



paradigm
TRANSPORTATION SOLUTIONS LIMITED

**4611 King Street East,
Kitchener**

**Transportation
Impact Study**

Paradigm Transportation Solutions Limited

2024-12
230375



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Client:**LJM Developments (King Street) Inc.**

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4611 King Street East, Kitchener Transportation Impact Study



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Executive Summary

Content

In July 2024, Paradigm Transportation Solutions Limited (Paradigm) prepare a Transportation Impact Brief for a proposed mixed-use development at 4611 King Street in the City of Kitchener.

The purpose of this study is to address comments on the July 2024 study provided by the City of Kitchener, Region of Waterloo, and the Ontario Ministry of Transportation.

Development Concept

The subject lands are on the south side King Street East and are vacant. The property owner plans to develop the site into a mixed-use development comprising 726 residential units, 1,242 m² (13,370 sq. ft.) of office uses, and 650 m² (7,000 sq. ft.) of retail uses. A total parking supply of 493 vehicular parking spaces, and 404 bicycle parking spaces is proposed.

Vehicle access is proposed via a right-in/right-out driveway connection to King Street West. The ultimate build-out year remains unknown.

Findings

The findings of this Transportation Impact Brief Update are as follows:

- ▶ The subject lands are vacant. The property owner plans to develop the site into a mixed-use development comprising 726 residential units, 650 m² (7,000 sq. ft.) of retail uses, and 1,242 m² (13,370 sq. ft.) of office uses.
- ▶ Under 2031 background traffic conditions (without the proposed development), several critical movements are forecast throughout the study area in both the AM peak hour and PM peak hour, primarily at the intersection of King Street East and Sportsworld Drive/Baxter Place.

In the PM peak hour, the eastbound left-turn movements on King Street East at Tu-Lane Street and the eastbound Highway 401 on-ramp/off-ramp, as well as the southbound left-turn movement from Tu-Lane Street onto King Street East are forecast to operate with delays greater than 55 seconds.

- ▶ Development of the site is estimated to generate 225 trips in the AM peak hour and 283 trips in the PM peak hour;



- ▶ Under 2031 total traffic conditions (with the proposed development), several critical movements are forecast throughout the study area in both the AM peak hour and PM peak hour, primarily at the intersection of King Street East and Sportsworld Drive/Baxter Place.

In both the AM peak hour and PM peak hour, the site-generated traffic introduces one additional critical movement: the westbound through movement on King Street East at the eastbound Highway 401 off-ramp.

The site driveway is forecast to operate at LOS F in both the AM peak hour and PM peak hour, with v/c ratios no less than 0.81. Forecast operations at the site driveway reflect the high volume of eastbound traffic on King Street East, which provide limited opportunities for driveway volumes to enter the traffic stream on King Street East.

- ▶ The future provision of an interchange ramp connecting southbound Highway 8 to westbound Highway 401 is forecast to reduce volumes on King Street East such that the driveway would be forecast to operate at LOS C in the AM peak hour (v/c ratio of 0.32) and LOS E in the PM peak hour (v/c ratio of 0.63).
- ▶ City of Kitchener Zoning By-law 2019-051 requires a minimum of 854 spaces, comprising 726 residential tenant spaces, 72 residential visitor spaces, 37 office parking spaces, and 19 commercial/retail parking spaces. The proposed parking supply of 493 spaces represents a potential deficit of 361 spaces.
- ▶ ITE parking demand data suggests a peak parking demand of 787 spaces (1.08 spaces per unit), which is less than the minimum required number of spaces (854 spaces), but greater than the proposed parking supply of 493 spaces (0.68 spaces per unit).

Conclusions

Based on the findings of this study, it is concluded that development of the subject site is forecast to have a minor impact on traffic operations at the study intersections. In both the AM peak hour and PM peak hour, the site-generated traffic introduces one additional critical movement: the westbound through movement on King Street East at the eastbound Highway 401 off-ramp. In the absence of signalized ramp terminals, and given the driveway's location near the west property line, U-turns could be completed at the turn-around location on King Street East, within the median immediately in front of the site.

Although the proposed supply is non-compliant with zoning by-law 2019-051, the development is within 150 metres of the Sportsworld



protected major transit station area (PMTSA). The Growing Together Plan and its associated official plan and zoning by-law amendments, approved by Council in March 2024, will not require a minimum number of parking spaces for multiple residential dwelling properties in the PMTSAs.

If the subject site were 150 metres west, it would only be required to provide a minimum number of visitor parking spaces within the proposed residential parking supply. There would be no minimum requirement for resident parking spaces, despite marginal differences in the transportation network.

Because the PMTSA boundary location is arbitrary to residents, vehicle ownership and parking demand trends on either side of the boundary are more likely to reflect the transportation network and its ability to accommodate travel by alternate modes. Whereas a residential development on the west side of the boundary could provide 0 spaces, developments on the immediate east side of the boundary must still provide a minimum of 1.0 space per dwelling.

Recommendations

Based on the findings and conclusions of this study, it is recommended the site be considered for approval with no requirement for off-site transportation network improvements, and a proposed parking supply of 0.68 spaces per unit.

Independent of the proposed development, it is also recommended the Region of Waterloo and Ministry of Transportation monitor the traffic volumes and signal timing plans throughout the King Street East corridor to identify opportunities to improve traffic operations.



Contents

1	Introduction	1
1.1	Overview	1
1.2	Purpose and Scope	1
2	Existing Conditions	4
2.1	Road Characteristics	4
2.2	Transit	5
2.3	Active Transportation	5
2.4	Traffic Volumes	9
3	Development Concept	12
4	Future Conditions	14
4.1	Road Configuration and Traffic Volumes	14
4.2	Forecast Site Traffic	17
4.2.1	Trip Generation	17
4.2.2	Trip Distribution	18
5	Traffic Operations Assessment	22
5.1	Methodology	22
5.2	2031 Background Traffic Conditions	23
5.3	2031 Total Traffic Conditions	26
5.4	Remedial Measures	29
6	Parking Assessment	31
6.1	Required Parking Supply	31
6.2	Estimated Parking Demand	32
6.3	Parking Policy	33
6.3.1	City of Kitchener Long-Term Parking Strategy	33
6.3.2	City of Kitchener Official Plan	33
6.3.3	City of Kitchener Growing Together	34
6.4	Parking Summary	35
7	Transportation Demand Management Plan	37
7.1	Existing Policies, Programs, and Strategies	37
7.1.1	Walking	37
7.1.2	Cycling	38
7.1.3	Transit	39
7.2	Potential Policies, Programs, and Strategies	39
7.2.1	Parking Management	39
7.2.2	Car Share Program	40
7.2.3	Travel Planning/Education/Promotion	41
7.2.4	TDM Coordinator	41
7.2.5	Subsidized Transit Passes	41



7.3 TDM Summary42

8 Conclusions and Recommendations43

8.1 Findings43

8.2 Conclusions.....44

8.3 Recommendations45

Appendices

Appendix A 2031 Background Traffic Operations Reports

Appendix B 2031 Total Traffic Operations Reports

Appendix C 2031 Total Traffic Operations Reports – Sensitivity Analysis

Figures

Figure 1.1: Location of Subject Site3

Figure 2.1: Existing Lane Configurations and Traffic Control6

Figure 2.2: Existing Transit Services7

Figure 2.3: Existing Traffic Volumes.....11

Figure 3.1: Conceptual Site Plan13

Figure 4.1: Assumed Lane Configurations and Traffic Control .15

Figure 4.2: 2031 Future Background Traffic Volumes16

Figure 4.3: Site Generated Traffic Volumes20

Figure 4.4: 2031 Future Total Traffic Volumes21

Tables

Table 2.1: Existing Transit Services8

Table 2.2: Existing TMC Data10

Table 4.1: Estimated Trip Generation19

Table 4.2: Estimated Trip Distribution.....19

Table 5.1: 2031 Traffic Operations – Without Development25

Table 5.2: 2031 Traffic Operations – With Development.....28

Table 5.3: 2031 Traffic Operations – With Development and Highway 8 Interchange Improvements30

Table 6.1: City of Kitchener Zoning By-law Parking Requirements.....31

Table 6.2: Parking Requirements.....31

Table 6.3: Estimated Parking Demands (ITE)32



1 Introduction

1.1 Overview

In July 2024, Paradigm Transportation Solutions Limited (Paradigm) prepare a Transportation Impact Brief for a proposed mixed-use development at 4611 King Street in the City of Kitchener. I am running a few minutes late; my previous meeting is running over. **Figure 1.1** Illustrates the site location on the west side of King Street East, south of Limerick Drive.

1.2 Purpose and Scope

The purpose of this study is to address comments on the July 2024 study provided by the City of Kitchener¹, Region of Waterloo², and Ontario Ministry of Transportation.

The scope of this study is generally consistent with that of the July 2024 Transportation Impact Brief and includes:

- ▶ A description of existing transportation network throughout the King Street East corridor from Sportsworld Drive to Highway 401;
- ▶ Estimates of future traffic volumes (with and without the development) at a study area comprising:
 - King Street East and Sportsworld Drive;
 - King Street East and Tu-Lane Street;
 - King Street East and Westbound Highway 401 Off-Ramp; and
 - King Street East and Eastbound Highway 401 Off-/On-Ramp.
- ▶ Analyses of the estimated transportation network impacts at each intersection above, with and without the development;
- ▶ The identification of remedial measures, if necessary, to support the proposed development;
- ▶ A review of the required parking and estimated parking demands of the proposed development; and

¹ City of Waterloo, *Pre-Submission Consultation Comment Form*, (City of Waterloo: Waterloo, 18 Oct. 2024).

² Region of Waterloo, *Official Plan Amendment OPA24/012 and Zoning By-law Amendment ZBA24/024 4611 King Street East*, (Region of Waterloo: Kitchener, 22 Oct. 2024).

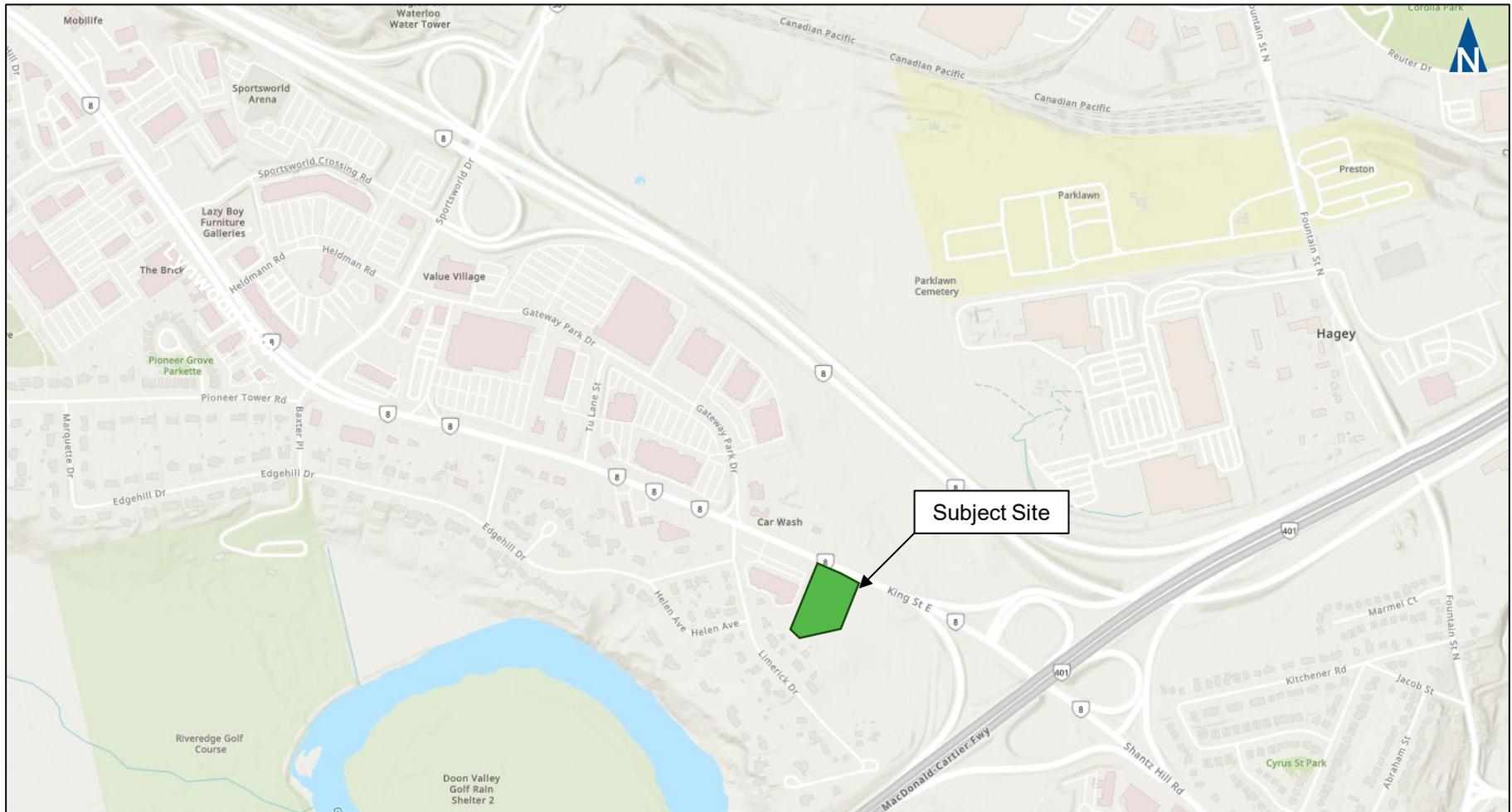


- ▶ The identification of proposed and existing transportation demand management (TDM) measures.

This study has been prepared in general accordance with the Region of Waterloo *Transportation Impact Study Guidelines*³ and reflects comments on the July 2024 study provided by the City of Kitchener, Region of Waterloo, and Ontario Ministry of Transportation.

³ Region of Waterloo, *Transportation Impact Study Guidelines*, (Kitchener: Region of Waterloo, 2014).





Not to Scale

Source: Waterloo Region GIS Locator (<https://maps.kitchener.ca/OnPointExternal/RMap/Default.aspx>), Esri, NASA, NGA, USGS, FEMA | Esri Community Maps Contributors, City of Cambridge, Province of Ontario, Esri Canada, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, NRCAN, Parks Canada



Location of Subject Site

4611 King Street East TIS
230375

Figure 1.1

2 Existing Conditions

2.1 Road Characteristics

The main study roads comprise King Street East, Sportsworld Drive, Tu-Lane Street, Gateway Park Drive, Limerick Drive and Ontario Highway 401. Each study road is described as follows:

- ▶ **King Street East** is a north-south regional road comprising two travel lanes per direction and operates under Region of Waterloo jurisdiction as Regional Road 8. Along the site's frontage, the road has a four-lane urban cross-section, and the posted speed limit is 60 km/h. Since the completion of the July 2024 study, raised centre medians have been built within the middle of the road, generally from Sportsworld Drive to the easterly limit of 4611 King Street East.
- ▶ **Sportsworld Drive** is an east-west four-lane regional road comprising two general purpose travel lanes per direction. On-road bicycle lanes are also provided on both sides of the road. The road has an urban-cross-section with a posted speed limit of 50 km/h and the road operates under Region of Waterloo jurisdiction as Regional Road 38. On the west side of King Street East, Sportsworld Drive splits into two roads: Baxter Place (a local road) and Pioneer Tower Road (a major community collector road).
- ▶ **Tu-Lane Street** is an east-west two-lane local street with an urban cross-section comprising one travel lane per direction. The speed limit is not posted and is assumed to be 50 km/h.
- ▶ **Gateway Park Drive** is an east-west to north-south minor neighbourhood collector street with a three-to-four lane urban cross-section comprising at least one travel lane per direction. A centre two-way left-turn lane is provided between Tu-Lane Drive and Sportsworld Drive. South of Tu-Lane Street, the road operates with one travel lane per direction with exclusive left-turn lanes provided at intermediate driveway connections. The speed limit is not posted and is assumed to be 50 km/h.
- ▶ **Limerick Drive** is an east-west to north-south local road with a two-lane urban cross-section, comprising one travel lane per direction. The speed limit is not posted and is assumed to be 50 km/h.

Figure 2.1 illustrates the existing lane configurations and traffic control at the study area intersections. At the time of writing, the off-ramp from eastbound Highway 401 to northbound King Street East, and the on-



ramp from King Street East onto eastbound Highway 401 were closed. These closures are illustrated in red on **Figure 2.1**.

2.2 Transit

Grand River Transit (GRT) is the public transit operator in the Region of Waterloo and operates two surface routes (Route 203 and Route 206) near the site. **Route 203 (iXpress Maple Grove)** operates between Cambridge Centre Station and Conestoga College Doon Campus – Door 3. **Route 206 (iXpress Coronation)** operates between Fairway Station and Southwood Drive and Cedar Street.

Both routes operate seven days a week and serve the following transit stops near the site:

- ▶ Stop 1636: South side of Gateway Park Drive, east of King Street East;
- ▶ Stop 1574: North side of Tu-Lane Street, east of King Street; and
- ▶ Stop 4223: West side of King Street East, south of Limerick Drive.

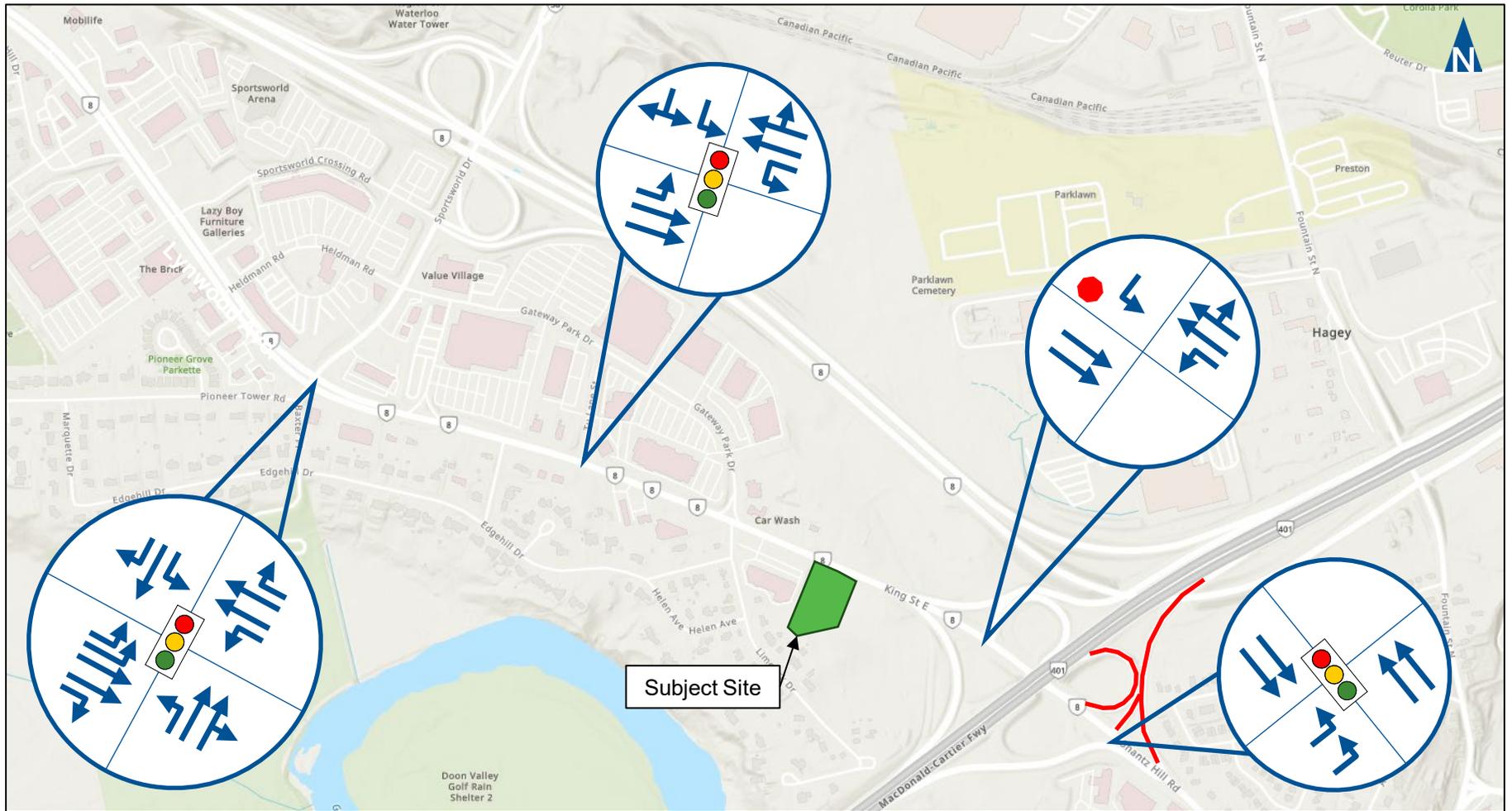
The site is also 1.4 km (20-minute walk) from the Sportsworld Station which provides connections to Route 67 (Eagle-Pinebush), Route 72 (Flex Boxwood), and Route 302 (ION Bus).

Figure 2.2 illustrates the existing transit services near the site. **Table 2.1** summarizes the operating hours and headways of both transit services operating on King Street East.

2.3 Active Transportation

Sidewalks are provided on both sides of all study roads, except Limerick Drive, Baxter Place and Pioneer Tower Road which do not include sidewalks on either side of the road. The intersections of King Street East and Sportsworld Drive and King Street East and Tu-Lane Street are signalized and include delineated crosswalks on all approaches. A shared multi-use path is provided on the east side of King Street, extending through the intersection with Gateway Park Drive to Sportsworld Drive. Sportsworld Drive also features on-road bicycle lanes on both sides of the road east of Gateway Park Drive.



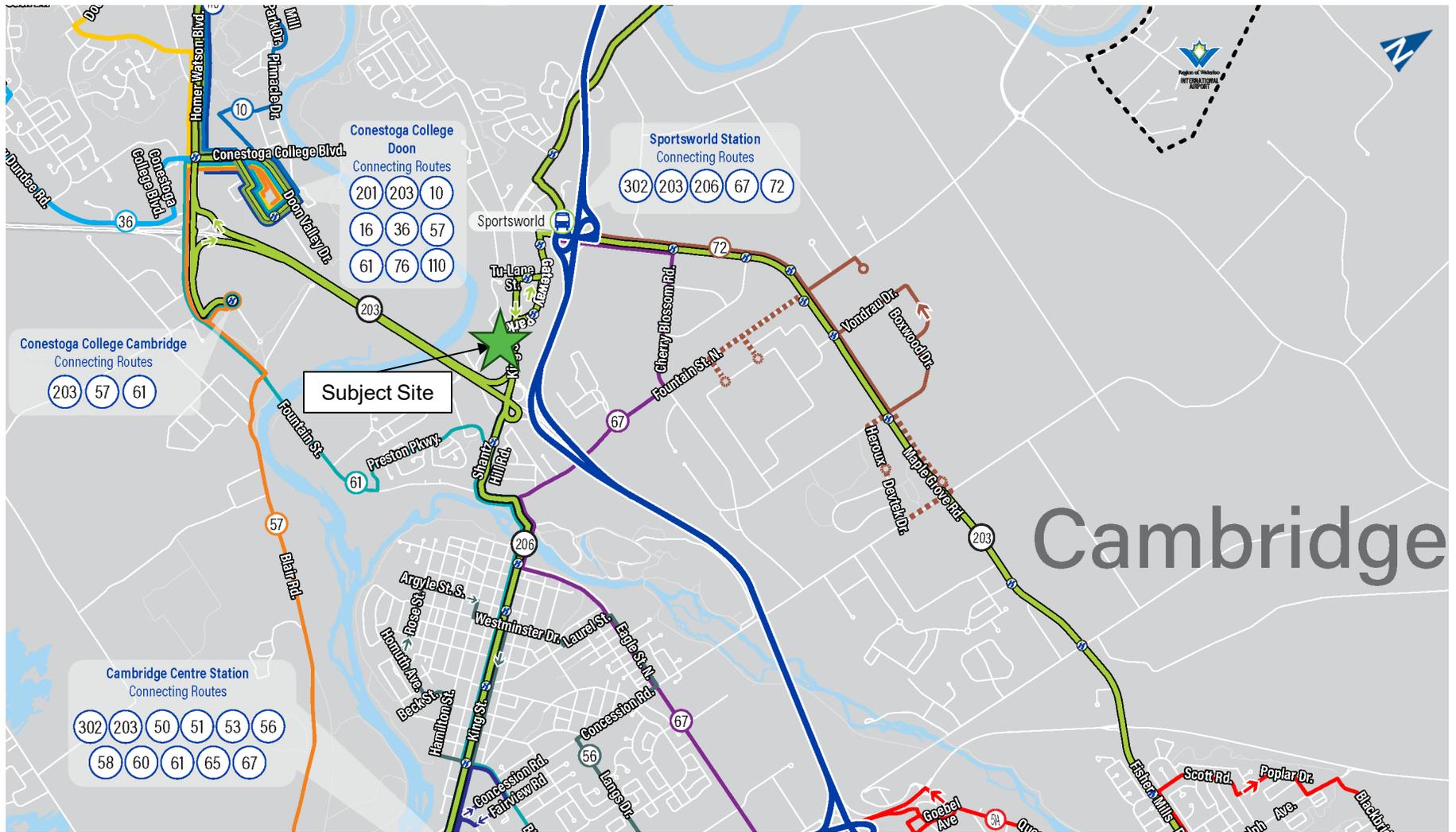


Not to Scale

Source: Waterloo Region GIS Locator (<https://maps.kitchener.ca/OnPointExternal/RMap/Default.aspx>), Esri, NASA, NGA, USGS, FEMA | Esri Community Maps Contributors, City of Cambridge, Province of Ontario, Esri Canada, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, NRCAN, Parks Canada



Existing Lane Configurations and Traffic Control



Not to Scale

Source: Grand River Transit System Map (https://www.grt.ca/en/schedules-maps/resources/2023-09-26-2023-system-map_09262023-web.pdf)



Existing Transit Services

TABLE 2.1: EXISTING TRANSIT SERVICES

Route	Direction	Weekday	Saturday	Sunday	Peak Headway
<i>Grand River Transit – Sportsworld Station</i>					
203 (iXpress Maple Grove)	To Conestoga College	06:36 – 09:38 15:11 – 18:08	07:05 – 21:28	09:35 – 21:28	30 mins (weekday) 60 mins (weekend)
	To Cambridge Centre Station	06:41 – 23:12	07:10 – 21:30	09:40 – 21:30	
206 (iXpress Coronation)	To Fairway Station	05:45 – 00:31 (next day)	06:32 – 00:16 (next day)	07:42 – 23:45	20-30 mins (weekday) 30 mins (weekend)
	To Southwood/C edar	05:44 – 00:15 (next day)	06:27 – 00:13 (next day)	07:56 – 00:12 (next day)	



2.4 Traffic Volumes

At the time of the July 2024 study, King Street East from Sportsworld Drive to Highway 401 was under construction to support intersection improvements, storm sewer replacement, and the construction of active transportation facilities. Construction started in 2022 and was expected to take several years. In addition, the eastbound off-ramp from Highway 401 to northbound King Street East, and the on-ramp from northbound and southbound King Street East onto eastbound Highway 401 were also closed. These closures are illustrated in red in **Figure 2.1**.

Paradigm conducted a supplemental site visit in November 2024 to

- ▶ 1) confirm the state of construction and the aforementioned closures; and
- ▶ 2) determine the feasibility of conducting turning movement counts at the study intersections.

As of November 2024, construction along King Street East was generally complete; however, the on-ramps to the eastbound Highway 401 remained closed, as well as the off-ramp from eastbound Highway 401 to northbound King Street East. Traffic from eastbound Highway 401 intending to travel north on King Street East was being accommodated by a traffic control signal at the intersection, as well as a modification of the westerly off-ramp to support eastbound left-turns onto King Street East.

For this TIS update, the Region of Waterloo provided historic turning movement count data for three of the four study intersections; data was not available for the intersection of King Street East and the eastbound Highway 401 off-ramp/on-ramp. **Table 2.2** summarizes the date of each count at each of the study intersections. **Figure 2.3** illustrates the volumes at each intersection based on the data provided by the Region.

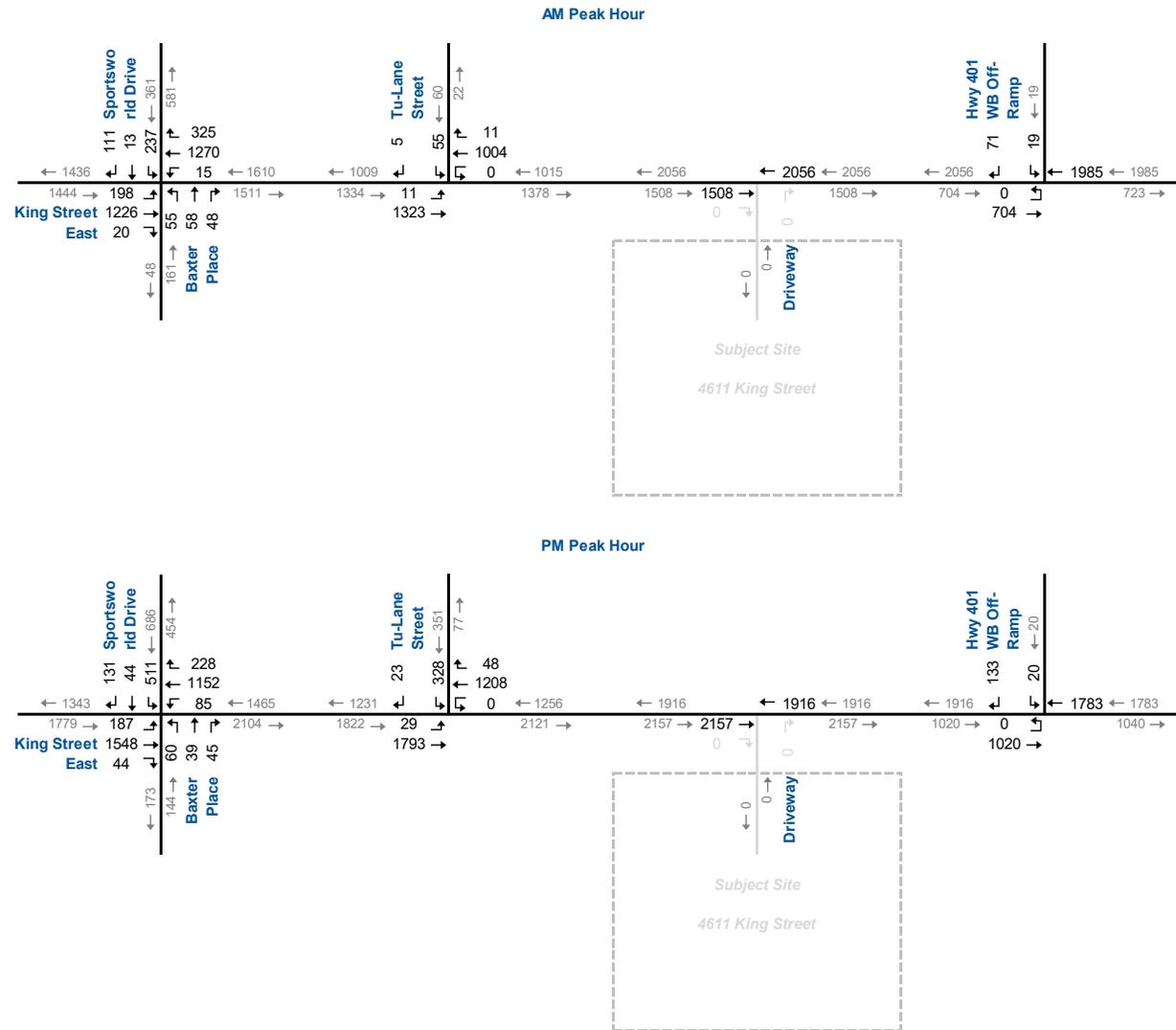
Because of the ongoing ramp closures, northbound and southbound traffic volumes on King Street East would be expected to still be atypical of conditions when these ramps are open. Therefore, Paradigm did not conduct additional turning movement counts at the study intersections. The volumes illustrated in **Figure 2.3** are included for illustrative purposes only.



