

TRAFFIC IMPACT STUDY  
BRONTE GREEN SUBDIVISION  
MERTON TERTIARY PLAN  
OAKVILLE

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# TABLE OF CONTENTS

	Page
1. INTRODUCTION.....	1
2. DRAFT PLAN OF SUBDIVISION.....	1
3. EXISTING CONDITIONS.....	2
3.1 Road System .....	2
3.2 Traffic Volumes .....	3
3.3 Transit Service.....	3
4. TRAFFIC FORECASTS.....	4
4.1 Background Traffic .....	4
4.2 Bronte Green Subdivision Traffic.....	4
4.3 Total Traffic.....	6
5. TRAFFIC OPERATIONS .....	6
5.1 Signalized Intersections.....	6
5.1.1 Bronte Road and Upper Middle Road.....	8
5.1.2 Bronte Road and North Access.....	8
5.1.3 Bronte Road and South Access.....	8
5.1.4 Bronte Road and Halton Region Woodlands Operations Centre Access .....	9
5.1.5 Bronte Road and North Service Road.....	9
5.1.6 North Service Road and Halton Region Access.....	10
5.1.7 Bronte Road and QEW Westbound Off-ramp .....	10
5.1.8 Bronte Road and QEW Eastbound Off-ramp.....	11
5.2 Internal Roadways.....	12
5.3 Traffic Calming.....	12
6. TRANSIT SERVICE.....	13
6.1 Existing Oakville Transit Routes.....	13
6.2 Internal Transit Route and Stops .....	13
7. CONCLUSIONS.....	13

## LIST OF TABLES

	Page
TABLE 1 - BRONTE GREEN TRIP GENERATION .....	5
TABLE 2 - SIGNALIZED INTERSECTION ANALYSIS (AM PEAK HOUR).....	7
TABLE 3 - SIGNALIZED INTERSECTION ANALYSIS (PM PEAK HOUR).....	7

## LIST OF FIGURES

FIGURE 1.	STUDY AREA
FIGURE 2.	BRONTE GREEN DRAFT PLAN OF SUBDIVISION
FIGURE 3.	EXISTING TRAFFIC
FIGURE 4.	2019 BACKGROUND TRAFFIC
FIGURE 5.	RESIDENTIAL SITE TRAFFIC
FIGURE 6.	COMMERCIAL SITE TRAFFIC
FIGURE 7.	2019 TOTAL TRAFFIC
FIGURE 8.	TRAFFIC CALMING LOCATIONS
FIGURE 9.	TRANSIT ROUTE AND STOP LOCATIONS

# TRAFFIC IMPACT STUDY BRONTE GREEN SUBDIVISION MERTON TERTIARY PLAN OAKVILLE

## 1. INTRODUCTION

This Traffic Impact Study (TIS) is submitted in support of applications made by Bronte Green Corporation for rezoning and for a draft plan of subdivision for the Bronte Green development within the Merton Tertiary Plan area in the Town of Oakville.

The Town of Oakville is currently in the process of preparing the Merton (QEW/Bronte Road) Tertiary Plan for the lands north of the QEW between Bronte Road and Third Line. Figure 1 shows the Merton Tertiary Plan boundary and the location of the Bronte Green subdivision.

Read, Voorhees has been retained to prepare a traffic impact study (TIS) for the Bronte Green application.

The design hours for the traffic analysis are the weekday morning and afternoon commuter peak hours. A five year horizon period to 2019 has been used for the subdivision analysis. Implementation is anticipated to have full occupancy by the end of 2016.

For longer term planning analysis a ten year horizon period to 2024 has also been evaluated.

The study area includes the two proposed subdivision access intersections on Bronte Road, and the existing signalized intersections at Bronte Road and Upper Middle Road, Bronte Road and Woodlands Operations Centre, Bronte Road and North Service Road, Bronte Road and the WB QEW off-ramp, and Bronte Road and the EB QEW off-ramp.

## 2. DRAFT PLAN OF SUBDIVISION

The development is located on the existing Saw Whet golf course lands. The draft plan of subdivision is shown on Figure 2.

The subdivision is primarily residential with a commercial or 'Main Street' area on Street A adjacent to Bronte Road.

The residential unit count is 785, made up of 180 townhouse units and 605 detached units. There is also a 0.49 ha. high density residential block on the north side of Street A at Bronte Road, and a 0.69 ha. Main Street mixed use block opposite on the south side of Street A. No specific development is yet proposed on these two blocks, but an assumption of 90 apartment units and 1,725 m<sup>2</sup> of retail use and 1,725 m<sup>2</sup> of office use have been included in the traffic forecast.

The road system within the subdivision has Street A as a major collector with a right-of-way of 25 metres on the first block in from Bronte Road and 20 metres on the remainder of the road. It runs from Bronte Road to the east limit of the subdivision.

There are two minor collectors, Street B and Street C which have a right-of-way of 18 metres. Street C intersects with Bronte Road and then turns south and runs down to Street B. Street B will run from Street C east to Street A, but as an interim condition will have a cul-de-sac near the SMW pond until future development provides the connection to Street A.

All other public roads are local roads with a 16 metre right-of-way.

The Fourteen Mile Creek valley is a major geographic feature which precludes any feasible access to the north or east from the Saw Whet property. Connection to the existing Oakville road system will be on Bronte Road at Street A and at Street C.

Provision has been made for a future extension of Street A south into the Deerfield lands, which is expected to continue to North Service Road. As noted above, provision has been made for extension of Street B east through the Deerfield lands to meet the Street A extension. Provision is also made for an extension of Street B west to link into the Woodlands Centre access on Bronte Road. However, this linkage is not assumed to be in place for the subdivision traffic analysis.

The Street A intersection on Bronte Road will be the location of an access for development of the lands on the west side of Bronte Road. Interim operation will be as a T intersection until the west side of Bronte Road develops.

The north end of the subdivision north of Fourteen Mile Creek and west of the hydro corridor will be developed as a condominium block. The developable frontage on Upper Middle Road is very close to Bronte Road, and therefore provision of a full moves access intersection on Upper Middle Road is not possible. The area will be accessed by a private internal road system that extends north from Street C. Internal circulation will be provided on private roads with 10 metre rights-of-way.

Spacing between the new intersections on Bronte Road is 440 metres from Upper Middle Road to Street C, and 360 metres between the Street C and Street A intersections. The distance between Street A and the Woodlands Operations Access is 400 metres.

### **3. EXISTING CONDITIONS**

#### **3.1 Road System**

Freeway service to the general Merton area is provided by the QEW which is a 6 lane facility plus 2 HOV lanes on this section. The highway provides connection to the east to Toronto and beyond and to the west to Hamilton and beyond. An interchange is located at Bronte Road.

Highway 407 is a 6 lane freeway located further to the north well outside the study area, also providing east-west service. An interchange is provided at Bronte Road.

Bronte Road is a four lane arterial road plus turn lanes at intersections. It provides north-south service through the area, and as noted has interchanges with the QEW to the south, and with Highway 407 to the north. Posted speed limit is 60 km/h. Bronte Road is under Region of Halton jurisdiction. The Region's TMP includes a recommendation for widening of Bronte Road to six lanes in the future from Speers Road to Highway 407. Bronte Road will be designated as a transit corridor with two of the lanes utilized as HOV lanes.

Upper Middle Road is an east-west arterial road north of the site that provides connection to the area further north of the QEW and with other north-south arterials. Upper Middle Road is under Region of Halton jurisdiction.

North Service Road is a major collector that serves the lands north of the QEW. The North Service Road runs from Bronte Road east to Third Line, and continues easterly across Oakville to Dorval Drive and Kerr Street. North Service Road is under Town jurisdiction.

Signalized intersections are located at Bronte Road and Upper Middle Road, at Bronte Road and Woodlands Operations access, at Bronte Road and North Service Road, at North Service Road and Halton Region Access, and at the two QEW Bronte Road interchange ramps.

## 3.2 Traffic Volumes

Figure 3 shows the existing peak hour traffic volumes in the vicinity of the site. The volumes are from the following counts:

Bronte Road and Upper Middle Road	February 2012 by Halton Region
Bronte Road and Woodlands Entrance	October 2012 by Read Voorhees
Bronte Road and North Service Road	June 2011 by Halton Region
North Service Road and Halton Centre driveways	December 2010 by Read Voorhees
Bronte Road and QEW westbound Off-ramp	June 2011 by Halton Region
Bronte Road and QEW eastbound Off-ramp	November 2013 by Read Voorhees

## 3.3 Transit Service

There are two Oakville Transit routes serving the Merton Tertiary Plan area and Halton Region Centre. The Upper Middle Route 6 service operates from the Bronte GO station along Bronte Road and across Upper Middle Road to the east end of Oakville at Winston Park. The Westoak Trails Route 13 service also operates from Bronte GO station up to and across West Oak Trails Blvd and connects to the Oakville GO Station at Cross Street. Headways are 20 minutes for the Upper Middle route, and 30 minutes for the Westoak Trails route.

As noted above, a Bronte Road widened to six lanes in the future will be a transit corridor with HOV lanes. However, the widening is not anticipated for the 2019 horizon period.

## 4. TRAFFIC FORECASTS

### 4.1 Background Traffic

The Halton Region Transportation Master Plan and the Oakville Transportation Master Plan (TMP) were updated in 2011 to provide traffic forecasts to 2031.

For long term planning in developing the Merton Tertiary Plan growth rates on the arterial roads in the study area were developed by a comparison of the 2031 assignments for the recommended plan in the TMP and the 2006 existing volumes calibration run. However, for the five year horizon period for the Bronte Green subdivision the background traffic on Bronte Road has been forecast by application of an annual growth rate of 2% over the intersection turning movements shown on Figure 3.

The Halton Region office complex on Bronte Road is within the Merton Tertiary Plan boundary. However, the existing development is not expected to change, so this segment is accounted for within the existing conditions data. There are no other site development approvals in the immediate vicinity of the Bronte Green proposal.

In the Merton Tertiary Plan traffic analysis allowance was made for possible commercial development as per the zoning on the QEW-Bronte Developments block on the east side of Bronte Road between the QEW Westbound off-ramp and North Service Road. However, there is no development application at present and therefore no forecast is added to the background traffic in this TIS.

Figure 4 shows the 2019 background traffic in the study area based on the above described arterial road growth rates applied to the existing volumes at the intersections.

### 4.2 Bronte Green Subdivision Traffic

Trip generation rates from the ITE Trip Generation Manual, Eighth Edition have been used as the base for subdivision traffic. For the single family units the rates for land use code 210 have been applied, and for townhouse units the rates for land use code 231 have been applied. For apartment units the rates for land use code 230 have been applied.

The retail commercial space will largely serve the subdivision, but there will also be some trips attracted as passby trips from traffic on Bronte Road. The rates from the ITE Trip Generation Manual for land use code 820 Shopping Centre have been applied using the fitted curve equation. The office auto trips will largely come from external zones. The rates from the ITE Trip Generation Manual for land use code 710 Office Building have been applied.

The ITE trip rates do not include a specific allowance for transit mode usage. Since future development in Oakville is being developed with a transit first policy and high quality transit service is being planned, the traffic generation forecast incorporates an anticipated transit mode split. For the 2019 horizon year a transit mode split of 5% has been applied to the site



traffic forecast for the Bronte Green subdivision. The overall Town objective is a 20% transit mode split by 2031.

The subdivision traffic forecast is shown in Table 1.

**Table 1 - BRONTE GREEN TRIP GENERATION**

USE	UNITS	A.M. PEAK HOUR		P.M. PEAK HOUR	
		In	Out	In	Out
Single family trip rate	Per unit	0.19	0.56	0.64	0.37
Units and Trips	605	115	339	387	224
Townhouse trip rate	Per unit	0.17	0.50	0.45	0.33
Units and Trips	180	31	90	81	59
Apartment trip rate	Per unit	0.07	0.37	0.35	0.17
Units and Trips	90	6	33	32	15
<b>SUB-TOTAL</b>	<b>875</b>	<b>152</b>	<b>462</b>	<b>500</b>	<b>298</b>
Transit trips		8	23	25	15
<b>NET SUB-TOTAL</b>		<b>144</b>	<b>439</b>	<b>475</b>	<b>283</b>
Retail trip rate	Per 100 m <sup>2</sup>	2.03	1.27	5.86	6.09
Floor Area and Trips	1725 m <sup>2</sup>	35	22	101	105
Office trip rate	Per 100 m <sup>2</sup>	1.36	0.19	0.25	1.24
Floor Area and Trips	1725 m <sup>2</sup>	26	4	5	23
<b>TOTAL AUTO TRIPS</b>		<b>205</b>	<b>461</b>	<b>576</b>	<b>388</b>
<b>EXTERNAL AUTO TRIPS</b>		<b>164</b>	<b>425</b>	<b>461</b>	<b>295</b>

The site generated traffic assigned to the road system is shown in Figures 5 and 6, for the residential use and for the commercial uses respectively.

The residential trips are oriented primarily to and from employment areas in Oakville and the adjacent GTA municipalities. The retail trips are assumed to be oriented by and large to the subdivision, with 25% as linked trips associated with the other purpose trips made by residents. A passby component of 25% is assumed to be from Bronte Road through traffic.

The directional distribution and assignment by roadway is as follows:

	Residential	Retail	Office
Internal to Bronte Green	4%	75% (25% link)	0%
West on QEW	15	0	15
East on QEW	31	0	15
East on Upper Middle	10	0	15
West on Upper Middle	0	0	5
East on North Service Road	10	0	15
South on Bronte Road	10	12 (passby)	20
North on Bronte Road	<u>20</u>	<u>13 (passby)</u>	<u>15</u>
TOTAL	100%	100%	100%

### 4.3 Total Traffic

Figure 7 shows the total 2019 traffic at the study area intersections.

