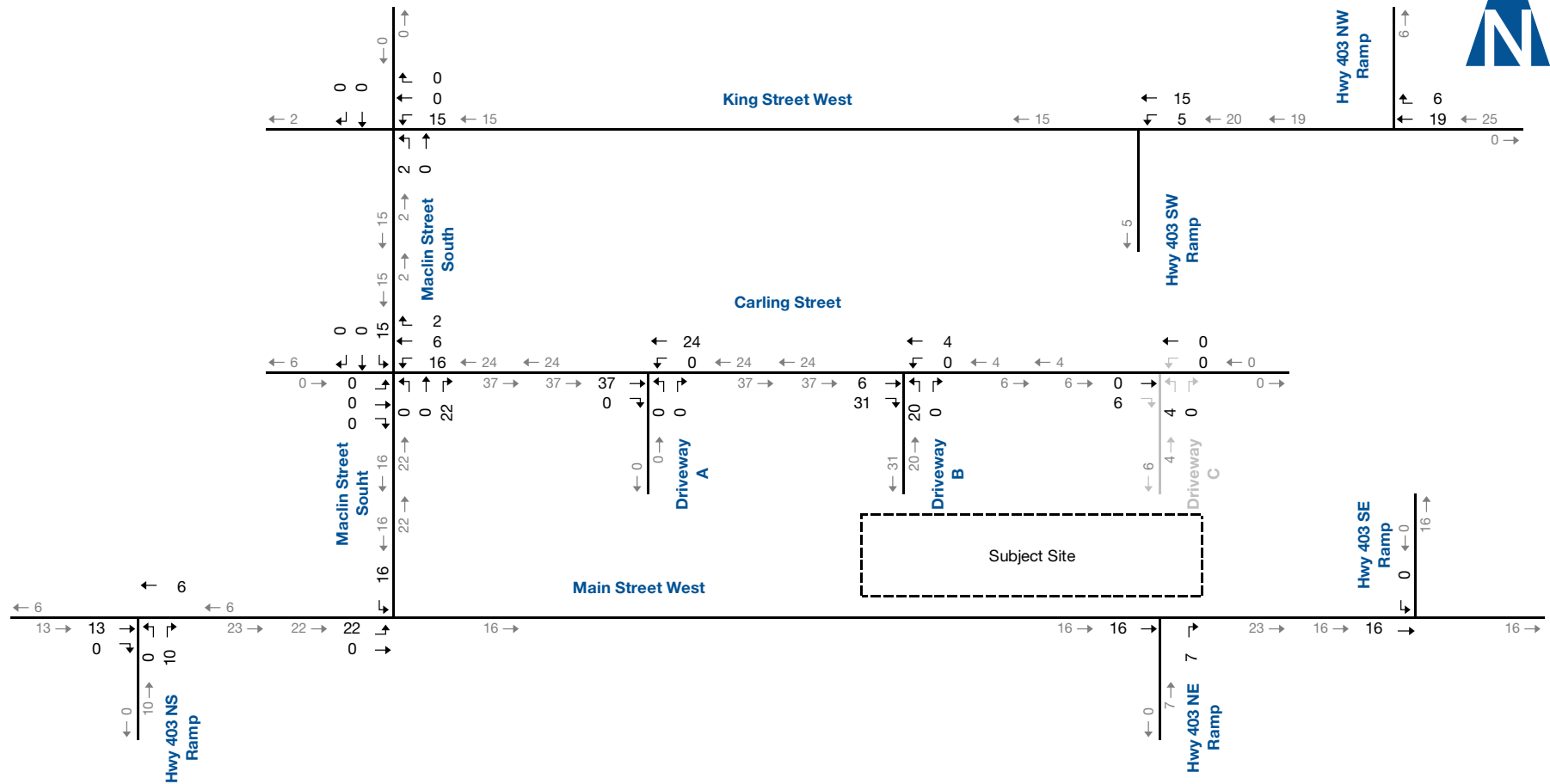
Directional Summary	Route	Inbound	Outbound
North	Highway 403	26%	25%
South	Highway 403	19%	19%
East	Main Street West	0%	23%
	King Street West	21%	0%
West	King Street West	0%	8%
	Main Street West	34%	25%
Total		100%	100%

Using the trip generation and trip distribution estimates, the site traffic was assigned to the road network.

Figure 3.2A and **3.2B** illustrates the trip assignment for the new trips forecast to be generated by the development.







4 Evaluation of Future Traffic Conditions

To remain consistent with MTO traffic impact study guidelines and adhere to the terms of reference established, a horizon year of 2018 (full-build out), 2023 (five years beyond full build out) and 2028 (ten years beyond full build out) has been utilized for total traffic analysis.

The future traffic volumes in the vicinity of the development will likely consist of increased non-site traffic volumes (background traffic), traffic generated by other developments, and the traffic forecast to be generated by the proposed development.

4.1 Background Traffic Growth

Future background traffic volume increases in the study area are expected to consist of growth due to general increases in population and employment as well as traffic generated by other proposed and approved new developments.

4.1.1 General Background Growth

The Longwood Road Class EA study identified an average annual traffic growth rate of 0.5% per annum for Main Street West to reflect population growth in Dundas. The same growth rate was further applied to travel demands on the study area roadways.

As the study was commissioned and ultimately accepted by the City of Hamilton, these growth rates have been further incorporated within this report to remain consistent.

4.1.2 Background Development



The West Hamilton Innovation District (WHID), which represents one of the City's key employment areas, is strategically located east of Highway 403, between Main Street West and Aberdeen Avenue. **Figure 4.1** illustrates the location of the WHID lands.

The McMaster Innovation Park (MIP) is located within the WHID and is proposed to construct ten buildings that provides over 1.7 million square feet of office, research and amenity space which will provide 2,500 employment opportunities. Projected background traffic growth for the MIP has been previously estimated as part of the "Longwood Road Class EA"⁴.

Appendix D provides traffic projections related to the MIP.

⁴ Longwood Road Class EA Traffic Generation, Distribution, and Assignment prepared by McCormick Rankin Corporation dated September 2011.



-  West Hamilton Industrial Area
-  McMaster Innovation Park



SOURCE: HAMILTON PLANNING AND ECONOMIC DEVELOPMENT DEPARTMENT

4.1.3 Growth Summary

The background traffic volumes within the study area are estimated to consist of:

- ▶ Generalized background traffic growth of 0.5% per annum;
- ▶ Traffic related to the nearby developments. After accounting for the distribution of this traffic to the adjacent road network, it is estimated that there could be 37 additional trips during the weekday AM peak hour and 111 additional trips during the weekday PM peak hour travelling along the developments frontage on Main Street West.

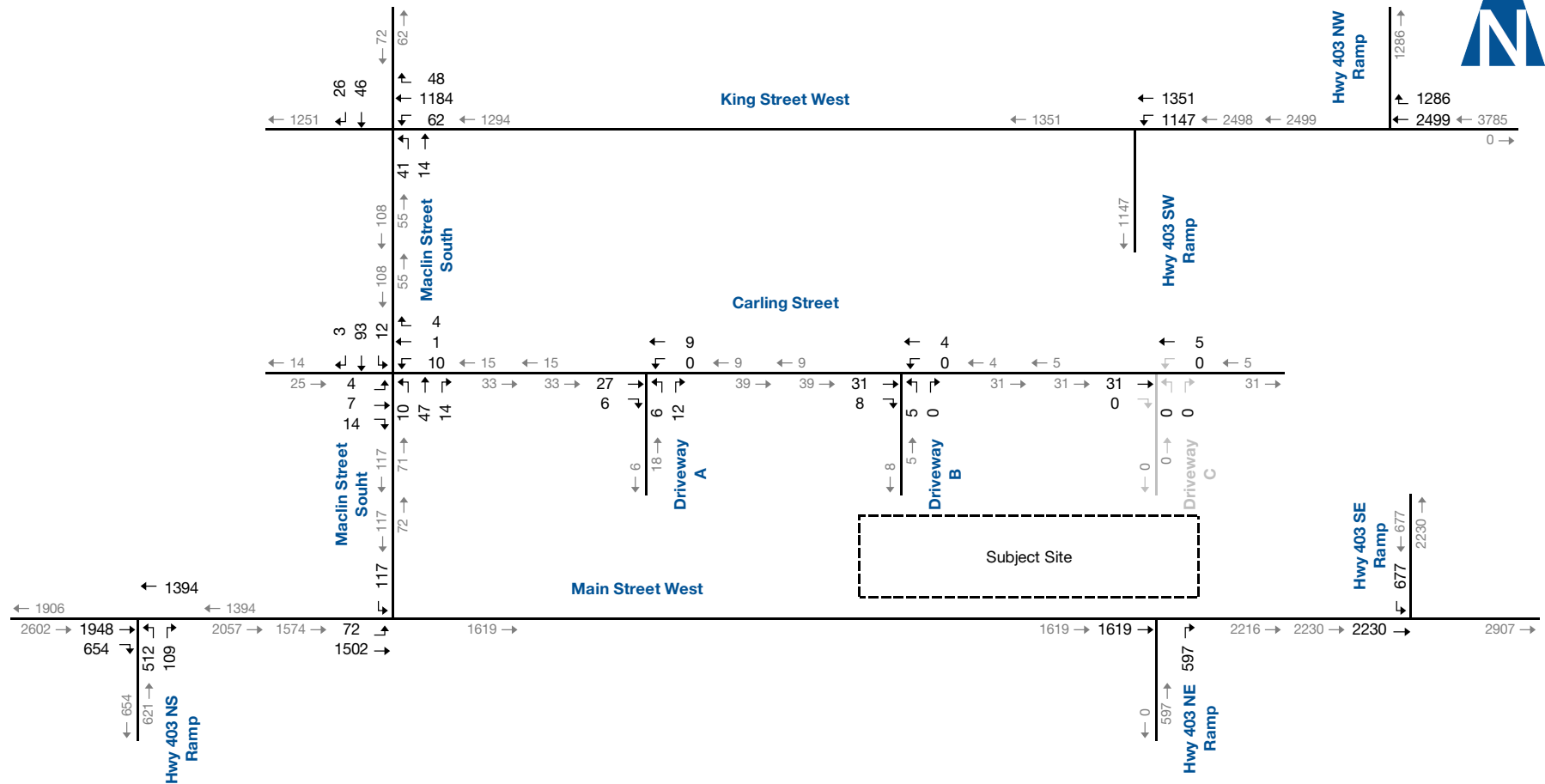
The background traffic volumes for the respective horizon years are illustrated in the following Figures:

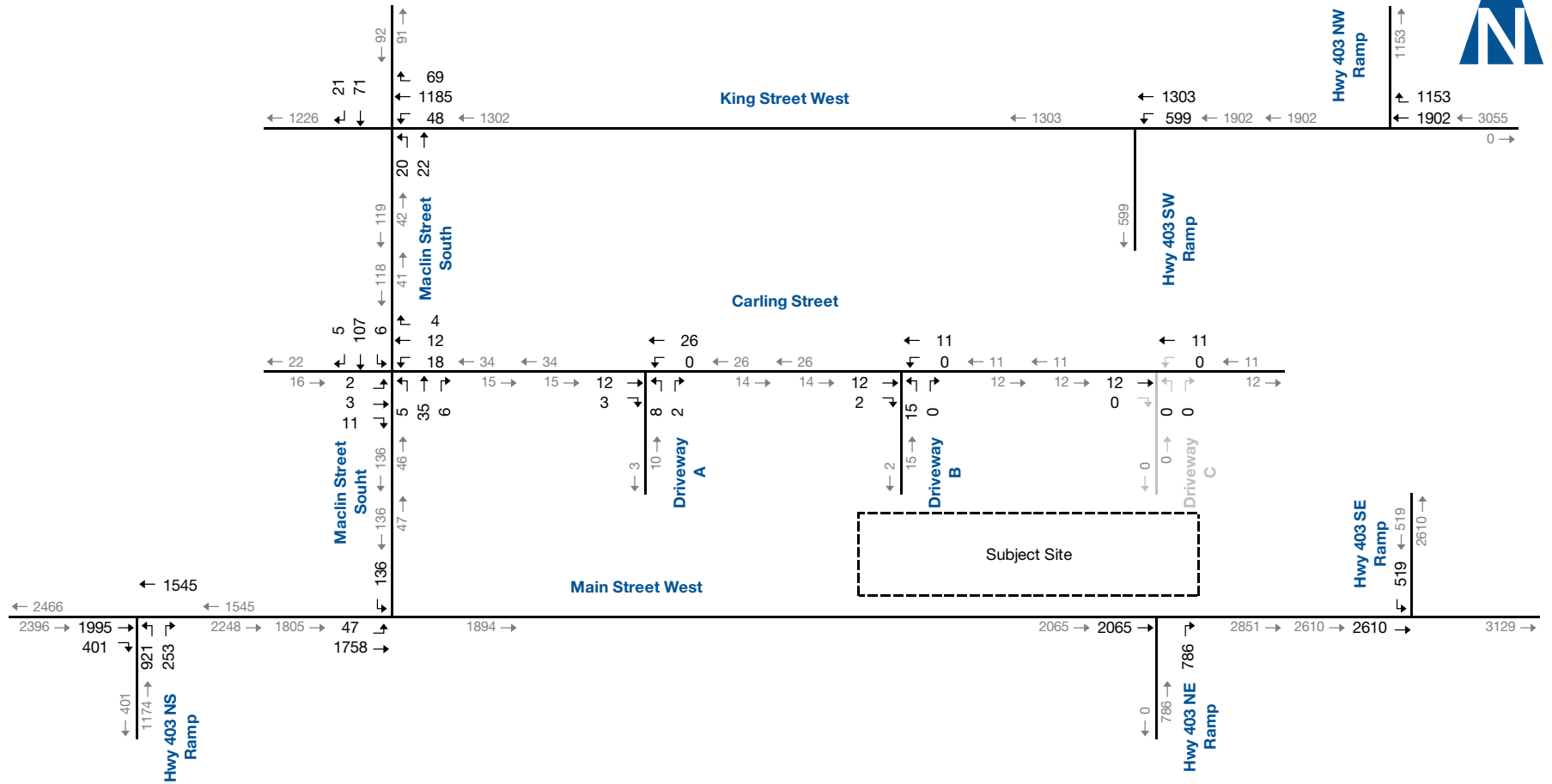
- ▶ **Figures 4.2A, 4.2B** - 2018 Background AM and PM peak hours;
- ▶ **Figures 4.3A, 4.3B** – 2023 Background AM and PM peak hours;
- ▶ **Figures 4.4A, 4.4B** - 2028 Background AM and PM peak hours.





Figure 4.2A





2023 Background AM Peak Hour Forecasts

4.2 Background Traffic Operations

Level of service analyses have been conducted using Synchro 9.1 with HCM 2000 procedures and SimTraffic for the weekday AM and PM peak hour conditions. SimTraffic was used to provide simulation statistics in the assessment of interchange performance based on the total delay per vehicle parameter as Synchro is unable to model these types of intersections with free-flow characteristics.

The intersections within the study area were assessed based on the same parameters as in the analysis of existing conditions except for optimizing signal timing splits at the signalized intersections.

Table 4.1 – Table 4.3 displays a summary of the future background operations and the following is noted:

- ▶ The intersection of Main Street West and Highway 403 NS Ramp is expected to continue to operate at level of service E with a volume to capacity ratio greater than 1.00 for the northbound left turn movement under all future horizons. The westbound through movement under the 2028 horizon is expected to operate at level of service E with a volume to capacity ratio greater than 1.00.
- ▶ All other intersections are projected to be operate with acceptable levels of service under the 2018, 2023 and 2028 background conditions.

Appendix E contains the detailed Synchro reports.

4.2.1 Capacity Constraints

The intersection of Main Street West and Highway 403 NS Ramp is projected to continue to operate with deficiencies under all future horizon scenarios. It is noted that the increase in delays and decreased performance has occurred without the proposed development. For this reason, it can be determined that the overall growth anticipated for the Study Area is the main reason behind the poor operations at the intersection.

Although it is conceivable that traffic growth will not occur to the extent forecast, the analysis suggest that further roadway capacity will be required to support build out of the area.

To improve the operations, implementation of shorter cyclers length during the 2028 weekday AM peak hour is expected to be required. However, given that the Main Street West corridor is synchronized, modifications to entire corridors signal timings are expected to be required to maintain synchronization.

No other capacity constraints have been identified.



TABLE 4.1: 2018 BACKGROUND OPERATIONS SUMMARY

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																Overall
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	1 - Highway 403 NS Ramp & Main Street West	TCS	LOS Delay V/C Queue	C 29 0.89 139	B 18 0.34 24	C 27		D 49 1.01 201		D 49	E 57 1.01 131	C 21 0.50 50	D 50					D 39 1.03		
	2 - Main Street West & Macklin Street South	TCS	LOS Delay V/C Queue	B 14 0.64 96	B 14 0.64 96	B 14								C 21 0.26 25			C 21	B 15		
	3 - Highway 403 NE Ramp & Main Street West	TWSC	LOS Delay V/C Queue	A 3 - -		A 3					A 2 - -	A 2						3 - -		
	4 - Highway 403 SE Ramp & Main Street West	TWSC	LOS Delay V/C Queue	A 1 - -		A 1								A 1 - -			A 1	1 - -		
	5 - Highway 403 NW Ramp & King Street West	TWSC	LOS Delay V/C Queue					A 0 - -	A 4 - -	A 2								2 - -		
	6 - Highway 403 SW Ramp & King Street West	TWSC	LOS Delay V/C Queue					A 3 - -	A 0 - -	A 1 - -								1 - -		
	7 - King Street West & Macklin Street South	TCS	LOS Delay V/C Queue					A 9 0.43 51		A 9	C 29 0.11 13		C 29	C 29 0.20 25			C 29	B 11		
	8 - Macklin Street South & Carling Street	TWSC	LOS Delay V/C Queue	A 10 0.02 1	A 10 0.02 1	A 10		B 11 0.05 1	B 11 0.05 1	B 11	A 1 0.00 0	A 1 0.00 0	A 1 0.00 0	A 1	A 1 0.00 0	A 1 0.00 0	A 1	3		
	9 - Carling Street & Driveway A	TWSC	LOS Delay V/C Queue	A 0 0.01 0	A 0 0.01 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0	A 9 0.01 0	A 9 0.01 0	A 9					2		
	10 - Carling Street & Driveway B	TWSC	LOS Delay V/C Queue	A 0 0.01 0	A 0 0.01 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0	A 9 0.02 0	A 9 0.02 0	A 9					3		
PM Peak Hour	1 - Highway 403 NS Ramp & Main Street West	TCS	LOS Delay V/C Queue	B 19 0.77 122	B 15 0.47 18	B 18		C 21 0.80 138		C 21	C 31 0.74 63	C 21 0.27 27	C 29					C 21 0.79		
	2 - Main Street West & Macklin Street South	TCS	LOS Delay V/C Queue	B 13 0.53 87	B 13 0.53 87	B 13								C 33 0.24 38			C 33	B 14		
	3 - Highway 403 NE Ramp & Main Street West	TWSC	LOS Delay V/C Queue	A 3 - -		A 3					A 1 - -	A 1						3 - -		
	4 - Highway 403 SE Ramp & Main Street West	TWSC	LOS Delay V/C Queue	A 1 - -		A 1								A 2 - -			A 2	1 - -		
	5 - Highway 403 NW Ramp & King Street West	TWSC	LOS Delay V/C Queue					A 2 - -	A 6 - -	A 3								3 - -		
	6 - Highway 403 SW Ramp & King Street West	TWSC	LOS Delay V/C Queue					A 5 - -	A 0 - -	A 2 - -								2 - -		
	7 - King Street West & Macklin Street South	TCS	LOS Delay V/C Queue					A 8 0.43 50		A 8	C 29 0.16 19		C 29	C 29 0.13 19			C 29	A 10		
	8 - Macklin Street South & Carling Street	TWSC	LOS Delay V/C Queue	A 10 0.04 1	A 10 0.04 1	A 10		A 10 0.02 1	A 10 0.02 1	A 10	A 1 0.01 0	A 1 0.01 0	A 1 0.01 0	A 1	A 1 0.01 0	A 1 0.01 0	A 1	3		
	9 - Carling Street & Driveway A	TWSC	LOS Delay V/C Queue	A 0 0.02 0	A 0 0.02 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0	A 9 0.02 1	A 9 0.02 1	A 9					3		
	10 - Carling Street & Driveway B	TWSC	LOS Delay V/C Queue	A 0 0.03 0	A 0 0.03 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0	A 9 0.01 0	A 9 0.01 0	A 9					1		

AWSC - All-Way Stop Control
 TWSC - Two-Way Stop Control
 TCS - Traffic Control TCS

RBT - Roundabout

MOE - Measure of Effectiveness
 LOS - Level of Service
 Delay - Average Delay per Vehicle in Seconds

V/C - Volume to Capacity Ratio
 Queue (m) - 95th Percentile Queue Length



TABLE 4.2: 2023 BACKGROUND OPERATIONS SUMMARY

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	1 - Highway 403 NS Ramp & Main Street West	TCS	LOS Delay V/C Queue	C 30 0.92 154	B 17 0.36 27	C 28		D 51 1.02 208	D 51		E 74 1.06 139	C 25 0.60 62	E 63						D 43 1.06	
	2 - Main Street West & Macklin Street South	TCS	LOS Delay V/C Queue	B 15 0.66 101	B 15 0.66 101	B 15									C 21 0.27 26			C 21	B 15	
	3 - Highway 403 NE Ramp & Main Street West	TWSC	LOS Delay V/C Queue	A 4 - -	A 4 - -	A 4					A 2 - -	A 2 - -							3 - -	
	4 - Highway 403 SE Ramp & Main Street West	TWSC	LOS Delay V/C Queue	A 1 - -	A 1 - -	A 1									A 1 - -			A 1 - -	1 - -	
	5 - Highway 403 NW Ramp & King Street West	TWSC	LOS Delay V/C Queue					A 1 - -	A 4 - -	A 2										2 - -
	6 - Highway 403 SW Ramp & King Street West	TWSC	LOS Delay V/C Queue					A 3 - -	A 0 - -	A 1 - -										1 - -
	7 - King Street West & Macklin Street South	TCS	LOS Delay V/C Queue					A 9 0.45 53	A 9		C 29 0.12 14	C 29			C 29 0.21 26			C 29	B 11	
	8 - Macklin Street South & Carling Street	TWSC	LOS Delay V/C Queue	A 10 0.02 1	A 10 0.02 1	A 10		B 11 0.06 1	B 11 0.06 1	B 11	A 1 0.00 0	A 1 0.00 0	A 1 0.00 0	A 1	A 1 0.00 0	A 1 0.00 0	A 1 0.00 0	A 1	3	
	9 - Carling Street & Driveway A	TWSC	LOS Delay V/C Queue	A 0 0.01 0	A 0 0.01 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0	A 9 0.01 0	A 9 0.01 0	A 9							2
	10 - Carling Street & Driveway B	TWSC	LOS Delay V/C Queue	A 0 0.01 0	A 0 0.01 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0	A 9 0.02 0	A 9 0.02 0	A 9							3
PM Peak Hour	1 - Highway 403 NS Ramp & Main Street West	TCS	LOS Delay V/C Queue	B 19 0.79 126	B 15 0.49 19	B 18		C 22 0.83 148	C 22		C 34 0.79 68	C 32 0.30 29	C 32						C 21 0.83	
	2 - Main Street West & Macklin Street South	TCS	LOS Delay V/C Queue	B 13 0.55 93	B 13 0.55 93	B 13									C 33 0.25 40			C 33	B 15	
	3 - Highway 403 NE Ramp & Main Street West	TWSC	LOS Delay V/C Queue	A 3 - -	A 3 - -	A 3					A 1 - -	A 1 - -							3 - -	
	4 - Highway 403 SE Ramp & Main Street West	TWSC	LOS Delay V/C Queue	A 1 - -	A 1 - -	A 1									A 2 - -			A 2 - -	1 - -	
	5 - Highway 403 NW Ramp & King Street West	TWSC	LOS Delay V/C Queue					A 3 - -	A 6 - -	A 4										4 - -
	6 - Highway 403 SW Ramp & King Street West	TWSC	LOS Delay V/C Queue					A 6 - -	A 0 - -	A 3 - -										3 - -
	7 - King Street West & Macklin Street South	TCS	LOS Delay V/C Queue					A 9 0.44 52	A 9		C 30 0.16 20	C 30			C 29 0.14 20			C 29	A 10	
	8 - Macklin Street South & Carling Street	TWSC	LOS Delay V/C Queue	A 10 0.04 1	A 10 0.04 1	A 10		B 11 0.02 1	B 11 0.02 1	B 11	A 1 0.01 0	A 1 0.01 0	A 1 0.01 0	A 1	A 1 0.01 0	A 1 0.01 0	A 1 0.01 0	A 1	3	
	9 - Carling Street & Driveway A	TWSC	LOS Delay V/C Queue	A 0 0.02 0	A 0 0.02 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0	A 9 0.02 1	A 9 0.02 1	A 9							3
	10 - Carling Street & Driveway B	TWSC	LOS Delay V/C Queue	A 0 0.03 0	A 0 0.03 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0	A 9 0.01 0	A 9 0.01 0	A 9							1

AWSC - All-Way Stop Control
 TWSC - Two-Way Stop Control
 TCS - Traffic Control TCS

RBT - Roundabout

MOE - Measure of Effectiveness
 LOS - Level of Service
 Delay - Average Delay per Vehicle in Seconds

V/C - Volume to Capacity Ratio
 Queue (m) - 95th Percentile Queue Length



TABLE 4.3: 2028 BACKGROUND OPERATIONS SUMMARY

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach															
				Eastbound				Westbound				Northbound				Southbound			
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach
AM Peak Hour	1 - Highway 403 NS Ramp & Main Street West	TCS	LOS Delay V/C Queue	D 47 1.02 195	B 18 0.39 33	D 43		E 57 1.04 215	E 57			E 77 1.08 140	D 37 0.82 107	E 67					
	2 - Main Street West & Macklin Street South	TCS	LOS Delay V/C Queue	B 15 0.68 104	B 15 0.68 104	B 15										C 21 0.28 27			C 21
	3 - Highway 403 NE Ramp & Main Street West	TWSC	LOS Delay V/C Queue	A 3 - -		A 3						A 2 - -		A 2					
	4 - Highway 403 SE Ramp & Main Street West	TWSC	LOS Delay V/C Queue	A 1 - -		A 1										A 1 - -			A 1
	5 - Highway 403 NW Ramp & King Street West	TWSC	LOS Delay V/C Queue					A 0 - -	A 5 - -		A 2								
	6 - Highway 403 SW Ramp & King Street West	TWSC	LOS Delay V/C Queue					A 3 - -	A 0 - -		A 1								
	7 - King Street West & Macklin Street South	TCS	LOS Delay V/C Queue					A 9 0.45 54			A 9		C 29 0.12 13		C 29		C 29 0.21 26		C 29
	8 - Macklin Street South & Carling Street	TWSC	LOS Delay V/C Queue	A 10 0.02 1	A 10 0.02 1	A 10		B 11 0.06 1	B 11 0.06 1	B 11		A 1 0.00 0	A 1 0.00 0	A 1 0.00 0		A 1 0.00 0	A 1 0.00 0	A 1 0.00 0	A 1
	9 - Carling Street & Driveway A	TWSC	LOS Delay V/C Queue	A 0 0.01 0	A 0 0.01 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0		A 9 0.01 0	A 9 0.01 0	A 9					
	10 - Carling Street & Driveway B	TWSC	LOS Delay V/C Queue	A 0 0.01 0	A 0 0.01 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0		A 9 0.02 0	A 9 0.02 0	A 9					
PM Peak Hour	1 - Highway 403 NS Ramp & Main Street West	TCS	LOS Delay V/C Queue	B 19 0.79 128	B 15 0.49 19	B 18		C 24 0.88 166	C 24			D 37 0.82 75	C 24 0.35 34	C 34					C 22 0.87
	2 - Main Street West & Macklin Street South	TCS	LOS Delay V/C Queue	B 14 0.58 99	B 14 0.58 99	B 14										C 33 0.25 40			C 33
	3 - Highway 403 NE Ramp & Main Street West	TWSC	LOS Delay V/C Queue	A 4 - -		A 4						A 1 - -		A 1					
	4 - Highway 403 SE Ramp & Main Street West	TWSC	LOS Delay V/C Queue	A 1 - -		A 1										A 1 - -			A 1
	5 - Highway 403 NW Ramp & King Street West	TWSC	LOS Delay V/C Queue					A 3 - -	A 5 - -		A 4								
	6 - Highway 403 SW Ramp & King Street West	TWSC	LOS Delay V/C Queue					A 7 - -	A 0 - -		A 3								
	7 - King Street West & Macklin Street South	TCS	LOS Delay V/C Queue					A 9 0.44 53			A 9		C 30 0.16 20		C 30		C 29 0.14 20		C 29
	8 - Macklin Street South & Carling Street	TWSC	LOS Delay V/C Queue	A 10 0.04 1	A 10 0.04 1	A 10		B 11 0.03 1	B 11 0.03 1	B 11		A 1 0.01 0	A 1 0.01 0	A 1 0.01 0		A 1 0.01 0	A 1 0.01 0	A 1 0.01 0	A 1
	9 - Carling Street & Driveway A	TWSC	LOS Delay V/C Queue	A 0 0.02 0	A 0 0.02 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0		A 9 0.02 1	A 9 0.02 1	A 9					
	10 - Carling Street & Driveway B	TWSC	LOS Delay V/C Queue	A 0 0.03 0	A 0 0.03 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0		A 9 0.01 0	A 9 0.01 0	A 9					

AWSC - All-Way Stop Control
 TWSC - Two-Way Stop Control
 TCS - Traffic Control TCS

RBT - Roundabout

MOE - Measure of Effectiveness
 LOS - Level of Service
 Delay - Average Delay per Vehicle in Seconds

V/C - Volume to Capacity Ratio
 Queue (m) - 95th Percentile Queue Length



4.3 Total Traffic Operations

Total traffic volumes include the background forecasts as well as the site generated forecasts. The total traffic volumes for the respective horizon years are illustrated in the following Figures:

- ▶ **Figures 4.5A, 4.5B** - 2018 Total AM and PM peak hours;
- ▶ **Figures 4.6A, 4.6B** - 2023 Total AM and PM peak hours;
- ▶ **Figures 4.7A, 4.7B** - 2028 Total AM and PM peak hours.

Operational analyses have been conducted using Synchro 9.1 with HCM 2000 procedures and SimTraffic for the weekday AM and PM peak hour conditions. SimTraffic was used to provide simulation statistics in the assessment of interchange performance based on the total delay per vehicle parameter as Synchro is unable to model these types of intersections with free-flow characteristics.

The intersections within the study area were assessed based on the same parameters as in the analysis of existing conditions except for optimizing signal timing splits at the signalized intersections.

Table 4.4 – Table 4.6 displays a summary of the future background operations and the following is noted:

- ▶ The intersection of Main Street West and Highway 403 NS Ramp is expected to continue to operate with capacity constraints for the northbound left turn movement under all scenarios and the westbound through movement under the 2028 scenario. The increase in delays and decreased performance between the background conditions and total conditions is marginal under the 2018, 2023 and 2028 horizons;
- ▶ All other intersections are projected to be operate with acceptable levels of service under the 2018, 2023 and 2028 total conditions.

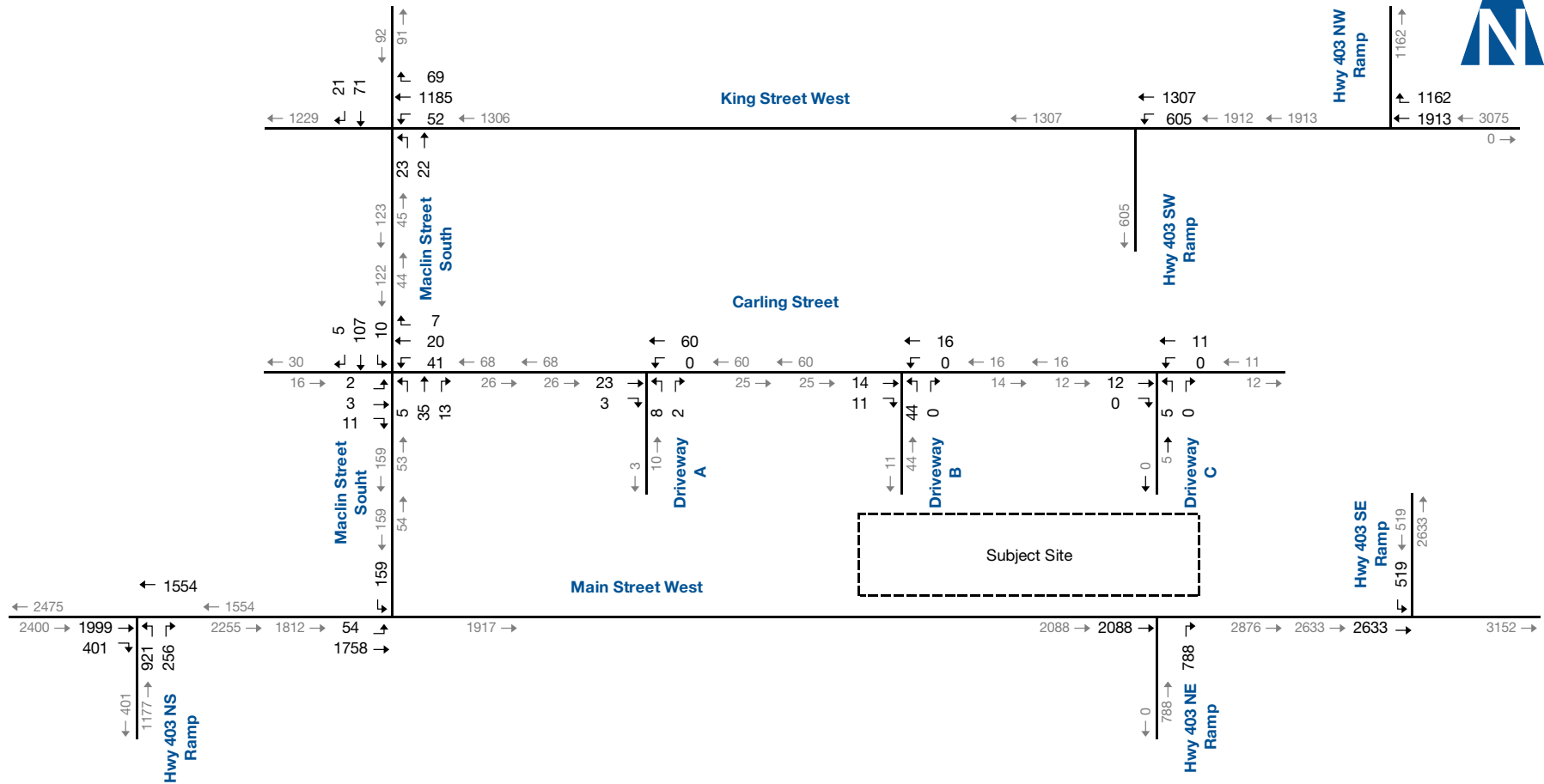
Appendix F contains the detailed Synchro reports.

4.3.1 Capacity Constraints

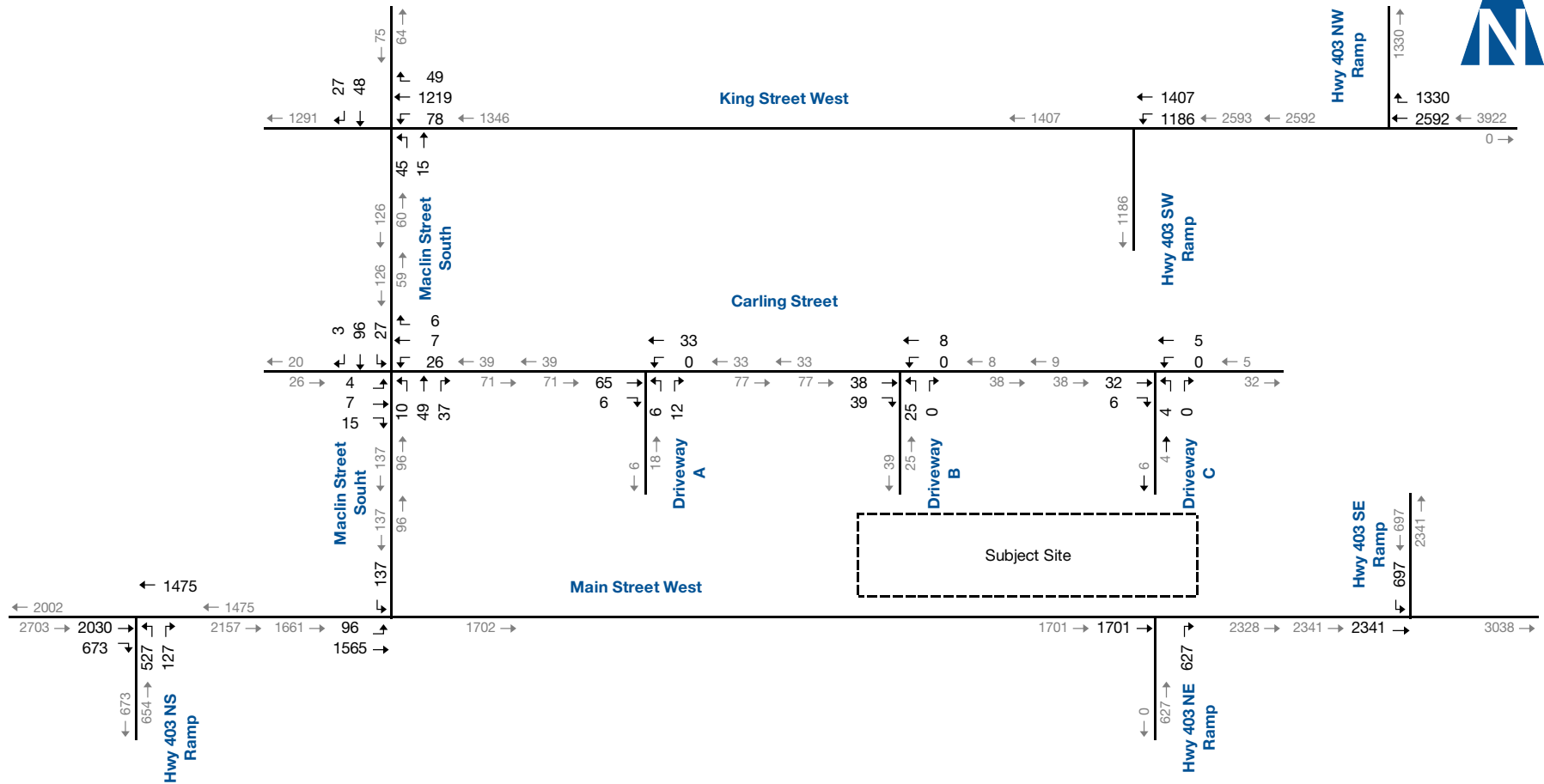
As stated under the background operations, the intersection of Main Street West and Highway 403 NS Ramp will require a shorter cycle length to accommodate the increased traffic volumes during the weekday AM peak hour under the 2028 horizon.

No other capacity constraints have been identified.