TABLE 2.2: EXISTING TMC DATA

Intersection	Date of TMC
King Street East and Sportsworld Drive/Pioneer Tower Road	October 31, 2019
King Street East and Tu-Lane Street	October 11, 2022
King Street East and Westbound Highway 401 Off-Ramp	May 23, 2019
King Street East and Eastbound Highway 401 Off-Ramp/On-Ramp	Not Available





Not to Scale



Existing Traffic Volumes

3 Development Concept

The subject lands are on the south side King Street East and are vacant. The property owner plans to develop the site into a mixed-use development comprising 726 residential units, 1,242 m² (13,370 sq. ft.) of office uses, and 650 m² (7,000 sq. ft.) of retail uses. A total parking supply of 493 vehicular parking spaces, and 404 bicycle parking spaces is proposed. Vehicle access is proposed via a right-in/right-out driveway connection to King Street West. The ultimate build-out year remains unknown. **Figure 3.1** illustrates the proposed concept plan.





Conceptual Site Plan

4611 King Street East TIS
230375

Figure 3.1

4 Future Conditions

4.1 Road Configuration and Traffic Volumes

In April 2021, the Region completed the *Stage 2 ION: Light Rail Transit from Kitchener to Cambridge Environmental Project Report*.⁴ The functional design of the Stage 2 ION LRT identified two general purpose travel lanes between Sportsworld Drive and the interchange with Highway 401. Traffic control signals were to be maintained at Sportsworld Drive and Tu-Lane Street, and both Highway 401 ramp terminals would be signalized. Traffic on Limerick Drive would be restricted to right-in/right-out (RIRO) only. **Figure 4.1** illustrates the lane configurations and traffic control assumed at each intersection in the *Environmental Project Report*.

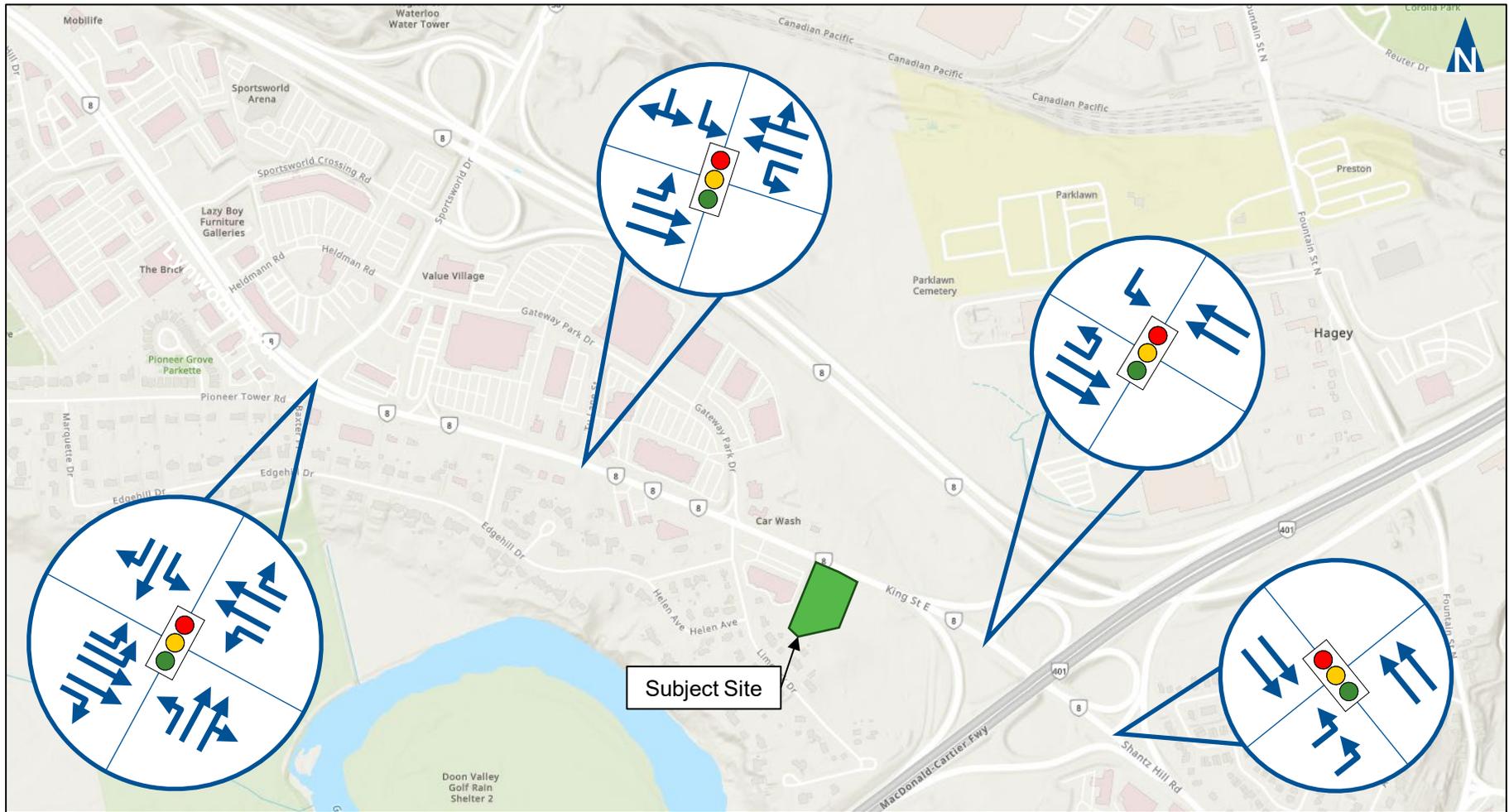
The lane configurations illustrated at Sportsworld Drive and King Street East, and Tu-Lane Road and King Street East are consistent with those noted during the site visit in November 2024. Westbound vehicles on King Street East are permitted to perform a U-turn at Tu-Lane Street using a dedicated U-turn lane. No separate signal phase is provided for this movement, and vehicles can execute a U-turn after yielding to eastbound traffic on King Street East. A temporary traffic signal is installed at King Street East and the eastbound Highway 401 off-ramp.

Due to the state of construction activity in the study area and the impacts to travel patterns, the analysis of traffic impacts in this TIS still relies on the 2031 traffic forecasts referenced in the *Traffic Impact Assessment Report* of the *Stage 2 ION: Light Rail Transit from Kitchener to Cambridge Environmental Project Report*.⁵ These provide an estimate of traffic volumes in the study area at 2031 in lieu of using existing data collection which would omit traffic volumes destined to eastbound Highway 401. **Figure 4.2** illustrates the estimated 2031 traffic volumes at the study intersections without the proposed development.

⁴ Region of Waterloo, *Stage 2 ION: Light Rail Transit from Kitchener to Cambridge Environmental Project Report*, (Waterloo: Region of Waterloo, 2021).

⁵ Region of Waterloo, *Stage 2 ION: Light Rail Transit from Kitchener to Cambridge Environmental Project Report*, (Waterloo: Region of Waterloo, 2021).



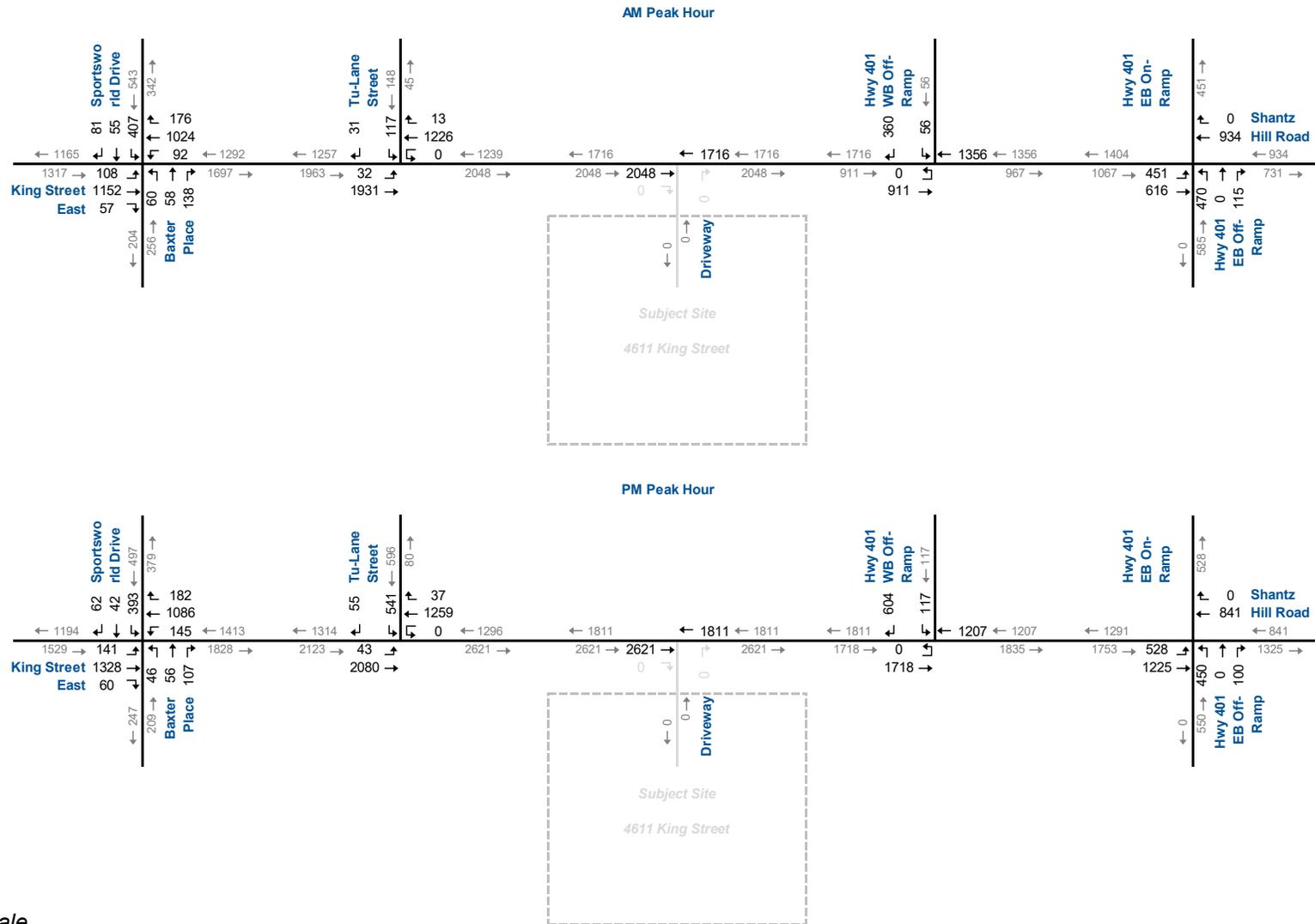


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Source: Waterloo Region GIS Locator (<https://maps.kitchener.ca/OnPointExternal/RMap/Default.aspx>), Esri, NASA, NGA, USGS, FEMA | Esri Community Maps Contributors, City of Cambridge, Province of Ontario, Esri Canada, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, NRCAN, Parks Canada



Assumed Lane Configurations and Traffic Control



Not to Scale



2031 Future Background Traffic Volumes

4611 King Street East TIS
230375

Figure 4.2

4.2 Forecast Site Traffic

4.2.1 Trip Generation

The site trip generation for the site reflects information published in the Institute of Transportation Engineers (ITE) *Trip Generation Manual*⁶ for three land use codes (LUCs):

- ▶ LUC 222 Multifamily Housing (High-Rise);
- ▶ LUC 710 General Office Building; and
- ▶ LUC 822 Strip Retail Plaza (under 40,000 sq. ft.).

Consistent with direction published in the ITE *Trip Generation Handbook*, the trip generation estimates for LUC 222 and LUC 710 reflect the published fitted curve equations whereas the estimates for LUC 822 use the average rates.⁷

In previous editions of the *Trip Generation Manual*, LUC 820 (Shopping Centre) included all forms of retail shopping centres, regardless of size. The 11th edition of the *Trip Generation Manual* now includes three separate land use codes for shopping centres of varying size. LUC 822 reflects a wide variety of shopping centre style developments with floor areas no greater than 40,000 square feet. It provides a high-level estimate of potential retail trips, in lieu of a more detailed trip generation estimate using specific retail land use by retail unit.

The trip generation estimates also include a calculation of pass-by trips which are a subset of trip generation that only apply to commercial and retail land uses. They represent a portion of the existing traffic using a road that may stop at a business along a route, for example, a motorist driving home from work and stopping for groceries. They do not load additional traffic onto the road network.

Because the 3rd edition of the *Trip Generation Handbook* does not include specific pass-by rates for each of the updated land use codes in the 11th edition of the *Trip Generation Manual*, the assumed pass-by rate for LUC 822 is based on the pass-by rates published in the ITE *Trip Generation Handbook* for LUC 820.⁸

⁶ Institute of Transportation Engineers, *Trip Generation Manual*, 11th ed., (Washington, DC: ITE, 2021).

⁷ Institute of Transportation Engineers, *Trip Generation Handbook*, 3rd ed., (Washington, DC: ITE, 2017). 27.

⁸ Institute of Transportation Engineers, *Trip Generation Handbook*, 3rd ed., (Washington, DC: ITE, 2017).



Table 4.1 summarizes the trip generation estimates and indicates the site is estimated to generate 225 trips in the AM peak hour and 283 trips in the PM peak hour. These estimates include a pass-by rate of 34% applied in the PM peak hour. ITE does not publish pass-by rates for the AM peak hour, since retail land uses are typically more heavily visited in the afternoon and evening.

4.2.2 Trip Distribution

The trip distribution developed for this study is based on the projected 2031 traffic patterns documented in the *Traffic Impact Assessment Report of the Stage 2 ION: Light Rail Transit from Kitchener to Cambridge Environmental Project Report*.⁹ **Table 4.2** summarizes the estimated trip distribution. **Figure 4.3** illustrates the estimated site traffic assignment in the weekday AM peak hour and weekday PM peak hour. **Figure 4.4** illustrates the forecast 2031 total traffic volumes.

⁹ Region of Waterloo, *Stage 2 ION: Light Rail Transit from Kitchener to Cambridge Environmental Project Report*, (Waterloo: Region of Waterloo, 2021).



TABLE 4.1: ESTIMATED TRIP GENERATION

LUC	AM Peak Hour				PM Peak Hour			
	Rate	In	Out	Total	Rate	In	Out	Total
222 (Multifamily Housing (High-Rise)) – 744 units	Eqn. ^[1]	47	132	179	Eqn. ^[2]	131	81	212
710 (General Office Building) – 12,149 sq. ft.	Eqn. ^[3]	26	4	30	Eqn. ^[4]	5	26	31
822 (Strip Retail Plaza (<40k sq. ft.) – 7,000 sq. ft.	2.36 ^[5]	10	6	16	Eqn. ^[6]	30	30	60
<i>Pass-by Trips</i>	0%	0	0	0	34%	-10	-10	-20
Total Trip Generation		83	142	225		156	127	283

Source: ITE Trip Generation Manual, 11th ed., (Washington, DC: ITE, 2021).

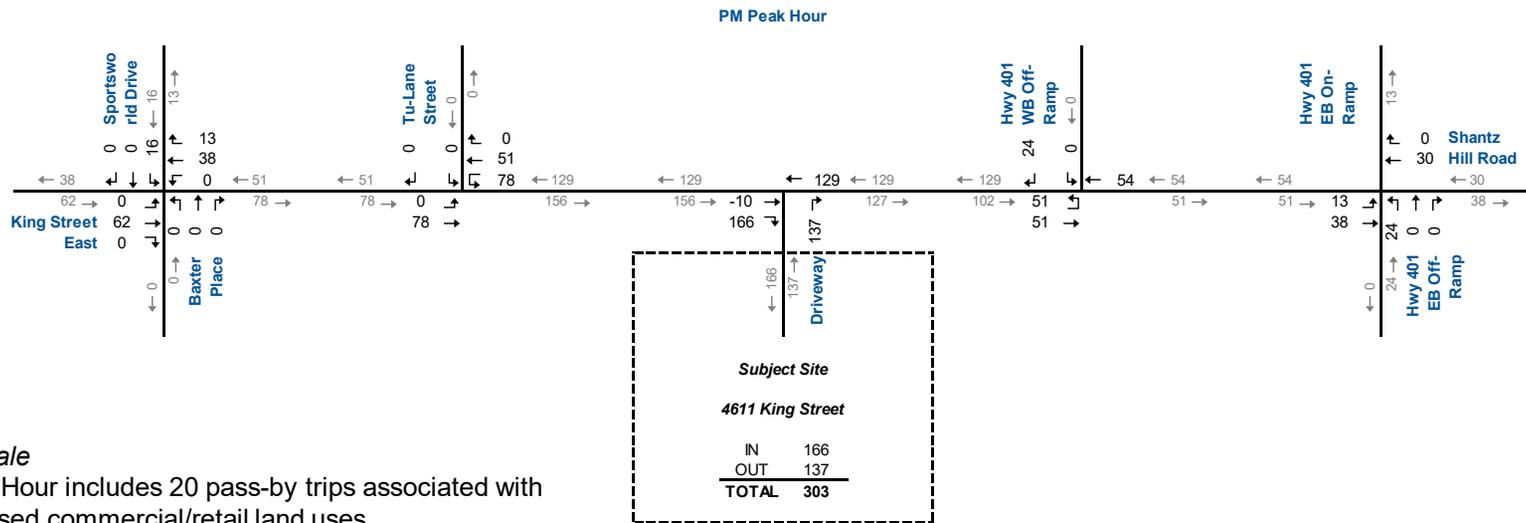
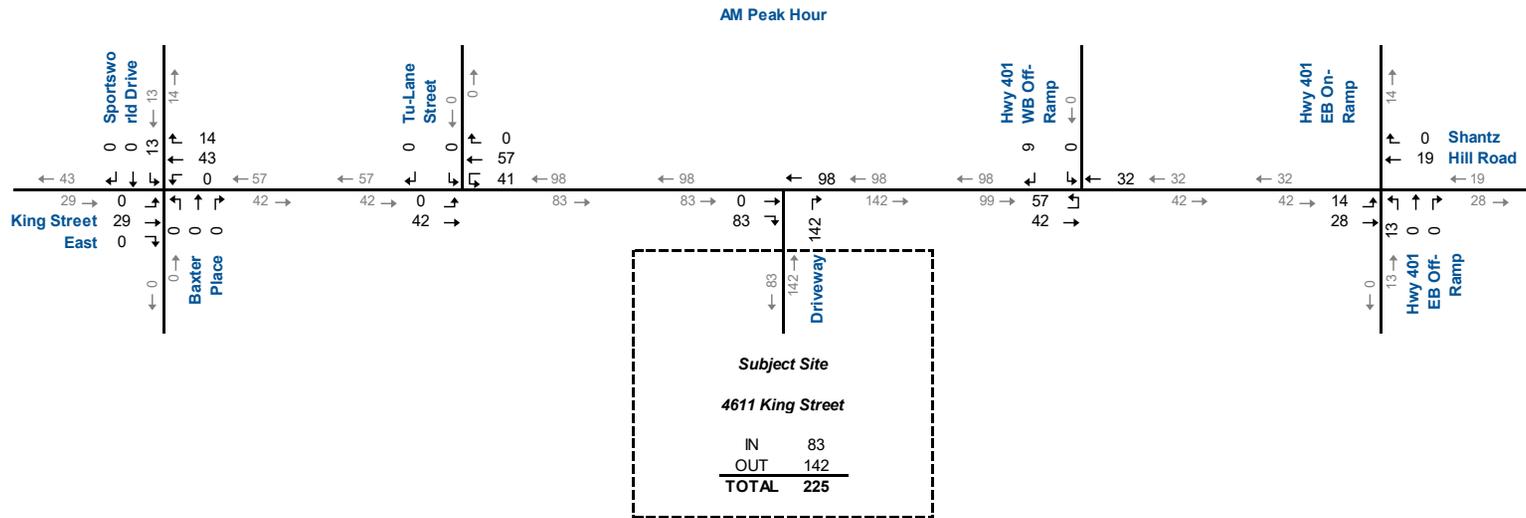
Notes:

1. LUC 222 (AM): $T = 0.22(X) + 18.85$, 26% entering, 74% exiting
2. LUC 222 (PM): $T = 0.26(X) + 23.12$, 62% entering, 38% exiting
3. LUC 710 (AM): $\ln(T) = 0.86 \ln(X) + 1.16$, 88% entering, 12% exiting
4. LUC 710 (PM): $\ln(T) = 0.83 \ln(X) + 1.29$, 17% entering, 83% exiting
5. LUC 822 (AM): 60% entering, 40% exiting
6. LUC 822 (PM): $\ln(T) = 0.71 \ln(X) + 2.72$, 50% entering, 50% exiting

TABLE 4.2: ESTIMATED TRIP DISTRIBUTION

Origin/Destination	AM Peak Hour		PM Peak Hour	
	In	Out	In	Out
North via Sportsworld Drive	15%	10%	10%	10%
North via Highway 401	10%	10%	15%	10%
South via Highway 401	15%	30%	15%	20%
West via King Street	35%	30%	40%	30%
East via King Street	25%	20%	20%	30%
Total	100%	100%	100%	100%



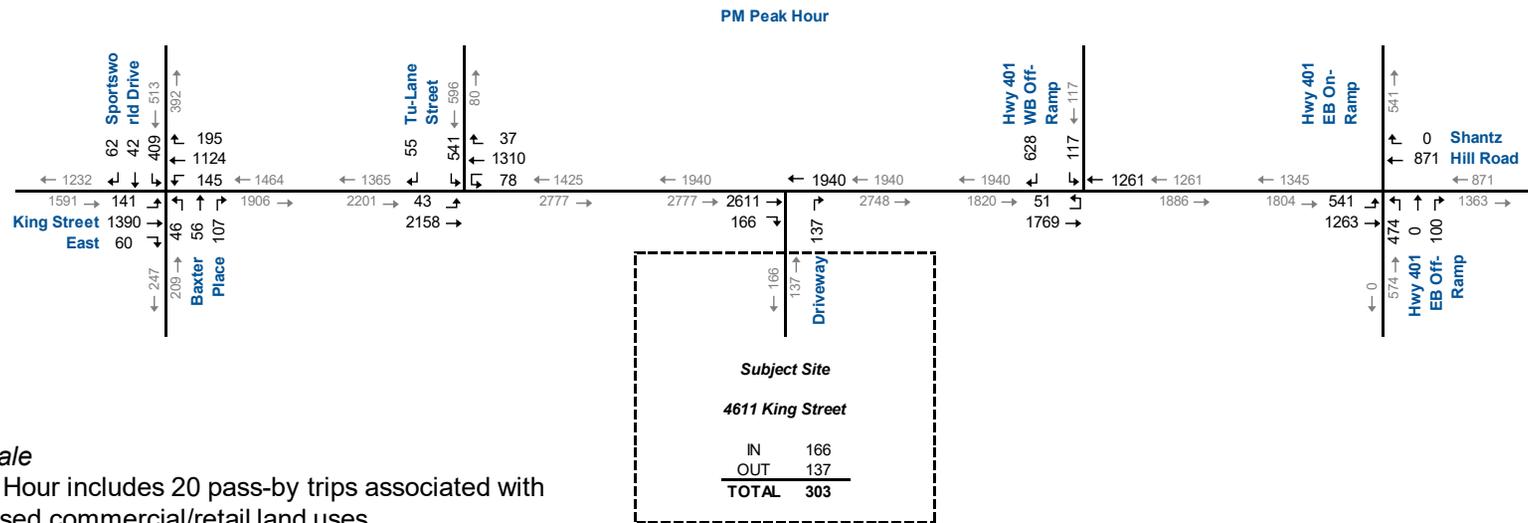
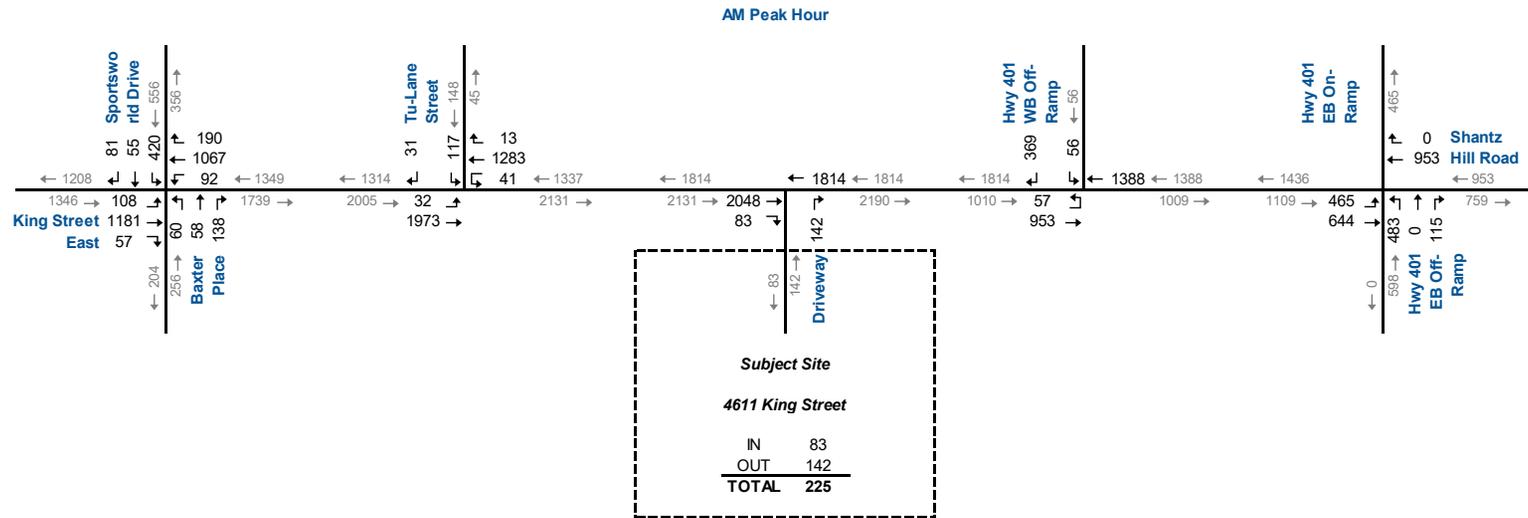


Not to Scale

PM Peak Hour includes 20 pass-by trips associated with the proposed commercial/retail land uses



Site Generated Traffic Volumes



Not to Scale

PM Peak Hour includes 20 pass-by trips associated with the proposed commercial/retail land uses



2031 Future Total Traffic Volumes

5 Traffic Operations Assessment

5.1 Methodology

Intersection Level of Service (LOS) is a recognized method of quantifying the efficiency of vehicular traffic flow at intersections and is based on the delay experienced by individual vehicles executing the various movements. The delay is related to the number of vehicles desiring to make a movement, compared to the estimated capacity for that movement. The capacity is based on several criteria related to opposing traffic flows, and at signalized intersections, signal timing.

The highest possible rating is LOS A, under which the average total delay at signalized and unsignalized intersections is equal or less than 10 seconds per vehicle. When the average delay for a movement exceeds 80 seconds at signalized intersections, or 50 seconds at unsignalized intersections, the movement is classified as LOS F.

While the LOS and volume-to-capacity (v/c) ratio for each movement are related, they are calculated independently. Therefore, it is possible to have a poor level of service associated with a low v/c ratio, or a good level of service associated with a high v/c ratio. Volume-to-capacity ratios exceeding 1.00 indicate a movement is exceeding its theoretical capacity.

The operations of the study intersections have been modelled and analyzed using Synchro 11, which implements the methodology of the Highway Capacity Manual (HCM). The analysis considers three separate measures of performance:

- ▶ The level of service (LOS) and average delay for each turning movement, measured in seconds (s);
- ▶ The volume to capacity (v/c) ratio for each movement; and
- ▶ The 95th percentile queue length, in metres (m).

The Region of Waterloo *Transportation Impact Study Guidelines* identify critical intersections as those operating at an overall LOS E or LOS F, regardless of control type (that is, signalized or unsignalized). The criteria for critical movements are where:

- ▶ The average control delay for individual movements is greater than 55 seconds;
- ▶ The estimated 95th percentile queue length for an exclusive movement exceeds the available lane storage, or will block an existing access;



- ▶ Exclusive turning lanes are inaccessible because of queue lengths in adjacent through lanes; and/or
- ▶ There is a poor quality of service for non-auto modes.¹⁰

The following sections summarize the results of the operational analyses.

5.2 2031 Background Traffic Conditions

The analysis of 2031 background traffic conditions assumes the 2031 background traffic volumes illustrated in **Figure 4.2**. The model also reflects the following parameters:

- ▶ Saturation flow rates consistent with those specified in the Region of Waterloo *Transportation Impact Studies (TIS) Requirements for Capacity Analysis, Roundabouts, Signal Warrants*;¹¹
- ▶ Heavy vehicle percentages used in the *Traffic Impact Assessment Report of the Stage 2 ION: Light Rail Transit from Kitchener to Cambridge Environmental Project Report*;¹²
- ▶ Existing lane geometry, traffic control, and signal timing at King Street East and Sportsworld Drive/Baxter Place and King Street East and Tu-Lane Street; and
- ▶ Proposed signal timing at both Highway 401 ramp terminals as assumed in the *Traffic Impact Assessment Report of the Stage 2 ION: Light Rail Transit from Kitchener to Cambridge Environmental Project Report*.¹³

Table 5.1 summarizes the projected level of service conditions in 2031 without the proposed development. Critical movements (including queues exceeding lane storage) are highlighted in yellow. **Appendix A** contains the detailed Synchro reports.

The analyses forecast several critical movements throughout the study area in both the AM peak hour and PM peak hour, primarily at the intersection of King Street East and Sportsworld Drive/Baxter Place. In the PM peak hour, the eastbound left-turn movements on King Street

¹⁰ Region of Waterloo, *Transportation Impact Study Guidelines*, (Waterloo: Region of Waterloo, 2014), 12.

¹¹ Region of Waterloo, *Transportation Impact Studies (TIS) Requirements for Capacity Analysis, Roundabouts, Signal Warrants*, (Waterloo: Region of Waterloo, 2013).

¹² Region of Waterloo, *Stage 2 ION: Light Rail Transit from Kitchener to Cambridge Environmental Project Report*, (Waterloo: Region of Waterloo, 2021).

¹³ Region of Waterloo, *Stage 2 ION: Light Rail Transit from Kitchener to Cambridge Environmental Project Report*, (Waterloo: Region of Waterloo, 2021).



East at Tu-Lane Street and the eastbound Highway 401 on-ramp/off-ramp are forecast to operate at LOS E, with delays greater than 55 seconds. The southbound left-turn movement from Tu-Lane Street onto King Street East is also forecast to operate at LOS E, with delays greater than 55 seconds.