## 5. TRAFFIC OPERATIONS

### 5.1 Signalized Intersections

The intersections have been analyzed using the Synchro program. The output data is included in the Appendix. The operating parameters used are a saturation flow rate of 1900 vphg, a cycle length of 120 seconds, and the timing and phasing is optimized. For existing conditions a peak hour factor of 0.92 is applied, and this is also used for the 2019 horizon scenarios.

In the future Bronte Road is to be widened to six lanes through the study area, from Upper Middle Road south to Speers Road, with the curb lanes to be utilized as HOV lanes. However, this is not anticipated to be in place by 2019. Therefore the analysis has assumed operation on Bronte Road to be as per existing conditions.

Table 4 shows the results of the analysis for existing traffic, for 2019 background traffic and for 2019 total traffic conditions. The table shows the overall intersection results, and data for any individual through movements that have v/c ratios higher than 0.85 and turning movements with a v/c ratio higher than 1.0.

**Table 2 - Signalized Intersection Analysis (AM Peak Hour)**

Intersection / Condition	Existing Traffic			Future Background 2019 Traffic			Future Total 2019 Traffic		
	Delay (sec)	LOS	HCM v/c	Delay (sec)	LOS	HCM v/c	Delay (sec)	LOS	HCM v/c
<b>A.M. Peak Hour</b>									
<b>Bronte &amp; Upper Middle</b>	<b>23.3</b>	<b>C</b>	<b>0.64</b>	<b>27.5</b>	<b>C</b>	<b>0.77</b>	<b>33.8</b>	<b>C</b>	<b>0.78</b>
Bronte & North Access	-	-	-	-	-	-	5.0	A	0.72
Bronte & South Access	-	-	-	-	-	-	14.8	B	0.86
Bronte & Woodlands	2.9	A	0.60	3.4	A	0.65	3.8	A	0.75
Bronte & North Service	3.1	A	0.46	3.2	A	0.54	3.5	A	0.62
NSR & Region Access	18.9	B	0.20	19.6	B	0.20	22.8	C	0.21
<b>Bronte &amp; WB Off-ramp</b>	<b>12.8</b>	<b>B</b>	<b>0.33</b>	<b>12.0</b>	<b>B</b>	<b>0.40</b>	<b>11.9</b>	<b>B</b>	<b>0.45</b>
WB right	48.6	D	0.39	44.4	D	0.11	45.8	D	0.20
WB left	48.1	D	0.42	48.5	D	0.55	48.9	D	0.54
NB thru	3.5	A	0.31	1.9	A	0.37	2.3	A	0.38
<b>Bronte &amp; EB Off-ramp</b>	<b>26.0</b>	<b>C</b>	<b>0.70</b>	<b>40.2</b>	<b>D</b>	<b>0.93</b>	<b>46.8</b>	<b>D</b>	<b>0.95</b>
WB left	52.4	D	0.78	65.6	E	0.97	72.6	E	0.98
WB thru/right	34.7	C	0.36	25.5	C	0.21	26.9	C	0.23
SB left	24.1	C	0.77	83.0	F	1.01	69.6	E	1.00
NB thru	25.8	C	0.51	40.3	D	0.74	80.8	F	1.02

**Table 3 - Signalized Intersection Analysis (PM Peak Hour)**

Intersection / Condition	Existing Traffic			Future Background 2019 Traffic			Future Total 2019 Traffic		
	Delay (sec)	LOS	HCM v/c	Delay (sec)	LOS	HCM v/c	Delay (sec)	LOS	HCM v/c
<b>P.M. Peak Hour</b>									
<b>Bronte and UMR</b>	<b>15.1</b>	<b>B</b>	<b>0.58</b>	<b>17.4</b>	<b>B</b>	<b>0.69</b>	<b>22.3</b>	<b>C</b>	<b>0.73</b>
Bronte & North Access	-	-	-	-	-	-	3.1	A	0.69
Bronte & South Access	-	-	-	-	-	-	20.2	C	0.85
NB thru	-	-	-	-	-	-	25.1	C	0.90
Bronte and Woodlands	3.1	A	0.56	3.5	A	0.65	5.0	A	0.77
Bronte & North Service	6.9	A	0.59	9.2	A	0.69	16.8	B	0.84
NB thru	3.5	A	0.65	7.9	A	0.76	18.1	B	0.94
NSR & Region Access	13.9	B	0.14	14.0	B	0.14	14.0	B	0.16
<b>Bronte &amp; WB Off-ramp</b>	<b>16.8</b>	<b>B</b>	<b>0.79</b>	<b>15.2</b>	<b>B</b>	<b>0.77</b>	<b>19.5</b>	<b>B</b>	<b>0.88</b>
WB right	51.7	D	0.83	52.1	D	0.72	63.2	E	0.87
WB left	31.7	C	0.24	46.5	D	0.70	45.0	D	0.74
NB thru	9.1	A	0.77	5.4	A	0.79	9.8	A	0.89
<b>Bronte &amp; EB Off-ramp</b>	<b>41.7</b>	<b>D</b>	<b>0.94</b>	<b>31.5</b>	<b>C</b>	<b>0.85</b>	<b>40.4</b>	<b>D</b>	<b>0.93</b>
WB left	36.3	D	0.34	72.8	E	0.92	65.8	E	0.89
WB thru/right	51.4	D	0.89	40.6	D	0.51	43.5	D	0.62
NB thru	54.6	D	0.98	31.0	C	0.86	49.2	D	0.98
SB left	79.5	E	0.95	66.4	E	0.87	82.3	F	0.98

### 5.1.1 Bronte Road and Upper Middle Road

The Bronte Road and Upper Middle Road intersection is presently operating at a v/c ratio of 0.64 in the a.m. peak hour and 0.58 in the p.m. peak hour. Level of service is at level C in the a.m. peak hour and level B in the p.m. peak hour. The signal phasing for existing conditions includes a southbound left turn phase, a northbound left turn phase, and a westbound left turn phase. A westbound double left turn lane configuration is now in place. These conditions are carried forward for the future traffic analysis.

With the 2019 background volumes level of service remains at level C in the a.m. peak hour and remains at level B in the p.m. peak hour. The v/c ratios are 0.77 in the a.m. peak hour and 0.69 in the p.m. peak hour.

With the Bronte Green traffic added to the road system, the Bronte Road and Upper Middle Road intersection level of service remains at level C in the a.m. peak hour and changes to level C in the p.m. peak hour. The v/c ratio in the a.m. peak hour increases by 0.01 to 0.78, and in the p.m. peak hour increases by 0.04 to 0.73.

No additional mitigation is required to accommodate the subdivision traffic.

### 5.1.2 Bronte Road and North Access

The North Access road in the subdivision plan will operate at level of service A in the a.m. peak hour and at level A in the p.m. peak hour. This access will service all the residential uses at the north end of the subdivision and by some of the units in the remainder of the subdivision. Two outbound lanes should be provided on the approach to Bronte Road, and designated as separate left turn and right turn lanes.

A separate southbound left turn lane is required at the intersection, but the volume of left turns during the peak hours does not require a separate signal phase. A northbound right turn lane will be provided to maximize available capacity on Bronte Road.

During the a.m. peak hour the southbound through lanes on Bronte Road are calculated to operate at level of service A based on average vehicle delay, and with a v/c ratio of 0.77. In the p.m. peak hour northbound Bronte Road is calculated to operate at level of service A based on average vehicle delay and with a v/c ratio of 0.69.

### 5.1.3 Bronte Road and South Access

The South Access road for the subdivision will be the busier of the two access roadways on Bronte Road since it is more central to the overall development, and it will serve the commercial site. The intersection will in the future have a west leg that serves the lands west of Bronte Road. However, initially it will operate as a T intersection. Two outbound lanes are required at the intersection on the east leg, operating as a left turn lane and a right turn lane. In the future the right lane will also accommodate any through traffic.

Northbound and southbound left turn lanes will be provided at the intersection, as will northbound and southbound right turn lanes to maximize available capacity on Bronte Road.

With the volumes forecast a separate southbound left turn phase is required in the p.m. peak hour. During the a.m. peak hour there is only a small volume of left turns. The intersection will operate in the a.m. peak hour with a v/c ratio of 0.86, and at level of service B. During the p.m. peak hour the v/c ratio is 0.85 and the level of service is level C.

Similar to the condition for Bronte Road noted above for the North Access, during the a.m. peak hour the southbound through traffic is calculated to operate at level of service A, and will have a v/c ratio of 0.88. In the p.m. peak hour the northbound through traffic on Bronte Road will operate at level of service C with a v/c ratio of 0.90.

#### **5.1.4 Bronte Road and Halton Region Woodlands Operations Centre Access**

The Bronte Road intersection at the Halton Region Woodlands Operations Centre access driveway is presently operating at a v/c ratio of 0.60 in the a.m. peak hour and 0.56 in the p.m. peak hour. Level of service is at level A in both peak hours. The volumes in and out of the Centre are minor and the signal is required in order to provide safe access out to a busy Bronte Road. Average vehicle delay at the intersection is only 2.5 seconds in the a.m. peak hour and 3.1 seconds in the p.m. peak hour.

For 2019 conditions with the background volumes the level of service remains at level A in both peak hours, and the v/c ratios are 0.65 in the a.m. peak hour and 0.65 in the p.m. peak hour.

With the Bronte Green subdivision traffic added to the road system, the intersection level of service remains at level A in the a.m. peak hour and remains at level A in the p.m. peak hour. The v/c ratio in the a.m. peak hour increases by 0.10 to 0.75, and in the p.m. peak hour increases by 0.12 to 0.77.

The intersection has adequate capacity and no other improvement is necessary to accommodate the 2019 forecast and the proposed Bronte Green development.

#### **5.1.5 Bronte Road and North Service Road**

The Bronte Road and North Service Road intersection is presently operating at a v/c ratio of 0.46 in the a.m. peak hour and 0.59 in the p.m. peak hour. Level of service is at level A in the a.m. peak hour and at level A in the p.m. peak hour.

With the 2019 background volumes level of service remains at level A in the a.m. peak hour and at level A in the p.m. peak hour. The intersection v/c ratios are 0.54 in the a.m. peak hour and 0.69 in the p.m. peak hour.

With the Bronte Green traffic added to the road system, the Bronte Road and North Service Road intersection level of service remains at level A in the a.m. peak hour and changes to level B in the p.m. peak hour. The v/c ratio in the a.m. peak hour increases by 0.08 to 0.62, and in the p.m. peak hour increases by 0.15 to 0.84.

The intersection already operates with two westbound left turn lanes, and no improvements are required to accommodate the proposed subdivision.

### 5.1.6 North Service Road and Halton Region Access

The North Service Road intersection with the Halton Region Centre access driveways is presently operating at a v/c ratio of 0.20 in the a.m. peak hour and 0.14 in the p.m. peak hour. Level of service is at level B in both peak hours.

No change is anticipated for the 2019 background volumes.

A small volume of Bronte Green subdivision traffic is expected to use the North Service Road to travel to and from the east. However, this will have negligible impact on the intersection. With the subdivision traffic added to the road volumes the v/c ratio in the a.m. peak hour increases by 0.01 to 0.21, and in the p.m. peak hour increases by 0.02 to 0.16.

The increases in average vehicle delay is small at 3 seconds in the a.m. peak hour, but because this changes from 19.1 seconds to 22.7 seconds this crosses the dividing line between levels of service B and C. In the p.m. peak hour there is no change in average vehicle delay and therefore no change from level of service B.

### 5.1.7 Bronte Road and QEW Westbound Off-ramp

The Bronte Road and QEW Westbound Off-ramp intersection is presently operating at a v/c ratio of 0.33 in the a.m. peak hour and 0.79 in the p.m. peak hour. Level of service is at level B in both peak hours.

The current right turn volume on the Off-ramp is higher than the left turn volume, particularly in the p.m. peak hour. However, the lane designation has two left turn lanes and one right turn lane. With the 2019 background traffic, the right turn volume is getting to a v/c ratio of 0.94 and is approaching the capacity of one lane. Therefore it is recommended that the present lane designation of two left turn lanes and one right turn lane be modified to make the centre lane an optional left/right lane. This requires only revised pavement marking, and does not involve any road construction

With this change the Bronte Road and QEW Westbound Off-ramp intersection level of service for 2019 background traffic remains at level B in both peak hours. The v/c ratio in the a.m. peak hour is 0.40, and in the p.m. peak hour is 0.77.

With the Bronte Green subdivision traffic added, the Bronte Road and QEW Westbound Off-ramp intersection level of service remains at level B in the a.m. peak hour and remains at

level B in the p.m. peak hour. The v/c ratio in the a.m. peak hour increases by 0.05 to 0.45, and in the p.m. peak hour increases by 0.11 to 0.88.

### 5.1.8 Bronte Road and QEW Eastbound Off-ramp

The Bronte Road and QEW Eastbound Off-ramp intersection is presently operating at a v/c ratio of 0.70 in the a.m. peak hour and 0.94 in the p.m. peak hour. Level of service is at level C in the a.m. peak hour and level D in the p.m. peak hour. The 2013 volumes at this intersection appear to have increased considerably over a previous count in 2010, doubling the volume for some ramp movements. Therefore the intersection is already approaching capacity in the p.m. peak hour if these volumes are representative of regular use.