2023 Total AM Peak Hour Forecasts





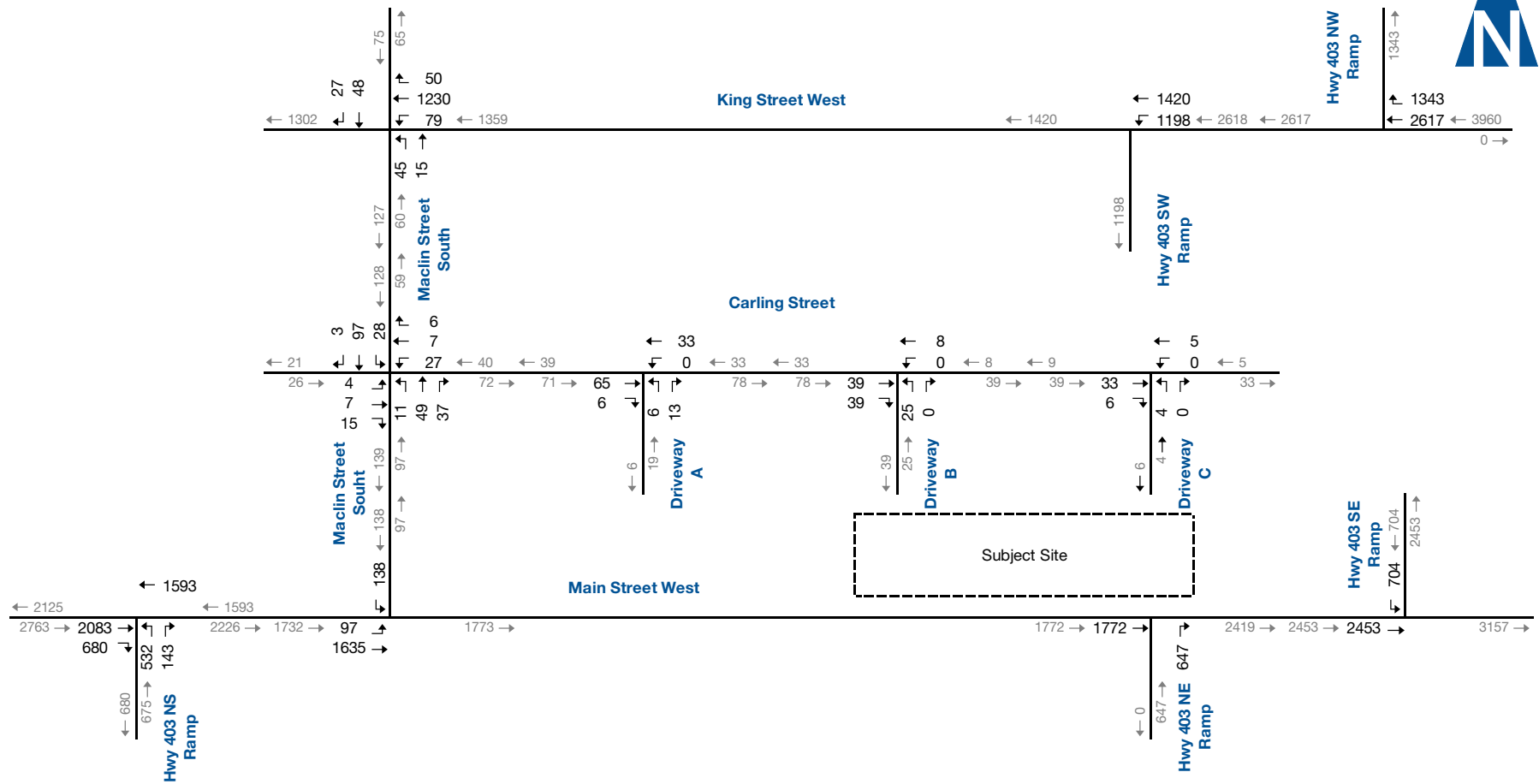


TABLE 4.4: 2018 TOTAL OPERATIONS SUMMARY

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	1 - Highway 403 NS Ramp & Main Street West	TCS	LOS Delay V/C Queue	C 27 0.88 137	B 17 0.33 23	C 26		D 46 1.00 200		D 46	E 62 1.03 132	C 22 0.52 52	D 54					D 38 1.03 138		
	2 - Main Street West & Macklin Street South	TCS	LOS Delay V/C Queue	B 14 0.65 97		B 14								C 22 0.31 31			C 22	B 15		
	3 - Highway 403 NE Ramp & Main Street West	TWSC	LOS Delay V/C Queue	A 3 - -		A 3					A 1 - -		A 1 - -					2 - -		
	4 - Highway 403 SE Ramp & Main Street West	TWSC	LOS Delay V/C Queue	A 1 - -		A 1								A 1 - -			A 1 - -	1 - -		
	5 - Highway 403 NW Ramp & King Street West	TWSC	LOS Delay V/C Queue					A 0 - -	A 5 - -	A 2								2 - -		
	6 - Highway 403 SW Ramp & King Street West	TWSC	LOS Delay V/C Queue					A 3 - -	A 0 - -	A 1 - -								1 - -		
	7 - King Street West & Macklin Street South	TCS	LOS Delay V/C Queue					A 9 0.44 52		A 9	C 29 0.12 14		C 29		C 29 0.20 25		C 29	B 11		
	8 - Macklin Street South & Carling Street	TWSC	LOS Delay V/C Queue	A 10 0.02 1	A 10 0.02 1	A 10		B 11 0.11 3	B 11 0.11 3	B 11	A 1 0.00 0	A 1 0.00 0	A 1		A 1 0.01 0	A 1 0.01 0	A 1	4		
	9 - Carling Street & Driveway A	TWSC	LOS Delay V/C Queue	A 0 0.02 0	A 0 0.02 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0	A 9 0.01 0	A 9 0.01 0	A 9					1		
	10 - Carling Street & Driveway B	TWSC	LOS Delay V/C Queue	A 0 0.02 0	A 0 0.02 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0	A 9 0.05 1	A 9 0.05 1	A 9					5		
	11 - Carling Street & Driveway C	TWSC	LOS Delay V/C Queue	A 0 0.01 0	A 0 0.01 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0	A 9 0.01 0	A 9 0.01 0	A 9					1		
PM Peak Hour	1 - Highway 403 NS Ramp & Main Street West	TCS	LOS Delay V/C Queue	C 20 0.78 123	B 15 0.47 19	B 18		C 22 0.81 139		C 22	C 31 0.74 63	C 22 0.30 29	C 29					C 21 0.8		
	2 - Main Street West & Macklin Street South	TCS	LOS Delay V/C Queue	B 13 0.54 89	B 13 0.54 89	B 13								C 33 0.27 43			C 33	B 15		
	3 - Highway 403 NE Ramp & Main Street West	TWSC	LOS Delay V/C Queue	A 3 - -		A 3					A 1 - -		A 1 - -					2 - -		
	4 - Highway 403 SE Ramp & Main Street West	TWSC	LOS Delay V/C Queue	A 1 - -		A 1								A 2 - -			A 2 - -	1 - -		
	5 - Highway 403 NW Ramp & King Street West	TWSC	LOS Delay V/C Queue					A 2 - -	A 7 - -	A 4								4 - -		
	6 - Highway 403 SW Ramp & King Street West	TWSC	LOS Delay V/C Queue					A 5 - -	A 0 - -	A 2 - -								3 - -		
	7 - King Street West & Macklin Street South	TCS	LOS Delay V/C Queue					A 9 0.43 51		A 9	C 30 0.16 20		C 30		C 29 0.13 19		C 29	A 10		
	8 - Macklin Street South & Carling Street	TWSC	LOS Delay V/C Queue	A 10 0.04 1	A 10 0.04 1	A 10		B 11 0.07 2	B 11 0.07 2	B 11	A 1 0.01 0	A 1 0.01 0	A 1		A 2 0.02 1	A 2 0.02 1	A 2	4		
	9 - Carling Street & Driveway A	TWSC	LOS Delay V/C Queue	A 0 0.05 0	A 0 0.05 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0	A 9 0.02 1	A 9 0.02 1	A 9					1		
	10 - Carling Street & Driveway B	TWSC	LOS Delay V/C Queue	A 0 0.05 0	A 0 0.05 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0	A 9 0.03 1	A 9 0.03 1	A 9					2		
	11 - Carling Street & Driveway C	TWSC	LOS Delay V/C Queue	A 0 0.02 0	A 0 0.02 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0	A 9 0.00 0	A 9 0.00 0	A 9					1		

AWSC - All-Way Stop Control
 TWSC - Two-Way Stop Control
 TCS - Traffic Control TCS

RBT - Roundabout

MOE - Measure of Effectiveness
 LOS - Level of Service
 Delay - Average Delay per Vehicle in Seconds

V/C - Volume to Capacity Ratio
 Queue (m) - 95th Percentile Queue Length



TABLE 4.5: 2023 TOTAL OPERATIONS SUMMARY

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	1 - Highway 403 NS Ramp & Main Street West	TCS	LOS Delay V/C Queue	C 31 0.92 155	B 17 0.36 27	C 28		D 52 1.02 210		D 52		E 74 1.06 139	C 25 0.61 63	E 63				D 44 1.06		
	2 - Main Street West & Macklin Street South	TCS	LOS Delay V/C Queue	B 15 0.67 102	B 15 0.67 102	B 15									C 22 0.32 32		C 22	B 15		
	3 - Highway 403 NE Ramp & Main Street West	TWSC	LOS Delay V/C Queue	A 3 - -	A 3 - -	A 3						A 2 - -	A 2 - -					3 - -		
	4 - Highway 403 SE Ramp & Main Street West	TWSC	LOS Delay V/C Queue	A 1 - -	A 1 - -	A 1									A 1 - -		A 1 - -	1 - -		
	5 - Highway 403 NW Ramp & King Street West	TWSC	LOS Delay V/C Queue					A 1 - -	A 4 - -	A 2								2 - -		
	6 - Highway 403 SW Ramp & King Street West	TWSC	LOS Delay V/C Queue					A 3 - -	A 0 - -	A 1 - -								1 - -		
	7 - King Street West & Macklin Street South	TCS	LOS Delay V/C Queue					A 9 0.45 53		A 9		C 29 0.12 15	C 29		C 29 0.21 26	C 29	B 11			
	8 - Macklin Street South & Carling Street	TWSC	LOS Delay V/C Queue	A 10 0.02 1	A 10 0.02 1	A 10	B 11 0.11 3	B 11 0.11 3	B 11	A 1 0.00 0	A 1 0.00 0	A 1 0.00 0	A 1	A 1 0.01 0	A 1 0.01 0	A 1	4			
	9 - Carling Street & Driveway A	TWSC	LOS Delay V/C Queue	A 0 0.02 0	A 0 0.02 0	A 0	A 0 0.00 0	A 0 0.00 0	A 0	A 9 0.01 0	A 9 0.01 0	A 9						1		
	10 - Carling Street & Driveway B	TWSC	LOS Delay V/C Queue	A 0 0.02 0	A 0 0.02 0	A 0	A 0 0.00 0	A 0 0.00 0	A 0	A 9 0.05 1	A 9 0.05 1	A 9						5		
	11 - Carling Street & Driveway C	TWSC	LOS Delay V/C Queue	A 0 0.01 0	A 0 0.01 0	A 0	A 0 0.00 0	A 0 0.00 0	A 0	A 9 0.01 0	A 9 0.01 0	A 9						1		
PM Peak Hour	1 - Highway 403 NS Ramp & Main Street West	TCS	LOS Delay V/C Queue	B 19 0.79 127	B 15 0.49 19	B 18		C 22 0.83 149		C 22		C 34 0.79 68	C 23 0.33 32	C 32				C 21 0.83		
	2 - Main Street West & Macklin Street South	TCS	LOS Delay V/C Queue	B 13 0.56 95	B 13 0.56 95	B 13									C 33 0.28 44		C 33	B 15		
	3 - Highway 403 NE Ramp & Main Street West	TWSC	LOS Delay V/C Queue	A 3 - -	A 3 - -	A 3						A 1 - -	A 1 - -					2 - -		
	4 - Highway 403 SE Ramp & Main Street West	TWSC	LOS Delay V/C Queue	A 1 - -	A 1 - -	A 1									A 1 - -		A 1 - -	1 - -		
	5 - Highway 403 NW Ramp & King Street West	TWSC	LOS Delay V/C Queue					A 2 - -	A 6 - -	A 3								3 - -		
	6 - Highway 403 SW Ramp & King Street West	TWSC	LOS Delay V/C Queue					A 5 - -	A 0 - -	A 2 - -								2 - -		
	7 - King Street West & Macklin Street South	TCS	LOS Delay V/C Queue					A 9 0.44 53		A 9		C 30 0.17 21	C 30		C 29 0.10 16	C 29	B 11			
	8 - Macklin Street South & Carling Street	TWSC	LOS Delay V/C Queue	A 10 0.04 1	A 10 0.04 1	A 10	B 11 0.07 2	B 11 0.07 2	B 11	A 1 0.01 0	A 1 0.01 0	A 1 0.01 0	A 1	A 2 0.02 1	A 2 0.02 1	A 2	4			
	9 - Carling Street & Driveway A	TWSC	LOS Delay V/C Queue	A 0 0.05 0	A 0 0.05 0	A 0	A 0 0.00 0	A 0 0.00 0	A 0	A 9 0.02 1	A 9 0.02 1	A 9						1		
	10 - Carling Street & Driveway B	TWSC	LOS Delay V/C Queue	A 0 0.05 0	A 0 0.05 0	A 0	A 0 0.00 0	A 0 0.00 0	A 0	A 9 0.02 1	A 9 0.02 1	A 9						1		
	11 - Carling Street & Driveway C	TWSC	LOS Delay V/C Queue	A 0 0.02 0	A 0 0.02 0	A 0	A 0 0.00 0	A 0 0.00 0	A 0	A 9 0.00 0	A 9 0.00 0	A 9						1		

AWSC - All-Way Stop Control
 TWSC - Two-Way Stop Control
 TCS - Traffic Control TCS

RBT - Roundabout

MOE - Measure of Effectiveness
 LOS - Level of Service
 Delay - Average Delay per Vehicle in Seconds

V/C - Volume to Capacity Ratio
 Queue (m) - 95th Percentile Queue Length



TABLE 4.6: 2028 TOTAL OPERATIONS SUMMARY

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				Eastbound				Westbound				Northbound				Southbound				Overall
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	1 - Highway 403 NS Ramp & Main Street West	TCS	LOS Delay V/C Queue	D 48 1.02 195	B 18 0.39 33	D 43		E 59 1.04 217		E 59		E 77 1.08 140	D 38 0.83 109	E 67					D 53 1.08	
	2 - Main Street West & Macklin Street South	TCS	LOS Delay V/C Queue	B 15 0.68 105	B 15											C 23 0.32 33		C 23	B 15	
	3 - Highway 403 NE Ramp & Main Street West	TWSC	LOS Delay V/C Queue	A 4 - -		A 4 - -							A 2 - -	A 2 - -					3 - -	
	4 - Highway 403 SE Ramp & Main Street West	TWSC	LOS Delay V/C Queue	A 1 - -		A 1 - -										A 1 - -		A 1 - -	1 - -	
	5 - Highway 403 NW Ramp & King Street West	TWSC	LOS Delay V/C Queue					A 0 - -	A 4 - -	A 2										2 - -
	6 - Highway 403 SW Ramp & King Street West	TWSC	LOS Delay V/C Queue					A 3 - -	A 0 - -	A 1 - -										1 - -
	7 - King Street West & Macklin Street South	TCS	LOS Delay V/C Queue					A 9 0.45 54		A 9		C 29 0.12 14		C 29		C 29 0.21 26		C 29	B 11	
	8 - Macklin Street South & Carling Street	TWSC	LOS Delay V/C Queue	A 10 0.02 1	A 10 0.02 1	A 10		B 11 0.12 3	B 11 0.11 3	B 11		A 1 0.00 0	A 1 0.00 0	A 1 0.00 0	A 1	A 1 0.00 0	A 1 0.00 0	A 1	4	
	9 - Carling Street & Driveway A	TWSC	LOS Delay V/C Queue	A 0 0.02 0	A 0 0.02 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0		A 9 0.01 0	A 9 0.01 0	A 9					1	
	10 - Carling Street & Driveway B	TWSC	LOS Delay V/C Queue	A 0 0.02 0	A 0 0.02 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0		A 9 0.05 0	A 9 0.05 0	A 9					5	
	11 - Carling Street & Driveway C	TWSC	LOS Delay V/C Queue	A 0 0.01 0	A 0 0.01 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0		A 9 0.01 0	A 9 0.01 0	A 9					1	
PM Peak Hour	1 - Highway 403 NS Ramp & Main Street West	TCS	LOS Delay V/C Queue	B 19 0.80 130	B 15 0.49 19	B 18		C 24 0.88 168		C 24		D 37 0.82 75	C 25 0.38 36	C 34					C 22 0.87	
	2 - Main Street West & Macklin Street South	TCS	LOS Delay V/C Queue	B 14 0.59 101	B 14											C 34 0.28 44		C 34	B 15	
	3 - Highway 403 NE Ramp & Main Street West	TWSC	LOS Delay V/C Queue	A 3 - -		A 3 - -							A 1 - -	A 1 - -					3 - -	
	4 - Highway 403 SE Ramp & Main Street West	TWSC	LOS Delay V/C Queue	A 1 - -		A 1 - -										A 2 - -		A 2 - -	1 - -	
	5 - Highway 403 NW Ramp & King Street West	TWSC	LOS Delay V/C Queue					A 2 - -	A 6 - -	A 3									3 - -	
	6 - Highway 403 SW Ramp & King Street West	TWSC	LOS Delay V/C Queue					A 5 - -	A 0 - -	A 2 - -									2 - -	
	7 - King Street West & Macklin Street South	TCS	LOS Delay V/C Queue					A 8 0.45 54		A 8		C 30 0.17 21		C 30		C 29 0.14 20		C 29	B 11	
	8 - Macklin Street South & Carling Street	TWSC	LOS Delay V/C Queue	A 10 0.04 1	A 10 0.04 1	A 10		B 11 0.07 2	B 11 0.07 2	B 11		A 1 0.01 0	A 1 0.01 0	A 1 0.01 0	A 1	A 2 0.02 1	A 2 0.02 1	A 2	4	
	9 - Carling Street & Driveway A	TWSC	LOS Delay V/C Queue	A 0 0.05 0	A 0 0.05 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0		A 9 0.02 1	A 9 0.02 1	A 9					1	
	10 - Carling Street & Driveway B	TWSC	LOS Delay V/C Queue	A 0 0.05 0	A 0 0.05 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0		A 9 0.01 1	A 9 0.01 1	A 9					2	
	11 - Carling Street & Driveway C	TWSC	LOS Delay V/C Queue	A 0 0.03 0	A 0 0.03 0	A 0		A 0 0.00 0	A 0 0.00 0	A 0		A 9 0.01 0	A 9 0.01 0	A 9					1	

AWSC - All-Way Stop Control
 TWSC - Two-Way Stop Control
 TCS - Traffic Control TCS

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 Delay - Average Delay per Vehicle in Seconds

V/C - Volume to Capacity Ratio
 Queue (m) - 95th Percentile Queue Length



5 Remedial Measures

5.1 Sight Distance

The Transportation Association of Canada (TAC) recommends that safe stopping sight distance be measured from an approaching driver eye height of 1.05 metres to an object height (e.g. taillights) of 0.38 metres at the proposed connection.

Table 5.1 summarizes the minimum sight distance requirements for a 60 kilometre per hour design speed. These standards are based on TAC design manuals.

TABLE 5.1: SIGHT DISTANCE REQUIREMENTS

Sight Distance	Design Speed
	60 km/h
Minimum Stopping Sight Distance (m)	90

Sight distance observations based on aerial imagery and a field visit indicate that sight distance within the road allowance to the east is limited by a bend along Carling Street. Sight distance to the west has no limitations.

Table 5.2 outlines the measurements taken.

TABLE 5.2: SIGHT DISTANCE MEASUREMENTS

Sight Distance	From/To the East		
	Measurement (m)		
	Driveway A	Driveway B	Driveway C
Stopping/Departure	115	70	55

Vehicles traveling from the east along Carling Street have a field of view of the development's driveway connections of approximately 115 to 55 metres; dependent on the connection. The field of view is limited by an existing bend of the roadway along Carling Street. For the assumed design speed, a minimum of 90 metres is typically required. Driveway A meets the requirement; however, Driveway B and C falls short between 20-35 metres.

Although the stopping sight distance criteria have not been met for Driveway B and C, there are mitigating factors to be considered as follows:

- ▶ Vehicles travelling from the east along Carling Street through the curve will be negotiating the turn at a lower speed than the posted speed limit. The available stopping sight distance is sufficient for a design speed of 40 kilometres per hour which requires 45 metres;



- ▶ The driveway connections to this section of Carling Street for the development and other parcels have been in existence for several years. As Carling Street caters to local traffic, regular road users are aware of the limited sight distance present at these connections.
- ▶ The peak hour westbound through volume travelling through the curvature is expected to be very low and would range between approximately 5 and 12 vehicles during the peak hours;

Limited stopping sight distance to the east presents a low safety risk and one that exists today as these driveway connections have been in existence for a number of years.

To further identify the limited sight distance to road users, installations of an Intersection Sign Controlled (WA 13A) sign and a Hidden Intersection tab sign (Wa-18t) should be provided along Carling Street prior to the bend in the roadway. These warning signs will provide drivers with advanced warning of the approaching intersections.⁵

5.2 Auxiliary Turn Lanes

The need for auxiliary turn lanes was reviewed for the unsignalized intersections.

5.2.1 Left-Turn Lane Warrants

All traffic into the development is forecast to originate as right turn movements. As no trips into the development are expected to consist of left turn movements, a left turn lane warrant was not conducted.

5.2.2 Right-Turn Lane

Although right turns are generally made more efficiently than left turn movements, exclusive right turn lanes are often provided, for many of the same reasons that left turn lanes are provided. In general, an exclusive right turn lane should be considered when the volume of right turning vehicles is between 10 to 20 percent of the through volume, subject to a minimum of 60 vehicles per hour (vph) in the design hour.

The 2028 total forecasted traffic volumes indicate the right turn volume at the driveway connections to the development less than 60 vph. As the volume of right turning traffic does not meet the specified criteria, separate right turn lanes are not recommended.

⁵ Rural Intersection Safety Handbook, Prepared by Delphi-MRC, Prepared for Transport Canada, March 2006.



5.3 Network Deficiencies

As mentioned previously in **Sub-Section 4.2.1**, implementation of a reduced cycle length during the weekday AM peak hour for the 2028 horizon will be required at the intersection of Main Street West and Highway 403 NS Ramp to improve the operations.

As the Main Street West corridor operates as a synchronized system, modifications to entire corridors signal timings are expected to be required with implementation of this improvement. This improvement is not a result of the proposed development as high delays are occurring under the base year operations and future background conditions.

5.3.1 Sensitivity Analysis

A sensitivity analysis to assess the intersection of Main Street West and Highway 403 NS Ramp has been undertaken for the 2028 AM peak hour total traffic forecasts with a reduced cycle length. **Table 5.3** summarizes the results of the sensitivity analysis.

Based on the analysis, Main Street West and Highway 403 NS ramp is projected to operate with improved operations for the westbound through movement during the AM peak hour.

Appendix G contains the detailed Synchro reports.



TABLE 5.3: 2028 AM PEAK HOUR TOTAL TRAFFE SENSITIVITY ANALYSIS

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach											
				Eastbound				Westbound				Northbound			
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach
AM Peak Hour	1 - Highway 403 NS Ramp & Main Street West	TCS	LOS	C	B	C		D	D	E	D	E			D
			Delay	28	11	25		35	35	66	47	61			36
			V/C	0.97	0.30			0.99		1.06	0.92				1.05
			Queue	137	12			154		104	91				

AWSC - All-Way Stop Control
 TWSC - Two-Way Stop Control
 TCS - Traffic Control TCS

RBT - Roundabout

MOE - Measure of Effectiveness
 LOS - Level of Service
 Delay - Average Delay per Vehicle in Seconds

V/C - Volume to Capacity Ratio
 Queue (m) - 95th Percentile Queue Length



6 Parking Supply Management

As with any equilibrium system, there are a minimum of two components that are required to be in balance to reach the equilibrium point. With parking systems this requires the balance of parking supply and demand. Reaching an appropriate supply level is equally important as demand. The ubiquitous oversupply of cheap and accessible parking has been long-identified as a major contributing factor to the growth in single-occupant vehicle (SOV) travel. Reduction of the proliferation of SOV travel has been identified in the City of Hamilton's Transportation Master Plan as a long-term desirable goal.

6.1 Zoning By-Law Requirements

The zoning for institutional, industrial, parks and open space uses as well as the Downtown Hamilton area is regulated by the New Zoning By-Law 05-200.

The remaining uses; including residential, is still regulated through the former Zoning By-Laws for the respective municipalities.

6.1.1 Zoning By-Law 6593

Zoning By-law 6593 is the current in-force By-law for the proposed development. The requirements stipulated in Zoning By-law are outlined in **Appendix H**. Based on the Zoning By-law 6593, the minimum parking rates for the proposed development are as follows:

- ▶ 1.25 spaces per unit for multiple dwellings.
- ▶ 0.25 spaces per unit for visitor parking.

Table 6.1 summarizes Zoning By-law 6593 minimum parking standard calculations for the development.

TABLE 6.1: ZONING REQUIREMENTS

Use	Units	Zoning By Law 6593	
		Parking Rate	Parking Spaces Required
Apartment Dwelling	167	1.25 spaces per unit	208.8
Visitor Parking	167	0.25 spaces per unit	41.8
Total Parking Required			374.3

As indicated in **Table 6.1**, under Zoning By-law 6593, the overall development requires 375 parking spaces.



6.1.2 Evolution of Parking Ratios

Parking standards are increasingly seen as an instrument of planning policy, and parking ratios are now looked at as having a key role in determining car use.

Parking ratios have existed in most cities since at least the 1950's and have often been amended incrementally by various means over time. Consequently, it is not surprising to find that municipalities are often unable to trace the justification or reasoning behind some of the older parking ratios found in their current Zoning By-laws.

Given that parking standards reflect an "average" condition, they will rarely prescribe the number of parking spaces to match the parking demands of any individual development project exactly. The empirical challenge is to develop some understanding of the range over which parking demand for a given use may vary, and the policy question is where in that range should the parking standard or ratio be set.

6.1.3 Applicability of Zoning By-Law 6593

There are fundamental issues that are related to the application of the parking policies provided in Zoning By-law 6593, particularly:

- ▶ The parking ratios of By-law 6593 provides separate rates for multi-residential developments located within the Downtown and for areas outside of the Downtown. However, this one-size-fits-all-areas approach to the areas outside of the Downtown does not consider the recent widespread adoption of urban "smart growth" practices, with emphasis on transit-supportive development.
- ▶ Zoning By-law 6593 came into effect in 1950 and reflects an outdated vision of unrestricted auto-mobility, and plentiful of free parking that undermines current land use and transportation goals of the City.
- ▶ Lack of recognition that the development is in proximity to McMaster University as well as shopping areas, and a future LRT Rapid Transit station (King Street West and Longwood Road South).
- ▶ Lack of recognition that the development will be mainly marketed towards the student population and transit users, which is less likely to own a vehicle, and are more likely to utilize active modes of transport and transit.
- ▶ Lack of recognition of micro units and the affects these units have with regard to parking requirements. While micro units still require some amount of parking dedicated, the requirements are substantially lower than those of typical units.
- ▶ There is a strong focus on the pedestrian environment, transit and an emphasis upon active transportation. As the development proposal places a focus on accommodating a suitable pedestrian



environment, one that would encourage active transportation based on the de-emphasis on parking and is consistent with the goals set out in the UHOP⁶, the use of the Zoning By-law 6593 does not reflect these goals.

6.1.4 New Zoning By-Law 05-200

The criteria used in Zoning By-law 6593, particularly with minimum parking requirements does not reflect the policies set out in UHOP with regard to reduced parking requirements in support of a broader range of uses and the promotion of active transportation modes.

As an Official Plan is a guiding document that provides direction and guidance on the management of communities, land use change and physical development, it is important to look at the future requirements as opposed to the past requirements to maintain and implement the policies developed.

As the New Zoning By-law 05-200 follows the policies set-out in Hamilton's 2014 Official Plan and is designed to replace each of the former municipalities' by-laws, it is important to further look at the requirements specified in this by-law, as these regulations will eventually be imposed and provide a comprehensive zoning guide for the entire City to follow.

The requirements stipulated in the Zoning By-law 05-200 are outlined in **Appendix I**. Based on the Zoning By-law 05-200, the minimum parking rates for the proposed development are as follows:

- ▶ 1.00 space per residential unit greater than 50 square metres;
- ▶ 0.30 spaces per residential unit equal or less than 50 square metres;
- and

Table 6.2 summarizes Zoning By-law 05-200 minimum parking standard calculations for the development.

TABLE 6.2: ZONING BY-LAW 05-200 PARKING REQUIREMENTS

Use	Units	Zoning By Law 05-200	
		Parking Rate	Parking Spaces Required
Apartment Dwelling > 50 Square Metres	119	1.00 spaces per unit	119.0
Apartment Dwelling < or = 50 Square Metres	48	0.30 spaces per unit	14.4
Total Parking Required			133.4

As indicated in **Table 6.2**, under the Zoning By-Law 05-200, the overall development requires 134 parking spaces.

⁶ Urban Hamilton Official Plan, February 2014.



6.2 Site Specific – Methodology for Reduction

The application of the parking by-law requirements as simple additive requirements has built into it an assumption that all land uses have similar peak demand. Published data supports the notion that parking demand varies based on numerous factors such as location and unit size.

The simplistic approach of superposition would result in the oversupply of parking at a given site as it ignores the temporal aspects of location criteria as the peaking characteristics can be different for each location. This methodology reviews site specific characteristics that would justify a reduction in parking requirements from the base Zoning By-law requirements.

6.2.1 Area-Specific Mode Choice

The need for parking is largely based in part on auto ownership. A review of vehicle ownership characteristics information provided by the 2011 Transportation Tomorrow Survey (TTS)⁷ for residents living in the regional area surrounding the site has been obtained. Information provided by the TTS program for the site area (GTA 2001 Zones 2501-2510) confirms that 36 percent of apartments surveyed do not own a vehicle. Further disposition of the survey results can conclude that the actual vehicle ownership, based on a weighted average is 0.76 vehicles per unit.

Table 6.3 summarizes the vehicle ownership characteristics from 2011.

TABLE 6.3: VEHICLES PER HOUSEHOLD (2011 TTS)

Dwelling Type	Vehicles in Household						Households	Vehicles	Average Ownership
	0	1	2	3	4	5			
House	615 7%	3869 46%	3155 37%	633 7%	160 2%	26 0%	8458	12848	1.52
Apartment	1617 36%	2405 54%	392 9%	33 1%	0 0%	18 0%	4465	3378	0.76
Townhouse	33 14%	97 40%	92 38%	20 8%	0 0%	0 0%	242	341	1.41

A review of historical TTS information over the past ten years indicates that the vehicle ownership has decreased from 0.84 to 0.76 vehicles per unit for apartment dwellings within the development area. Based on this trend it is reasonable to assume a further decline in vehicle ownership has occurred for the current year and expected to continue to decline in the future.

Table 6.4 summarizes the vehicle ownership characteristics from 2001.

⁷ The Transportation Tomorrow Survey (TTS) is a comprehensive travel survey conducted in the Greater Toronto and Hamilton Area (GTHA) once every five years.



TABLE 6.4: VEHICLES PER HOUSEHOLD (2001 TTS)

Dwelling Type	Vehicles in Household						Households	Vehicles	Average Ownership
	0	1	2	3	4	5			
House	1200 14%	4034 48%	2608 31%	384 5%	74 1%	26 0%	8326	10828	1.30
Apartment	1642 29%	3362 60%	535 10%	39 1%	20 0%	18 0%	5616	4719	0.84
Townhouse	46 16%	197 69%	44 15%	0 0%	0 0%	0 0%	287	285	0.99

With respect to parking, the vehicle ownership evaluation offers some insight into parking requirements of the immediate area. In general, this review indicates that, despite preconceived notions, not all residents in apartment dwellings outside of the defined downtown as specified in the Zoning By-law own a vehicle. This provides further justification that opportunities exist to provide reduced parking requirements associated with the proposed development given the site's location and proximity to transit, and the access to local amenities that can be met through active travel modes.

6.2.2 Area-Specific Mode Share

A review of travel characteristics information provided by the 2011 Transportation Tomorrow Survey (TTS) for residents living in the area surrounding the site confirms that a significant proportion of travel undertaken during the morning and afternoon peak periods is undertaken by non-auto means.

Auto-related travel is not a highly predominant mode of transportation for residents of the surrounding area during peak periods; as compared to other parts of the City. Information provided by the TTS program for the site area (GTA 2001 Zones 2501-2510) suggests that the proportion of people who choose to drive for travel purposes (including drivers, taxis and motorcycles) in the area during the morning and afternoon peak weekday periods is in the order of 60 percent of all travel undertaken. The balance of travel is undertaken as passengers in a car (17 percent) or using transit (11 percent) or by bicycle/walking (12 percent). Furthermore, a review of historical TTS information over the past 10 years indicates that sustainable transportation mode choices for commuting trips within the vicinity of the development during peak hours has been consistent at around 25% of all trips.

With the development located adjacent to a future LRT line, it is expected that the subject development will attract residents that will utilize transit as a primary mode choice for commuting with limited reliance on utilizing or even owning a vehicle. The implementation of the LRT is also expected to further increase transit usage for the immediate area which will create less demand for on-street and off-street vehicle parking areas.

The parking supply that is proposed will provide a parking resource that will logically be utilized by building residents who need a car for day-to-day use. The proposed parking supply would provide for approximately 44 percent of

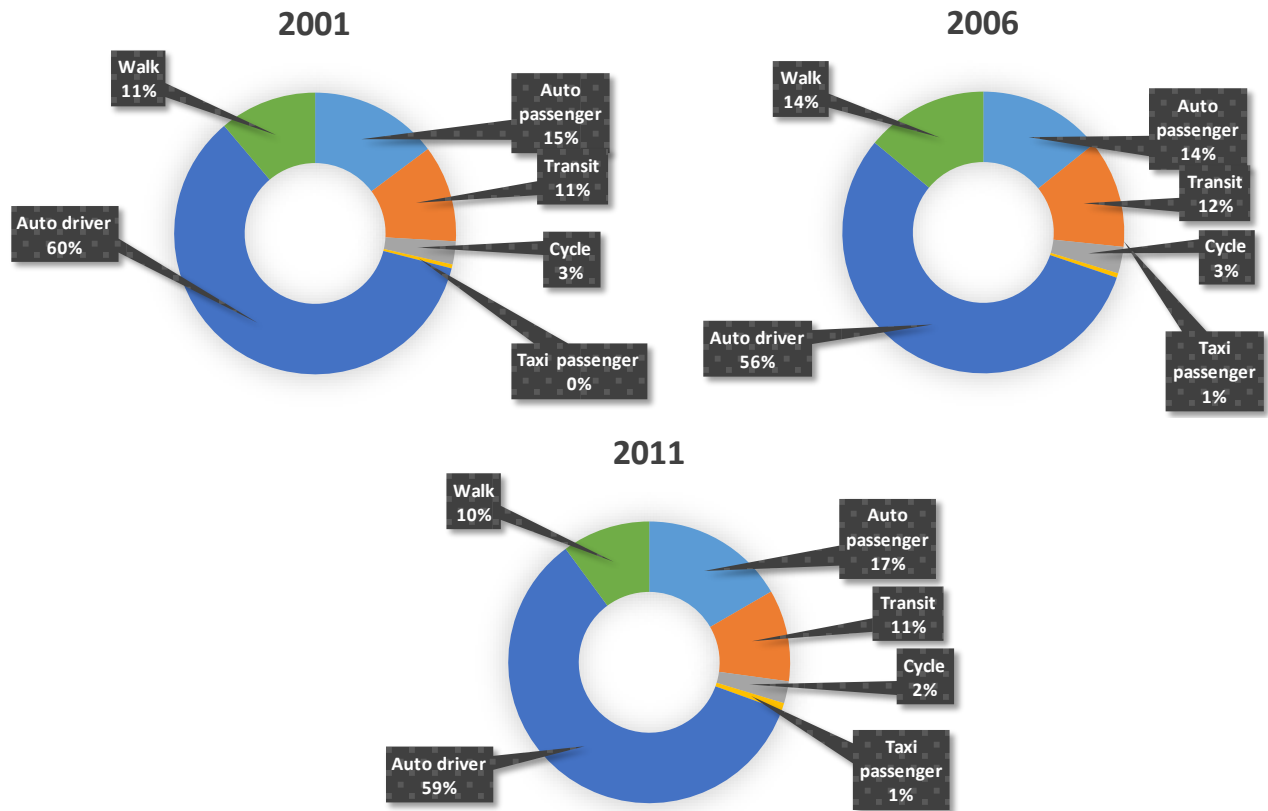


all units in the building which would satisfy a large portion of building occupants who need to drive on a recurring basis. As noted above, the TTS data indicates that 59 percent of area residents drive for commuting purposes.

Chart 6.5 outline historic trends in peak period commuting trip characteristics within the study area.



CHART 6.5: COMMUTING TRIPS IN THE STUDY AREA



6.2.3 Area-Specific Recognition

Applying the 2011 vehicle ownership data set, the potential parking supply for the overall site can be estimated. As the Zoning By-Law 05-200 has specified a reduced rate for units less than 50 square metres (micro-units), the vehicle ownership rates have been applied to units greater than 50 square metres. The basis of this is that micro units inherently already contributed to reduced parking requirements as the limited space attracts young professional singles with a primary importance on being within proximity to work/school/transit with little emphasis on requiring a parking space⁸.

Table 6.6 outlines the estimated the parking demand based on the vehicle ownership rates.

TABLE 6.6: PARKING DEMAND BASED ON VEHICLE OWNERSHIP

Use	Units	2011 TTS Vehicle Ownership Rates	
		Parking Rate	Parking Spaces Required
Apartment Dwelling > 50 Square Metres	119	0.76 spaces per unit	90.4
Apartment Dwelling < or = 50 Square Metres	48	0.30 spaces per unit	14.4
Total Parking Required			104.8

With consideration taken into account for 2011 vehicle ownership rates, the total parking requirement would be closer to 105 parking spaces as opposed to the 134-space requirement as outlined with the use of Zoning By-law 05-200 without vehicle ownership consideration.

Additionally, as the vehicle ownership rates utilized in the calculation are from 2011, historical TTS information over the past ten years indicates vehicle ownership rates for apartment units have decreased by about 10%. Thus, the current vehicle ownership rates are expected to be less than 0.76 and closer to 0.71 spaces which would further suggest the proposed parking supply proposed is adequate.

⁸ The Macro View on Micro Units, Urban Land Institute, 2014



6.3 Industry Standard – Methodology for Reduction

There are numerous industry associations and institutions that are dedicated to the survey and review of parking requirements related to various land uses. These associations collect, review and disseminate information related to parking demand, supply and appropriate design standards.

The accepted industry standard for the determination of potential parking demand is the Institute of the Transportation Engineers' Parking Generation. ITE provides information for a variety of land uses, including residential, commercial and senior housing land uses. This methodology briefly highlights industry findings related to the development parking supply utilizing industry standard rates.

6.3.1 ITE Parking Standards

Parking demand is a function of land use type, size, and location. The Institute of Transportation Engineers (ITE) publishes parking demand estimates by land use type, which are often the starting point for parking demand analyses. The data collected and published in ITE's Parking Generation⁹ report most closely represents suburban conditions with more auto-dependent development patterns. The following ITE land use codes has been utilized for the purposes of estimating the base parking generation for the development:

- ▶ **LUC 222 (High-Rise Apartment).** This land use code is described as units located in buildings that have three or more levels. Both condos and towns are included in this land use.
- ▶ ITE does not have specific rates for micro units, as a result, a rate of 0.30 has been utilized to remain consistent with Zoning By-Law 05-200

Table 6.7 outlines parking rates from ITE which is inclusive of residential and visitor requirements.

TABLE 6.7: ITE PARKING REQUIREMENTS

Land Use Code	Units	ITE Parking Estimates	
		Parking Rate	Parking Requirements
222 - High-Rise Apartment	119	1.37 spaces per unit	163.0
Zoning By-Law 05-200	48	0.30 spaces per unit	14.4
Total Parking Required			177.4

⁹ Institute of Transportation Engineers Parking Generation, 4th Edition, 2010



As indicated in **Table 6.7**, under the ITE base rates, the overall development requires 178 parking spaces.

6.3.2 Adjusted for Vehicle Ownership

The rates provided by ITE must also take into account the relationship between parking demand and factors such as location and unit size. Locations in urban centres will generate less demand than suburban locations and smaller units generate less demand than larger units. These relationships are the result of related household factors such as size, income and auto ownership, and locations factors such as proximity to other uses, availability and opportunities to use alternative travel modes and, in some instances, alternative off-site parking opportunities.

This is re-iterated in Shared Parking by the Urban Land Institute¹⁰ which states that if local vehicle ownership data cannot be obtained, an adjustment of about 80 percent to reflect vehicle ownership is appropriate for locations that are not downtown, but well served by transit. **Section 6.2** has demonstrated that that actual vehicle ownership for apartment units in the immediate area is closer to 64 percent. Adjusting the ITE base rates to reflect this indicates a parking ratio of 0.88 spaces per unit should be used for the proposed development.

Table 6.8 summarizes the estimated ITE parking demand calculations with adjustments made to reflect vehicle ownership rates.

TABLE 6.8: ITE PARKING REQUIREMENTS – ADJUSTED

Land Use Code	Units	ITE Parking Estimates	
		Parking Rate	Parking Requirements
222 - High-Rise Apartment	119	0.88 spaces per unit ¹	104.7
Zoning By-Law 05-200	48	0.30 spaces per unit	14.4
Total Parking Required			119.1

¹ Base rate adjusted to reflect vehicle ownership characteristics

With consideration taken into account for vehicle ownership rates, the total parking requirement would be closer to 120 parking spaces.

¹⁰ Shared Parking, Urban Land Institute, January 2005



6.4 Comparable Sites – Methodology for Reduction

To better understand the actual parking demand that can be expected for a development of this type, a parking utilization surveys were undertaken at two different sites with similar land uses to the proposed development. The parking utilization surveys were carried out in 15 minute increments from the hours of 4 PM to 10 PM. The parking surveys are provided in **Appendix J**.

This methodology briefly highlights the development parking supply when compared to locally sourced data.

6.4.1 Beverly Hills Apartment (644 Main Street West, Hamilton)

As this is an existing apartment building with plans to expand with a second tower, the parking demand expected at the new building would be best represented by the current activity.

644 Main Street West is a 15-storey apartment building containing 281 units. Residential parking is provided through a two-level podium parking garage that contains 299 parking spaces and 15 on-site surface parking spaces along the frontage to Carling Street. Visitor parking is currently provided through 11 on-site surface parking spaces along the frontage to Macklin Street South. This development has units ranging from bachelor to 3 bedroom penthouses.

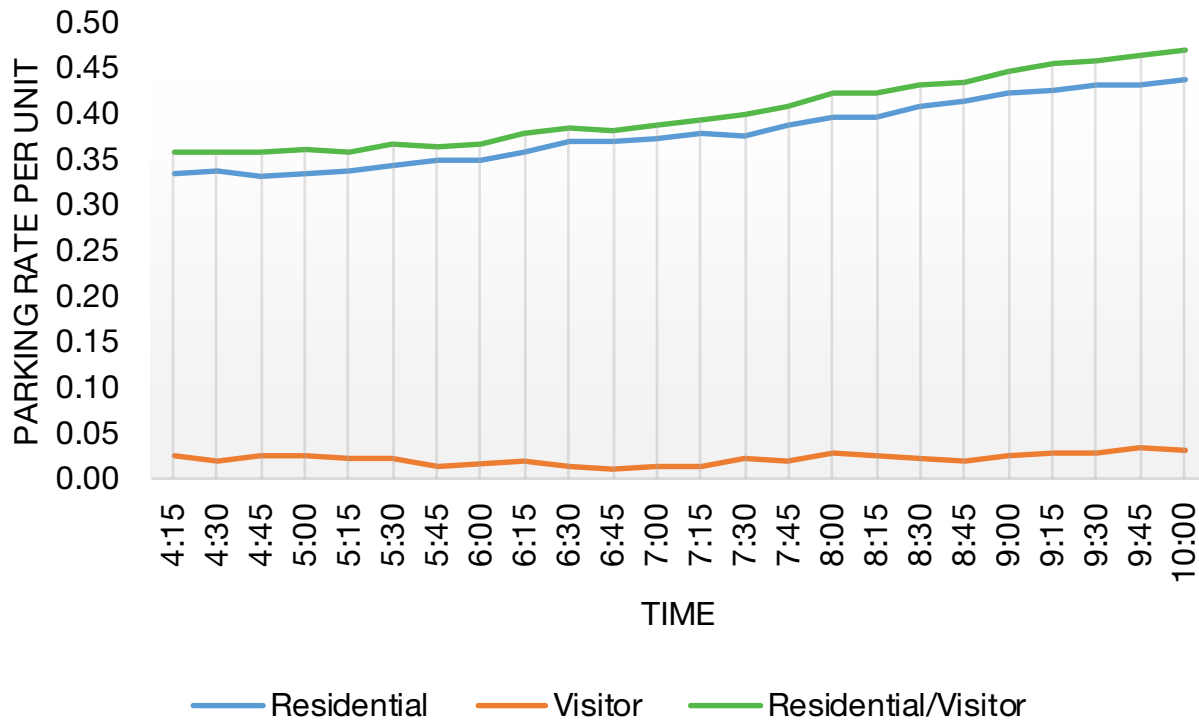
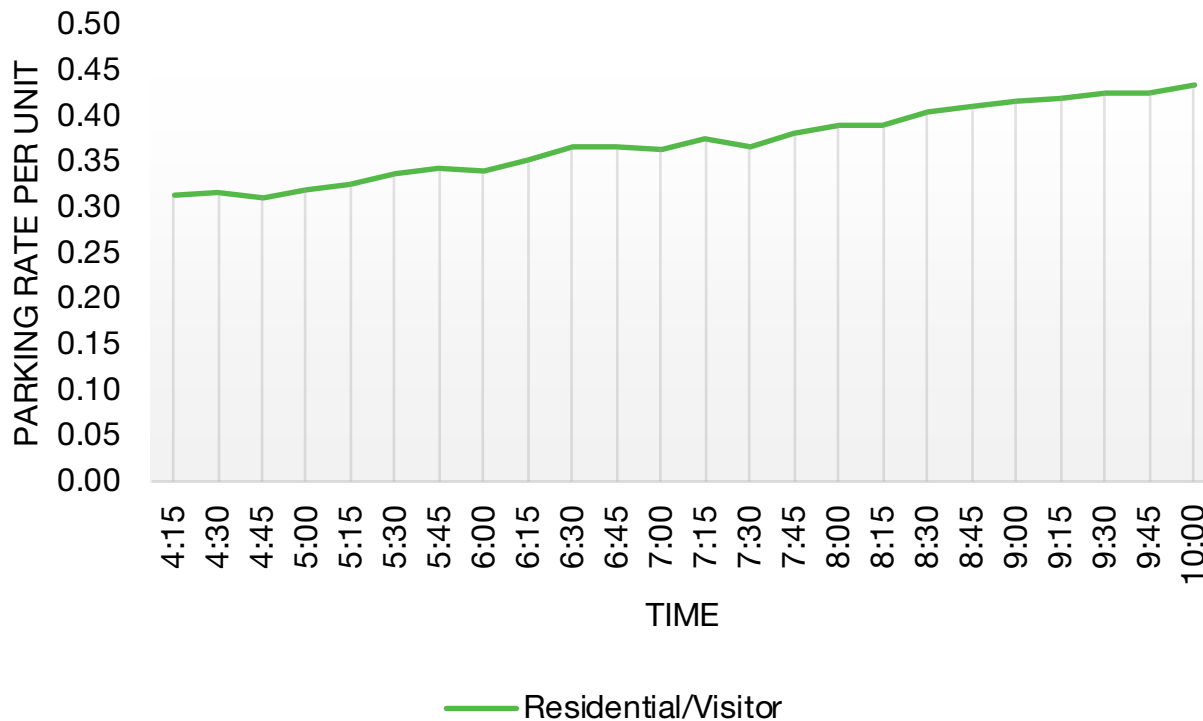
The parking surveys indicate that residential and visitor parking demand was calculated at 0.49 parking spaces per unit. **Chart 6.9** outlines the parking demand trend.

6.4.2 Tiara (770 Queenston Road, Hamilton)

770 Queenston Road is a 9-floor apartment building that contains 215 units (160 one bedrooms and 55 two bedrooms) with 215 surface parking spaces. The apartment building is located within the northeast quadrant of Queenston Road and Greenford Drive/Kenora Avenue. This location is well served by transit and is located within a convenient walking distance of retail and commercial establishment, similar to the amenities surrounding the proposed development.

The parking surveys indicate that residential and visitor parking demand was calculated at 0.43 parking spaces per unit. **Chart 6.10** outlines the parking demand trend.



CHART 6.9: 644 MAIN STREET WEST (BEVERLY) PARKING DEMAND TREND**CHART 6.10: 770 QUEENSTON ROAD (TIARA) PARKING DEMAND TREND**

6.4.3 Calculated Design Value (CDV)

A peak resident parking demand of 0.46 spaces per unit were observed throughout the survey period and is substantially lower than the requirements stipulated in Zoning By-law 05-200.