TABLE 5.1: 2031 TRAFFIC OPERATIONS – WITHOUT DEVELOPMENT

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	King Street East and Sportsworld Drive/Baxter Place	TCS	LOS Delay V/C Q Ex Avail.	E 56 0.45 27 85 58	D 43 0.90 208 - -	C 23 0.05 0 40 >	D 43	F 47 0.74 46 50 4	D 43 0.16 194 50 28	C 27 0.16 22 50 28	D 41	E 57 0.52 32 -	E 56 0.57 27 -	> > > > >	E 56	E 63 0.83 125 -	E 55 0.76 119 -	C 31 0.07 9 -	E 55	D 45 0.83
	King Street East and Tu-Lane Street	TCS	LOS Delay V/C Q Ex Avail.	D 50 0.43 18 30 13	B 12 0.84 187 -	> > > > >	B 13	B 11 0.60 112 -	> > > > >	B 11						D 42 0.47 24 -	> > > > >	D 42	B 14 0.83	
	King Street East and WB Hwy 401 Off/On-Ramp	TCS	LOS Delay V/C Q Ex Avail.		A 4 0.36 42 -		A 4	A 5 0.55 79 -		A 5						D 47 0.48 24 -			D 47	A 6 0.55
	King Street East and EB Hwy 401 Off/On-Ramp	TCS	LOS Delay V/C Q Ex Avail.	D 48 0.91 171 175 4	A 8 0.30 49 -		C 25	D 53 0.94 181 -		D 53	D 46 0.77 76 -		C 35 0.09 15 -		D 44					D 39 0.90
PM Peak Hour	King Street East and Sportsworld Drive/Baxter Place	TCS	LOS Delay V/C Q Ex Avail.	E 57 0.52 33 85 52	D 44 0.92 253 -	C 21 0.05 0 40 >	D 44	F 123 1.07 84 50 -34	D 40 0.85 212 -	C 25 0.18 24 50 26	D 47	E 58 0.41 28 -	E 57 0.42 25 -	> > > > >	E 57	E 63 0.82 104 -	E 56 0.76 99 -	C 32 0.05 5 -	E 56	D 48 0.91
	King Street East and Tu-Lane Street	TCS	LOS Delay V/C Q Ex Avail.	E 68 0.51 27 30 4	C 29 0.94 323 -	> > > > >	C 30	C 24 0.74 186 -	> > > > >	C 24						E 76 0.96 127 -	> > > > >	E 76	D 36 0.98	
	King Street East and WB Hwy 401 Off/On-Ramp	TCS	LOS Delay V/C Q Ex Avail.		A 10 0.74 152 -		A 10	A 7 0.54 81 -		A 7						D 43 0.59 40 -			D 43	B 10 0.72
	King Street East and EB Hwy 401 Off/On-Ramp	TCS	LOS Delay V/C Q Ex Avail.	E 60 0.98 204 175 -29	A 10 0.57 116 -		C 25	D 50 0.91 158 -		D 50	D 46 0.77 72 -		D 35 0.15 20 -		D 44					C 35 0.95

MOE - Measure of Effectiveness
 LOS - Level of Service
 Delay - Average Delay per Vehicle in Seconds
 Q - 95th Percentile Queue Length (m)
 Ex. - Existing Available Storage (m)
 Avail. - Available Storage (m)
 TCS - Traffic Control Signal
 TWSC - Two-Way Stop Control
 <- Shared Left/Through Lane
 >- Shared Right/Through Lane

5.3 2031 Total Traffic Conditions

The analysis of 2031 total traffic conditions assumes the 2031 total traffic volumes illustrated in **Figure 4.4**. The model also reflects the following parameters:

- ▶ Saturation flow rates consistent with those specified in the *Region of Waterloo Transportation Impact Studies (TIS) Requirements for Capacity Analysis, Roundabouts, Signal Warrants*;¹⁴
- ▶ Heavy vehicle percentages used in the *Traffic Impact Assessment Report of the Stage 2 ION: Light Rail Transit from Kitchener to Cambridge Environmental Project Report*;¹⁵
- ▶ Existing lane geometry, traffic control, and signal timing at King Street East and Sportsworld Drive/Baxter Place and King Street East and Tu-Lane Street; and
- ▶ Proposed signal timing at both Highway 401 ramp terminals as assumed in the *Traffic Impact Assessment Report of the Stage 2 ION: Light Rail Transit from Kitchener to Cambridge Environmental Project Report*.¹⁶

At the intersection of King Street East and the westbound Highway 401 off-ramp, the analysis also assumes an eastbound U-turn lane with 15-metres of storage similar to the westbound U-turn lane provided at Tu-Lane Street. This U-turn movement is permissive and permits drivers to complete a U-turn movement when eastbound traffic on King Street East is provided a green ball indication from the traffic control signal. U-turns are not permitted when vehicles exiting the westbound Highway 401 have the right-of-way.

Table 5.2 summarizes the projected level of service conditions in 2031 with the proposed development. Like the results summarized in **Table 5.1**, several movements throughout the study area are forecast to operate with delays greater than 55 seconds, or queues exceeding lane capacity. **Appendix B** contains the detailed Synchro reports.

Operations of many of the critical movements are nearly identical to those in **Table 5.1**. In both the AM peak hour and PM peak hour, the site-generated traffic introduces one additional critical movement: the

¹⁴ Region of Waterloo, *Transportation Impact Studies (TIS) Requirements for Capacity Analysis, Roundabouts, Signal Warrants*, (Waterloo: Region of Waterloo, 2013).

¹⁵ Region of Waterloo, *Stage 2 ION: Light Rail Transit from Kitchener to Cambridge Environmental Project Report*, (Waterloo: Region of Waterloo, 2021).

¹⁶ Region of Waterloo, *Stage 2 ION: Light Rail Transit from Kitchener to Cambridge Environmental Project Report*, (Waterloo: Region of Waterloo, 2021).



westbound through movement on King Street East at the eastbound Highway 401 off-ramp. This movement is forecast to operate with an average additional delay of six seconds in the AM peak hour and seven seconds in the PM peak hour. The assumed U-turn movements at Tu-Lane Street and the westbound Highway 401 off-ramp are forecast to operate at acceptable levels of service and within capacity. In the absence of signalized ramp terminals, and given the driveway's location near the west property line, U-turns could be completed at the turn-around location on King Street East, immediately in front of the site.

The driveway connection to King Street East is forecast to operate at LOS F, with v/c ratios of 0.81 and 1.36 in the respective AM peak hour and PM peak hour. These conditions correspond to a high volume of eastbound traffic on King Street East (approximately 2,130 vehicles in the AM peak hour, and 2,750 vehicles in the PM peak hour) which provide limited opportunities for driveway volumes to enter the traffic stream on King Street East.



TABLE 5.2: 2031 TRAFFIC OPERATIONS – WITH DEVELOPMENT

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	King Street East and Sportsworld Drive/Baxter Place	TCS	LOS Delay V/C Q Ex Avail.	E 58 0.47 27 85 58	D 43 0.90 218 - -	C 23 0.05 0 40 40	D 44	F 53 0.77 48 50 2	D 44 0.88 215 - -	C 27 0.19 26 50 24	D 42	E 59 0.53 32 -	E 59 0.59 27 -	> > > >	E 59	E 68 0.85 132 -	E 58 0.77 123 -	C 32 0.07 9 -	E 58	D 47 0.84
	King Street East and Tu-Lane Street	TCS	LOS Delay V/C Q Ex Avail.	D 47 0.33 18 30 13	B 13 0.85 199 -	> > > >	B 13	A 10 0.26 5 30 26	B 12 0.64 121 -	> > >	B 12					D 43 0.48 24 -	> > >	D 43	B 14 0.84	
	King Street East and WB Hwy 401 Off/On-Ramp	TCS	LOS Delay V/C Q Ex Avail.	A 7 0.30 11 15 4	A 4 0.38 45 -		A 4	A 5 0.57 83 -		A 5						D 47 0.48 24 -			D 47	A 6 0.56
	King Street East and EB Hwy 401 Off/On-Ramp	TCS	LOS Delay V/C Q Ex Avail.	D 52 0.93 182 175 -7	A 8 0.31 53 -		C 27	E 59 0.97 189 -		E 59	D 47 0.78 78 -		C 35 0.09 15 -	D 44						D 42 0.92
	King Street East and Residential Driveway	TWSC	LOS Delay V/C Q Ex Avail.		UM -> -> ->		UM	UM -> -> ->		UM				F 76 0.81 46 -	F 76					
PM Peak Hour	King Street East and Sportsworld Drive/Baxter Place	TCS	LOS Delay V/C Q Ex Avail.	E 58 0.53 33 85 52	D 54 0.98 275 -	C 21 0.05 0 40 -	D 53	F 127 1.07 84 50 -34	D 44 0.89 225 -	C 26 0.20 29 50 21	D 50	E 59 0.41 28 -	E 58 0.43 25 -	> > >	E 58	E 64 0.83 112 -	E 56 0.76 103 -	C 31 0.05 5 -	E 56	D 52 0.92
	King Street East and Tu-Lane Street	TCS	LOS Delay V/C Q Ex Avail.	E 66 0.44 27 30 4	C 35 0.97 391 -	> > >	D 35	D 35 0.56 27 30 3	C 26 0.78 200 -	> > >	C 26					E 78 0.97 127 -	> > >	E 78	D 39 1.00	
	King Street East and WB Hwy 401 Off/On-Ramp	TCS	LOS Delay V/C Q Ex Avail.	A 8 0.26 11 15 4	B 11 0.76 163 -		B 11	A 7 0.56 87 -		A 7						D 43 0.59 40 -			D 43	B 10 0.74
	King Street East and EB Hwy 401 Off/On-Ramp	TCS	LOS Delay V/C Q Ex Avail.	E 70 1.01 215 175 -40	B 11 0.60 126 -		C 28	E 56 0.95 170 -		E 56	D 46 0.78 76 -		C 35 0.15 20 -	D 44						D 39 0.98
	King Street East and Residential Driveway	TWSC	LOS Delay V/C Q Ex Avail.		UM -> -> ->		UM	UM -> -> ->		UM				F 282 1.36 83 -	F 282					

MOE - Measure of Effectiveness
 LOS - Level of Service
 Delay - Average Delay per Vehicle in Seconds
 Q - 95th Percentile Queue Length (m)
 Ex. - Existing Available Storage (m)
 Avail. - Available Storage (m)
 TCS - Traffic Control Signal
 TWSC - Two-Way Stop Control
 <- Shared Left/Through Lane
 >- Shared Right/Through Lane
 UM - Unopposed Movement



5.4 Remedial Measures

The analyses in **Section 5.3** indicate development of the site is forecast to have minor impact on traffic operations in the study area. The site-generated traffic results in one additional critical movement in each of the weekday AM peak hour and the weekday PM peak hour, not accounting for the operations at the site driveway. Independent of the proposed development it is recommended the Region of Waterloo and Ministry of Transportation monitor the traffic volumes and signal timing plans throughout the King Street East corridor to identify opportunities to improve traffic operations.

The reader is cautioned that the 2031 traffic forecasts referenced in the *Traffic Impact Assessment Report of the Stage 2 ION: Light Rail Transit from Kitchener to Cambridge Environmental Project Report*¹⁷ assume the existing transportation network as it relates to Highway 8 and Highway 401. Under existing conditions, southbound motorists on Highway 8 destined for westbound Highway 401 must use King Street East to connect between each highway because Highway 8 does not provide a direct connection to westbound Highway 401.

Sheet 11 of the functional design drawings that form part of the *Stage 2 ION Environmental Project Report* indicate the future provision of a grade separated ramp from southbound Highway 8 onto westbound Highway 401.¹⁸ This new ramp connection is outside the purview of the Stage 2 LRT project, but could reduce traffic volumes on King Street East by removing the need for traffic to use King Street East to connect from southbound Highway 8 to westbound Highway 401.

The traffic volumes illustrated in **Figure 4.2** indicate a loss of 1,137 vehicles between Tu-Lane Street and the westbound Highway 401 off-ramp in the AM peak hour, and a loss of 903 vehicles in the PM peak hour. These lost trips are assumed to represent those entering westbound Highway 401. It is acknowledged not all of these trips may be vehicles from Highway 8 southbound, and could also include trips to/from Limerick Drive.

Table 5.3 summarizes the estimated traffic operations at the site driveway assuming a reduction in volumes on King Street East. **Appendix C** contains the detailed Synchro reports. The site driveway is forecast to operate at LOS C (v/c ratio of 0.32) in the AM peak hour and LOS E (v/c ratio of 0.63) in the PM peak hour.

¹⁷ Region of Waterloo, *Stage 2 ION: Light Rail Transit from Kitchener to Cambridge Environmental Project Report*, (Waterloo: Region of Waterloo, 2021).

¹⁸ Region of Waterloo, *Stage 2 ION: Light Rail Transit from Kitchener to Cambridge Environmental Project Report*, (Waterloo: Region of Waterloo, 2021).



TABLE 5.3: 2031 TRAFFIC OPERATIONS – WITH DEVELOPMENT AND HIGHWAY 8 INTERCHANGE IMPROVEMENTS

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	King Street East and Residential Driveway	TWSC	LOS Delay V/C Q Ex Avail.	-	UM	>	UM	-	UM	-	UM	-	-	-	C 16 0.32 11 -	C 16	-	-	-	-
PM Peak Hour	King Street East and Residential Driveway	TWSC	LOS Delay V/C Q Ex Avail.	-	UM	>	UM	-	UM	-	UM	-	-	-	E 44 0.63 31 -	E 44	-	-	-	-

MOE - Measure of Effectiveness

LOS - Level of Service

Delay - Average Delay per Vehicle in Seconds

Q - 95th Percentile Queue Length (m)

Ex. - Existing Available Storage (m)

Avail. - Available Storage (m)

TCS - Traffic Control Signal

TWSC - Two-Way Stop Control

<- Shared Left/Through Lane

>- Shared Right/Through Lane

UM - Unopposed Movement



6 Parking Assessment

6.1 Required Parking Supply

The City of Kitchener maintains two zoning by-laws (ZBLs): 2019-051 and 85-1. Review of the City of Kitchener online zoning tool indicates the subject site is governed by ZBL 2019-051. Section 5 of ZBL 2019-051 defines minimum and maximum parking rates. **Table 6.1** summarizes those rates applicable to the site.

TABLE 6.1: CITY OF KITCHENER ZONING BY-LAW PARKING REQUIREMENTS

Land Use	Minimum	Minimum (Visitor)	Maximum
Multiple Residential Buildings	1.0 per dwelling unit	81+ dwelling units: 0.1 per dwelling unit	1.4 per dwelling unit
Office	1.0 per 33 m ² GFA	N/A	1.0 per 25 m ² GFA
Services and Retail	1.0 per 33 m ² GFA	N/A	1.0 per 24 m ² GFA

Table 6.2 summarizes the parking requirements for the site and indicate a minimum of 854 spaces (including 72 visitor spaces) and a maximum of 1,092 spaces. The proposed supply of 493 parking spaces represents a potential deficit of 361 spaces.

TABLE 6.2: PARKING REQUIREMENTS

Land Use	Minimum	Minimum Visitor	Maximum
Multiple Residential Buildings – 726 units	726	72	1,016
Office – 1,242 m ² GFA	37	-	49
Services and Retail – 650 m ² GFA	19	-	27
Total	782	72	1,092



6.2 Estimated Parking Demand

The Institute of Transportation Engineers (ITE) *Parking Generation Manual*¹⁹, is an industry standard document that reflects real-world parking demands observed at a variety of land uses in the United States and Canada. Peak parking demands for the site have been estimated using three land use codes (LUC) in the *Parking Generation Manual*:

- ▶ LUC 222: Multifamily Housing (High-Rise));
- ▶ LUC 710: General Office Building; and
- ▶ LUC 820: Shopping Centre.

Table 6.3 summarizes the estimated weekday parking demands for the site, based on average weekday parking demand rates. The ITE parking demand data suggests a peak parking demand of 787 spaces, which is less than the minimum required number of spaces (854 spaces), but greater than the proposed parking supply (493 spaces). The represents a potential deficit of 294 spaces.

This analysis does not account for the potential for shared parking between the residential visitor, and commercial/office parking spaces.

TABLE 6.3: ESTIMATED PARKING DEMANDS (ITE)

Land Use	Units	GFA (sq. ft.)	Weekday
LUC 222 (Multifamily Housing (High-Rise)) ^[1]	726	-	741
LUC 710 (General Office Building) ^[2]	-	13,370	26
LUC 820 (Shopping Centre) ^[3]	-	7,000	20
Estimated Parking Demand			787

Notes

1. Average weekday parking demand of 1.02 vehicles per dwelling unit
2. Average weekday parking demand of 1.95 vehicles per 1,000 sq. ft. GFA
3. Average weekday parking demand of 2.79 vehicles per 1,000 sq. ft. GFA

¹⁹ Institute of Transportation Engineers, *Parking Generation Manual*, 5th ed., (Washington, DC: ITE, 2019).



6.3 Parking Policy

City policies can promote the use of non-auto travel modes and the implementation of transportation demand management (TDM) policies, programs, and initiatives. These policies can impact parking trends and promote reduced parking supply requirements in major developments.

The City of Kitchener Long Term Parking Strategy, and Official Plan promote the use of alternate modes of transportation and recognize that an oversupply of parking and the location of developments can influence travel mode choice.

6.3.1 City of Kitchener Long-Term Parking Strategy

The City of Kitchener *Long-Term Parking Strategy*²⁰ outlines principles in reducing auto-dependency and increasing the use of alternative modes of transportation. The strategy identifies four main factors that influence auto-usage: residential development, the price of gas, the price of parking, and the convenience of rapid transit. The *Long-Term Parking Strategy* included the following key recommendations related to parking policy:

- ▶ Review the parking requirements of the zoning bylaw to more accurately reflect the current modal split;
- ▶ As part of the [City's] TDM strategy, focus on measures that encourage downtown employees, when faced with rising transportation costs, to use alternative modes of transportation.
- ▶ In conjunction with Planning staff, and through the implementation of both the Redevelopment Strategy for City-Owned Downtown Lands and the Kitchener Growth Management Strategy, explore opportunities for increasing residential development in and around Downtown.

As noted in **Section 6.1**, the City updated its zoning by-law in 2019, and the site is governed by the updated parking requirements in zoning by-law 2019-051.

6.3.2 City of Kitchener Official Plan

Section 13.C.1 of the City of Kitchener Official Plan identifies the following active transportation and TDM objectives:

²⁰ City of Kitchener Infrastructure Services and Economic Development, *Long-Term Parking Strategy*, (Kitchener: City of Kitchener, 2011), 2.



- ▶ To enhance the pedestrian realm in order to increase levels of convenience, comfort, and safety, and encourage more pedestrian movement and trips.
- ▶ To encourage pedestrian movement and cycling as viable means of travel among destinations within the City.
- ▶ To support and enhance sustainable transportation choices and discourage single occupant vehicle trips.
- ▶ To reduce traffic congestion, parking supply needs, and demand for parking spaces by encouraging various modes of travel.

The objectives are supported by the zoning by-law and other regulatory, and planning initiatives.

6.3.3 City of Kitchener Growing Together

In March 2024, Kitchener City Council approved the Growing Together plan summarized in Staff Report DSD-2024-005.²¹ The staff report included six attachments specific to official plan and zoning by-law amendments to implement the recommendations of the staff report, which apply to protected major transit station (PMTSA) and non-PMTSA lands:

- ▶ Attachment A – Proposed Official Plan Amendment (PMTSA lands)
- ▶ Attachment B – Proposed Official Plan Amendment (non-PMTSA lands)
- ▶ Attachment C – Proposed Official Plan Amendment (removal of secondary plans)
- ▶ Attachment D – Proposed Zoning By-law Amendment (PMTSA lands)
- ▶ Attachment E – Proposed Zoning By-law Amendment (non-PMTSA lands)
- ▶ Attachment F – Public Submissions Received Post-January 29, 2024

Schedule C of Attachment A illustrates the proposed boundaries of the protected major transit station areas and the urban growth centre (downtown). These boundaries now “align with the confirmed PMTSA

²¹ <https://www.engagewr.ca/growingtogether>



boundaries as established by the Region and approved by the province in April 2023.”²²

At Limerick Drive, the boundary for the Sportsworld PMTSA bisects King Street East, approximately 150 metres west of the subject site. If the PMTSA boundary were shifted 150 metres east, the site would be in the Sportsworld PMTSA, and be subject to the revised parking requirements for Strategic Growth Area (SGA) zones outlined in Attachment D of Staff Report DSD-2024-005:

- ▶ Multiple Residential Buildings:
 - Minimum parking spaces: No minimum
 - Minimum visitor parking spaces: 10% of provided parking spaces, only where 11 or more dwelling units are on a lot;
 - Maximum parking spaces: 1.4 per dwelling unit.
- ▶ Office
 - No minimum or maximum
- ▶ Services and Retail
 - Minimum parking spaces: No minimum
 - Maximum parking spaces: 1 per 72 m².

Under these revised parking rates, the site would not be required to provide any parking spaces, and would only be required to assign 10% of the proposed parking supply to visitor parking.

Because the PMTSA boundary location is arbitrary to residents, vehicle ownership and parking demand trends – at least in the near term – are more likely to reflect the existing transportation system. As properties are developed in the PMTSAs, and the parking supply matures to reflect the above noted parking requirements, vehicle ownership trends would be expected to change in response. In areas where new parking is not required or not being provided, vehicle ownership rates would be expected to decline. At a maximum supply of 1.4 per dwelling unit, parking demands would not be expected to exceed this upper bound.

6.4 Parking Summary

The findings of this parking assessment are as follows:

²² City of Kitchener, *DSD-2024-005 Attachment 'A' Proposed Official Plan Amendment (PMTSA Lands)*, (Kitchener: City of Kitchener, 2024), 3.



- ▶ Under zoning by-law 2019-051, the site requires a minimum of 854 spaces, comprising 726 residential tenant spaces, 72 residential visitor spaces, 37 office parking spaces, and 19 commercial/retail parking spaces;
- ▶ Data published by ITE suggests a peak parking demand of 787 spaces (1.08 spaces per unit), which is greater than the proposed parking supply of 0.68 spaces per unit;

Based on the findings of this parking study, it is concluded that the proposed parking supply is non-compliant with zoning by-law 2019-051, and is less than the estimated parking demand as calculated using parking demand data published by ITE.

Although the proposed supply is non-compliant with the in-force zoning by-law, the development is within 150 metres of the Sportsworld Station protected major transit station area (PMTSA). The Growing Together Plan and its associated official plan and zoning by-law amendments, approved by Council in March 2024, do not require a minimum number of parking spaces to be provided for multiple residential dwelling properties in a PMTSAs.

Because the site is just outside the PMTSA boundary for Sportsworld Station, the subject lands are required to provide a minimum of 1.0 space per dwelling unit, plus 0.1 spaces per dwelling unit for visitor parking, up to a maximum of 1.4 spaces per dwelling unit (including visitor). If the subject site were 150 metres west it would be in the PMTSA boundary and would not be required to provide any parking spaces, despite marginal differences in the transportation network.

Because the PMTSA boundary location is arbitrary to residents, vehicle ownership and parking demand trends on either side of the boundary are more likely to reflect the transportation network and its ability to accommodate travel by alternate modes. Whereas a residential development on the east side of the boundary could provide 0 spaces, developments on the immediate west side of the boundary must still provide a minimum of 1.0 space per dwelling.

The proposed parking supply of 0.68 spaces per unit provides a parking rate reflective of the subject site's location in an area earmarked for future transit network enhancements.



7 Transportation Demand Management Plan

Transportation Demand Management (TDM) refers to policies, programs, and initiatives that improve the efficiency of the road network and encourage the use of alternative modes of transportation. TDM programs consider how people's choices of travel mode are affected by land use patterns and composition, development design, parking availability, parking cost, and the relative cost, convenience, and availability of alternative modes of travel.

TDM strategies at a development can be divided into two basic categories: pre-occupancy and post-occupancy. Pre-occupancy strategies and initiatives are critical because they are most likely to determine how attractive, convenient, and safe alternative travel modes will be once the site is occupied. These can include such measures as secure bike parking, a lower vehicle parking supply, or safe pedestrian routes between the development and the municipal sidewalk network. In some cases, these measures affect the built form of a development, and are difficult to modify after building completion.

After a development is built, incentives can be offered to encourage the use of alternative modes of transportation, but these incentives are only effective if the development and surrounding area are designed to facilitate the incentives. These can include subsidies to use transit, rideshare programs, or disseminating information about alternative travel modes.

7.1 Existing Policies, Programs, and Strategies

7.1.1 Walking

Most every trip begins and ends as a walking trip. The pedestrian accessibility of a development is essential in helping ensure that those that can walk, have access to safe, comfortable, and well-lit pedestrian connections.

As noted in **Section 2.3**, sidewalks are provided on both sides of all study roads, except Limerick Drive, Baxter Place and Pioneer Tower Road. Sidewalks are not provided on either side of these roads. A shared multi-use path is provided on the east side of King Street, extending through the intersection with Gateway Park Drive to Sportsworld Drive. A sidewalk is also provided on the south side of King Street East terminating at the east edge of the subject site.



The intersections of King Street East and Sportsworld Drive and King Street East and Tu-Lane Street are signalized and include delineated crosswalks on all approaches.

The concept plan illustrated in **Figure 3.1** includes active building frontages onto King Street East, with pedestrian entrances to the retail spaces via King Street East. Pedestrian entrance to the residential components of the site are proposed via a sidewalk connection on the west side of Building A, which will connect to the existing municipal sidewalk network on King Street East. Access to the underground parking garage is in the northwest corner of the site, away from pedestrian circulation areas. A delineated crosswalk is proposed across the loading area between Building A and Building B.

7.1.2 Cycling

As noted in **Section 2.3**, a shared multi-use path is provided on the north side of King Street East, and on-road bicycle lanes are provided on both sides of Sportsworld Drive east of Gateway Park Drive. The development is proposing 167 bicycle parking spaces, comprising 161 residential spaces, and 6 commercial/retail/visitor spaces.

The City of Kitchener Zoning By-law specifies the following minimum parking requirements for bicycle parking spaces:

- ▶ Multiple Residential Buildings:
 - A minimum of 0.5 Class A bicycle parking spaces per dwelling unit;
 - A minimum of 2 Class B bicycle spaces, or 6 where more than 20 dwelling units are on a lot.
- ▶ Office
 - A minimum of 1 Class A bicycle parking space per 500 m² GFA
 - A minimum of 1 Class B bicycle parking space per 750 m² GFA
- ▶ Services and Retail
 - A minimum of 1 Class A bicycle parking space per 1,000 m² GFA
 - A minimum of 1 Class B bicycle parking space per 333 m² GFA

Under this zoning by-law, 377 parking spaces would be required, comprising 369 residential bicycle spaces (363 Type A and 6 Type B) and 8 commercial/retail spaces (4 Type A and 4 Type B).



7.1.3 Transit

As noted in **Section 2.2**, Grand River Transit (GRT) operates two surface routes (Route 203 and Route 206) near the site. Both routes operate seven days a week and serve transit stops on Gateway Park Drive, Tu-Lane Street, and King Street East. Both routes also serve Sportsworld Station, which is a 1.4 km (20-minute walk) from the site and provides connections to Route 67 (Eagle-Pinebush), Route 72 (Flex Boxwood), and Route 302 (ION Bus).

These routes are accessible via existing sidewalks in the study area. These routes also provide good connectivity to the broader network and key destinations within the Region including malls, Uptown Waterloo, and universities/colleges.

7.2 Potential Policies, Programs, and Strategies

7.2.1 Parking Management

Parking management refers to “*various policies and programs that result in more efficient use of parking resources.*”²³ They include but are not limited to unbundled parking, shared parking, and parking pricing.

Unbundled parking policies separate the cost of a parking space from the lease or ownership cost of a dwelling unit. This enables those who want or need a parking space to purchase or rent the spaces they need. For residents who do not need (or do not want a parking space) unbundled parking allows them to purchase or rent a unit without the need to pay for a parking space they do not need.

The purchase or rental cost of each parking space remains unknown, however, charging for parking can also help manage parking demands. By removing the provision of free parking on-site, residents can compare the cost and convenience of owning or renting a parking space(s) to that of alternative modes of transportation. Providing a “right-size” parking supply for a development can reduce the potential for unused parking spaces and the oversupply of parking spaces.

The proposed parking supply is less than required in the City of Kitchener zoning by-law (see **Chapter 6**). It is also less than the estimated parking demand based on data published by the Institute of Transportation Engineers (ITE). However, the development is within

²³ Victoria Transport Policy Institute, *Parking Management: Strategies, Evaluation, and Planning*, 2021.



150 metres of the Sportsworld Station protected major transit station area (PMTSA).

The Growing Together Plan and its associated official plan and zoning by-law amendments, approved by Council in March 2024, do not require a minimum number of parking spaces to be provided for multiple residential dwelling properties in a PMTSA. If the subject site were 150 metres west it would be in the PMTSA boundary and would not be required to provide any parking spaces, despite marginal differences in the transportation network. Because the site is just outside the PMTSA boundary for Sportsworld Station, the subject lands are required to provide a minimum of 1.0 space per dwelling unit, plus 0.1 spaces per dwelling unit for visitor parking, up to a maximum of 1.4 spaces per dwelling unit (including visitor).

Because the PMTSA boundary location is arbitrary to residents, vehicle ownership and parking demand trends on either side of the boundary are more likely to reflect the transportation network and its ability to accommodate travel by alternate modes. Whereas a residential development on the east side of the boundary could provide 0 spaces, developments on the immediate west side of the boundary must still provide a minimum of 1.0 space per dwelling.

As noted in **Chapter 6** the proposed parking supply of 0.68 spaces per unit provides a parking rate reflective of the subject site's location in an area earmarked for future transit network enhancements.

7.2.2 Car Share Program

Car sharing refers to automobile rental services intended to substitute for private vehicle ownership. It makes occasional use of a vehicle affordable while providing an incentive to minimize the use of a personal vehicle for every trip. When complemented by robust alternative transportation systems (for example, higher-order rapid transit, and safe and accessible cycling networks) car sharing programs provide travel options to households. Where car sharing services are available, some households may reduce their vehicle ownership, either shifting from two to one vehicle, or from one to zero vehicles.

By providing this type of mode share on site, lower automobile ownership rates and parking requirements can be further obtained. Residents of the building could choose to use walking, transit or cycling as their primary mode of travel and use the car share as a secondary mode of travel.



There are three car share providers in Waterloo Region: Communauto, ZipCar, and Enterprise CarShare, each with several locations across the region. The availability of car share spaces in premium locations on-site would allow residents of the development and surrounding community who normally would not need a vehicle for their daily activities to be comfortable with the decision to not own a vehicle.

7.2.3 Travel Planning/Education/Promotion

Increasing awareness of sustainable transportation opportunities for residents and visitors of the subject site should be considered by the developer.

Providing a welcome package to new residents and tenants can help support the use of alternate modes of transportation near the site. This can include information about local transit services, car share programs, or bike parking locations.

General education of all modes of transportation, including their benefits and how to make the best use of them, are a key component to TDM success. The strategies require cooperation and coordination with several partners, including transit providers, building owners, area municipalities as well as residents.

By educating about sustainable modes of travel as well as providing travel demand management tools and incentives, TDM can be further integrated within the development to promote all modes of transportation.

7.2.4 TDM Coordinator

Delegating an interested individual or hiring an individual as part of the building's staff, to act as a coordinator for the TDM measures can support the continuity and uptake of said programs.

The TDM coordinator can provide information on nearby transit, active transportation and carshare, and administer access to secured bicycle parking. It is expected that a representative of the City of Kitchener will be available to assist the TDM coordinator to help get the programs started during the early stages of operations.

7.2.5 Subsidized Transit Passes

Providing subsidized transit passes to all residents of the development for a minimum period of two years could further encourage transit as a primary mode of transportation for trips to/from the subject development.



7.3 TDM Summary

Based on the details outlined herein, the following confirmed initiatives and measures will help support the use of alternative modes of transportation, and likely reduce the parking demands of the site:

- ▶ Active building frontages on to King Street East with primary building entrances onto King Street East;
- ▶ Providing 404 bicycle parking spaces, comprising 398 class A spaces and six class B spaces; and
- ▶ Providing a vehicle parking supply less than required by the municipal zoning by-law.

The development's location provides connectivity to GRT bus services on King Street East which provides connections to the ION LRT via Sportsworld station. These routes provide connectivity to other Grand River Transit (GRT) routes, and destinations throughout the Region.

To further promote TDM, and the multi-modal transportation network near the site, the developer and/or building owner (as applicable) could consider:

- ▶ Unbundling the costs of parking spaces for the costs of units to support residents and tenants who do not own a vehicle;
- ▶ Providing subsidized transit passes for all residents;
- ▶ Providing transit and active transportation information in a welcome package to new residents and tenants, including the posting of this information in a central location;
- ▶ Delegating or hiring a TDM coordinator; and
- ▶ Partnering with a car sharing organization to provide car sharing services on-site.



8 Conclusions and Recommendations

8.1 Findings

The findings of this Transportation Impact Brief Update are as follows:

- ▶ The subject lands are vacant. The property owner plans to develop the site into a mixed-use development comprising 726 residential units, 650 m² (7,000 sq. ft.) of retail uses, and 1,242 m² (13,370 sq. ft.) of office uses.
- ▶ Under 2031 background traffic conditions (without the proposed development), several critical movements are forecast throughout the study area in both the AM peak hour and PM peak hour, primarily at the intersection of King Street East and Sportsworld Drive/Baxter Place.