With the 2019 background volumes and the current ramp geometry the level of service would move into level D in the a.m. peak hour and level E in the p.m. peak hour. The v/c ratios would be 0.77 in the a.m. peak hour and 1.02 in the p.m. peak hour.

With the Bronte Green traffic added to the intersection, the Bronte Road and QEW Eastbound Off-ramp intersection would change to level of service D in the a.m. peak hour, and change to level F in the p.m. peak hour. The v/c ratio in the a.m. peak hour would increase to 0.86, and in the p.m. peak hour to 1.18.

Therefore with the future 2019 volume increases as forecast, mitigation may be required. The Merton Tertiary Plan traffic analysis recommended that for the long term the improvement that would add capacity to the intersection is a second right turn lane on the eastbound off-ramp on the approach to Bronte Road. This movement is a heavy right turn volume, currently 481 vph in the a.m. and 576 vph in the p.m. peak hour. The 2019 right turn volume is forecast to increase by 70 to 551 vph in the a.m., and increase by 130 to 706 vph in the p.m. peak hour.

However, an interim mitigation measure will also accommodate the 2019 volumes, without having to construct an additional lane. At the QEW Eastbound Off-ramp the current lane designation has two left turn lanes and a through-right lane. The existing volumes of left and right turns on the off-ramp are about equal in the a.m. peak hour, but the right turn is substantially higher than the left turn in the p.m. peak hour. This imbalance in the p.m. peak hour is forecast to be even greater in the future scenarios. Therefore it is recommended that the lane designations on the off ramp be revised to have only one exclusive left turn lane, designate the centre lane as a through/right lane to accommodate the through movement into the carpool lot, and have one exclusive right turn lane.

With this revision the Bronte Road and QEW Eastbound Off-ramp intersection will operate for 2019 background traffic in the a.m. peak hour with a v/c ratio of 0.93 and level of service D. In the p.m. peak hour the 2019 background v/c ratio is 0.85 and level of service is C.

For 2019 total traffic in the a.m. peak hour the v/c ratio is 0.95 and level of service is D, and in the p.m. peak hour the v/c ratio is 0.93 and level of service is D.

As noted above, this mitigation does not require any construction, but for the long term traffic forecasts beyond 2019 an additional right turn lane is recommended on the approach to Bronte Road to accommodate higher volumes.

It is noted that the Synchro analysis has been carried out using a peak hour factor of 0.92. Under capacity conditions the peak hour factor will increase towards 1.0, and the intersection v/c ratios will decline compared to the noted values.

## 5.2 Internal Roadways

The roadways within Bronte Green subdivision will be constructed to the standard established for each classification of road in the Town's Design Guidelines.

The highest directional volumes are in the order of 650 vph on Street A, the South Access road, at the intersection with Bronte Road. The volumes disperse along Street A eastward into the subdivision. This section of the South Access is adjacent to the commercial block, and a right-of-way of 25 metres has been provided. A four lane cross section is recommended in this block to facilitate access and possibly provide parking. All other roadways in the subdivision can be constructed with two through lanes. The central Street A collector road has a 20 metre right-of-way, and can have a third centre turning lane provided in the cross section.

All intersections within the subdivisions can operate satisfactorily with Stop sign control. Traffic signals are not warranted at any intersection within the Bronte Green plan.

## 5.3 Traffic Calming

The primary initial measure for traffic calming is identification of sections of straight roadway that are longer than 300 metres for roads that are expected to operate with a posted speed limit of 50 km/h. This would apply to the collector system, made up of Street A, Street C and Street B. For local roads that are posted with speed limits of 40 km/h the critical length of straight road is 160 metres.

The traffic calming features are to be located to achieve the Town's goals of eliminating the potential for speeding, and creating safe pedestrian and cycling environments. The use of all-way Stop sign control at the intersection of the collector roads also acts as a traffic calming factor.

Figure 8 shows the location of the proposed traffic calming features.

It is recommended that all-way Stop sign control be implemented at the intersection of Street A and Street C, and at the intersection of Street B and Street C. This would leave the east section of Street A as a long section of straight road that can be mitigated with a curb extension treatment at the intersection with Street T/Street V. Street C would also have a long straight section between Streets A and B, which can be mitigated with a curb extension treatment at the intersection with Street M



The traffic calming features can be finalized as part of the detailed road design that will subsequently be prepared for the subdivision.

## 6. TRANSIT SERVICE

### 6.1 Existing Oakville Transit Routes

At the present time Oakville Transit operates regular service along Bronte Road on Route 6 and Route 13. A 400 metre walking distance from Bronte Road would cover the area over to the hydro corridor. Service to development east of the hydro corridor would require a route into the subdivision.

### 6.2 Internal Transit Route and Stops

Transit service for the Merton Tertiary Plan area in the long term would likely be provided by a route through the lands on the Street A collector road intersecting Bronte Road and North Service Road.

As the subdivision develops the area from Bronte Road to the hydro corridor can be served by the transit service on Bronte Road since it is within a 400 metre coverage zone. The units east of the hydro corridor would require an internal transit route for coverage since that area extends a further 400 metres east of the hydro corridor. This would require a routing to and from Bronte Road along Street A with an interim turn around provision until the Deerfield lands develop and provide a connection to North Service Road.

Transit stop locations would be located at the intersections with Street C, Street I, Street U and at an interim turnaround loop at the end of Street A. Average stop spacing is in the order of 150 to 200 metres.

Figure 9 shows the transit route and transit stop locations along Street A.

## 7. CONCLUSIONS

The Bronte Green subdivision is located on the east side of Bronte Road, and is presently operating as the Saw Whet golf course.

The residential unit count is 785, made up of 180 townhouse units and 605 detached units. There is also a 0.49 ha. high density residential block on the north side of Street A at Bronte Road, and a 0.69 ha. mixed use block on the opposite south side of Street A. An assumption of 90 apartment units and 1,725 m<sup>2</sup> of retail uses and 1,725 m<sup>2</sup> of office uses been included in the traffic forecast.

Road access for the subdivision will be two connections to Bronte Road, at Street A and at Street C. Provision has been made for future extension of Street A south into the Deerfield lands, which is expected to continue to North Service Road. Provision has also been made for extension of Street B east to meet a Street A extension, and for a future extension of Street B west to link into the Woodlands Centre access to Bronte Road.

A 5 year horizon period to 2019 has been used for traffic forecasting. The subdivision is expected to be completed and occupied by the end of 2016. The growth rate applied to Bronte Road for traffic forecasting is a 2% annual rate applied to existing volumes. Bronte Road is planned to be widened to six lanes in the future from Upper Middle Road down to Speers Road, but this is not expected to be in place for the 2019 horizon period.

The traffic operations analysis indicates that the existing road system can accommodate the 2019 background forecast plus the Bronte Green traffic within the study area. However, operational changes that modify the lane configurations are recommended at the two QEW off-ramp intersections.

At the Bronte Road and QEW Westbound Off-ramp it is recommended that the centre lane be designated as an optional left or right turn lane. The right turn volume in the p.m. peak hour is much higher than the left turn volume. Similarly, at the Bronte Road and QEW Eastbound Off-ramp it is recommended that the ramp lane designations be modified to create a left turn lane, a through/right lane, and a right turn lane. The right turn volume in the p.m. peak hour is much higher than the left turn volume. No new construction at the ramp terminals is required for these modifications.

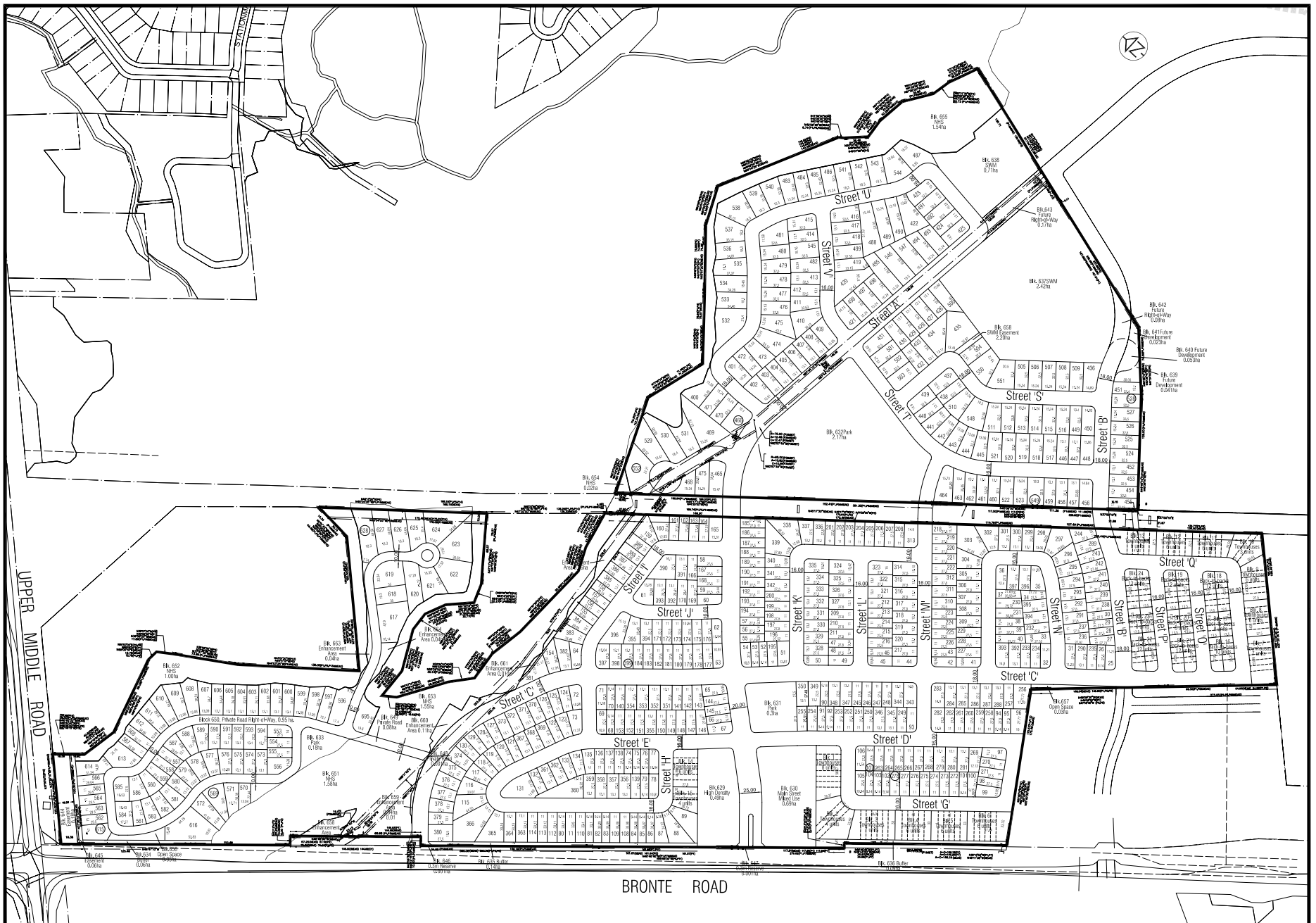
The traffic volumes within the Bronte Green subdivision can be accommodated on two lane roadways throughout the plan, although it is recommended that the section of Street A adjacent to the commercial block be constructed as a four lane road.

All intersections within the subdivision can operate satisfactorily with Stop sign control.

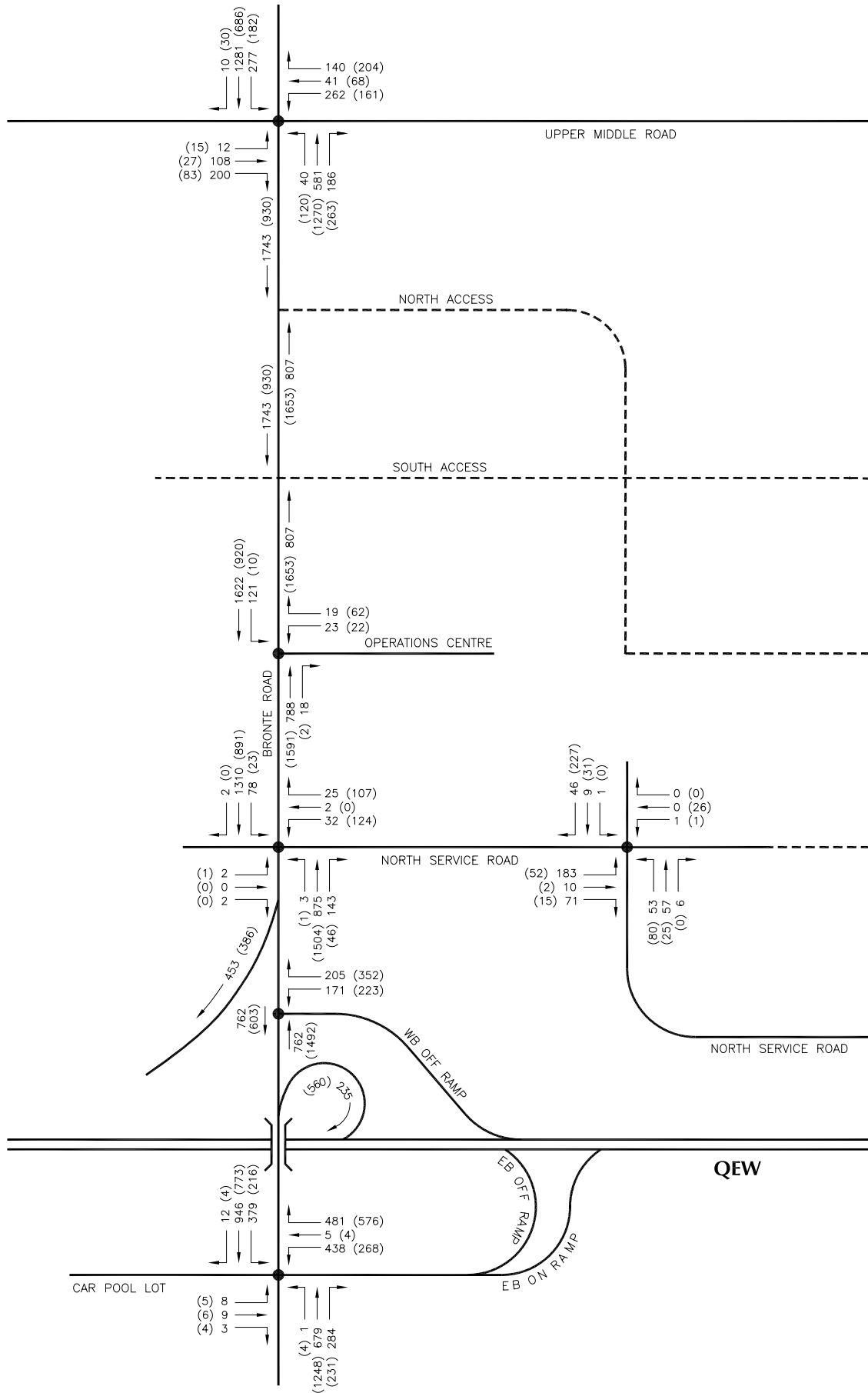
Traffic calming can be provided within the subdivision with the all-way Stop control that is recommended on the collector road system, and with curb extensions along the straight sections of the collector roads.