Based on the parking utilization surveys, an appropriate design value for the parking requirements is noted to be 0.46 parking spaces per unit inclusive of resident and visitor parking requirements.

As the developments surveyed are noted to have similar densities and similar unit sizes, the rate outlined above is noted to be an accurate representation of demand expected for the proposed development.

Applying the design value of 0.46 parking spaces per unit (inclusive of residential and visitor), the potential daily peak parking demand for the development would be 77 spaces as outlined in **Table 6.11**.

TABLE 6.11: DESIGN VALUE ESTIMATED DEMAND

Use	Units	Calculated Design Value	
		Parking Rate	Parking Spaces Required
Apartment Dwelling	167	0.46 spaces per unit	76.8
Total Parking Required			76.8

The results of a parking survey conducted at the existing apartment building at 644 Main Street West indicates that a significant amount of parking spaces is not utilized. This results in significant parking supply efficiencies that could be pooled with the proposed development, if required, to provide for optimal use of available parking infrastructure.



6.5 Urban Hamilton Official Plan

The City's Zoning By-law 05-200 came into effect in 2005. The criteria provided in the By-law, particularly with minimum parking requirements should have some flexibility with granting a lower parking requirement to reflect the policies set out in Hamilton's 2014 Urban Official Plan (UHOP) ¹¹ which states:

Policy E.2.3.1.16

"Reduced parking requirements shall be considered to encourage a broader range of uses and densities and to support transit"

Policy E.2.3.1.14

"The Downtown Urban Growth Centre shall be designed to accommodate all modes of transportation with a focus on transit and active transportation including pedestrian and cycling trips within the Downtown and between the Downtown and the surrounding Neighbourhoods"

The manner in which intensification is to be accommodated is contemplated in a number of Policies within the UHOP. There is a strong focus on the pedestrian environment and an emphasis upon active transportation and transit. As the development proposal places a focus on accommodating a suitable pedestrian environment, one that would encourage active transportation based on the de-emphasis on parking, the site's location relative to employment, retail, and recreational opportunities, along with a design emphasis on street activity is consistent with the goals set out in the UHOP.

As the UHOP is a guiding document that provides direction and guidance on the management of communities, land use change and physical development, it is important to look at the future requirements as opposed to the past requirements to maintain and implement the policies developed and to provide a paradigm shift in encouraging residents of the development as well as citizens to consider sustainable mode choices.

The provision of limited parking provides Hamiltonians who may not require such an amenity the option of living in a development that is more equitable and a development that encourages sustainable travel as a primary mode choice.

¹¹ Urban Hamilton Official Plan, February 2014.



6.6 Transit Oriented Guidelines

The Transit Oriented Development (TOD) guidelines¹² require density through a compact form and promote clustering of mixed uses and higher densities within 400 metres of a transit station area. The guideline also strongly promotes supporting parking reductions in these areas in order to encourage attentive travel forms of transportation and reduce dependence on driving as the primary travel mode.

On this basis, the proposed location (within 400 metres of a transit station/future LRT line) and form of development (high density) would be consistent with the general intent of the TOD guidelines, thus provides additional justification in providing a reduced vehicle parking supply.

6.7 Visitor Parking

The parking requirements in Zoning By-law 6593 requires visitor parking spaces to be provided whereas Zoning By-law 05-200 does not require any. This shift in visitor parking space requirements is largely driven by the City's long-term objective to reduce dependency on automobiles and to promote alternative modes of transportation.

In keeping with the City's long term objective, a reduced number of parking spaces for the site has been provided to further encourage prospective residents and visitors of the site to utilize sustainable transportation modes. However, as it is understood that not every visitor to the site can utilize transit or active transportation choices, a limited number of visitor parking spaces (23 spaces) will be provided.

6.8 Shared Parking Arrangement

The parking survey results completed at the existing apartment unit at 644 Main Street West indicates the existing two level underground parking podium consist of 299 parking spaces whereas only half of these spaces are required based on market demands. In the event that a shortfall would occur, shared parking accommodations could be considered.

This type of arrangement would occur through a private lease (or alternative) arrangements where the proposed development would work directly with the existing development to lease parking, in the event a shortfall occurs. This arrangement is expected to work particularly well as the land uses have complementary uses/parking demand and the existing development has an excess of parking supply.

¹² Transit Oriented Development Guidelines for Hamilton Volume 2, Council Adopted August 2010.



6.9 Summary of Parking Demand

The overall site provides for 96 parking spaces, this equates to a parking ratio of 0.57 parking space per unit. In addition, 5 tandem spaces are proposed however are not included in the parking supply calculations.

Paradigm's approach to the overall parking supply for 644 Main Street West is to assess the parking requirements for the overall site and to adopt parking ratios that recognize empirical evidence that parking demand has many factors and varies according to household size, income, auto ownership, and locational factors such as proximity to other uses and availability of multiple transportation mobility options.

Accordingly, the parking requirements for the overall site under the Zoning By-law 6593 is 375 parking spaces whereas the requirements specified in Zoning By-law 05-200 specifies a total of 134 parking spaces.

The requirements specified in Zoning By-law 6593 reflects an outdated vision of unrestricted auto-mobility, and plentiful of free parking that undermines current land use and transportation goals of the City. As the development's frontage is located along the future LRT line, applying the requirements from this by-law can inhibit the development's ability in aligning its objectives and goals in promoting the development as transit oriented to future residents.

Encouraging compact communities, sustainable transportation choices, and housing affordability are well-established objectives. However, parking is at the centre of these objectives. Given that high-density represents a large portion of new housing starts in the City of Hamilton, and will remain so over the long term as the population grows. Having current and efficient parking requirements are critical to the achievement of a sustainable region and livable neighborhoods.

The amount of parking required in new high-density developments should reflect current and emerging trends. Transit ridership continues to increase year after year, in part from improved transit service levels as well as future network improvements such as the LRT proposed along the developments frontage to Main Street West. Since 2001, the developments surrounding area has experienced consistency in Hamiltonians willingness to use transit as a primary commuting option.

The proposed development is estimated to have weekday parking demands in the order of 77 to 375 spaces depending upon the methodology used. The comparable site methodology is the best predictor of the parking demand as this data is representative of demand at local sources. The parking surveys were conducted on five separate occasions at two separate sites with land uses similar to the proposed development. The surveys demonstrate that parking demand at higher density developments in Hamilton is well below the requirements stipulated in the City's Zoning requirements as well as industry standard requirements.



Collected data at the survey sites are further supported by the vehicle ownership rates and mode split characteristics of apartment units within the immediate area. The 2011 TTS data stipulates that residential automobile use is noted to be about 59 percent per unit and is similar to the parking ratio provided at the proposed development.

As the development, will be constructed to provide housing options to Hamiltonians that would be sustainable given the multiple number of transportation options available, it is likely that as the study area develops and community further matures with incorporation of the LRT, this will result in a further shift to transit supportive travel modes. This is of particular importance as the lands are located along the LRT Line which will provide efficient transit service locally and regionally through connections to GO Transit stations.

The development will be marketed as transit supportive and promote active transportation achieving this intent primarily by taking advantage of its geographical location. It will also introduce a significant portion of the residential population of the development to maximize the benefits of the site's walkable access to a comprehensive and integrated transit system. As the development promotes the use of other modes of transportation through limited on-site vehicle parking and increased access too safe and covered bicycle parking, the development plays a significant role in setting an example for residents to consider non-automotive travel if they chose to rent a unit.

Hamilton's Urban Official Plan (UHOP) Policies E.2.3.1.14 and E.2.3.1.16 emphasize that all forms of transportation are to be encouraged and that reduced parking standards shall be contemplated to encourage a broader range of land uses and densities to support transit. The proposed development is considered to balance these parking and transportation policy objectives, through a combination of a parking structure, bicycle parking and overall density of the development that support the existing and extensive transit system within the City of Hamilton.

Of importance in consideration in granting the development a lower parking requirement is that if a shortfall would occur, shared parking accommodations could be considered with the existing apartment building located at 644 Main Street West through a lease arrangement. Results from the parking survey indicate this existing development has well over 100 parking spaces that are not being utilized during peak demand.



6.10 Property Design Elements

The site has been designed to be supportive of measure to reduce the dependency on automobile use by providing and incorporating design objectives. To assist in managing the demand for parking at the site, the development will include the following measures.

6.10.1 Secure Bicycle Parking

Active modes play important roles in a diverse transport system. Walking and cycling provide access to public transit; often the best way to improve and encourage public transit travel is to improve local walking and cycling conditions. As stated within the City's UHOP, the desire it to make walking, cycling and public transit preferred transportation options.

The current two level podium parking garage consist of 38 secure indoor bicycle parking spaces. The owner intends to provide additional bicycle parking spaces within the new single level parking podium, it is unclear as to the amount at this time, however expected to meet demand as dictated by residents of the development.

6.10.2 Transit Supportive

The development will facilitate on-site pedestrian access to the greater sidewalk network, which in turn will provide access to the transit stops. There are currently six transit routes running within 500 metres of the development site, including a future LRT route. This is very beneficial to encouraging residents to utilize transit, by providing easy access to multiple locations.

6.10.3 Parking Management

Parking Management is a general term for strategies that encourage more efficient use of existing parking facilities, reduce parking demand and shift travel to non-SOV modes. Managing parking helps to reduce the undesirable impacts of parking demand on local and regional traffic levels and the resulting impacts on community livability and design.

The most effective parking strategies are cost based or pricing measures that link parking rates more directly to demand. Unbundling parking costs is one tool which requires parking spaces be leased ("unbundled") from the rent of a unit. This gives a financial incentive inducing individuals to drive less or own fewer cars. Overall, this serves to reduce parking demand and shift peak-hour commute trips to non-single occupant vehicle modes. Including the price of parking in an overall lease can increase costs whether the tenant has a car, but be perceived as an invisible cost by the customer.

The owner will provide parking as an additional cost in the rental price of a unit. Within utilizing this type of parking arrangement, the price of the parking



space(s) is separated from the rent or purchase price and allows residents to pay only for parking that they need.

6.10.4 Summary

The proposed development represents a compact, transit-supportive built form that maximizes the utility of the land and will create additional housing choices for residents of Hamilton. Facilities for active transportation will be provided through bicycle parking areas for residents, as well as creating a high quality and safe pedestrian environment to promote active transportation and transit usage. The development of these facilities along within the reduced parking standard will meet the needs of the development while minimizing potential oversupply.



7 Conclusions and Recommendations

7.1 Conclusions

Based on the investigations carried out, it is concluded that:

Transportation Overview

- ▶ Under existing conditions, most intersections in the study area are operating at acceptable levels of service during the weekday peak hours. Exception to this is at the intersection of Main Street West and Highway 403 NS Ramp where the northbound left turn movement exceeds the theoretical capacity.
- ▶ Under background conditions, most intersections in the study area are forecast to operate at acceptable levels of service during the weekday peak hours. Exception to this is at the intersection of Main Street West and Highway 403 NS Ramp where the northbound left turn movement exceeds the theoretical capacity under all scenarios and the westbound through movement exceeds theoretical capacity under the 2028 horizon;
- ▶ With full development and occupancy of the property, the subject site is forecast to generate 45 new trips during the weekday AM peak hour and 61 new trips during the weekday PM peak hour.
- ▶ Under total traffic conditions all intersections are forecast to operate with similar operations as noted under the background scenarios.
- ▶ No auxiliary turn lanes are required at the developments driveway connections to Carling Street;
- ▶ Limited sight distance is noted to be present to the east along Carling Street. However, as vehicles travelling through the bend in the road will be negotiating the turn at a lower speed, the available stopping sight distance is sufficient for a design speed of 40 kilometres per hour;

Parking Overview

- ▶ The overall site will encompass 96 parking spaces. This equates to a parking ratio of 0.57 parking space per unit. In addition to the 96 parking spaces, 5 tandem spaces will be provided.
- ▶ The site has been designed to be supportive of measures to reduce the dependency on automobile use by providing and incorporating travel demand management measures consisting of:
 - The owner intends to provide additional bicycle parking spaces within the new single level parking podium, it is unclear as to the amount at this time, however expected to meet demand as dictated by residents of the development.



- The development will facilitate on-site pedestrian access to the greater sidewalk network, which in turn will provide access to the transit stops.
 - The owner will provide parking as an additional cost in the rental price of a unit. With utilizing this type of parking arrangement, the price of the parking space(s) is separated from the rent or purchase price and allows residents to pay only for parking that they need.
- Vehicle ownership data indicates that the overall site would require a total of 105 parking (0.63 spaces per unit). Mode split rates further confirm this as the proportion of people in this area of the City who choose to drive for travel purposes is 60 percent of all trips. This rate includes residential requirements.
- The requirements specified by ITE's Parking Generation with adjustments made to account for vehicle ownership indicates the potential parking demand for the proposed development would be in the order of 120 parking spaces (0.72 spaces per unit). This rate includes residential and visitor requirements.
- To better understand the actual parking demand that can be expected for a development of this type, a parking utilization survey was undertaken at the existing site and at a secondary site located at 770 Queenston Road. Parking demand from the comparable sites indicates a total of 77 parking spaces (0.46 spaces per unit) would be required. This rate includes residential and visitor requirements. The comparable site methodology is the best predictor of the parking demand as this data is representative of demand at local sources.
- The development is located adjacent to a future LRT line that is anticipated to begin construction in 2019. The site therefore falls within the City's TOD guideline area. The TOD is a high intensive development area within a 400-metre radius to a transit station area that promotes use of existing and future transit infrastructure and discourages auto oriented uses.
- Within the context of being located in a TOD area, the land use lends itself to being less reliant on auto use where residents and visitors can take advantage of the additional transportation choices such as walking, cycling and transit. It is expected that the land use will generate little resident parking due to the locale in combination with the proposed overall design and marketing strategy of the project.
- Alternative transportation options provide significant encouragement to residents within the building to explore alternative options given the fact that parking will be at a premium in terms of cost and provided on a limited basis;
- The current by-law requirements are excessive compared to actual needs. This has been confirmed based on parking demand data collected at comparable sites.



- ▶ Shared parking accommodations could be considered with the existing apartment building located at 644 Main Street West. Results from the parking survey indicate this existing development has well over 100 parking spaces that are not being utilized during peak demand.

7.2 Recommendations

Based on the findings of this study, it is recommended that:

- ▶ The City of Hamilton and Ministry of Transportation Ontario recognize the conclusions drawn above;
- ▶ Installations of an Intersection Sign Controlled (WA 13A) sign and a Hidden Intersection tab sign (Wa-18t) should be provided along Carling Street prior to the bend in the roadway to identify the limited sight distance;
- ▶ The signalized intersections along the Main Street West and King Street West corridors be monitored by the City of Hamilton to ensure signal timings are optimized for future traffic conditions and coordination is maintained throughout; and
- ▶ The City of Hamilton support the proposed Zoning By-law variance in order to allow the provision of 96 parking spaces for the overall site.



Appendix A

Terms of Reference



Adam Makarewicz

From: Shebib, Rich <Rich.Shebib@hamilton.ca>
Sent: Friday, October 21, 2016 8:50 AM
To: Adam Makarewicz; Mendoza, Tim
Cc: Galloway, Rob; Thai, Huy (MTO)
Subject: RE: 161720: 644 Main Street West (Hamilton) Transportation & Parking Study Work Plan

Hello Adam,
Rob (copied) should be able to assist with traffic signal timings.

For any traffic counts, please visit our mapping tool (MS2) for all currently available studies. <http://hamilton.ms2soft.com/>

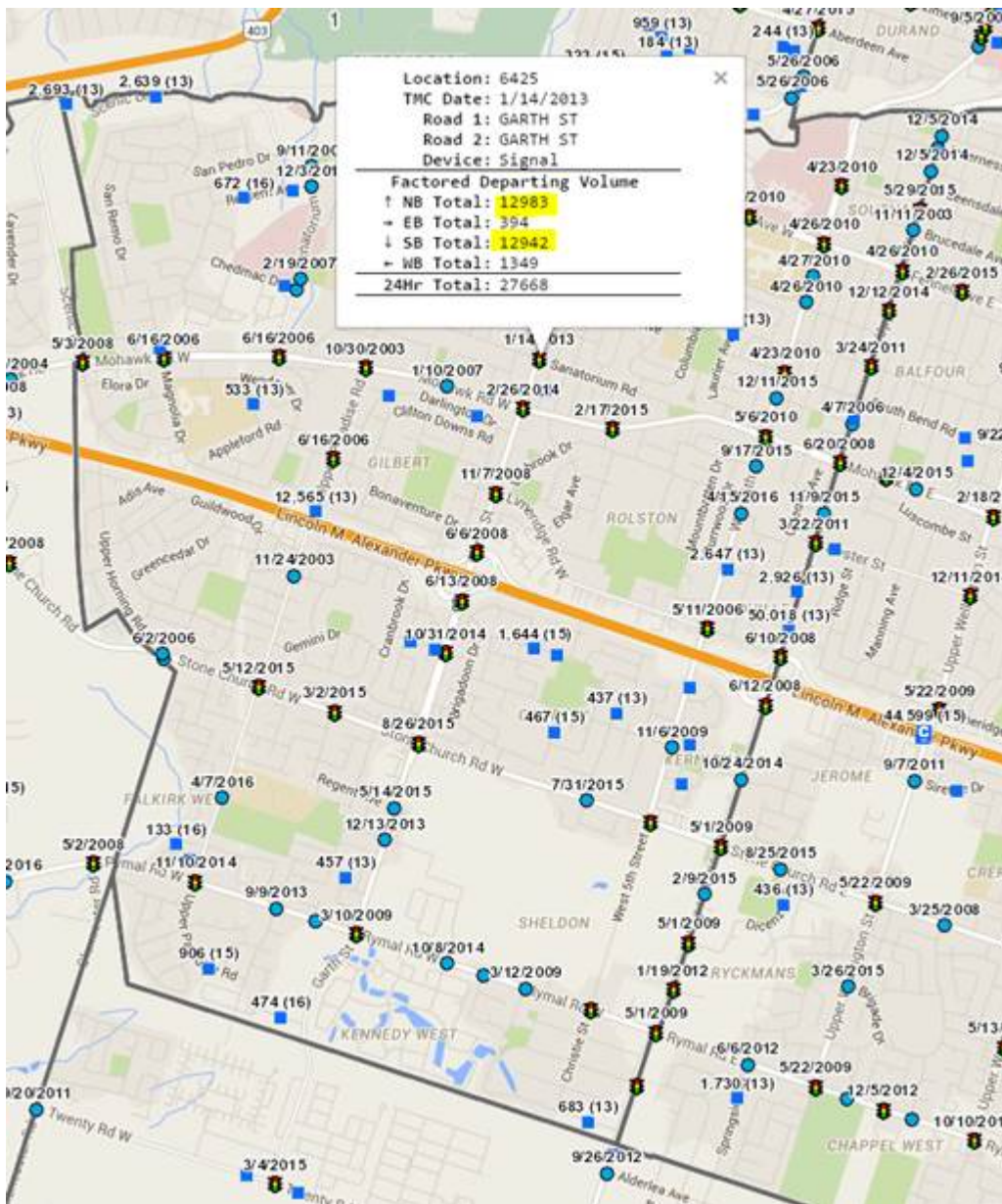
For any location we have a count, there will be a signal or icon that when you click on it, a 24hr volume will display as a popup (see samples below).

Should you require more detailed information, send me back an email and we can provide you with the full study (broken down in 15min increments) that is available at a cost of \$62.10 per location. Once you find a location that has been counted, provide us with the location id to expedite the process.

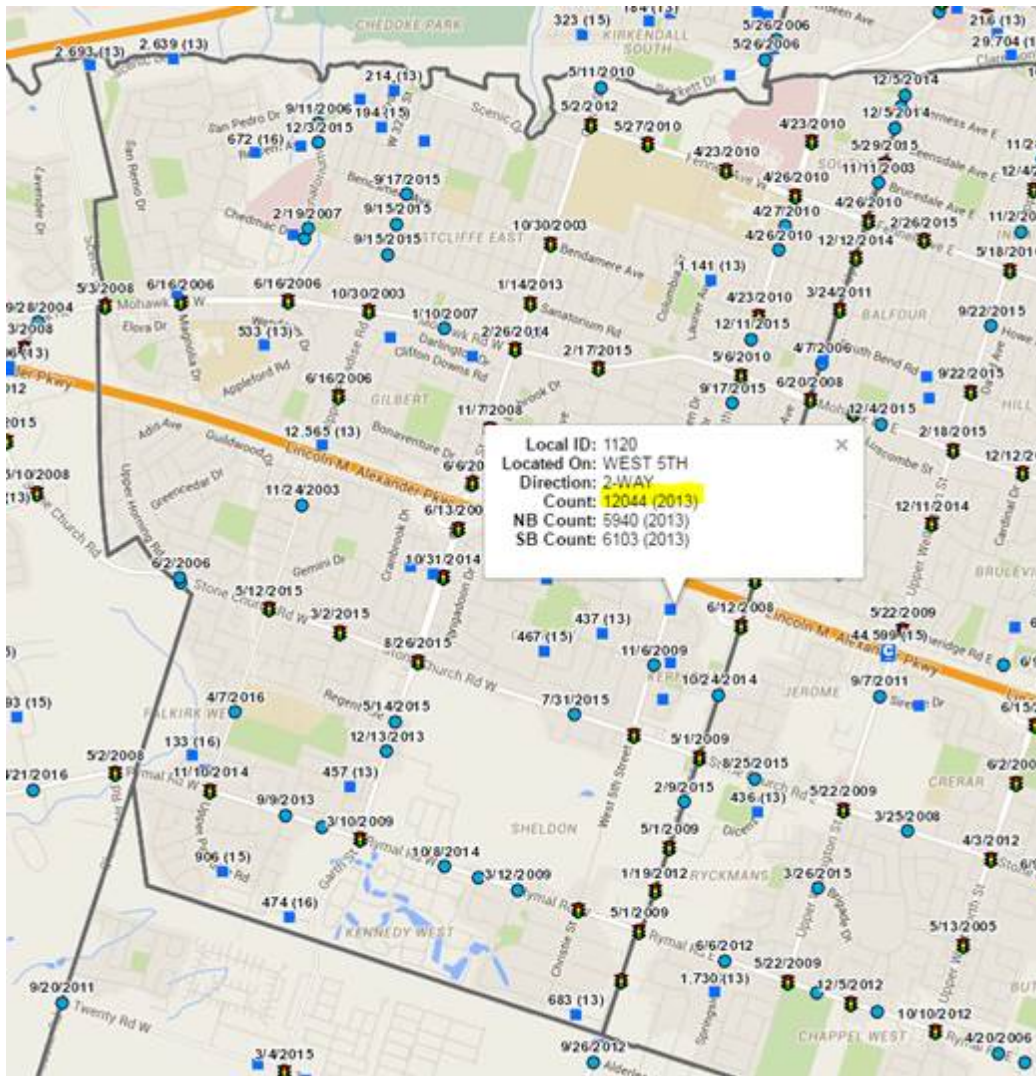
For any location you feel is too old, please provide me with a list of locations and I will have our contractor count the intersections. This will provide you with the latest count, and help build up our own system. You will however still be required to pay the \$62.10 per intersection, but I'm sure that will be much lower than hiring your own contractor.

Turning Movement Counts (at intersections, signal icon, or circle on the map).

Example: Totalling the two directions on the street you are looking at will give you the 24hr volume on that street alone.



Mid blocks (at locations between two intersections, square on the map).
 Example: the popup illustrates the 24 volume in the popup labelled as 'Count'



Rich Shebib

Project Manager

Corridor Management Section

Engineering Services Division

Public Works Department, City of Hamilton

77 James St N, Ste 320, Hamilton, ON, L8R 2K3

T: 905.546.2424 ext. 3909 F: 905.540.5926

Permit Applications: <http://hamilton.ca/cm>

Closure Notices: <http://hamilton.ca/roadclosures>

From: Adam Makarewicz [mailto:amakarewicz@ptsl.com]

Sent: October-18-16 10:40 AM

To: Shebib, Rich; Thai, Huy (MTO); Mendoza, Tim

Subject: 161720: 644 Main Street West (Hamilton) Transportation & Parking Study Work Plan

Good Morning Gentlemen,

Paradigm has been retained to undertake a Transportation Impact Study (TIS) and Parking Justification Study for the proposed rental apartment located at 644 Main Street West in Hamilton. The proposed development is located within the Main/King/Queenston rapid transit corridor which is shown in the new Urban Hamilton Official Plan (2009) as a Primary Corridor in the City's urban structure.

Can you please review our proposed scope of work with your staff and provide comments no later than **Tuesday October 25, 2016** so we may remain consistent with our schedule to have deliverables met. I am still waiting for an updated site plan, however please find attached the proposed schematic taken from the feasibility study.

Transportation Impact Study

Data Collection:

We will obtain the most current traffic counts and current signal timing and phasing plans for any existing traffic signal (where applicable) at the following study area intersections:

- King Street and Macklin Street South;
- Macklin Street South and Carling Street;
- Main Street West and Macklin Street South;
- Main Street West and Highway 403 Off Ramp Terminals; and
- King Street West and Highway 403 On Ramp Terminals.

If sufficient count data is not available from the local agencies (i.e. less than 2 years old) Paradigm will arrange to have new data collected. The current signal timing and phasing plans, as well as controller information for any existing traffic signal in the study area will be collected. Paradigm will undertake a trip generation study at 644 Main Street West as this will provide the trip generation and distribution of traffic which can be applied to the new building.

Traffic Forecasting:

We will develop estimates of the expected trip generation for the site using the data collected from the trip generation study. Development traffic will be distributed and assigned to the roadway network based on existing traffic flows and plausible routes within the study area. Traffic projections will be required for build-out, 5 years from build-out and 10 years from build-out to satisfy the MTO Traffic Impact Study requirements. Future background traffic forecasts will be based on historical growth rates, previous studies and/or land use assumptions provided by the local agencies, and will account for nearby adjacent identified development to the extent possible.

Operational Analyses:

Using the existing traffic counts and the traffic forecasts developed, we will evaluate the operations of the five (5) intersections as well as the developments driveway connection(s) during the weekday AM and PM peak hours for existing conditions and future conditions (with and without the development). The operation analysis will assess Level of Service (LOS) and queuing conditions for the intersections and driveways. Based on this analysis we will identify the need for auxiliary lanes, changes to traffic control and any other operational improvements.

Report and Recommendations:

We will prepare and submit a draft and final report documenting the study complete with recommendations regarding the proposed development from a traffic operational perspective. This report will also include Parking Justification findings and recommendations.

Parking Justification Study:

We understand that the client is seeking a variance to supply less than the parking requirements prescribed in the City of Hamilton Zoning By-law. The City of Hamilton has stated that "On-street parking in this neighborhood is heavily regulated leaving no opportunity for overflow parking in this area. The applicant should ensure that all parking requirements can be met on site. HMPS may require a parking study should the applicant wish to submit a plan that does not conform with the zoning by-law

requirements.” The intent of the parking study is to ensure the proposed use and proposed parking supply will be sufficient to accommodate the expected parking demands for the site. Based on the latest site concept plan there are 204 apartment units proposed with a parking supply of 126 parking spaces which is equivalent to 0.62 parking space per unit.

Area Parking Inventory:

Paradigm staff will undertake a site visit to inventory the current available on-street parking within convenient walking distance of the building (150 metres) and other related features such as pedestrian and cycling amenity and transit service. We will also survey the existing apartment building located directly to the west of the proposed development to obtain confirmation of the existing supply at each location including resident and visitor parking spaces.

Parking Generation:

Paradigm will review the ITE Parking Generation – 4th Edition to assess the parking generation for the site assuming a Rental Apartment land use. Furthermore, we will look at the TTS data for the area and consider automobile ownership and the percentage of trips made by alternative modes of travel. The site is located only steps away from the B-Line which will be a further consideration to support a parking variance for this site.

Parking Utilization Surveys:

Paradigm will conduct utilization surveys at the existing apartment located directly to the west of the proposed development. We will survey three days at the proxy site (two weekdays and one weekend). Surveys will be undertaken from 4PM to 10PM each day to capture the peak resident and visitor parking demands.

Define Existing Parking Characteristics:

Using the information collected, Paradigm will summarize the parking supply and demand data for each of the respective residential sites illustrating where surplus and deficits occur. The existing parking characteristics will be defined with reference to peak periods and existing utilization levels.

Parking Assessment:

Based on the planned on-site parking supply we will assess the extent to which parking demand can be accommodated on the site and the potential for spill-over parking that may need to be accommodated within the surrounding area.

Regards,

Adam J. Makarewicz, Dipl.T., C.E.T. MITE

Transportation Engineering Technologist

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Adam Makarewicz

From: Mendoza, Tim <Tim.Mendoza@hamilton.ca>
Sent: Wednesday, October 19, 2016 9:16 AM
To: Adam Makarewicz; Shebib, Rich; Thai, Huy (MTO)
Subject: RE: 161720: 644 Main Street West (Hamilton) Transportation & Parking Study Work Plan

Hi Adam,

The general scope of the parking study appears to be appropriate, just a couple things we would like the study to consider:

- The number and frequency of parking occurring on-street that are parking as visitors or tenants at the proxy site, there is a heavy on-street presence that may be over-flow from the proxy site.
- We would like to have some data on a newer site as well with similar characteristics, older buildings don't seem to attract the same type of tenants, newer buildings tend to attract people with higher wealth who may require additional vehicles.

The study should be completed on a typical day and be sensitive to low peak parking days such as holidays, weather inclement days, etc.

Thanks,

Tim Mendoza
Parking Technologist
City of Hamilton,
Planning and Economic Development Department
71 Main Street West, 5th Floor, L8P 5Y5
Tim.Mendoza@hamilton.ca
Ph. 905.546.2424 ext. 6364

From: Adam Makarewicz [mailto:amakarewicz@ptsl.com]
Sent: October-18-16 10:40 AM
To: Shebib, Rich; Thai, Huy (MTO); Mendoza, Tim
Subject: 161720: 644 Main Street West (Hamilton) Transportation & Parking Study Work Plan

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Define Existing Parking Characteristics:

Using the information collected, Paradigm will summarize the parking supply and demand data for each of the respective residential sites illustrating where surplus and deficits occur. The existing parking characteristics will be defined with reference to peak periods and existing utilization levels.

Parking Assessment:

Based on the planned on-site parking supply we will assess the extent to which parking demand can be accommodated on the site and the potential for spill-over parking that may need to be accommodated within the surrounding area.

Regards,

Adam J. Makarewicz, Dipl.T., C.E.T. MITE

Transportation Engineering Technologist



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Appendix B

Traffic Data



King St W @ Hwy 403 Ramp Terminal

Morning Peak Diagram

Specified Period

From: 7:00:00

To: 9:00:00

One Hour Peak

From: 7:45:00

To: 8:45:00

Municipality: Hamilton

Site #: 0000000001

Intersection: King St W & Hwy 403 Ramp Termin

TFR File #: 3

Count date: 2-Nov-2016

Weather conditions:

Clear am, Rain pm

Person(s) who counted:

Diane

** Non-Signalized Intersection **

Major Road: King St W runs W/E

North Leg Total: 1109

North Entering: 0

North Peds: 0

Peds Cross: \times

Heavys	0	0	0	0
Trucks	0	0	0	0
Cars	0	0	0	0
Totals	0	0	0	0



Heavys 15

Trucks 17

Cars 1077

Totals 1109

East Leg Total: 2938

East Entering: 2938

East Peds: 0

Peds Cross: \times

Heavys	Trucks	Cars	Totals
8	87	1158	1253

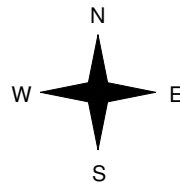


King St W

Heavys	Trucks	Cars	Totals
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0



Hwy 403 SB Ramp



Hwy 403 NB Ramp

Cars	Trucks	Heavys	Totals
1077	17	15	1109
1158	87	8	1253
515	38	23	576
2750	142	46	



King St W



Cars	Trucks	Heavys	Totals
0	0	0	0

Peds Cross: \times

West Peds: 0

West Entering: 0

West Leg Total: 1253

Cars	515
Trucks	38
Heavys	23
Totals	576



Cars	0	0	0	0
Trucks	0	0	0	0
Heavys	0	0	0	0
Totals	0	0	0	0

Peds Cross: \times

South Peds: 0

South Entering: 0

South Leg Total: 576

Comments

King St W @ Hwy 403 Ramp Terminal

Mid-day Peak Diagram

Specified Period

From: 11:00:00

To: 14:00:00

One Hour Peak

From: 11:45:00

To: 12:45:00

Municipality: Hamilton

Site #: 0000000001

Intersection: King St W & Hwy 403 Ramp Termin

TFR File #: 3

Count date: 2-Nov-2016

Weather conditions:

Clear am, Rain pm

Person(s) who counted:

Diane

** Non-Signalized Intersection **

Major Road: King St W runs W/E

North Leg Total: 732

North Entering: 0

North Peds: 0

Peds Cross: 0

Heavys	0	0	0	0
Trucks	0	0	0	0
Cars	0	0	0	0
Totals	0	0	0	0



Heavys 22

Trucks 8

Cars 702

Totals 732

East Leg Total: 2316

East Entering: 2316

East Peds: 0

Peds Cross: 0

Heavys	Trucks	Cars	Totals
7	44	929	980

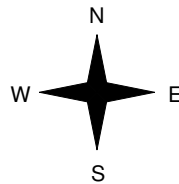


King St W

Heavys	Trucks	Cars	Totals
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0



Hwy 403 SB Ramp



Hwy 403 NB Ramp



Cars	Trucks	Heavys	Totals
702	8	22	732
929	44	7	980
558	23	23	604
2189	75	52	

King St W



Cars	Trucks	Heavys	Totals
0	0	0	0

Peds Cross: 0

West Peds: 0

West Entering: 0

West Leg Total: 980

Cars	558
Trucks	23
Heavys	23
Totals	604



Cars	0	0	0	0
Trucks	0	0	0	0
Heavys	0	0	0	0
Totals	0	0	0	0

Peds Cross: 0

South Peds: 0

South Entering: 0

South Leg Total: 604

Comments

King St W @ Hwy 403 Ramp Terminal

Afternoon Peak Diagram

Specified Period

From: 15:00:00

To: 18:00:00

One Hour Peak

From: 16:30:00

To: 17:30:00

Municipality: Hamilton

Site #: 0000000001

Intersection: King St W & Hwy 403 Ramp Termin

TFR File #: 3

Count date: 2-Nov-2016

Weather conditions:

Clear am, Rain pm

Person(s) who counted:

Diane

** Non-Signalized Intersection **

Major Road: King St W runs W/E

North Leg Total: 1273

North Entering: 0

North Peds: 0

Peds Cross: 0

Heavys	0	0	0	0
Trucks	0	0	0	0
Cars	0	0	0	0
Totals	0	0	0	0



Heavys 9

Trucks 27

Cars 1237

Totals 1273

East Leg Total: 3747

East Entering: 3747

East Peds: 0

Peds Cross: 0

Heavys	Trucks	Cars	Totals
1	34	1303	1338

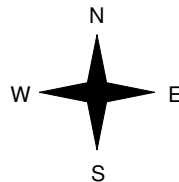


King St W

Heavys	Trucks	Cars	Totals
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0



Hwy 403 SB Ramp



Hwy 403 NB Ramp



Cars	Trucks	Heavys	Totals
1237	27	9	1273
1303	34	1	1338
1104	23	9	1136
3644	84	19	

King St W



Cars	Trucks	Heavys	Totals
0	0	0	0

Peds Cross: 0

West Peds: 0

West Entering: 0

West Leg Total: 1338

Cars	1104
Trucks	23
Heavys	9
Totals	1136



Cars	0	0	0	0
Trucks	0	0	0	0
Heavys	0	0	0	0
Totals	0	0	0	0

Peds Cross: 0

South Peds: 0

South Entering: 0

South Leg Total: 1136

Comments

King St W @ Hwy 403 Ramp Terminal

Total Count Diagram

Municipality: Hamilton
Site #: 0000000001
Intersection: King St W & Hwy 403 Ramp Termin
TFR File #: 3
Count date: 2-Nov-2016

Weather conditions:
 Clear am, Rain pm
Person(s) who counted:
 Diane

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

Major Road: King St W runs W/E

North Leg Total: 7672
 North Entering: 0
 North Peds: 0
 Peds Cross: \nlessgtr

	Heavys	Trucks	Cars	Totals
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
Totals	0	0	0	0



	Heavys	Trucks	Cars	Totals
132	150	7390	7672	

East Leg Total: 22031
 East Entering: 22031
 East Peds: 0
 Peds Cross: \nlessgtr

Heavys	Trucks	Cars	Totals
41	404	8074	8519

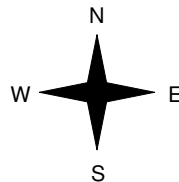


Hwy 403 NB Ramp

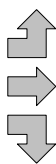
Cars	Trucks	Heavys	Totals
7390	150	132	7672
8074	404	41	8519
5514	170	156	5840
20978	724	329	



King St W



Heavys	Trucks	Cars	Totals
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0



Hwy 403 SB Ramp

King St W



Cars	Trucks	Heavys	Totals
0	0	0	0

Peds Cross: \nlessgtr
 West Peds: 0
 West Entering: 0
 West Leg Total: 8519

Cars	Trucks	Heavys	Totals
5514	170	156	5840



Cars	Trucks	Heavys	Totals
0	0	0	0
0	0	0	0
0	0	0	0
Totals	0	0	0

Peds Cross: \nlessgtr
 South Peds: 0
 South Entering: 0
 South Leg Total: 5840

Comments

Macklin St S @ Carling St

Morning Peak Diagram

Specified Period

From: 7:00:00

To: 9:00:00

One Hour Peak

From: 8:00:00

To: 9:00:00

Municipality: Hamilton

Site #: 0000000002

Intersection: Macklin St S & Carling St

TFR File #: 2

Count date: 1-Nov-2016

Weather conditions:

Sunny/Dry

Person(s) who counted:

Armando

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

Major Road: Macklin St S runs N/S

North Leg Total: 147

North Entering: 110

North Peds: 4

Peds Cross: \times

Heavys	0	0	0	0
Trucks	0	7	0	7
Cars	5	92	6	103
Totals	5	99	6	



Heavys 1

Trucks 5

Cars 31

Totals 37

East Leg Total: 47

East Entering: 32

East Peds: 29

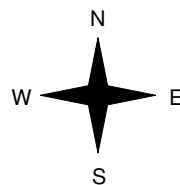
Peds Cross: \times

Heavys	Trucks	Cars	Totals
0	1	21	22



Carling St

Heavys	Trucks	Cars	Totals
0	0	2	2
0	0	3	3
0	0	11	11
0	0	16	



Macklin St S

Macklin St S

Cars	Trucks	Heavys	Totals
4	0	0	4
12	0	0	12
16	0	0	16
32	0	0	

Carling St



Cars	Trucks	Heavys	Totals
15	0	0	15

Peds Cross: \times

West Peds: 17

West Entering: 16

West Leg Total: 38

Cars	119
Trucks	7
Heavys	0
Totals	126



Cars	4	25	6	35
Trucks	1	5	0	6
Heavys	0	1	0	1
Totals	5	31	6	

Peds Cross: \times

South Peds: 21

South Entering: 42

South Leg Total: 168

Comments

Macklin St S @ Carling St

Mid-day Peak Diagram

Specified Period

From: 11:00:00

To: 14:00:00

One Hour Peak

From: 11:00:00

To: 12:00:00

Municipality: Hamilton

Site #: 0000000002

Intersection: Macklin St S & Carling St

TFR File #: 2

Count date: 1-Nov-2016

Weather conditions:

Sunny/Dry

Person(s) who counted:

Armando

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

Major Road: Macklin St S runs N/S

North Leg Total: 114

North Entering: 72

North Peds: 3

Peds Cross: \bowtie

Heavys	0	0	0	0
Trucks	0	2	0	2
Cars	3	62	5	70
Totals	3	64	5	



Heavys	0
Trucks	4
Cars	38
Totals	42

East Leg Total: 34

East Entering: 22

East Peds: 20

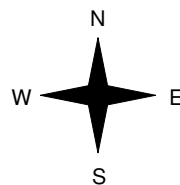
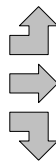
Peds Cross: \bowtie

Heavys	Trucks	Cars	Totals
0	0	16	16



Carling St

Heavys	Trucks	Cars	Totals
0	0	3	3
0	0	3	3
0	0	3	3
0	0	9	



Macklin St S

Macklin St S

Cars	Trucks	Heavys	Totals
5	0	0	5
6	0	0	6
11	0	0	11
22	0	0	

Carling St



Cars	Trucks	Heavys	Totals
12	0	0	12

Peds Cross: \bowtie

West Peds: 3

West Entering: 9

West Leg Total: 25

Cars	76	Cars	7	30	4	41
Trucks	2	Trucks	0	4	0	4
Heavys	0	Heavys	0	0	0	0
Totals	78	Totals	7	34	4	



Peds Cross: \bowtie

South Peds: 5

South Entering: 45

South Leg Total: 123

Comments

Macklin St S @ Carling St

Afternoon Peak Diagram

Specified Period

From: 15:00:00

To: 18:00:00

One Hour Peak

From: 17:00:00

To: 18:00:00

Municipality: Hamilton

Site #: 0000000002

Intersection: Macklin St S & Carling St

TFR File #: 2

Count date: 1-Nov-2016

Weather conditions:

Sunny/Dry

Person(s) who counted:

Armando

** Non-Signalized Intersection **

Major Road: Macklin St S runs N/S

North Leg Total: 159

North Entering: 113

North Peds: 8

Peds Cross: \times

	Heavys	Trucks	Cars	Totals
North	0	0	0	0
East	0	0	0	0
South	3	98	12	113
Totals	3	98	12	



Heavys 0

Trucks 1

Cars 45

Totals 46

East Leg Total: 46

East Entering: 16

East Peds: 24

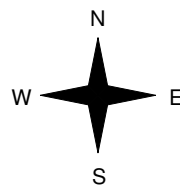
Peds Cross: \times

Heavys	Trucks	Cars	Totals
0	0	12	12



Carling St

Heavys	Trucks	Cars	Totals
0	0	4	4
0	0	7	7
0	0	15	15
0	0	26	



Macklin St S

Macklin St S

Cars	Trucks	Heavys	Totals
4	0	0	4
1	0	0	1
11	0	0	11
16	0	0	

Carling St



Cars	Trucks	Heavys	Totals
30	0	0	30

Peds Cross: \times

West Peds: 13

West Entering: 26

West Leg Total: 38

Cars	Trucks	Heavys	Totals
124	0	0	124



Cars	Trucks	Heavys	Totals
8	0	0	8
37	1	0	38
11	0	0	11
56	1	0	

Peds Cross: \times

South Peds: 14

South Entering: 57

South Leg Total: 181

Comments

Macklin St S @ Carling St

Total Count Diagram

Municipality: Hamilton
Site #: 0000000002
Intersection: Macklin St S & Carling St
TFR File #: 2
Count date: 1-Nov-2016

Weather conditions:
 Sunny/Dry
Person(s) who counted:
 Armando

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

Major Road: Macklin St S runs N/S

North Leg Total: 972
 North Entering: 679
 North Peds: 22
 Peds Cross: \bowtie

	Heavys	Trucks	Cars	Totals
North	0	2	0	2
East	0	19	0	19
South	26	588	44	658
Totals	26	609	44	

	Heavys	Trucks	Cars	Totals
North	1	17	275	293

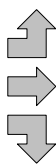
East Leg Total: 255
 East Entering: 143
 East Peds: 150
 Peds Cross: \bowtie

Heavys	Trucks	Cars	Totals
0	2	111	113

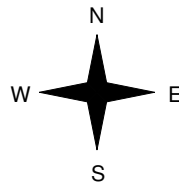


Carling St

Heavys	Trucks	Cars	Totals
0	0	21	21
0	0	18	18
0	1	50	51
0	1	89	



Macklin St S



Cars	Trucks	Heavys	Totals
25	0	0	25
33	0	0	33
84	1	0	85
142	1	0	

Carling St



Cars	Trucks	Heavys	Totals
111	1	0	112

Peds Cross: \bowtie
 West Peds: 71
 West Entering: 90
 West Leg Total: 203

	Cars	Trucks	Heavys	Totals
West	722	21	2	745
North	52	2	0	54
East	229	17	1	247
South	49	1	0	50
Totals	330	20	1	