In the PM peak hour, the eastbound left-turn movements on King Street East at Tu-Lane Street and the eastbound Highway 401 on-ramp/off-ramp, as well as the southbound left-turn movement from Tu-Lane Street onto King Street East are forecast to operate with delays greater than 55 seconds.

- ▶ Development of the site is estimated to generate 225 trips in the AM peak hour and 283 trips in the PM peak hour;
- ▶ Under 2031 total traffic conditions (with the proposed development), several critical movements are forecast throughout the study area in both the AM peak hour and PM peak hour, primarily at the intersection of King Street East and Sportsworld Drive/Baxter Place.

In both the AM peak hour and PM peak hour, the site-generated traffic introduces one additional critical movement: the westbound through movement on King Street East at the eastbound Highway 401 off-ramp.

The site driveway is forecast to operate at LOS F in both the AM peak hour and PM peak hour, with v/c ratios no less than 0.81. Forecast operations at the site driveway reflect the high volume of eastbound traffic on King Street East, which provide limited opportunities for driveway volumes to enter the traffic stream on King Street East.

- ▶ The future provision of an interchange ramp connecting southbound Highway 8 to westbound Highway 401 is forecast to reduce volumes on King Street East such that the driveway would be forecast to operate at LOS C in the AM peak hour (v/c ratio of 0.32) and LOS E in the PM peak hour (v/c ratio of 0.63).



- ▶ City of Kitchener Zoning By-law 2019-051 requires a minimum of 854 spaces, comprising 726 residential tenant spaces, 72 residential visitor spaces, 37 office parking spaces, and 19 commercial/retail parking spaces. The proposed parking supply of 493 spaces represents a potential deficit of 361 spaces.
- ▶ ITE parking demand data suggests a peak parking demand of 787 spaces (1.08 spaces per unit), which is less than the minimum required number of spaces (854 spaces), but greater than the proposed parking supply of 493 spaces (0.68 spaces per unit).

8.2 Conclusions

Based on the findings of this study, it is concluded that development of the subject site is forecast to have a minor impact on traffic operations at the study intersections. In both the AM peak hour and PM peak hour, the site-generated traffic introduces one additional critical movement: the westbound through movement on King Street East at the eastbound Highway 401 off-ramp. In the absence of signalized ramp terminals, and given the driveway's location near the west property line, U-turns could be completed at the turn-around location on King Street East, within the median immediately in front of the site.

Although the proposed supply is non-compliant with zoning by-law 2019-051, the development is within 150 metres of the Sportsworld protected major transit station area (PMTSA). The Growing Together Plan and its associated official plan and zoning by-law amendments, approved by Council in March 2024, will not require a minimum number of parking spaces for multiple residential dwelling properties in the PMTSAs.

If the subject site were 150 metres west, it would only be required to provide a minimum number of visitor parking spaces within the proposed residential parking supply. There would be no minimum requirement for resident parking spaces, despite marginal differences in the transportation network.

Because the PMTSA boundary location is arbitrary to residents, vehicle ownership and parking demand trends on either side of the boundary are more likely to reflect the transportation network and its ability to accommodate travel by alternate modes. Whereas a residential development on the west side of the boundary could provide 0 spaces, developments on the immediate east side of the boundary must still provide a minimum of 1.0 space per dwelling.



The proposed parking supply of 0.68 spaces per unit provides a parking rate reflective of the subject site's location in an area earmarked for future transit network enhancements.

8.3 Recommendations

Based on the findings and conclusions of this study, it is recommended the site be considered for approval with no requirement for off-site transportation network improvements, and a proposed parking supply of 0.68 spaces per unit.

Independent of the proposed development, it is also recommended the Region of Waterloo and Ministry of Transportation monitor the traffic volumes and signal timing plans throughout the King Street East corridor to identify opportunities to improve traffic operations.



Appendix A

2031 Background Traffic Operations Reports



Lanes, Volumes, Timings

1: Baxter Place/Sportsworld Crossing & King Street East 2031 Background Conditions (no LRT): AM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	108	1152	57	92	1024	176	60	58	138	407	55	81
Future Volume (vph)	108	1152	57	92	1024	176	60	58	138	407	55	81
Ideal Flow (vphpl)	1775	1900	1750	1775	1900	1750	1775	1775	1775	1775	1900	1750
Storage Length (m)	85.0		40.0	50.0		50.0	0.0		0.0	0.0		0.0
Storage Lanes	2		1	1		1	1		0	1		1
Taper Length (m)	65.0			35.0			7.5			7.5		
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.95	0.95	0.95	1.00
Fr			0.850			0.850		0.894				0.850
Fit Protected	0.950			0.950			0.950			0.950	0.963	
Satd. Flow (prot)	3176	3471	1144	1479	3438	1365	1576	2971	0	1381	1548	1365
Fit Permitted	0.950			0.087			0.950			0.950	0.963	
Satd. Flow (perm)	3176	3471	1144	135	3438	1365	1576	2971	0	1381	1548	1365
Right Turn on Red			Yes		Yes			Yes			Yes	
Satd. Flow (RTOR)			125			169		111				89
Link Speed (k/h)		60			60			50				50
Link Distance (m)		356.0			509.9			162.7				242.9
Travel Time (s)		21.4			30.6			11.7				17.5
Peak Hour Factor	0.92	0.92	0.92	0.93	0.93	0.93	0.73	0.73	0.73	0.91	0.91	0.91
Heavy Vehicles (%)	3%	4%	30%	14%	5%	9%	7%	5%	0%	16%	0%	9%
Adj. Flow (vph)	117	1252	62	99	1101	189	82	79	189	447	60	89
Shared Lane Traffic (%)										44%		
Lane Group Flow (vph)	117	1252	62	99	1101	189	82	268	0	250	257	89
Enter Blocked Intersection	No											
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Thru	Right	Left	Left	Right
Median Width(m)		7.2			7.2			3.6				3.6
Link Offset(m)		0.0			0.0			0.0				0.0
Crosswalk Width(m)		4.8			4.8			4.8				4.8
Two way Left Turn Lane												
Headway Factor	1.09	1.00	1.11	1.09	1.00	1.11	1.09	1.09	1.09	1.09	1.00	1.11
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2	1	1	2	1	1	2		1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru		Left	Thru	Right
Leading Detector (m)	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0		2.0	10.0	2.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6		2.0	0.6	2.0
Detector 1 Type	CI+Ex		CI+Ex	CI+Ex	CI+Ex							
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 2 Position(m)		9.4			9.4			9.4				9.4
Detector 2 Size(m)		0.6			0.6			0.6				0.6
Detector 2 Type		CI+Ex			CI+Ex			CI+Ex				CI+Ex
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0				0.0
Turn Type	Prot	NA	Perm	pm+pt	NA	Perm	Split	NA		Split	NA	pt+ov
Protected Phases	1	6		5	2		8	8		4	4	4 1

Lanes, Volumes, Timings

1: Baxter Place/Sportsworld Crossing & King Street East 2031 Background Conditions (no LRT): AM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases												
Detector Phase	1	6	6	5	2	2	8	8		4	4	4 1
Switch Phase												
Minimum Initial (s)	7.0	30.0	30.0	7.0	30.0	30.0	8.0	8.0		8.0	8.0	
Minimum Split (s)	13.0	57.6	57.6	12.0	57.6	57.6	27.3	27.3		15.8	15.8	
Total Split (s)	26.0	57.6	57.6	12.0	57.6	57.6	27.3	27.3		37.8	37.8	
Total Split (%)	17.5%	38.7%	38.7%	8.1%	38.7%	38.7%	18.4%	18.4%		25.4%	25.4%	
Maximum Green (s)	20.0	50.0	50.0	7.0	50.0	50.0	20.0	20.0		30.0	30.0	
Yellow Time (s)	4.0	3.7	3.7	3.0	3.7	3.7	3.3	3.3		3.3	3.3	
All-Red Time (s)	2.0	3.9	3.9	2.0	3.9	3.9	4.0	4.0		4.5	4.5	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	7.6	7.6	5.0	7.6	7.6	7.3	7.3		7.8	7.8	
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag						
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	Min	Min	None	Min	Min	None	None		None	None	
Walk Time (s)		10.0	10.0		10.0	10.0		10.0		10.0	10.0	
Flash Dont Walk (s)		40.0	40.0		40.0	40.0		25.0		25.0	25.0	
Pedestrian Calls (#/hr)		0	0		0	0		0		0	0	
Act Effct Green (s)	10.2	50.4	50.4	56.0	46.3	46.3	12.5	12.5		27.5	27.5	35.8
Actuated g/C Ratio	0.08	0.40	0.40	0.45	0.37	0.37	0.10	0.10		0.22	0.22	0.29
v/c Ratio	0.46	0.90	0.12	0.73	0.87	0.31	0.53	0.68		0.83	0.76	0.20
Control Delay	63.3	45.3	0.4	53.3	46.1	7.3	68.5	41.7		71.2	62.9	5.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	63.3	45.3	0.4	53.3	46.1	7.3	68.5	41.7		71.2	62.9	5.0
LOS	E	D	A	D	D	A	E	D		E	E	A
Approach Delay		44.9			41.4			48.0				57.7
Approach LOS		D			D			D				E
Intersection Summary												
Area Type:	Other											
Cycle Length:	148.7											
Actuated Cycle Length:	125.5											
Natural Cycle:	125											
Control Type:	Actuated-Uncoordinated											
Maximum v/c Ratio:	0.90											
Intersection Signal Delay:	45.9						Intersection LOS: D					
Intersection Capacity Utilization:	80.1%						ICU Level of Service D					
Analysis Period (min):	15											
Split and Phases:	1: Baxter Place/Sportsworld Crossing & King Street East											

Queues

1: Baxter Place/Sportsworld Crossing & King Street East 2031 Background Conditions (no LRT): AM Peak Hour



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	117	1252	62	99	1101	189	82	268	250	257	89
v/c Ratio	0.46	0.90	0.12	0.73	0.87	0.31	0.53	0.68	0.83	0.76	0.20
Control Delay	63.3	45.3	0.4	53.3	46.1	7.3	68.5	41.7	71.2	62.9	5.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	63.3	45.3	0.4	53.3	46.1	7.3	68.5	41.7	71.2	62.9	5.0
Queue Length 50th (m)	16.0	163.2	0.0	13.4	142.8	3.4	21.7	21.9	68.2	68.7	0.0
Queue Length 95th (m)	27.2	208.3	0.0	#46.1	#194.1	21.7	32.0	27.0	#124.9	#118.6	8.6
Internal Link Dist (m)		332.0		485.9			138.7		218.9		
Turn Bay Length (m)	85.0		40.0	50.0		50.0					
Base Capacity (vph)	513	1795	652	136	1389	652	254	573	334	375	586
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.23	0.70	0.10	0.73	0.79	0.29	0.32	0.47	0.75	0.69	0.15

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

1: Baxter Place/Sportsworld Crossing & King Street East 2031 Background Conditions (no LRT): AM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	108	1152	57	92	1024	176	60	58	138	407	55	81
Future Volume (vph)	108	1152	57	92	1024	176	60	58	138	407	55	81
Ideal Flow (vphpl)	1775	1900	1750	1775	1900	1750	1775	1775	1775	1775	1900	1750
Total Lost time (s)	6.0	7.6	7.6	5.0	7.6	7.6	7.3	7.3		7.8	7.8	7.8
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	1.00	0.95		0.95	0.95	1.00
Fr	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.89		1.00	1.00	0.85
Fit Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	0.96	1.00
Satd. Flow (prot)	3176	3471	1144	1479	3438	1365	1576	2972		1381	1548	1365
Fit Permitted	0.95	1.00	1.00	0.09	1.00	1.00	0.95	1.00		0.95	0.96	1.00
Satd. Flow (perm)	3176	3471	1144	135	3438	1365	1576	2972		1381	1548	1365
Peak-hour factor, PHF	0.92	0.92	0.92	0.93	0.93	0.93	0.73	0.73	0.73	0.91	0.91	0.91
Adj. Flow (vph)	117	1252	62	99	1101	189	82	79	189	447	60	89
RTOR Reduction (vph)	0	0	37	0	0	107	0	100	0	0	0	62
Lane Group Flow (vph)	117	1252	25	99	1101	82	82	168	0	250	257	27
Heavy Vehicles (%)	3%	4%	30%	14%	5%	9%	7%	5%	0%	16%	0%	9%
Turn Type	Prot	NA	Perm	pm+pt	NA	Perm	Split	NA		Split	NA	pt+ov
Protected Phases	1	6		5	2		8	8		4	4	4
Permitted Phases			6	2		2						
Actuated Green, G (s)	10.2	50.3	50.3	53.3	46.2	46.2	12.5	12.5		27.4	27.4	37.6
Effective Green, g (s)	10.2	50.3	50.3	53.3	46.2	46.2	12.5	12.5		27.4	27.4	37.6
Actuated g/C Ratio	0.08	0.40	0.40	0.43	0.37	0.37	0.10	0.10		0.22	0.22	0.30
Clearance Time (s)	6.0	7.6	7.6	5.0	7.6	7.6	7.3	7.3		7.8	7.8	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	259	1396	460	133	1270	504	157	297		302	339	410
v/s Ratio Prot	0.04	c0.36		c0.04	0.32		0.05	c0.06		c0.18	0.17	0.02
v/s Ratio Perm			0.02	0.27		0.06						
v/c Ratio	0.45	0.90	0.05	0.74	0.87	0.16	0.52	0.57		0.83	0.76	0.07
Uniform Delay, d1	54.7	34.9	22.8	27.2	36.5	26.4	53.4	53.7		46.5	45.7	31.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.3	7.9	0.0	20.0	6.5	0.2	3.1	2.5		16.8	9.3	0.1
Delay (s)	56.0	42.8	22.9	47.2	43.0	26.6	56.5	56.1		63.3	55.0	31.2
Level of Service	E	D	C	D	D	C	E	E		E	E	C
Approach Delay (s)		43.0			41.1			56.2				55.0
Approach LOS		D			D			E				D

Intersection Summary

HCM 2000 Control Delay	45.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	125.0	Sum of lost time (s)	28.7
Intersection Capacity Utilization	80.1%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lanes, Volumes, Timings

2: King Street East & Tu-Lane Street

2031 Background Conditions (no LRT): AM Peak Hour

Lane Group	EBL	EBT	WBU	WBT	WBR	SBL	SBR
Lane Configurations	↔	↕	↔	↕	↔	↕	↕
Traffic Volume (vph)	32	1931	0	1226	13	117	31
Future Volume (vph)	32	1931	0	1226	13	117	31
Ideal Flow (vphpl)	1775	1900	1775	1775	1775	1775	1765
Storage Length (m)	30.0		30.0		0.0	45.0	0.0
Storage Lanes	1		1		0	1	0
Taper Length (m)	15.0		15.0			65.0	
Lane Util. Factor	1.00	0.95	1.00	0.95	0.95	0.97	0.95
Frt				0.998		0.968	
Flt Protected	0.950					0.962	
Satd. Flow (prot)	1686	3406	1740	3205	0	2994	0
Flt Permitted	0.950					0.962	
Satd. Flow (perm)	1686	3406	1740	3205	0	2994	0
Right Turn on Red					Yes		Yes
Satd. Flow (RTOR)				1		27	
Link Speed (k/h)		60		60		50	
Link Distance (m)		509.9		794.2		182.3	
Travel Time (s)		30.6		47.7		13.1	
Peak Hour Factor	0.91	0.91	0.92	0.98	0.98	0.80	0.80
Heavy Vehicles (%)	0%	6%	2%	5%	5%	9%	0%
Adj. Flow (vph)	35	2122	0	1251	13	146	39
Shared Lane Traffic (%)							
Lane Group Flow (vph)	35	2122	0	1264	0	185	0
Enter Blocked Intersection	No						
Lane Alignment	Left	Left	R NA	Left	Right	Left	Right
Median Width(m)		3.6		3.6		7.2	
Link Offset(m)		0.0		0.0		0.0	
Crosswalk Width(m)		4.8		4.8		4.8	
Two way Left Turn Lane							
Headway Factor	1.09	1.00	1.09	1.09	1.09	1.09	1.10
Turning Speed (k/h)	25		15		15	25	15
Number of Detectors	1	2	1	2		1	
Detector Template	Left	Thru	Left	Thru		Left	
Leading Detector (m)	2.0	10.0	2.0	10.0		2.0	
Trailing Detector (m)	0.0	0.0	0.0	0.0		0.0	
Detector 1 Position(m)	0.0	0.0	0.0	0.0		0.0	
Detector 1 Size(m)	2.0	0.6	2.0	0.6		2.0	
Detector 1 Type	CI+Ex	CI+Ex	CI+Ex	CI+Ex		CI+Ex	
Detector 1 Channel							
Detector 1 Extend (s)	0.0	0.0	0.0	0.0		0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0		0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0		0.0	
Detector 2 Position(m)		9.4		9.4			
Detector 2 Size(m)		0.6		0.6			
Detector 2 Type		CI+Ex		CI+Ex			
Detector 2 Channel							
Detector 2 Extend (s)		0.0		0.0			
Turn Type	Prot	NA	Perm	NA		Prot	
Protected Phases	5	2		6		8	

Lanes, Volumes, Timings

2: King Street East & Tu-Lane Street

2031 Background Conditions (no LRT): AM Peak Hour

Lane Group	EBL	EBT	WBU	WBT	WBR	SBL	SBR
Permitted Phases			6				
Detector Phase	5	2	6	6		8	
Switch Phase							
Minimum Initial (s)	5.0	65.1	65.1	65.1		10.0	
Minimum Split (s)	10.0	72.0	72.0	72.0		17.1	
Total Split (s)	14.4	72.0	72.0	72.0		33.6	
Total Split (%)	12.0%	60.0%	60.0%	60.0%		28.0%	
Maximum Green (s)	10.4	65.1	65.1	65.1		26.5	
Yellow Time (s)	3.0	3.7	3.7	3.7		3.3	
All-Red Time (s)	1.0	3.2	3.2	3.2		3.8	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0		0.0	
Total Lost Time (s)	4.0	6.9	6.9	6.9		7.1	
Lead/Lag	Lead		Lag	Lag			
Lead-Lag Optimize?							
Vehicle Extension (s)	3.0	3.0	3.0	3.0		3.0	
Recall Mode	None	Max	Max	Max		None	
Walk Time (s)		54.1	54.1	54.1		7.0	
Flash Dont Walk (s)		11.0	11.0	11.0		19.5	
Pedestrian Calls (#/hr)		0	0	0		0	
Act Effct Green (s)	7.6	72.7		65.5		11.4	
Actuated g/C Ratio	0.08	0.74		0.67		0.12	
v/c Ratio	0.27	0.84		0.59		0.50	
Control Delay	50.0	13.0		11.7		40.6	
Queue Delay	0.0	0.0		0.0		0.0	
Total Delay	50.0	13.0		11.7		40.6	
LOS	D	B		B		D	
Approach Delay		13.6		11.7		40.6	
Approach LOS		B		B		D	
Intersection Summary							
Area Type:	Other						
Cycle Length:	120						
Actuated Cycle Length:	98.2						
Natural Cycle:	100						
Control Type:	Actuated-Uncoordinated						
Maximum v/c Ratio:	0.84						
Intersection Signal Delay:	14.3			Intersection LOS: B			
Intersection Capacity Utilization:	74.3%			ICU Level of Service D			
Analysis Period (min):	15						
Split and Phases:	2: King Street East & Tu-Lane Street						

Queues

2: King Street East & Tu-Lane Street

2031 Background Conditions (no LRT): AM Peak Hour



Lane Group	EBL	EBT	WBT	SBL
Lane Group Flow (vph)	35	2122	1264	185
v/c Ratio	0.27	0.84	0.59	0.50
Control Delay	50.0	13.0	11.7	40.6
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	50.0	13.0	11.7	40.6
Queue Length 50th (m)	7.0	123.2	73.6	16.1
Queue Length 95th (m)	17.5	186.8	112.2	24.2
Internal Link Dist (m)		485.9	770.2	158.3
Turn Bay Length (m)	30.0			45.0
Base Capacity (vph)	179	2774	2137	832
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.20	0.76	0.59	0.22

Intersection Summary

HCM Signalized Intersection Capacity Analysis

2: King Street East & Tu-Lane Street

2031 Background Conditions (no LRT): AM Peak Hour



Movement	EBL	EBT	WBU	WBT	WBR	SBL	SBR
Lane Configurations	↔	↕↕	↔	↕↕	↔	↕↕	↕↕
Traffic Volume (vph)	32	1931	0	1226	13	117	31
Future Volume (vph)	32	1931	0	1226	13	117	31
Ideal Flow (vphpl)	1775	1900	1775	1775	1775	1775	1765
Total Lost time (s)	4.0	6.9		6.9		7.1	
Lane Util. Factor	1.00	0.95		0.95		0.97	
Fr	1.00	1.00		1.00		0.97	
Fit Protected	0.95	1.00		1.00		0.96	
Satd. Flow (prot)	1686	3406		3207		2995	
Fit Permitted	0.95	1.00		1.00		0.96	
Satd. Flow (perm)	1686	3406		3207		2995	
Peak-hour factor, PHF	0.91	0.91	0.92	0.98	0.98	0.80	0.80
Adj. Flow (vph)	35	2122	0	1251	13	146	39
RTOR Reduction (vph)	0	0	0	0	0	24	0
Lane Group Flow (vph)	35	2122	0	1264	0	161	0
Heavy Vehicles (%)	0%	6%	2%	5%	5%	9%	0%
Turn Type	Prot	NA	Perm	NA		Prot	
Protected Phases	5	2		6		8	
Permitted Phases			6				
Actuated Green, G (s)	4.9	74.4		65.5		11.4	
Effective Green, g (s)	4.9	74.4		65.5		11.4	
Actuated g/C Ratio	0.05	0.75		0.66		0.11	
Clearance Time (s)	4.0	6.9		6.9		7.1	
Vehicle Extension (s)	3.0	3.0		3.0		3.0	
Lane Grp Cap (vph)	82	2539		2104		342	
v/s Ratio Prot	0.02	c0.62		0.39		c0.05	
v/s Ratio Perm							
v/c Ratio	0.43	0.84		0.60		0.47	
Uniform Delay, d1	46.1	8.6		9.7		41.4	
Progression Factor	1.00	1.00		1.00		1.00	
Incremental Delay, d2	3.5	3.4		1.3		1.0	
Delay (s)	49.6	12.0		11.0		42.4	
Level of Service	D	B		B		D	
Approach Delay (s)		12.6		11.0		42.4	
Approach LOS		B		B		D	

Intersection Summary

HCM 2000 Control Delay	13.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	99.8	Sum of lost time (s)	18.0
Intersection Capacity Utilization	74.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Lanes, Volumes, Timings

3: King Street East & WB Hwy 401 Off-Ramp

2031 Background Conditions (no LRT): AM Peak Hour



Lane Group	EBU	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↔		↔↔	↔↔		↔	
Traffic Volume (vph)	0	0	911	1356	0	56	0
Future Volume (vph)	0	0	911	1356	0	56	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1775	1775
Storage Length (m)		15.0			0.0	0.0	0.0
Storage Lanes		1			0	1	0
Taper Length (m)		15.0				7.5	
Lane Util. Factor	1.00	1.00	0.95	0.95	1.00	1.00	1.00
Frt							
Flt Protected						0.950	
Satd. Flow (prot)	1863	0	3574	3471	0	1653	0
Flt Permitted						0.950	
Satd. Flow (perm)	1863	0	3574	3471	0	1653	0
Right Turn on Red					Yes		Yes
Satd. Flow (RTOR)							
Link Speed (k/h)			60	60		50	
Link Distance (m)			794.2	296.3		232.6	
Travel Time (s)			47.7	17.8		16.7	
Peak Hour Factor	0.92	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	2%	0%	1%	4%	0%	2%	2%
Adj. Flow (vph)	0	0	1012	1507	0	62	0
Shared Lane Traffic (%)							
Lane Group Flow (vph)	0	0	1012	1507	0	62	0
Enter Blocked Intersection	No	No	No	No	No	No	No
Lane Alignment	R NA	Left	Left	Left	Right	Left	Right
Median Width(m)			3.6	3.6		3.6	
Link Offset(m)			0.0	0.0		0.0	
Crosswalk Width(m)			4.8	4.8		4.8	
Two way Left Turn Lane							
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.09	1.09
Turning Speed (k/h)	15	25			15	25	15
Number of Detectors	1		2	2		1	
Detector Template	Left		Thru	Thru		Left	
Leading Detector (m)	2.0		10.0	10.0		2.0	
Trailing Detector (m)	0.0		0.0	0.0		0.0	
Detector 1 Position(m)	0.0		0.0	0.0		0.0	
Detector 1 Size(m)	2.0		0.6	0.6		2.0	
Detector 1 Type	CI+Ex		CI+Ex	CI+Ex		CI+Ex	
Detector 1 Channel							
Detector 1 Extend (s)	0.0		0.0	0.0		0.0	
Detector 1 Queue (s)	0.0		0.0	0.0		0.0	
Detector 1 Delay (s)	0.0		0.0	0.0		0.0	
Detector 2 Position(m)			9.4	9.4			
Detector 2 Size(m)			0.6	0.6			
Detector 2 Type			CI+Ex	CI+Ex			
Detector 2 Channel							
Detector 2 Extend (s)			0.0	0.0			
Turn Type	Perm		NA	NA		Prot	
Protected Phases			4	8		6	

Lanes, Volumes, Timings

3: King Street East & WB Hwy 401 Off-Ramp

2031 Background Conditions (no LRT): AM Peak Hour

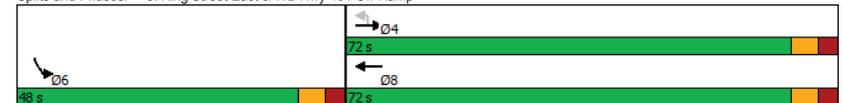


Lane Group	EBU	EBL	EBT	WBT	WBR	SBL	SBR
Permitted Phases							
Detector Phase	4		4	8		6	
Switch Phase							
Minimum Initial (s)	5.0		5.0	5.0		5.0	
Minimum Split (s)	25.0		25.0	25.0		25.0	
Total Split (s)	72.0		72.0	72.0		48.0	
Total Split (%)	60.0%		60.0%	60.0%		40.0%	
Maximum Green (s)	65.0		65.0	65.0		41.0	
Yellow Time (s)	4.0		4.0	4.0		4.0	
All-Red Time (s)	3.0		3.0	3.0		3.0	
Lost Time Adjust (s)	0.0		0.0	0.0		0.0	
Total Lost Time (s)	7.0		7.0	7.0		7.0	
Lead/Lag							
Lead-Lag Optimize?							
Vehicle Extension (s)	3.0		3.0	3.0		3.0	
Recall Mode	Max		Max	Max		None	
Walk Time (s)	7.0		7.0	7.0		7.0	
Flash Dont Walk (s)	11.0		11.0	11.0		11.0	
Pedestrian Calls (#/hr)	0		0	0		0	
Act Effct Green (s)			80.4	80.4		9.1	
Actuated g/C Ratio			0.81	0.81		0.09	
v/c Ratio			0.35	0.53		0.41	
Control Delay			3.9	5.3		51.0	
Queue Delay			0.0	0.0		0.0	
Total Delay			3.9	5.3		51.0	
LOS			A	A		D	
Approach Delay			3.9	5.3		51.0	
Approach LOS			A	A		D	

Intersection Summary

Area Type:	Other
Cycle Length:	120
Actuated Cycle Length:	99
Natural Cycle:	60
Control Type:	Semi Act-Uncoord
Maximum v/c Ratio:	0.53
Intersection Signal Delay:	5.9
Intersection Capacity Utilization:	82.7%
Intersection LOS:	A
ICU Level of Service:	E
Analysis Period (min):	15

Splits and Phases: 3: King Street East & WB Hwy 401 Off-Ramp



Queues

3: King Street East & WB Hwy 401 Off-Ramp

2031 Background Conditions (no LRT): AM Peak Hour

	→	←	↘
Lane Group	EBT	WBT	SBL
Lane Group Flow (vph)	1012	1507	62
v/c Ratio	0.35	0.53	0.41
Control Delay	3.9	5.3	51.0
Queue Delay	0.0	0.0	0.0
Total Delay	3.9	5.3	51.0
Queue Length 50th (m)	28.4	53.6	12.6
Queue Length 95th (m)	42.4	79.0	24.3
Internal Link Dist (m)	770.2	272.3	208.6
Turn Bay Length (m)			
Base Capacity (vph)	2901	2817	687
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.35	0.53	0.09
Intersection Summary			

HCM Signalized Intersection Capacity Analysis

3: King Street East & WB Hwy 401 Off-Ramp

2031 Background Conditions (no LRT): AM Peak Hour

	↘	↗	→	←	↖	↙	↘
Movement	EBU	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↓		↑↑	↑↑		↓	
Traffic Volume (vph)	0	0	911	1356	0	56	0
Future Volume (vph)	0	0	911	1356	0	56	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1775	1775
Total Lost time (s)			7.0	7.0		7.0	
Lane Util. Factor			0.95	0.95		1.00	
Fr _t			1.00	1.00		1.00	
Fit Protected			1.00	1.00		0.95	
Satd. Flow (prot)			3574	3471		1653	
Fit Permitted			1.00	1.00		0.95	
Satd. Flow (perm)			3574	3471		1653	
Peak-hour factor, PHF	0.92	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	0	1012	1507	0	62	0
RTOR Reduction (vph)	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	1012	1507	0	62	0
Heavy Vehicles (%)	2%	0%	1%	4%	0%	2%	2%
Turn Type	Perm		NA	NA		Prot	
Protected Phases			4	8		6	
Permitted Phases	4						
Actuated Green, G (s)			78.8	78.8		7.8	
Effective Green, g (s)			78.8	78.8		7.8	
Actuated g/C Ratio			0.78	0.78		0.08	
Clearance Time (s)			7.0	7.0		7.0	
Vehicle Extension (s)			3.0	3.0		3.0	
Lane Grp Cap (vph)			2799	2718		128	
v/s Ratio Prot			0.28	c0.43		c0.04	
v/s Ratio Perm							
v/c Ratio			0.36	0.55		0.48	
Uniform Delay, d1			3.3	4.2		44.5	
Progression Factor			1.00	1.00		1.00	
Incremental Delay, d2			0.4	0.8		2.9	
Delay (s)			3.7	5.0		47.3	
Level of Service			A	A		D	
Approach Delay (s)			3.7	5.0		47.3	
Approach LOS			A	A		D	
Intersection Summary							
HCM 2000 Control Delay			5.5		HCM 2000 Level of Service		A
HCM 2000 Volume to Capacity ratio			0.55				
Actuated Cycle Length (s)			100.6		Sum of lost time (s)		14.0
Intersection Capacity Utilization			82.7%		ICU Level of Service		E
Analysis Period (min)			15				
c Critical Lane Group							