Transit service is now being provided along Bronte Road, and in the long term Bronte Road is to be designated as a transit corridor with HOV lanes. Transit service is expected to operate in the longer term future on Street A between Bronte Road and North Service Road. In the interim an internal route to and from Bronte Road can be provided to have all units within 400 metres of transit service.





**DRAFT PLAN OF SUBDIVISION**  
**FIGURE 2**

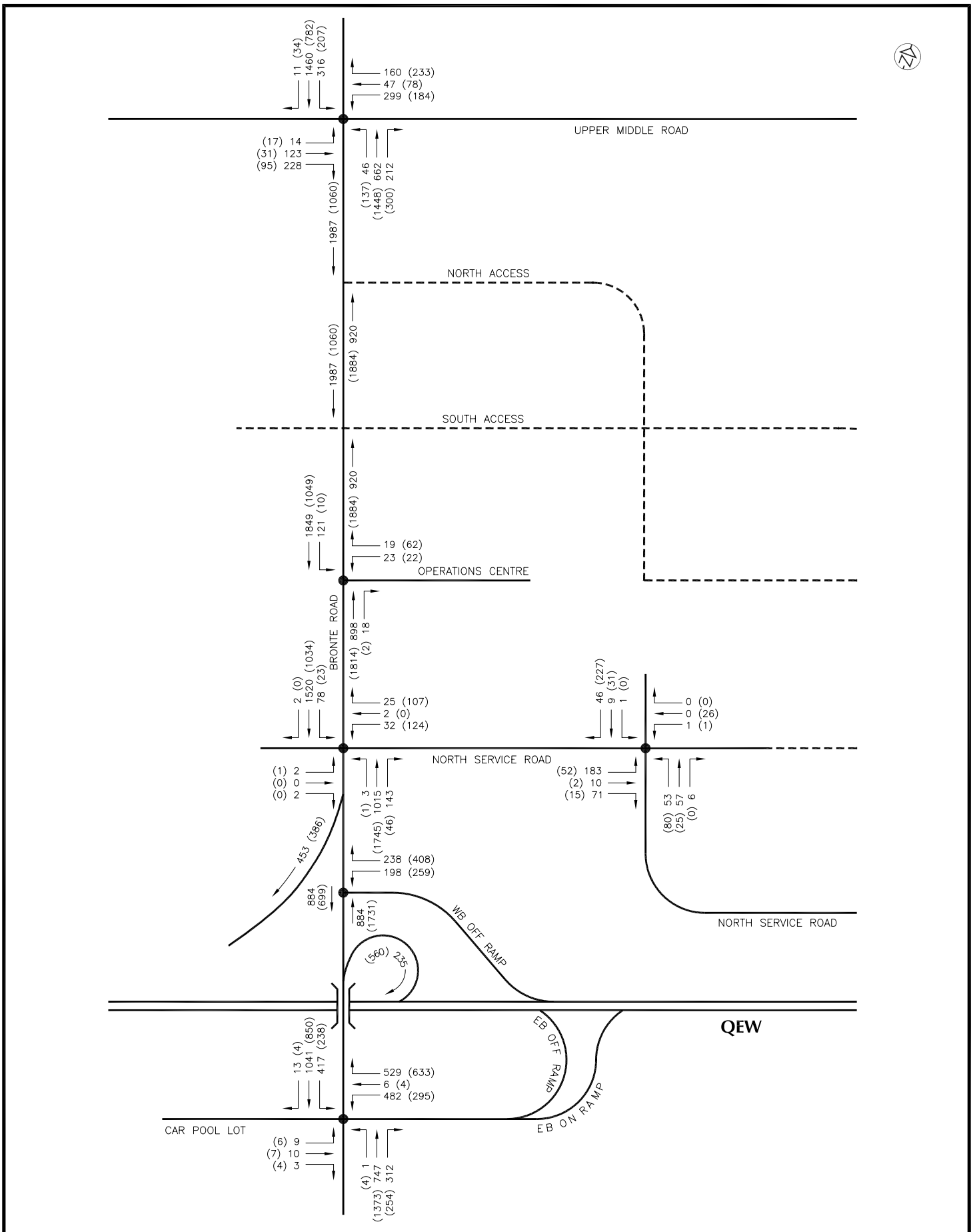


**LEGEND**

- 48 A.M. PEAK HOUR VOLUME
- (11) P.M. PEAK HOUR VOLUME
- SIGNALIZED INTERSECTION

**EXISTING TRAFFIC**

**FIGURE 3**

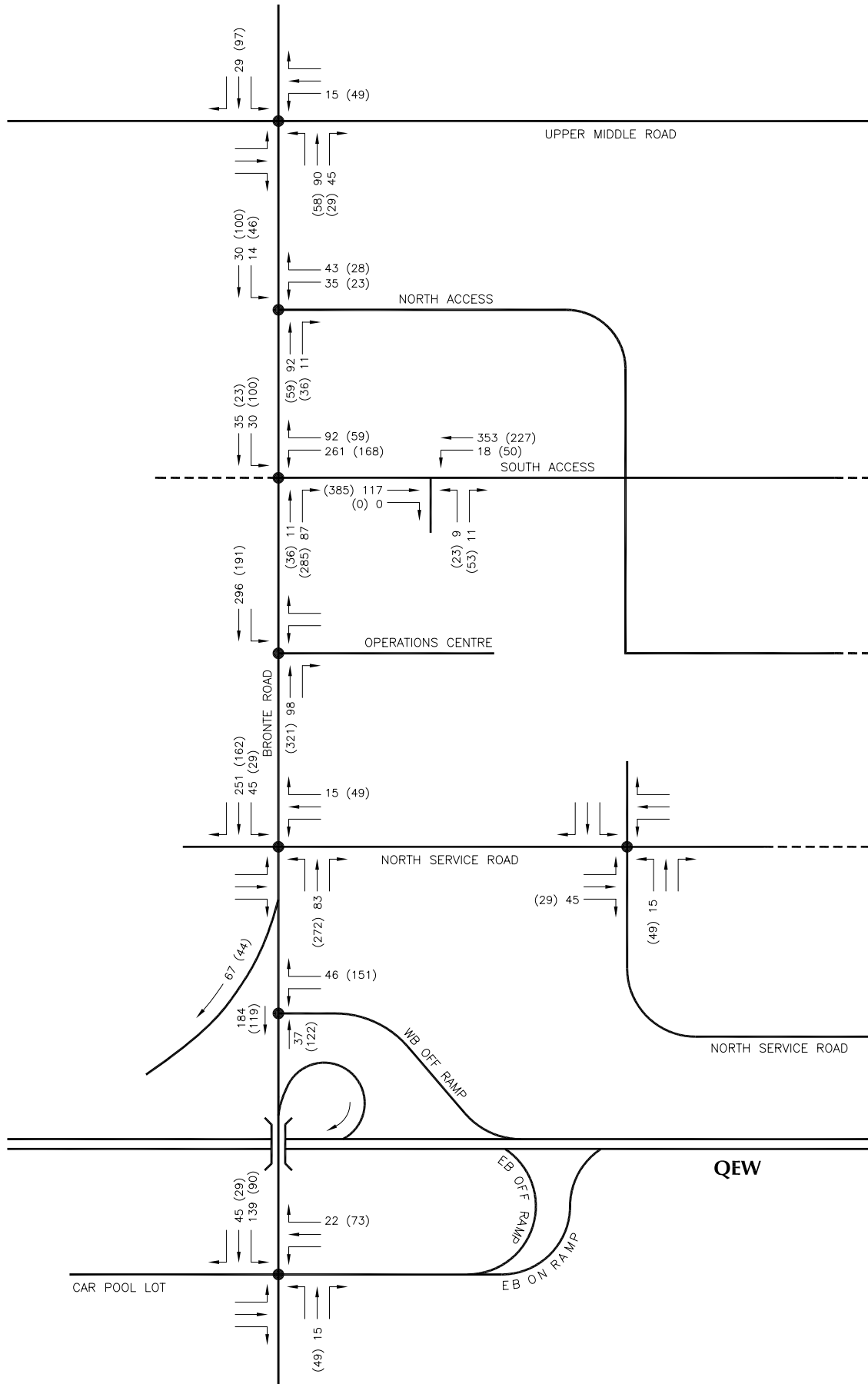


**LEGEND**

- 48 A.M. PEAK HOUR VOLUME
- (11) P.M. PEAK HOUR VOLUME
- SIGNALIZED INTERSECTION

**2019 BACKGROUND TRAFFIC**

**FIGURE 4**

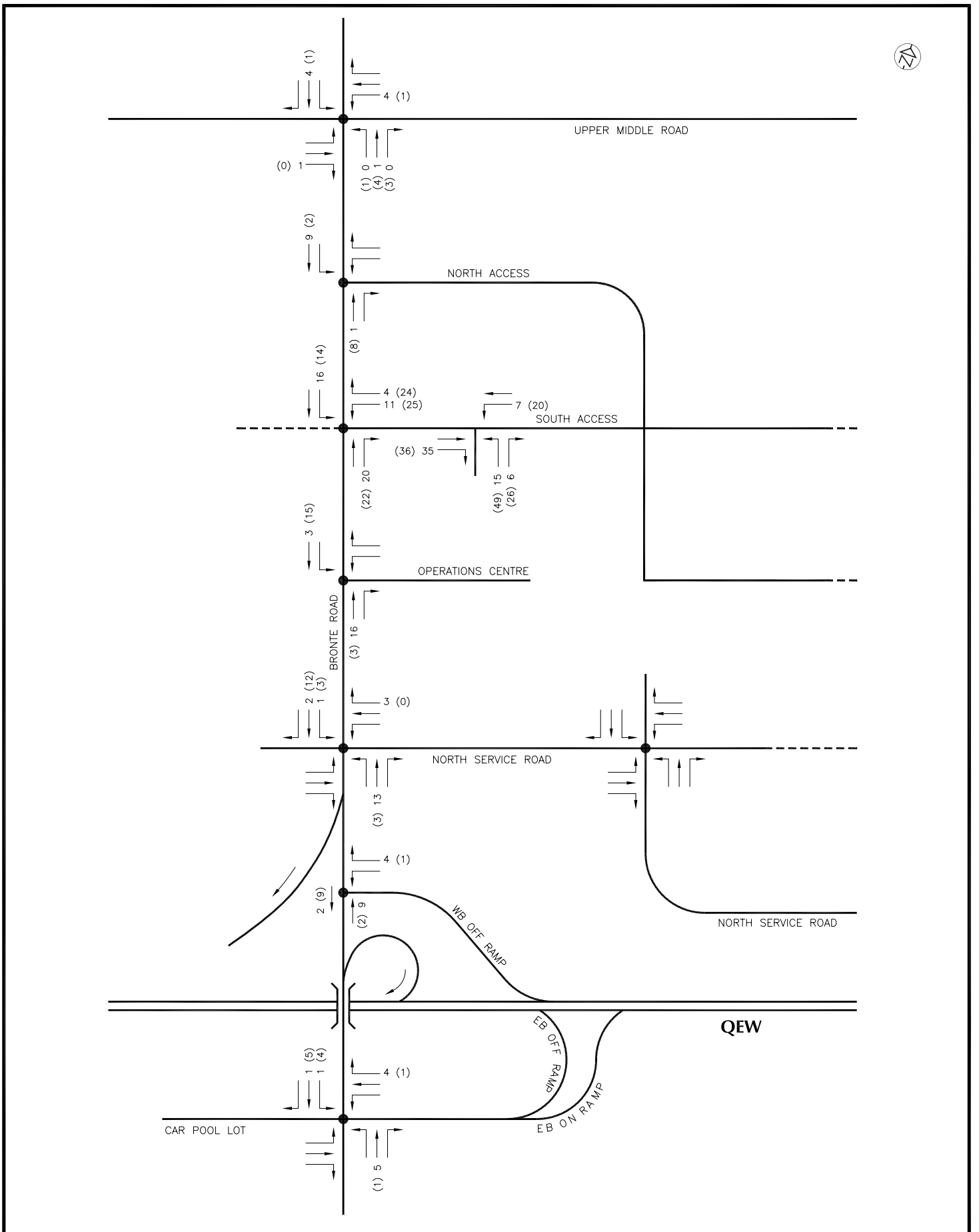


**LEGEND**

- 48 A.M. PEAK HOUR VOLUME
- (11) P.M. PEAK HOUR VOLUME
- SIGNALIZED INTERSECTION

**RESIDENTIAL SITE TRAFFIC**

**FIGURE 5**



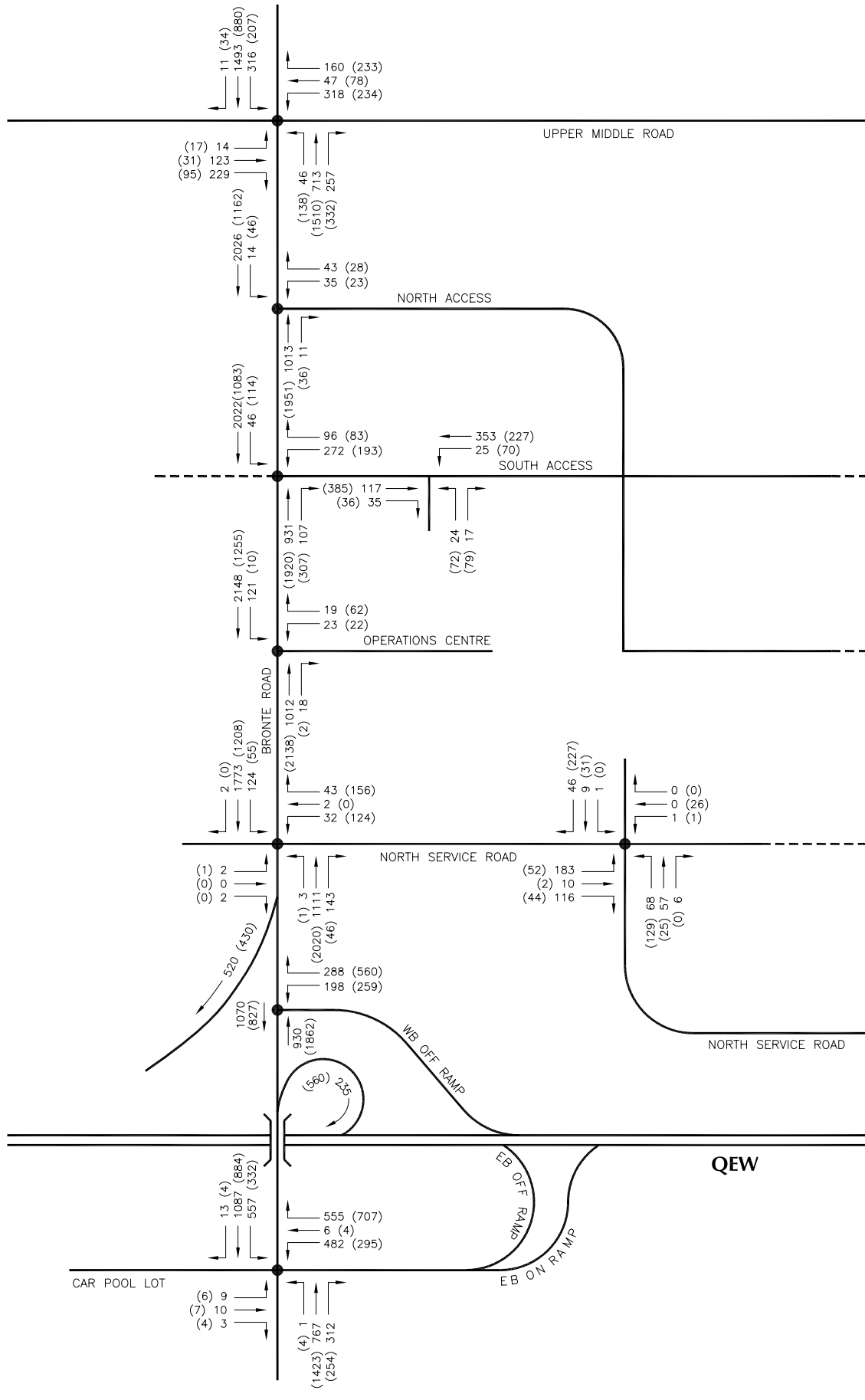
**LEGEND**

- 48 A.M. PEAK HOUR VOLUME
- (11) P.M. PEAK HOUR VOLUME
- SIGNALIZED INTERSECTION

**COMMERCIAL SITE TRAFFIC**

**FIGURE 6**



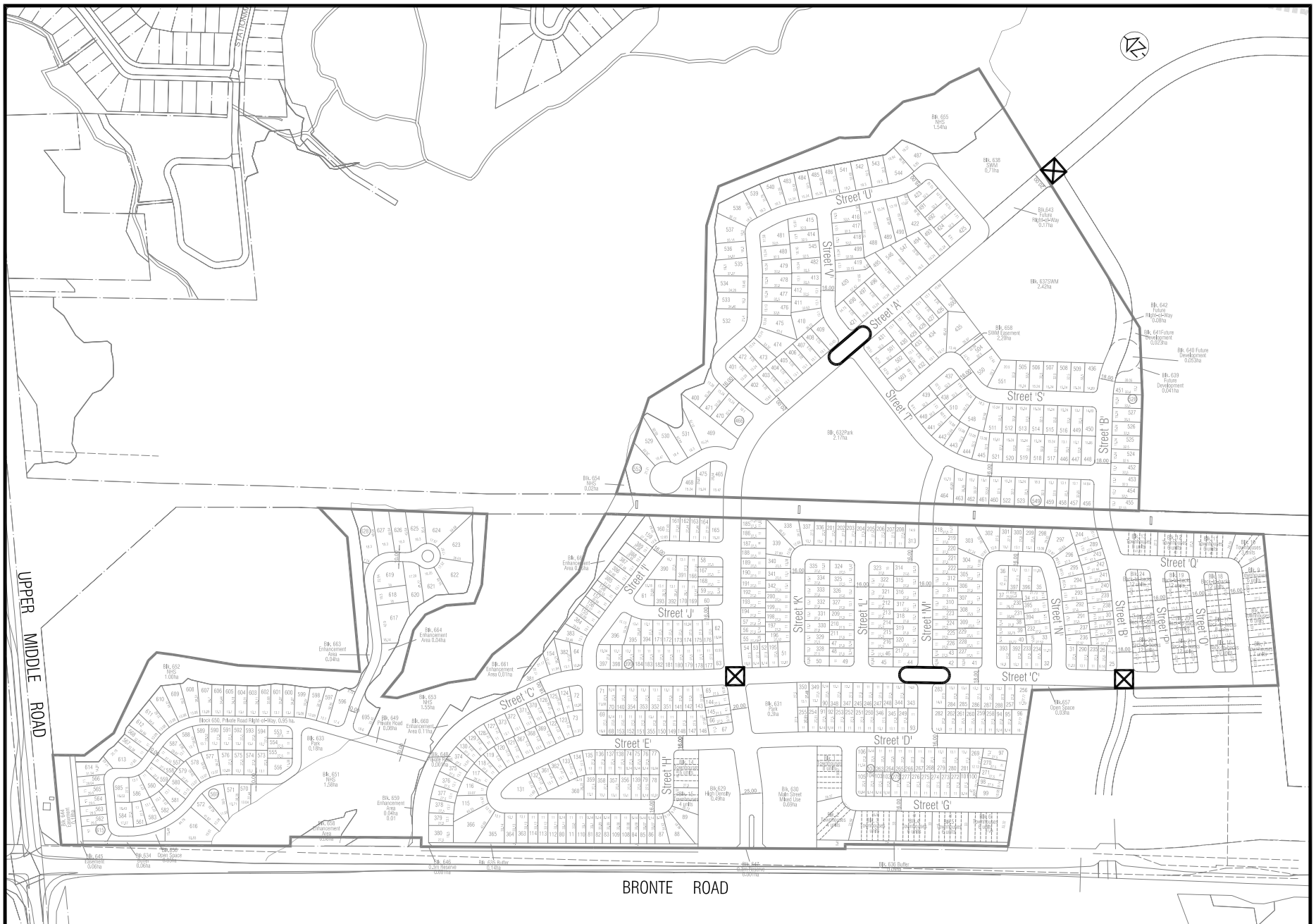




**LEGEND**

- 48 A.M. PEAK HOUR VOLUME
- (11) P.M. PEAK HOUR VOLUME
- SIGNALIZED INTERSECTION

**2019 TOTAL TRAFFIC**

**FIGURE 7**



-  CURB BUMP OUT
-  FOUR WAY STOP

# TRAFFIC CALMING LOCATIONS

FIGURE 8



**APPENDIX**  
**SYNCHRO OUTPUT**

HCM Signalized Intersection Capacity Analysis  
18: UPPER MIDDLE & BRONTE

EXISTING  
AM PEAK HOUR

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	12	108	200	262	41	140	40	581	186	277	1281	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		3.0	4.0	4.0	4.0	4.0	4.0	0.0	4.0	4.0
Lane Util. Factor	1.00	0.95		0.97	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.90		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1785	3222		3395	1879	1566	1785	3336	1536	1750	3433	1597
Flt Permitted	0.73	1.00		0.95	1.00	1.00	0.16	1.00	1.00	0.34	1.00	1.00
Satd. Flow (perm)	1367	3222		3395	1879	1566	298	3336	1536	624	3433	1597
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	13	117	217	285	45	152	43	632	202	301	1392	11
RTOR Reduction (vph)	0	45	0	0	0	104	0	0	106	0	0	4
Lane Group Flow (vph)	13	289	0	285	45	48	43	632	96	301	1392	7
Heavy Vehicles (%)	0%	0%	0%	2%	0%	2%	0%	7%	4%	2%	4%	0%
Turn Type	Perm			Prot		Perm	Perm		Perm	pm+pt		Perm
Protected Phases		4		3	8			2		1	6	
Permitted Phases	4					8	2		2	6		6