Peds Cross: \bowtie
 South Peds: 114
 South Entering: 351
 South Leg Total: 1096

Comments

Main St W @ Macklin St S

Morning Peak Diagram

Specified Period

From: 7:00:00

To: 9:00:00

One Hour Peak

From: 8:00:00

To: 9:00:00

Municipality: Hamilton

Site #: 0000000003

Intersection: Main St W & Macklin St S

TFR File #: 2

Count date: 1-Nov-2016

Weather conditions:

Clear/Dry

Person(s) who counted:

Diane

** Signalized Intersection **

Major Road: Main St W runs W/E

North Leg Total: 176

North Entering: 131

North Peds: 16

Peds Cross: \times

	Heavys	Trucks	Cars	Totals
0	0	9	122	131



	Heavys	Trucks	Cars	Totals
0	6	39	45	

East Leg Total: 1804

East Entering: 0

East Peds: 0

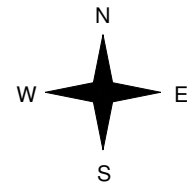
Peds Cross: \times

Heavys	Trucks	Cars	Totals
0	0	0	0



Main St W

Heavys	Trucks	Cars	Totals
0	6	39	45
2	93	1578	1673
2	99	1617	



Macklin St S

Cars	Trucks	Heavys	Totals
0	0	0	0
0	0	0	0
0	0	0	

Main St W



Cars	Trucks	Heavys	Totals
1700	102	2	1804

Peds Cross: \times

West Peds: 39

West Entering: 1718

West Leg Total: 1718

Comments

Main St W @ Macklin St S

Mid-day Peak Diagram

Specified Period

From: 11:00:00

To: 14:00:00

One Hour Peak

From: 12:30:00

To: 13:30:00

Municipality: Hamilton

Site #: 0000000003

Intersection: Main St W & Macklin St S

TFR File #: 2

Count date: 1-Nov-2016

Weather conditions:

Clear/Dry

Person(s) who counted:

Diane

** Signalized Intersection **

Major Road: Main St W runs W/E

North Leg Total: 134

North Entering: 89

North Peds: 12

Peds Cross: 8

Heavys	0	0	0
Trucks	0	1	1
Cars	0	88	88
Totals	0	89	



Heavys	0
Trucks	1
Cars	44
Totals	45

East Leg Total: 1191

East Entering: 0

East Peds: 15

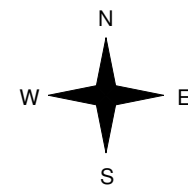
Peds Cross: 15

Heavys	Trucks	Cars	Totals
0	0	0	0



Main St W

Heavys	Trucks	Cars	Totals
0	1	44	45
1	71	1030	1102
1	72	1074	



Macklin St S

Cars	Trucks	Heavys	Totals
0	0	0	0
0	0	0	0
0	0	0	

Main St W



Cars	Trucks	Heavys	Totals
1118	72	1	1191

Peds Cross: 15

West Peds: 19

West Entering: 1147

West Leg Total: 1147

Comments

Main St W @ Macklin St S

Afternoon Peak Diagram

Specified Period

From: 15:00:00

To: 18:00:00

One Hour Peak

From: 16:45:00

To: 17:45:00

Municipality: Hamilton

Site #: 0000000003

Intersection: Main St W & Macklin St S

TFR File #: 2

Count date: 1-Nov-2016

Weather conditions:

Clear/Dry

Person(s) who counted:

Diane

** Signalized Intersection **

Major Road: Main St W runs W/E

North Leg Total: 187

North Entering: 116

North Peds: 4

Peds Cross: \times

	Heavys	Trucks	Cars	Totals
North	0	0	0	0
East	0	0	0	0
South	0	0	0	0
West	0	0	0	0
Totals	0	0	116	116



	Heavys	Trucks	Cars	Totals
North	0	1	70	71
East	0	0	0	0
South	0	0	0	0
West	0	0	0	0
Totals	0	1	70	71

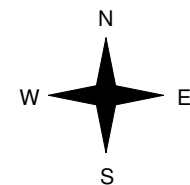
East Leg Total: 1567
 East Entering: 0
 East Peds: 22
 Peds Cross: \times

Heavys	Trucks	Cars	Totals
0	0	0	0



Main St W

Heavys	Trucks	Cars	Totals
0	1	70	71
0	45	1406	1451
0	46	1476	



Macklin St S

Cars	Trucks	Heavys	Totals
0	0	0	0
0	0	0	0
0	0	0	



Main St W



Cars	Trucks	Heavys	Totals
1522	45	0	1567

Peds Cross: \times

West Peds: 30

West Entering: 1522

West Leg Total: 1522

Comments

Main St W @ Macklin St S

Total Count Diagram

Municipality: Hamilton
Site #: 0000000003
Intersection: Main St W & Macklin St S
TFR File #: 2
Count date: 1-Nov-2016

Weather conditions:
Clear/Dry
Person(s) who counted:
Diane

**** Signalized Intersection ****

Major Road: Main St W runs W/E

North Leg Total: 1237
North Entering: 845
North Peds: 128
Peds Cross: \times

	Heavys	Trucks	Cars	Totals
0	0	28	817	845



	Heavys	Trucks	Cars	Totals
0	19	373	392	

East Leg Total: 10839
East Entering: 0
East Peds: 83
Peds Cross: \times

Heavys	Trucks	Cars	Totals
0	0	0	0



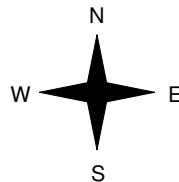
Macklin St S



Cars	Trucks	Heavys	Totals
0	0	0	0
0	0	0	0
0	0	0	0



Main St W



Heavys	Trucks	Cars	Totals
0	19	373	392
10	556	9428	9994
10	575	9801	



Main St W



Cars	Trucks	Heavys	Totals
10245	584	10	10839

Peds Cross: \times
West Peds: 195
West Entering: 10386
West Leg Total: 10386

Comments

Intersection: **King St**
 Direction: (East/West)
 Road Condition: Dry
 Comments:

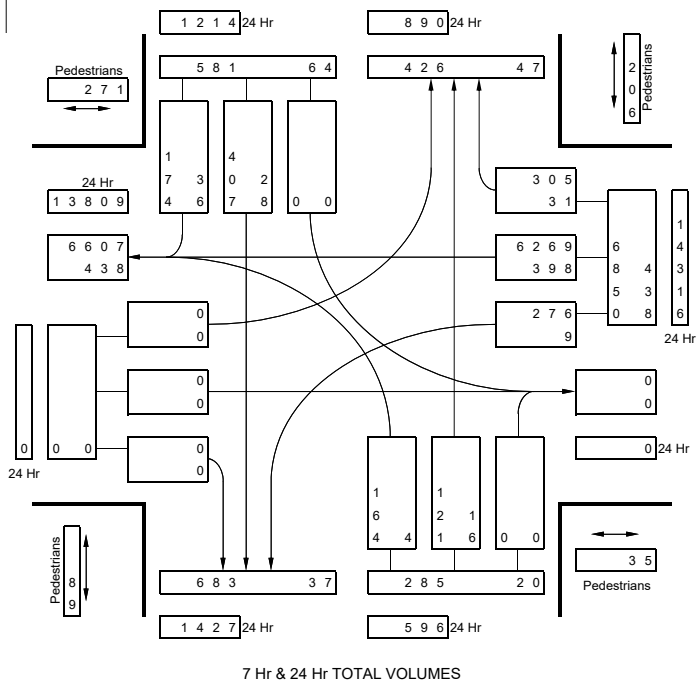
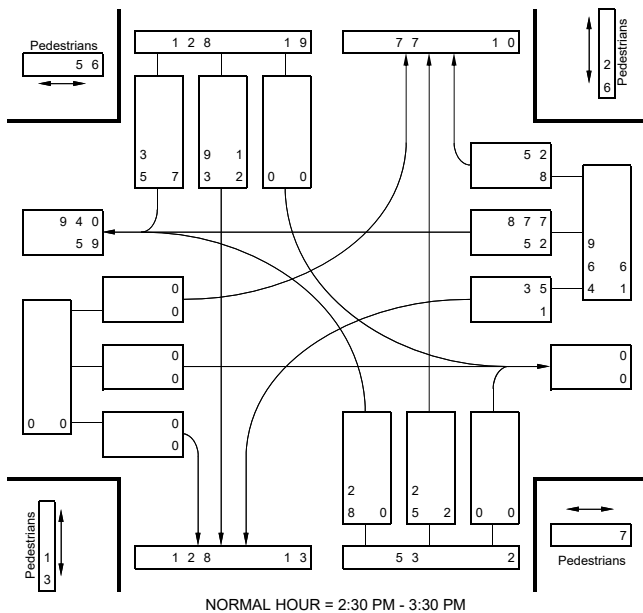
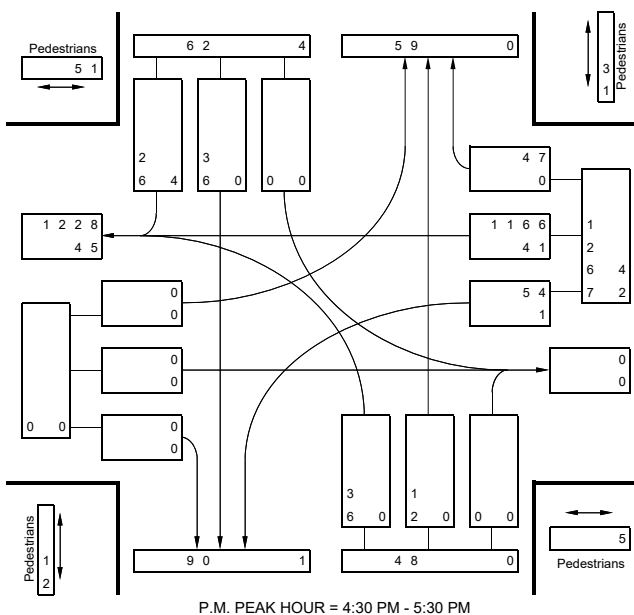
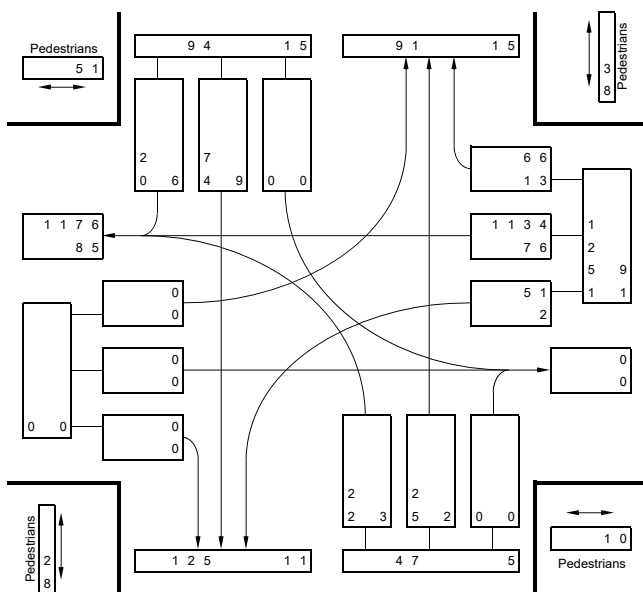
King St
 (East/West)

at
 Weather: Cloudy

Macklin St
 (North/South)

Total Vehicles: 7,716
 M.V.E./Year: 5.483
 AWDT Factor: 2.09

Date: Monday
 May 25, 2015
 Period: 7 hours



Appendix C

Base Year Traffic Operations Reports



3: Hwy. 403 NE Ramp & Main Street West Performance by movement

Movement	EBT	NBR	All
Denied Del/Veh (s)	0.0	0.6	0.2
Total Del/Veh (s)	3.6	1.4	2.9

4: Main Street West & Hwy 403 SE Ramp Performance by movement

Movement	EBT	SBL	All
Denied Del/Veh (s)	0.0	0.4	0.1
Total Del/Veh (s)	0.8	0.9	0.8

5: King Street West & Hwy 403 NW Ramp Performance by movement

Movement	WBT	WBR	All
Denied Del/Veh (s)	0.3	0.7	0.4
Total Del/Veh (s)	0.4	3.3	1.3

6: Hwy 403 SW Ramp & King Street West Performance by movement

Movement	WBL	WBT	All
Denied Del/Veh (s)	0.0	0.0	0.0
Total Del/Veh (s)	3.0	0.4	1.1

Total Zone Performance

Denied Del/Veh (s)		0.5
Total Del/Veh (s)		64.5

3: Hwy. 403 NE Ramp & Main Street West Performance by movement

Movement	EBT	NBR	All
Denied Del/Veh (s)	0.0	0.6	0.2
Total Del/Veh (s)	3.3	1.1	2.7

4: Main Street West & Hwy 403 SE Ramp Performance by movement

Movement	EBT	SBL	All
Denied Del/Veh (s)	0.0	0.6	0.1
Total Del/Veh (s)	0.6	1.2	0.8

5: King Street West & Hwy 403 NW Ramp Performance by movement

Movement	WBT	WBR	All
Denied Del/Veh (s)	1.5	2.1	1.7
Total Del/Veh (s)	1.5	6.3	3.2

6: Hwy 403 SW Ramp & King Street West Performance by movement

Movement	WBL	WBT	All
Denied Del/Veh (s)	0.0	0.0	0.0
Total Del/Veh (s)	4.6	0.2	2.3

Total Zone Performance

Denied Del/Veh (s)		1.4
Total Del/Veh (s)		89.4

Queues
1: Hwy 403 NS Ramp & Main Street West

161720 - Base Year AM Peak Hour.syn
01/26/2017

	→	↘	←	↙	↗
Lane Group	EBT	EBR	WBT	NBL	NBR
Lane Group Flow (vph)	1887	420	1597	963	170
v/c Ratio	0.82	0.48	0.98	1.01	0.36
Control Delay	25.1	4.2	43.9	57.5	19.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	25.1	4.2	43.9	57.5	19.0
Queue Length 50th (m)	101.9	2.6	141.3	~86.4	18.7
Queue Length 95th (m)	121.7	18.5	#194.1	#129.5	34.5
Internal Link Dist (m)	243.1		438.7	39.5	
Turn Bay Length (m)		60.0			
Base Capacity (vph)	2315	884	1627	956	466
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.82	0.48	0.98	1.01	0.36

Intersection Summary

- ~ 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.

HCM Signalized Intersection Capacity Analysis
1: Hwy 403 NS Ramp & Main Street West

161720 - Base Year AM Peak Hour.syn
01/26/2017

	→	↘	↙	←	↗	↘
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑	↑		↑↑	↑	↑
Traffic Volume (vph)	1736	386	0	1469	886	156
Future Volume (vph)	1736	386	0	1469	886	156
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.91	1.00		0.95	0.97	1.00
Flpb, ped/bikes	1.00	0.96		1.00	1.00	0.66
Flpb, ped/bikes	1.00	1.00		1.00	0.62	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	1.00	1.00		1.00	0.95	1.00
Satd. Flow (prot)	5043	1464		3544	2108	1025
Flt Permitted	1.00	1.00		1.00	0.95	1.00
Satd. Flow (perm)	5043	1464		3544	2108	1025
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1887	420	0	1597	963	170
RTOR Reduction (vph)	0	212	0	0	0	2
Lane Group Flow (vph)	1887	208	0	1597	963	168
Confl. Peds. (#/hr)		13	13		174	363
Heavy Vehicles (%)	4%	7%	0%	3%	4%	5%
Turn Type	NA	Perm		NA	Perm	Perm
Protected Phases	2			2		
Permitted Phases		2			4	4
Actuated Green, G (s)	40.0	40.0		40.0	40.0	40.0
Effective Green, g (s)	42.2	42.2		42.2	41.7	41.7
Actuated g/C Ratio	0.46	0.46		0.46	0.45	0.45
Clearance Time (s)	6.2	6.2		6.2	5.7	5.7
Lane Grp Cap (vph)	2315	672		1627	956	465
v/s Ratio Prot	0.37			c0.45		
v/s Ratio Perm		0.14			c0.46	0.16
v/c Ratio	0.82	0.31		0.98	1.01	0.36
Uniform Delay, d1	21.5	15.7		24.5	25.1	16.4
Progression Factor	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	3.3	1.2		18.3	30.9	2.2
Delay (s)	24.8	16.9		42.8	56.0	18.6
Level of Service	C	B		D	E	B
Approach Delay (s)	23.3			42.8	50.4	
Approach LOS	C			D	D	

Intersection Summary

HCM 2000 Control Delay	35.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	91.9	Sum of lost time (s)	9.7
Intersection Capacity Utilization	72.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Queues
2: Main Street West & Macklin Street South

161720 - Base Year AM Peak Hour.syn
01/26/2017

	→	↘
Lane Group	EBT	SBL
Lane Group Flow (vph)	1867	142
v/c Ratio	0.68	0.23
Control Delay	17.1	29.4
Queue Delay	0.0	0.0
Total Delay	17.1	29.4
Queue Length 50th (m)	88.4	18.4
Queue Length 95th (m)	104.3	36.1
Internal Link Dist (m)	128.2	144.0
Turn Bay Length (m)		
Base Capacity (vph)	2761	614
Starvation Cap Reductn	0	0
Spillback Cap Reductn	0	0
Storage Cap Reductn	0	0
Reduced v/c Ratio	0.68	0.23
Intersection Summary		

HCM Signalized Intersection Capacity Analysis
2: Main Street West & Macklin Street South

161720 - Base Year AM Peak Hour.syn
01/26/2017

	↖	→	←	↗	↘	↙
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↖↖↖			↘	
Traffic Volume (vph)	45	1673	0	0	131	0
Future Volume (vph)	45	1673	0	0	131	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	
Lane Util. Factor		0.91			1.00	
Frpb, ped/bikes		1.00			1.00	
Flpb, ped/bikes		1.00			1.00	
Frt		1.00			1.00	
Flt Protected		1.00			0.95	
Satd. Flow (prot)		4930			1706	
Flt Permitted		1.00			0.95	
Satd. Flow (perm)		4930			1706	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	49	1818	0	0	142	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1867	0	0	142	0
Confl. Peds. (#/hr)		16				
Heavy Vehicles (%)	13%	6%	0%	0%	7%	0%
Turn Type	Perm	NA			Perm	
Protected Phases		2				
Permitted Phases	2				4	
Actuated Green, G (s)		54.3			34.3	
Effective Green, g (s)		56.0			36.0	
Actuated g/C Ratio		0.56			0.36	
Clearance Time (s)		5.7			5.7	
Lane Grp Cap (vph)		2760			614	
v/s Ratio Prot						
v/s Ratio Perm		0.38			0.08	
v/c Ratio		0.68			0.23	
Uniform Delay, d1		15.6			22.3	
Progression Factor		1.00			1.25	
Incremental Delay, d2		1.4			0.9	
Delay (s)		16.9			28.9	
Level of Service		B			C	
Approach Delay (s)		16.9	0.0		28.9	
Approach LOS		B	A		C	
Intersection Summary						
HCM 2000 Control Delay		17.8			HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio		0.51				
Actuated Cycle Length (s)		100.0			Sum of lost time (s)	9.7
Intersection Capacity Utilization		52.4%			ICU Level of Service	A
Analysis Period (min)		15				
c Critical Lane Group						

Queues
7: Macklin Street South & King Street West

161720 - Base Year AM Peak Hour.syn
01/26/2017

	←	↑	↓
Lane Group	WBT	NBT	SBT
Lane Group Flow (vph)	1361	44	96
v/c Ratio	0.40	0.14	0.28
Control Delay	6.1	36.8	30.8
Queue Delay	0.0	0.0	0.0
Total Delay	6.1	36.8	30.8
Queue Length 50th (m)	33.0	8.7	13.3
Queue Length 95th (m)	39.9	14.3	27.5
Internal Link Dist (m)	442.1	56.1	46.4
Turn Bay Length (m)			
Base Capacity (vph)	3445	307	343
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.40	0.14	0.28
Intersection Summary			
m Volume for 95th percentile queue is metered by upstream signal.			

















HCM Signalized Intersection Capacity Analysis
7: Macklin Street South & King Street West

161720 - Base Year AM Peak Hour.syn
01/26/2017

	↖	→	↗	↙	←	↖	↗	↑	↙	↗	↓	↖
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↔↔↔			↔			↔	
Traffic Volume (vph)	0	0	0	46	1140	66	19	21	0	0	68	20
Future Volume (vph)	0	0	0	46	1140	66	19	21	0	0	68	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0			4.0			4.0	
Lane Util. Factor					0.91			1.00			1.00	
Frpb, ped/bikes					1.00			1.00			0.99	
Flpb, ped/bikes					1.00			0.98			1.00	
Frt					0.99			1.00			0.97	
Flt Protected					1.00			0.98			1.00	
Satd. Flow (prot)					4845			1660			1582	
Flt Permitted					1.00			0.86			1.00	
Satd. Flow (perm)					4845			1467			1582	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	50	1239	72	21	23	0	0	74	22
RTOR Reduction (vph)	0	0	0	0	6	0	0	0	0	0	11	0
Lane Group Flow (vph)	0	0	0	0	1355	0	0	44	0	0	85	0
Confl. Peds. (#/hr)	51		10	10		51	28		38	38		28
Heavy Vehicles (%)	0%	0%	0%	4%	6%	20%	14%	8%	0%	0%	12%	30%
Turn Type				Perm	NA		Perm	NA			NA	
Protected Phases					2			4			4	
Permitted Phases				2			4					
Actuated Green, G (s)					70.0			19.6			19.6	
Effective Green, g (s)					71.0			21.0			21.0	
Actuated g/C Ratio					0.71			0.21			0.21	
Clearance Time (s)					5.0			5.4			5.4	
Lane Grp Cap (vph)					3439			308			332	
v/s Ratio Prot											c0.05	
v/s Ratio Perm					0.28			0.03				
v/c Ratio					0.39			0.14			0.26	
Uniform Delay, d1					5.8			32.2			33.0	
Progression Factor					1.00			1.10			1.00	
Incremental Delay, d2					0.3			0.8			1.9	
Delay (s)					6.2			36.2			34.8	
Level of Service					A			D			C	
Approach Delay (s)		0.0			6.2			36.2			34.8	
Approach LOS		A			A			D			C	
Intersection Summary												
HCM 2000 Control Delay		8.9									A	
HCM 2000 Volume to Capacity ratio		0.36										
Actuated Cycle Length (s)		100.0				Sum of lost time (s)		8.0				
Intersection Capacity Utilization		55.0%				ICU Level of Service		B				
Analysis Period (min)		15										
c Critical Lane Group												










HCM Unsignalized Intersection Capacity Analysis
8: Macklin Street South & Carling Street

161720 - Base Year AM Peak Hour.syn
01/26/2017

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	2	3	11	17	12	4	5	34	6	6	103	5
Future Volume (Veh/h)	2	3	11	17	12	4	5	34	6	6	103	5
Sign Control	Stop			Stop			Free			Free		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	3	12	18	13	4	5	37	7	7	112	5
Pedestrians	17			29			21			4		
Lane Width (m)	3.7			3.7			3.7			3.7		
Walking Speed (m/s)	1.1			1.1			1.1			1.1		
Percent Blockage	2			3			2			0		
Right turn flare (veh)												
Median type							None			None		
Median storage (veh)												
Upstream signal (m)							168			80		
pX, platoon unblocked	0.98	0.98	0.98	0.98	0.98	0.98						
vC, conflicting volume	210	228	152	242	228	74	134				73	
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	190	208	131	222	207	74	112				73	
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.3				4.1	
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.4				2.2	
p0 queue free %	100	100	99	97	98	100	100				100	
cM capacity (veh/h)	703	646	876	652	646	962	1329				1496	
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	17	35	49	124								
Volume Left	2	18	5	7								
Volume Right	12	4	7	5								
cSH	802	675	1329	1496								
Volume to Capacity	0.02	0.05	0.00	0.00								
Queue Length 95th (m)	0.5	1.2	0.1	0.1								
Control Delay (s)	9.6	10.6	0.8	0.5								
Lane LOS	A	B	A	A								
Approach Delay (s)	9.6	10.6	0.8	0.5								
Approach LOS	A	B										
Intersection Summary												
Average Delay	2.8											
Intersection Capacity Utilization	24.9%			ICU Level of Service			A					
Analysis Period (min)	15											

HCM Unsignalized Intersection Capacity Analysis
9: Driveway A & Carling Street

161720 - Base Year AM Peak Hour.syn
01/26/2017

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	12	3	0	25	8	2
Future Volume (Veh/h)	12	3	0	25	8	2
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	13	3	0	27	9	2
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			16		42	14
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			16		42	14
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	100
cM capacity (veh/h)			1602		970	1065
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	16	27	11			
Volume Left	0	0	9			
Volume Right	3	0	2			
cSH	1700	1602	986			
Volume to Capacity	0.01	0.00	0.01			
Queue Length 95th (m)	0.0	0.0	0.3			
Control Delay (s)	0.0	0.0	8.7			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	8.7			
Approach LOS			A			
Intersection Summary						
Average Delay			1.8			
Intersection Capacity Utilization			13.3%	ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
10: Driveway B & Carling Street

161720 - Base Year AM Peak Hour.syn
01/26/2017

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↗			↖	↗	↖
Traffic Volume (veh/h)	12	2	0	11	14	0
Future Volume (Veh/h)	12	2	0	11	14	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	13	2	0	12	15	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			15		26	14
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			15		26	14
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		98	100
cM capacity (veh/h)			1603		989	1066
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	15	12	15			
Volume Left	0	0	15			
Volume Right	2	0	0			
cSH	1700	1603	989			
Volume to Capacity	0.01	0.00	0.02			
Queue Length 95th (m)	0.0	0.0	0.4			
Control Delay (s)	0.0	0.0	8.7			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	8.7			
Approach LOS			A			
Intersection Summary						
Average Delay			3.1			
Intersection Capacity Utilization			13.3%		ICU Level of Service	A
Analysis Period (min)			15			

Queues

1: Hwy 403 NS Ramp & Main Street West

161720 - Base Year PM Peak Hour.syn
01/26/2017

	→	↘	↙	←	↖	↗
Lane Group	EBT	EBR	WBT	NBL	NBR	
Lane Group Flow (vph)	2072	703	1426	551	107	
v/c Ratio	0.88	0.67	0.88	0.62	0.21	
Control Delay	28.0	6.7	30.2	22.8	16.2	
Queue Delay	0.0	0.0	0.0	0.0	0.0	
Total Delay	28.0	6.7	30.2	22.8	16.2	
Queue Length 50th (m)	117.3	10.5	115.8	36.8	10.8	
Queue Length 95th (m)	139.4	41.8	#148.4	53.9	21.5	
Internal Link Dist (m)	243.1		438.7	39.5		
Turn Bay Length (m)		60.0				
Base Capacity (vph)	2361	1043	1627	892	511	
Starvation Cap Reductn	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	
Reduced v/c Ratio	0.88	0.67	0.88	0.62	0.21	
Intersection Summary						
#	95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.					

HCM Signalized Intersection Capacity Analysis
1: Hwy 403 NS Ramp & Main Street West

161720 - Base Year PM Peak Hour.syn
01/26/2017

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑	↑		↑↑	↑↑	↑
Traffic Volume (vph)	1906	647	0	1312	507	98
Future Volume (vph)	1906	647	0	1312	507	98
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.91	1.00		0.95	0.97	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.76
Flpb, ped/bikes	1.00	1.00		1.00	0.58	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	1.00	1.00		1.00	0.95	1.00
Satd. Flow (prot)	5142	1570		3544	1967	1125
Flt Permitted	1.00	1.00		1.00	0.95	1.00
Satd. Flow (perm)	5142	1570		3544	1967	1125
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2072	703	0	1426	551	107
RTOR Reduction (vph)	0	323	0	0	0	1
Lane Group Flow (vph)	2072	380	0	1426	551	106
Confl. Peds. (#/hr)					193	179
Heavy Vehicles (%)	2%	4%	0%	3%	4%	10%
Turn Type	NA	Perm		NA	Perm	Perm
Protected Phases	2			2		
Permitted Phases		2			4	4
Actuated Green, G (s)	40.0	40.0		40.0	40.0	40.0
Effective Green, g (s)	42.2	42.2		42.2	41.7	41.7
Actuated g/C Ratio	0.46	0.46		0.46	0.45	0.45
Clearance Time (s)	6.2	6.2		6.2	5.7	5.7
Lane Grp Cap (vph)	2361	720		1627	892	510
v/s Ratio Prot	c0.40			0.40		
v/s Ratio Perm		0.24			c0.28	0.09
v/c Ratio	0.88	0.53		0.88	0.62	0.21
Uniform Delay, d1	22.5	17.7		22.5	19.1	15.1
Progression Factor	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	5.0	2.8		7.0	3.2	0.9
Delay (s)	27.5	20.5		29.5	22.3	16.1
Level of Service	C	C		C	C	B
Approach Delay (s)	25.7			29.5	21.2	
Approach LOS	C			C	C	
Intersection Summary						
HCM 2000 Control Delay		26.2		HCM 2000 Level of Service		C
HCM 2000 Volume to Capacity ratio		0.76				
Actuated Cycle Length (s)		91.9		Sum of lost time (s)		9.7
Intersection Capacity Utilization		61.0%		ICU Level of Service		B
Analysis Period (min)		15				
c Critical Lane Group						

Queues
2: Main Street West & Macklin Street South

161720 - Base Year PM Peak Hour.syn
01/26/2017

	→	↘
Lane Group	EBT	SBL
Lane Group Flow (vph)	1654	126
v/c Ratio	0.51	0.24
Control Delay	12.7	33.2
Queue Delay	0.0	0.0
Total Delay	12.7	33.2
Queue Length 50th (m)	72.0	22.3
Queue Length 95th (m)	83.1	38.0
Internal Link Dist (m)	128.2	144.0
Turn Bay Length (m)		
Base Capacity (vph)	3220	531
Starvation Cap Reductn	0	0
Spillback Cap Reductn	0	0
Storage Cap Reductn	0	0
Reduced v/c Ratio	0.51	0.24
Intersection Summary		

HCM Signalized Intersection Capacity Analysis
2: Main Street West & Macklin Street South

161720 - Base Year PM Peak Hour.syn
01/26/2017

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔↔↔			↔	
Traffic Volume (vph)	71	1451	0	0	116	0
Future Volume (vph)	71	1451	0	0	116	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	
Lane Util. Factor		0.91			1.00	
Frpb, ped/bikes		1.00			1.00	
Flpb, ped/bikes		1.00			0.97	
Frt		1.00			1.00	
Flt Protected		1.00			0.95	
Satd. Flow (prot)		5083			1772	
Flt Permitted		1.00			0.95	
Satd. Flow (perm)		5083			1772	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	77	1577	0	0	126	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1654	0	0	126	0
Confl. Peds. (#/hr)	4				22	
Heavy Vehicles (%)	1%	3%	0%	0%	0%	0%
Turn Type	Perm	NA			Perm	
Protected Phases		2				
Permitted Phases	2				4	
Actuated Green, G (s)		74.3			34.3	
Effective Green, g (s)		76.0			36.0	
Actuated g/C Ratio		0.63			0.30	
Clearance Time (s)		5.7			5.7	
Lane Grp Cap (vph)		3219			531	
v/s Ratio Prot						
v/s Ratio Perm		0.33			0.07	
v/c Ratio		0.51			0.24	
Uniform Delay, d1		12.0			31.7	
Progression Factor		1.00			1.00	
Incremental Delay, d2		0.6			1.1	
Delay (s)		12.5			32.7	
Level of Service		B			C	
Approach Delay (s)		12.5	0.0		32.7	
Approach LOS		B	A		C	
Intersection Summary						
HCM 2000 Control Delay		14.0			HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio		0.43				
Actuated Cycle Length (s)		120.0			Sum of lost time (s)	9.7
Intersection Capacity Utilization		48.6%			ICU Level of Service	A
Analysis Period (min)		15				
c Critical Lane Group						

Queues

7: Macklin Street South & King Street West

161720 - Base Year PM Peak Hour.syn
01/26/2017

Lane Group	WBT	NBT	SBT
Lane Group Flow (vph)	1391	60	78
v/c Ratio	0.39	0.20	0.21
Control Delay	6.1	34.6	24.5
Queue Delay	0.0	0.0	0.0
Total Delay	6.1	34.6	24.5
Queue Length 50th (m)	33.8	9.7	8.3
Queue Length 95th (m)	40.7	20.5	20.4
Internal Link Dist (m)	442.1	56.1	46.4
Turn Bay Length (m)			
Base Capacity (vph)	3556	307	380
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.39	0.20	0.21
Intersection Summary			

HCM Signalized Intersection Capacity Analysis
7: Macklin Street South & King Street West

161720 - Base Year PM Peak Hour.syn
01/26/2017

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	61	1172	47	41	14	0	0	46	26
Future Volume (vph)	0	0	0	61	1172	47	41	14	0	0	46	26
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0			4.0			4.0	
Lane Util. Factor					0.91			1.00			1.00	
Frpb, ped/bikes					1.00			1.00			0.99	
Flpb, ped/bikes					1.00			0.99			1.00	
Frt					0.99			1.00			0.95	
Flt Protected					1.00			0.96			1.00	
Satd. Flow (prot)					4998			1827			1715	
Flt Permitted					1.00			0.77			1.00	
Satd. Flow (perm)					4998			1463			1715	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	66	1274	51	45	15	0	0	50	28
RTOR Reduction (vph)	0	0	0	0	4	0	0	0	0	0	21	0
Lane Group Flow (vph)	0	0	0	0	1387	0	0	60	0	0	57	0
Confl. Peds. (#/hr)	51		5	5		51	12		31	31		12
Heavy Vehicles (%)	0%	0%	0%	2%	4%	0%	0%	0%	0%	0%	0%	15%
Turn Type				Perm	NA		Perm	NA			NA	
Protected Phases					2			4			4	
Permitted Phases				2			4					
Actuated Green, G (s)					70.0			19.6			19.6	
Effective Green, g (s)					71.0			21.0			21.0	
Actuated g/C Ratio					0.71			0.21			0.21	
Clearance Time (s)					5.0			5.4			5.4	
Lane Grp Cap (vph)					3548			307			360	
v/s Ratio Prot											0.03	
v/s Ratio Perm					0.28			0.04				
v/c Ratio					0.39			0.20			0.16	
Uniform Delay, d1					5.8			32.5			32.3	
Progression Factor					1.00			1.00			1.00	
Incremental Delay, d2					0.3			1.4			0.9	
Delay (s)					6.1			34.0			33.2	
Level of Service					A			C			C	
Approach Delay (s)		0.0			6.1			34.0			33.2	
Approach LOS		A			A			C			C	
Intersection Summary												
HCM 2000 Control Delay		8.6			HCM 2000 Level of Service					A		
HCM 2000 Volume to Capacity ratio		0.35										
Actuated Cycle Length (s)		100.0			Sum of lost time (s)					8.0		
Intersection Capacity Utilization		55.0%			ICU Level of Service					B		
Analysis Period (min)		15										
c Critical Lane Group												











HCM Unsignalized Intersection Capacity Analysis
8: Macklin Street South & Carling Street

161720 - Base Year PM Peak Hour.syn
01/26/2017

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	4	7	14	10	1	4	10	47	14	12	92	3
Future Volume (Veh/h)	4	7	14	10	1	4	10	47	14	12	92	3
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	4	8	15	11	1	4	11	51	15	13	100	3
Pedestrians		13			24			14			8	
Lane Width (m)		3.7			3.7			3.7			3.7	
Walking Speed (m/s)		1.1			1.1			1.1			1.1	
Percent Blockage		1			2			1			1	
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (m)								168			80	
pX, platoon unblocked												
vC, conflicting volume	234	252	128	265	246	90	116			90		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	234	252	128	265	246	90	116			90		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	99	98	98	100	100	99			99		
cM capacity (veh/h)	679	621	903	623	625	942	1466			1482		
Direction, Lane #												
Volume Total	27	16	77	116								
Volume Left	4	11	11	13								
Volume Right	15	4	15	3								
cSH	763	681	1466	1482								
Volume to Capacity	0.04	0.02	0.01	0.01								
Queue Length 95th (m)	0.8	0.5	0.2	0.2								
Control Delay (s)	9.9	10.4	1.1	0.9								
Lane LOS	A	B	A	A								
Approach Delay (s)	9.9	10.4	1.1	0.9								
Approach LOS	A	B										
Intersection Summary												
Average Delay		2.6										
Intersection Capacity Utilization		23.8%			ICU Level of Service					A		
Analysis Period (min)		15										










HCM Unsignalized Intersection Capacity Analysis
9: Driveway A & Carling Street

161720 - Base Year PM Peak Hour.syn
01/26/2017

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations					 	
Traffic Volume (veh/h)	27	6	0	9	6	12
Future Volume (Veh/h)	27	6	0	9	6	12
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	29	7	0	10	7	13
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			36		42	32
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			36		42	32
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	99
cM capacity (veh/h)			1575		968	1041
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	36	10	20			
Volume Left	0	0	7			
Volume Right	7	0	13			
cSH	1700	1575	1015			
Volume to Capacity	0.02	0.00	0.02			
Queue Length 95th (m)	0.0	0.0	0.5			
Control Delay (s)	0.0	0.0	8.6			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	8.6			
Approach LOS			A			
Intersection Summary						
Average Delay			2.6			
Intersection Capacity Utilization			13.3%	ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
10: Driveway B & Carling Street

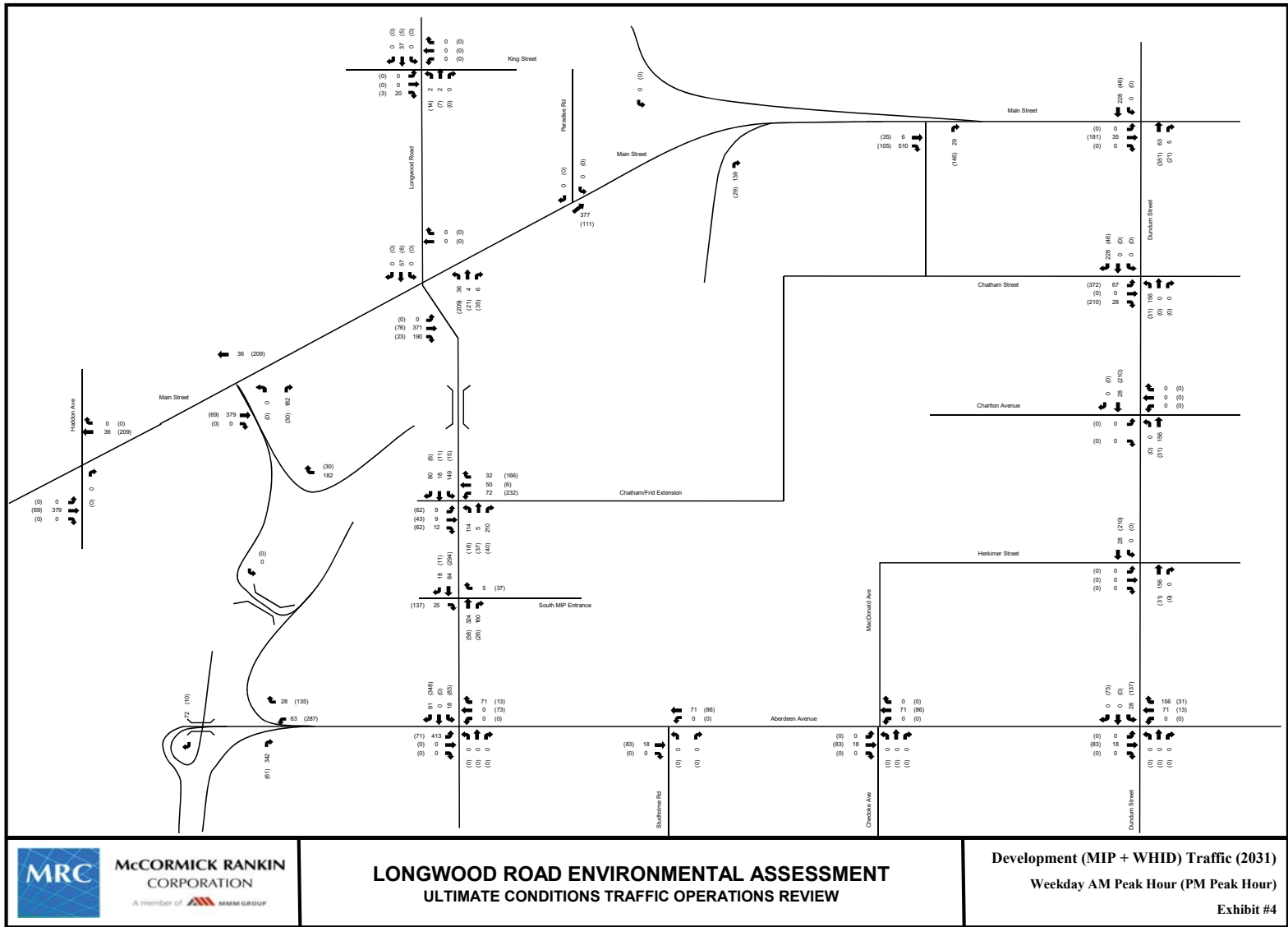
161720 - Base Year PM Peak Hour.syn
01/26/2017

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	31	8	0	4	5	0
Future Volume (Veh/h)	31	8	0	4	5	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	34	9	0	4	5	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None		None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			43		42	38
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			43		42	38
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	100
cM capacity (veh/h)			1566		968	1033
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	43	4	5			
Volume Left	0	0	5			
Volume Right	9	0	0			
cSH	1700	1566	968			
Volume to Capacity	0.03	0.00	0.01			
Queue Length 95th (m)	0.0	0.0	0.1			
Control Delay (s)	0.0	0.0	8.7			
Lane LOS	A					
Approach Delay (s)	0.0	0.0	8.7			
Approach LOS	A					
Intersection Summary						
Average Delay			0.8			
Intersection Capacity Utilization			13.3%	ICU Level of Service	A	
Analysis Period (min)			15			

Appendix D

Approved Developments Trip Generation & Projections





Appendix E

Background Traffic Operations Reports



3: Hwy. 403 NE Ramp & Main Street West Performance by movement

Movement	EBT	NBR	All
Denied Del/Veh (s)	0.0	0.9	0.3
Total Del/Veh (s)	3.3	1.9	2.9

4: Main Street West & Hwy 403 SE Ramp Performance by movement

Movement	EBT	SBL	All
Denied Del/Veh (s)	0.0	0.3	0.0
Total Del/Veh (s)	0.7	0.9	0.7

5: King Street West & Hwy 403 NW Ramp Performance by movement

Movement	WBT	WBR	All
Denied Del/Veh (s)	0.3	0.6	0.4
Total Del/Veh (s)	0.3	3.8	1.6

6: Hwy 403 SW Ramp & King Street West Performance by movement

Movement	WBL	WBT	All
Denied Del/Veh (s)	0.0	0.0	0.0
Total Del/Veh (s)	2.9	0.3	1.0

Total Zone Performance

Denied Del/Veh (s)		0.5
Total Del/Veh (s)		55.1

3: Hwy. 403 NE Ramp & Main Street West Performance by movement

Movement	EBT	NBR	All
Denied Del/Veh (s)	0.0	0.6	0.2
Total Del/Veh (s)	3.0	1.1	2.5

4: Main Street West & Hwy 403 SE Ramp Performance by movement

Movement	EBT	SBL	All
Denied Del/Veh (s)	0.0	0.8	0.2
Total Del/Veh (s)	0.6	1.8	0.9

5: King Street West & Hwy 403 NW Ramp Performance by movement

Movement	WBT	WBR	All
Denied Del/Veh (s)	1.6	1.6	1.6
Total Del/Veh (s)	1.9	5.6	3.2

6: Hwy 403 SW Ramp & King Street West Performance by movement

Movement	WBL	WBT	All
Denied Del/Veh (s)	0.0	0.0	0.0
Total Del/Veh (s)	4.5	0.3	2.1

Total Zone Performance

Denied Del/Veh (s)		1.4
Total Del/Veh (s)		154.0

Queues
1: Hwy 403 NS Ramp & Main Street West

161720 - 2018 Background AM Peak Hour.syn
01/26/2017

	→	↘	←	↙	↗
Lane Group	EBT	EBR	WBT	NBL	NBR
Lane Group Flow (vph)	2042	424	1625	973	236
v/c Ratio	0.89	0.49	1.01	1.01	0.50
Control Delay	29.0	5.2	50.0	58.0	22.1
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	29.0	5.2	50.0	58.0	22.1
Queue Length 50th (m)	116.9	5.9	~148.4	~88.0	28.1
Queue Length 95th (m)	138.9	24.4	#200.9	#130.8	50.0
Internal Link Dist (m)	243.1		438.7	39.5	
Turn Bay Length (m)		60.0			
Base Capacity (vph)	2299	864	1615	963	469
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.89	0.49	1.01	1.01	0.50

Intersection Summary

- ~ 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.