Lanes, Volumes, Timings

4: EB Hwy 401 Off-Ramp/EB Hwy 401 On-Ramp & King Street East Conditions (no LRT): AM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↔	↔	↕	↔	↔	↕	↔	↔	↕	↔
Traffic Volume (vph)	451	616	0	0	934	0	470	0	115	0	0	0
Future Volume (vph)	451	616	0	0	934	0	470	0	115	0	0	0
Ideal Flow (vphpl)	1775	1900	1900	1900	1900	1900	1775	1900	1750	1900	1900	1900
Storage Length (m)	175.0		0.0	0.0			0.0	90.0		0.0	0.0	0.0
Storage Lanes	1		0	0			1		1	0		0
Taper Length (m)	25.0			7.5				55.0		7.5		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt								0.850				
Flt Protected	0.950						0.950					
Satd. Flow (prot)	1637	3471	0	0	3505	0	3207	0	1458	0	0	0
Flt Permitted	0.102						0.950					
Satd. Flow (perm)	176	3471	0	0	3505	0	3207	0	1458	0	0	0
Right Turn on Red			Yes			Yes		Yes				Yes
Satd. Flow (RTOR)								128				
Link Speed (k/h)	60				60			50				50
Link Distance (m)	296.3				238.1			280.3				135.0
Travel Time (s)	17.8				14.3			20.2				9.7
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	3%	4%	0%	0%	3%	0%	2%	0%	2%	0%	0%	0%
Adj. Flow (vph)	501	684	0	0	1038	0	522	0	128	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	501	684	0	0	1038	0	522	0	128	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.6			3.6			7.2			7.2	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.09	1.00	1.00	1.00	1.00	1.00	1.09	1.11	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2			2		1		1			
Detector Template	Left	Thru			Thru		Left		Right			
Leading Detector (m)	2.0	10.0			10.0		2.0		2.0			
Trailing Detector (m)	0.0	0.0			0.0		0.0		0.0			
Detector 1 Position(m)	0.0	0.0			0.0		0.0		0.0			
Detector 1 Size(m)	2.0	0.6			0.6		2.0		2.0			
Detector 1 Type	CI+Ex	CI+Ex			CI+Ex		CI+Ex		CI+Ex			
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0			0.0		0.0		0.0			
Detector 1 Queue (s)	0.0	0.0			0.0		0.0		0.0			
Detector 1 Delay (s)	0.0	0.0			0.0		0.0		0.0			
Detector 2 Position(m)		9.4			9.4							
Detector 2 Size(m)		0.6			0.6							
Detector 2 Type		CI+Ex			CI+Ex							
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0							
Turn Type	pm+pt	NA			NA		Prot		Perm			
Protected Phases	1	6			2		4					

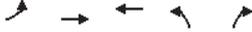
Lanes, Volumes, Timings

4: EB Hwy 401 Off-Ramp/EB Hwy 401 On-Ramp & King Street East Conditions (no LRT): AM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	6											4
Detector Phase	1	6										4
Switch Phase												
Minimum Initial (s)	5.0	20.0			20.0				10.0			10.0
Minimum Split (s)	10.0	27.0			27.0				25.0			25.0
Total Split (s)	38.0	79.0			41.0				41.0			41.0
Total Split (%)	31.7%	65.8%			34.2%				34.2%			34.2%
Maximum Green (s)	33.0	72.0			34.0				34.0			34.0
Yellow Time (s)	3.0	4.0			4.0				4.0			4.0
All-Red Time (s)	2.0	3.0			3.0				3.0			3.0
Lost Time Adjust (s)	0.0	0.0			0.0				0.0			0.0
Total Lost Time (s)	5.0	7.0			7.0				7.0			7.0
Lead/Lag	Lead				Lag							
Lead-Lag Optimize?	Yes				Yes							
Vehicle Extension (s)	3.0	3.0			3.0				3.0			3.0
Recall Mode	None	None			Max				None			None
Walk Time (s)		7.0			7.0				7.0			7.0
Flash Dont Walk (s)		11.0			11.0				11.0			11.0
Pedestrian Calls (#/hr)		0			0				0			0
Act Effct Green (s)	73.5	71.5			34.1				22.9			22.9
Actuated g/C Ratio	0.68	0.66			0.31				0.21			0.21
v/c Ratio	0.90	0.30			0.94				0.77			0.31
Control Delay	48.9	8.7			53.7				48.7			8.2
Queue Delay	0.0	0.0			0.0				0.0			0.0
Total Delay	48.9	8.7			53.7				48.7			8.2
LOS	D	A			D				D			A
Approach Delay		25.7			53.7				40.7			
Approach LOS		C			D				D			
Intersection Summary												
Area Type:	Other											
Cycle Length:	120											
Actuated Cycle Length:	108.4											
Natural Cycle:	90											
Control Type:	Actuated-Uncoordinated											
Maximum v/c Ratio:	0.94											
Intersection Signal Delay:	39.2						Intersection LOS: D					
Intersection Capacity Utilization:	82.7%						ICU Level of Service E					
Analysis Period (min):	15											
Splits and Phases:	4: EB Hwy 401 Off-Ramp/EB Hwy 401 On-Ramp & King Street East											

Queues

4: EB Hwy 401 Off-Ramp/EB Hwy 401 On-Ramp & King Street East and Conditions (no LRT): AM Peak Hour



Lane Group	EBL	EBT	WBT	NBL	NBR
Lane Group Flow (vph)	501	684	1038	522	128
v/c Ratio	0.90	0.30	0.94	0.77	0.31
Control Delay	48.9	8.7	53.7	48.7	8.2
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	48.9	8.7	53.7	48.7	8.2
Queue Length 50th (m)	88.8	30.6	118.5	57.1	0.0
Queue Length 95th (m)	#170.8	49.0	#181.0	75.9	15.3
Internal Link Dist (m)		272.3	214.1		
Turn Bay Length (m)	175.0			90.0	
Base Capacity (vph)	565	2311	1102	1008	546
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	0.30	0.94	0.52	0.23

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

HCM Signalized Intersection Capacity Analysis

4: EB Hwy 401 Off-Ramp/EB Hwy 401 On-Ramp & King Street East and Conditions (no LRT): AM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔↔			↔↔		↔↔		↔			
Traffic Volume (vph)	451	616	0	0	934	0	470	0	115	0	0	0
Future Volume (vph)	451	616	0	0	934	0	470	0	115	0	0	0
Ideal Flow (vphpl)	1775	1900	1900	1900	1900	1900	1775	1900	1750	1900	1900	1900
Total Lost time (s)	5.0	7.0			7.0		7.0		7.0			
Lane Util. Factor	1.00	0.95			0.95		0.97		1.00			
Fr	1.00	1.00			1.00		1.00		0.85			
Fit Protected	0.95	1.00			1.00		0.95		1.00			
Satd. Flow (prot)	1637	3471			3505		3207		1458			
Fit Permitted	0.10	1.00			1.00		0.95		1.00			
Satd. Flow (perm)	176	3471			3505		3207		1458			
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	501	684	0	0	1038	0	522	0	128	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	101	0	0	0
Lane Group Flow (vph)	501	684	0	0	1038	0	522	0	27	0	0	0
Heavy Vehicles (%)	3%	4%	0%	0%	3%	0%	2%	0%	2%	0%	0%	0%
Turn Type	pm+pt	NA			NA		Prot		Perm			
Protected Phases	1	6			2		4					
Permitted Phases	6								4			
Actuated Green, G (s)	71.5	71.5			34.1		22.9		22.9			
Effective Green, g (s)	71.5	71.5			34.1		22.9		22.9			
Actuated g/C Ratio	0.66	0.66			0.31		0.21		0.21			
Clearance Time (s)	5.0	7.0			7.0		7.0		7.0			
Vehicle Extension (s)	3.0	3.0			3.0		3.0		3.0			
Lane Grp Cap (vph)	552	2289			1102		677		308			
v/s Ratio Prot	c0.27	0.20			0.30		c0.16					
v/s Ratio Perm	c0.33								0.02			
v/c Ratio	0.91	0.30			0.94		0.77		0.09			
Uniform Delay, d1	29.3	7.8			36.2		40.3		34.4			
Progression Factor	1.00	1.00			1.00		1.00		1.00			
Incremental Delay, d2	18.6	0.1			16.3		5.4		0.1			
Delay (s)	47.9	7.9			52.5		45.7		34.5			
Level of Service	D	A			D		D		C			
Approach Delay (s)		24.8			52.5			43.5			0.0	
Approach LOS		C			D			D			A	

Intersection Summary
 HCM 2000 Control Delay 39.0 HCM 2000 Level of Service D
 HCM 2000 Volume to Capacity ratio 0.90
 Actuated Cycle Length (s) 108.4 Sum of lost time (s) 19.0
 Intersection Capacity Utilization 82.7% ICU Level of Service E
 Analysis Period (min) 15
 c Critical Lane Group

Lanes, Volumes, Timings

1: Baxter Place/Sportsworld Crossing & King Street East 2031 Background Conditions (no LRT): PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	141	1328	60	145	1086	182	46	56	107	393	42	62
Future Volume (vph)	141	1328	60	145	1086	182	46	56	107	393	42	62
Ideal Flow (vphpl)	1775	1900	1750	1775	1900	1750	1775	1775	1775	1775	1900	1750
Storage Length (m)	85.0		40.0	50.0		50.0	0.0		0.0	0.0		0.0
Storage Lanes	2		1	1		1	1		0	1		1
Taper Length (m)	65.0			35.0			7.5			7.5		
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.95	0.95	0.95	1.00
Fr			0.850			0.850		0.902				0.850
Fit Protected	0.950			0.950			0.950			0.950	0.961	
Satd. Flow (prot)	3239	3539	1444	1686	3539	1417	1606	2944	0	1483	1629	1473
Fit Permitted	0.950			0.080			0.950			0.950	0.961	
Satd. Flow (perm)	3239	3539	1444	142	3539	1417	1606	2944	0	1483	1629	1473
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			121			164			97			84
Link Speed (k/h)		60			60				50			50
Link Distance (m)		356.0			509.9				162.7			242.9
Travel Time (s)		21.4			30.6				11.7			17.5
Peak Hour Factor	0.93	0.93	0.93	0.92	0.92	0.92	0.88	0.88	0.88	0.84	0.84	0.84
Heavy Vehicles (%)	1%	2%	3%	0%	2%	5%	4%	3%	8%	0%	1%	1%
Adj. Flow (vph)	152	1428	65	158	1180	198	52	64	122	468	50	74
Shared Lane Traffic (%)									45%			
Lane Group Flow (vph)	152	1428	65	158	1180	198	52	186	0	257	261	74
Enter Blocked Intersection	No											
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Thru	Left	Right	Left	Right
Median Width(m)		7.2			7.2				3.6			3.6
Link Offset(m)		0.0			0.0				0.0			0.0
Crosswalk Width(m)		4.8			4.8				4.8			4.8
Two way Left Turn Lane												
Headway Factor	1.09	1.00	1.11	1.09	1.00	1.11	1.09	1.09	1.09	1.09	1.00	1.11
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2	1	1	2	1	1	2		1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru	Left	Thru	Right	
Leading Detector (m)	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0		2.0	10.0	2.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6		2.0	0.6	2.0
Detector 1 Type	CI+Ex		CI+Ex	CI+Ex	CI+Ex							
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 2 Position(m)					9.4					9.4		
Detector 2 Size(m)					0.6					0.6		
Detector 2 Type					CI+Ex					CI+Ex		
Detector 2 Channel												
Detector 2 Extend (s)					0.0					0.0		
Turn Type	Prot	NA	Perm	pm+pt	NA	Perm	Split	NA		Split	NA	pt+ov
Protected Phases	1	6		5	2		8	8		4	4	4 1

Lanes, Volumes, Timings

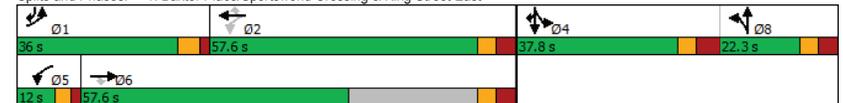
1: Baxter Place/Sportsworld Crossing & King Street East 2031 Background Conditions (no LRT): PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases												
Detector Phase	1	6	6	5	2	2	8	8		4	4	4 1
Switch Phase												
Minimum Initial (s)	7.0	30.0	30.0	7.0	30.0	30.0	8.0	8.0		8.0	8.0	
Minimum Split (s)	13.0	57.6	57.6	12.0	57.6	57.6	27.3	27.3		15.8	15.8	
Total Split (s)	36.0	57.6	57.6	12.0	57.6	57.6	22.3	22.3		37.8	37.8	
Total Split (%)	23.4%	37.5%	37.5%	7.8%	37.5%	37.5%	14.5%	14.5%		24.6%	24.6%	
Maximum Green (s)	30.0	50.0	50.0	7.0	50.0	50.0	15.0	15.0		30.0	30.0	
Yellow Time (s)	4.0	3.7	3.7	3.0	3.7	3.7	3.3	3.3		3.3	3.3	
All-Red Time (s)	2.0	3.9	3.9	2.0	3.9	3.9	4.0	4.0		4.5	4.5	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	7.6	7.6	5.0	7.6	7.6	7.3	7.3		7.8	7.8	
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag						
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	Min	Min	None	Min	Min	None	None		None	None	
Walk Time (s)		10.0	10.0		10.0	10.0		10.0		10.0	10.0	
Flash Dont Walk (s)		40.0	40.0		40.0	40.0		25.0		25.0	25.0	
Pedestrian Calls (#/hr)		0	0		0	0		0		0	0	
Act Effct Green (s)	11.4	55.6	55.6	59.8	50.2	50.2	10.0	10.0		27.0	27.0	36.6
Actuated g/C Ratio	0.09	0.44	0.44	0.47	0.39	0.39	0.08	0.08		0.21	0.21	0.29
v/c Ratio	0.53	0.93	0.09	1.05	0.85	0.30	0.41	0.58		0.82	0.76	0.15
Control Delay	63.1	45.8	0.3	114.6	43.0	8.0	67.8	35.5		69.6	62.6	3.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	63.1	45.8	0.3	114.6	43.0	8.0	67.8	35.5		69.6	62.6	3.8
LOS	E	D	A	F	D	A	E	D		E	E	A
Approach Delay		45.6			45.9			42.5				58.3
Approach LOS		D			D			D				E

Intersection Summary

Area Type:	Other
Cycle Length:	153.7
Actuated Cycle Length:	127.4
Natural Cycle:	125
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	1.05
Intersection Signal Delay:	47.4
Intersection Capacity Utilization:	87.0%
ICU Level of Service:	E
Analysis Period (min):	15

Splits and Phases: 1: Baxter Place/Sportsworld Crossing & King Street East



Queues

1: Baxter Place/Sportsworld Crossing & King Street East 2031 Background Conditions (no LRT): PM Peak Hour



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	152	1428	65	158	1180	198	52	186	257	261	74
v/c Ratio	0.53	0.93	0.09	1.05	0.85	0.30	0.41	0.58	0.82	0.76	0.15
Control Delay	63.1	45.8	0.3	114.6	43.0	8.0	67.8	35.5	69.6	62.6	3.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	63.1	45.8	0.3	114.6	43.0	8.0	67.8	35.5	69.6	62.6	3.8
Queue Length 50th (m)	20.5	191.3	0.0	~30.3	152.7	5.7	13.7	12.2	68.1	68.2	0.0
Queue Length 95th (m)	32.9	#253.2	0.0	#83.8	#211.6	24.4	27.6	24.6	#104.3	99.2	5.3
Internal Link Dist (m)		332.0		485.9			138.7		218.9		
Turn Bay Length (m)	85.0		40.0	50.0		50.0					
Base Capacity (vph)	765	2063	892	151	1394	657	189	433	350	384	720
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.20	0.69	0.07	1.05	0.85	0.30	0.28	0.43	0.73	0.68	0.10

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: Baxter Place/Sportsworld Crossing & King Street East 2031 Background Conditions (no LRT): PM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	141	1328	60	145	1086	182	46	56	107	393	42	62
Future Volume (vph)	141	1328	60	145	1086	182	46	56	107	393	42	62
Ideal Flow (vphpl)	1775	1900	1750	1775	1900	1750	1775	1775	1775	1775	1900	1750
Total Lost time (s)	6.0	7.6	7.6	5.0	7.6	7.6	7.3	7.3		7.8	7.8	7.8
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	1.00	0.95		0.95	0.95	1.00
Fr	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.90		1.00	1.00	0.85
Fit Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	0.96	1.00
Satd. Flow (prot)	3239	3539	1444	1686	3539	1417	1606	2942		1483	1629	1473
Fit Permitted	0.95	1.00	1.00	0.08	1.00	1.00	0.95	1.00		0.95	0.96	1.00
Satd. Flow (perm)	3239	3539	1444	141	3539	1417	1606	2942		1483	1629	1473
Peak-hour factor, PHF	0.93	0.93	0.93	0.92	0.92	0.92	0.88	0.88	0.88	0.84	0.84	0.84
Adj. Flow (vph)	152	1428	65	158	1180	198	52	64	122	468	50	74
RTOR Reduction (vph)	0	0	37	0	0	99	0	89	0	0	0	52
Lane Group Flow (vph)	152	1428	28	158	1180	99	52	97	0	257	261	22
Heavy Vehicles (%)	1%	2%	3%	0%	2%	5%	5%	4%	3%	8%	0%	1%
Turn Type	Prot	NA	Perm	pm+pt	NA	Perm	Split	NA		Split	NA	pt+ov
Protected Phases	1	6		5	2		8	8		4	4	4
Permitted Phases			6	2		2						
Actuated Green, G (s)	11.4	55.6	55.6	57.2	50.2	50.2	10.0	10.0		27.0	27.0	38.4
Effective Green, g (s)	11.4	55.6	55.6	57.2	50.2	50.2	10.0	10.0		27.0	27.0	38.4
Actuated g/C Ratio	0.09	0.44	0.44	0.45	0.39	0.39	0.08	0.08		0.21	0.21	0.30
Clearance Time (s)	6.0	7.6	7.6	5.0	7.6	7.6	7.3	7.3		7.8	7.8	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	290	1545	630	148	1395	558	126	231		314	345	444
v/s Ratio Prot	0.05	c0.40		c0.06	0.33		0.03	c0.03		c0.17	0.16	0.02
v/s Ratio Perm			0.02	c0.42		0.07						
v/c Ratio	0.52	0.92	0.05	1.07	0.85	0.18	0.41	0.42		0.82	0.76	0.05
Uniform Delay, d1	55.4	33.9	20.6	30.2	35.0	25.1	55.9	55.9		47.8	47.1	31.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.7	9.7	0.0	93.1	4.9	0.2	2.2	1.2		15.2	9.1	0.0
Delay (s)	57.1	43.5	20.6	123.3	40.0	25.3	58.0	57.1		63.0	56.2	31.6
Level of Service	E	D	C	F	D	C	E	E		E	E	C
Approach Delay (s)		43.9			46.6			57.3			56.1	
Approach LOS		D			D			E			E	

Intersection Summary

- HCM 2000 Control Delay: 47.5, HCM 2000 Level of Service: D
- HCM 2000 Volume to Capacity ratio: 0.91
- Actuated Cycle Length (s): 127.3, Sum of lost time (s): 28.7
- Intersection Capacity Utilization: 87.0%, ICU Level of Service: E
- Analysis Period (min): 15
- c Critical Lane Group

Lanes, Volumes, Timings

2: King Street East & Tu-Lane Street

2031 Background Conditions (no LRT): PM Peak Hour

Lane Group	EBL	EBT	WBU	WBT	WBR	SBL	SBR
Lane Configurations	↔	↕	↔	↕	↔	↕	↕
Traffic Volume (vph)	43	2080	0	1259	37	541	55
Future Volume (vph)	43	2080	0	1259	37	541	55
Ideal Flow (vphpl)	1775	1900	1775	1775	1775	1775	1765
Storage Length (m)	30.0		30.0		0.0	45.0	0.0
Storage Lanes	1		1		0	1	0
Taper Length (m)	15.0		15.0			65.0	
Lane Util. Factor	1.00	0.95	1.00	0.95	0.95	0.97	0.95
Frt				0.996		0.986	
Flt Protected	0.950					0.957	
Satd. Flow (prot)	1686	3505	1740	3261	0	3220	0
Flt Permitted	0.950					0.957	
Satd. Flow (perm)	1686	3505	1740	3261	0	3220	0
Right Turn on Red					Yes		Yes
Satd. Flow (RTOR)				3		7	
Link Speed (k/h)		60		60		50	
Link Distance (m)		509.9		794.2		182.3	
Travel Time (s)		30.6		47.7		13.1	
Peak Hour Factor	0.95	0.95	0.92	0.92	0.92	0.82	0.82
Heavy Vehicles (%)	0%	3%	2%	3%	3%	1%	0%
Adj. Flow (vph)	45	2189	0	1368	40	660	67
Shared Lane Traffic (%)							
Lane Group Flow (vph)	45	2189	0	1408	0	727	0
Enter Blocked Intersection	No						
Lane Alignment	Left	Left	R NA	Left	Right	Left	Right
Median Width(m)		3.6		3.6		7.2	
Link Offset(m)		0.0		0.0		0.0	
Crosswalk Width(m)		4.8		4.8		4.8	
Two way Left Turn Lane							
Headway Factor	1.09	1.00	1.09	1.09	1.09	1.09	1.10
Turning Speed (k/h)	25		15		15	25	15
Number of Detectors	1	2	1	2		1	
Detector Template	Left	Thru	Left	Thru		Left	
Leading Detector (m)	2.0	10.0	2.0	10.0		2.0	
Trailing Detector (m)	0.0	0.0	0.0	0.0		0.0	
Detector 1 Position(m)	0.0	0.0	0.0	0.0		0.0	
Detector 1 Size(m)	2.0	0.6	2.0	0.6		2.0	
Detector 1 Type	CI+Ex	CI+Ex	CI+Ex	CI+Ex		CI+Ex	
Detector 1 Channel							
Detector 1 Extend (s)	0.0	0.0	0.0	0.0		0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0		0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0		0.0	
Detector 2 Position(m)			9.4			9.4	
Detector 2 Size(m)			0.6			0.6	
Detector 2 Type			CI+Ex			CI+Ex	
Detector 2 Channel							
Detector 2 Extend (s)			0.0			0.0	
Turn Type	Prot	NA	Perm	NA		Prot	
Protected Phases	5	2		6		8	

Lanes, Volumes, Timings

2: King Street East & Tu-Lane Street

2031 Background Conditions (no LRT): PM Peak Hour

Lane Group	EBL	EBT	WBU	WBT	WBR	SBL	SBR
Permitted Phases				6			
Detector Phase	5	2		6		8	
Switch Phase							
Minimum Initial (s)	5.0	79.9	79.9	79.9		10.0	
Minimum Split (s)	10.0	86.8	86.8	86.8		17.1	
Total Split (s)	14.0	86.8	86.8	86.8		39.2	
Total Split (%)	10.0%	62.0%	62.0%	62.0%		28.0%	
Maximum Green (s)	10.0	79.9	79.9	79.9		32.1	
Yellow Time (s)	3.0	3.7	3.7	3.7		3.3	
All-Red Time (s)	1.0	3.2	3.2	3.2		3.8	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0		0.0	
Total Lost Time (s)	4.0	6.9	6.9	6.9		7.1	
Lead/Lag	Lead		Lag	Lag			
Lead-Lag Optimize?							
Vehicle Extension (s)	3.0	3.0	3.0	3.0		3.0	
Recall Mode	None	Max	Max	Max		None	
Walk Time (s)		54.1	54.1	54.1		7.0	
Flash Dont Walk (s)		11.0	11.0	11.0		19.5	
Pedestrian Calls (#/hr)		0	0	0		0	
Act Effct Green (s)	8.4	90.4		80.0		31.9	
Actuated g/C Ratio	0.06	0.66		0.59		0.23	
v/c Ratio	0.44	0.94		0.73		0.96	
Control Delay	75.8	30.4		24.0		75.2	
Queue Delay	0.0	0.0		0.0		0.0	
Total Delay	75.8	30.4		24.0		75.2	
LOS	E	C		C		E	
Approach Delay		31.3		24.0		75.2	
Approach LOS		C		C		E	
Intersection Summary							
Area Type:	Other						
Cycle Length:	140						
Actuated Cycle Length:	136.3						
Natural Cycle:	125						
Control Type:	Actuated-Uncoordinated						
Maximum v/c Ratio:	0.96						
Intersection Signal Delay:	36.2			Intersection LOS: D			
Intersection Capacity Utilization	96.6%			ICU Level of Service F			
Analysis Period (min)	15						
Split and Phases:	2: King Street East & Tu-Lane Street						

Queues

2: King Street East & Tu-Lane Street

2031 Background Conditions (no LRT): PM Peak Hour



Lane Group	EBL	EBT	WBT	SBL
Lane Group Flow (vph)	45	2189	1408	727
v/c Ratio	0.44	0.94	0.73	0.96
Control Delay	75.8	30.4	24.0	75.2
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	75.8	30.4	24.0	75.2
Queue Length 50th (m)	12.7	273.5	153.8	107.6
Queue Length 95th (m)	26.5	322.6	186.4	#126.8
Internal Link Dist (m)		485.9	770.2	158.3
Turn Bay Length (m)	30.0			45.0
Base Capacity (vph)	123	2418	1916	764
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.37	0.91	0.73	0.95

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

2: King Street East & Tu-Lane Street

2031 Background Conditions (no LRT): PM Peak Hour



Movement	EBL	EBT	WBU	WBT	WBR	SBL	SBR
Lane Configurations	↖	↗	↖	↗	↖	↗	↖
Traffic Volume (vph)	43	2080	0	1259	37	541	55
Future Volume (vph)	43	2080	0	1259	37	541	55
Ideal Flow (vphpl)	1775	1900	1775	1775	1775	1775	1765
Total Lost time (s)	4.0	6.9		6.9		7.1	
Lane Util. Factor	1.00	0.95		0.95		0.97	
Fr	1.00	1.00		1.00		0.99	
Fit Protected	0.95	1.00		1.00		0.96	
Satd. Flow (prot)	1686	3505		3260		3219	
Fit Permitted	0.95	1.00		1.00		0.96	
Satd. Flow (perm)	1686	3505		3260		3219	
Peak-hour factor, PHF	0.95	0.95	0.92	0.92	0.92	0.82	0.82
Adj. Flow (vph)	45	2189	0	1368	40	660	67
RTOR Reduction (vph)	0	0	0	1	0	5	0
Lane Group Flow (vph)	45	2189	0	1407	0	722	0
Heavy Vehicles (%)	0%	3%	2%	3%	3%	1%	0%
Turn Type	Prot	NA	Perm	NA		Prot	
Protected Phases	5	2		6		8	
Permitted Phases			6				
Actuated Green, G (s)	7.2	91.3		80.1		31.9	
Effective Green, g (s)	7.2	91.3		80.1		31.9	
Actuated g/C Ratio	0.05	0.67		0.58		0.23	
Clearance Time (s)	4.0	6.9		6.9		7.1	
Vehicle Extension (s)	3.0	3.0		3.0		3.0	
Lane Grp Cap (vph)	88	2332		1903		748	
v/s Ratio Prot	0.03	c0.62		0.43		c0.22	
v/s Ratio Perm							
v/c Ratio	0.51	0.94		0.74		0.96	
Uniform Delay, d1	63.3	20.5		20.9		52.1	
Progression Factor	1.00	1.00		1.00		1.00	
Incremental Delay, d2	4.9	8.9		2.6		24.3	
Delay (s)	68.2	29.4		23.5		76.4	
Level of Service	E	C		C		E	
Approach Delay (s)		30.2		23.5		76.4	
Approach LOS		C		C		E	

Intersection Summary

HCM 2000 Control Delay	35.7	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	137.2	Sum of lost time (s)	18.0
Intersection Capacity Utilization	96.6%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Lanes, Volumes, Timings

3: King Street East & WB Hwy 401 Off-Ramp

2031 Background Conditions (no LRT): PM Peak Hour

Lane Group	EBU	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↔		↔↔	↔↔		↔	
Traffic Volume (vph)	0	0	1718	1207	0	117	0
Future Volume (vph)	0	0	1718	1207	0	117	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1775	1775
Storage Length (m)		15.0			0.0	0.0	0.0
Storage Lanes		1			0	1	0
Taper Length (m)		15.0				7.5	
Lane Util. Factor	1.00	1.00	0.95	0.95	1.00	1.00	1.00
Frt							
Flt Protected						0.950	
Satd. Flow (prot)	1863	0	3574	3471	0	1653	0
Flt Permitted						0.950	
Satd. Flow (perm)	1863	0	3574	3471	0	1653	0
Right Turn on Red					Yes		Yes
Satd. Flow (RTOR)							
Link Speed (k/h)			60	60		50	
Link Distance (m)			794.2	296.3		232.6	
Travel Time (s)			47.7	17.8		16.7	
Peak Hour Factor	0.92	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	2%	0%	1%	4%	0%	2%	2%
Adj. Flow (vph)	0	0	1909	1341	0	130	0
Shared Lane Traffic (%)							
Lane Group Flow (vph)	0	0	1909	1341	0	130	0
Enter Blocked Intersection	No	No	No	No	No	No	No
Lane Alignment	R NA	Left	Left	Left	Right	Left	Right
Median Width(m)			3.6	3.6		3.6	
Link Offset(m)			0.0	0.0		0.0	
Crosswalk Width(m)			4.8	4.8		4.8	
Two way Left Turn Lane							
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.09	1.09
Turning Speed (k/h)	15	25			15	25	15
Number of Detectors	1		2	2		1	
Detector Template	Left		Thru	Thru		Left	
Leading Detector (m)	2.0		10.0	10.0		2.0	
Trailing Detector (m)	0.0		0.0	0.0		0.0	
Detector 1 Position(m)	0.0		0.0	0.0		0.0	
Detector 1 Size(m)	2.0		0.6	0.6		2.0	
Detector 1 Type	CI+Ex		CI+Ex	CI+Ex		CI+Ex	
Detector 1 Channel							
Detector 1 Extend (s)	0.0		0.0	0.0		0.0	
Detector 1 Queue (s)	0.0		0.0	0.0		0.0	
Detector 1 Delay (s)	0.0		0.0	0.0		0.0	
Detector 2 Position(m)			9.4	9.4			
Detector 2 Size(m)			0.6	0.6			
Detector 2 Type			CI+Ex	CI+Ex			
Detector 2 Channel							
Detector 2 Extend (s)			0.0	0.0			
Turn Type	Perm		NA	NA		Prot	
Protected Phases			4	8		6	

Lanes, Volumes, Timings

3: King Street East & WB Hwy 401 Off-Ramp

2031 Background Conditions (no LRT): PM Peak Hour

Lane Group	EBU	EBL	EBT	WBT	WBR	SBL	SBR
Permitted Phases	4						
Detector Phase	4		4			8	
Switch Phase							
Minimum Initial (s)	5.0		5.0		5.0		5.0
Minimum Split (s)	25.0		25.0		25.0		25.0
Total Split (s)	69.0		69.0		69.0		51.0
Total Split (%)	57.5%		57.5%		57.5%		42.5%
Maximum Green (s)	62.0		62.0		62.0		44.0
Yellow Time (s)	4.0		4.0		4.0		4.0
All-Red Time (s)	3.0		3.0		3.0		3.0
Lost Time Adjust (s)	0.0		0.0		0.0		0.0
Total Lost Time (s)	7.0		7.0		7.0		7.0
Lead/Lag							
Lead-Lag Optimize?							
Vehicle Extension (s)	3.0		3.0		3.0		3.0
Recall Mode	Max		Max		Max		None
Walk Time (s)	7.0		7.0		7.0		7.0
Flash Dont Walk (s)	11.0		11.0		11.0		11.0
Pedestrian Calls (#/hr)	0		0		0		0
Act Effct Green (s)	68.4		68.4		68.4		12.7
Actuated g/C Ratio	0.72		0.72		0.72		0.13
v/c Ratio	0.74		0.54		0.54		0.59
Control Delay	11.0		7.5		7.5		48.6
Queue Delay	0.0		0.0		0.0		0.0
Total Delay	11.0		7.5		7.5		48.6
LOS	B		A		A		D
Approach Delay	11.0		7.5		7.5		48.6
Approach LOS	B		A		A		D
Intersection Summary							
Area Type:	Other						
Cycle Length:	120						
Actuated Cycle Length:	95.2						
Natural Cycle:	75						
Control Type:	Actuated-Uncoordinated						
Maximum v/c Ratio:	0.74						
Intersection Signal Delay:	11.1			Intersection LOS: B			
Intersection Capacity Utilization:	84.1%			ICU Level of Service E			
Analysis Period (min)	15						
Splits and Phases: 3: King Street East & WB Hwy 401 Off-Ramp							

Queues

3: King Street East & WB Hwy 401 Off-Ramp

2031 Background Conditions (no LRT): PM Peak Hour

	→	←	↘
Lane Group	EBT	WBT	SBL
Lane Group Flow (vph)	1909	1341	130
v/c Ratio	0.74	0.54	0.59
Control Delay	11.0	7.5	48.6
Queue Delay	0.0	0.0	0.0
Total Delay	11.0	7.5	48.6
Queue Length 50th (m)	98.7	52.7	23.5
Queue Length 95th (m)	151.8	81.1	39.9
Internal Link Dist (m)	770.2	272.3	208.6
Turn Bay Length (m)			
Base Capacity (vph)	2569	2495	765
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.74	0.54	0.17
Intersection Summary			