Actuated Green, G (s)	15.3	15.3		14.4	34.7	34.7	54.3	54.3	54.3	71.3	71.3	71.3
Effective Green, g (s)	18.3	18.3		16.4	37.7	37.7	57.3	57.3	57.3	74.3	74.3	74.3
Actuated g/C Ratio	0.15	0.15		0.14	0.31	0.31	0.48	0.48	0.48	0.62	0.62	0.62
Clearance Time (s)	7.0	7.0		5.0	7.0	7.0	7.0	7.0	7.0	3.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	208	491		464	590	492	142	1593	733	546	2126	989
v/s Ratio Prot		c0.09		c0.08	0.02			0.19		0.08	c0.41	
v/s Ratio Perm	0.01					0.03	0.14		0.06	0.26		0.00
v/c Ratio	0.06	0.59		0.61	0.08	0.10	0.30	0.40	0.13	0.55	0.65	0.01
Uniform Delay, d1	43.5	47.3		48.8	28.9	29.1	19.1	20.2	17.5	11.2	14.6	8.7
Progression Factor	1.00	1.00		0.71	0.72	0.42	1.10	1.04	2.24	1.00	1.00	1.00
Incremental Delay, d2	0.1	1.8		2.4	0.1	0.1	5.3	0.7	0.4	1.2	1.6	0.0
Delay (s)	43.6	49.2		37.0	20.8	12.4	26.3	21.7	39.5	12.4	16.2	8.8
Level of Service	D	D		D	C	B	C	C	D	B	B	A
Approach Delay (s)		48.9			27.7			26.0			15.5	
Approach LOS		D			C			C			B	
<b>Intersection Summary</b>												
HCM Average Control Delay			23.3									HCM Level of Service C
HCM Volume to Capacity ratio			0.64									
Actuated Cycle Length (s)			120.0									Sum of lost time (s) 11.0
Intersection Capacity Utilization			69.0%									ICU Level of Service C
Analysis Period (min)			15									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis  
15: WOODLANDS & BRONTE

EXISTING  
AM PEAK HOUR



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	23	19	794	18	121	1716
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1566	1521	3400	1597	1785	3400
Flt Permitted	0.95	1.00	1.00	1.00	0.32	1.00
Satd. Flow (perm)	1566	1521	3400	1597	608	3400
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	25	21	863	20	132	1865
RTOR Reduction (vph)	0	20	0	3	0	0
Lane Group Flow (vph)	25	1	863	17	132	1865
Heavy Vehicles (%)	14%	5%	5%	0%	0%	5%
Turn Type	custom		Perm		Perm	
Protected Phases			2			6
Permitted Phases	8	8	2		6	
Actuated Green, G (s)	5.1	5.1	100.9	100.9	100.9	100.9
Effective Green, g (s)	8.1	8.1	103.9	103.9	103.9	103.9
Actuated g/C Ratio	0.07	0.07	0.87	0.87	0.87	0.87
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	106	103	2944	1383	526	2944
v/s Ratio Prot			0.25			c0.55
v/s Ratio Perm	c0.02	0.00	0.01		0.22	
v/c Ratio	0.24	0.01	0.29	0.01	0.25	0.63
Uniform Delay, d1	53.0	52.2	1.4	1.1	1.4	2.4
Progression Factor	1.00	1.00	1.09	1.51	0.67	0.60
Incremental Delay, d2	1.1	0.1	0.2	0.0	0.9	0.8
Delay (s)	54.2	52.3	1.8	1.7	1.8	2.3
Level of Service	D	D	A	A	A	A
Approach Delay (s)	53.3		1.8		2.3	
Approach LOS	D		A		A	