HCM Signalized Intersection Capacity Analysis 161720 - 2018 Background AM Peak Hour.syn
1: Hwy 403 NS Ramp & Main Street West

01/26/2017

	→	↘	↙	←	↗	↘
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑	↑		↑↑	↑↑	↑
Traffic Volume (vph)	1879	390	0	1495	895	217
Future Volume (vph)	1879	390	0	1495	895	217
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.91	1.00		0.95	0.97	1.00
Frpb, ped/bikes	1.00	0.96		1.00	1.00	0.66
Flpb, ped/bikes	1.00	1.00		1.00	0.62	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	1.00	1.00		1.00	0.95	1.00
Satd. Flow (prot)	5043	1464		3544	2108	1025
Flt Permitted	1.00	1.00		1.00	0.95	1.00
Satd. Flow (perm)	5043	1464		3544	2108	1025
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2042	424	0	1625	973	236
RTOR Reduction (vph)	0	197	0	0	0	1
Lane Group Flow (vph)	2042	227	0	1625	973	235
Confl. Peds. (#/hr)	13		13		174	363
Heavy Vehicles (%)	4%	7%	0%	3%	4%	5%
Turn Type	NA	Perm		NA	Perm	Perm
Protected Phases	2			2		
Permitted Phases		2			4	4
Actuated Green, G (s)	39.7	39.7		39.7	40.3	40.3
Effective Green, g (s)	41.9	41.9		41.9	42.0	42.0
Actuated g/C Ratio	0.46	0.46		0.46	0.46	0.46
Clearance Time (s)	6.2	6.2		6.2	5.7	5.7
Lane Grp Cap (vph)	2299	667		1615	963	468
v/s Ratio Prot	0.40			c0.46		
v/s Ratio Perm		0.15			c0.46	0.23
v/c Ratio	0.89	0.34		1.01	1.01	0.50
Uniform Delay, d1	22.9	16.1		25.0	25.0	17.6
Progression Factor	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	5.6	1.4		23.9	31.6	3.8
Delay (s)	28.5	17.5		48.9	56.5	21.4
Level of Service	C	B		D	E	C
Approach Delay (s)	26.6			48.9	49.7	
Approach LOS	C			D	D	

Intersection Summary


HCM 2000 Control Delay	38.7	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.03		
Actuated Cycle Length (s)	91.9	Sum of lost time (s)	9.7
Intersection Capacity Utilization	73.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Queues

2: Main Street West & Macklin Street South

161720 - 2018 Background AM Peak Hour.syn

01/26/2017




Lane Group	EBT	SBL
Lane Group Flow (vph)	1899	143
v/c Ratio	0.64	0.26
Control Delay	14.3	21.1
Queue Delay	0.0	0.0
Total Delay	14.3	21.1
Queue Length 50th (m)	81.2	15.4
Queue Length 95th (m)	95.8	25.2
Internal Link Dist (m)	128.2	144.0
Turn Bay Length (m)		
Base Capacity (vph)	2958	545
Starvation Cap Reductn	0	0
Spillback Cap Reductn	0	0
Storage Cap Reductn	0	0
Reduced v/c Ratio	0.64	0.26

Intersection Summary

HCM Signalized Intersection Capacity Analysis 161720 - 2018 Background AM Peak Hour.syn

2: Main Street West & Macklin Street South

01/26/2017



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔↔↔			↔	
Traffic Volume (vph)	45	1702	0	0	132	0
Future Volume (vph)	45	1702	0	0	132	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	
Lane Util. Factor		0.91			1.00	
Flpb, ped/bikes		1.00			1.00	
Flpb, ped/bikes		1.00			1.00	
Frt		1.00			1.00	
Flt Protected		1.00			0.95	
Satd. Flow (prot)		4930			1706	
Flt Permitted		1.00			0.95	
Satd. Flow (perm)		4930			1706	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	49	1850	0	0	143	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1899	0	0	143	0
Confl. Peds. (#/hr)		16				
Heavy Vehicles (%)	13%	6%	0%	0%	7%	0%
Turn Type	Perm	NA			Perm	
Protected Phases		2				
Permitted Phases	2				4	
Actuated Green, G (s)		58.3			30.3	
Effective Green, g (s)		60.0			32.0	
Actuated g/C Ratio		0.60			0.32	
Clearance Time (s)		5.7			5.7	
Lane Grp Cap (vph)		2958			545	
v/s Ratio Prot						
v/s Ratio Perm		0.39			0.08	
v/c Ratio		0.64			0.26	
Uniform Delay, d1		13.0			25.2	
Progression Factor		1.00			0.77	
Incremental Delay, d2		1.1			1.2	
Delay (s)		14.1			20.7	
Level of Service		B			C	
Approach Delay (s)		14.1	0.0		20.7	
Approach LOS		B	A		C	

Intersection Summary

HCM 2000 Control Delay	14.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	9.7
Intersection Capacity Utilization	53.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Queues
7: Macklin Street South & King Street West

















161720 - 2018 Background AM Peak Hour.syn
01/26/2017

	←	↑	↓
Lane Group	WBT	NBT	SBT
Lane Group Flow (vph)	1374	44	97
v/c Ratio	0.44	0.11	0.22
Control Delay	8.9	29.6	25.8
Queue Delay	0.0	0.0	0.0
Total Delay	8.9	29.6	25.8
Queue Length 50th (m)	42.4	7.8	12.4
Queue Length 95th (m)	51.3	13.4	25.4
Internal Link Dist (m)	442.1	56.1	46.4
Turn Bay Length (m)			
Base Capacity (vph)	3154	400	437
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.44	0.11	0.22
Intersection Summary			
m Volume for 95th percentile queue is metered by upstream signal.			










HCM Signalized Intersection Capacity Analysis 161720 - 2018 Background AM Peak Hour.syn
7: Macklin Street South & King Street West
01/26/2017

	↖	→	↗	↙	←	↖	↗	↑	↙	↗	↓	↖
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↖↖↖			↗			↖	
Traffic Volume (vph)	0	0	0	46	1151	67	19	21	0	0	69	20
Future Volume (vph)	0	0	0	46	1151	67	19	21	0	0	69	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0			4.0			4.0	
Lane Util. Factor					0.91			1.00			1.00	
Flpb, ped/bikes					1.00			1.00			0.99	
Flpb, ped/bikes					1.00			0.98			1.00	
Frt					0.99			1.00			0.97	
Flt Protected					1.00			0.98			1.00	
Satd. Flow (prot)					4845			1660			1583	
Flt Permitted					1.00			0.87			1.00	
Satd. Flow (perm)					4845			1483			1583	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	50	1251	73	21	23	0	0	75	22
RTOR Reduction (vph)	0	0	0	0	6	0	0	0	0	0	10	0
Lane Group Flow (vph)	0	0	0	0	1368	0	0	44	0	0	87	0
Confl. Peds. (#/hr)	51		10	10		51	28		38	38		28
Heavy Vehicles (%)	0%	0%	0%	4%	6%	20%	14%	8%	0%	0%	12%	30%
Turn Type				Perm	NA		Perm	NA			NA	
Protected Phases					2			4			4	
Permitted Phases				2			4					
Actuated Green, G (s)					64.0			25.6			25.6	
Effective Green, g (s)					65.0			27.0			27.0	
Actuated g/C Ratio					0.65			0.27			0.27	
Clearance Time (s)					5.0			5.4			5.4	
Lane Grp Cap (vph)					3149			400			427	
v/s Ratio Prot											c0.05	
v/s Ratio Perm					0.28			0.03				
v/c Ratio					0.43			0.11			0.20	
Uniform Delay, d1					8.5			27.5			28.2	
Progression Factor					1.00			1.04			1.00	
Incremental Delay, d2					0.4			0.5			1.1	
Delay (s)					9.0			29.1			29.3	
Level of Service					A			C			C	
Approach Delay (s)		0.0			9.0			29.1			29.3	
Approach LOS		A			A			C			C	
Intersection Summary												
HCM 2000 Control Delay		10.9								B		
HCM 2000 Volume to Capacity ratio		0.37										
Actuated Cycle Length (s)		100.0				Sum of lost time (s)		8.0				
Intersection Capacity Utilization		55.0%				ICU Level of Service		B				
Analysis Period (min)		15										
c Critical Lane Group												










HCM Unsignalized Intersection Capacity Analysis 161720 - 2018 Background AM Peak Hour.syn
8: Macklin Street South & Carling Street 01/26/2017

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	2	3	11	17	12	4	5	34	6	6	104	5
Future Volume (Veh/h)	2	3	11	17	12	4	5	34	6	6	104	5
Sign Control	Stop			Stop			Free			Free		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	3	12	18	13	4	5	37	7	7	113	5
Pedestrians	17			29			21			4		
Lane Width (m)	3.7			3.7			3.7			3.7		
Walking Speed (m/s)	1.1			1.1			1.1			1.1		
Percent Blockage	2			3			2			0		
Right turn flare (veh)												
Median type							None			None		
Median storage (veh)												
Upstream signal (m)							168			80		
pX, platoon unblocked	0.99	0.99	0.99	0.99	0.99	0.99						
vC, conflicting volume	212	230	154	244	228	74	135				73	
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	195	213	136	227	212	74	118				73	
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.3				4.1	
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.4				2.2	
p0 queue free %	100	100	99	97	98	100	100				100	
cM capacity (veh/h)	700	643	873	649	644	962	1327				1496	
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	17	35	49	125								
Volume Left	2	18	5	7								
Volume Right	12	4	7	5								
cSH	799	672	1327	1496								
Volume to Capacity	0.02	0.05	0.00	0.00								
Queue Length 95th (m)	0.5	1.3	0.1	0.1								
Control Delay (s)	9.6	10.7	0.8	0.5								
Lane LOS	A	B	A	A								
Approach Delay (s)	9.6	10.7	0.8	0.5								
Approach LOS	A	B										
Intersection Summary												
Average Delay	2.8											
Intersection Capacity Utilization	24.9%			ICU Level of Service			A					
Analysis Period (min)	15											

HCM Unsignalized Intersection Capacity Analysis 161720 - 2018 Background AM Peak Hour.syn
9: Driveway A & Carling Street 01/26/2017

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	12	3	0	25	8	2
Future Volume (Veh/h)	12	3	0	25	8	2
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	13	3	0	27	9	2
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			16		42	14
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			16		42	14
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	100
cM capacity (veh/h)			1602		970	1065
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	16	27	11			
Volume Left	0	0	9			
Volume Right	3	0	2			
cSH	1700	1602	986			
Volume to Capacity	0.01	0.00	0.01			
Queue Length 95th (m)	0.0	0.0	0.3			
Control Delay (s)	0.0	0.0	8.7			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	8.7			
Approach LOS			A			
Intersection Summary						
Average Delay			1.8			
Intersection Capacity Utilization			13.3%	ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis 161720 - 2018 Background AM Peak Hour.syn
10: Driveway B & Carling Street 01/26/2017

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	12	2	0	11	14	0
Future Volume (Veh/h)	12	2	0	11	14	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	13	2	0	12	15	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			15		26	14
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			15		26	14
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		98	100
cM capacity (veh/h)			1603		989	1066
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	15	12	15			
Volume Left	0	0	15			
Volume Right	2	0	0			
cSH	1700	1603	989			
Volume to Capacity	0.01	0.00	0.02			
Queue Length 95th (m)	0.0	0.0	0.4			
Control Delay (s)	0.0	0.0	8.7			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	8.7			
Approach LOS			A			
Intersection Summary						
Average Delay			3.1			
Intersection Capacity Utilization		13.3%		ICU Level of Service		A
Analysis Period (min)		15				

Queues 161720 - 2018 Background PM Peak Hour.syn
1: Hwy 403 NS Ramp & Main Street West 01/26/2017

	→	↘	↙	←	↖	↗
Lane Group	EBT	EBR	WBT	NBL	NBR	
Lane Group Flow (vph)	2117	711	1515	557	118	
v/c Ratio	0.77	0.62	0.80	0.74	0.27	
Control Delay	19.6	3.9	21.8	31.9	21.2	
Queue Delay	0.0	0.0	0.0	0.0	0.0	
Total Delay	19.6	3.9	21.8	31.9	21.2	
Queue Length 50th (m)	102.8	2.2	108.8	43.0	13.6	
Queue Length 95th (m)	122.1	18.3	138.2	62.8	26.7	
Internal Link Dist (m)	243.1		438.7	39.5		
Turn Bay Length (m)	60.0					
Base Capacity (vph)	2736	1154	1885	749	430	
Starvation Cap Reductn	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	
Reduced v/c Ratio	0.77	0.62	0.80	0.74	0.27	
Intersection Summary						











HCM Signalized Intersection Capacity Analysis 161720 - 2018 Background PM Peak Hour.syn
1: Hwy 403 NS Ramp & Main Street West 01/26/2017

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑	↑		↑↑	↑↑	↑
Traffic Volume (vph)	1948	654	0	1394	512	109
Future Volume (vph)	1948	654	0	1394	512	109
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.91	1.00		0.95	0.97	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.76
Flpb, ped/bikes	1.00	1.00		1.00	0.58	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	1.00	1.00		1.00	0.95	1.00
Satd. Flow (prot)	5142	1570		3544	1967	1125
Flt Permitted	1.00	1.00		1.00	0.95	1.00
Satd. Flow (perm)	5142	1570		3544	1967	1125
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2117	711	0	1515	557	118
RTOR Reduction (vph)	0	320	0	0	0	2
Lane Group Flow (vph)	2117	391	0	1515	557	116
Confl. Peds. (#/hr)					193	179
Heavy Vehicles (%)	2%	4%	0%	3%	4%	10%
Turn Type	NA	Perm		NA	Perm	Perm
Protected Phases	2			2		
Permitted Phases		2			4	4
Actuated Green, G (s)	46.7	46.7		46.7	33.3	33.3
Effective Green, g (s)	48.9	48.9		48.9	35.0	35.0
Actuated g/C Ratio	0.53	0.53		0.53	0.38	0.38
Clearance Time (s)	6.2	6.2		6.2	5.7	5.7
Lane Grp Cap (vph)	2736	835		1885	749	428
v/s Ratio Prot	0.41			0.43		
v/s Ratio Perm		0.25			0.28	0.10
v/c Ratio	0.77	0.47		0.80	0.74	0.27
Uniform Delay, d1	17.1	13.4		17.6	24.6	19.6
Progression Factor	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	2.2	1.9		3.8	6.6	1.5
Delay (s)	19.3	15.3		21.3	31.2	21.2
Level of Service	B	B		C	C	C
Approach Delay (s)	18.3			21.3	29.4	
Approach LOS	B			C	C	
Intersection Summary						
HCM 2000 Control Delay		20.7		HCM 2000 Level of Service		C
HCM 2000 Volume to Capacity ratio		0.79				
Actuated Cycle Length (s)		91.9		Sum of lost time (s)		9.7
Intersection Capacity Utilization		62.7%		ICU Level of Service		B
Analysis Period (min)		15				
c Critical Lane Group						




Queues 161720 - 2018 Background PM Peak Hour.syn
2: Main Street West & Macklin Street South 01/26/2017

	→	↘
Lane Group	EBT	SBL
Lane Group Flow (vph)	1711	127
v/c Ratio	0.53	0.24
Control Delay	12.9	33.2
Queue Delay	0.0	0.0
Total Delay	12.9	33.2
Queue Length 50th (m)	75.8	22.5
Queue Length 95th (m)	87.3	38.4
Internal Link Dist (m)	128.2	144.0
Turn Bay Length (m)		
Base Capacity (vph)	3220	531
Starvation Cap Reductn	0	0
Spillback Cap Reductn	0	0
Storage Cap Reductn	0	0
Reduced v/c Ratio	0.53	0.24
Intersection Summary		




















HCM Signalized Intersection Capacity Analysis 161720 - 2018 Background PM Peak Hour.syn
2: Main Street West & Macklin Street South 01/26/2017

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		  				
Traffic Volume (vph)	72	1502	0	0	117	0
Future Volume (vph)	72	1502	0	0	117	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	
Lane Util. Factor		0.91			1.00	
Frpb, ped/bikes		1.00			1.00	
Flpb, ped/bikes		1.00			0.97	
Frt		1.00			1.00	
Flt Protected		1.00			0.95	
Satd. Flow (prot)		5083			1772	
Flt Permitted		1.00			0.95	
Satd. Flow (perm)		5083			1772	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	78	1633	0	0	127	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1711	0	0	127	0
Confl. Peds. (#/hr)	4				22	
Heavy Vehicles (%)	1%	3%	0%	0%	0%	0%
Turn Type	Perm	NA			Perm	
Protected Phases		2				
Permitted Phases	2				4	
Actuated Green, G (s)		74.3			34.3	
Effective Green, g (s)		76.0			36.0	
Actuated g/C Ratio		0.63			0.30	
Clearance Time (s)		5.7			5.7	
Lane Grp Cap (vph)		3219			531	
v/s Ratio Prot						
v/s Ratio Perm		0.34			0.07	
v/c Ratio		0.53			0.24	
Uniform Delay, d1		12.2			31.7	
Progression Factor		1.00			1.00	
Incremental Delay, d2		0.6			1.1	
Delay (s)		12.8			32.7	
Level of Service		B			C	
Approach Delay (s)		12.8	0.0		32.7	
Approach LOS		B	A		C	
Intersection Summary						
HCM 2000 Control Delay		14.2			HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio		0.44				
Actuated Cycle Length (s)		120.0			Sum of lost time (s)	9.7
Intersection Capacity Utilization		49.6%			ICU Level of Service	A
Analysis Period (min)		15				
c Critical Lane Group						

Queues 161720 - 2018 Background PM Peak Hour.syn
7: Macklin Street South & King Street West 01/26/2017

			
Lane Group	WBT	NBT	SBT
Lane Group Flow (vph)	1406	60	78
v/c Ratio	0.43	0.16	0.17
Control Delay	8.4	30.0	20.9
Queue Delay	0.0	0.0	0.0
Total Delay	8.4	30.0	20.9
Queue Length 50th (m)	41.9	9.0	7.6
Queue Length 95th (m)	50.4	19.1	18.9
Internal Link Dist (m)	442.1	56.1	46.4
Turn Bay Length (m)			
Base Capacity (vph)	3302	385	466
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.43	0.16	0.17
Intersection Summary			











HCM Signalized Intersection Capacity Analysis 161720 - 2018 Background PM Peak Hour.syn
7: Macklin Street South & King Street West 01/26/2017

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					  			 			 	
Traffic Volume (vph)	0	0	0	62	1184	48	41	14	0	0	46	26
Future Volume (vph)	0	0	0	62	1184	48	41	14	0	0	46	26
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0			4.0			4.0	
Lane Util. Factor					0.91			1.00			1.00	
Flpb, ped/bikes					1.00			1.00			0.99	
Flpb, ped/bikes					1.00			0.99			1.00	
Frt					0.99			1.00			0.95	
Flt Protected					1.00			0.96			1.00	
Satd. Flow (prot)					4998			1827			1715	
Flt Permitted					1.00			0.78			1.00	
Satd. Flow (perm)					4998			1484			1715	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	67	1287	52	45	15	0	0	50	28
RTOR Reduction (vph)	0	0	0	0	4	0	0	0	0	0	20	0
Lane Group Flow (vph)	0	0	0	0	1402	0	0	60	0	0	58	0
Conf. Peds. (#/hr)	51		5	5		51	12		31	31		12
Heavy Vehicles (%)	0%	0%	0%	2%	4%	0%	0%	0%	0%	0%	0%	15%
Turn Type				Perm	NA		Perm	NA			NA	
Protected Phases					2			4			4	
Permitted Phases				2			4					
Actuated Green, G (s)					65.0			24.6			24.6	
Effective Green, g (s)					66.0			26.0			26.0	
Actuated g/C Ratio					0.66			0.26			0.26	
Clearance Time (s)					5.0			5.4			5.4	
Lane Grp Cap (vph)					3298			385			445	
v/s Ratio Prot											0.03	
v/s Ratio Perm					0.28			0.04				
v/c Ratio					0.43			0.16			0.13	
Uniform Delay, d1					8.0			28.5			28.3	
Progression Factor					1.00			1.00			1.00	
Incremental Delay, d2					0.4			0.9			0.6	
Delay (s)					8.4			29.4			28.9	
Level of Service					A			C			C	
Approach Delay (s)		0.0			8.4			29.4			28.9	
Approach LOS		A			A			C			C	
Intersection Summary												
HCM 2000 Control Delay		10.3			HCM 2000 Level of Service						B	
HCM 2000 Volume to Capacity ratio		0.35										
Actuated Cycle Length (s)		100.0			Sum of lost time (s)						8.0	
Intersection Capacity Utilization		55.0%			ICU Level of Service						B	
Analysis Period (min)		15										
c Critical Lane Group												










HCM Unsignalized Intersection Capacity Analysis 161720 - 2018 Background PM Peak Hour.syn
8: Macklin Street South & Carling Street 01/26/2017

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	4	7	14	10	1	4	10	47	14	12	93	3
Future Volume (Veh/h)	4	7	14	10	1	4	10	47	14	12	93	3
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	4	8	15	11	1	4	11	51	15	13	101	3
Pedestrians		13			24			14			8	
Lane Width (m)		3.7			3.7			3.7			3.7	
Walking Speed (m/s)		1.1			1.1			1.1			1.1	
Percent Blockage		1			2			1			1	
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (m)								168			80	
pX, platoon unblocked												
vC, conflicting volume	234	254	130	266	248	90	117			90		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	234	254	130	266	248	90	117			90		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	99	98	98	100	100	99			99		
cM capacity (veh/h)	678	620	901	622	624	942	1465			1482		
Direction, Lane #												
Volume Total	27	16	77	117								
Volume Left	4	11	11	13								
Volume Right	15	4	15	3								
cSH	762	680	1465	1482								
Volume to Capacity	0.04	0.02	0.01	0.01								
Queue Length 95th (m)	0.8	0.5	0.2	0.2								
Control Delay (s)	9.9	10.4	1.1	0.9								
Lane LOS	A	B	A	A								
Approach Delay (s)	9.9	10.4	1.1	0.9								
Approach LOS	A	B										
Intersection Summary												
Average Delay		2.6										
Intersection Capacity Utilization		23.8%			ICU Level of Service						A	
Analysis Period (min)		15										

HCM Unsignalized Intersection Capacity Analysis 161720 - 2018 Background PM Peak Hour.syn
9: Driveway A & Carling Street 01/26/2017

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations					 	
Traffic Volume (veh/h)	27	6	0	9	6	12
Future Volume (Veh/h)	27	6	0	9	6	12
Sign Control	Free		Free		Stop	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	29	7	0	10	7	13
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None		None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			36		42	32
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			36		42	32
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	99
cM capacity (veh/h)			1575		968	1041
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	36	10	20			
Volume Left	0	0	7			
Volume Right	7	0	13			
cSH	1700	1575	1015			
Volume to Capacity	0.02	0.00	0.02			
Queue Length 95th (m)	0.0	0.0	0.5			
Control Delay (s)	0.0	0.0	8.6			
Lane LOS	A					
Approach Delay (s)	0.0	0.0	8.6			
Approach LOS	A					
Intersection Summary						
Average Delay			2.6			
Intersection Capacity Utilization			13.3%	ICU Level of Service	A	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis 161720 - 2018 Background PM Peak Hour.syn
10: Driveway B & Carling Street 01/26/2017

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	31	8	0	4	5	0
Future Volume (Veh/h)	31	8	0	4	5	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	34	9	0	4	5	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None		None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			43		42	38
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			43		42	38
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	100
cM capacity (veh/h)			1566		968	1033
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	43	4	5			
Volume Left	0	0	5			
Volume Right	9	0	0			
cSH	1700	1566	968			
Volume to Capacity	0.03	0.00	0.01			
Queue Length 95th (m)	0.0	0.0	0.1			
Control Delay (s)	0.0	0.0	8.7			
Lane LOS	A					
Approach Delay (s)	0.0	0.0	8.7			
Approach LOS	A					
Intersection Summary						
Average Delay			0.8			
Intersection Capacity Utilization			13.3%	ICU Level of Service	A	
Analysis Period (min)			15			

3: Hwy. 403 NE Ramp & Main Street West Performance by movement

Movement	EBT	NBR	All
Denied Del/Veh (s)	0.0	0.7	0.2
Total Del/Veh (s)	3.7	1.8	3.1

4: Main Street West & Hwy 403 SE Ramp Performance by movement

Movement	EBT	SBL	All
Denied Del/Veh (s)	0.0	0.4	0.1
Total Del/Veh (s)	0.8	1.0	0.8

5: King Street West & Hwy 403 NW Ramp Performance by movement

Movement	WBT	WBR	All
Denied Del/Veh (s)	0.3	0.7	0.5
Total Del/Veh (s)	0.5	3.8	1.8

6: Hwy 403 SW Ramp & King Street West Performance by movement

Movement	WBL	WBT	All
Denied Del/Veh (s)	0.0	0.0	0.0
Total Del/Veh (s)	3.0	0.3	1.1

Total Zone Performance

Denied Del/Veh (s)		0.5
Total Del/Veh (s)		55.1

3: Hwy. 403 NE Ramp & Main Street West Performance by movement

Movement	EBT	NBR	All
Denied Del/Veh (s)	0.0	0.5	0.1
Total Del/Veh (s)	3.0	1.3	2.6

4: Main Street West & Hwy 403 SE Ramp Performance by movement

Movement	EBT	SBL	All
Denied Del/Veh (s)	0.0	0.6	0.1
Total Del/Veh (s)	0.7	1.5	0.9

5: King Street West & Hwy 403 NW Ramp Performance by movement

Movement	WBT	WBR	All
Denied Del/Veh (s)	1.6	2.2	1.8
Total Del/Veh (s)	2.5	5.9	3.6

6: Hwy 403 SW Ramp & King Street West Performance by movement

Movement	WBL	WBT	All
Denied Del/Veh (s)	0.0	0.0	0.0
Total Del/Veh (s)	5.8	0.4	2.8

Total Zone Performance

Denied Del/Veh (s)		1.5
Total Del/Veh (s)		117.4

Queues
1: Hwy 403 NS Ramp & Main Street West

161720 - 2023 Background AM Peak Hour.syn
01/26/2017

	→	↘	←	↙	↗
Lane Group	EBT	EBR	WBT	NBL	NBR
Lane Group Flow (vph)	2168	436	1679	1001	275
v/c Ratio	0.92	0.50	1.02	1.06	0.60
Control Delay	30.9	5.5	51.5	75.0	26.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	30.9	5.5	51.5	75.0	26.0
Queue Length 50th (m)	126.4	7.4	~156.8	~101.5	35.5
Queue Length 95th (m)	#153.6	26.9	#207.8	#138.5	62.3
Internal Link Dist (m)	243.1		438.7	39.5	
Turn Bay Length (m)		60.0			
Base Capacity (vph)	2354	874	1654	940	457
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.92	0.50	1.02	1.06	0.60

Intersection Summary

- ~ 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.

HCM Signalized Intersection Capacity Analysis 161720 - 2023 Background AM Peak Hour.syn
1: Hwy 403 NS Ramp & Main Street West

01/26/2017

	→	↘	↙	←	↗	↘
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑	↑		↑↑	↑	↑
Traffic Volume (vph)	1995	401	0	1545	921	253
Future Volume (vph)	1995	401	0	1545	921	253
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.91	1.00		0.95	0.97	1.00
Frpb, ped/bikes	1.00	0.96		1.00	1.00	0.66
Flpb, ped/bikes	1.00	1.00		1.00	0.62	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	1.00	1.00		1.00	0.95	1.00
Satd. Flow (prot)	5043	1464		3544	2108	1025
Flt Permitted	1.00	1.00		1.00	0.95	1.00
Satd. Flow (perm)	5043	1464		3544	2108	1025
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2168	436	0	1679	1001	275
RTOR Reduction (vph)	0	191	0	0	0	1
Lane Group Flow (vph)	2168	245	0	1679	1001	274
Confl. Peds. (#/hr)	13		13		174	363
Heavy Vehicles (%)	4%	7%	0%	3%	4%	5%
Turn Type	NA	Perm		NA	Perm	Perm
Protected Phases	2			2		
Permitted Phases		2			4	4
Actuated Green, G (s)	40.7	40.7		40.7	39.3	39.3
Effective Green, g (s)	42.9	42.9		42.9	41.0	41.0
Actuated g/C Ratio	0.47	0.47		0.47	0.45	0.45
Clearance Time (s)	6.2	6.2		6.2	5.7	5.7
Lane Grp Cap (vph)	2354	683		1654	940	457
v/s Ratio Prot	0.43			c0.47		
v/s Ratio Perm		0.17			c0.47	0.27
v/c Ratio	0.92	0.36		1.02	1.06	0.60
Uniform Delay, d1	22.9	15.7		24.5	25.5	19.3
Progression Factor	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	7.4	1.5		26.0	48.2	5.7
Delay (s)	30.3	17.1		50.5	73.7	25.0
Level of Service	C	B		D	E	C
Approach Delay (s)	28.1			50.5	63.2	
Approach LOS	C			D	E	

Intersection Summary


HCM 2000 Control Delay	42.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.06		
Actuated Cycle Length (s)	91.9	Sum of lost time (s)	9.7
Intersection Capacity Utilization	75.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Queues

2: Main Street West & Macklin Street South

161720 - 2023 Background AM Peak Hour.syn

01/26/2017



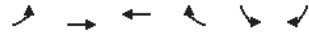
Lane Group	EBT	SBL
Lane Group Flow (vph)	1962	148
v/c Ratio	0.66	0.27
Control Delay	14.7	21.3
Queue Delay	0.0	0.0
Total Delay	14.7	21.3
Queue Length 50th (m)	85.7	16.2
Queue Length 95th (m)	101.0	26.3
Internal Link Dist (m)	128.2	144.0
Turn Bay Length (m)		
Base Capacity (vph)	2958	545
Starvation Cap Reductn	0	0
Spillback Cap Reductn	0	0
Storage Cap Reductn	0	0
Reduced v/c Ratio	0.66	0.27

Intersection Summary

HCM Signalized Intersection Capacity Analysis 161720 - 2023 Background AM Peak Hour.syn

2: Main Street West & Macklin Street South

01/26/2017



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔↔↔			↔	
Traffic Volume (vph)	47	1758	0	0	136	0
Future Volume (vph)	47	1758	0	0	136	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	
Lane Util. Factor		0.91			1.00	
Flpb, ped/bikes		1.00			1.00	
Flpb, ped/bikes		1.00			1.00	
Frt		1.00			1.00	
Flt Protected		1.00			0.95	
Satd. Flow (prot)		4930			1706	
Flt Permitted		1.00			0.95	
Satd. Flow (perm)		4930			1706	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	51	1911	0	0	148	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1962	0	0	148	0
Confl. Peds. (#/hr)		16				
Heavy Vehicles (%)	13%	6%	0%	0%	7%	0%
Turn Type	Perm	NA			Perm	
Protected Phases		2				
Permitted Phases	2				4	
Actuated Green, G (s)		58.3			30.3	
Effective Green, g (s)		60.0			32.0	
Actuated g/C Ratio		0.60			0.32	
Clearance Time (s)		5.7			5.7	
Lane Grp Cap (vph)		2958			545	
v/s Ratio Prot						
v/s Ratio Perm		0.40			0.09	
v/c Ratio		0.66			0.27	
Uniform Delay, d1		13.3			25.3	
Progression Factor		1.00			0.78	
Incremental Delay, d2		1.2			1.2	
Delay (s)		14.5			20.9	
Level of Service		B			C	
Approach Delay (s)		14.5	0.0		20.9	
Approach LOS		B	A		C	

Intersection Summary

HCM 2000 Control Delay	14.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	9.7
Intersection Capacity Utilization	54.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Queues
7: Macklin Street South & King Street West

161720 - 2023 Background AM Peak Hour.syn
01/26/2017

















	←	↑	↓
Lane Group	WBT	NBT	SBT
Lane Group Flow (vph)	1415	46	100
v/c Ratio	0.45	0.12	0.23
Control Delay	9.1	29.4	25.7
Queue Delay	0.0	0.0	0.0
Total Delay	9.1	29.4	25.7
Queue Length 50th (m)	44.2	8.2	12.7
Queue Length 95th (m)	53.2	13.6	26.0
Internal Link Dist (m)	442.1	56.1	46.4
Turn Bay Length (m)			
Base Capacity (vph)	3154	398	438
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.45	0.12	0.23
Intersection Summary			
m Volume for 95th percentile queue is metered by upstream signal.			

HCM Signalized Intersection Capacity Analysis 161720 - 2023 Background AM Peak Hour.syn
7: Macklin Street South & King Street West










01/26/2017

	↖	→	↗	↙	←	↖	↗	↑	↙	↗	↓	↖
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↔↔↔			↔			↔	
Traffic Volume (vph)	0	0	0	48	1185	69	20	22	0	0	71	21
Future Volume (vph)	0	0	0	48	1185	69	20	22	0	0	71	21
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0			4.0			4.0	
Lane Util. Factor					0.91			1.00			1.00	
Flpb, ped/bikes					1.00			1.00			0.99	
Flpb, ped/bikes					1.00			0.98			1.00	
Frt					0.99			1.00			0.97	
Flt Protected					1.00			0.98			1.00	
Satd. Flow (prot)					4845			1660			1581	
Flt Permitted					1.00			0.87			1.00	
Satd. Flow (perm)					4845			1478			1581	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	52	1288	75	22	24	0	0	77	23
RTOR Reduction (vph)	0	0	0	0	6	0	0	0	0	0	11	0
Lane Group Flow (vph)	0	0	0	0	1409	0	0	46	0	0	89	0
Confl. Peds. (#/hr)	51		10	10		51	28		38	38		28
Heavy Vehicles (%)	0%	0%	0%	4%	6%	20%	14%	8%	0%	0%	12%	30%
Turn Type				Perm	NA		Perm	NA			NA	
Protected Phases					2			4			4	
Permitted Phases				2			4					
Actuated Green, G (s)					64.0			25.6			25.6	
Effective Green, g (s)					65.0			27.0			27.0	
Actuated g/C Ratio					0.65			0.27			0.27	
Clearance Time (s)					5.0			5.4			5.4	
Lane Grp Cap (vph)					3149			399			426	
v/s Ratio Prot											c0.06	
v/s Ratio Perm					0.29			0.03				
v/c Ratio					0.45			0.12			0.21	
Uniform Delay, d1					8.6			27.5			28.2	
Progression Factor					1.00			1.03			1.00	
Incremental Delay, d2					0.5			0.5			1.1	
Delay (s)					9.1			28.9			29.4	
Level of Service					A			C			C	
Approach Delay (s)		0.0			9.1			28.9			29.4	
Approach LOS		A			A			C			C	
Intersection Summary												
HCM 2000 Control Delay					11.0						B	
HCM 2000 Volume to Capacity ratio					0.38							
Actuated Cycle Length (s)					100.0			Sum of lost time (s)			8.0	
Intersection Capacity Utilization					55.0%			ICU Level of Service			B	
Analysis Period (min)					15							
c Critical Lane Group												










HCM Unsignalized Intersection Capacity Analysis 161720 - 2023 Background AM Peak Hour.syn
8: Macklin Street South & Carling Street 01/26/2017

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	2	3	11	18	12	4	5	35	6	6	107	5
Future Volume (Veh/h)	2	3	11	18	12	4	5	35	6	6	107	5
Sign Control		Stop				Free					Free	
Grade		0%				0%					0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	3	12	20	13	4	5	38	7	7	116	5
Pedestrians		17				29					4	
Lane Width (m)		3.7				3.7					3.7	
Walking Speed (m/s)		1.1				1.1					1.1	
Percent Blockage		2				3					0	
Right turn flare (veh)												
Median type									None		None	
Median storage (veh)												
Upstream signal (m)									168		80	
pX, platoon unblocked	0.99	0.99	0.99	0.99	0.99		0.99					
vC, conflicting volume	216	234	156	248	232	74	138			74		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	199	217	139	231	216	74	120			74		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.3			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.4			2.2		
p0 queue free %	100	100	99	97	98	100	100			100		
cM capacity (veh/h)	696	640	870	645	641	961	1323			1495		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	17	37	50	128								
Volume Left	2	20	5	7								
Volume Right	12	4	7	5								
cSH	796	667	1323	1495								
Volume to Capacity	0.02	0.06	0.00	0.00								
Queue Length 95th (m)	0.5	1.3	0.1	0.1								
Control Delay (s)	9.6	10.7	0.8	0.4								
Lane LOS	A	B	A	A								
Approach Delay (s)	9.6	10.7	0.8	0.4								
Approach LOS	A	B										
Intersection Summary												
Average Delay	2.8											
Intersection Capacity Utilization	25.0%			ICU Level of Service					A			
Analysis Period (min)	15											






HCM Unsignalized Intersection Capacity Analysis 161720 - 2023 Background AM Peak Hour.syn
9: Driveway A & Carling Street 01/26/2017

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	12	3	0	26	8	2
Future Volume (Veh/h)	12	3	0	26	8	2
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	13	3	0	28	9	2
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			16		42	14
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			16		42	14
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	100
cM capacity (veh/h)			1602		968	1065
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	16	28	11			
Volume Left	0	0	9			
Volume Right	3	0	2			
cSH	1700	1602	985			
Volume to Capacity	0.01	0.00	0.01			
Queue Length 95th (m)	0.0	0.0	0.3			
Control Delay (s)	0.0	0.0	8.7			
Lane LOS	A					
Approach Delay (s)	0.0	0.0	8.7			
Approach LOS	A					
Intersection Summary						
Average Delay			1.7			
Intersection Capacity Utilization			13.3%	ICU Level of Service	A	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis 161720 - 2023 Background AM Peak Hour.syn
10: Driveway B & Carling Street 01/26/2017

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	12	2	0	11	15	0
Future Volume (Veh/h)	12	2	0	11	15	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	13	2	0	12	16	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			15		26	14
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			15		26	14
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		98	100
cM capacity (veh/h)			1603		989	1066
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	15	12	16			
Volume Left	0	0	16			
Volume Right	2	0	0			
cSH	1700	1603	989			
Volume to Capacity	0.01	0.00	0.02			
Queue Length 95th (m)	0.0	0.0	0.4			
Control Delay (s)	0.0	0.0	8.7			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	8.7			
Approach LOS			A			
Intersection Summary						
Average Delay			3.2			
Intersection Capacity Utilization			13.3%	ICU Level of Service		A
Analysis Period (min)			15			

Queues 161720 - 2023 Background PM Peak Hour.syn
1: Hwy 403 NS Ramp & Main Street West 01/26/2017

					
Lane Group	EBT	EBR	WBT	NBL	NBR
Lane Group Flow (vph)	2192	732	1597	573	127
v/c Ratio	0.79	0.63	0.83	0.79	0.30
Control Delay	19.3	4.0	22.3	35.2	22.4
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	19.3	4.0	22.3	35.2	22.4
Queue Length 50th (m)	106.5	2.9	116.5	45.6	15.1
Queue Length 95th (m)	126.1	19.0	147.6	#67.9	29.2
Internal Link Dist (m)	243.1		438.7	39.5	
Turn Bay Length (m)	60.0				
Base Capacity (vph)	2792	1170	1924	727	418
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.79	0.63	0.83	0.79	0.30
Intersection Summary					
# 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.					