HCM Signalized Intersection Capacity Analysis

3: King Street East & WB Hwy 401 Off-Ramp

2031 Background Conditions (no LRT): PM Peak Hour

	↙	↖	→	←	↗	↘	↙
Movement	EBU	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↓		↑↑	↑↑		↓	
Traffic Volume (vph)	0	0	1718	1207	0	117	0
Future Volume (vph)	0	0	1718	1207	0	117	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1775	1775
Total Lost time (s)			7.0	7.0		7.0	
Lane Util. Factor			0.95	0.95		1.00	
Fr			1.00	1.00		1.00	
Fit Protected			1.00	1.00		0.95	
Satd. Flow (prot)			3574	3471		1653	
Fit Permitted			1.00	1.00		0.95	
Satd. Flow (perm)			3574	3471		1653	
Peak-hour factor, PHF	0.92	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	0	1909	1341	0	130	0
RTOR Reduction (vph)	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	1909	1341	0	130	0
Heavy Vehicles (%)	2%	0%	1%	4%	0%	2%	2%
Turn Type	Perm		NA	NA		Prot	
Protected Phases			4	8		6	
Permitted Phases	4						
Actuated Green, G (s)			68.4	68.4		12.7	
Effective Green, g (s)			68.4	68.4		12.7	
Actuated g/C Ratio			0.72	0.72		0.13	
Clearance Time (s)			7.0	7.0		7.0	
Vehicle Extension (s)			3.0	3.0		3.0	
Lane Grp Cap (vph)			2570	2496		220	
v/s Ratio Prot			c0.53	0.39		c0.08	
v/s Ratio Perm							
v/c Ratio			0.74	0.54		0.59	
Uniform Delay, d1			8.0	6.1		38.8	
Progression Factor			1.00	1.00		1.00	
Incremental Delay, d2			2.0	0.8		4.2	
Delay (s)			10.0	6.9		43.0	
Level of Service			B	A		D	
Approach Delay (s)			10.0	6.9		43.0	
Approach LOS			B	A		D	
Intersection Summary							
HCM 2000 Control Delay			10.1		HCM 2000 Level of Service		B
HCM 2000 Volume to Capacity ratio			0.72				
Actuated Cycle Length (s)			95.1		Sum of lost time (s)		14.0
Intersection Capacity Utilization			84.1%		ICU Level of Service		E
Analysis Period (min)			15				
c Critical Lane Group							

Lanes, Volumes, Timings

4: EB Hwy 401 Off-Ramp/EB Hwy 401 On-Ramp & King Street East and Conditions (no LRT): PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↔	↔	↕	↔	↔	↕	↔	↔	↔	↔
Traffic Volume (vph)	528	1225	0	0	841	0	450	0	100	0	0	0
Future Volume (vph)	528	1225	0	0	841	0	450	0	100	0	0	0
Ideal Flow (vphpl)	1775	1900	1900	1900	1900	1900	1775	1900	1750	1900	1900	1900
Storage Length (m)	175.0		0.0	0.0		0.0	90.0		0.0	0.0		0.0
Storage Lanes	1		0	0		0	1		1	0		0
Taper Length (m)	25.0			7.5			55.0			7.5		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt								0.850				
Flt Protected	0.950						0.950					
Satd. Flow (prot)	1637	3574	0	0	3539	0	3207	0	1458	0	0	0
Flt Permitted	0.111						0.950					
Satd. Flow (perm)	191	3574	0	0	3539	0	3207	0	1458	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)									82			
Link Speed (k/h)		60			60			50				50
Link Distance (m)		296.3			238.1			280.3				135.0
Travel Time (s)		17.8			14.3			20.2				9.7
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	3%	1%	0%	0%	2%	0%	2%	0%	2%	0%	0%	0%
Adj. Flow (vph)	587	1361	0	0	934	0	500	0	111	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	587	1361	0	0	934	0	500	0	111	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.6			3.6			7.2				7.2
Link Offset(m)		0.0			0.0			0.0				0.0
Crosswalk Width(m)		4.8			4.8			4.8				4.8
Two way Left Turn Lane												
Headway Factor	1.09	1.00	1.00	1.00	1.00	1.00	1.09	1.11	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2			2		1		1			
Detector Template	Left	Thru			Thru		Left		Right			
Leading Detector (m)	2.0	10.0			10.0		2.0		2.0			
Trailing Detector (m)	0.0	0.0			0.0		0.0		0.0			
Detector 1 Position(m)	0.0	0.0			0.0		0.0		0.0			
Detector 1 Size(m)	2.0	0.6			0.6		2.0		2.0			
Detector 1 Type	CI+Ex	CI+Ex			CI+Ex		CI+Ex		CI+Ex			
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0			0.0		0.0		0.0			
Detector 1 Queue (s)	0.0	0.0			0.0		0.0		0.0			
Detector 1 Delay (s)	0.0	0.0			0.0		0.0		0.0			
Detector 2 Position(m)		9.4			9.4							
Detector 2 Size(m)		0.6			0.6							
Detector 2 Type		CI+Ex			CI+Ex							
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0							
Turn Type	pm+pt	NA			NA		Prot		Perm			
Protected Phases	1	6			2		4					

Lanes, Volumes, Timings

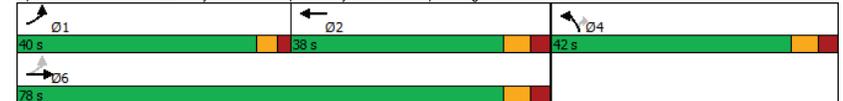
4: EB Hwy 401 Off-Ramp/EB Hwy 401 On-Ramp & King Street East and Conditions (no LRT): PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	6											4
Detector Phase	1	6										4
Switch Phase												
Minimum Initial (s)	5.0	20.0			20.0		10.0		10.0			
Minimum Split (s)	10.0	27.0			27.0		25.0		25.0			
Total Split (s)	40.0	78.0			38.0		42.0		42.0			
Total Split (%)	33.3%	65.0%			31.7%		35.0%		35.0%			
Maximum Green (s)	35.0	71.0			31.0		35.0		35.0			
Yellow Time (s)	3.0	4.0			4.0		4.0		4.0			
All-Red Time (s)	2.0	3.0			3.0		3.0		3.0			
Lost Time Adjust (s)	0.0	0.0			0.0		0.0		0.0			
Total Lost Time (s)	5.0	7.0			7.0		7.0		7.0			
Lead/Lag	Lead				Lag							
Lead-Lag Optimize?	Yes				Yes							
Vehicle Extension (s)	3.0	3.0			3.0		3.0		3.0			
Recall Mode	None	None			Max		None		None			
Walk Time (s)		7.0			7.0		7.0		7.0			
Flash Dont Walk (s)		11.0			11.0		11.0		11.0			
Pedestrian Calls (#/hr)		0			0		0		0			
Act Effct Green (s)	73.2	71.1			31.1		21.8		21.8			
Actuated g/C Ratio	0.68	0.66			0.29		0.20		0.20			
v/c Ratio	0.97	0.57			0.91		0.77		0.31			
Control Delay	59.3	11.5			50.9		48.4		14.4			
Queue Delay	0.0	0.0			0.0		0.0		0.0			
Total Delay	59.3	11.5			50.9		48.4		14.4			
LOS	E	B			D		D		B			
Approach Delay		25.9			50.9				42.2			
Approach LOS		C			D				D			

Intersection Summary

Area Type:	Other
Cycle Length:	120
Actuated Cycle Length:	107
Natural Cycle:	90
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	0.97
Intersection Signal Delay:	35.4
Intersection Capacity Utilization:	84.1%
ICU Level of Service:	E
Intersection LOS:	D
Analysis Period (min):	15

Splits and Phases: 4: EB Hwy 401 Off-Ramp/EB Hwy 401 On-Ramp & King Street East



Queues

4: EB Hwy 401 Off-Ramp/EB Hwy 401 On-Ramp & King Street East and Conditions (no LRT): PM Peak Hour

	↖	→	←	↙	↗
Lane Group	EBL	EBT	WBT	NBL	NBR
Lane Group Flow (vph)	587	1361	934	500	111
v/c Ratio	0.97	0.57	0.91	0.77	0.31
Control Delay	59.3	11.5	50.9	48.4	14.4
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	59.3	11.5	50.9	48.4	14.4
Queue Length 50th (m)	108.4	76.1	103.4	53.6	5.2
Queue Length 95th (m)	#203.9	116.0	#158.0	71.8	19.9
Internal Link Dist (m)		272.3	214.1		
Turn Bay Length (m)	175.0			90.0	
Base Capacity (vph)	604	2376	1027	1051	533
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	0.57	0.91	0.48	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

4: EB Hwy 401 Off-Ramp/EB Hwy 401 On-Ramp & King Street East and Conditions (no LRT): PM Peak Hour

	↖	→	↘	↙	←	↗	↖	↙	↘	↗	↘	↙	↘
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations	↖	↖↗			↖↗		↖↗		↖				
Traffic Volume (vph)	528	1225	0	0	841	0	450	0	100	0	0	0	
Future Volume (vph)	528	1225	0	0	841	0	450	0	100	0	0	0	
Ideal Flow (vphpl)	1775	1900	1900	1900	1900	1900	1775	1900	1750	1900	1900	1900	
Total Lost time (s)	5.0	7.0			7.0		7.0		7.0				
Lane Util. Factor	1.00	0.95			0.95		0.97		1.00				
Fr	1.00	1.00			1.00		1.00		0.85				
Fit Protected	0.95	1.00			1.00		0.95		1.00				
Satd. Flow (prot)	1637	3574			3539		3207		1458				
Fit Permitted	0.11	1.00			1.00		0.95		1.00				
Satd. Flow (perm)	191	3574			3539		3207		1458				
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
Adj. Flow (vph)	587	1361	0	0	934	0	500	0	111	0	0	0	
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	65	0	0	0	
Lane Group Flow (vph)	587	1361	0	0	934	0	500	0	46	0	0	0	
Heavy Vehicles (%)	3%	1%	0%	0%	2%	0%	2%	0%	2%	0%	0%	0%	
Turn Type	pm+pt	NA			NA		Prot		Perm				
Protected Phases	1	6			2		4						
Permitted Phases	6								4				
Actuated Green, G (s)	71.2	71.2			31.1		21.8		21.8				
Effective Green, g (s)	71.2	71.2			31.1		21.8		21.8				
Actuated g/C Ratio	0.67	0.67			0.29		0.20		0.20				
Clearance Time (s)	5.0	7.0			7.0		7.0		7.0				
Vehicle Extension (s)	3.0	3.0			3.0		3.0		3.0				
Lane Grp Cap (vph)	601	2378			1028		653		297				
v/s Ratio Prot	c0.32	0.38			0.26		c0.16						
v/s Ratio Perm	c0.33								0.03				
v/c Ratio	0.98	0.57			0.91		0.77		0.15				
Uniform Delay, d1	29.2	9.7			36.6		40.2		35.0				
Progression Factor	1.00	1.00			1.00		1.00		1.00				
Incremental Delay, d2	30.5	0.3			13.2		5.3		0.2				
Delay (s)	59.7	10.0			49.8		45.5		35.3				
Level of Service	E	B			D		D		D				
Approach Delay (s)		25.0			49.8			43.7			0.0		
Approach LOS		C			D			D			A		

Intersection Summary
 HCM 2000 Control Delay 34.9 HCM 2000 Level of Service C
 HCM 2000 Volume to Capacity ratio 0.95
 Actuated Cycle Length (s) 107.0 Sum of lost time (s) 19.0
 Intersection Capacity Utilization 84.1% ICU Level of Service E
 Analysis Period (min) 15
 c Critical Lane Group

Appendix B

2031 Total Traffic Operations Reports



Lanes, Volumes, Timings

1: Baxter Place/Sportsworld Crossing & King Street East 2031 Total Conditions (no LRT): AM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	108	1181	57	92	1067	190	60	58	138	420	55	81
Future Volume (vph)	108	1181	57	92	1067	190	60	58	138	420	55	81
Ideal Flow (vphpl)	1775	1900	1750	1775	1900	1750	1775	1775	1775	1775	1900	1750
Storage Length (m)	85.0		40.0	50.0		50.0	0.0		0.0	0.0		0.0
Storage Lanes	2		1	1		1	1		0	1		1
Taper Length (m)	65.0			35.0			7.5			7.5		
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.95	0.95	0.95	1.00
Frt			0.850			0.850		0.894				0.850
Fit Protected	0.950			0.950			0.950			0.950	0.963	
Satd. Flow (prot)	3176	3471	1144	1479	3438	1365	1576	2971	0	1381	1547	1365
Fit Permitted	0.950			0.081			0.950			0.950	0.963	
Satd. Flow (perm)	3176	3471	1144	126	3438	1365	1576	2971	0	1381	1547	1365
Right Turn on Red			Yes		Yes			Yes			Yes	
Satd. Flow (RTOR)			125			169		108				89
Link Speed (k/h)		60			60			50				50
Link Distance (m)		356.0			509.9			162.7				242.9
Travel Time (s)		21.4			30.6			11.7				17.5
Peak Hour Factor	0.92	0.92	0.92	0.93	0.93	0.93	0.73	0.73	0.73	0.91	0.91	0.91
Heavy Vehicles (%)	3%	4%	30%	14%	5%	9%	7%	5%	0%	16%	0%	9%
Adj. Flow (vph)	117	1284	62	99	1147	204	82	79	189	462	60	89
Shared Lane Traffic (%)										44%		
Lane Group Flow (vph)	117	1284	62	99	1147	204	82	268	0	259	263	89
Enter Blocked Intersection	No	No	No	No	No							
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Right	Left	Left	Left	Right
Median Width(m)		7.2			7.2			3.6				3.6
Link Offset(m)		0.0			0.0			0.0				0.0
Crosswalk Width(m)		4.8			4.8			4.8				4.8
Two way Left Turn Lane												
Headway Factor	1.09	1.00	1.11	1.09	1.00	1.11	1.09	1.09	1.09	1.09	1.00	1.11
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2	1	1	2	1	1	2		1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru		Left	Thru	Right
Leading Detector (m)	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0		2.0	10.0	2.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6		2.0	0.6	2.0
Detector 1 Type	CI+Ex		CI+Ex	CI+Ex	CI+Ex							
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 2 Position(m)		9.4			9.4			9.4				9.4
Detector 2 Size(m)		0.6			0.6			0.6				0.6
Detector 2 Type		CI+Ex			CI+Ex			CI+Ex				CI+Ex
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0				0.0
Turn Type	Prot	NA	Perm	pm+pt	NA	Perm	Split	NA		Split	NA	pt+ov
Protected Phases	1	6		5	2		8	8		4	4	4 1

Lanes, Volumes, Timings

1: Baxter Place/Sportsworld Crossing & King Street East 2031 Total Conditions (no LRT): AM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases			6	2		2						
Detector Phase	1	6	6	5	2	2	8	8		4	4	4 1
Switch Phase												
Minimum Initial (s)	7.0	30.0	30.0	7.0	30.0	30.0	8.0	8.0		8.0	8.0	
Minimum Split (s)	13.0	57.6	57.6	12.0	57.6	57.6	27.3	27.3		15.8	15.8	
Total Split (s)	26.0	57.6	57.6	12.0	57.6	57.6	27.3	27.3		37.8	37.8	
Total Split (%)	17.5%	38.7%	38.7%	8.1%	38.7%	38.7%	18.4%	18.4%		25.4%	25.4%	
Maximum Green (s)	20.0	50.0	50.0	7.0	50.0	50.0	20.0	20.0		30.0	30.0	
Yellow Time (s)	4.0	3.7	3.7	3.0	3.7	3.7	3.3	3.3		3.3	3.3	
All-Red Time (s)	2.0	3.9	3.9	2.0	3.9	3.9	4.0	4.0		4.5	4.5	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	7.6	7.6	5.0	7.6	7.6	7.3	7.3		7.8	7.8	
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag						
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	Min	Min	None	Min	Min	None	None		None	None	
Walk Time (s)		10.0	10.0		10.0	10.0		10.0		10.0	10.0	
Flash Dont Walk (s)		40.0	40.0		40.0	40.0		25.0		25.0	25.0	
Pedestrian Calls (#/hr)		0	0		0	0		0		0	0	
Act Effct Green (s)	10.2	53.4	53.4	58.8	49.2	49.2	12.7	12.7		28.6	28.6	37.0
Actuated g/C Ratio	0.08	0.41	0.41	0.45	0.38	0.38	0.10	0.10		0.22	0.22	0.29
v/c Ratio	0.47	0.90	0.11	0.76	0.88	0.33	0.53	0.69		0.85	0.77	0.20
Control Delay	64.7	45.6	0.4	59.2	47.1	8.5	69.7	43.6		74.5	64.5	4.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	64.7	45.6	0.4	59.2	47.1	8.5	69.7	43.6		74.5	64.5	4.9
LOS	E	D	A	E	D	A	E	D		E	E	A
Approach Delay		45.2			42.5			49.7				60.1
Approach LOS		D			D			D				E
Intersection Summary												
Area Type:	Other											
Cycle Length:	148.7											
Actuated Cycle Length:	129.5											
Natural Cycle:	125											
Control Type:	Actuated-Uncoordinated											
Maximum v/c Ratio:	0.90											
Intersection Signal Delay:	47.0						Intersection LOS: D					
Intersection Capacity Utilization:	81.3%						ICU Level of Service D					
Analysis Period (min):	15											
Splits and Phases:	1: Baxter Place/Sportsworld Crossing & King Street East											

Queues

1: Baxter Place/Sportsworld Crossing & King Street East 2031 Total Conditions (no LRT): AM Peak Hour

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	117	1284	62	99	1147	204	82	268	259	263	89
v/c Ratio	0.47	0.90	0.11	0.76	0.88	0.33	0.53	0.69	0.85	0.77	0.20
Control Delay	64.7	45.6	0.4	59.2	47.1	8.5	69.7	43.6	74.5	64.5	4.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	64.7	45.6	0.4	59.2	47.1	8.5	69.7	43.6	74.5	64.5	4.9
Queue Length 50th (m)	16.0	170.2	0.0	13.4	152.2	6.0	21.7	22.4	71.2	70.9	0.0
Queue Length 95th (m)	27.3	#217.9	0.0	#48.4	#214.7	26.2	32.0	27.3	#131.5	#122.8	8.6
Internal Link Dist (m)		332.0		485.9				138.7		218.9	
Turn Bay Length (m)	85.0		40.0	50.0		50.0					
Base Capacity (vph)	493	1725	631	130	1335	633	244	552	321	360	566
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.24	0.74	0.10	0.76	0.86	0.32	0.34	0.49	0.81	0.73	0.16

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

1: Baxter Place/Sportsworld Crossing & King Street East 2031 Total Conditions (no LRT): AM Peak Hour

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	108	1181	57	92	1067	190	60	58	138	420	55	81
Future Volume (vph)	108	1181	57	92	1067	190	60	58	138	420	55	81
Ideal Flow (vphpl)	1775	1900	1750	1775	1900	1750	1775	1775	1775	1775	1900	1750
Total Lost time (s)	6.0	7.6	7.6	5.0	7.6	7.6	7.3	7.3		7.8	7.8	7.8
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	1.00	0.95		0.95	0.95	1.00
Fr	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.89		1.00	1.00	0.85
Fit Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	0.96	1.00
Satd. Flow (prot)	3176	3471	1144	1479	3438	1365	1576	2972		1381	1547	1365
Fit Permitted	0.95	1.00	1.00	0.08	1.00	1.00	0.95	1.00		0.95	0.96	1.00
Satd. Flow (perm)	3176	3471	1144	127	3438	1365	1576	2972		1381	1547	1365
Peak-hour factor, PHF	0.92	0.92	0.92	0.93	0.93	0.93	0.73	0.73	0.73	0.91	0.91	0.91
Adj. Flow (vph)	117	1284	62	99	1147	204	82	79	189	462	60	89
RTOR Reduction (vph)	0	0	36	0	0	105	0	97	0	0	0	62
Lane Group Flow (vph)	117	1284	26	99	1147	99	82	171	0	259	263	27
Heavy Vehicles (%)	3%	4%	30%	14%	5%	9%	7%	5%	0%	16%	0%	9%
Turn Type	Prot	NA	Perm	pm+pt	NA	Perm	Split	NA		Split	NA	pt+ov
Protected Phases	1	6		5	2		8	8		4	4	4
Permitted Phases			6	2		2						
Actuated Green, G (s)	10.2	53.4	53.4	56.2	49.2	49.2	12.7	12.7		28.6	28.6	38.8
Effective Green, g (s)	10.2	53.4	53.4	56.2	49.2	49.2	12.7	12.7		28.6	28.6	38.8
Actuated g/C Ratio	0.08	0.41	0.41	0.43	0.38	0.38	0.10	0.10		0.22	0.22	0.30
Clearance Time (s)	6.0	7.6	7.6	5.0	7.6	7.6	7.3	7.3		7.8	7.8	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	250	1432	472	128	1307	518	154	291		305	341	409
v/s Ratio Prot	0.04	c0.37		c0.04	0.33		0.05	c0.06		c0.19	0.17	0.02
v/s Ratio Perm			0.02	0.29		0.07						
v/c Ratio	0.47	0.90	0.05	0.77	0.88	0.19	0.53	0.59		0.85	0.77	0.07
Uniform Delay, d1	57.0	35.4	22.8	28.1	37.3	26.8	55.5	55.8		48.3	47.3	32.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.4	7.7	0.0	24.7	6.9	0.2	3.5	3.0		19.3	10.3	0.1
Delay (s)	58.4	43.1	22.9	52.7	44.2	27.0	59.0	58.8		67.6	57.6	32.4
Level of Service	E	D	C	D	D	C	E	E		E	E	C
Approach Delay (s)		43.5			42.4			58.9			58.2	
Approach LOS		D			D			E			E	

Intersection Summary

HCM 2000 Control Delay 46.8 HCM 2000 Level of Service D
 HCM 2000 Volume to Capacity ratio 0.84
 Actuated Cycle Length (s) 129.4 Sum of lost time (s) 28.7
 Intersection Capacity Utilization 81.3% ICU Level of Service D
 Analysis Period (min) 15
 c Critical Lane Group

Lanes, Volumes, Timings

2: King Street East & Tu-Lane Street

2031 Total Conditions (no LRT): AM Peak Hour

Lane Group	EBL	EBT	WBU	WBT	WBR	SBL	SBR
Lane Configurations	↔	↕	↔	↕	↔	↕	↔
Traffic Volume (vph)	32	1973	41	1283	13	117	31
Future Volume (vph)	32	1973	41	1283	13	117	31
Ideal Flow (vphpl)	1775	1900	1775	1775	1775	1775	1765
Storage Length (m)	30.0		30.0		0.0	45.0	0.0
Storage Lanes	1		1		0	1	0
Taper Length (m)	15.0		15.0			65.0	
Lane Util. Factor	1.00	0.95	1.00	0.95	0.95	0.97	0.95
Frt				0.999		0.968	
Flt Protected	0.950		0.950			0.962	
Satd. Flow (prot)	1686	3406	1653	3209	0	2994	0
Flt Permitted	0.950		0.061			0.962	
Satd. Flow (perm)	1686	3406	106	3209	0	2994	0
Right Turn on Red					Yes		Yes
Satd. Flow (RTOR)				1		27	
Link Speed (k/h)		60		60		50	
Link Distance (m)		509.9		461.0		182.3	
Travel Time (s)		30.6		27.7		13.1	
Peak Hour Factor	0.91	0.91	0.92	0.98	0.98	0.80	0.80
Heavy Vehicles (%)	0%	6%	2%	5%	5%	9%	0%
Adj. Flow (vph)	35	2168	45	1309	13	146	39
Shared Lane Traffic (%)							
Lane Group Flow (vph)	35	2168	45	1322	0	185	0
Enter Blocked Intersection	No						
Lane Alignment	Left	Left	R NA	Left	Right	Left	Right
Median Width(m)		3.6		3.6		7.2	
Link Offset(m)		0.0		0.0		0.0	
Crosswalk Width(m)		4.8		4.8		4.8	
Two way Left Turn Lane							
Headway Factor	1.09	1.00	1.09	1.09	1.09	1.09	1.10
Turning Speed (k/h)	25		15		15	25	15
Number of Detectors	1	2	1	2		1	
Detector Template	Left	Thru	Left	Thru		Left	
Leading Detector (m)	2.0	10.0	2.0	10.0		2.0	
Trailing Detector (m)	0.0	0.0	0.0	0.0		0.0	
Detector 1 Position(m)	0.0	0.0	0.0	0.0		0.0	
Detector 1 Size(m)	2.0	0.6	2.0	0.6		2.0	
Detector 1 Type	CI+Ex	CI+Ex	CI+Ex	CI+Ex		CI+Ex	
Detector 1 Channel							
Detector 1 Extend (s)	0.0	0.0	0.0	0.0		0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0		0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0		0.0	
Detector 2 Position(m)		9.4		9.4			
Detector 2 Size(m)		0.6		0.6			
Detector 2 Type		CI+Ex		CI+Ex			
Detector 2 Channel							
Detector 2 Extend (s)		0.0		0.0			
Turn Type	Prot	NA	pm+pt	NA		Prot	
Protected Phases	5	2!	5!	6		8	

Lanes, Volumes, Timings

2: King Street East & Tu-Lane Street

2031 Total Conditions (no LRT): AM Peak Hour

Lane Group	EBL	EBT	WBU	WBT	WBR	SBL	SBR
Permitted Phases			6				
Detector Phase	5	2	5	6		8	
Switch Phase							
Minimum Initial (s)	5.0	65.1	5.0	65.1		10.0	
Minimum Split (s)	10.0	72.0	10.0	72.0		17.1	
Total Split (s)	14.4	72.0	14.4	72.0		33.6	
Total Split (%)	12.0%	60.0%	12.0%	60.0%		28.0%	
Maximum Green (s)	10.4	65.1	10.4	65.1		26.5	
Yellow Time (s)	3.0	3.7	3.0	3.7		3.3	
All-Red Time (s)	1.0	3.2	1.0	3.2		3.8	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0		0.0	
Total Lost Time (s)	4.0	6.9	4.0	6.9		7.1	
Lead/Lag	Lead		Lead		Lag		
Lead-Lag Optimize?					Yes		
Vehicle Extension (s)	3.0	3.0	3.0	3.0		3.0	
Recall Mode	None	Max	None	Max		None	
Walk Time (s)		54.1		54.1		7.0	
Flash Dont Walk (s)		11.0		11.0		19.5	
Pedestrian Calls (#/hr)		0		0		0	
Act Effct Green (s)	7.6	74.8	74.6	65.4		11.4	
Actuated g/C Ratio	0.08	0.75	0.74	0.65		0.11	
v/c Ratio	0.28	0.85	0.23	0.63		0.51	
Control Delay	50.6	13.5	5.9	13.0		41.5	
Queue Delay	0.0	0.0	0.0	0.0		0.0	
Total Delay	50.6	13.5	5.9	13.0		41.5	
LOS	D	B	A	B		D	
Approach Delay		14.1		12.8		41.5	
Approach LOS		B		B		D	
Intersection Summary							
Area Type:	Other						
Cycle Length:	120						
Actuated Cycle Length:	100.3						
Natural Cycle:	100						
Control Type:	Actuated-Uncoordinated						
Maximum v/c Ratio:	0.85						
Intersection Signal Delay:	15.0			Intersection LOS: B			
Intersection Capacity Utilization:	74.5%			ICU Level of Service D			
Analysis Period (min):	15						
! Phase conflict between lane groups.							
Splits and Phases: 2: King Street East & Tu-Lane Street							

Queues

2: King Street East & Tu-Lane Street

2031 Total Conditions (no LRT): AM Peak Hour

Lane Group	EBL	EBT	WBU	WBT	SBL
Lane Group Flow (vph)	35	2168	45	1322	185
v/c Ratio	0.28	0.85	0.23	0.63	0.51
Control Delay	50.6	13.5	5.9	13.0	41.5
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	50.6	13.5	5.9	13.0	41.5
Queue Length 50th (m)	7.0	130.7	1.6	79.3	16.1
Queue Length 95th (m)	17.5	198.8	4.5	120.8	24.2
Internal Link Dist (m)		485.9		437.0	158.3
Turn Bay Length (m)	30.0		30.0		45.0
Base Capacity (vph)	175	2710	241	2091	814
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	0.20	0.80	0.19	0.63	0.23
Intersection Summary					

HCM Signalized Intersection Capacity Analysis

2: King Street East & Tu-Lane Street

2031 Total Conditions (no LRT): AM Peak Hour

Movement	EBL	EBT	WBU	WBT	WBR	SBL	SBR
Lane Configurations							
Traffic Volume (vph)	32	1973	41	1283	13	117	31
Future Volume (vph)	32	1973	41	1283	13	117	31
Ideal Flow (vphpl)	1775	1900	1775	1775	1775	1775	1765
Total Lost time (s)	4.0	6.9	4.0	6.9			7.1
Lane Util. Factor	1.00	0.95	1.00	0.95			0.97
Fr	1.00	1.00	1.00	1.00			0.97
Fit Protected	0.95	1.00	0.95	1.00			0.96
Satd. Flow (prot)	1686	3406	1653	3207			2995
Fit Permitted	0.95	1.00	0.06	1.00			0.96
Satd. Flow (perm)	1686	3406	106	3207			2995
Peak-hour factor, PHF	0.91	0.91	0.92	0.98	0.98	0.80	0.80
Adj. Flow (vph)	35	2168	45	1309	13	146	39
RTOR Reduction (vph)	0	0	0	0	0	24	0
Lane Group Flow (vph)	35	2168	45	1322	0	161	0
Heavy Vehicles (%)	0%	6%	2%	5%	5%	9%	0%
Turn Type	Prot	NA	pm+pt	NA		Prot	
Protected Phases	5	2!	5!	6		8	
Permitted Phases			6				
Actuated Green, G (s)	6.4	75.8	71.8	65.4		11.4	
Effective Green, g (s)	6.4	75.8	71.8	65.4		11.4	
Actuated g/C Ratio	0.06	0.75	0.71	0.65		0.11	
Clearance Time (s)	4.0	6.9	4.0	6.9		7.1	
Vehicle Extension (s)	3.0	3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	106	2551	173	2072		337	
v/s Ratio Prot	0.02	c0.64	0.02	0.41		c0.05	
v/s Ratio Perm			0.17				
v/c Ratio	0.33	0.85	0.26	0.64		0.48	
Uniform Delay, d1	45.3	8.8	9.1	10.8		42.1	
Progression Factor	1.00	1.00	1.00	1.00		1.00	
Incremental Delay, d2	1.8	3.8	0.8	1.5		1.1	
Delay (s)	47.2	12.6	9.9	12.3		43.2	
Level of Service	D	B	A	B		D	
Approach Delay (s)		13.1		12.2		43.2	
Approach LOS		B		B		D	
Intersection Summary							
HCM 2000 Control Delay			14.3		HCM 2000 Level of Service		B
HCM 2000 Volume to Capacity ratio			0.84				
Actuated Cycle Length (s)			101.2		Sum of lost time (s)		18.0
Intersection Capacity Utilization			74.5%		ICU Level of Service		D
Analysis Period (min)			15				
! Phase conflict between lane groups.							
c Critical Lane Group							