Intersection Summary

HCM Average Control Delay	2.9	HCM Level of Service	A
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	57.4%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

# HCM Signalized Intersection Capacity Analysis

## 8: NSR & BRONTE

EXISTING  
AM PEAK HOUR



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕		↙	↘	↗	↖	↕	↗	↖	↕	↗
Volume (vph)	2	0	2	32	2	25	3	875	143	78	1310	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		3.0	4.0	4.0	4.0	4.0	3.0	4.0	4.0	
Lane Util. Factor		1.00		0.95	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Frt		0.93		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.98		0.95	0.96	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1709		1615	1636	1439	1785	3275	1566	1733	3367	
Flt Permitted		0.83		0.77	0.95	1.00	0.16	1.00	1.00	0.28	1.00	
Satd. Flow (perm)		1458		1301	1618	1439	298	3275	1566	515	3367	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2	0	2	35	2	27	3	951	155	85	1424	2
RTOR Reduction (vph)	0	2	0	0	0	23	0	0	22	0	0	0
Lane Group Flow (vph)	0	2	0	19	18	4	3	951	133	85	1426	0
Heavy Vehicles (%)	0%	0%	0%	5%	0%	11%	0%	9%	2%	3%	6%	0%
Turn Type	Perm			pm+pt		Perm	Perm		pm+ov	Perm		
Protected Phases		4		3	8			2	3		6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)		1.3		14.6	14.6	14.6	91.4	91.4	100.7	91.4	91.4	
Effective Green, g (s)		4.3		15.6	17.6	17.6	94.4	94.4	102.7	94.4	94.4	
Actuated g/C Ratio		0.04		0.13	0.15	0.15	0.79	0.79	0.86	0.79	0.79	
Clearance Time (s)		7.0		4.0	7.0	7.0	7.0	7.0	4.0	7.0	7.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		52		196	239	211	234	2576	1340	405	2649	
v/s Ratio Prot				c0.01	c0.01			0.29	0.01		c0.42	
v/s Ratio Perm		0.00		0.00	0.00	0.00	0.01		0.08	0.17		
v/c Ratio		0.04		0.10	0.08	0.02	0.01	0.37	0.10	0.21	0.54	
Uniform Delay, d1		55.9		46.0	44.2	43.8	2.8	3.8	1.4	3.3	4.7	
Progression Factor		1.00		0.71	0.69	0.97	0.54	0.49	0.75	0.27	0.33	
Incremental Delay, d2		0.3		0.2	0.1	0.0	0.1	0.4	0.0	0.9	0.6	
Delay (s)		56.2		33.0	30.7	42.6	1.6	2.3	1.1	1.8	2.2	
Level of Service		E		C	C	D	A	A	A	A	A	
Approach Delay (s)		56.2			36.4			2.1			2.2	
Approach LOS		E			D			A			A	

### Intersection Summary

HCM Average Control Delay	3.1	HCM Level of Service	A
HCM Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	7.0
Intersection Capacity Utilization	52.9%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

# HCM Signalized Intersection Capacity Analysis

## 11: NSR-EW & NSR-Halton

EXISTING  
AM PEAK HOUR



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	183	10	71	1	0	0	53	57	6	1	9	46
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0			4.0	4.0			4.0	4.0
Lane Util. Factor	1.00	1.00		1.00			1.00	1.00			1.00	1.00
Frt	1.00	0.87		1.00			1.00	0.98			1.00	0.85
Flt Protected	0.95	1.00		0.95			0.95	1.00			1.00	1.00
Satd. Flow (prot)	1785	1618		1785			1716	1850			1870	1597
Flt Permitted	0.76	1.00		0.70			0.75	1.00			0.99	1.00
Satd. Flow (perm)	1423	1618		1315			1356	1850			1857	1597
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	199	11	77	1	0	0	58	62	7	1	10	50
RTOR Reduction (vph)	0	30	0	0	0	0	0	3	0	0	0	34
Lane Group Flow (vph)	199	58	0	1	0	0	58	66	0	0	11	16
Heavy Vehicles (%)	0%	0%	1%	0%	0%	0%	4%	0%	0%	0%	0%	0%
Turn Type	Perm			Perm			Perm			Perm		Perm
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		4
Actuated Green, G (s)	71.0	71.0		71.0			35.0	35.0			35.0	35.0
Effective Green, g (s)	74.0	74.0		74.0			38.0	38.0			38.0	38.0
Actuated g/C Ratio	0.62	0.62		0.62			0.32	0.32			0.32	0.32
Clearance Time (s)	7.0	7.0		7.0			7.0	7.0			7.0	7.0
Vehicle Extension (s)	3.0	3.0		3.0			3.0	3.0			3.0	3.0
Lane Grp Cap (vph)	878	998		811			429	586			588	506
v/s Ratio Prot		0.04						0.04				
v/s Ratio Perm	c0.14			0.00			c0.04				0.01	0.01
v/c Ratio	0.23	0.06		0.00			0.14	0.11			0.02	0.03
Uniform Delay, d1	10.2	9.1		8.8			29.3	29.0			28.2	28.3
Progression Factor	1.11	1.40		1.00			1.00	1.00			1.00	1.00
Incremental Delay, d2	0.6	0.1		0.0			0.7	0.4			0.1	0.1
Delay (s)	11.9	12.9		8.8			29.9	29.4			28.2	28.4
Level of Service	B	B		A			C	C			C	C
Approach Delay (s)		12.2			8.8			29.7			28.4	
Approach LOS		B			A			C			C	

### Intersection Summary

HCM Average Control Delay	18.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.20		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	33.1%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group



# HCM Signalized Intersection Capacity Analysis

## 6: WB OFF RAMP & BRONTE

EXISTING  
AM PEAK HOUR



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	171	205	762	0	0	762
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0			4.0
Lane Util. Factor	0.97	1.00	0.95			0.95
Frt	1.00	0.85	1.00			1.00
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3298	1452	3336			3400
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3298	1452	3336			3400
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	186	223	828	0	0	828
RTOR Reduction (vph)	0	146	0	0	0	0
Lane Group Flow (vph)	186	77	828	0	0	828
Heavy Vehicles (%)	5%	10%	7%	2%	2%	5%
Turn Type	Perm					
Protected Phases	8		2			6
Permitted Phases	8					
Actuated Green, G (s)	13.3	13.3	92.7			92.7
Effective Green, g (s)	16.3	16.3	95.7			95.7
Actuated g/C Ratio	0.14	0.14	0.80			0.80
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)	448	197	2660			2712
v/s Ratio Prot	c0.06		c0.25			0.24
v/s Ratio Perm		0.05				
v/c Ratio	0.42	0.39	0.31			0.31
Uniform Delay, d1	47.5	47.3	3.3			3.3
Progression Factor	1.00	1.00	1.00			1.27
Incremental Delay, d2	0.6	1.3	0.3			0.3
Delay (s)	48.1	48.6	3.5			4.4
Level of Service	D	D	A			A
Approach Delay (s)	48.4		3.5			4.4
Approach LOS	D		A			A

### Intersection Summary

HCM Average Control Delay	12.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.33		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	40.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

# HCM Signalized Intersection Capacity Analysis

## 3: EB OFF RAMP & BRONTE

EXISTING  
AM PEAK HOUR



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖↗	↗		↖	↕	↗	↖	↕	↗
Volume (vph)	8	9	3	438	5	481	1	679	284	379	946	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		4.0	3.0		4.0	4.0	4.0	3.0	4.0	
Lane Util. Factor	1.00	1.00		0.97	1.00		1.00	0.95	1.00	1.00	0.95	
Frbp, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.97		1.00	0.85		1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1785	1814		3236	1482		1785	3305	1529	1750	3428	
Flt Permitted	0.53	1.00		0.95	1.00		0.28	1.00	1.00	0.25	1.00	
Satd. Flow (perm)	989	1814		3236	1482		517	3305	1529	454	3428	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	9	10	3	476	5	523	1	738	309	412	1028	13
RTOR Reduction (vph)	0	3	0	0	374	0	0	0	174	0	1	0
Lane Group Flow (vph)	9	10	0	476	154	0	1	738	135	412	1040	0
Confl. Peds. (#/hr)									1	1		
Heavy Vehicles (%)	0%	0%	0%	7%	0%	8%	0%	8%	2%	2%	4%	0%
Turn Type	Perm			Prot			Perm		Perm	pm+pt		
Protected Phases		4		3	8			2			1	6
Permitted Phases	4						2		2		6	
Actuated Green, G (s)	4.6	4.6		21.7	31.3		49.4	49.4	49.4	75.7	75.7	
Effective Green, g (s)	7.6	7.6		22.7	34.3		52.4	52.4	52.4	75.7	78.7	
Actuated g/C Ratio	0.06	0.06		0.19	0.29		0.44	0.44	0.44	0.63	0.66	
Clearance Time (s)	6.0	6.0		5.0	6.0		7.0	7.0	7.0	3.0	7.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	63	115		612	424		226	1443	668	538	2248	
v/s Ratio Prot		0.01		c0.15	c0.10			0.22		c0.15	0.30	
v/s Ratio Perm	0.01						0.00		0.09	c0.33		
v/c Ratio	0.14	0.09		0.78	0.36		0.00	0.51	0.20	0.77	0.46	
Uniform Delay, d1	53.1	52.9		46.3	34.2		19.1	24.5	20.9	13.9	10.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.27	1.01	
Incremental Delay, d2	1.0	0.3		6.2	0.5		0.0	1.3	0.7	6.4	0.7	
Delay (s)	54.2	53.3		52.4	34.7		19.1	25.8	21.6	24.1	11.0	
Level of Service	D	D		D	C		B	C	C	C	B	
Approach Delay (s)		53.6			43.1			24.6			14.7	
Approach LOS		D			D			C			B	
























### Intersection Summary

HCM Average Control Delay	26.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	7.0
Intersection Capacity Utilization	79.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 18: UPPER MIDDLE & BRONTE

EXISTING  
PM PEAK HOUR

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	15	27	83	161	68	204	120	1270	263	182	686	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		3.0	4.0	4.0	4.0	4.0	4.0	0.0	4.0	4.0
Lane Util. Factor	1.00	0.95		0.97	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.89		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1785	3165		3395	1879	1566	1785	3336	1536	1750	3433	1597
Flt Permitted	0.71	1.00		0.95	1.00	1.00	0.37	1.00	1.00	0.13	1.00	1.00
Satd. Flow (perm)	1332	3165		3395	1879	1566	692	3336	1536	231	3433	1597
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	16	29	90	175	74	222	130	1380	286	198	746	33
RTOR Reduction (vph)	0	82	0	0	0	177	0	0	74	0	0	9
Lane Group Flow (vph)	16	37	0	175	74	45	130	1380	212	198	746	24
Heavy Vehicles (%)	0%	0%	0%	2%	0%	2%	0%	7%	4%	2%	4%	0%
Turn Type	Perm			Prot		Perm	Perm		Perm	pm+pt		Perm
Protected Phases		4		3	8			2		1	6	
Permitted Phases	4					8	2		2	6		6
Actuated Green, G (s)	7.1	7.1		8.0	20.1	20.1	71.5	71.5	71.5	85.9	85.9	85.9
Effective Green, g (s)	10.1	10.1		10.0	23.1	23.1	74.5	74.5	74.5	88.9	88.9	88.9
Actuated g/C Ratio	0.08	0.08		0.08	0.19	0.19	0.62	0.62	0.62	0.74	0.74	0.74
Clearance Time (s)	7.0	7.0		5.0	7.0	7.0	7.0	7.0	7.0	3.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	112	266		283	362	301	430	2071	954	353	2543	1183
v/s Ratio Prot		0.01		c0.05	c0.04			c0.41		c0.07	0.22	
v/s Ratio Perm	0.01					0.03	0.19		0.14	0.35		0.02
v/c Ratio	0.14	0.14		0.62	0.20	0.15	0.30	0.67	0.22	0.56	0.29	0.02
Uniform Delay, d1	50.9	50.9		53.2	40.7	40.3	10.6	14.7	10.0	11.2	5.1	4.1
Progression Factor	1.00	1.00		0.69	0.73	1.74	0.39	0.45	0.22	1.00	1.00	1.00
Incremental Delay, d2	0.6	0.2		3.8	0.3	0.2	1.5	1.4	0.4	2.0	0.3	0.0
Delay (s)	51.5	51.2		40.6	29.9	70.1	5.6	8.0	2.7	13.2	5.4	4.1
Level of Service	D	D		D	C	E	A	A	A	B	A	A
Approach Delay (s)		51.2			52.8			7.0			7.0	
Approach LOS		D			D			A			A	

### Intersection Summary

HCM Average Control Delay	15.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	7.0
Intersection Capacity Utilization	66.4%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