HCM Signalized Intersection Capacity Analysis 161720 - 2023 Background PM Peak Hour.syn
1: Hwy 403 NS Ramp & Main Street West 01/26/2017

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑	↑		↑↑	↑↑	↑
Traffic Volume (vph)	2017	673	0	1469	527	117
Future Volume (vph)	2017	673	0	1469	527	117
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.91	1.00		0.95	0.97	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.76
Flpb, ped/bikes	1.00	1.00		1.00	0.58	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	1.00	1.00		1.00	0.95	1.00
Satd. Flow (prot)	5142	1570		3544	1967	1125
Flt Permitted	1.00	1.00		1.00	0.95	1.00
Satd. Flow (perm)	5142	1570		3544	1967	1125
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2192	732	0	1597	573	127
RTOR Reduction (vph)	0	318	0	0	0	3
Lane Group Flow (vph)	2192	414	0	1597	573	124
Confl. Peds. (#/hr)					193	179
Heavy Vehicles (%)	2%	4%	0%	3%	4%	10%
Turn Type	NA	Perm		NA	Perm	Perm
Protected Phases	2			2		
Permitted Phases		2			4	4
Actuated Green, G (s)	47.7	47.7		47.7	32.3	32.3
Effective Green, g (s)	49.9	49.9		49.9	34.0	34.0
Actuated g/C Ratio	0.54	0.54		0.54	0.37	0.37
Clearance Time (s)	6.2	6.2		6.2	5.7	5.7
Lane Grp Cap (vph)	2792	852		1924	727	416
v/s Ratio Prot	0.43			0.45		
v/s Ratio Perm		0.26			0.29	0.11
v/c Ratio	0.79	0.49		0.83	0.79	0.30
Uniform Delay, d1	16.7	13.0		17.5	25.7	20.5
Progression Factor	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	2.3	2.0		4.3	8.5	1.8
Delay (s)	19.0	15.0		21.8	34.2	22.3
Level of Service	B	B		C	C	C
Approach Delay (s)	18.0			21.8	32.1	
Approach LOS	B			C	C	
Intersection Summary						
HCM 2000 Control Delay		21.1		HCM 2000 Level of Service		C
HCM 2000 Volume to Capacity ratio		0.83				
Actuated Cycle Length (s)		91.9		Sum of lost time (s)		9.7
Intersection Capacity Utilization		64.8%		ICU Level of Service		C
Analysis Period (min)		15				
c Critical Lane Group						




Queues 161720 - 2023 Background PM Peak Hour.syn
2: Main Street West & Macklin Street South 01/26/2017

	→	↘
Lane Group	EBT	SBL
Lane Group Flow (vph)	1781	132
v/c Ratio	0.55	0.25
Control Delay	13.2	33.3
Queue Delay	0.0	0.0
Total Delay	13.2	33.3
Queue Length 50th (m)	80.6	23.5
Queue Length 95th (m)	92.6	39.7
Internal Link Dist (m)	128.2	144.0
Turn Bay Length (m)		
Base Capacity (vph)	3219	531
Starvation Cap Reductn	0	0
Spillback Cap Reductn	0	0
Storage Cap Reductn	0	0
Reduced v/c Ratio	0.55	0.25
Intersection Summary		

HCM Signalized Intersection Capacity Analysis 161720 - 2023 Background PM Peak Hour.syn
2: Main Street West & Macklin Street South 01/26/2017

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		  				
Traffic Volume (vph)	74	1565	0	0	121	0
Future Volume (vph)	74	1565	0	0	121	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	
Lane Util. Factor		0.91			1.00	
Frpb, ped/bikes		1.00			1.00	
Flpb, ped/bikes		1.00			0.97	
Frt		1.00			1.00	
Flt Protected		1.00			0.95	
Satd. Flow (prot)		5083			1772	
Flt Permitted		1.00			0.95	
Satd. Flow (perm)		5083			1772	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	80	1701	0	0	132	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1781	0	0	132	0
Confl. Peds. (#/hr)	4				22	
Heavy Vehicles (%)	1%	3%	0%	0%	0%	0%
Turn Type	Perm	NA			Perm	
Protected Phases		2				
Permitted Phases	2				4	
Actuated Green, G (s)		74.3			34.3	
Effective Green, g (s)		76.0			36.0	
Actuated g/C Ratio		0.63			0.30	
Clearance Time (s)		5.7			5.7	
Lane Grp Cap (vph)		3219			531	
v/s Ratio Prot						
v/s Ratio Perm		0.35			0.07	
v/c Ratio		0.55			0.25	
Uniform Delay, d1		12.4			31.8	
Progression Factor		1.00			1.00	
Incremental Delay, d2		0.7			1.1	
Delay (s)		13.1			32.9	
Level of Service		B			C	
Approach Delay (s)		13.1	0.0		32.9	
Approach LOS		B	A		C	
Intersection Summary						
HCM 2000 Control Delay		14.5			HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio		0.46				
Actuated Cycle Length (s)		120.0			Sum of lost time (s)	9.7
Intersection Capacity Utilization		50.9%			ICU Level of Service	A
Analysis Period (min)		15				
c Critical Lane Group						

Queues 161720 - 2023 Background PM Peak Hour.syn
7: Macklin Street South & King Street West 01/26/2017

			
Lane Group	WBT	NBT	SBT
Lane Group Flow (vph)	1446	63	81
v/c Ratio	0.44	0.16	0.17
Control Delay	8.5	30.1	21.1
Queue Delay	0.0	0.0	0.0
Total Delay	8.5	30.1	21.1
Queue Length 50th (m)	43.6	9.4	8.0
Queue Length 95th (m)	52.3	19.9	19.5
Internal Link Dist (m)	442.1	56.1	46.4
Turn Bay Length (m)			
Base Capacity (vph)	3306	384	466
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.44	0.16	0.17
Intersection Summary			

HCM Signalized Intersection Capacity Analysis 161720 - 2023 Background PM Peak Hour.syn
7: Macklin Street South & King Street West 01/26/2017

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	63	1219	49	43	15	0	0	48	27
Future Volume (vph)	0	0	0	63	1219	49	43	15	0	0	48	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0			4.0			4.0	
Lane Util. Factor					0.91			1.00			1.00	
Flpb, ped/bikes					1.00			1.00			0.99	
Flpb, ped/bikes					1.00			0.99			1.00	
Frt					0.99			1.00			0.95	
Flt Protected					1.00			0.96			1.00	
Satd. Flow (prot)					4998			1827			1715	
Flt Permitted					1.00			0.78			1.00	
Satd. Flow (perm)					4998			1478			1715	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	68	1325	53	47	16	0	0	52	29
RTOR Reduction (vph)	0	0	0	0	4	0	0	0	0	0	20	0
Lane Group Flow (vph)	0	0	0	0	1442	0	0	63	0	0	61	0
Confl. Peds. (#/hr)	51		5	5		51	12		31	31		12
Heavy Vehicles (%)	0%	0%	0%	2%	4%	0%	0%	0%	0%	0%	0%	15%
Turn Type				Perm	NA		Perm	NA			NA	
Protected Phases					2			4			4	
Permitted Phases				2			4					
Actuated Green, G (s)					65.0			24.6			24.6	
Effective Green, g (s)					66.0			26.0			26.0	
Actuated g/C Ratio					0.66			0.26			0.26	
Clearance Time (s)					5.0			5.4			5.4	
Lane Grp Cap (vph)					3298			384			445	
v/s Ratio Prot											0.04	
v/s Ratio Perm					0.29			0.04				
v/c Ratio					0.44			0.16			0.14	
Uniform Delay, d1					8.1			28.6			28.4	
Progression Factor					1.00			1.00			1.00	
Incremental Delay, d2					0.4			0.9			0.6	
Delay (s)					8.5			29.5			29.0	
Level of Service					A			C			C	
Approach Delay (s)		0.0			8.5			29.5			29.0	
Approach LOS		A			A			C			C	

Intersection Summary			
HCM 2000 Control Delay	10.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.36		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	55.0%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			











HCM Unsignalized Intersection Capacity Analysis 161720 - 2023 Background PM Peak Hour.syn
8: Macklin Street South & Carling Street 01/26/2017

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	4	7	15	10	1	4	10	49	15	12	96	3
Future Volume (Veh/h)	4	7	15	10	1	4	10	49	15	12	96	3
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	4	8	16	11	1	4	11	53	16	13	104	3
Pedestrians		13			24			14			8	
Lane Width (m)		3.7			3.7			3.7			3.7	
Walking Speed (m/s)		1.1			1.1			1.1			1.1	
Percent Blockage		1			2			1			1	
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (m)								168			80	
pX, platoon unblocked												
vC, conflicting volume	240	260	132	272	253	93	120			93		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	240	260	132	272	253	93	120			93		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	99	98	98	100	100	99			99		
cM capacity (veh/h)	672	615	898	615	620	939	1461			1479		










Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	28	16	80	120
Volume Left	4	11	11	13
Volume Right	16	4	16	3
cSH	761	674	1461	1479
Volume to Capacity	0.04	0.02	0.01	0.01
Queue Length 95th (m)	0.9	0.6	0.2	0.2
Control Delay (s)	9.9	10.5	1.1	0.9
Lane LOS	A	B	A	A
Approach Delay (s)	9.9	10.5	1.1	0.9
Approach LOS	A	B		

Intersection Summary			
Average Delay	2.6		
Intersection Capacity Utilization	23.9%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis 161720 - 2023 Background PM Peak Hour.syn
9: Driveway A & Carling Street 01/26/2017

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations					 	
Traffic Volume (veh/h)	28	6	0	9	6	12
Future Volume (Veh/h)	28	6	0	9	6	12
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	30	7	0	10	7	13
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			37		44	34
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			37		44	34
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	99
cM capacity (veh/h)			1574		967	1040
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	37	10	20			
Volume Left	0	0	7			
Volume Right	7	0	13			
cSH	1700	1574	1013			
Volume to Capacity	0.02	0.00	0.02			
Queue Length 95th (m)	0.0	0.0	0.5			
Control Delay (s)	0.0	0.0	8.6			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	8.6			
Approach LOS			A			
Intersection Summary						
Average Delay			2.6			
Intersection Capacity Utilization			13.3%	ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis 161720 - 2023 Background PM Peak Hour.syn
10: Driveway B & Carling Street 01/26/2017

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	32	8	0	4	5	0
Future Volume (Veh/h)	32	8	0	4	5	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	35	9	0	4	5	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			44		44	40
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			44		44	40
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	100
cM capacity (veh/h)			1564		967	1032
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	44	4	5			
Volume Left	0	0	5			
Volume Right	9	0	0			
cSH	1700	1564	967			
Volume to Capacity	0.03	0.00	0.01			
Queue Length 95th (m)	0.0	0.0	0.1			
Control Delay (s)	0.0	0.0	8.7			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	8.7			
Approach LOS			A			
Intersection Summary						
Average Delay			0.8			
Intersection Capacity Utilization		13.3%		ICU Level of Service		A
Analysis Period (min)		15				

SimTraffic Performance Report
Baseline

SimTraffic Performance Report
01/25/2017

3: Hwy. 403 NE Ramp & Main Street West Performance by movement

Movement	EBT	NBR	All
Denied Del/Veh (s)	0.0	1.0	0.3
Total Del/Veh (s)	3.3	2.3	3.0

4: Main Street West & Hwy 403 SE Ramp Performance by movement

Movement	EBT	SBL	All
Denied Del/Veh (s)	0.0	0.4	0.1
Total Del/Veh (s)	0.6	0.9	0.7

5: King Street West & Hwy 403 NW Ramp Performance by movement

Movement	WBT	WBR	All
Denied Del/Veh (s)	0.7	0.9	0.8
Total Del/Veh (s)	0.4	4.7	2.1

6: Hwy 403 SW Ramp & King Street West Performance by movement

Movement	WBL	WBT	All
Denied Del/Veh (s)	0.0	0.0	0.0
Total Del/Veh (s)	3.0	0.3	1.0

Total Zone Performance

Denied Del/Veh (s)		0.7
Total Del/Veh (s)		25.4

SimTraffic Performance Report
Baseline

SimTraffic Performance Report
01/25/2017

3: Hwy. 403 NE Ramp & Main Street West Performance by movement

Movement	EBT	NBR	All
Denied Del/Veh (s)	0.0	0.4	0.1
Total Del/Veh (s)	3.9	1.4	3.3

4: Main Street West & Hwy 403 SE Ramp Performance by movement

Movement	EBT	SBL	All
Denied Del/Veh (s)	0.0	0.5	0.1
Total Del/Veh (s)	0.7	1.1	0.8

5: King Street West & Hwy 403 NW Ramp Performance by movement

Movement	WBT	WBR	All
Denied Del/Veh (s)	1.6	1.5	1.6
Total Del/Veh (s)	3.2	4.9	3.8

6: Hwy 403 SW Ramp & King Street West Performance by movement

Movement	WBL	WBT	All
Denied Del/Veh (s)	0.0	0.0	0.0
Total Del/Veh (s)	6.5	0.4	3.1

Total Zone Performance

Denied Del/Veh (s)		1.3
Total Del/Veh (s)		229.7

Queues
1: Hwy 403 NS Ramp & Main Street West

161720 - 2028 Background AM Peak Hour.syn
01/26/2017

	→	↘	←	↙	↗
Lane Group	EBT	EBR	WBT	NBL	NBR
Lane Group Flow (vph)	2393	440	1715	1011	375
v/c Ratio	1.02	0.51	1.04	1.08	0.82
Control Delay	48.2	6.7	57.9	78.5	39.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	48.2	6.7	57.9	78.5	39.3
Queue Length 50th (m)	~156.3	11.0	~173.5	~103.5	55.9
Queue Length 95th (m)	#194.5	32.9	#214.9	#140.4	#107.4
Internal Link Dist (m)	243.1		438.7	39.5	
Turn Bay Length (m)		60.0			
Base Capacity (vph)	2354	858	1654	940	457
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	1.02	0.51	1.04	1.08	0.82

Intersection Summary

- ~ 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.

HCM Signalized Intersection Capacity Analysis 161720 - 2028 Background AM Peak Hour.syn
1: Hwy 403 NS Ramp & Main Street West
01/26/2017

	→	↘	↙	←	↗	↘
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑	↑		↑↑	↑↑	↑
Traffic Volume (vph)	2202	405	0	1578	930	345
Future Volume (vph)	2202	405	0	1578	930	345
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.91	1.00		0.95	0.97	1.00
Flpb, ped/bikes	1.00	0.96		1.00	1.00	0.66
Flpb, ped/bikes	1.00	1.00		1.00	0.62	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	1.00	1.00		1.00	0.95	1.00
Satd. Flow (prot)	5043	1464		3544	2108	1025
Flt Permitted	1.00	1.00		1.00	0.95	1.00
Satd. Flow (perm)	5043	1464		3544	2108	1025
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2393	440	0	1715	1011	375
RTOR Reduction (vph)	0	175	0	0	0	1
Lane Group Flow (vph)	2393	265	0	1715	1011	374
Confl. Peds. (#/hr)	13		13		174	363
Heavy Vehicles (%)	4%	7%	0%	3%	4%	5%
Turn Type	NA	Perm		NA	Perm	Perm
Protected Phases	2			2		
Permitted Phases		2			4	4
Actuated Green, G (s)	40.7	40.7		40.7	39.3	39.3
Effective Green, g (s)	42.9	42.9		42.9	41.0	41.0
Actuated g/C Ratio	0.47	0.47		0.47	0.45	0.45
Clearance Time (s)	6.2	6.2		6.2	5.7	5.7
Lane Grp Cap (vph)	2354	683		1654	940	457
v/s Ratio Prot	0.47			c0.48		
v/s Ratio Perm		0.18			c0.48	0.37
v/c Ratio	1.02	0.39		1.04	1.08	0.82
Uniform Delay, d1	24.5	16.0		24.5	25.5	22.2
Progression Factor	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	22.8	1.7		32.3	51.9	15.1
Delay (s)	47.3	17.6		56.8	77.3	37.3
Level of Service	D	B		E	E	D
Approach Delay (s)	42.7			56.8	66.5	
Approach LOS	D			E	E	

Intersection Summary

HCM 2000 Control Delay	52.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.08		
Actuated Cycle Length (s)	91.9	Sum of lost time (s)	9.7
Intersection Capacity Utilization	79.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Queues

2: Main Street West & Macklin Street South

161720 - 2028 Background AM Peak Hour.syn

01/26/2017

Lane Group	EBT	SBL
Lane Group Flow (vph)	2001	150
v/c Ratio	0.68	0.28
Control Delay	14.9	21.3
Queue Delay	0.0	0.0
Total Delay	14.9	21.3
Queue Length 50th (m)	88.5	16.4
Queue Length 95th (m)	104.3	26.8
Internal Link Dist (m)	128.2	144.0
Turn Bay Length (m)		
Base Capacity (vph)	2958	545
Starvation Cap Reductn	0	0
Spillback Cap Reductn	0	0
Storage Cap Reductn	0	0
Reduced v/c Ratio	0.68	0.28

Intersection Summary

HCM Signalized Intersection Capacity Analysis 161720 - 2028 Background AM Peak Hour.syn

2: Main Street West & Macklin Street South

01/26/2017

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔↔↔			↔	
Traffic Volume (vph)	47	1794	0	0	138	0
Future Volume (vph)	47	1794	0	0	138	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	
Lane Util. Factor		0.91			1.00	
Flpb, ped/bikes		1.00			1.00	
Flpb, ped/bikes		1.00			1.00	
Frt		1.00			1.00	
Flt Protected		1.00			0.95	
Satd. Flow (prot)		4930			1706	
Flt Permitted		1.00			0.95	
Satd. Flow (perm)		4930			1706	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	51	1950	0	0	150	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	2001	0	0	150	0
Confl. Peds. (#/hr)		16				
Heavy Vehicles (%)	13%	6%	0%	0%	7%	0%
Turn Type	Perm	NA			Perm	
Protected Phases		2				
Permitted Phases	2				4	
Actuated Green, G (s)		58.3			30.3	
Effective Green, g (s)		60.0			32.0	
Actuated g/C Ratio		0.60			0.32	
Clearance Time (s)		5.7			5.7	
Lane Grp Cap (vph)		2958			545	
v/s Ratio Prot						
v/s Ratio Perm		0.41			0.09	
v/c Ratio		0.68			0.28	
Uniform Delay, d1		13.5			25.4	
Progression Factor		1.00			0.78	
Incremental Delay, d2		1.3			1.2	
Delay (s)		14.7			20.9	
Level of Service		B			C	
Approach Delay (s)		14.7	0.0		20.9	
Approach LOS		B	A		C	

Intersection Summary

HCM 2000 Control Delay	15.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	9.7
Intersection Capacity Utilization	54.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Queues
7: Macklin Street South & King Street West

161720 - 2028 Background AM Peak Hour.syn
01/26/2017

















	←	↑	↓
Lane Group	WBT	NBT	SBT
Lane Group Flow (vph)	1429	46	100
v/c Ratio	0.45	0.12	0.23
Control Delay	9.1	29.2	25.7
Queue Delay	0.0	0.0	0.0
Total Delay	9.1	29.2	25.7
Queue Length 50th (m)	44.7	8.2	12.7
Queue Length 95th (m)	54.0	13.4	26.0
Internal Link Dist (m)	442.1	56.1	46.4
Turn Bay Length (m)			
Base Capacity (vph)	3154	398	438
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.45	0.12	0.23
Intersection Summary			
m Volume for 95th percentile queue is metered by upstream signal.			

HCM Signalized Intersection Capacity Analysis 161720 - 2028 Background AM Peak Hour.syn
7: Macklin Street South & King Street West










01/26/2017

	↖	→	↗	↙	←	↖	↗	↑	↙	↗	↓	↖
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↔↔↔			↔			↔	
Traffic Volume (vph)	0	0	0	48	1197	70	20	22	0	0	71	21
Future Volume (vph)	0	0	0	48	1197	70	20	22	0	0	71	21
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0			4.0			4.0	
Lane Util. Factor					0.91			1.00			1.00	
Frpb, ped/bikes					1.00			1.00			0.99	
Flpb, ped/bikes					1.00			0.98			1.00	
Frt					0.99			1.00			0.97	
Flt Protected					1.00			0.98			1.00	
Satd. Flow (prot)					4845			1660			1581	
Flt Permitted					1.00			0.87			1.00	
Satd. Flow (perm)					4845			1478			1581	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	52	1301	76	22	24	0	0	77	23
RTOR Reduction (vph)	0	0	0	0	6	0	0	0	0	0	11	0
Lane Group Flow (vph)	0	0	0	0	1423	0	0	46	0	0	89	0
Confl. Peds. (#/hr)	51		10	10		51	28		38	38		28
Heavy Vehicles (%)	0%	0%	0%	4%	6%	20%	14%	8%	0%	0%	12%	30%
Turn Type				Perm	NA		Perm	NA			NA	
Protected Phases					2			4			4	
Permitted Phases				2			4					
Actuated Green, G (s)					64.0			25.6			25.6	
Effective Green, g (s)					65.0			27.0			27.0	
Actuated g/C Ratio					0.65			0.27			0.27	
Clearance Time (s)					5.0			5.4			5.4	
Lane Grp Cap (vph)					3149			399			426	
v/s Ratio Prot											0.06	
v/s Ratio Perm					0.29			0.03				
v/c Ratio					0.45			0.12			0.21	
Uniform Delay, d1					8.7			27.5			28.2	
Progression Factor					1.00			1.03			1.00	
Incremental Delay, d2					0.5			0.5			1.1	
Delay (s)					9.1			28.7			29.4	
Level of Service					A			C			C	
Approach Delay (s)		0.0			9.1			28.7			29.4	
Approach LOS		A			A			C			C	
Intersection Summary												
HCM 2000 Control Delay					11.0						B	
HCM 2000 Volume to Capacity ratio					0.38							
Actuated Cycle Length (s)					100.0						8.0	
Intersection Capacity Utilization					55.0%						B	
Analysis Period (min)					15							
c Critical Lane Group												










HCM Unsignalized Intersection Capacity Analysis 161720 - 2028 Background AM Peak Hour.syn
8: Macklin Street South & Carling Street 01/26/2017

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	2	3	12	18	13	4	5	36	6	6	108	5
Future Volume (Veh/h)	2	3	12	18	13	4	5	36	6	6	108	5
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	3	13	20	14	4	5	39	7	7	117	5
Pedestrians		17			29			21			4	
Lane Width (m)		3.7			3.7			3.7			3.7	
Walking Speed (m/s)		1.1			1.1			1.1			1.1	
Percent Blockage		2			3			2			0	
Right turn flare (veh)												
Median type									None		None	
Median storage (veh)												
Upstream signal (m)									168		80	
pX, platoon unblocked	0.99	0.99	0.99	0.99	0.99		0.99					
vC, conflicting volume	218	236	158	250	234	76	139	75				
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	200	218	139	233	217	76	120	75				
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.3	4.1				
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.4	2.2				
p0 queue free %	100	100	99	97	98	100	100	100				
cM capacity (veh/h)	693	639	869	642	640	960	1322	1493				
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	18	38	51	129								
Volume Left	2	20	5	7								
Volume Right	13	4	7	5								
cSH	799	664	1322	1493								
Volume to Capacity	0.02	0.06	0.00	0.00								
Queue Length 95th (m)	0.5	1.4	0.1	0.1								
Control Delay (s)	9.6	10.7	0.8	0.4								
Lane LOS	A	B	A	A								
Approach Delay (s)	9.6	10.7	0.8	0.4								
Approach LOS	A	B										
Intersection Summary												
Average Delay	2.9											
Intersection Capacity Utilization	25.0%			ICU Level of Service					A			
Analysis Period (min)	15											

HCM Unsignalized Intersection Capacity Analysis 161720 - 2028 Background AM Peak Hour.syn
9: Driveway A & Carling Street 01/26/2017

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	13	3	0	26	8	2
Future Volume (Veh/h)	13	3	0	26	8	2
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	14	3	0	28	9	2
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			17		44	16
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			17		44	16
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	100
cM capacity (veh/h)			1600		967	1064
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	17	28	11			
Volume Left	0	0	9			
Volume Right	3	0	2			
cSH	1700	1600	983			
Volume to Capacity	0.01	0.00	0.01			
Queue Length 95th (m)	0.0	0.0	0.3			
Control Delay (s)	0.0	0.0	8.7			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	8.7			
Approach LOS			A			
Intersection Summary						
Average Delay			1.7			
Intersection Capacity Utilization			13.3%	ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis 161720 - 2028 Background AM Peak Hour.syn
10: Driveway B & Carling Street 01/26/2017

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	13	2	0	12	15	0
Future Volume (Veh/h)	13	2	0	12	15	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	14	2	0	13	16	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			16		28	15
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			16		28	15
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		98	100
cM capacity (veh/h)			1602		987	1065
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	16	13	16			
Volume Left	0	0	16			
Volume Right	2	0	0			
cSH	1700	1602	987			
Volume to Capacity	0.01	0.00	0.02			
Queue Length 95th (m)	0.0	0.0	0.4			
Control Delay (s)	0.0	0.0	8.7			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	8.7			
Approach LOS			A			
Intersection Summary						
Average Delay			3.1			
Intersection Capacity Utilization			13.3%	ICU Level of Service		A
Analysis Period (min)			15			

Queues 161720 - 2028 Background PM Peak Hour.syn
1: Hwy 403 NS Ramp & Main Street West 01/26/2017

	→	↘	↙	←	↖	↗
Lane Group	EBT	EBR	WBT	NBL	NBR	
Lane Group Flow (vph)	2250	739	1725	578	145	
v/c Ratio	0.79	0.63	0.88	0.82	0.36	
Control Delay	18.9	3.9	24.5	38.0	24.2	
Queue Delay	0.0	0.0	0.0	0.0	0.0	
Total Delay	18.9	3.9	24.5	38.0	24.2	
Queue Length 50th (m)	108.3	3.0	130.8	47.1	18.0	
Queue Length 95th (m)	128.3	18.6	166.3	#74.6	33.8	
Internal Link Dist (m)	243.1		438.7	39.5		
Turn Bay Length (m)	60.0					
Base Capacity (vph)	2847	1181	1962	706	406	
Starvation Cap Reductn	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	
Reduced v/c Ratio	0.79	0.63	0.88	0.82	0.36	
Intersection Summary						
#	95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.					











HCM Signalized Intersection Capacity Analysis 161720 - 2028 Background PM Peak Hour.syn
1: Hwy 403 NS Ramp & Main Street West 01/26/2017

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑	↑		↑↑	↑↑	↑
Traffic Volume (vph)	2070	680	0	1587	532	133
Future Volume (vph)	2070	680	0	1587	532	133
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.91	1.00		0.95	0.97	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.76
Flpb, ped/bikes	1.00	1.00		1.00	0.58	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	1.00	1.00		1.00	0.95	1.00
Satd. Flow (prot)	5142	1570		3544	1967	1125
Flt Permitted	1.00	1.00		1.00	0.95	1.00
Satd. Flow (perm)	5142	1570		3544	1967	1125
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2250	739	0	1725	578	145
RTOR Reduction (vph)	0	312	0	0	0	3
Lane Group Flow (vph)	2250	427	0	1725	578	142
Confl. Peds. (#/hr)					193	179
Heavy Vehicles (%)	2%	4%	0%	3%	4%	10%
Turn Type	NA	Perm		NA	Perm	Perm
Protected Phases	2			2		
Permitted Phases		2			4	4
Actuated Green, G (s)	48.7	48.7		48.7	31.3	31.3
Effective Green, g (s)	50.9	50.9		50.9	33.0	33.0
Actuated g/C Ratio	0.55	0.55		0.55	0.36	0.36
Clearance Time (s)	6.2	6.2		6.2	5.7	5.7
Lane Grp Cap (vph)	2847	869		1962	706	403
v/s Ratio Prot	0.44			c0.49		
v/s Ratio Perm		0.27			c0.29	0.13
v/c Ratio	0.79	0.49		0.88	0.82	0.35
Uniform Delay, d1	16.3	12.6		17.8	26.7	21.6
Progression Factor	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	2.3	2.0		6.0	10.2	2.4
Delay (s)	18.6	14.5		23.8	37.0	24.0
Level of Service	B	B		C	D	C
Approach Delay (s)	17.6			23.8	34.4	
Approach LOS	B			C	C	
Intersection Summary						
HCM 2000 Control Delay		21.8		HCM 2000 Level of Service		C
HCM 2000 Volume to Capacity ratio		0.87				
Actuated Cycle Length (s)		91.9		Sum of lost time (s)		9.7
Intersection Capacity Utilization		68.0%		ICU Level of Service		C
Analysis Period (min)		15				
c Critical Lane Group						




Queues 161720 - 2028 Background PM Peak Hour.syn
2: Main Street West & Macklin Street South 01/26/2017

	→	↘
Lane Group	EBT	SBL
Lane Group Flow (vph)	1859	133
v/c Ratio	0.58	0.25
Control Delay	13.6	33.4
Queue Delay	0.0	0.0
Total Delay	13.6	33.4
Queue Length 50th (m)	86.1	23.7
Queue Length 95th (m)	98.7	39.9
Internal Link Dist (m)	128.2	144.0
Turn Bay Length (m)		
Base Capacity (vph)	3219	531
Starvation Cap Reductn	0	0
Spillback Cap Reductn	0	0
Storage Cap Reductn	0	0
Reduced v/c Ratio	0.58	0.25
Intersection Summary		

HCM Signalized Intersection Capacity Analysis 161720 - 2028 Background PM Peak Hour.syn
2: Main Street West & Macklin Street South 01/26/2017

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		  				
Traffic Volume (vph)	75	1635	0	0	122	0
Future Volume (vph)	75	1635	0	0	122	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	
Lane Util. Factor		0.91			1.00	
Frpb, ped/bikes		1.00			1.00	
Flpb, ped/bikes		1.00			0.97	
Frt		1.00			1.00	
Flt Protected		1.00			0.95	
Satd. Flow (prot)		5083			1772	
Flt Permitted		1.00			0.95	
Satd. Flow (perm)		5083			1772	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	82	1777	0	0	133	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1859	0	0	133	0
Confl. Peds. (#/hr)	4				22	
Heavy Vehicles (%)	1%	3%	0%	0%	0%	0%
Turn Type	Perm	NA			Perm	
Protected Phases		2				
Permitted Phases	2				4	
Actuated Green, G (s)		74.3			34.3	
Effective Green, g (s)		76.0			36.0	
Actuated g/C Ratio		0.63			0.30	
Clearance Time (s)		5.7			5.7	
Lane Grp Cap (vph)		3219			531	
v/s Ratio Prot						
v/s Ratio Perm		0.37			c0.08	
v/c Ratio		0.58			0.25	
Uniform Delay, d1		12.7			31.8	
Progression Factor		1.00			1.00	
Incremental Delay, d2		0.8			1.1	
Delay (s)		13.5			32.9	
Level of Service		B			C	
Approach Delay (s)		13.5	0.0		32.9	
Approach LOS		B	A		C	
Intersection Summary						
HCM 2000 Control Delay		14.8			HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio		0.48				
Actuated Cycle Length (s)		120.0			Sum of lost time (s)	9.7
Intersection Capacity Utilization		52.3%			ICU Level of Service	A
Analysis Period (min)		15				
c Critical Lane Group						

Queues 161720 - 2028 Background PM Peak Hour.syn
7: Macklin Street South & King Street West 01/26/2017

			
Lane Group	WBT	NBT	SBT
Lane Group Flow (vph)	1461	63	81
v/c Ratio	0.44	0.16	0.17
Control Delay	8.6	30.1	21.1
Queue Delay	0.0	0.0	0.0
Total Delay	8.6	30.1	21.1
Queue Length 50th (m)	44.3	9.4	8.0
Queue Length 95th (m)	53.0	19.9	19.5
Internal Link Dist (m)	442.1	56.1	46.4
Turn Bay Length (m)			
Base Capacity (vph)	3302	384	466
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.44	0.16	0.17
Intersection Summary			

HCM Signalized Intersection Capacity Analysis 161720 - 2028 Background PM Peak Hour.syn
7: Macklin Street South & King Street West 01/26/2017

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	64	1230	50	43	15	0	0	48	27
Future Volume (vph)	0	0	0	64	1230	50	43	15	0	0	48	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0			4.0			4.0	
Lane Util. Factor					0.91			1.00			1.00	
Frpb, ped/bikes					1.00			1.00			0.99	
Flpb, ped/bikes					1.00			0.99			1.00	
Frt					0.99			1.00			0.95	
Flt Protected					1.00			0.96			1.00	
Satd. Flow (prot)					4998			1827			1715	
Flt Permitted					1.00			0.78			1.00	
Satd. Flow (perm)					4998			1478			1715	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	70	1337	54	47	16	0	0	52	29
RTOR Reduction (vph)	0	0	0	0	4	0	0	0	0	0	20	0
Lane Group Flow (vph)	0	0	0	0	1457	0	0	63	0	0	61	0
Confl. Peds. (#/hr)	51		5	5		51	12		31	31		12
Heavy Vehicles (%)	0%	0%	0%	2%	4%	0%	0%	0%	0%	0%	0%	15%
Turn Type				Perm	NA		Perm	NA			NA	
Protected Phases					2			4			4	
Permitted Phases				2			4					
Actuated Green, G (s)					65.0			24.6			24.6	
Effective Green, g (s)					66.0			26.0			26.0	
Actuated g/C Ratio					0.66			0.26			0.26	
Clearance Time (s)					5.0			5.4			5.4	
Lane Grp Cap (vph)					3298			384			445	
v/s Ratio Prot											0.04	
v/s Ratio Perm					0.29			0.04				
v/c Ratio					0.44			0.16			0.14	
Uniform Delay, d1					8.2			28.6			28.4	
Progression Factor					1.00			1.00			1.00	
Incremental Delay, d2					0.4			0.9			0.6	
Delay (s)					8.6			29.5			29.0	
Level of Service					A			C			C	
Approach Delay (s)		0.0			8.6			29.5			29.0	
Approach LOS		A			A			C			C	

Intersection Summary			
HCM 2000 Control Delay	10.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.36		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	55.0%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			










HCM Unsignalized Intersection Capacity Analysis 161720 - 2028 Background PM Peak Hour.syn
8: Macklin Street South & Carling Street 01/26/2017

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	4	7	15	11	1	4	11	49	15	13	97	3
Future Volume (Veh/h)	4	7	15	11	1	4	11	49	15	13	97	3
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	4	8	16	12	1	4	12	53	16	14	105	3
Pedestrians		13			24			14			8	
Lane Width (m)		3.7			3.7			3.7			3.7	
Walking Speed (m/s)		1.1			1.1			1.1			1.1	
Percent Blockage		1			2			1			1	
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (m)								168			80	
pX, platoon unblocked												
vC, conflicting volume	245	264	134	278	258	93	121			93		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	245	264	134	278	258	93	121			93		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	99	98	98	100	100	99			99		
cM capacity (veh/h)	667	610	897	610	615	939	1460			1479		










Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	28	17	81	122
Volume Left	4	12	12	14
Volume Right	16	4	16	3
cSH	758	665	1460	1479
Volume to Capacity	0.04	0.03	0.01	0.01
Queue Length 95th (m)	0.9	0.6	0.2	0.2
Control Delay (s)	9.9	10.6	1.2	0.9
Lane LOS	A	B	A	A
Approach Delay (s)	9.9	10.6	1.2	0.9
Approach LOS	A	B		

Intersection Summary			
Average Delay	2.7		
Intersection Capacity Utilization	23.9%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis 161720 - 2028 Background PM Peak Hour.syn
9: Driveway A & Carling Street 01/26/2017

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	28	6	0	9	6	13
Future Volume (Veh/h)	28	6	0	9	6	13
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	30	7	0	10	7	14
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			37		44	34
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			37		44	34
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	99
cM capacity (veh/h)			1574		967	1040
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	37	10	21			
Volume Left	0	0	7			
Volume Right	7	0	14			
cSH	1700	1574	1014			
Volume to Capacity	0.02	0.00	0.02			
Queue Length 95th (m)	0.0	0.0	0.5			
Control Delay (s)	0.0	0.0	8.6			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	8.6			
Approach LOS			A			
Intersection Summary						
Average Delay			2.7			
Intersection Capacity Utilization			13.3%	ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis 161720 - 2028 Background PM Peak Hour.syn
10: Driveway B & Carling Street 01/26/2017

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	33	8	0	4	5	0
Future Volume (Veh/h)	33	8	0	4	5	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	36	9	0	4	5	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			45		44	40
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			45		44	40
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	100
cM capacity (veh/h)			1563		966	1031
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	45	4	5			
Volume Left	0	0	5			
Volume Right	9	0	0			
cSH	1700	1563	966			
Volume to Capacity	0.03	0.00	0.01			
Queue Length 95th (m)	0.0	0.0	0.1			
Control Delay (s)	0.0	0.0	8.7			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	8.7			
Approach LOS			A			
Intersection Summary						
Average Delay			0.8			
Intersection Capacity Utilization		13.3%		ICU Level of Service		A
Analysis Period (min)			15			

Appendix F

Total Traffic Operations Reports



3: Hwy. 403 NE Ramp & Main Street West Performance by movement

Movement	EBT	NBR	All
Denied Del/Veh (s)	0.0	0.5	0.1
Total Del/Veh (s)	2.9	1.2	2.4

4: Main Street West & Hwy 403 SE Ramp Performance by movement

Movement	EBT	SBL	All
Denied Del/Veh (s)	0.0	0.7	0.1
Total Del/Veh (s)	0.6	1.0	0.7

5: King Street West & Hwy 403 NW Ramp Performance by movement

Movement	WBT	WBR	All
Denied Del/Veh (s)	0.3	0.7	0.4
Total Del/Veh (s)	0.4	4.6	2.0

6: Hwy 403 SW Ramp & King Street West Performance by movement

Movement	WBL	WBT	All
Denied Del/Veh (s)	0.0	0.0	0.0
Total Del/Veh (s)	3.0	0.3	1.1

Total Zone Performance

Denied Del/Veh (s)		0.5
Total Del/Veh (s)		59.5

3: Hwy. 403 NE Ramp & Main Street West Performance by movement

Movement	EBT	NBR	All
Denied Del/Veh (s)	0.0	0.5	0.1
Total Del/Veh (s)	2.9	1.3	2.4

4: Main Street West & Hwy 403 SE Ramp Performance by movement

Movement	EBT	SBL	All
Denied Del/Veh (s)	0.0	0.9	0.2
Total Del/Veh (s)	0.7	2.0	1.0

5: King Street West & Hwy 403 NW Ramp Performance by movement

Movement	WBT	WBR	All
Denied Del/Veh (s)	1.4	1.7	1.5
Total Del/Veh (s)	2.0	6.7	3.5

6: Hwy 403 SW Ramp & King Street West Performance by movement

Movement	WBL	WBT	All
Denied Del/Veh (s)	0.0	0.0	0.0
Total Del/Veh (s)	5.4	0.4	2.8

Total Zone Performance

Denied Del/Veh (s)		1.3
Total Del/Veh (s)		152.8

Queues
1: Hwy 403 NS Ramp & Main Street West

161720 - 2018 Total AM Peak Hour.syn
01/26/2017

	→	↘	←	↙	↗
Lane Group	EBT	EBR	WBT	NBL	NBR
Lane Group Flow (vph)	2047	424	1635	973	239
v/c Ratio	0.88	0.48	1.00	1.03	0.52
Control Delay	27.7	4.9	46.9	63.2	23.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	27.7	4.9	46.9	63.2	23.0
Queue Length 50th (m)	115.4	5.4	146.1	~95.5	29.1
Queue Length 95th (m)	137.3	23.2	#200.2	#132.3	51.5
Internal Link Dist (m)	243.1		438.7	39.5	
Turn Bay Length (m)		60.0			
Base Capacity (vph)	2337	875	1642	947	461
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.88	0.48	1.00	1.03	0.52

Intersection Summary

- ~ 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.

HCM Signalized Intersection Capacity Analysis
1: Hwy 403 NS Ramp & Main Street West

161720 - 2018 Total AM Peak Hour.syn
01/26/2017

	→	↘	↙	←	↗	↘
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑	↑		↑↑	↑↑	↑
Traffic Volume (vph)	1883	390	0	1504	895	220
Future Volume (vph)	1883	390	0	1504	895	220
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.91	1.00		0.95	0.97	1.00
Frpb, ped/bikes	1.00	0.96		1.00	1.00	0.66
Flpb, ped/bikes	1.00	1.00		1.00	0.62	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	1.00	1.00		1.00	0.95	1.00
Satd. Flow (prot)	5043	1464		3544	2108	1025
Flt Permitted	1.00	1.00		1.00	0.95	1.00
Satd. Flow (perm)	5043	1464		3544	2108	1025
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2047	424	0	1635	973	239
RTOR Reduction (vph)	0	197	0	0	0	1
Lane Group Flow (vph)	2047	227	0	1635	973	238
Confl. Peds. (#/hr)	13		13		174	363
Heavy Vehicles (%)	4%	7%	0%	3%	4%	5%
Turn Type	NA	Perm		NA	Perm	Perm
Protected Phases	2			2		
Permitted Phases		2			4	4
Actuated Green, G (s)	40.4	40.4		40.4	39.6	39.6
Effective Green, g (s)	42.6	42.6		42.6	41.3	41.3
Actuated g/C Ratio	0.46	0.46		0.46	0.45	0.45
Clearance Time (s)	6.2	6.2		6.2	5.7	5.7
Lane Grp Cap (vph)	2337	678		1642	947	460
v/s Ratio Prot	0.41			c0.46		
v/s Ratio Perm		0.16			c0.46	0.23
v/c Ratio	0.88	0.33		1.00	1.03	0.52
Uniform Delay, d1	22.3	15.7		24.6	25.3	18.1
Progression Factor	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	5.0	1.3		21.2	36.5	4.1
Delay (s)	27.3	17.0		45.8	61.8	22.3
Level of Service	C	B		D	E	C
Approach Delay (s)	25.5			45.8	54.0	
Approach LOS	C			D	D	

Intersection Summary

HCM 2000 Control Delay	38.2	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.03		
Actuated Cycle Length (s)	91.9	Sum of lost time (s)	9.7
Intersection Capacity Utilization	73.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Queues

2: Main Street West & Macklin Street South

161720 - 2018 Total AM Peak Hour.syn

01/26/2017

	→	↘
Lane Group	EBT	SBL
Lane Group Flow (vph)	1907	168
v/c Ratio	0.64	0.31
Control Delay	14.3	22.6
Queue Delay	0.0	0.0
Total Delay	14.3	22.6
Queue Length 50th (m)	81.9	19.5
Queue Length 95th (m)	96.5	31.1
Internal Link Dist (m)	128.2	144.0
Turn Bay Length (m)		
Base Capacity (vph)	2958	545
Starvation Cap Reductn	0	0
Spillback Cap Reductn	0	0
Storage Cap Reductn	0	0
Reduced v/c Ratio	0.64	0.31

Intersection Summary

HCM Signalized Intersection Capacity Analysis

2: Main Street West & Macklin Street South

161720 - 2018 Total AM Peak Hour.syn

01/26/2017

	↖	→	←	↗	↘	↙
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔↔↔			↖	
Traffic Volume (vph)	52	1702	0	0	155	0
Future Volume (vph)	52	1702	0	0	155	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	
Lane Util. Factor		0.91			1.00	
Flpb, ped/bikes		1.00			1.00	
Flpb, ped/bikes		1.00			1.00	
Frt		1.00			1.00	
Flt Protected		1.00			0.95	
Satd. Flow (prot)		4927			1706	
Flt Permitted		1.00			0.95	
Satd. Flow (perm)		4927			1706	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	57	1850	0	0	168	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1907	0	0	168	0
Confl. Peds. (#/hr)		16				
Heavy Vehicles (%)	13%	6%	0%	0%	7%	0%
Turn Type	Perm	NA			Perm	
Protected Phases		2				
Permitted Phases	2				4	
Actuated Green, G (s)		58.3			30.3	
Effective Green, g (s)		60.0			32.0	
Actuated g/C Ratio		0.60			0.32	
Clearance Time (s)		5.7			5.7	
Lane Grp Cap (vph)		2956			545	
v/s Ratio Prot						
v/s Ratio Perm		0.39			0.10	
v/c Ratio		0.65			0.31	
Uniform Delay, d1		13.1			25.7	
Progression Factor		1.00			0.81	
Incremental Delay, d2		1.1			1.4	
Delay (s)		14.2			22.2	
Level of Service		B			C	
Approach Delay (s)		14.2	0.0		22.2	
Approach LOS		B	A		C	

Intersection Summary

HCM 2000 Control Delay	14.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	9.7
Intersection Capacity Utilization	53.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Queues
7: Macklin Street South & King Street West

161720 - 2018 Total AM Peak Hour.syn
01/26/2017

















	←	↑	↓
Lane Group	WBT	NBT	SBT
Lane Group Flow (vph)	1378	47	97
v/c Ratio	0.44	0.12	0.22
Control Delay	9.0	29.7	25.8
Queue Delay	0.0	0.0	0.0
Total Delay	9.0	29.7	25.8
Queue Length 50th (m)	42.6	8.3	12.4
Queue Length 95th (m)	51.5	14.3	25.4
Internal Link Dist (m)	442.1	56.1	46.4
Turn Bay Length (m)			
Base Capacity (vph)	3154	393	437
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.44	0.12	0.22
Intersection Summary			
m Volume for 95th percentile queue is metered by upstream signal.			