Lanes, Volumes, Timings

3: King Street East & WB Hwy 401 Off-Ramp

2031 Total Conditions (no LRT): AM Peak Hour



Lane Group	EBU	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↔		↔↔	↔↔		↔	
Traffic Volume (vph)	57	0	953	1388	0	56	0
Future Volume (vph)	57	0	953	1388	0	56	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1775	1775
Storage Length (m)		15.0			0.0	0.0	0.0
Storage Lanes		1			0	1	0
Taper Length (m)		15.0				7.5	
Lane Util. Factor	1.00	1.00	0.95	0.95	1.00	1.00	1.00
Frt							
Flt Protected	0.950					0.950	
Satd. Flow (prot)	1770	0	3574	3471	0	1653	0
Flt Permitted	0.143					0.950	
Satd. Flow (perm)	266	0	3574	3471	0	1653	0
Right Turn on Red					Yes		Yes
Satd. Flow (RTOR)							
Link Speed (k/h)			60	60		50	
Link Distance (m)			332.9	296.3		232.6	
Travel Time (s)			20.0	17.8		16.7	
Peak Hour Factor	0.92	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	2%	0%	1%	4%	0%	2%	2%
Adj. Flow (vph)	62	0	1059	1542	0	62	0
Shared Lane Traffic (%)							
Lane Group Flow (vph)	62	0	1059	1542	0	62	0
Enter Blocked Intersection	No	No	No	No	No	No	No
Lane Alignment	R NA	Left	Left	Left	Right	Left	Right
Median Width(m)			3.6	3.6		3.6	
Link Offset(m)			0.0	0.0		0.0	
Crosswalk Width(m)			4.8	4.8		4.8	
Two way Left Turn Lane							
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.09	1.09
Turning Speed (k/h)	15	25			15	25	15
Number of Detectors	1		2	2		1	
Detector Template	Left		Thru	Thru		Left	
Leading Detector (m)	2.0		10.0	10.0		2.0	
Trailing Detector (m)	0.0		0.0	0.0		0.0	
Detector 1 Position(m)	0.0		0.0	0.0		0.0	
Detector 1 Size(m)	2.0		0.6	0.6		2.0	
Detector 1 Type	CI+Ex		CI+Ex	CI+Ex		CI+Ex	
Detector 1 Channel							
Detector 1 Extend (s)	0.0		0.0	0.0		0.0	
Detector 1 Queue (s)	0.0		0.0	0.0		0.0	
Detector 1 Delay (s)	0.0		0.0	0.0		0.0	
Detector 2 Position(m)			9.4	9.4			
Detector 2 Size(m)			0.6	0.6			
Detector 2 Type			CI+Ex	CI+Ex			
Detector 2 Channel							
Detector 2 Extend (s)			0.0	0.0			
Turn Type	Perm		NA	NA		Prot	
Protected Phases			4	8		6	

Lanes, Volumes, Timings

3: King Street East & WB Hwy 401 Off-Ramp

2031 Total Conditions (no LRT): AM Peak Hour

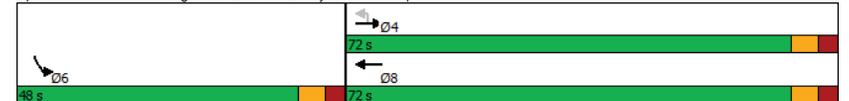


Lane Group	EBU	EBL	EBT	WBT	WBR	SBL	SBR
Permitted Phases	4						
Detector Phase	4		4			8	
Switch Phase							
Minimum Initial (s)	5.0		5.0		5.0		5.0
Minimum Split (s)	25.0		25.0		25.0		25.0
Total Split (s)	72.0		72.0		72.0		48.0
Total Split (%)	60.0%		60.0%		60.0%		40.0%
Maximum Green (s)	65.0		65.0		65.0		41.0
Yellow Time (s)	4.0		4.0		4.0		4.0
All-Red Time (s)	3.0		3.0		3.0		3.0
Lost Time Adjust (s)	0.0		0.0		0.0		0.0
Total Lost Time (s)	7.0		7.0		7.0		7.0
Lead/Lag							
Lead-Lag Optimize?							
Vehicle Extension (s)	3.0		3.0		3.0		3.0
Recall Mode	Max		Max		Max		None
Walk Time (s)	7.0		7.0		7.0		7.0
Flash Dont Walk (s)	11.0		11.0		11.0		11.0
Pedestrian Calls (#/hr)	0		0		0		0
Act Effct Green (s)	80.4		80.4		80.4		9.1
Actuated g/C Ratio	0.81		0.81		0.81		0.09
v/c Ratio	0.29		0.37		0.55		0.41
Control Delay	8.1		4.0		5.4		51.0
Queue Delay	0.0		0.0		0.0		0.0
Total Delay	8.1		4.0		5.4		51.0
LOS	A		A		A		D
Approach Delay			4.2		5.4		51.0
Approach LOS			A		A		D

Intersection Summary

Area Type:	Other	
Cycle Length:	120	
Actuated Cycle Length:	99	
Natural Cycle:	60	
Control Type:	Semi Act-Uncoord	
Maximum v/c Ratio:	0.55	
Intersection Signal Delay:	6.0	Intersection LOS: A
Intersection Capacity Utilization:	84.5%	ICU Level of Service E
Analysis Period (min):	15	

Splits and Phases: 3: King Street East & WB Hwy 401 Off-Ramp



Queues

3: King Street East & WB Hwy 401 Off-Ramp

2031 Total Conditions (no LRT): AM Peak Hour

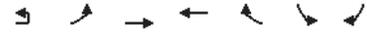


Lane Group	EBU	EBT	WBT	SBL
Lane Group Flow (vph)	62	1059	1542	62
v/c Ratio	0.29	0.37	0.55	0.41
Control Delay	8.1	4.0	5.4	51.0
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	8.1	4.0	5.4	51.0
Queue Length 50th (m)	3.1	30.3	56.0	12.6
Queue Length 95th (m)	10.8	45.2	82.7	24.3
Internal Link Dist (m)		308.9	272.3	208.6
Turn Bay Length (m)	15.0			
Base Capacity (vph)	216	2901	2817	687
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.29	0.37	0.55	0.09
Intersection Summary				

HCM Signalized Intersection Capacity Analysis

3: King Street East & WB Hwy 401 Off-Ramp

2031 Total Conditions (no LRT): AM Peak Hour



Movement	EBU	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↓		↑↑	↑↑		↓	
Traffic Volume (vph)	57	0	953	1388	0	56	0
Future Volume (vph)	57	0	953	1388	0	56	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1775	1775
Total Lost time (s)	7.0		7.0	7.0		7.0	
Lane Util. Factor	1.00		0.95	0.95		1.00	
Fr	1.00		1.00	1.00		1.00	
Fit Protected	0.95		1.00	1.00		0.95	
Satd. Flow (prot)	1770		3574	3471		1653	
Fit Permitted	0.14		1.00	1.00		0.95	
Satd. Flow (perm)	267		3574	3471		1653	
Peak-hour factor, PHF	0.92	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	62	0	1059	1542	0	62	0
RTOR Reduction (vph)	0	0	0	0	0	0	0
Lane Group Flow (vph)	62	0	1059	1542	0	62	0
Heavy Vehicles (%)	2%	0%	1%	4%	0%	2%	2%
Turn Type	Perm		NA	NA		Prot	
Protected Phases			4	8		6	
Permitted Phases	4						
Actuated Green, G (s)	78.8		78.8	78.8		7.8	
Effective Green, g (s)	78.8		78.8	78.8		7.8	
Actuated g/C Ratio	0.78		0.78	0.78		0.08	
Clearance Time (s)	7.0		7.0	7.0		7.0	
Vehicle Extension (s)	3.0		3.0	3.0		3.0	
Lane Grp Cap (vph)	209		2799	2718		128	
v/s Ratio Prot			0.30	c0.44		c0.04	
v/s Ratio Perm	0.23						
v/c Ratio	0.30		0.38	0.57		0.48	
Uniform Delay, d1	3.1		3.4	4.3		44.5	
Progression Factor	1.00		1.00	1.00		1.00	
Incremental Delay, d2	3.6		0.4	0.9		2.9	
Delay (s)	6.7		3.7	5.1		47.3	
Level of Service	A		A	A		D	
Approach Delay (s)			3.9	5.1		47.3	
Approach LOS			A	A		D	
Intersection Summary							
HCM 2000 Control Delay			5.6		HCM 2000 Level of Service		A
HCM 2000 Volume to Capacity ratio			0.56				
Actuated Cycle Length (s)			100.6		Sum of lost time (s)		14.0
Intersection Capacity Utilization			84.5%		ICU Level of Service		E
Analysis Period (min)			15				
c Critical Lane Group							

Lanes, Volumes, Timings

4: EB Hwy 401 Off-Ramp/EB Hwy 401 On-Ramp & King Street East Partial Conditions (no LRT): AM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔↔			↔↔		↔↔		↔			
Traffic Volume (vph)	465	644	0	0	953	0	483	0	115	0	0	0
Future Volume (vph)	465	644	0	0	953	0	483	0	115	0	0	0
Ideal Flow (vphpl)	1775	1900	1900	1900	1900	1900	1775	1900	1750	1900	1900	1900
Storage Length (m)	175.0		0.0	0.0		0.0	90.0		0.0	0.0		0.0
Storage Lanes	1		0	0		0	1		1	0		0
Taper Length (m)	25.0			7.5			55.0			7.5		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt								0.850				
Flt Protected	0.950						0.950					
Satd. Flow (prot)	1637	3471	0	0	3505	0	3207	0	1458	0	0	0
Flt Permitted	0.102						0.950					
Satd. Flow (perm)	176	3471	0	0	3505	0	3207	0	1458	0	0	0
Right Turn on Red			Yes			Yes		Yes				Yes
Satd. Flow (RTOR)								128				
Link Speed (k/h)	60				60			50				50
Link Distance (m)	296.3				238.1			280.3				135.0
Travel Time (s)	17.8				14.3			20.2				9.7
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	3%	4%	0%	0%	3%	0%	2%	0%	2%	0%	0%	0%
Adj. Flow (vph)	517	716	0	0	1059	0	537	0	128	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	517	716	0	0	1059	0	537	0	128	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)	3.6				3.6			7.2				7.2
Link Offset(m)	0.0				0.0			0.0				0.0
Crosswalk Width(m)	4.8				4.8			4.8				4.8
Two way Left Turn Lane												
Headway Factor	1.09	1.00	1.00	1.00	1.00	1.00	1.09	1.11	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2			2		1		1			
Detector Template	Left	Thru			Thru		Left		Right			
Leading Detector (m)	2.0	10.0			10.0		2.0		2.0			
Trailing Detector (m)	0.0	0.0			0.0		0.0		0.0			
Detector 1 Position(m)	0.0	0.0			0.0		0.0		0.0			
Detector 1 Size(m)	2.0	0.6			0.6		2.0		2.0			
Detector 1 Type	CI+Ex	CI+Ex			CI+Ex		CI+Ex		CI+Ex			
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0			0.0		0.0		0.0			
Detector 1 Queue (s)	0.0	0.0			0.0		0.0		0.0			
Detector 1 Delay (s)	0.0	0.0			0.0		0.0		0.0			
Detector 2 Position(m)		9.4					9.4					
Detector 2 Size(m)		0.6					0.6					
Detector 2 Type		CI+Ex					CI+Ex					
Detector 2 Channel												
Detector 2 Extend (s)		0.0					0.0					
Turn Type	pm+pt	NA			NA		Prot		Perm			
Protected Phases	1	6			2		4					

Lanes, Volumes, Timings

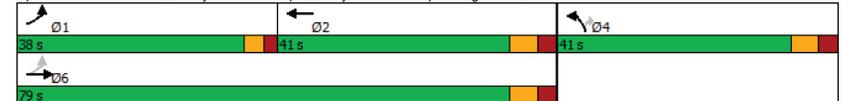
4: EB Hwy 401 Off-Ramp/EB Hwy 401 On-Ramp & King Street East Partial Conditions (no LRT): AM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	6											4
Detector Phase	1	6										4
Switch Phase												
Minimum Initial (s)	5.0	20.0			20.0		10.0		10.0			10.0
Minimum Split (s)	10.0	27.0			27.0		25.0		25.0			25.0
Total Split (s)	38.0	79.0			41.0		41.0		41.0			41.0
Total Split (%)	31.7%	65.8%			34.2%		34.2%		34.2%			34.2%
Maximum Green (s)	33.0	72.0			34.0		34.0		34.0			34.0
Yellow Time (s)	3.0	4.0			4.0		4.0		4.0			4.0
All-Red Time (s)	2.0	3.0			3.0		3.0		3.0			3.0
Lost Time Adjust (s)	0.0	0.0			0.0		0.0		0.0			0.0
Total Lost Time (s)	5.0	7.0			7.0		7.0		7.0			7.0
Lead/Lag	Lead				Lag							
Lead-Lag Optimize?	Yes				Yes							
Vehicle Extension (s)	3.0	3.0			3.0		3.0		3.0			3.0
Recall Mode	None	None			Max		None		None			None
Walk Time (s)		7.0			7.0		7.0		7.0			7.0
Flash Dont Walk (s)		11.0			11.0		11.0		11.0			11.0
Pedestrian Calls (#/hr)		0			0		0		0			0
Act Effct Green (s)	74.1	72.1			34.1		23.5		23.5			23.5
Actuated g/C Ratio	0.68	0.66			0.31		0.21		0.21			0.21
v/c Ratio	0.92	0.31			0.97		0.78		0.31			0.31
Control Delay	53.0	9.0			59.8		49.3		8.0			8.0
Queue Delay	0.0	0.0			0.0		0.0		0.0			0.0
Total Delay	53.0	9.0			59.8		49.3		8.0			8.0
LOS	D	A			E		D		A			A
Approach Delay		27.5			59.8				41.3			
Approach LOS		C			E				D			

Intersection Summary

Area Type:	Other
Cycle Length:	120
Actuated Cycle Length:	109.6
Natural Cycle:	90
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	0.97
Intersection Signal Delay:	42.1
Intersection Capacity Utilization:	84.5%
ICU Level of Service:	E
Intersection LOS:	D
Analysis Period (min):	15

Splits and Phases: 4: EB Hwy 401 Off-Ramp/EB Hwy 401 On-Ramp & King Street East



Queues

4: EB Hwy 401 Off-Ramp/EB Hwy 401 On-Ramp & King Street East Initial Conditions (no LRT): AM Peak Hour

Lane Group	EBL	EBT	WBT	NBL	NBR
Lane Group Flow (vph)	517	716	1059	537	128
v/c Ratio	0.92	0.31	0.97	0.78	0.31
Control Delay	53.0	9.0	59.8	49.3	8.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	53.0	9.0	59.8	49.3	8.0
Queue Length 50th (m)	94.5	32.9	122.7	59.0	0.0
Queue Length 95th (m)	#181.8	52.6	#188.5	78.0	15.1
Internal Link Dist (m)		272.3	214.1		
Turn Bay Length (m)	175.0			90.0	
Base Capacity (vph)	559	2284	1089	996	541
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	0.31	0.97	0.54	0.24

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

HCM Signalized Intersection Capacity Analysis

4: EB Hwy 401 Off-Ramp/EB Hwy 401 On-Ramp & King Street East Initial Conditions (no LRT): AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	465	644	0	0	953	0	483	0	115	0	0	0
Future Volume (vph)	465	644	0	0	953	0	483	0	115	0	0	0
Ideal Flow (vphpl)	1775	1900	1900	1900	1900	1900	1775	1900	1750	1900	1900	1900
Total Lost time (s)	5.0	7.0			7.0		7.0		7.0			
Lane Util. Factor	1.00	0.95			0.95		0.97		1.00			
Fr	1.00	1.00			1.00		1.00		0.85			
Fit Protected	0.95	1.00			1.00		0.95		1.00			
Satd. Flow (prot)	1637	3471			3505		3207		1458			
Fit Permitted	0.10	1.00			1.00		0.95		1.00			
Satd. Flow (perm)	176	3471			3505		3207		1458			
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	517	716	0	0	1059	0	537	0	128	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	101	0	0	0
Lane Group Flow (vph)	517	716	0	0	1059	0	537	0	27	0	0	0
Heavy Vehicles (%)	3%	4%	0%	0%	3%	0%	2%	0%	2%	0%	0%	0%
Turn Type	pm+pt	NA			NA		Prot		Perm			
Protected Phases	1	6			2		4					
Permitted Phases	6						4					
Actuated Green, G (s)	72.2	72.2			34.1		23.5		23.5			
Effective Green, g (s)	72.2	72.2			34.1		23.5		23.5			
Actuated g/C Ratio	0.66	0.66			0.31		0.21		0.21			
Clearance Time (s)	5.0	7.0			7.0		7.0		7.0			
Vehicle Extension (s)	3.0	3.0			3.0		3.0		3.0			
Lane Grp Cap (vph)	556	2284			1089		687		312			
v/s Ratio Prot	c0.28	0.21			0.30		c0.17					
v/s Ratio Perm	c0.33								0.02			
v/c Ratio	0.93	0.31			0.97		0.78		0.09			
Uniform Delay, d1	30.2	8.1			37.3		40.7		34.5			
Progression Factor	1.00	1.00			1.00		1.00		1.00			
Incremental Delay, d2	22.0	0.1			21.4		5.8		0.1			
Delay (s)	52.2	8.2			58.7		46.5		34.6			
Level of Service	D	A			E		D		C			
Approach Delay (s)		26.6			58.7		44.2				0.0	
Approach LOS		C			E		D				A	

Intersection Summary
 HCM 2000 Control Delay 42.1 HCM 2000 Level of Service D
 HCM 2000 Volume to Capacity ratio 0.92
 Actuated Cycle Length (s) 109.7 Sum of lost time (s) 19.0
 Intersection Capacity Utilization 84.5% ICU Level of Service E
 Analysis Period (min) 15
 c Critical Lane Group

Lanes, Volumes, Timings

6: Site Driveway & King Street East

2031 Total Conditions (no LRT): AM Peak Hour

	→	↘	↙	←	↖	↗
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑		↑
Traffic Volume (vph)	2048	83	0	1814	0	142
Future Volume (vph)	2048	83	0	1814	0	142
Ideal Flow (vphpl)	1775	1775	1900	1900	1900	1750
Lane Util. Factor	0.95	0.95	1.00	0.95	1.00	1.00
Fr _t	0.994					0.865
Fit Protected						
Satd. Flow (prot)	3167	0	0	3539	0	1484
Fit Permitted						
Satd. Flow (perm)	3167	0	0	3539	0	1484
Link Speed (k/h)	60			60	50	
Link Distance (m)	461.0			332.9	137.5	
Travel Time (s)	27.7			20.0	9.9	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	6%	2%	2%	2%	2%	2%
Adj. Flow (vph)	2226	90	0	1972	0	154
Shared Lane Traffic (%)						
Lane Group Flow (vph)	2316	0	0	1972	0	154
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.6			3.6	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	4.8			4.8	4.8	
Two way Left Turn Lane						
Headway Factor	1.09	1.09	1.00	1.00	1.00	1.11
Turning Speed (k/h)		15	25		25	15
Sign Control	Free			Free	Stop	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	79.6%
ICU Level of Service	D
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis

6: Site Driveway & King Street East

2031 Total Conditions (no LRT): AM Peak Hour

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑		↑
Traffic Volume (veh/h)	2048	83	0	1814	0	142
Future Volume (Veh/h)	2048	83	0	1814	0	142
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)	2226	90	0	1972	0	154
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)				333		
pX, platoon unblocked					0.80	
vC, conflicting volume			2316		3257	1158
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			2316		3322	1158
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	19
cM capacity (veh/h)			212		5	189

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	1484	832	986	986	154
Volume Left	0	0	0	0	0
Volume Right	0	90	0	0	154
eSH	1700	1700	1700	1700	189
Volume to Capacity	0.87	0.49	0.58	0.58	0.81
Queue Length 95th (m)	0.0	0.0	0.0	0.0	45.7
Control Delay (s)	0.0	0.0	0.0	0.0	75.5
Lane LOS					F
Approach Delay (s)	0.0		0.0		75.5
Approach LOS					F

Intersection Summary

Average Delay	2.6
Intersection Capacity Utilization	79.6%
ICU Level of Service	D
Analysis Period (min)	15

Lanes, Volumes, Timings

1: Baxter Place/Sportsworld Crossing & King Street East 2031 Total Conditions (no LRT): PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	141	1390	60	145	1124	195	46	56	107	409	42	62
Future Volume (vph)	141	1390	60	145	1124	195	46	56	107	409	42	62
Ideal Flow (vphpl)	1775	1900	1750	1775	1900	1750	1775	1775	1775	1775	1900	1750
Storage Length (m)	85.0		40.0	50.0		50.0	0.0		0.0	0.0		0.0
Storage Lanes	2		1	1		1	1		0	1		1
Taper Length (m)	65.0			35.0			7.5			7.5		
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.95	0.95	0.95	1.00
Frt			0.850			0.850		0.902				0.850
Fit Protected	0.950			0.950			0.950			0.950	0.961	
Satd. Flow (prot)	3239	3539	1444	1686	3539	1417	1606	2944	0	1483	1629	1473
Fit Permitted	0.950			0.080			0.950			0.950	0.961	
Satd. Flow (perm)	3239	3539	1444	142	3539	1417	1606	2944	0	1483	1629	1473
Right Turn on Red			Yes			Yes		Yes			Yes	
Satd. Flow (RTOR)			121			164		94			84	
Link Speed (k/h)		60			60			50			50	
Link Distance (m)		356.0			509.9			162.7			242.9	
Travel Time (s)		21.4			30.6			11.7			17.5	
Peak Hour Factor	0.93	0.93	0.93	0.92	0.92	0.92	0.88	0.88	0.88	0.84	0.84	0.84
Heavy Vehicles (%)	1%	2%	3%	0%	2%	5%	4%	3%	8%	0%	1%	1%
Adj. Flow (vph)	152	1495	65	158	1222	212	52	64	122	487	50	74
Shared Lane Traffic (%)									45%			
Lane Group Flow (vph)	152	1495	65	158	1222	212	52	186	0	268	269	74
Enter Blocked Intersection	No											
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Thru	Right	Left	Left	Right
Median Width(m)		7.2			7.2			3.6			3.6	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		4.8			4.8			4.8			4.8	
Two way Left Turn Lane												
Headway Factor	1.09	1.00	1.11	1.09	1.00	1.11	1.09	1.09	1.09	1.09	1.00	1.11
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2	1	1	2	1	1	2		1	2	1
Detector Template	Left	Thru	Right	Left	Thru	Right	Left	Thru		Left	Thru	Right
Leading Detector (m)	2.0	10.0	2.0	2.0	10.0	2.0	2.0	10.0		2.0	10.0	2.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Size(m)	2.0	0.6	2.0	2.0	0.6	2.0	2.0	0.6		2.0	0.6	2.0
Detector 1 Type	CI+Ex		CI+Ex	CI+Ex	CI+Ex							
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Detector 2 Position(m)		9.4			9.4			9.4			9.4	
Detector 2 Size(m)		0.6			0.6			0.6			0.6	
Detector 2 Type		CI+Ex			CI+Ex			CI+Ex			CI+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Prot	NA	Perm	pm+pt	NA	Perm	Split	NA		Split	NA	pt+ov
Protected Phases	1	6		5	2		8	8		4	4	4 1

Lanes, Volumes, Timings

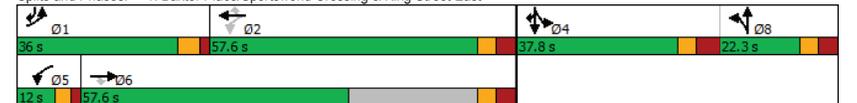
1: Baxter Place/Sportsworld Crossing & King Street East 2031 Total Conditions (no LRT): PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases			6	2		2						
Detector Phase	1	6	6	5	2	2	8	8		4	4	4 1
Switch Phase												
Minimum Initial (s)	7.0	30.0	30.0	7.0	30.0	30.0	8.0	8.0		8.0	8.0	
Minimum Split (s)	13.0	57.6	57.6	12.0	57.6	57.6	27.3	27.3		15.8	15.8	
Total Split (s)	36.0	57.6	57.6	12.0	57.6	57.6	22.3	22.3		37.8	37.8	
Total Split (%)	23.4%	37.5%	37.5%	7.8%	37.5%	37.5%	14.5%	14.5%		24.6%	24.6%	
Maximum Green (s)	30.0	50.0	50.0	7.0	50.0	50.0	15.0	15.0		30.0	30.0	
Yellow Time (s)	4.0	3.7	3.7	3.0	3.7	3.7	3.3	3.3		3.3	3.3	
All-Red Time (s)	2.0	3.9	3.9	2.0	3.9	3.9	4.0	4.0		4.5	4.5	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.0	7.6	7.6	5.0	7.6	7.6	7.3	7.3		7.8	7.8	
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag						
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	None	Min	Min	None	Min	Min	None	None		None	None	
Walk Time (s)		10.0	10.0		10.0	10.0	10.0	10.0		10.0	10.0	
Flash Dont Walk (s)		40.0	40.0		40.0	40.0	25.0	25.0		26.0	26.0	
Pedestrian Calls (#/hr)		0	0		0	0	0	0		0	0	
Act Effct Green (s)	11.4	55.5	55.5	59.8	50.1	50.1	10.1	10.1		28.1	28.1	37.7
Actuated g/C Ratio	0.09	0.43	0.43	0.47	0.39	0.39	0.08	0.08		0.22	0.22	0.29
v/c Ratio	0.53	0.98	0.09	1.05	0.89	0.32	0.42	0.59		0.83	0.76	0.15
Control Delay	63.6	54.7	0.3	117.8	46.3	9.3	68.0	36.6		69.8	62.0	3.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	63.6	54.7	0.3	117.8	46.3	9.3	68.0	36.6		69.8	62.0	3.8
LOS	E	D	A	F	D	A	E	D		E	E	A
Approach Delay		53.4			48.4		43.5				58.4	
Approach LOS		D			D		D				E	

Intersection Summary

Area Type:	Other
Cycle Length:	153.7
Actuated Cycle Length:	128.5
Natural Cycle:	145
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	1.05
Intersection Signal Delay:	51.7
Intersection Capacity Utilization:	89.2%
ICU Level of Service:	E
Intersection LOS:	D
Analysis Period (min):	15

Splits and Phases: 1: Baxter Place/Sportsworld Crossing & King Street East



Queues

1: Baxter Place/Sportsworld Crossing & King Street East 2031 Total Conditions (no LRT): PM Peak Hour

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	152	1495	65	158	1222	212	52	186	268	269	74
v/c Ratio	0.53	0.98	0.09	1.05	0.89	0.32	0.42	0.59	0.83	0.76	0.15
Control Delay	63.6	54.7	0.3	117.8	46.3	9.3	68.0	36.6	69.8	62.0	3.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	63.6	54.7	0.3	117.8	46.3	9.3	68.0	36.6	69.8	62.0	3.8
Queue Length 50th (m)	20.5	206.9	0.0	-30.3	161.0	8.1	13.7	12.6	71.6	70.6	0.0
Queue Length 95th (m)	33.0	#274.5	0.0	#83.9	#225.1	29.0	27.6	25.1	#112.0	102.7	5.3
Internal Link Dist (m)		332.0		485.9				138.7		218.9	
Turn Bay Length (m)	85.0		40.0	50.0		50.0					
Base Capacity (vph)	758	2043	884	150	1380	653	188	427	347	381	714
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.20	0.73	0.07	1.05	0.89	0.32	0.28	0.44	0.77	0.71	0.10

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: Baxter Place/Sportsworld Crossing & King Street East 2031 Total Conditions (no LRT): PM Peak Hour

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	141	1390	60	145	1124	195	46	56	107	409	42	62
Future Volume (vph)	141	1390	60	145	1124	195	46	56	107	409	42	62
Ideal Flow (vphpl)	1775	1900	1750	1775	1900	1750	1775	1775	1775	1775	1900	1750
Total Lost time (s)	6.0	7.6	7.6	5.0	7.6	7.6	7.3	7.3		7.8	7.8	7.8
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	1.00	0.95		0.95	0.95	1.00
Fr	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.90		1.00	1.00	0.85
Fit Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	0.96	1.00
Satd. Flow (prot)	3239	3539	1444	1686	3539	1417	1606	2942		1483	1628	1473
Fit Permitted	0.95	1.00	1.00	0.08	1.00	1.00	0.95	1.00		0.95	0.96	1.00
Satd. Flow (perm)	3239	3539	1444	142	3539	1417	1606	2942		1483	1628	1473
Peak-hour factor, PHF	0.93	0.93	0.93	0.92	0.92	0.92	0.88	0.88	0.88	0.84	0.84	0.84
Adj. Flow (vph)	152	1495	65	158	1222	212	52	64	122	487	50	74
RTOR Reduction (vph)	0	0	37	0	0	100	0	87	0	0	0	51
Lane Group Flow (vph)	152	1495	28	158	1222	112	52	99	0	268	269	23
Heavy Vehicles (%)	1%	2%	3%	0%	2%	5%	5%	4%	3%	8%	0%	1%
Turn Type	Prot	NA	Perm	pm+pt	NA	Perm	Split	NA		Split	NA	pt+ov
Protected Phases	1	6		5	2		8	8		4	4	4
Permitted Phases			6	2		2						
Actuated Green, G (s)	11.4	55.5	55.5	57.1	50.1	50.1	10.1	10.1		28.1	28.1	39.5
Effective Green, g (s)	11.4	55.5	55.5	57.1	50.1	50.1	10.1	10.1		28.1	28.1	39.5
Actuated g/C Ratio	0.09	0.43	0.43	0.44	0.39	0.39	0.08	0.08		0.22	0.22	0.31
Clearance Time (s)	6.0	7.6	7.6	5.0	7.6	7.6	7.3	7.3		7.8	7.8	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	287	1529	624	147	1380	552	126	231		324	356	453
v/s Ratio Prot	0.05	c0.42		c0.06	0.35		0.03	c0.03		c0.18	0.17	0.02
v/s Ratio Perm			0.02	c0.42		0.08						
v/c Ratio	0.53	0.98	0.05	1.07	0.89	0.20	0.41	0.43		0.83	0.76	0.05
Uniform Delay, d1	55.9	35.8	21.1	31.3	36.5	25.9	56.3	56.4		47.8	46.9	31.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.8	17.8	0.0	95.6	7.2	0.2	2.2	1.3		15.7	8.8	0.0
Delay (s)	57.7	53.6	21.1	127.0	43.6	26.1	58.5	57.7		63.6	55.8	31.3
Level of Service	E	D	C	F	D	C	E	E		E	E	C
Approach Delay (s)		52.7			49.6		57.9				56.2	
Approach LOS		D			D		E				E	

Intersection Summary

- HCM 2000 Control Delay 52.3 HCM 2000 Level of Service D
- HCM 2000 Volume to Capacity ratio 0.92
- Actuated Cycle Length (s) 128.4 Sum of lost time (s) 28.7
- Intersection Capacity Utilization 89.2% ICU Level of Service E
- Analysis Period (min) 15
- c Critical Lane Group

Lanes, Volumes, Timings

2: King Street East & Tu-Lane Street

2031 Total Conditions (no LRT): PM Peak Hour

Lane Group	EBL	EBT	WBU	WBT	WBR	SBL	SBR
Lane Configurations	↔	↕	↔	↕	↔	↕	↕
Traffic Volume (vph)	43	2158	78	1310	37	541	55
Future Volume (vph)	43	2158	78	1310	37	541	55
Ideal Flow (vphpl)	1775	1900	1775	1775	1775	1775	1765
Storage Length (m)	30.0		30.0		0.0	45.0	0.0
Storage Lanes	1		1		0	1	0
Taper Length (m)	15.0		15.0			65.0	
Lane Util. Factor	1.00	0.95	1.00	0.95	0.95	0.97	0.95
Frt				0.996		0.986	
Flt Protected	0.950		0.950			0.957	
Satd. Flow (prot)	1686	3505	1653	3261	0	3220	0
Flt Permitted	0.950		0.050			0.957	
Satd. Flow (perm)	1686	3505	87	3261	0	3220	0
Right Turn on Red					Yes		Yes
Satd. Flow (RTOR)				3		7	
Link Speed (k/h)		60		60		50	
Link Distance (m)		509.9		462.0		182.3	
Travel Time (s)		30.6		27.7		13.1	
Peak Hour Factor	0.95	0.95	0.92	0.92	0.92	0.82	0.82
Heavy Vehicles (%)	0%	3%	2%	3%	3%	1%	0%
Adj. Flow (vph)	45	2272	85	1424	40	660	67
Shared Lane Traffic (%)							
Lane Group Flow (vph)	45	2272	85	1464	0	727	0
Enter Blocked Intersection	No						
Lane Alignment	Left	Left	R NA	Left	Right	Left	Right
Median Width(m)		3.6		3.6		7.2	
Link Offset(m)		0.0		0.0		0.0	
Crosswalk Width(m)		4.8		4.8		4.8	
Two way Left Turn Lane							
Headway Factor	1.09	1.00	1.09	1.09	1.09	1.09	1.10
Turning Speed (k/h)	25		15		15	25	15
Number of Detectors	1	2	1	2		1	
Detector Template	Left	Thru	Left	Thru		Left	
Leading Detector (m)	2.0	10.0	2.0	10.0		2.0	
Trailing Detector (m)	0.0	0.0	0.0	0.0		0.0	
Detector 1 Position(m)	0.0	0.0	0.0	0.0		0.0	
Detector 1 Size(m)	2.0	0.6	2.0	0.6		2.0	
Detector 1 Type	CI+Ex	CI+Ex	CI+Ex	CI+Ex		CI+Ex	
Detector 1 Channel							
Detector 1 Extend (s)	0.0	0.0	0.0	0.0		0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0		0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0		0.0	
Detector 2 Position(m)		9.4		9.4			
Detector 2 Size(m)		0.6		0.6			
Detector 2 Type		CI+Ex		CI+Ex			
Detector 2 Channel							
Detector 2 Extend (s)		0.0		0.0			
Turn Type	Prot	NA	pm+pt	NA		Prot	
Protected Phases	5	2!	5!	6		8	