# HCM Signalized Intersection Capacity Analysis

## 15: WOODLANDS & BRONTE

EXISTING  
PM PEAK HOUR



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	22	62	1591	2	10	920
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1566	1521	3400	1597	1785	3400
Flt Permitted	0.95	1.00	1.00	1.00	0.12	1.00
Satd. Flow (perm)	1566	1521	3400	1597	223	3400
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	24	67	1729	2	11	1000
RTOR Reduction (vph)	0	49	0	0	0	0
Lane Group Flow (vph)	24	18	1729	2	11	1000
Heavy Vehicles (%)	14%	5%	5%	0%	0%	5%
Turn Type	custom		Perm		Perm	
Protected Phases			2			6
Permitted Phases	8	8	2		6	
Actuated Green, G (s)	6.6	6.6	99.4	99.4	99.4	99.4
Effective Green, g (s)	9.6	9.6	102.4	102.4	102.4	102.4
Actuated g/C Ratio	0.08	0.08	0.85	0.85	0.85	0.85
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	125	122	2901	1363	190	2901
v/s Ratio Prot			c0.51			0.29
v/s Ratio Perm	c0.02	0.01	0.00		0.05	
v/c Ratio	0.19	0.15	0.60	0.00	0.06	0.34
Uniform Delay, d1	51.6	51.4	2.6	1.3	1.4	1.8
Progression Factor	1.00	1.00	0.24	0.27	0.76	0.76
Incremental Delay, d2	0.8	0.6	0.7	0.0	0.6	0.3
Delay (s)	52.3	52.0	1.4	0.3	1.6	1.7
Level of Service	D	D	A	A	A	A
Approach Delay (s)	52.1		1.4		1.7	
Approach LOS	D		A		A	

### Intersection Summary

HCM Average Control Delay	3.1	HCM Level of Service	A
HCM Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	54.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

# HCM Signalized Intersection Capacity Analysis

## 8: NSR & BRONTE

EXISTING  
PM PEAK HOUR

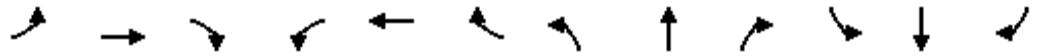
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	1	0	0	124	0	107	1	1504	46	23	891	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		3.0	4.0	4.0	4.0	4.0	0.0	4.0	4.0	
Lane Util. Factor		1.00		0.95	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Frt		1.00		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.95		0.95	0.95	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1785		1615	1615	1439	1785	3275	1566	1733	3368	
Flt Permitted		0.71		0.88	0.76	1.00	0.27	1.00	1.00	0.12	1.00	
Satd. Flow (perm)		1335		1504	1287	1439	514	3275	1566	211	3368	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1	0	0	135	0	116	1	1635	50	25	968	0
RTOR Reduction (vph)	0	0	0	0	0	37	0	0	6	0	0	0
Lane Group Flow (vph)	0	1	0	67	68	79	1	1635	44	25	968	0
Heavy Vehicles (%)	0%	0%	0%	5%	0%	11%	0%	9%	2%	3%	6%	0%
Turn Type	Perm			pm+pt		Perm	Perm		pm+ov	Perm		
Protected Phases		4		3	8			2	3		6	
Permitted Phases	4			8		8	2	2		6		
Actuated Green, G (s)		2.7		16.8	16.8	16.8	89.2	89.2	100.3	89.2	89.2	
Effective Green, g (s)		5.7		16.8	19.8	19.8	92.2	92.2	106.3	92.2	92.2	
Actuated g/C Ratio		0.05		0.14	0.16	0.16	0.77	0.77	0.89	0.77	0.77	
Clearance Time (s)		7.0		3.0	7.0	7.0	7.0	7.0	3.0	7.0	7.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		63		221	251	237	395	2516	1387	162	2588	
v/s Ratio Prot				0.03	0.03			c0.50	0.00		0.29	
v/s Ratio Perm		0.00		0.01	0.01	c0.06	0.00		0.02	0.12		
v/c Ratio		0.02		0.30	0.27	0.33	0.00	0.65	0.03	0.15	0.37	
Uniform Delay, d1		54.5		46.3	43.8	44.3	3.2	6.4	0.8	3.7	4.5	
Progression Factor		1.00		0.96	0.96	0.94	0.59	0.41	0.07	0.72	0.71	
Incremental Delay, d2		0.1		0.8	0.6	0.8	0.0	0.8	0.0	1.9	0.4	
Delay (s)		54.6		45.3	42.8	42.6	1.9	3.5	0.1	4.6	3.6	
Level of Service		D		D	D	D	A	A	A	A	A	
Approach Delay (s)		54.6			43.4			3.4			3.6	
Approach LOS		D			D			A			A	
<b>Intersection Summary</b>												
HCM Average Control Delay			6.9		HCM Level of Service					A		
HCM Volume to Capacity ratio			0.59									
Actuated Cycle Length (s)			120.0		Sum of lost time (s)					8.0		
Intersection Capacity Utilization			61.5%		ICU Level of Service					B		
Analysis Period (min)			15									

c Critical Lane Group

# HCM Signalized Intersection Capacity Analysis

## 11: NSR-EW & NSR-Halton

EXISTING  
PM PEAK HOUR



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	52	2	15	1	26	0	80	25	0	0	31	227
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0			4.0	4.0
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00			1.00	1.00
Frt	1.00	0.87		1.00	1.00		1.00	1.00			1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00			1.00	1.00
Satd. Flow (prot)	1785	1614		1785	1879		1716	1879			1879	1597
Flt Permitted	0.74	1.00		0.75	1.00		0.73	1.00			1.00	1.00
Satd. Flow (perm)	1388	1614		1401	1879		1328	1879			1879	1597
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	57	2	16	1	28	0	87	27	0	0	34	247
RTOR Reduction (vph)	0	11	0	0	0	0	0	0	0	0	0	99
Lane Group Flow (vph)	57	7	0	1	28	0	87	27	0	0	34	148
Heavy Vehicles (%)	0%	0%	1%	0%	0%	0%	4%	0%	0%	0%	0%	0%
Turn Type	Perm			Perm			Perm			Perm		Perm
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		4
Actuated Green, G (s)	37.0	37.0		37.0	37.0		69.0	69.0			69.0	69.0
Effective Green, g (s)	40.0	40.0		40.0	40.0		72.0	72.0			72.0	72.0
Actuated g/C Ratio	0.33	0.33		0.33	0.33		0.60	0.60			0.60	0.60
Clearance Time (s)	7.0	7.0		7.0	7.0		7.0	7.0			7.0	7.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0			3.0	3.0
Lane Grp Cap (vph)	463	538		467	626		797	1127			1127	958
v/s Ratio Prot		0.00			0.01			0.01			0.02	
v/s Ratio Perm	c0.04			0.00			0.07					c0.09
v/c Ratio	0.12	0.01		0.00	0.04		0.11	0.02			0.03	0.15
Uniform Delay, d1	27.8	26.8		26.7	27.1		10.3	9.7			9.8	10.6
Progression Factor	0.95	0.87		1.00	1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2	0.5	0.0		0.0	0.1		0.3	0.0			0.0	0.3
Delay (s)	26.8	23.3		26.7	27.2		10.5	9.8			9.8	10.9
Level of Service	C	C		C	C		B	A			A	B
Approach Delay (s)		26.0			27.2			10.4			10.8	
Approach LOS		C			C			B			B	

### Intersection Summary

HCM Average Control Delay	13.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.14		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	31.8%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

# HCM Signalized Intersection Capacity Analysis

## 6: WB OFF RAMP & BRONTE

EXISTING  
PM PEAK HOUR



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	223	352	1492	0	0	603
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0			4.0
Lane Util. Factor	0.97	1.00	0.95			0.95
Frt	1.00	0.85	1.00			1.00
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3298	1452	3336			3400
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3298	1452	3336			3400
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	242	383	1622	0	0	655
RTOR Reduction (vph)	0	19	0	0	0	0
Lane Group Flow (vph)	242	364	1622	0	0	655
Heavy Vehicles (%)	5%	10%	7%	2%	2%	5%
Turn Type	Perm					
Protected Phases	8		2			6
Permitted Phases	8					
Actuated Green, G (s)	33.2	33.2	72.8			72.8
Effective Green, g (s)	36.2	36.2	75.8			75.8
Actuated g/C Ratio	0.30	0.30	0.63			0.63
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)	995	438	2107			2148
v/s Ratio Prot	0.07		c0.49			0.19
v/s Ratio Perm	c0.25					
v/c Ratio	0.24	0.83	0.77			0.30
Uniform Delay, d1	31.6	39.1	15.8			10.1
Progression Factor	1.00	1.00	0.51			0.96
Incremental Delay, d2	0.1	12.6	0.9			0.4
Delay (s)	31.7	51.7	9.1			10.0
Level of Service	C	D	A			B
Approach Delay (s)	44.0		9.1			10.0
Approach LOS	D		A			B

Intersection Summary			
HCM Average Control Delay	16.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	69.7%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

# HCM Signalized Intersection Capacity Analysis

## 3: EB OFF RAMP & BRONTE

EXISTING  
PM PEAK HOUR






























Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↗	↘		↗↘	↘		↗	↕	↗	↗	↕	↘
Volume (vph)	5	6	4	268	4	576	4	1248	231	216	773	4
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	3.0	4.0	
Lane Util. Factor	1.00	1.00		0.97	1.00		1.00	0.95	1.00	1.00	0.95	
Frbp, ped/bikes	1.00	1.00		1.00	0.99		1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.95		1.00	0.85		1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1783	1776		3298	1408		1785	3336	1551	1653	3398	
Flt Permitted	0.39	1.00		0.95	1.00		0.33	1.00	1.00	0.08	1.00	
Satd. Flow (perm)	736	1776		3298	1408		629	3336	1551	140	3398	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	7	4	291	4	626	4	1357	251	235	840	4
RTOR Reduction (vph)	0	4	0	0	156	0	0	0	99	0	0	0
Lane Group Flow (vph)	5	7	0	291	474	0	4	1357	152	235	844	0
Confl. Peds. (#/hr)	1						1					
Heavy Vehicles (%)	0%	0%	0%	5%	0%	12%	0%	7%	3%	8%	5%	0%
Turn Type	Perm			Prot			Perm		Perm		pm+pt	
Protected Phases		4		3	8			2			1	6
Permitted Phases	4						2		2		6	
Actuated Green, G (s)	7.2	7.2		30.2	42.4		46.8	46.8	46.8	63.6	63.6	
Effective Green, g (s)	10.2	10.2		31.2	45.4		49.8	49.8	49.8	63.6	66.6	
Actuated g/C Ratio	0.08	0.08		0.26	0.38		0.42	0.42	0.42	0.53	0.55	
Clearance Time (s)	7.0	7.0		5.0	7.0		7.0	7.0	7.0	3.0	7.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	63	151		857	533		261	1384	644	248	1886	
v/s Ratio Prot		0.00		0.09	c0.34			c0.41		c0.11	0.25	
v/s Ratio Perm	0.01						0.01		0.10	0.39		
v/c Ratio	0.08	0.05		0.34	0.89		0.02	0.98	0.24	0.95	0.45	
Uniform Delay, d1	50.6	50.4		36.0	34.9		20.7	34.6	22.8	36.6	15.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.03	0.62	
Incremental Delay, d2	0.5	0.1		0.2	16.5		0.1	20.0	0.9	42.0	0.8	
Delay (s)	51.1	50.6		36.3	51.4		20.8	54.6	23.6	79.5	10.6	
Level of Service	D	D		D	D		C	D	C	E	B	
Approach Delay (s)		50.7			46.6			49.7			25.6	
Approach LOS		D			D			D			C	

Intersection Summary		
HCM Average Control Delay	41.7	HCM Level of Service
HCM Volume to Capacity ratio	0.94	D
Actuated Cycle Length (s)	120.0	Sum of lost time (s)
Intersection Capacity Utilization	92.4%	11.0
Analysis Period (min)	15	ICU Level of Service
c Critical Lane Group		F



HCM Signalized Intersection Capacity Analysis  
18: UPPER MIDDLE & BRONTE

2019 BACKGROUND  
AM PEAK HOUR

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations				 				 			 	
Volume (vph)	14	123	228	299	47	160	46	662	212	316	1460	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0	0.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1785	1879	1597	3395	1879	1566	1785	3336	1536	1750	3433	1597
Flt Permitted	0.72	1.00	1.00	0.95	1.00	1.00	0.10	1.00	1.00	0.30	1.00	1.00
Satd. Flow (perm)	1360	1879	1597	3395	1879	1566	192	3336	1536	553	3433	1597
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	15	134	248	325	51	174	50	720	230	343	1587	12
RTOR Reduction (vph)	0	0	26	0	0	119	0	0	116	0	0	4
Lane Group Flow (vph)	15	134	222	325	51	55	50	720	114	343	1587	8
Heavy Vehicles (%)	0%	0%	0%	2%	0%	2%	0%	7%	4%	2%	4%	0%
Turn Type	Perm		Perm	Prot		Perm	Perm		Perm	pm+pt		Perm
Protected Phases		4		3	8			2		1	6	
Permitted Phases	4		4			8	2		2	6		6
Actuated Green, G (s)	18.0	18.0	18.0	12.0	35.0	35.0	56.3	56.3	56.3	71.0	71.0	71.0
Effective Green, g (s)	21.0	21.0	21.0	14.0	38.0	38.0	59.3	59.3	59.3	74.0	74.0	74.0
Actuated g/C Ratio	0.18	0.18	0.18	0.12	0.32	0.32	0.49	0.49	0.49	0.62	0.62	0.62
Clearance Time (s)	7.0	7.0	7.0	5.0	7.0	7.0	7.0	7.0	7.0	3.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	238	329	279	396	595	496	95	1649	759	488	2117	985
v/s Ratio Prot		0.07		c0.10	0.03			0.22		0.09	c0.46	
v/s Ratio Perm	0.01		c0.14			0.04	0.26		0.07	0.35		0.01
v/c Ratio	0.06	0.41	0.80	0.82	0.09	0.11	0.53	0.44	0.15	0.70	0.75	0.01
Uniform Delay, d1	41.3	44.0	47.5	51.8	28.8	29.0	20.7	19.6	16.6	12.2	16.4	8.9
Progression Factor	1.00	1.00	1.00	0.75	0.77	0.70	1.06	1.12	2.38	1.00	1.00	1.00
Incremental Delay, d2	0.1	0.8	14.6	12.6	0.1	0.1	18.7	0.8	0.4	4.6	2.5	0.0
Delay (s)	41.4	44.8	62.0	51.4	22.1	20.4	40.7	22.7	39.9	16.7	18.9	8.9
Level of Service	D	D	E	D	C	C	D	C	D	B	B	A
Approach Delay (s)		55.4			38.8			27.6			18.4	
Approach LOS		E			D			C			B	
<b>Intersection Summary</b>												
HCM Average Control Delay			27.5								HCM Level of Service	C
HCM Volume to Capacity ratio			0.77									
Actuated Cycle Length (s)			120.0								Sum of lost time (s)	11.0
Intersection Capacity Utilization			73.0%								ICU Level of Service	D
Analysis Period (min)			15									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis  
 15: WOODLANDS & BRONTE