HCM Signalized Intersection Capacity Analysis
7: Macklin Street South & King Street West










161720 - 2018 Total AM Peak Hour.syn
01/26/2017

	↖	→	↗	↙	←	↖	↗	↑	↙	↗	↓	↖
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↔↔↔			↔			↔	
Traffic Volume (vph)	0	0	0	50	1151	67	22	21	0	0	69	20
Future Volume (vph)	0	0	0	50	1151	67	22	21	0	0	69	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0			4.0			4.0	
Lane Util. Factor					0.91			1.00			1.00	
Flpb, ped/bikes					1.00			1.00			0.99	
Flpb, ped/bikes					1.00			0.98			1.00	
Frt					0.99			1.00			0.97	
Flt Protected					1.00			0.98			1.00	
Satd. Flow (prot)					4845			1652			1583	
Flt Permitted					1.00			0.86			1.00	
Satd. Flow (perm)					4845			1457			1583	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	54	1251	73	24	23	0	0	75	22
RTOR Reduction (vph)	0	0	0	0	6	0	0	0	0	0	10	0
Lane Group Flow (vph)	0	0	0	0	1372	0	0	47	0	0	87	0
Confl. Peds. (#/hr)	51		10	10		51	28		38	38		28
Heavy Vehicles (%)	0%	0%	0%	4%	6%	20%	14%	8%	0%	0%	12%	30%
Turn Type				Perm	NA		Perm	NA			NA	
Protected Phases					2			4			4	
Permitted Phases				2			4					
Actuated Green, G (s)					64.0			25.6			25.6	
Effective Green, g (s)					65.0			27.0			27.0	
Actuated g/C Ratio					0.65			0.27			0.27	
Clearance Time (s)					5.0			5.4			5.4	
Lane Grp Cap (vph)					3149			393			427	
v/s Ratio Prot											c0.05	
v/s Ratio Perm					0.28			0.03				
v/c Ratio					0.44			0.12			0.20	
Uniform Delay, d1					8.5			27.5			28.2	
Progression Factor					1.00			1.04			1.00	
Incremental Delay, d2					0.4			0.5			1.1	
Delay (s)					9.0			29.1			29.3	
Level of Service					A			C			C	
Approach Delay (s)		0.0			9.0			29.1			29.3	
Approach LOS		A			A			C			C	
Intersection Summary												
HCM 2000 Control Delay					10.9						B	
HCM 2000 Volume to Capacity ratio					0.37							
Actuated Cycle Length (s)					100.0						8.0	
Intersection Capacity Utilization					55.0%						B	
Analysis Period (min)					15							
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis 161720 - 2018 Total AM Peak Hour.syn
8: Macklin Street South & Carling Street 01/26/2017










												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	2	3	11	40	20	7	5	34	13	10	104	5
Future Volume (Veh/h)	2	3	11	40	20	7	5	34	13	10	104	5
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	3	12	43	22	8	5	37	14	11	113	5
Pedestrians		17			29			21			4	
Lane Width (m)		3.7			3.7			3.7			3.7	
Walking Speed (m/s)		1.1			1.1			1.1			1.1	
Percent Blockage		2			3			2			0	
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (m)								168			80	
pX, platoon unblocked	0.99	0.99	0.99	0.99	0.99		0.99					
vC, conflicting volume	232	244	154	255	240	77	135			80		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	215	228	136	239	224	77	118			80		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.3			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.4			2.2		
p0 queue free %	100	100	99	93	97	99	100			99		
cM capacity (veh/h)	667	629	873	636	633	958	1327			1487		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	17	73	56	129								
Volume Left	2	43	5	11								
Volume Right	12	8	14	5								
cSH	790	659	1327	1487								
Volume to Capacity	0.02	0.11	0.00	0.01								
Queue Length 95th (m)	0.5	2.8	0.1	0.2								
Control Delay (s)	9.7	11.1	0.7	0.7								
Lane LOS	A	B	A	A								
Approach Delay (s)	9.7	11.1	0.7	0.7								
Approach LOS	A	B										
Intersection Summary												
Average Delay	4.0											
Intersection Capacity Utilization	27.8%			ICU Level of Service			A					
Analysis Period (min)	15											

HCM Unsignalized Intersection Capacity Analysis 161720 - 2018 Total AM Peak Hour.syn
9: Driveway A & Carling Street 01/26/2017

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	23	3	0	59	8	2
Future Volume (Veh/h)	23	3	0	59	8	2
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	25	3	0	64	9	2
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			28		90	26
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			28		90	26
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	100
cM capacity (veh/h)			1585		910	1049
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	28	64	11			
Volume Left	0	0	9			
Volume Right	3	0	2			
cSH	1700	1585	932			
Volume to Capacity	0.02	0.00	0.01			
Queue Length 95th (m)	0.0	0.0	0.3			
Control Delay (s)	0.0	0.0	8.9			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	8.9			
Approach LOS			A			
Intersection Summary						
Average Delay			1.0			
Intersection Capacity Utilization			13.3%	ICU Level of Service		A
Analysis Period (min)			15			




HCM Unsignalized Intersection Capacity Analysis
10: Driveway B & Carling Street

161720 - 2018 Total AM Peak Hour.syn
01/26/2017

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	14	11	0	16	43	0
Future Volume (Veh/h)	14	11	0	16	43	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	15	12	0	17	47	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None		None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			27		38	21
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			27		38	21
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		95	100
cM capacity (veh/h)			1587		974	1056
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	27	17	47			
Volume Left	0	0	47			
Volume Right	12	0	0			
cSH	1700	1587	974			
Volume to Capacity	0.02	0.00	0.05			
Queue Length 95th (m)	0.0	0.0	1.2			
Control Delay (s)	0.0	0.0	8.9			
Lane LOS	A					
Approach Delay (s)	0.0	0.0	8.9			
Approach LOS	A					
Intersection Summary						
Average Delay			4.6			
Intersection Capacity Utilization			13.3%	ICU Level of Service	A	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
11: Driveway C & Carling Street

161720 - 2018 Total AM Peak Hour.syn
01/26/2017

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	12	0	0	11	5	0
Future Volume (Veh/h)	12	0	0	11	5	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	13	0	0	12	5	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			13		25	13
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			13		25	13
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	100
cM capacity (veh/h)			1606		991	1067
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	13	12	5			
Volume Left	0	0	5			
Volume Right	0	0	0			
cSH	1700	1606	991			
Volume to Capacity	0.01	0.00	0.01			
Queue Length 95th (m)	0.0	0.0	0.1			
Control Delay (s)	0.0	0.0	8.7			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	8.7			
Approach LOS			A			
Intersection Summary						
Average Delay			1.4			
Intersection Capacity Utilization			13.3%	ICU Level of Service		A
Analysis Period (min)			15			







Queues
1: Hwy 403 NS Ramp & Main Street West

161720 - 2018 Total PM Peak Hour.syn
01/26/2017

	→	↘	←	↙	↗
Lane Group	EBT	EBR	WBT	NBL	NBR
Lane Group Flow (vph)	2132	711	1522	557	129
v/c Ratio	0.78	0.62	0.81	0.74	0.30
Control Delay	19.7	3.9	21.9	31.9	21.7
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	19.7	3.9	21.9	31.9	21.7
Queue Length 50th (m)	104.2	2.7	109.6	43.0	15.1
Queue Length 95th (m)	123.4	18.9	139.4	62.8	29.0
Internal Link Dist (m)	243.1		438.7	39.5	
Turn Bay Length (m)		60.0			
Base Capacity (vph)	2736	1152	1885	749	430
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.78	0.62	0.81	0.74	0.30
Intersection Summary					

HCM Signalized Intersection Capacity Analysis
1: Hwy 403 NS Ramp & Main Street West

161720 - 2018 Total PM Peak Hour.syn
01/26/2017

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑	↑		↑↑	↑↑	↑
Traffic Volume (vph)	1961	654	0	1400	512	119
Future Volume (vph)	1961	654	0	1400	512	119
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.91	1.00		0.95	0.97	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.76
Flpb, ped/bikes	1.00	1.00		1.00	0.58	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	1.00	1.00		1.00	0.95	1.00
Satd. Flow (prot)	5142	1570		3544	1967	1125
Flt Permitted	1.00	1.00		1.00	0.95	1.00
Satd. Flow (perm)	5142	1570		3544	1967	1125
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2132	711	0	1522	557	129
RTOR Reduction (vph)	0	317	0	0	0	2
Lane Group Flow (vph)	2132	394	0	1522	557	127
Confl. Peds. (#/hr)					193	179
Heavy Vehicles (%)	2%	4%	0%	3%	4%	10%
Turn Type	NA	Perm		NA	Perm	Perm
Protected Phases	2			2		
Permitted Phases		2			4	4
Actuated Green, G (s)	46.7	46.7		46.7	33.3	33.3
Effective Green, g (s)	48.9	48.9		48.9	35.0	35.0
Actuated g/C Ratio	0.53	0.53		0.53	0.38	0.38
Clearance Time (s)	6.2	6.2		6.2	5.7	5.7
Lane Grp Cap (vph)	2736	835		1885	749	428
v/s Ratio Prot	0.41			c0.43		
v/s Ratio Perm		0.25			c0.28	0.11
v/c Ratio	0.78	0.47		0.81	0.74	0.30
Uniform Delay, d1	17.2	13.4		17.6	24.6	19.8
Progression Factor	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	2.3	1.9		3.8	6.6	1.8
Delay (s)	19.5	15.3		21.5	31.2	21.6
Level of Service	B	B		C	C	C
Approach Delay (s)	18.4			21.5	29.4	
Approach LOS	B			C	C	
Intersection Summary						
HCM 2000 Control Delay	20.8			HCM 2000 Level of Service		C
HCM 2000 Volume to Capacity ratio	0.80					
Actuated Cycle Length (s)	91.9			Sum of lost time (s)		9.7
Intersection Capacity Utilization	62.9%			ICU Level of Service		B
Analysis Period (min)	15					
c Critical Lane Group						

Queues
2: Main Street West & Macklin Street South

161720 - 2018 Total PM Peak Hour.syn
01/26/2017

	→	↘
Lane Group	EBT	SBL
Lane Group Flow (vph)	1735	145
v/c Ratio	0.54	0.27
Control Delay	13.0	33.8
Queue Delay	0.0	0.0
Total Delay	13.0	33.8
Queue Length 50th (m)	77.4	26.0
Queue Length 95th (m)	89.2	43.1
Internal Link Dist (m)	128.2	144.0
Turn Bay Length (m)		
Base Capacity (vph)	3217	531
Starvation Cap Reductn	0	0
Spillback Cap Reductn	0	0
Storage Cap Reductn	0	0
Reduced v/c Ratio	0.54	0.27
Intersection Summary		

HCM Signalized Intersection Capacity Analysis
2: Main Street West & Macklin Street South

161720 - 2018 Total PM Peak Hour.syn
01/26/2017

	↙	→	←	↗	↘	↙
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔↔↔			↔	
Traffic Volume (vph)	94	1502	0	0	133	0
Future Volume (vph)	94	1502	0	0	133	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	
Lane Util. Factor		0.91			1.00	
Flpb, ped/bikes		1.00			1.00	
Flpb, ped/bikes		1.00			0.97	
Frt		1.00			1.00	
Flt Protected		1.00			0.95	
Satd. Flow (prot)		5081			1772	
Flt Permitted		1.00			0.95	
Satd. Flow (perm)		5081			1772	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	102	1633	0	0	145	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1735	0	0	145	0
Confl. Peds. (#/hr)		4			22	
Heavy Vehicles (%)	1%	3%	0%	0%	0%	0%
Turn Type	Perm	NA			Perm	
Protected Phases		2				
Permitted Phases	2				4	
Actuated Green, G (s)		74.3			34.3	
Effective Green, g (s)		76.0			36.0	
Actuated g/C Ratio		0.63			0.30	
Clearance Time (s)		5.7			5.7	
Lane Grp Cap (vph)		3217			531	
v/s Ratio Prot						
v/s Ratio Perm		0.34			0.08	
v/c Ratio		0.54			0.27	
Uniform Delay, d1		12.3			32.0	
Progression Factor		1.00			1.00	
Incremental Delay, d2		0.7			1.3	
Delay (s)		12.9			33.3	
Level of Service		B			C	
Approach Delay (s)		12.9	0.0		33.3	
Approach LOS		B	A		C	
Intersection Summary						
HCM 2000 Control Delay		14.5			HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio		0.46				
Actuated Cycle Length (s)		120.0			Sum of lost time (s)	9.7
Intersection Capacity Utilization		50.1%			ICU Level of Service	A
Analysis Period (min)		15				
c Critical Lane Group						

Queues
7: Macklin Street South & King Street West

161720 - 2018 Total PM Peak Hour.syn
01/26/2017

















	←	↑	↓
Lane Group	WBT	NBT	SBT
Lane Group Flow (vph)	1423	62	78
v/c Ratio	0.43	0.16	0.17
Control Delay	8.5	30.1	20.9
Queue Delay	0.0	0.0	0.0
Total Delay	8.5	30.1	20.9
Queue Length 50th (m)	42.6	9.3	7.6
Queue Length 95th (m)	51.3	19.8	18.9
Internal Link Dist (m)	442.1	56.1	46.4
Turn Bay Length (m)			
Base Capacity (vph)	3302	383	466
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.43	0.16	0.17
Intersection Summary			

HCM Signalized Intersection Capacity Analysis
7: Macklin Street South & King Street West









161720 - 2018 Total PM Peak Hour.syn
01/26/2017

	↖	→	↗	↙	←	↖	↗	↑	↙	↗	↓	↖
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↔↔↔			↔			↔	
Traffic Volume (vph)	0	0	0	77	1184	48	43	14	0	0	46	26
Future Volume (vph)	0	0	0	77	1184	48	43	14	0	0	46	26
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0			4.0			4.0	
Lane Util. Factor					0.91			1.00			1.00	
Flpb, ped/bikes					1.00			1.00			0.99	
Flpb, ped/bikes					1.00			0.99			1.00	
Frt					0.99			1.00			0.95	
Flt Protected					1.00			0.96			1.00	
Satd. Flow (prot)					4996			1826			1715	
Flt Permitted					1.00			0.78			1.00	
Satd. Flow (perm)					4996			1476			1715	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	84	1287	52	47	15	0	0	50	28
RTOR Reduction (vph)	0	0	0	0	4	0	0	0	0	0	20	0
Lane Group Flow (vph)	0	0	0	0	1419	0	0	62	0	0	58	0
Confl. Peds. (#/hr)	51		5	5		51	12		31	31		12
Heavy Vehicles (%)	0%	0%	0%	2%	4%	0%	0%	0%	0%	0%	0%	15%
Turn Type				Perm	NA		Perm	NA			NA	
Protected Phases					2			4			4	
Permitted Phases				2			4					
Actuated Green, G (s)					65.0			24.6			24.6	
Effective Green, g (s)					66.0			26.0			26.0	
Actuated g/C Ratio					0.66			0.26			0.26	
Clearance Time (s)					5.0			5.4			5.4	
Lane Grp Cap (vph)					3297			383			445	
v/s Ratio Prot											0.03	
v/s Ratio Perm					0.28			c0.04				
v/c Ratio					0.43			0.16			0.13	
Uniform Delay, d1					8.1			28.6			28.3	
Progression Factor					1.00			1.00			1.00	
Incremental Delay, d2					0.4			0.9			0.6	
Delay (s)					8.5			29.5			28.9	
Level of Service					A			C			C	
Approach Delay (s)		0.0			8.5			29.5			28.9	
Approach LOS		A			A			C			C	
Intersection Summary												
HCM 2000 Control Delay					10.3						B	
HCM 2000 Volume to Capacity ratio					0.35							
Actuated Cycle Length (s)					100.0			Sum of lost time (s)			8.0	
Intersection Capacity Utilization					55.0%			ICU Level of Service			B	
Analysis Period (min)					15							
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis 161720 - 2018 Total PM Peak Hour.syn
8: Macklin Street South & Carling Street 01/26/2017

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	4	7	14	26	7	6	10	47	36	27	93	3
Future Volume (Veh/h)	4	7	14	26	7	6	10	47	36	27	93	3
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	4	8	15	28	8	7	11	51	39	29	101	3
Pedestrians		13			24			14			8	
Lane Width (m)		3.7			3.7			3.7			3.7	
Walking Speed (m/s)		1.1			1.1			1.1			1.1	
Percent Blockage		1			2			1			1	
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (m)								168			80	
pX, platoon unblocked												
vC, conflicting volume	285	310	130	310	292	102	117			114		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	285	310	130	310	292	102	117			114		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	99	98	95	99	99	99			98		
cM capacity (veh/h)	615	570	901	577	584	928	1465			1453		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	27	43	101	133								
Volume Left	4	28	11	29								
Volume Right	15	7	39	3								
cSH	726	616	1465	1453								
Volume to Capacity	0.04	0.07	0.01	0.02								
Queue Length 95th (m)	0.9	1.7	0.2	0.5								
Control Delay (s)	10.1	11.3	0.9	1.8								
Lane LOS	B	B	A	A								
Approach Delay (s)	10.1	11.3	0.9	1.8								
Approach LOS	B	B										
Intersection Summary												
Average Delay			3.6									
Intersection Capacity Utilization			27.3%		ICU Level of Service					A		
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis 161720 - 2018 Total PM Peak Hour.syn
9: Driveway A & Carling Street 01/26/2017

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	64	6	0	33	6	12
Future Volume (Veh/h)	64	6	0	33	6	12
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	70	7	0	36	7	13
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None		None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			77		110	74
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			77		110	74
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	99
cM capacity (veh/h)			1522		888	988
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	77	36	20			
Volume Left	0	0	7			
Volume Right	7	0	13			
cSH	1700	1522	951			
Volume to Capacity	0.05	0.00	0.02			
Queue Length 95th (m)	0.0	0.0	0.5			
Control Delay (s)	0.0	0.0	8.9			
Lane LOS	A					
Approach Delay (s)	0.0	0.0	8.9			
Approach LOS	A					
Intersection Summary						
Average Delay			1.3			
Intersection Capacity Utilization			13.7%	ICU Level of Service	A	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
10: Driveway B & Carling Street

161720 - 2018 Total PM Peak Hour.syn
01/26/2017

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↘			↘	↘	
Traffic Volume (veh/h)	37	39	0	8	25	0
Future Volume (Veh/h)	37	39	0	8	25	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	40	42	0	9	27	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			82		70	61
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			82		70	61
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		97	100
cM capacity (veh/h)			1515		934	1004
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	82	9	27			
Volume Left	0	0	27			
Volume Right	42	0	0			
cSH	1700	1515	934			
Volume to Capacity	0.05	0.00	0.03			
Queue Length 95th (m)	0.0	0.0	0.7			
Control Delay (s)	0.0	0.0	9.0			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	9.0			
Approach LOS			A			
Intersection Summary						
Average Delay			2.1			
Intersection Capacity Utilization			14.3%	ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
11: Driveway C & Carling Street

161720 - 2018 Total PM Peak Hour.syn
01/26/2017

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↘			↘	↘	
Traffic Volume (veh/h)	31	6	0	5	4	0
Future Volume (Veh/h)	31	6	0	5	4	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	34	7	0	5	4	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			41		42	38
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			41		42	38
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			1568		968	1035
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	41	5	4			
Volume Left	0	0	4			
Volume Right	7	0	0			
cSH	1700	1568	968			
Volume to Capacity	0.02	0.00	0.00			
Queue Length 95th (m)	0.0	0.0	0.1			
Control Delay (s)	0.0	0.0	8.7			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	8.7			
Approach LOS			A			
Intersection Summary						
Average Delay			0.7			
Intersection Capacity Utilization			13.3%	ICU Level of Service		A
Analysis Period (min)			15			

3: Hwy. 403 NE Ramp & Main Street West Performance by movement

Movement	EBT	NBR	All
Denied Del/Veh (s)	0.0	0.7	0.2
Total Del/Veh (s)	3.4	1.5	2.9

4: Main Street West & Hwy 403 SE Ramp Performance by movement

Movement	EBT	SBL	All
Denied Del/Veh (s)	0.0	0.4	0.1
Total Del/Veh (s)	0.7	1.0	0.7

5: King Street West & Hwy 403 NW Ramp Performance by movement

Movement	WBT	WBR	All
Denied Del/Veh (s)	0.2	0.5	0.3
Total Del/Veh (s)	0.5	4.0	1.8

6: Hwy 403 SW Ramp & King Street West Performance by movement

Movement	WBL	WBT	All
Denied Del/Veh (s)	0.0	0.0	0.0
Total Del/Veh (s)	2.8	0.3	1.0

Total Zone Performance

Denied Del/Veh (s)		0.4
Total Del/Veh (s)		39.5

3: Hwy. 403 NE Ramp & Main Street West Performance by movement

Movement	EBT	NBR	All
Denied Del/Veh (s)	0.0	0.5	0.1
Total Del/Veh (s)	2.8	1.2	2.4

4: Main Street West & Hwy 403 SE Ramp Performance by movement

Movement	EBT	SBL	All
Denied Del/Veh (s)	0.0	0.7	0.2
Total Del/Veh (s)	0.5	1.2	0.7

5: King Street West & Hwy 403 NW Ramp Performance by movement

Movement	WBT	WBR	All
Denied Del/Veh (s)	1.4	1.7	1.5
Total Del/Veh (s)	2.0	6.0	3.4

6: Hwy 403 SW Ramp & King Street West Performance by movement

Movement	WBL	WBT	All
Denied Del/Veh (s)	0.0	0.0	0.0
Total Del/Veh (s)	5.0	0.3	2.4

Total Zone Performance

Denied Del/Veh (s)		1.3
Total Del/Veh (s)		128.0

Queues
1: Hwy 403 NS Ramp & Main Street West

161720 - 2023 Total AM Peak Hour.syn
01/26/2017

	→	↘	←	↙	↗
Lane Group	EBT	EBR	WBT	NBL	NBR
Lane Group Flow (vph)	2173	436	1689	1001	278
v/c Ratio	0.92	0.50	1.02	1.06	0.61
Control Delay	31.1	5.5	53.2	75.0	26.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	31.1	5.5	53.2	75.0	26.3
Queue Length 50th (m)	127.1	7.5	~160.4	~101.5	36.0
Queue Length 95th (m)	#155.1	27.0	#209.8	#138.5	63.4
Internal Link Dist (m)	243.1		438.7	39.5	
Turn Bay Length (m)		60.0			
Base Capacity (vph)	2354	874	1654	940	457
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.92	0.50	1.02	1.06	0.61

Intersection Summary

- ~ 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.

HCM Signalized Intersection Capacity Analysis
1: Hwy 403 NS Ramp & Main Street West

161720 - 2023 Total AM Peak Hour.syn
01/26/2017

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑	↑		↑↑	↑	↑
Traffic Volume (vph)	1999	401	0	1554	921	256
Future Volume (vph)	1999	401	0	1554	921	256
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.91	1.00		0.95	0.97	1.00
Frpb, ped/bikes	1.00	0.96		1.00	1.00	0.66
Flpb, ped/bikes	1.00	1.00		1.00	0.62	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	1.00	1.00		1.00	0.95	1.00
Satd. Flow (prot)	5043	1464		3544	2108	1025
Flt Permitted	1.00	1.00		1.00	0.95	1.00
Satd. Flow (perm)	5043	1464		3544	2108	1025
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2173	436	0	1689	1001	278
RTOR Reduction (vph)	0	191	0	0	0	1
Lane Group Flow (vph)	2173	245	0	1689	1001	277
Confl. Peds. (#/hr)	13		13		174	363
Heavy Vehicles (%)	4%	7%	0%	3%	4%	5%
Turn Type	NA	Perm		NA	Perm	Perm
Protected Phases	2			2		
Permitted Phases		2			4	4
Actuated Green, G (s)	40.7	40.7		40.7	39.3	39.3
Effective Green, g (s)	42.9	42.9		42.9	41.0	41.0
Actuated g/C Ratio	0.47	0.47		0.47	0.45	0.45
Clearance Time (s)	6.2	6.2		6.2	5.7	5.7
Lane Grp Cap (vph)	2354	683		1654	940	457
v/s Ratio Prot	0.43			c0.48		
v/s Ratio Perm		0.17			c0.47	0.27
v/c Ratio	0.92	0.36		1.02	1.06	0.61
Uniform Delay, d1	23.0	15.7		24.5	25.5	19.3
Progression Factor	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	7.5	1.5		27.6	48.2	5.9
Delay (s)	30.5	17.2		52.1	73.7	25.2
Level of Service	C	B		D	E	C
Approach Delay (s)	28.3			52.1	63.1	
Approach LOS	C			D	E	

Intersection Summary

HCM 2000 Control Delay	43.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.06		
Actuated Cycle Length (s)	91.9	Sum of lost time (s)	9.7
Intersection Capacity Utilization	75.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Queues
2: Main Street West & Macklin Street South

161720 - 2023 Total AM Peak Hour.syn
01/26/2017

Lane Group	EBT	SBL
Lane Group Flow (vph)	1970	173
v/c Ratio	0.67	0.32
Control Delay	14.7	22.8
Queue Delay	0.0	0.0
Total Delay	14.7	22.8
Queue Length 50th (m)	86.3	20.2
Queue Length 95th (m)	101.6	32.4
Internal Link Dist (m)	128.2	144.0
Turn Bay Length (m)		
Base Capacity (vph)	2957	545
Starvation Cap Reductn	0	0
Spillback Cap Reductn	0	0
Storage Cap Reductn	0	0
Reduced v/c Ratio	0.67	0.32
Intersection Summary		

HCM Signalized Intersection Capacity Analysis
2: Main Street West & Macklin Street South

161720 - 2023 Total AM Peak Hour.syn
01/26/2017

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔↔↔			↔	
Traffic Volume (vph)	54	1758	0	0	159	0
Future Volume (vph)	54	1758	0	0	159	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	
Lane Util. Factor		0.91			1.00	
Flpb, ped/bikes		1.00			1.00	
Flpb, ped/bikes		1.00			1.00	
Frt		1.00			1.00	
Flt Protected		1.00			0.95	
Satd. Flow (prot)		4927			1706	
Flt Permitted		1.00			0.95	
Satd. Flow (perm)		4927			1706	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	59	1911	0	0	173	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1970	0	0	173	0
Confl. Peds. (#/hr)		16				
Heavy Vehicles (%)	13%	6%	0%	0%	7%	0%
Turn Type	Perm	NA			Perm	
Protected Phases		2				
Permitted Phases	2				4	
Actuated Green, G (s)		58.3			30.3	
Effective Green, g (s)		60.0			32.0	
Actuated g/C Ratio		0.60			0.32	
Clearance Time (s)		5.7			5.7	
Lane Grp Cap (vph)		2956			545	
v/s Ratio Prot						
v/s Ratio Perm		0.40			0.10	
v/c Ratio		0.67			0.32	
Uniform Delay, d1		13.3			25.7	
Progression Factor		1.00			0.81	
Incremental Delay, d2		1.2			1.5	
Delay (s)		14.5			22.4	
Level of Service		B			C	
Approach Delay (s)		14.5	0.0		22.4	
Approach LOS		B	A		C	
Intersection Summary						
HCM 2000 Control Delay		15.2			HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio		0.56				
Actuated Cycle Length (s)		100.0			Sum of lost time (s)	9.7
Intersection Capacity Utilization		54.2%			ICU Level of Service	A
Analysis Period (min)		15				
c Critical Lane Group						

Queues
7: Macklin Street South & King Street West

161720 - 2023 Total AM Peak Hour.syn
01/26/2017

















	←	↑	↓
Lane Group	WBT	NBT	SBT
Lane Group Flow (vph)	1420	49	100
v/c Ratio	0.45	0.12	0.23
Control Delay	9.1	29.6	25.7
Queue Delay	0.0	0.0	0.0
Total Delay	9.1	29.6	25.7
Queue Length 50th (m)	44.3	8.6	12.7
Queue Length 95th (m)	53.4	14.6	26.0
Internal Link Dist (m)	442.1	56.1	46.4
Turn Bay Length (m)			
Base Capacity (vph)	3154	392	438
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.45	0.13	0.23
Intersection Summary			
m Volume for 95th percentile queue is metered by upstream signal.			

HCM Signalized Intersection Capacity Analysis
7: Macklin Street South & King Street West










161720 - 2023 Total AM Peak Hour.syn
01/26/2017

	↖	→	↗	↙	←	↖	↗	↑	↙	↗	↓	↖
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↔↔↔			↔			↔	
Traffic Volume (vph)	0	0	0	52	1185	69	23	22	0	0	71	21
Future Volume (vph)	0	0	0	52	1185	69	23	22	0	0	71	21
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0			4.0			4.0	
Lane Util. Factor					0.91			1.00			1.00	
Flpb, ped/bikes					1.00			1.00			0.99	
Flpb, ped/bikes					1.00			0.98			1.00	
Frt					0.99			1.00			0.97	
Flt Protected					1.00			0.98			1.00	
Satd. Flow (prot)					4845			1652			1581	
Flt Permitted					1.00			0.86			1.00	
Satd. Flow (perm)					4845			1453			1581	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	57	1288	75	25	24	0	0	77	23
RTOR Reduction (vph)	0	0	0	0	6	0	0	0	0	0	11	0
Lane Group Flow (vph)	0	0	0	0	1414	0	0	49	0	0	89	0
Confl. Peds. (#/hr)	51		10	10		51	28		38	38		28
Heavy Vehicles (%)	0%	0%	0%	4%	6%	20%	14%	8%	0%	0%	12%	30%
Turn Type				Perm	NA		Perm	NA			NA	
Protected Phases					2			4			4	
Permitted Phases				2			4					
Actuated Green, G (s)					64.0			25.6			25.6	
Effective Green, g (s)					65.0			27.0			27.0	
Actuated g/C Ratio					0.65			0.27			0.27	
Clearance Time (s)					5.0			5.4			5.4	
Lane Grp Cap (vph)					3149			392			426	
v/s Ratio Prot											c0.06	
v/s Ratio Perm					0.29			0.03				
v/c Ratio					0.45			0.12			0.21	
Uniform Delay, d1					8.6			27.6			28.2	
Progression Factor					1.00			1.03			1.00	
Incremental Delay, d2					0.5			0.6			1.1	
Delay (s)					9.1			29.1			29.4	
Level of Service					A			C			C	
Approach Delay (s)		0.0			9.1			29.1			29.4	
Approach LOS		A			A			C			C	
Intersection Summary												
HCM 2000 Control Delay					11.0						B	
HCM 2000 Volume to Capacity ratio					0.38							
Actuated Cycle Length (s)					100.0			Sum of lost time (s)			8.0	
Intersection Capacity Utilization					55.0%			ICU Level of Service			B	
Analysis Period (min)					15							
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis 161720 - 2023 Total AM Peak Hour.syn
8: Macklin Street South & Carling Street 01/26/2017

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	2	3	11	41	20	7	5	35	13	10	107	5
Future Volume (Veh/h)	2	3	11	41	20	7	5	35	13	10	107	5
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	3	12	45	22	8	5	38	14	11	116	5
Pedestrians		17			29			21			4	
Lane Width (m)		3.7			3.7			3.7			3.7	
Walking Speed (m/s)		1.1			1.1			1.1			1.1	
Percent Blockage		2			3			2			0	
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (m)								168			80	
pX, platoon unblocked	0.99	0.99	0.99	0.99	0.99		0.99					
vC, conflicting volume	236	248	156	259	244	78	138			81		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	220	233	140	244	229	78	122			81		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.3			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.4			2.2		
p0 queue free %	100	100	99	93	97	99	100			99		
cM capacity (veh/h)	662	626	869	632	629	956	1323			1486		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	17	75	57	132								
Volume Left	2	45	5	11								
Volume Right	12	8	14	5								
cSH	786	655	1323	1486								
Volume to Capacity	0.02	0.11	0.00	0.01								
Queue Length 95th (m)	0.5	2.9	0.1	0.2								
Control Delay (s)	9.7	11.2	0.7	0.7								
Lane LOS	A	B	A	A								
Approach Delay (s)	9.7	11.2	0.7	0.7								
Approach LOS	A	B										
Intersection Summary												
Average Delay	4.0											
Intersection Capacity Utilization	28.0%			ICU Level of Service			A					
Analysis Period (min)	15											

HCM Unsignalized Intersection Capacity Analysis 161720 - 2023 Total AM Peak Hour.syn
9: Driveway A & Carling Street 01/26/2017

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	23	3	0	60	8	2
Future Volume (Veh/h)	23	3	0	60	8	2
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	25	3	0	65	9	2
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None		None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			28		92	26
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			28		92	26
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	100
cM capacity (veh/h)			1585		909	1049
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	28	65	11			
Volume Left	0	0	9			
Volume Right	3	0	2			
cSH	1700	1585	931			
Volume to Capacity	0.02	0.00	0.01			
Queue Length 95th (m)	0.0	0.0	0.3			
Control Delay (s)	0.0	0.0	8.9			
Lane LOS	A					
Approach Delay (s)	0.0	0.0	8.9			
Approach LOS	A					
Intersection Summary						
Average Delay			0.9			
Intersection Capacity Utilization			13.3%	ICU Level of Service	A	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
10: Driveway B & Carling Street

161720 - 2023 Total AM Peak Hour.syn
01/26/2017

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↩			↩	↩	
Traffic Volume (veh/h)	14	11	0	16	44	0
Future Volume (Veh/h)	14	11	0	16	44	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	15	12	0	17	48	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			27		38	21
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			27		38	21
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		95	100
cM capacity (veh/h)			1587		974	1056
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	27	17	48			
Volume Left	0	0	48			
Volume Right	12	0	0			
cSH	1700	1587	974			
Volume to Capacity	0.02	0.00	0.05			
Queue Length 95th (m)	0.0	0.0	1.2			
Control Delay (s)	0.0	0.0	8.9			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	8.9			
Approach LOS			A			
Intersection Summary						
Average Delay			4.6			
Intersection Capacity Utilization			13.3%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
11: Driveway C & Carling Street

161720 - 2023 Total AM Peak Hour.syn
01/26/2017

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↩			↩	↩	
Traffic Volume (veh/h)	12	0	0	11	5	0
Future Volume (Veh/h)	12	0	0	11	5	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	13	0	0	12	5	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			13		25	13
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			13		25	13
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	100
cM capacity (veh/h)			1606		991	1067
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	13	12	5			
Volume Left	0	0	5			
Volume Right	0	0	0			
cSH	1700	1606	991			
Volume to Capacity	0.01	0.00	0.01			
Queue Length 95th (m)	0.0	0.0	0.1			
Control Delay (s)	0.0	0.0	8.7			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	8.7			
Approach LOS			A			
Intersection Summary						
Average Delay			1.4			
Intersection Capacity Utilization			13.3%		ICU Level of Service	A
Analysis Period (min)			15			

Queues
1: Hwy 403 NS Ramp & Main Street West

161720 - 2023 Total PM Peak Hour.syn
01/26/2017

	→	↘	←	↙	↗
Lane Group	EBT	EBR	WBT	NBL	NBR
Lane Group Flow (vph)	2207	732	1603	573	138
v/c Ratio	0.79	0.63	0.83	0.79	0.33
Control Delay	19.5	4.0	22.4	35.2	22.9
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	19.5	4.0	22.4	35.2	22.9
Queue Length 50th (m)	107.6	3.2	117.1	45.6	16.7
Queue Length 95th (m)	127.4	19.4	148.6	#67.9	31.6
Internal Link Dist (m)	243.1		438.7	39.5	
Turn Bay Length (m)		60.0			
Base Capacity (vph)	2792	1168	1924	727	418
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.79	0.63	0.83	0.79	0.33

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis
1: Hwy 403 NS Ramp & Main Street West

161720 - 2023 Total PM Peak Hour.syn
01/26/2017

	→	↘	↙	←	↗	↘
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑	↑		↑↑	↑	↑
Traffic Volume (vph)	2030	673	0	1475	527	127
Future Volume (vph)	2030	673	0	1475	527	127
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.91	1.00		0.95	0.97	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00	0.76
Flpb, ped/bikes	1.00	1.00		1.00	0.58	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	1.00	1.00		1.00	0.95	1.00
Satd. Flow (prot)	5142	1570		3544	1967	1125
Flt Permitted	1.00	1.00		1.00	0.95	1.00
Satd. Flow (perm)	5142	1570		3544	1967	1125
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2207	732	0	1603	573	138
RTOR Reduction (vph)	0	316	0	0	0	3
Lane Group Flow (vph)	2207	416	0	1603	573	135
Confl. Peds. (#/hr)					193	179
Heavy Vehicles (%)	2%	4%	0%	3%	4%	10%
Turn Type	NA	Perm		NA	Perm	Perm
Protected Phases	2			2		
Permitted Phases		2			4	4
Actuated Green, G (s)	47.7	47.7		47.7	32.3	32.3
Effective Green, g (s)	49.9	49.9		49.9	34.0	34.0
Actuated g/C Ratio	0.54	0.54		0.54	0.37	0.37
Clearance Time (s)	6.2	6.2		6.2	5.7	5.7
Lane Grp Cap (vph)	2792	852		1924	727	416
v/s Ratio Prot	0.43			c0.45		
v/s Ratio Perm		0.27			c0.29	0.12
v/c Ratio	0.79	0.49		0.83	0.79	0.33
Uniform Delay, d1	16.8	13.1		17.5	25.7	20.7
Progression Factor	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	2.4	2.0		4.4	8.5	2.1
Delay (s)	19.2	15.1		21.9	34.2	22.8
Level of Service	B	B		C	C	C
Approach Delay (s)	18.2			21.9	32.0	
Approach LOS	B			C	C	

Intersection Summary

HCM 2000 Control Delay	21.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	91.9	Sum of lost time (s)	9.7
Intersection Capacity Utilization	64.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Queues

2: Main Street West & Macklin Street South

161720 - 2023 Total PM Peak Hour.syn

01/26/2017

	→	↘
Lane Group	EBT	SBL
Lane Group Flow (vph)	1805	149
v/c Ratio	0.56	0.28
Control Delay	13.3	33.9
Queue Delay	0.0	0.0
Total Delay	13.3	33.9
Queue Length 50th (m)	82.2	26.8
Queue Length 95th (m)	94.6	44.2
Internal Link Dist (m)	128.2	144.0
Turn Bay Length (m)		
Base Capacity (vph)	3217	531
Starvation Cap Reductn	0	0
Spillback Cap Reductn	0	0
Storage Cap Reductn	0	0
Reduced v/c Ratio	0.56	0.28

Intersection Summary

HCM Signalized Intersection Capacity Analysis

2: Main Street West & Macklin Street South

161720 - 2023 Total PM Peak Hour.syn

01/26/2017

	↖	→	←	↗	↘	↙
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔↔↔			↖	
Traffic Volume (vph)	96	1565	0	0	137	0
Future Volume (vph)	96	1565	0	0	137	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	
Lane Util. Factor		0.91			1.00	
Flpb, ped/bikes		1.00			1.00	
Flpb, ped/bikes		1.00			0.97	
Frt		1.00			1.00	
Flt Protected		1.00			0.95	
Satd. Flow (prot)		5081			1772	
Flt Permitted		1.00			0.95	
Satd. Flow (perm)		5081			1772	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	104	1701	0	0	149	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1805	0	0	149	0
Confl. Peds. (#/hr)	4				22	
Heavy Vehicles (%)	1%	3%	0%	0%	0%	0%
Turn Type	Perm	NA			Perm	
Protected Phases		2				
Permitted Phases	2				4	
Actuated Green, G (s)		74.3			34.3	
Effective Green, g (s)		76.0			36.0	
Actuated g/C Ratio		0.63			0.30	
Clearance Time (s)		5.7			5.7	
Lane Grp Cap (vph)		3217			531	
v/s Ratio Prot						
v/s Ratio Perm		0.36			0.08	
v/c Ratio		0.56			0.28	
Uniform Delay, d1		12.5			32.1	
Progression Factor		1.00			1.00	
Incremental Delay, d2		0.7			1.3	
Delay (s)		13.2			33.4	
Level of Service		B			C	
Approach Delay (s)		13.2	0.0		33.4	
Approach LOS		B	A		C	

Intersection Summary

HCM 2000 Control Delay	14.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.48		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	9.7
Intersection Capacity Utilization	51.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Queues
7: Macklin Street South & King Street West

161720 - 2023 Total PM Peak Hour.syn
01/26/2017

















	←	↑	↓
Lane Group	WBT	NBT	SBT
Lane Group Flow (vph)	1463	65	81
v/c Ratio	0.44	0.17	0.18
Control Delay	8.6	30.2	14.0
Queue Delay	0.0	0.0	0.0
Total Delay	8.6	30.2	14.0
Queue Length 50th (m)	44.4	9.8	4.2
Queue Length 95th (m)	53.1	20.7	15.5
Internal Link Dist (m)	442.1	56.1	46.4
Turn Bay Length (m)			
Base Capacity (vph)	3302	381	445
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.44	0.17	0.18
Intersection Summary			

HCM Signalized Intersection Capacity Analysis
7: Macklin Street South & King Street West









161720 - 2023 Total PM Peak Hour.syn
01/26/2017

	↖	→	↗	↙	←	↖	↗	↑	↙	↗	↓	↖
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↔↔↔			↔			↔	
Traffic Volume (vph)	0	0	0	78	1219	49	45	15	0	0	27	48
Future Volume (vph)	0	0	0	78	1219	49	45	15	0	0	27	48
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0			4.0			4.0	
Lane Util. Factor					0.91			1.00			1.00	
Frpb, ped/bikes					1.00			1.00			0.98	
Flpb, ped/bikes					1.00			0.99			1.00	
Frt					0.99			1.00			0.91	
Flt Protected					1.00			0.96			1.00	
Satd. Flow (prot)					4997			1826			1568	
Flt Permitted					1.00			0.78			1.00	
Satd. Flow (perm)					4997			1470			1568	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	85	1325	53	49	16	0	0	29	52
RTOR Reduction (vph)	0	0	0	0	4	0	0	0	0	0	38	0
Lane Group Flow (vph)	0	0	0	0	1459	0	0	65	0	0	43	0
Confl. Peds. (#/hr)	51		5	5		51	12		31	31		12
Heavy Vehicles (%)	0%	0%	0%	2%	4%	0%	0%	0%	0%	0%	0%	15%
Turn Type				Perm	NA		Perm	NA			NA	
Protected Phases					2			4			4	
Permitted Phases				2			4					
Actuated Green, G (s)					65.0			24.6			24.6	
Effective Green, g (s)					66.0			26.0			26.0	
Actuated g/C Ratio					0.66			0.26			0.26	
Clearance Time (s)					5.0			5.4			5.4	
Lane Grp Cap (vph)					3298			382			407	
v/s Ratio Prot											0.03	
v/s Ratio Perm					0.29			c0.04				
v/c Ratio					0.44			0.17			0.10	
Uniform Delay, d1					8.2			28.6			28.1	
Progression Factor					1.00			1.00			1.00	
Incremental Delay, d2					0.4			1.0			0.5	
Delay (s)					8.6			29.6			28.7	
Level of Service					A			C			C	
Approach Delay (s)		0.0			8.6			29.6			28.7	
Approach LOS		A			A			C			C	
Intersection Summary												
HCM 2000 Control Delay					10.5						B	
HCM 2000 Volume to Capacity ratio					0.37							
Actuated Cycle Length (s)					100.0			Sum of lost time (s)			8.0	
Intersection Capacity Utilization					55.0%			ICU Level of Service			B	
Analysis Period (min)					15							
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis 161720 - 2023 Total PM Peak Hour.syn
8: Macklin Street South & Carling Street 01/26/2017

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	4	7	15	26	7	6	10	49	37	27	96	3
Future Volume (Veh/h)	4	7	15	26	7	6	10	49	37	27	96	3
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	4	8	16	28	8	7	11	53	40	29	104	3
Pedestrians		13			24			14			8	
Lane Width (m)		3.7			3.7			3.7			3.7	
Walking Speed (m/s)		1.1			1.1			1.1			1.1	
Percent Blockage		1			2			1			1	
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (m)								168			80	
pX, platoon unblocked												
vC, conflicting volume	290	316	132	316	297	105	120			117		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	290	316	132	316	297	105	120			117		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	99	98	95	99	99	99			98		
cM capacity (veh/h)	610	566	898	571	580	925	1461			1449		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	28	43	104	136								
Volume Left	4	28	11	29								
Volume Right	16	7	40	3								
cSH	727	610	1461	1449								
Volume to Capacity	0.04	0.07	0.01	0.02								
Queue Length 95th (m)	0.9	1.7	0.2	0.5								
Control Delay (s)	10.1	11.3	0.8	1.7								
Lane LOS	B	B	A	A								
Approach Delay (s)	10.1	11.3	0.8	1.7								
Approach LOS	B	B										
Intersection Summary												
Average Delay			3.5									
Intersection Capacity Utilization			27.6%		ICU Level of Service					A		
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis 161720 - 2023 Total PM Peak Hour.syn
9: Driveway A & Carling Street 01/26/2017

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	65	6	0	33	6	12
Future Volume (Veh/h)	65	6	0	33	6	12
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	71	7	0	36	7	13
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None		None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			78		110	74
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			78		110	74
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	99
cM capacity (veh/h)			1520		886	987
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	78	36	20			
Volume Left	0	0	7			
Volume Right	7	0	13			
cSH	1700	1520	949			
Volume to Capacity	0.05	0.00	0.02			
Queue Length 95th (m)	0.0	0.0	0.5			
Control Delay (s)	0.0	0.0	8.9			
Lane LOS	A					
Approach Delay (s)	0.0	0.0	8.9			
Approach LOS	A					
Intersection Summary						
Average Delay			1.3			
Intersection Capacity Utilization			13.8%		ICU Level of Service	
Analysis Period (min)			15		A	

HCM Unsignalized Intersection Capacity Analysis
10: Driveway B & Carling Street

161720 - 2023 Total PM Peak Hour.syn
01/26/2017

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↩			↩	↩	
Traffic Volume (veh/h)	38	39	0	8	25	0
Future Volume (Veh/h)	38	39	0	8	25	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	41	42	0	9	27	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			83		71	62
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			83		71	62
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		97	100
cM capacity (veh/h)			1514		933	1003
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	83	9	27			
Volume Left	0	0	27			
Volume Right	42	0	0			
cSH	1700	1514	933			
Volume to Capacity	0.05	0.00	0.03			
Queue Length 95th (m)	0.0	0.0	0.7			
Control Delay (s)	0.0	0.0	9.0			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	9.0			
Approach LOS			A			
Intersection Summary						
Average Delay			2.0			
Intersection Capacity Utilization			14.4%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
11: Driveway C & Carling Street

161720 - 2023 Total PM Peak Hour.syn
01/26/2017

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↩			↩	↩	
Traffic Volume (veh/h)	32	6	0	5	4	0
Future Volume (Veh/h)	32	6	0	5	4	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	35	7	0	5	4	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			42		44	38
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			42		44	38
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			1567		967	1033
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	42	5	4			
Volume Left	0	0	4			
Volume Right	7	0	0			
cSH	1700	1567	967			
Volume to Capacity	0.02	0.00	0.00			
Queue Length 95th (m)	0.0	0.0	0.1			
Control Delay (s)	0.0	0.0	8.7			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	8.7			
Approach LOS			A			
Intersection Summary						
Average Delay			0.7			
Intersection Capacity Utilization			13.3%		ICU Level of Service	A
Analysis Period (min)			15			

3: Hwy. 403 NE Ramp & Main Street West Performance by movement

Movement	EBT	NBR	All
Denied Del/Veh (s)	0.0	0.8	0.2
Total Del/Veh (s)	3.5	2.1	3.1

4: Main Street West & Hwy 403 SE Ramp Performance by movement

Movement	EBT	SBL	All
Denied Del/Veh (s)	0.0	0.8	0.1
Total Del/Veh (s)	0.6	1.4	0.8

5: King Street West & Hwy 403 NW Ramp Performance by movement

Movement	WBT	WBR	All
Denied Del/Veh (s)	0.3	0.6	0.4
Total Del/Veh (s)	0.3	4.2	1.7

6: Hwy 403 SW Ramp & King Street West Performance by movement

Movement	WBL	WBT	All
Denied Del/Veh (s)	0.0	0.0	0.0
Total Del/Veh (s)	3.1	0.3	1.2

Total Zone Performance

Denied Del/Veh (s)		0.5
Total Del/Veh (s)		33.2

3: Hwy. 403 NE Ramp & Main Street West Performance by movement

Movement	EBT	NBR	All
Denied Del/Veh (s)	0.0	0.4	0.1
Total Del/Veh (s)	2.7	1.1	2.3

4: Main Street West & Hwy 403 SE Ramp Performance by movement

Movement	EBT	SBL	All
Denied Del/Veh (s)	0.0	0.6	0.1
Total Del/Veh (s)	0.6	1.1	0.8

5: King Street West & Hwy 403 NW Ramp Performance by movement

Movement	WBT	WBR	All
Denied Del/Veh (s)	2.2	2.7	2.3
Total Del/Veh (s)	1.9	6.4	3.5

6: Hwy 403 SW Ramp & King Street West Performance by movement

Movement	WBL	WBT	All
Denied Del/Veh (s)	0.0	0.0	0.0
Total Del/Veh (s)	5.3	0.3	2.6

Total Zone Performance

Denied Del/Veh (s)		1.9
Total Del/Veh (s)		217.7

Queues
1: Hwy 403 NS Ramp & Main Street West

161720 - 2028 Total AM Peak Hour.syn
01/26/2017

	→	↘	←	↙	↗
Lane Group	EBT	EBR	WBT	NBL	NBR
Lane Group Flow (vph)	2398	440	1725	1011	378
v/c Ratio	1.02	0.51	1.04	1.08	0.83
Control Delay	48.8	6.7	59.8	78.5	39.9
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	48.8	6.7	59.8	78.5	39.9
Queue Length 50th (m)	~157.7	11.1	~175.4	~103.5	56.6
Queue Length 95th (m)	#195.2	33.1	#217.1	#140.4	#108.5
Internal Link Dist (m)	243.1		438.7	39.5	
Turn Bay Length (m)		60.0			
Base Capacity (vph)	2354	857	1654	940	457
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	1.02	0.51	1.04	1.08	0.83

Intersection Summary

~ 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.