Lanes, Volumes, Timings

2: King Street East & Tu-Lane Street

2031 Total Conditions (no LRT): PM Peak Hour

Lane Group	EBL	EBT	WBU	WBT	WBR	SBL	SBR
Permitted Phases			6				
Detector Phase	5	2	5	6		8	
Switch Phase							
Minimum Initial (s)	5.0	79.9	5.0	79.9		10.0	
Minimum Split (s)	10.0	86.8	10.0	86.8		17.1	
Total Split (s)	14.0	86.8	14.0	86.8		39.2	
Total Split (%)	10.0%	62.0%	10.0%	62.0%		28.0%	
Maximum Green (s)	10.0	79.9	10.0	79.9		32.1	
Yellow Time (s)	3.0	3.7	3.0	3.7		3.3	
All-Red Time (s)	1.0	3.2	1.0	3.2		3.8	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0		0.0	
Total Lost Time (s)	4.0	6.9	4.0	6.9		7.1	
Lead/Lag	Lead		Lead		Lag		
Lead-Lag Optimize?				Yes			
Vehicle Extension (s)	3.0	3.0	3.0	3.0		3.0	
Recall Mode	None	Max	None	Max		None	
Walk Time (s)		54.1		54.1		7.0	
Flash Dont Walk (s)		11.0		11.0		19.5	
Pedestrian Calls (#/hr)		0		0		0	
Act Effct Green (s)	8.5	92.5	91.4	79.9		32.1	
Actuated g/C Ratio	0.06	0.67	0.66	0.58		0.23	
v/c Ratio	0.43	0.97	0.56	0.78		0.97	
Control Delay	75.7	35.2	33.8	26.3		78.1	
Queue Delay	0.0	0.0	0.0	0.0		0.0	
Total Delay	75.7	35.2	33.8	26.3		78.1	
LOS	E	D	C	C		E	
Approach Delay		36.0		26.8		78.1	
Approach LOS		D		C		E	
Intersection Summary							
Area Type:	Other						
Cycle Length:	140						
Actuated Cycle Length:	138.6						
Natural Cycle:	125						
Control Type:	Actuated-Uncoordinated						
Maximum v/c Ratio:	0.97						
Intersection Signal Delay:	39.5			Intersection LOS: D			
Intersection Capacity Utilization	99.4%			ICU Level of Service F			
Analysis Period (min)	15						
! Phase conflict between lane groups.							
Splits and Phases: 2: King Street East & Tu-Lane Street							

Queues

2: King Street East & Tu-Lane Street

2031 Total Conditions (no LRT): PM Peak Hour



Lane Group	EBL	EBT	WBU	WBT	SBL
Lane Group Flow (vph)	45	2272	85	1464	727
v/c Ratio	0.43	0.97	0.56	0.78	0.97
Control Delay	75.7	35.2	33.8	26.3	78.1
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	75.7	35.2	33.8	26.3	78.1
Queue Length 50th (m)	12.7	303.0	7.8	165.1	107.6
Queue Length 95th (m)	26.5	#390.6	26.6	199.6	#126.8
Internal Link Dist (m)		485.9		438.0	158.3
Turn Bay Length (m)	30.0		30.0		45.0
Base Capacity (vph)	121	2375	171	1881	751
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	0.37	0.96	0.50	0.78	0.97

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis

2: King Street East & Tu-Lane Street

2031 Total Conditions (no LRT): PM Peak Hour



Movement	EBL	EBT	WBU	WBT	WBR	SBL	SBR
Lane Configurations	↔	↕↕	↔	↕↕		↕↕	↕↕
Traffic Volume (vph)	43	2158	78	1310	37	541	55
Future Volume (vph)	43	2158	78	1310	37	541	55
Ideal Flow (vphpl)	1775	1900	1775	1775	1775	1775	1765
Total Lost time (s)	4.0	6.9	4.0	6.9		7.1	
Lane Util. Factor	1.00	0.95	1.00	0.95		0.97	
Fr	1.00	1.00	1.00	1.00		0.99	
Fit Protected	0.95	1.00	0.95	1.00		0.96	
Satd. Flow (prot)	1686	3505	1653	3261		3219	
Fit Permitted	0.95	1.00	0.05	1.00		0.96	
Satd. Flow (perm)	1686	3505	87	3261		3219	
Peak-hour factor, PHF	0.95	0.95	0.92	0.92	0.92	0.82	0.82
Adj. Flow (vph)	45	2272	85	1424	40	660	67
RTOR Reduction (vph)	0	0	0	1	0	5	0
Lane Group Flow (vph)	45	2272	85	1463	0	722	0
Heavy Vehicles (%)	0%	3%	2%	3%	3%	1%	0%
Turn Type	Prot	NA	pm+pt	NA		Prot	
Protected Phases	5	2!	5!	6		8	
Permitted Phases			6				
Actuated Green, G (s)	8.5	92.5	88.5	80.0		32.1	
Effective Green, g (s)	8.5	92.5	88.5	80.0		32.1	
Actuated g/C Ratio	0.06	0.67	0.64	0.58		0.23	
Clearance Time (s)	4.0	6.9	4.0	6.9		7.1	
Vehicle Extension (s)	3.0	3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	103	2339	151	1882		745	
v/s Ratio Prot	0.03	c0.65	0.03	0.45		c0.22	
v/s Ratio Perm			0.32				
v/c Ratio	0.44	0.97	0.56	0.78		0.97	
Uniform Delay, d1	62.7	21.8	30.2	22.5		52.8	
Progression Factor	1.00	1.00	1.00	1.00		1.00	
Incremental Delay, d2	2.9	13.0	4.7	3.2		25.1	
Delay (s)	65.7	34.8	35.0	25.7		77.9	
Level of Service	E	C	C	C		E	
Approach Delay (s)		35.4		26.2		77.9	
Approach LOS		D		C		E	

Intersection Summary

HCM 2000 Control Delay	39.0	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	138.6	Sum of lost time (s)	18.0
Intersection Capacity Utilization	99.4%	ICU Level of Service	F
Analysis Period (min)	15		
! Phase conflict between lane groups.			
c Critical Lane Group			

Lanes, Volumes, Timings

3: King Street East & WB Hwy 401 Off-Ramp

2031 Total Conditions (no LRT): PM Peak Hour



Lane Group	EBU	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↔		↔↔	↔↔		↔	
Traffic Volume (vph)	51	0	1769	1261	0	117	0
Future Volume (vph)	51	0	1769	1261	0	117	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1775	1775
Storage Length (m)		15.0			0.0	0.0	0.0
Storage Lanes		1			0	1	0
Taper Length (m)		15.0				7.5	
Lane Util. Factor	1.00	1.00	0.95	0.95	1.00	1.00	1.00
Frt							
Flt Protected	0.950					0.950	
Satd. Flow (prot)	1770	0	3574	3471	0	1653	0
Flt Permitted	0.159					0.950	
Satd. Flow (perm)	296	0	3574	3471	0	1653	0
Right Turn on Red					Yes		Yes
Satd. Flow (RTOR)							
Link Speed (k/h)			60	60		50	
Link Distance (m)			332.0	296.3		232.6	
Travel Time (s)			19.9	17.8		16.7	
Peak Hour Factor	0.92	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	2%	0%	1%	4%	0%	2%	2%
Adj. Flow (vph)	55	0	1966	1401	0	130	0
Shared Lane Traffic (%)							
Lane Group Flow (vph)	55	0	1966	1401	0	130	0
Enter Blocked Intersection	No	No	No	No	No	No	No
Lane Alignment	R NA	Left	Left	Left	Right	Left	Right
Median Width(m)			3.6	3.6		3.6	
Link Offset(m)			0.0	0.0		0.0	
Crosswalk Width(m)			4.8	4.8		4.8	
Two way Left Turn Lane							
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.09	1.09
Turning Speed (k/h)	15	25			15	25	15
Number of Detectors	1		2	2		1	
Detector Template	Left		Thru	Thru		Left	
Leading Detector (m)	2.0		10.0	10.0		2.0	
Trailing Detector (m)	0.0		0.0	0.0		0.0	
Detector 1 Position(m)	0.0		0.0	0.0		0.0	
Detector 1 Size(m)	2.0		0.6	0.6		2.0	
Detector 1 Type	CI+Ex		CI+Ex	CI+Ex		CI+Ex	
Detector 1 Channel							
Detector 1 Extend (s)	0.0		0.0	0.0		0.0	
Detector 1 Queue (s)	0.0		0.0	0.0		0.0	
Detector 1 Delay (s)	0.0		0.0	0.0		0.0	
Detector 2 Position(m)			9.4	9.4			
Detector 2 Size(m)			0.6	0.6			
Detector 2 Type			CI+Ex	CI+Ex			
Detector 2 Channel							
Detector 2 Extend (s)			0.0	0.0			
Turn Type	Perm		NA	NA		Prot	
Protected Phases			4	8		6	

Lanes, Volumes, Timings

3: King Street East & WB Hwy 401 Off-Ramp

2031 Total Conditions (no LRT): PM Peak Hour

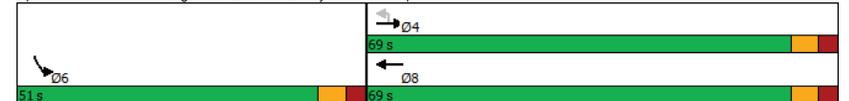


Lane Group	EBU	EBL	EBT	WBT	WBR	SBL	SBR
Permitted Phases	4						
Detector Phase	4		4			8	
Switch Phase							
Minimum Initial (s)	5.0		5.0		5.0		5.0
Minimum Split (s)	25.0		25.0		25.0		25.0
Total Split (s)	69.0		69.0		69.0		51.0
Total Split (%)	57.5%		57.5%		57.5%		42.5%
Maximum Green (s)	62.0		62.0		62.0		44.0
Yellow Time (s)	4.0		4.0		4.0		4.0
All-Red Time (s)	3.0		3.0		3.0		3.0
Lost Time Adjust (s)	0.0		0.0		0.0		0.0
Total Lost Time (s)	7.0		7.0		7.0		7.0
Lead/Lag							
Lead-Lag Optimize?							
Vehicle Extension (s)	3.0		3.0		3.0		3.0
Recall Mode	Max		Max		Max		None
Walk Time (s)	7.0		7.0		7.0		7.0
Flash Dont Walk (s)	11.0		11.0		11.0		11.0
Pedestrian Calls (#/hr)	0		0		0		0
Act Effct Green (s)	68.4		68.4		68.4		12.7
Actuated g/C Ratio	0.72		0.72		0.72		0.13
v/c Ratio	0.26		0.77		0.56		0.59
Control Delay	9.3		11.6		7.8		48.6
Queue Delay	0.0		0.0		0.0		0.0
Total Delay	9.3		11.6		7.8		48.6
LOS	A		B		A		D
Approach Delay			11.6		7.8		48.6
Approach LOS			B		A		D

Intersection Summary

Area Type:	Other	
Cycle Length:	120	
Actuated Cycle Length:	95.2	
Natural Cycle:	75	
Control Type:	Actuated-Uncoordinated	
Maximum v/c Ratio:	0.77	
Intersection Signal Delay:	11.4	Intersection LOS: B
Intersection Capacity Utilization	86.5%	ICU Level of Service E
Analysis Period (min)	15	

Splits and Phases: 3: King Street East & WB Hwy 401 Off-Ramp



Queues

3: King Street East & WB Hwy 401 Off-Ramp

2031 Total Conditions (no LRT): PM Peak Hour

	EBU	EBT	WBT	SBL
Lane Group Flow (vph)	55	1966	1401	130
v/c Ratio	0.26	0.77	0.56	0.59
Control Delay	9.3	11.6	7.8	48.6
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	9.3	11.6	7.8	48.6
Queue Length 50th (m)	3.1	105.4	56.7	23.5
Queue Length 95th (m)	10.9	162.8	87.2	39.9
Internal Link Dist (m)		308.0	272.3	208.6
Turn Bay Length (m)	15.0			
Base Capacity (vph)	212	2569	2495	765
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.26	0.77	0.56	0.17
Intersection Summary				

HCM Signalized Intersection Capacity Analysis

3: King Street East & WB Hwy 401 Off-Ramp

2031 Total Conditions (no LRT): PM Peak Hour

	EBU	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↓		↑↑	↑↑		↓	
Traffic Volume (vph)	51	0	1769	1261	0	117	0
Future Volume (vph)	51	0	1769	1261	0	117	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1775	1775
Total Lost time (s)	7.0		7.0	7.0		7.0	
Lane Util. Factor	1.00		0.95	0.95		1.00	
Flt	1.00		1.00	1.00		1.00	
Flt Protected	0.95		1.00	1.00		0.95	
Satd. Flow (prot)	1770		3574	3471		1653	
Flt Permitted	0.16		1.00	1.00		0.95	
Satd. Flow (perm)	297		3574	3471		1653	
Peak-hour factor, PHF	0.92	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	55	0	1966	1401	0	130	0
RTOR Reduction (vph)	0	0	0	0	0	0	0
Lane Group Flow (vph)	55	0	1966	1401	0	130	0
Heavy Vehicles (%)	2%	0%	1%	4%	0%	2%	2%
Turn Type	Perm		NA	NA		Prot	
Protected Phases			4	8		6	
Permitted Phases	4						
Actuated Green, G (s)	68.4		68.4	68.4		12.7	
Effective Green, g (s)	68.4		68.4	68.4		12.7	
Actuated g/C Ratio	0.72		0.72	0.72		0.13	
Clearance Time (s)	7.0		7.0	7.0		7.0	
Vehicle Extension (s)	3.0		3.0	3.0		3.0	
Lane Grp Cap (vph)	213		2570	2496		220	
v/s Ratio Prot			c0.55	0.40		c0.08	
v/s Ratio Perm	0.19						
v/c Ratio	0.26		0.76	0.56		0.59	
Uniform Delay, d1	4.6		8.3	6.3		38.8	
Progression Factor	1.00		1.00	1.00		1.00	
Incremental Delay, d2	2.9		2.2	0.9		4.2	
Delay (s)	7.5		10.6	7.2		43.0	
Level of Service	A		B	A		D	
Approach Delay (s)			10.5	7.2		43.0	
Approach LOS			B	A		D	
Intersection Summary							
HCM 2000 Control Delay			10.4		HCM 2000 Level of Service		B
HCM 2000 Volume to Capacity ratio			0.74				
Actuated Cycle Length (s)			95.1		Sum of lost time (s)		14.0
Intersection Capacity Utilization			86.5%		ICU Level of Service		E
Analysis Period (min)			15				
c Critical Lane Group							

Lanes, Volumes, Timings

4: EB Hwy 401 Off-Ramp/EB Hwy 401 On-Ramp & King Street East Partial Conditions (no LRT): PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↔	↔	↕	↔	↔	↕	↔	↔	↔	↔
Traffic Volume (vph)	541	1263	0	0	871	0	474	0	100	0	0	0
Future Volume (vph)	541	1263	0	0	871	0	474	0	100	0	0	0
Ideal Flow (vphpl)	1775	1900	1900	1900	1900	1900	1775	1900	1750	1900	1900	1900
Storage Length (m)	175.0		0.0	0.0		0.0	90.0		0.0	0.0		0.0
Storage Lanes	1		0	0		0	1		1	0		0
Taper Length (m)	25.0			7.5			55.0			7.5		
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Fr								0.850				
Flt Protected	0.950						0.950					
Satd. Flow (prot)	1637	3574	0	0	3539	0	3207	0	1458	0	0	0
Flt Permitted	0.111						0.950					
Satd. Flow (perm)	191	3574	0	0	3539	0	3207	0	1458	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)									82			
Link Speed (k/h)		60			60			50				50
Link Distance (m)		296.3			238.1			280.3				135.0
Travel Time (s)		17.8			14.3			20.2				9.7
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	3%	1%	0%	0%	2%	0%	2%	0%	2%	0%	0%	0%
Adj. Flow (vph)	601	1403	0	0	968	0	527	0	111	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	601	1403	0	0	968	0	527	0	111	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.6			3.6			7.2				7.2
Link Offset(m)		0.0			0.0			0.0				0.0
Crosswalk Width(m)		4.8			4.8			4.8				4.8
Two way Left Turn Lane												
Headway Factor	1.09	1.00	1.00	1.00	1.00	1.00	1.09	1.11	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25		15	25		15	25		15	25		15
Number of Detectors	1	2			2		1		1			
Detector Template	Left	Thru			Thru		Left		Right			
Leading Detector (m)	2.0	10.0			10.0		2.0		2.0			
Trailing Detector (m)	0.0	0.0			0.0		0.0		0.0			
Detector 1 Position(m)	0.0	0.0			0.0		0.0		0.0			
Detector 1 Size(m)	2.0	0.6			0.6		2.0		2.0			
Detector 1 Type	CI+Ex	CI+Ex			CI+Ex		CI+Ex		CI+Ex			
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0			0.0		0.0		0.0			
Detector 1 Queue (s)	0.0	0.0			0.0		0.0		0.0			
Detector 1 Delay (s)	0.0	0.0			0.0		0.0		0.0			
Detector 2 Position(m)		9.4			9.4							
Detector 2 Size(m)		0.6			0.6							
Detector 2 Type		CI+Ex			CI+Ex							
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0							
Turn Type	pm+pt	NA			NA		Prot		Perm			
Protected Phases	1	6			2		4					

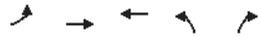
Lanes, Volumes, Timings

4: EB Hwy 401 Off-Ramp/EB Hwy 401 On-Ramp & King Street East Partial Conditions (no LRT): PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	6											4
Detector Phase	1	6										4
Switch Phase												
Minimum Initial (s)	5.0	20.0					20.0			10.0		10.0
Minimum Split (s)	10.0	27.0					27.0			25.0		25.0
Total Split (s)	40.0	78.0					38.0			42.0		42.0
Total Split (%)	33.3%	65.0%					31.7%			35.0%		35.0%
Maximum Green (s)	35.0	71.0					31.0			35.0		35.0
Yellow Time (s)	3.0	4.0					4.0			4.0		4.0
All-Red Time (s)	2.0	3.0					3.0			3.0		3.0
Lost Time Adjust (s)	0.0	0.0					0.0			0.0		0.0
Total Lost Time (s)	5.0	7.0					7.0			7.0		7.0
Lead/Lag	Lead						Lag					
Lead-Lag Optimize?	Yes						Yes					
Vehicle Extension (s)	3.0	3.0					3.0			3.0		3.0
Recall Mode	None	None					Max			None		None
Walk Time (s)		7.0					7.0			7.0		7.0
Flash Dont Walk (s)		11.0					11.0			11.0		11.0
Pedestrian Calls (#/hr)		0					0			0		0
Act Effct Green (s)	73.1	71.1					31.1			22.9		22.9
Actuated g/C Ratio	0.68	0.66					0.29			0.21		0.21
v/c Ratio	1.01	0.60					0.95			0.78		0.30
Control Delay	67.9	12.3					57.6			48.6		14.0
Queue Delay	0.0	0.0					0.0			0.0		0.0
Total Delay	67.9	12.3					57.6			48.6		14.0
LOS	E	B					E			D		B
Approach Delay		29.0					57.6			42.6		
Approach LOS		C					E			D		
Intersection Summary												
Area Type:	Other											
Cycle Length:	120											
Actuated Cycle Length:	108											
Natural Cycle:	90											
Control Type:	Actuated-Uncoordinated											
Maximum v/c Ratio:	1.01											
Intersection Signal Delay:	39.0						Intersection LOS: D					
Intersection Capacity Utilization:	86.5%						ICU Level of Service E					
Analysis Period (min):	15											
Splits and Phases:	4: EB Hwy 401 Off-Ramp/EB Hwy 401 On-Ramp & King Street East											

Queues

4: EB Hwy 401 Off-Ramp/EB Hwy 401 On-Ramp & King Street East Critical Conditions (no LRT): PM Peak Hour



Lane Group	EBL	EBT	WBT	NBL	NBR
Lane Group Flow (vph)	601	1403	968	527	111
v/c Ratio	1.01	0.60	0.95	0.78	0.30
Control Delay	67.9	12.3	57.6	48.6	14.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	67.9	12.3	57.6	48.6	14.0
Queue Length 50th (m)	~116.0	82.9	110.2	57.0	5.2
Queue Length 95th (m)	#214.7	125.8	#170.1	75.7	19.9
Internal Link Dist (m)		272.3	214.1		
Turn Bay Length (m)	175.0			90.0	
Base Capacity (vph)	598	2353	1017	1040	528
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	1.01	0.60	0.95	0.51	0.21

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

4: EB Hwy 401 Off-Ramp/EB Hwy 401 On-Ramp & King Street East Critical Conditions (no LRT): PM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔↔			↔↔		↔↔		↔			
Traffic Volume (vph)	541	1263	0	0	871	0	474	0	100	0	0	0
Future Volume (vph)	541	1263	0	0	871	0	474	0	100	0	0	0
Ideal Flow (vphpl)	1775	1900	1900	1900	1900	1900	1775	1900	1750	1900	1900	1900
Total Lost time (s)	5.0	7.0			7.0		7.0		7.0			
Lane Util. Factor	1.00	0.95			0.95		0.97		1.00			
Fr	1.00	1.00			1.00		1.00		0.85			
Fit Protected	0.95	1.00			1.00		0.95		1.00			
Satd. Flow (prot)	1637	3574			3539		3207		1458			
Fit Permitted	0.11	1.00			1.00		0.95		1.00			
Satd. Flow (perm)	191	3574			3539		3207		1458			
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	601	1403	0	0	968	0	527	0	111	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	65	0	0	0
Lane Group Flow (vph)	601	1403	0	0	968	0	527	0	46	0	0	0
Heavy Vehicles (%)	3%	1%	0%	0%	2%	0%	2%	0%	2%	0%	0%	0%
Turn Type	pm+pt	NA			NA		Prot		Perm			
Protected Phases	1	6			2		4					
Permitted Phases	6								4			
Actuated Green, G (s)	71.2	71.2			31.1		22.9		22.9			
Effective Green, g (s)	71.2	71.2			31.1		22.9		22.9			
Actuated g/C Ratio	0.66	0.66			0.29		0.21		0.21			
Clearance Time (s)	5.0	7.0			7.0		7.0		7.0			
Vehicle Extension (s)	3.0	3.0			3.0		3.0		3.0			
Lane Grp Cap (vph)	595	2354			1018		679		308			
v/s Ratio Prot	c0.33	0.39			0.27		c0.16					
v/s Ratio Perm	c0.34								0.03			
v/c Ratio	1.01	0.60			0.95		0.78		0.15			
Uniform Delay, d1	30.2	10.4			37.8		40.2		34.7			
Progression Factor	1.00	1.00			1.00		1.00		1.00			
Incremental Delay, d2	39.4	0.4			18.6		5.6		0.2			
Delay (s)	69.7	10.8			56.3		45.7		34.9			
Level of Service	E	B			E		D		C			
Approach Delay (s)		28.4			56.3			43.9			0.0	
Approach LOS		C			E			D			A	

Intersection Summary
 HCM 2000 Control Delay 38.6 HCM 2000 Level of Service D
 HCM 2000 Volume to Capacity ratio 0.98
 Actuated Cycle Length (s) 108.1 Sum of lost time (s) 19.0
 Intersection Capacity Utilization 86.5% ICU Level of Service E
 Analysis Period (min) 15
 c Critical Lane Group

Lanes, Volumes, Timings

6: Site Driveway & King Street East

2031 Total Conditions (no LRT): PM Peak Hour

	→	↘	↙	←	↖	↗
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↕↕			↕↕		↕
Traffic Volume (vph)	2611	166	0	1940	0	137
Future Volume (vph)	2611	166	0	1940	0	137
Ideal Flow (vphpl)	1775	1775	1900	1900	1900	1750
Lane Util. Factor	0.95	0.95	1.00	0.95	1.00	1.00
Fr _t	0.991					0.865
Fit Protected						
Satd. Flow (prot)	3247	0	0	3505	0	1484
Fit Permitted						
Satd. Flow (perm)	3247	0	0	3505	0	1484
Link Speed (k/h)	60			60	50	
Link Distance (m)	462.0			332.0	121.5	
Travel Time (s)	27.7			19.9	8.7	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	3%	2%	2%	3%	2%	2%
Adj. Flow (vph)	2838	180	0	2109	0	149
Shared Lane Traffic (%)						
Lane Group Flow (vph)	3018	0	0	2109	0	149
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.6			3.6	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	4.8			4.8	4.8	
Two way Left Turn Lane						
Headway Factor	1.09	1.09	1.00	1.00	1.00	1.11
Turning Speed (k/h)		15	25		25	15
Sign Control	Free			Free	Stop	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	98.8%
ICU Level of Service	F
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis

6: Site Driveway & King Street East

2031 Total Conditions (no LRT): PM Peak Hour

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↕↕			↕↕		↕
Traffic Volume (veh/h)	2611	166	0	1940	0	137
Future Volume (Veh/h)	2611	166	0	1940	0	137
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)	2838	180	0	2109	0	149
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)				332		
pX, platoon unblocked					0.79	
vC, conflicting volume			3018		3982	1509
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			3018		4241	1509
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	0
cM capacity (veh/h)			111		1	110

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	1892	1126	1054	1054	149
Volume Left	0	0	0	0	0
Volume Right	0	180	0	0	149
eSH	1700	1700	1700	1700	110
Volume to Capacity	1.11	0.66	0.62	0.62	1.36
Queue Length 95th (m)	0.0	0.0	0.0	0.0	82.7
Control Delay (s)	0.0	0.0	0.0	0.0	282.4
Lane LOS					F
Approach Delay (s)	0.0		0.0		282.4
Approach LOS					F

Intersection Summary

Average Delay	8.0
Intersection Capacity Utilization	98.8%
ICU Level of Service	F
Analysis Period (min)	15

Appendix C

2031 Total Traffic Operations Reports – Sensitivity Analysis



Lanes, Volumes, Timings

6: Site Driveway & King Street East

2031 Total Conditions (no LRT): AM Peak Hour (Sensitivity Analysis)

	→	↘	↙	←	↖	↗
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↕↕			↕↕		↕
Traffic Volume (vph)	911	83	0	1814	0	142
Future Volume (vph)	911	83	0	1814	0	142
Ideal Flow (vphpl)	1775	1775	1900	1900	1900	1750
Lane Util. Factor	0.95	0.95	1.00	0.95	1.00	1.00
Fr _t	0.987					0.865
Fit Protected						
Satd. Flow (prot)	3150	0	0	3539	0	1484
Fit Permitted						
Satd. Flow (perm)	3150	0	0	3539	0	1484
Link Speed (k/h)	60			60	50	
Link Distance (m)	461.0			332.9	137.5	
Travel Time (s)	27.7			20.0	9.9	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	6%	2%	2%	2%	2%	2%
Adj. Flow (vph)	990	90	0	1972	0	154
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1080	0	0	1972	0	154
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.6			3.6	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	4.8			4.8	4.8	
Two way Left Turn Lane						
Headway Factor	1.09	1.09	1.00	1.00	1.00	1.11
Turning Speed (k/h)		15	25		25	15
Sign Control	Free			Free	Stop	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	53.5%
Analysis Period (min)	15
	ICU Level of Service A

HCM Unsignalized Intersection Capacity Analysis

6: Site Driveway & King Street East

2031 Total Conditions (no LRT): AM Peak Hour (Sensitivity Analysis)

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↕↕			↕↕		↕
Traffic Volume (veh/h)	911	83	0	1814	0	142
Future Volume (Veh/h)	911	83	0	1814	0	142
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)	990	90	0	1972	0	154
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)				333		
pX, platoon unblocked					0.62	
vC, conflicting volume			1080		2021	540
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1080		1418	540
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	68
cM capacity (veh/h)			641		79	486

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	660	420	986	986	154
Volume Left	0	0	0	0	0
Volume Right	0	90	0	0	154
eSH	1700	1700	1700	1700	486
Volume to Capacity	0.39	0.25	0.58	0.58	0.32
Queue Length 95th (m)	0.0	0.0	0.0	0.0	10.8
Control Delay (s)	0.0	0.0	0.0	0.0	15.8
Lane LOS					C
Approach Delay (s)	0.0		0.0		15.8
Approach LOS					C

Intersection Summary

Average Delay	0.8
Intersection Capacity Utilization	53.5%
Analysis Period (min)	15
	ICU Level of Service A

Lanes, Volumes, Timings

6: Site Driveway & King Street East

2031 Total Conditions (no LRT): PM Peak Hour

	→	↘	↙	←	↖	↗
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑		↑
Traffic Volume (vph)	1708	166	0	1940	0	137
Future Volume (vph)	1708	166	0	1940	0	137
Ideal Flow (vphpl)	1775	1775	1900	1900	1900	1750
Lane Util. Factor	0.95	0.95	1.00	0.95	1.00	1.00
Fr _t	0.987					0.865
Fit Protected						
Satd. Flow (prot)	3234	0	0	3505	0	1484
Fit Permitted						
Satd. Flow (perm)	3234	0	0	3505	0	1484
Link Speed (k/h)	60			60	50	
Link Distance (m)	462.0			332.0	121.5	
Travel Time (s)	27.7			19.9	8.7	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	3%	2%	2%	3%	2%	2%
Adj. Flow (vph)	1857	180	0	2109	0	149
Shared Lane Traffic (%)						
Lane Group Flow (vph)	2037	0	0	2109	0	149
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	3.6			3.6	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	4.8			4.8	4.8	
Two way Left Turn Lane						
Headway Factor	1.09	1.09	1.00	1.00	1.00	1.11
Turning Speed (k/h)		15	25		25	15
Sign Control	Free			Free	Stop	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	72.1%
ICU Level of Service	C
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis

6: Site Driveway & King Street East

2031 Total Conditions (no LRT): PM Peak Hour

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑		↑
Traffic Volume (veh/h)	1708	166	0	1940	0	137
Future Volume (Veh/h)	1708	166	0	1940	0	137
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)	1857	180	0	2109	0	149
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)				332		
pX, platoon unblocked					0.66	
vC, conflicting volume			2037		3002	1018
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			2037		3002	1018
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	37
cM capacity (veh/h)			274		7	235

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	1238	799	1054	1054	149
Volume Left	0	0	0	0	0
Volume Right	0	180	0	0	149
eSH	1700	1700	1700	1700	235
Volume to Capacity	0.73	0.47	0.62	0.62	0.63
Queue Length 95th (m)	0.0	0.0	0.0	0.0	30.7
Control Delay (s)	0.0	0.0	0.0	0.0	43.7
Lane LOS					E
Approach Delay (s)	0.0		0.0		43.7
Approach LOS					E

Intersection Summary

Average Delay	1.5
Intersection Capacity Utilization	72.1%
ICU Level of Service	C
Analysis Period (min)	15