HCM Signalized Intersection Capacity Analysis
1: Hwy 403 NS Ramp & Main Street West

161720 - 2028 Total AM Peak Hour.syn
01/26/2017

	→	↘	↙	←	↗	↘
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑	↑		↑↑	↑	↑
Traffic Volume (vph)	2206	405	0	1587	930	348
Future Volume (vph)	2206	405	0	1587	930	348
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.91	1.00		0.95	0.97	1.00
Flpb, ped/bikes	1.00	0.96		1.00	1.00	0.66
Flpb, ped/bikes	1.00	1.00		1.00	0.62	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	1.00	1.00		1.00	0.95	1.00
Satd. Flow (prot)	5043	1464		3544	2108	1025
Flt Permitted	1.00	1.00		1.00	0.95	1.00
Satd. Flow (perm)	5043	1464		3544	2108	1025
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2398	440	0	1725	1011	378
RTOR Reduction (vph)	0	174	0	0	0	1
Lane Group Flow (vph)	2398	266	0	1725	1011	377
Confl. Peds. (#/hr)	13		13		174	363
Heavy Vehicles (%)	4%	7%	0%	3%	4%	5%
Turn Type	NA	Perm		NA	Perm	Perm
Protected Phases	2			2		
Permitted Phases		2			4	4
Actuated Green, G (s)	40.7	40.7		40.7	39.3	39.3
Effective Green, g (s)	42.9	42.9		42.9	41.0	41.0
Actuated g/C Ratio	0.47	0.47		0.47	0.45	0.45
Clearance Time (s)	6.2	6.2		6.2	5.7	5.7
Lane Grp Cap (vph)	2354	683		1654	940	457
v/s Ratio Prot	0.48			c0.49		
v/s Ratio Perm		0.18			c0.48	0.37
v/c Ratio	1.02	0.39		1.04	1.08	0.83
Uniform Delay, d1	24.5	16.0		24.5	25.5	22.3
Progression Factor	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	23.4	1.7		34.2	51.9	15.6
Delay (s)	47.9	17.6		58.7	77.3	37.9
Level of Service	D	B		E	E	D
Approach Delay (s)	43.2			58.7	66.6	
Approach LOS	D			E	E	

Intersection Summary

HCM 2000 Control Delay 53.2 HCM 2000 Level of Service D
HCM 2000 Volume to Capacity ratio 1.08
Actuated Cycle Length (s) 91.9 Sum of lost time (s) 9.7
Intersection Capacity Utilization 79.9% ICU Level of Service D
Analysis Period (min) 15
c Critical Lane Group

Queues
2: Main Street West & Macklin Street South

161720 - 2028 Total AM Peak Hour.syn
01/26/2017

Lane Group	EBT	SBL
Lane Group Flow (vph)	2009	175
v/c Ratio	0.68	0.32
Control Delay	15.0	23.0
Queue Delay	0.0	0.0
Total Delay	15.0	23.0
Queue Length 50th (m)	89.2	20.5
Queue Length 95th (m)	105.0	32.6
Internal Link Dist (m)	128.2	144.0
Turn Bay Length (m)		
Base Capacity (vph)	2958	545
Starvation Cap Reductn	0	0
Spillback Cap Reductn	0	0
Storage Cap Reductn	0	0
Reduced v/c Ratio	0.68	0.32
Intersection Summary		

HCM Signalized Intersection Capacity Analysis
2: Main Street West & Macklin Street South

161720 - 2028 Total AM Peak Hour.syn
01/26/2017

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔↔↔			↔	
Traffic Volume (vph)	54	1794	0	0	161	0
Future Volume (vph)	54	1794	0	0	161	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	
Lane Util. Factor		0.91			1.00	
Flpb, ped/bikes		1.00			1.00	
Flpb, ped/bikes		1.00			1.00	
Frt		1.00			1.00	
Flt Protected		1.00			0.95	
Satd. Flow (prot)		4927			1706	
Flt Permitted		1.00			0.95	
Satd. Flow (perm)		4927			1706	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	59	1950	0	0	175	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	2009	0	0	175	0
Confl. Peds. (#/hr)		16				
Heavy Vehicles (%)	13%	6%	0%	0%	7%	0%
Turn Type	Perm	NA			Perm	
Protected Phases		2				
Permitted Phases	2				4	
Actuated Green, G (s)		58.3			30.3	
Effective Green, g (s)		60.0			32.0	
Actuated g/C Ratio		0.60			0.32	
Clearance Time (s)		5.7			5.7	
Lane Grp Cap (vph)		2956			545	
v/s Ratio Prot						
v/s Ratio Perm		0.41			0.10	
v/c Ratio		0.68			0.32	
Uniform Delay, d1		13.5			25.8	
Progression Factor		1.00			0.82	
Incremental Delay, d2		1.3			1.5	
Delay (s)		14.8			22.6	
Level of Service		B			C	
Approach Delay (s)		14.8	0.0		22.6	
Approach LOS		B	A		C	
Intersection Summary						
HCM 2000 Control Delay		15.4			HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio		0.57				
Actuated Cycle Length (s)		100.0			Sum of lost time (s)	9.7
Intersection Capacity Utilization		54.9%			ICU Level of Service	A
Analysis Period (min)		15				
c Critical Lane Group						

Queues
7: Macklin Street South & King Street West

161720 - 2028 Total AM Peak Hour.syn
01/26/2017

















	←	↑	↓
Lane Group	WBT	NBT	SBT
Lane Group Flow (vph)	1434	49	100
v/c Ratio	0.45	0.12	0.23
Control Delay	9.1	29.3	25.7
Queue Delay	0.0	0.0	0.0
Total Delay	9.1	29.3	25.7
Queue Length 50th (m)	45.0	8.7	12.7
Queue Length 95th (m)	54.3	14.3	26.0
Internal Link Dist (m)	442.1	56.1	46.4
Turn Bay Length (m)			
Base Capacity (vph)	3154	392	438
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.45	0.13	0.23
Intersection Summary			
m Volume for 95th percentile queue is metered by upstream signal.			

HCM Signalized Intersection Capacity Analysis
7: Macklin Street South & King Street West










161720 - 2028 Total AM Peak Hour.syn
01/26/2017

	↖	→	↗	↙	←	↖	↗	↑	↙	↗	↓	↖
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↔↔↔			↔			↔	
Traffic Volume (vph)	0	0	0	52	1197	70	23	22	0	0	71	21
Future Volume (vph)	0	0	0	52	1197	70	23	22	0	0	71	21
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0			4.0			4.0	
Lane Util. Factor					0.91			1.00			1.00	
Flpb, ped/bikes					1.00			1.00			0.99	
Flpb, ped/bikes					1.00			0.98			1.00	
Frt					0.99			1.00			0.97	
Flt Protected					1.00			0.98			1.00	
Satd. Flow (prot)					4845			1652			1581	
Flt Permitted					1.00			0.86			1.00	
Satd. Flow (perm)					4845			1453			1581	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	57	1301	76	25	24	0	0	77	23
RTOR Reduction (vph)	0	0	0	0	6	0	0	0	0	0	11	0
Lane Group Flow (vph)	0	0	0	0	1428	0	0	49	0	0	89	0
Confl. Peds. (#/hr)	51		10	10		51	28		38	38		28
Heavy Vehicles (%)	0%	0%	0%	4%	6%	20%	14%	8%	0%	0%	12%	30%
Turn Type				Perm	NA		Perm	NA			NA	
Protected Phases					2			4			4	
Permitted Phases				2			4					
Actuated Green, G (s)					64.0			25.6			25.6	
Effective Green, g (s)					65.0			27.0			27.0	
Actuated g/C Ratio					0.65			0.27			0.27	
Clearance Time (s)					5.0			5.4			5.4	
Lane Grp Cap (vph)					3149			392			426	
v/s Ratio Prot											c0.06	
v/s Ratio Perm					0.29			0.03				
v/c Ratio					0.45			0.12			0.21	
Uniform Delay, d1					8.7			27.6			28.2	
Progression Factor					1.00			1.02			1.00	
Incremental Delay, d2					0.5			0.6			1.1	
Delay (s)					9.2			28.8			29.4	
Level of Service					A			C			C	
Approach Delay (s)		0.0			9.2			28.8			29.4	
Approach LOS		A			A			C			C	
Intersection Summary												
HCM 2000 Control Delay					11.0						B	
HCM 2000 Volume to Capacity ratio					0.38							
Actuated Cycle Length (s)					100.0			Sum of lost time (s)			8.0	
Intersection Capacity Utilization					55.0%			ICU Level of Service			B	
Analysis Period (min)					15							
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis 161720 - 2028 Total AM Peak Hour.syn
8: Macklin Street South & Carling Street 01/26/2017

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	2	3	12	41	21	7	5	36	13	10	108	5
Future Volume (Veh/h)	2	3	12	41	21	7	5	36	13	10	108	5
Sign Control	Stop			Stop			Free			Free		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	3	13	45	23	8	5	39	14	11	117	5
Pedestrians	17			29			21			4		
Lane Width (m)	3.7			3.7			3.7			3.7		
Walking Speed (m/s)	1.1			1.1			1.1			1.1		
Percent Blockage	2			3			2			0		
Right turn flare (veh)												
Median type							None			None		
Median storage (veh)												
Upstream signal (m)							168			80		
pX, platoon unblocked	0.99	0.99	0.99	0.99	0.99		0.99					
vC, conflicting volume	238	250	158	262	246	79	139			82		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	221	234	140	246	230	79	121			82		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.3			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.4			2.2		
p0 queue free %	100	100	99	93	96	99	100			99		
cM capacity (veh/h)	660	625	868	629	628	955	1322			1485		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	18	76	58	133								
Volume Left	2	45	5	11								
Volume Right	13	8	14	5								
cSH	789	652	1322	1485								
Volume to Capacity	0.02	0.12	0.00	0.01								
Queue Length 95th (m)	0.5	3.0	0.1	0.2								
Control Delay (s)	9.7	11.2	0.7	0.7								
Lane LOS	A	B	A	A								
Approach Delay (s)	9.7	11.2	0.7	0.7								
Approach LOS	A	B										
Intersection Summary												
Average Delay	4.1											
Intersection Capacity Utilization	28.1%			ICU Level of Service			A					
Analysis Period (min)	15											

HCM Unsignalized Intersection Capacity Analysis 161720 - 2028 Total AM Peak Hour.syn
9: Driveway A & Carling Street 01/26/2017

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	24	3	0	60	8	2
Future Volume (Veh/h)	24	3	0	60	8	2
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	26	3	0	65	9	2
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			29		92	28
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			29		92	28
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	100
cM capacity (veh/h)			1584		908	1048
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	29	65	11			
Volume Left	0	0	9			
Volume Right	3	0	2			
cSH	1700	1584	930			
Volume to Capacity	0.02	0.00	0.01			
Queue Length 95th (m)	0.0	0.0	0.3			
Control Delay (s)	0.0	0.0	8.9			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	8.9			
Approach LOS			A			
Intersection Summary						
Average Delay			0.9			
Intersection Capacity Utilization			13.3%	ICU Level of Service	A	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
10: Driveway B & Carling Street

161720 - 2028 Total AM Peak Hour.syn
01/26/2017

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↩			↩	↩	
Traffic Volume (veh/h)	15	11	0	17	44	0
Future Volume (Veh/h)	15	11	0	17	44	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	16	12	0	18	48	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			28		40	22
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			28		40	22
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		95	100
cM capacity (veh/h)			1585		972	1055
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	28	18	48			
Volume Left	0	0	48			
Volume Right	12	0	0			
cSH	1700	1585	972			
Volume to Capacity	0.02	0.00	0.05			
Queue Length 95th (m)	0.0	0.0	1.2			
Control Delay (s)	0.0	0.0	8.9			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	8.9			
Approach LOS			A			
Intersection Summary						
Average Delay			4.5			
Intersection Capacity Utilization			13.3%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
11: Driveway C & Carling Street

161720 - 2028 Total AM Peak Hour.syn
01/26/2017

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↩			↩	↩	
Traffic Volume (veh/h)	13	0	0	12	5	0
Future Volume (Veh/h)	13	0	0	12	5	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	14	0	0	13	5	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			14		27	14
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			14		27	14
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	100
cM capacity (veh/h)			1604		988	1066
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	14	13	5			
Volume Left	0	0	5			
Volume Right	0	0	0			
cSH	1700	1604	988			
Volume to Capacity	0.01	0.00	0.01			
Queue Length 95th (m)	0.0	0.0	0.1			
Control Delay (s)	0.0	0.0	8.7			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	8.7			
Approach LOS			A			
Intersection Summary						
Average Delay			1.4			
Intersection Capacity Utilization			13.3%		ICU Level of Service	A
Analysis Period (min)			15			

Queues
1: Hwy 403 NS Ramp & Main Street West

161720 - 2028 Total PM Peak Hour.syn
01/26/2017

	→	↘	←	↙	↗
Lane Group	EBT	EBR	WBT	NBL	NBR
Lane Group Flow (vph)	2264	739	1732	578	155
v/c Ratio	0.80	0.63	0.88	0.82	0.38
Control Delay	19.0	3.9	24.8	38.0	24.7
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	19.0	3.9	24.8	38.0	24.7
Queue Length 50th (m)	109.5	3.3	131.7	47.1	19.5
Queue Length 95th (m)	129.7	19.0	167.7	#74.6	36.2
Internal Link Dist (m)	243.1		438.7	39.5	
Turn Bay Length (m)		60.0			
Base Capacity (vph)	2847	1180	1962	706	406
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.80	0.63	0.88	0.82	0.38

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis
1: Hwy 403 NS Ramp & Main Street West

161720 - 2028 Total PM Peak Hour.syn
01/26/2017

	→	↘	↙	←	↗	↘
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑	↑		↑↑	↑	↑
Traffic Volume (vph)	2083	680	0	1593	532	143
Future Volume (vph)	2083	680	0	1593	532	143
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.91	1.00		0.95	0.97	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.76
Flpb, ped/bikes	1.00	1.00		1.00	0.58	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	1.00	1.00		1.00	0.95	1.00
Satd. Flow (prot)	5142	1570		3544	1967	1125
Flt Permitted	1.00	1.00		1.00	0.95	1.00
Satd. Flow (perm)	5142	1570		3544	1967	1125
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2264	739	0	1732	578	155
RTOR Reduction (vph)	0	311	0	0	0	3
Lane Group Flow (vph)	2264	428	0	1732	578	152
Confl. Peds. (#/hr)					193	179
Heavy Vehicles (%)	2%	4%	0%	3%	4%	10%
Turn Type	NA	Perm		NA	Perm	Perm
Protected Phases	2			2		
Permitted Phases		2			4	4
Actuated Green, G (s)	48.7	48.7		48.7	31.3	31.3
Effective Green, g (s)	50.9	50.9		50.9	33.0	33.0
Actuated g/C Ratio	0.55	0.55		0.55	0.36	0.36
Clearance Time (s)	6.2	6.2		6.2	5.7	5.7
Lane Grp Cap (vph)	2847	869		1962	706	403
v/s Ratio Prot	0.44			c0.49		
v/s Ratio Perm		0.27			c0.29	0.14
v/c Ratio	0.80	0.49		0.88	0.82	0.38
Uniform Delay, d1	16.3	12.6		17.9	26.7	21.8
Progression Factor	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	2.4	2.0		6.2	10.2	2.7
Delay (s)	18.7	14.6		24.1	37.0	24.5
Level of Service	B	B		C	D	C
Approach Delay (s)	17.7			24.1	34.3	
Approach LOS	B			C	C	

Intersection Summary

HCM 2000 Control Delay	22.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	91.9	Sum of lost time (s)	9.7
Intersection Capacity Utilization	68.2%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Queues

2: Main Street West & Macklin Street South

161720 - 2028 Total PM Peak Hour.syn

01/26/2017

Lane Group	EBT	SBL
Lane Group Flow (vph)	1882	150
v/c Ratio	0.59	0.28
Control Delay	13.7	33.9
Queue Delay	0.0	0.0
Total Delay	13.7	33.9
Queue Length 50th (m)	87.8	27.0
Queue Length 95th (m)	100.6	44.4
Internal Link Dist (m)	128.2	144.0
Turn Bay Length (m)		
Base Capacity (vph)	3217	531
Starvation Cap Reductn	0	0
Spillback Cap Reductn	0	0
Storage Cap Reductn	0	0
Reduced v/c Ratio	0.59	0.28

Intersection Summary

HCM Signalized Intersection Capacity Analysis

2: Main Street West & Macklin Street South

161720 - 2028 Total PM Peak Hour.syn

01/26/2017

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔↔↔			↔	
Traffic Volume (vph)	97	1635	0	0	138	0
Future Volume (vph)	97	1635	0	0	138	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	
Lane Util. Factor		0.91			1.00	
Flpb, ped/bikes		1.00			1.00	
Flpb, ped/bikes		1.00			0.97	
Frt		1.00			1.00	
Flt Protected		1.00			0.95	
Satd. Flow (prot)		5081			1772	
Flt Permitted		1.00			0.95	
Satd. Flow (perm)		5081			1772	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	105	1777	0	0	150	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	1882	0	0	150	0
Confl. Peds. (#/hr)	4				22	
Heavy Vehicles (%)	1%	3%	0%	0%	0%	0%
Turn Type	Perm	NA			Perm	
Protected Phases		2				
Permitted Phases	2				4	
Actuated Green, G (s)		74.3			34.3	
Effective Green, g (s)		76.0			36.0	
Actuated g/C Ratio		0.63			0.30	
Clearance Time (s)		5.7			5.7	
Lane Grp Cap (vph)		3217			531	
v/s Ratio Prot						
v/s Ratio Perm		0.37			0.08	
v/c Ratio		0.59			0.28	
Uniform Delay, d1		12.8			32.1	
Progression Factor		1.00			1.00	
Incremental Delay, d2		0.8			1.3	
Delay (s)		13.6			33.5	
Level of Service		B			C	
Approach Delay (s)		13.6	0.0		33.5	
Approach LOS		B	A		C	

Intersection Summary

HCM 2000 Control Delay	15.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	9.7
Intersection Capacity Utilization	52.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Queues
7: Macklin Street South & King Street West

161720 - 2028 Total PM Peak Hour.syn
01/26/2017

















	←	↑	↓
Lane Group	WBT	NBT	SBT
Lane Group Flow (vph)	1477	65	81
v/c Ratio	0.45	0.17	0.17
Control Delay	8.6	30.2	21.1
Queue Delay	0.0	0.0	0.0
Total Delay	8.6	30.2	21.1
Queue Length 50th (m)	44.9	9.8	8.0
Queue Length 95th (m)	53.8	20.7	19.5
Internal Link Dist (m)	442.1	56.1	46.4
Turn Bay Length (m)			
Base Capacity (vph)	3302	382	466
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.45	0.17	0.17
Intersection Summary			

HCM Signalized Intersection Capacity Analysis
7: Macklin Street South & King Street West




161720 - 2028 Total PM Peak Hour.syn
01/26/2017

	↖	→	↗	↙	←	↖	↗	↑	↙	↗	↓	↖
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↔↔↔			↔			↔	
Traffic Volume (vph)	0	0	0	79	1230	50	45	15	0	0	48	27
Future Volume (vph)	0	0	0	79	1230	50	45	15	0	0	48	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0			4.0			4.0	
Lane Util. Factor					0.91			1.00			1.00	
Frpb, ped/bikes					1.00			1.00			0.99	
Flpb, ped/bikes					1.00			0.99			1.00	
Frt					0.99			1.00			0.95	
Flt Protected					1.00			0.96			1.00	
Satd. Flow (prot)					4996			1826			1715	
Flt Permitted					1.00			0.78			1.00	
Satd. Flow (perm)					4996			1470			1715	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	86	1337	54	49	16	0	0	52	29
RTOR Reduction (vph)	0	0	0	0	4	0	0	0	0	0	20	0
Lane Group Flow (vph)	0	0	0	0	1473	0	0	65	0	0	61	0
Confl. Peds. (#/hr)	51		5	5		51	12		31	31		12
Heavy Vehicles (%)	0%	0%	0%	2%	4%	0%	0%	0%	0%	0%	0%	15%
Turn Type				Perm	NA		Perm	NA			NA	
Protected Phases					2			4			4	
Permitted Phases				2			4					
Actuated Green, G (s)					65.0			24.6			24.6	
Effective Green, g (s)					66.0			26.0			26.0	
Actuated g/C Ratio					0.66			0.26			0.26	
Clearance Time (s)					5.0			5.4			5.4	
Lane Grp Cap (vph)					3297			382			445	
v/s Ratio Prot											0.04	
v/s Ratio Perm					0.29			c0.04				
v/c Ratio					0.45			0.17			0.14	
Uniform Delay, d1					8.2			28.6			28.4	
Progression Factor					1.00			1.00			1.00	
Incremental Delay, d2					0.4			1.0			0.6	
Delay (s)					8.6			29.6			29.0	
Level of Service					A			C			C	
Approach Delay (s)		0.0			8.6			29.6			29.0	
Approach LOS		A			A			C			C	
Intersection Summary												
HCM 2000 Control Delay					10.5						B	
HCM 2000 Volume to Capacity ratio					0.37							
Actuated Cycle Length (s)					100.0			Sum of lost time (s)			8.0	
Intersection Capacity Utilization					55.0%			ICU Level of Service			B	
Analysis Period (min)					15							
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis 161720 - 2028 Total PM Peak Hour.syn
8: Macklin Street South & Carling Street 01/26/2017

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	4	7	15	27	7	6	11	49	37	28	97	3
Future Volume (Veh/h)	4	7	15	27	7	6	11	49	37	28	97	3
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	4	8	16	29	8	7	12	53	40	30	105	3
Pedestrians		13			24			14			8	
Lane Width (m)		3.7			3.7			3.7			3.7	
Walking Speed (m/s)		1.1			1.1			1.1			1.1	
Percent Blockage		1			2			1			1	
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (m)								168			80	
pX, platoon unblocked												
vC, conflicting volume	296	320	134	322	302	105	121			117		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	296	320	134	322	302	105	121			117		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	99	98	95	99	99	99			98		
cM capacity (veh/h)	605	562	897	566	575	925	1460			1449		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	28	44	105	138								
Volume Left	4	29	12	30								
Volume Right	16	7	40	3								
cSH	723	605	1460	1449								
Volume to Capacity	0.04	0.07	0.01	0.02								
Queue Length 95th (m)	0.9	1.8	0.2	0.5								
Control Delay (s)	10.2	11.4	0.9	1.8								
Lane LOS	B	B	A	A								
Approach Delay (s)	10.2	11.4	0.9	1.8								
Approach LOS	B	B										
Intersection Summary												
Average Delay			3.6									
Intersection Capacity Utilization			27.7%		ICU Level of Service					A		
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis 161720 - 2028 Total PM Peak Hour.syn
9: Driveway A & Carling Street 01/26/2017

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	65	6	0	33	6	13
Future Volume (Veh/h)	65	6	0	33	6	13
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	71	7	0	36	7	14
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None		None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			78		110	74
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			78		110	74
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	99
cM capacity (veh/h)			1520		886	987
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	78	36	21			
Volume Left	0	0	7			
Volume Right	7	0	14			
cSH	1700	1520	951			
Volume to Capacity	0.05	0.00	0.02			
Queue Length 95th (m)	0.0	0.0	0.5			
Control Delay (s)	0.0	0.0	8.9			
Lane LOS	A					
Approach Delay (s)	0.0	0.0	8.9			
Approach LOS	A					
Intersection Summary						
Average Delay			1.4			
Intersection Capacity Utilization			13.8%		ICU Level of Service	
Analysis Period (min)			15		A	

HCM Unsignalized Intersection Capacity Analysis
10: Driveway B & Carling Street

161720 - 2028 Total PM Peak Hour.syn
01/26/2017

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↩			↩	↩	
Traffic Volume (veh/h)	39	39	0	8	25	0
Future Volume (Veh/h)	39	39	0	8	25	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	42	42	0	9	27	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			84		72	63
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			84		72	63
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		97	100
cM capacity (veh/h)			1513		932	1002
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	84	9	27			
Volume Left	0	0	27			
Volume Right	42	0	0			
cSH	1700	1513	932			
Volume to Capacity	0.05	0.00	0.03			
Queue Length 95th (m)	0.0	0.0	0.7			
Control Delay (s)	0.0	0.0	9.0			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	9.0			
Approach LOS			A			
Intersection Summary						
Average Delay			2.0			
Intersection Capacity Utilization			14.4%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
11: Driveway C & Carling Street

161720 - 2028 Total PM Peak Hour.syn
01/26/2017

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↩			↩	↩	
Traffic Volume (veh/h)	33	6	0	5	4	0
Future Volume (Veh/h)	33	6	0	5	4	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	36	7	0	5	4	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			43		44	40
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			43		44	40
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			1566		966	1032
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	43	5	4			
Volume Left	0	0	4			
Volume Right	7	0	0			
cSH	1700	1566	966			
Volume to Capacity	0.03	0.00	0.00			
Queue Length 95th (m)	0.0	0.0	0.1			
Control Delay (s)	0.0	0.0	8.7			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	8.7			
Approach LOS			A			
Intersection Summary						
Average Delay			0.7			
Intersection Capacity Utilization			13.3%		ICU Level of Service	A
Analysis Period (min)			15			

Appendix G

Sensitivity Analysis Operations Reports



Queues

161720 - 2028 Total AM Peak Hour.syn

01/26/2017

1: Hwy 403 NS Ramp & Main Street West



Lane Group	EBT	EBR	WBT	NBL	NBR
Lane Group Flow (vph)	2398	440	1725	1011	378
v/c Ratio	0.97	0.46	0.99	1.06	0.92
Control Delay	29.1	2.9	37.4	68.4	51.1
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	29.1	2.9	37.4	68.4	51.1
Queue Length 50th (m)	95.6	0.0	100.8	~70.7	41.9
Queue Length 95th (m)	#137.4	12.2	#154.3	#103.8	#90.9
Internal Link Dist (m)	243.1		438.7	39.5	
Turn Bay Length (m)		60.0			
Base Capacity (vph)	2482	948	1744	956	411
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.97	0.46	0.99	1.06	0.92

Intersection Summary







- ~ 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.

HCM Signalized Intersection Capacity Analysis

1: Hwy 403 NS Ramp & Main Street West

161720 - 2028 Total AM Peak Hour.syn

01/26/2017

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑	↑		↑↑	↑↑	↑
Traffic Volume (vph)	2206	405	0	1587	930	348
Future Volume (vph)	2206	405	0	1587	930	348
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.91	1.00		0.95	0.97	1.00
Frpb, ped/bikes	1.00	0.97		1.00	1.00	0.69
Flpb, ped/bikes	1.00	1.00		1.00	0.73	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	1.00	1.00		1.00	0.95	1.00
Satd. Flow (prot)	5043	1473		3544	2488	1068
Flt Permitted	1.00	1.00		1.00	0.95	1.00
Satd. Flow (perm)	5043	1473		3544	2488	1068
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2398	440	0	1725	1011	378
RTOR Reduction (vph)	0	223	0	0	0	1
Lane Group Flow (vph)	2398	217	0	1725	1011	377
Confl. Peds. (#/hr)		13	13		174	363
Heavy Vehicles (%)	4%	7%	0%	3%	4%	5%
Turn Type	NA	Perm		NA	Perm	Perm
Protected Phases	2			2		
Permitted Phases		2			4	4
Actuated Green, G (s)	29.8	29.8		29.8	23.3	23.3
Effective Green, g (s)	32.0	32.0		32.0	25.0	25.0
Actuated g/C Ratio	0.49	0.49		0.49	0.38	0.38
Clearance Time (s)	6.2	6.2		6.2	5.7	5.7
Lane Grp Cap (vph)	2482	725		1744	956	410
v/s Ratio Prot	0.48			c0.49		
v/s Ratio Perm		0.15			c0.41	0.35
v/c Ratio	0.97	0.30		0.99	1.06	0.92
Uniform Delay, d1	16.0	9.8		16.3	20.0	19.1
Progression Factor	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	11.7	1.1		19.1	45.6	28.3
Delay (s)	27.7	10.9		35.4	65.6	47.4
Level of Service	C	B		D	E	D
Approach Delay (s)	25.1			35.4	60.6	
Approach LOS	C			D	E	
Intersection Summary						
HCM 2000 Control Delay			36.4		HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio			1.05			
Actuated Cycle Length (s)			65.0		Sum of lost time (s)	9.7
Intersection Capacity Utilization			79.9%		ICU Level of Service	D
Analysis Period (min)			15			
c Critical Lane Group						

Appendix H

Zoning By-law 6593



**TABLE 1 - MINIMUM REQUIRED PARKING FOR,
RESIDENTIAL, INSTITUTIONAL, PUBLIC AND COMMERCIAL USES**

TABLE 1

Class of Use (Column 1)	Minimum Number of Required Parking Spaces (Column 2)
1. <u>Residential Uses</u>	
(a) Single family dwelling;	(a) 2 parking spaces for each Class A dwelling unit, for the first 8 habitable rooms in the dwelling unit plus 0.5 parking space for each additional habitable room; (97-112)
(b) Two family dwelling;	(b) 1 space per Class A dwelling unit;
(c) Three family dwelling;	(c) 1.33 spaces per Class A dwelling unit;
(d) Townhouse dwelling, Maisonette dwelling, Maisonette dwelling;	(d) 1.5 spaces per Class A dwelling unit;
(e) Street Townhouse dwelling;	(e) 1 space per Class A dwelling unit;
(f) Townhouse dwelling, Maisonette dwelling with garage parking space enclosed or attached to each dwelling unit;	(f) 1.3 spaces per dwelling unit of which 1 space shall be covered and attached to or enclosed within each dwelling unit;
(g) Multiple dwelling;	(g) 1.25 spaces per Class A dwelling unit except as follows: <ul style="list-style-type: none"> (i) 0.8 of a space per Class A dwelling unit within area "A", shown on Schedule "H"; (ii) 1 space per Class A dwelling unit within area "B", shown on Schedule "H";
(h) Student Residence not located on a campus, containing separate dwelling units for each student;	(h) 1 space per Class A dwelling unit;

<u>Class of Use (Column 1)</u>	<u>Minimum Number of Required Parking Spaces (Column 2)</u>
(i) Housekeeping dwelling unit;	(i) 1 space per dwelling unit;
(j) Lodging House, (Hostel - , Deleted by 01-143) (02-043) Tourist Home; (92-170)	(j) 1 space per 2 persons who may be lawfully accommodated;
(k) (Home for Elderly Persons - Deleted by 01-143)	(k) (i) (Deleted by 01-143) (ii) (Deleted by 01-143)
(l) Residential Care Facility, (Short-Term Care Facility - Deleted by 01-143) Retirement Home, Emergency Shelter and Corrections Residence (01-143)	(l) 1 space per 3 persons who may be lawfully accommodated;
(m) Hotel, Motel, Motor Hotel, Motor Court.	(m) 1 space per guest room or unit except as follows: (i) 0 spaces within Area "A" shown on Schedule "I".

2. **Institutional Uses**

(a) Children's Residence;	(a) 1 space per 6 persons who may be lawfully accommodated;
(b) (Nursing Home, Home for the Aged – Deleted by 01-143) Long Term Care Facility; (01-143)	(b) 1 space per 3 patient beds;
(c) Day Nursery (90-248) Correctional Facility; (01-143)	(c) 1 space per 6 children who may be lawfully accommodated (90-248) 1 space per 3 persons (01-143)

3. **Public Uses**

(a) Art Gallery, Museum, Observatory, Library, Church;	(a) Nil;
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<u>Class of Use (Column 1)</u>		<u>Minimum Number of Required Parking Spaces (Column 2)</u>	
(b)	School;		
(i)	Elementary;	(b) (i)	1.25 spaces per classroom;
(ii)	Secondary;	(ii)	1.8 spaces per classroom;
(iii)	Secondary - Grade 13 only;	(iii)	2.5 spaces per classroom;
(iv)	University, College, Commercial, Technical;	(iv)	6 spaces per classroom;
(c)	Place of Assembly, Private Club, Lodge, Fraternity House, Sorority House, Labour Union Hall;	(c)	1 space per 6 persons who may be lawfully accommodated;
(d)	Public Offices;	(d)	1 space per 31.0 square metres of floor area in excess of 450.0 square metres;

4. **Commercial Uses**

(a)	Medical Office, including Doctor, Dentist, Osteopath, Drugless Practitioner;	(a)	1 space per 19.0 square metres of floor area;
(b)	Funeral Home;	(b)	1 space per 23.0 square metres of floor area;
(c)	General Office, Medical Laboratory;	(c)	1 space per 31.0 square metres of floor area in excess of 450.0 square metres;
(d)	Banks and Other Similar Financial Institutions;	(d)	1 space per 31.0 square metres of floor areas;
(e)	Bowling Alley;	(e)	3 spaces per lane;
(f)	Tavern, Public House, Beverage Room, Restaurant, Theatre, Cinema and any place of assembly for commercial use;	(f)	1 space per 6 persons who may be lawfully accommodated;
(g)	Warehouse;	(g)	1 space per 115.0 square metres of floor

area;

<u>Class of Use</u> <u>(Column 1)</u>	<u>Minimum Number of Required</u> <u>Parking Spaces</u> <u>(Column 2)</u>
(i) Sales establishment, leasing establishment, service shop, retail store, shopping centre and any other commercial use not otherwise mentioned in paragraph number 4 of column 1 of Table 1.	(i) 1 space for every 31.0 square metres of floor area for that portion of the floor area between 450.0 square metres up to and including 3,700 square metres and additional; (i) 1 space for every 17.0 sq. m. of floor area for that portion of the floor area between 3,700 square metres up to and including 12,800 square metres and an additional, (ii) 1 space for every 20.0 square metres of floor area for that portion of the floor area in excess of 12,800 square metres.

TABLE 2 - MINIMUM REQUIRED RESIDENTIAL VISITOR PARKING

TABLE 2

<u>Class of Residential Use (Column 1)</u>	<u>Minimum Number of Required Parking Spaces (Column 2)</u>
1. Multiple dwellings within area "A", shown on Schedule "H".	0.16 of a space per Class A dwelling unit.
2. Multiple dwellings within area "B", shown on Schedule "H".	0.20 of a space per Class A dwelling unit.
3. Multiple dwellings not in areas referred to in paragraphs 1 and 2.	0.25 of a space per Class A dwelling unit.
4. (Home for Elderly Persons - Deleted by 01-143)	
5. Townhouse dwelling, Maisonette dwelling.	0.30 of a space per Class A dwelling unit.
6. Three family dwelling.	0.33 of a space per Class A dwelling unit.

Appendix I

Zoning By-law 05-200



SECTION 5: PARKING**ZONING BY-LAW**

Office	1 for each 50 square metres of gross floor area in excess of 450 square metres, which accommodates such use.
Private Club or Lodge	1 for each 50 square metres of gross floor area in excess of 450 square metres, which accommodates such use.
Veterinary Service	1 for each 50 square metres of gross floor area in excess of 450 square metres, which accommodates such use.

(By-law 11-276, November 16, 2011)

- b) Notwithstanding Subsection a) above, for any permitted use or uses within any Downtown Zone located in all or part of a building existing on the effective date of this By-law, no parking spaces are required provided that the number of parking spaces which existed on the effective date of this By-law shall continue to be provided and maintained. Where an addition or expansion of an existing building is proposed, the parking requirements of Section 5.6 a) above, shall only apply to the use or uses contained within the increased gross floor area.

(By-law 14-238, September 10, 2014)

- c) Parking Schedule for All Zones, except the Downtown Zones

<u>Column 1</u>	<u>Column 2</u>
i. Residential Uses	
Single Detached Dwelling, Semi-Detached Dwelling, Duplex Dwelling Dwelling Unit	1 for each dwelling unit
Multiple Dwelling Street Townhouse Dwelling	1 for each dwelling unit, except where a dwelling unit is 50 square metres in gross floor area or less, in which case, parking shall be provided at a rate of 0.3 spaces for each such unit.

Appendix J

Comparable Sites - Parking Survey Data



770 Queenston Road - Parking Utilization Survey

Time Ending	Tuesday June 28, 2016		Wednesday June 29, 2016		Two Day Average	
	Occupied	Unoccupied	Occupied	Unoccupied	Occupied	Unoccupied
4:15	86	129	87	128	87	129
4:30	87	128	87	128	87	128
4:45	88	127	84	131	86	129
5:00	91	124	86	129	89	127
5:15	92	123	88	127	90	125
5:30	93	122	93	122	93	122
5:45	95	120	94	121	95	121
6:00	95	120	92	123	94	122
6:15	96	119	98	117	97	118
6:30	101	114	101	114	101	114
6:45	103	112	99	116	101	114
7:00	101	114	100	115	101	115
7:15	105	110	102	113	104	112
7:30	104	111	99	116	102	114
7:45	109	106	101	114	105	110
8:00	111	104	105	110	108	107
8:15	109	106	106	109	108	108
8:30	115	100	108	107	112	104
8:45	117	98	110	105	114	102
9:00	118	97	112	103	115	100
9:15	117	98	115	100	116	99
9:30	116	99	119	96	118	98
9:45	117	98	118	97	118	98
10:00	119	96	121	94	120	95
Maximum Observed	119	129	121	131	120	129
Minimum Observed	86	96	84	94	86	95
Average Observed	104	111	101	114	102	113

644 Main Street West - Parking Garage - Parking Utilization Survey

Time Ending	Thursday September 8, 2016		Friday September 9, 2016		Saturday September 10, 2016		Three Day Average	
	Occupied	Unoccupied	Occupied	Unoccupied	Occupied	Unoccupied	Occupied	Unoccupied
4:15	83	216	84	215	100	199	89	210
4:30	84	215	84	215	102	197	90	209
4:45	85	214	81	218	100	199	89	210
5:00	88	211	83	216	99	200	90	209
5:15	88	211	85	214	97	202	90	209
5:30	89	210	90	209	97	202	92	207
5:45	91	208	90	209	99	200	93	206
6:00	91	208	88	211	100	199	93	206
6:15	91	208	94	205	101	198	95	204
6:30	95	204	97	202	101	198	98	201
6:45	97	202	95	204	101	198	98	201
7:00	95	204	96	203	104	195	98	201
7:15	99	200	98	201	104	195	100	199
7:30	98	201	95	204	105	194	99	200
7:45	102	197	97	202	107	192	102	197
8:00	105	194	101	198	109	190	105	194
8:15	103	196	101	198	109	190	104	195
8:30	109	190	103	196	111	188	108	191
8:45	111	188	105	194	112	187	109	190
9:00	112	187	107	192	115	184	111	188
9:15	111	188	110	189	116	183	112	187
9:30	110	189	112	187	116	183	113	186
9:45	110	189	112	187	117	182	113	186
10:00	112	187	115	184	118	181	115	184
Maximum Observed	112	216	115	218	118	202	115	210
Minimum Observed	83	187	81	184	97	181	89	184
Average Observed	98	201	97	202	106	193	100	199

644 Main Street West - Carling Street Surface Parking Lot - Parking Utilization Survey

Time Ending	Thursday September 8, 2016		Friday September 9, 2016		Saturday September 10, 2016		Three Day Average	
	Occupied	Unoccupied	Occupied	Unoccupied	Occupied	Unoccupied	Occupied	Unoccupied
4:15	3	12	3	12	4	11	3	12
4:30	3	12	3	12	3	12	3	12
4:45	3	12	3	12	3	12	3	12
5:00	3	12	3	12	2	13	3	12
5:15	4	11	3	12	2	13	3	12
5:30	4	11	3	12	3	12	3	12
5:45	4	11	4	11	3	12	4	11
6:00	4	11	4	11	3	12	4	11
6:15	5	10	4	11	3	12	4	11
6:30	6	9	4	11	4	11	5	10
6:45	6	9	4	11	4	11	5	10
7:00	6	9	4	11	4	11	5	10
7:15	6	9	4	11	4	11	5	10
7:30	6	9	4	11	4	11	5	10
7:45	7	8	4	11	4	11	5	10
8:00	6	9	4	11	4	11	5	10
8:15	6	9	5	10	4	11	5	10
8:30	6	9	5	10	5	10	5	10
8:45	6	9	5	10	5	10	5	10
9:00	6	9	5	10	5	10	5	10
9:15	6	9	5	10	5	10	5	10
9:30	6	9	7	8	6	9	6	9
9:45	7	8	6	9	6	9	6	9
10:00	7	8	6	9	6	9	6	9
Maximum Observed	7	12	7	12	6	13	6	12
Minimum Observed	3	8	3	8	2	9	3	9
Average Observed	5	10	4	11	4	11	5	11

644 Main Street West - Macklin Street Surface Parking Lot - Parking Utilization Survey

Time Ending	Thursday September 8, 2016		Friday September 9, 2016		Saturday September 10, 2016		Three Day Average	
	Occupied	Unoccupied	Occupied	Unoccupied	Occupied	Unoccupied	Occupied	Unoccupied
4:15	3	8	11	0	7	4	7	4
4:30	3	8	7	4	8	3	6	5
4:45	5	6	8	3	9	2	7	4
5:00	5	6	6	5	11	0	7	4
5:15	6	5	5	6	8	3	6	5
5:30	6	5	5	6	8	3	6	5
5:45	4	7	4	7	4	7	4	7
6:00	7	4	3	8	4	7	5	6
6:15	6	5	4	7	6	5	5	6
6:30	6	5	3	8	4	7	4	7
6:45	4	7	4	7	2	9	3	8
7:00	5	6	6	5	2	9	4	7
7:15	3	8	6	5	3	8	4	7
7:30	8	3	6	5	5	6	6	5
7:45	7	4	7	4	3	8	6	5
8:00	9	2	9	2	5	6	8	3
8:15	9	2	9	2	4	7	7	4
8:30	8	3	9	2	2	9	6	5
8:45	7	4	9	2	1	10	6	5
9:00	9	2	9	2	3	8	7	4
9:15	9	2	10	1	5	6	8	3
9:30	8	3	8	3	8	3	8	3
9:45	9	2	9	2	10	1	9	2
10:00	9	2	9	2	8	3	9	2
Maximum Observed	9	8	11	8	11	10	9	8
Minimum Observed	3	2	3	0	1	0	3	2
Average Observed	6	5	7	4	5	6	6	5