2019 BACKGROUND  
 AM PEAK HOUR



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	23	19	898	18	121	1849
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1566	1521	3400	1597	1785	3400
Flt Permitted	0.95	1.00	1.00	1.00	0.29	1.00
Satd. Flow (perm)	1566	1521	3400	1597	539	3400
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	25	21	976	20	132	2010
RTOR Reduction (vph)	0	20	0	3	0	0
Lane Group Flow (vph)	25	1	976	17	132	2010
Heavy Vehicles (%)	14%	5%	5%	0%	0%	5%
Turn Type	custom		Perm		Perm	
Protected Phases			2			6
Permitted Phases	8	8	2		6	
Actuated Green, G (s)	5.1	5.1	100.9	100.9	100.9	100.9
Effective Green, g (s)	8.1	8.1	103.9	103.9	103.9	103.9
Actuated g/C Ratio	0.07	0.07	0.87	0.87	0.87	0.87
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	106	103	2944	1383	467	2944
v/s Ratio Prot			0.29			c0.59
v/s Ratio Perm	c0.02	0.00	0.01		0.25	
v/c Ratio	0.24	0.01	0.33	0.01	0.28	0.68
Uniform Delay, d1	53.0	52.2	1.5	1.1	1.4	2.6
Progression Factor	1.00	1.00	1.48	2.21	0.95	0.76
Incremental Delay, d2	1.1	0.1	0.3	0.0	0.9	0.8
Delay (s)	54.2	52.3	2.5	2.4	2.3	2.8
Level of Service	D	D	A	A	A	A
Approach Delay (s)	53.3		2.5		2.8	
Approach LOS	D		A		A	























**Intersection Summary**

HCM Average Control Delay	3.4	HCM Level of Service	A
HCM Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	61.1%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis  
8: NSR & BRONTE

2019 BACKGROUND  
AM PEAK HOUR

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Volume (vph)	2	0	2	32	2	25	3	1015	143	78	1520	2	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)		4.0		3.0	4.0	4.0	4.0	4.0	3.0	4.0	4.0		
Lane Util. Factor		1.00		0.95	0.95	1.00	1.00	0.95	1.00	1.00	0.95		
Frt		0.93		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00		
Flt Protected		0.98		0.95	0.96	1.00	0.95	1.00	1.00	0.95	1.00		
Satd. Flow (prot)		1709		1615	1636	1439	1785	3275	1566	1733	3367		
Flt Permitted		0.83		0.77	0.94	1.00	0.12	1.00	1.00	0.24	1.00		
Satd. Flow (perm)		1458		1301	1604	1439	221	3275	1566	432	3367		
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	
Adj. Flow (vph)	2	0	2	35	2	27	3	1103	155	85	1652	2	
RTOR Reduction (vph)	0	2	0	0	0	23	0	0	22	0	0	0	
Lane Group Flow (vph)	0	2	0	19	18	4	3	1103	133	85	1654	0	
Heavy Vehicles (%)	0%	0%	0%	5%	0%	11%	0%	9%	2%	3%	6%	0%	
Turn Type	Perm			pm+pt		Perm	Perm		pm+ov	Perm			
Protected Phases		4		3	8			2	3		6		
Permitted Phases	4			8		8	2		2		6		
Actuated Green, G (s)		1.3		14.3	14.3	14.3	91.7	91.7	100.7	91.7	91.7		
Effective Green, g (s)		4.3		15.3	17.3	17.3	94.7	94.7	102.7	94.7	94.7		
Actuated g/C Ratio		0.04		0.13	0.14	0.14	0.79	0.79	0.86	0.79	0.79		
Clearance Time (s)		7.0		4.0	7.0	7.0	7.0	7.0	4.0	7.0	7.0		
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
Lane Grp Cap (vph)		52		192	234	207	174	2585	1340	341	2657		
v/s Ratio Prot				c0.01	c0.01			0.34	0.01		c0.49		
v/s Ratio Perm		0.00		0.00	0.00	0.00	0.01		0.08	0.20			
v/c Ratio		0.04		0.10	0.08	0.02	0.02	0.43	0.10	0.25	0.62		
Uniform Delay, d1		55.9		46.2	44.4	44.1	2.7	4.0	1.4	3.3	5.2		
Progression Factor		1.00		0.73	0.71	1.02	0.47	0.40	0.44	0.28	0.38		
Incremental Delay, d2		0.3		0.2	0.1	0.0	0.2	0.5	0.0	1.3	0.8		
Delay (s)		56.2		34.2	31.9	45.0	1.5	2.1	0.6	2.2	2.8		
Level of Service		E		C	C	D	A	A	A	A	A		
Approach Delay (s)		56.2			38.1			1.9			2.8		
Approach LOS		E			D			A			A		
<b>Intersection Summary</b>													
HCM Average Control Delay			3.2									HCM Level of Service	A
HCM Volume to Capacity ratio			0.54										
Actuated Cycle Length (s)			120.0									Sum of lost time (s)	7.0
Intersection Capacity Utilization			58.7%									ICU Level of Service	B
Analysis Period (min)			15										

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis  
 11: NSR-EW & NSR-Halton

2019 BACKGROUND  
 AM PEAK HOUR



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	183	10	71	1	0	0	53	57	6	1	9	46
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0			4.0	4.0			4.0	4.0
Lane Util. Factor	1.00	1.00		1.00			1.00	1.00			1.00	1.00
Frt	1.00	0.87		1.00			1.00	0.98			1.00	0.85
Flt Protected	0.95	1.00		0.95			0.95	1.00			1.00	1.00
Satd. Flow (prot)	1785	1618		1785			1716	1850			1870	1597
Flt Permitted	0.76	1.00		0.70			0.75	1.00			0.99	1.00
Satd. Flow (perm)	1423	1618		1315			1356	1850			1857	1597
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	199	11	77	1	0	0	58	62	7	1	10	50
RTOR Reduction (vph)	0	30	0	0	0	0	0	3	0	0	0	34
Lane Group Flow (vph)	199	58	0	1	0	0	58	66	0	0	11	16
Heavy Vehicles (%)	0%	0%	1%	0%	0%	0%	4%	0%	0%	0%	0%	0%
Turn Type	Perm			Perm			Perm			Perm		Perm
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		4
Actuated Green, G (s)	71.0	71.0		71.0			35.0	35.0			35.0	35.0
Effective Green, g (s)	74.0	74.0		74.0			38.0	38.0			38.0	38.0
Actuated g/C Ratio	0.62	0.62		0.62			0.32	0.32			0.32	0.32
Clearance Time (s)	7.0	7.0		7.0			7.0	7.0			7.0	7.0
Vehicle Extension (s)	3.0	3.0		3.0			3.0	3.0			3.0	3.0
Lane Grp Cap (vph)	878	998		811			429	586			588	506
v/s Ratio Prot		0.04						0.04				
v/s Ratio Perm	c0.14			0.00			c0.04				0.01	0.01
v/c Ratio	0.23	0.06		0.00			0.14	0.11			0.02	0.03
Uniform Delay, d1	10.2	9.1		8.8			29.3	29.0			28.2	28.3
Progression Factor	1.17	1.61		1.00			1.00	1.00			1.00	1.00
Incremental Delay, d2	0.6	0.1		0.0			0.7	0.4			0.1	0.1
Delay (s)	12.6	14.9		8.8			29.9	29.4			28.2	28.4
Level of Service	B	B		A			C	C			C	C
Approach Delay (s)		13.3			8.8			29.7			28.4	
Approach LOS		B			A			C			C	

Intersection Summary		
HCM Average Control Delay	19.6	HCM Level of Service
HCM Volume to Capacity ratio	0.20	B
Actuated Cycle Length (s)	120.0	Sum of lost time (s)
Intersection Capacity Utilization	33.1%	8.0
Analysis Period (min)	15	ICU Level of Service
		A

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis  
6: WB OFF RAMP & BRONTE

2019 BACKGROUND  
AM PEAK HOUR



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	198	238	884	0	0	884
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0			4.0
Lane Util. Factor	0.97	0.91	0.95			0.95
Frt	0.95	0.85	1.00			1.00
Flt Protected	0.97	1.00	1.00			1.00
Satd. Flow (prot)	3140	1321	3336			3400
Flt Permitted	0.97	1.00	1.00			1.00
Satd. Flow (perm)	3140	1321	3336			3400
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	215	259	961	0	0	961
RTOR Reduction (vph)	66	128	0	0	0	0
Lane Group Flow (vph)	258	23	961	0	0	961
Heavy Vehicles (%)	5%	10%	7%	2%	2%	5%
Turn Type	Perm					
Protected Phases	8		2			6
Permitted Phases	8					
Actuated Green, G (s)	15.0	15.0	91.0			91.0
Effective Green, g (s)	18.0	18.0	94.0			94.0
Actuated g/C Ratio	0.15	0.15	0.78			0.78
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)	471	198	2613			2663
v/s Ratio Prot	c0.08		c0.29			0.28
v/s Ratio Perm		0.02				
v/c Ratio	0.55	0.11	0.37			0.36
Uniform Delay, d1	47.2	44.1	4.0			3.9
Progression Factor	1.00	1.00	0.40			1.15
Incremental Delay, d2	1.3	0.3	0.3			0.3
Delay (s)	48.5	44.4	1.9			4.8
Level of Service	D	D	A			A
Approach Delay (s)	47.2		1.9			4.8
Approach LOS	D		A			A

Intersection Summary

HCM Average Control Delay	12.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.40		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	40.9%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

# HCM Signalized Intersection Capacity Analysis

## 3: EB OFF RAMP & BRONTE

2019 BACKGROUND  
AM PEAK HOUR



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	9	10	3	482	6	529	1	747	312	417	1041	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		3.0	3.0	3.0	4.0	4.0	4.0	3.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	0.95	0.95	1.00	0.95	1.00	1.00	0.95	
Frbp, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.97		1.00	0.85	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1785	1818		1668	1413	1405	1785	3305	1529	1750	3428	
Flt Permitted	0.57	1.00		0.48	1.00	1.00	0.25	1.00	1.00	0.14	1.00	
Satd. Flow (perm)	1080	1818		845	1413	1405	466	3305	1529	250	3428	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	10	11	3	524	7	575	1	812	339	453	1132	14
RTOR Reduction (vph)	0	3	0	0	176	183	0	0	221	0	1	0
Lane Group Flow (vph)	10	11	0	524	113	110	1	812	118	453	1145	0
Confl. Peds. (#/hr)									1	1		
Heavy Vehicles (%)	0%	0%	0%	7%	0%	8%	0%	8%	2%	2%	4%	0%
Turn Type	Perm			pm+pt			Perm	Perm		Perm	pm+pt	
Protected Phases		4		3	8			2			1	6
Permitted Phases	4			8		8	2		2		6	
Actuated Green, G (s)	4.4	4.4		42.2	42.2	42.2	36.6	36.6	36.6	64.8	64.8	
Effective Green, g (s)	7.4	7.4		43.2	45.2	45.2	39.6	39.6	39.6	64.8	67.8	
Actuated g/C Ratio	0.06	0.06		0.36	0.38	0.38	0.33	0.33	0.33	0.54	0.56	
Clearance Time (s)	6.0	6.0		4.0	6.0	6.0	7.0	7.0	7.0	3.0	7.0	
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)	67	112		543	532	529	154	1091	505	450	1937	
v/s Ratio Prot		0.01		c0.28	0.08			0.25		c0.21	0.33	
v/s Ratio Perm	0.01			c0.07		0.08	0.00		0.08	c0.33		
v/c Ratio	0.15	0.10		0.97	0.21	0.21	0.01	0.74	0.23	1.01	0.59	
Uniform Delay, d1	53.3	53.2		35.9	25.3	25.3	27.0	35.7	29.2	33.5	17.0	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.17	1.20	
Incremental Delay, d2	1.0	0.4		29.7	0.2	0.2	0.1	4.6	1.1	43.6	1.3	
Delay (s)	54.4	53.5		65.6	25.5	25.5	27.1	40.3	30.3	83.0	21.8	
Level of Service	D	D		E	C	C	C	D	C	F	C	
Approach Delay (s)		53.9			44.5			37.3			39.2	
Approach LOS		D			D			D			D	

### Intersection Summary

HCM Average Control Delay	40.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	6.0
Intersection Capacity Utilization	87.1%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis  
18: UPPER MIDDLE & BRONTE

2019 BACKGROUND  
PM PEAK HOUR



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	17	31	95	184	78	233	137	1448	300	207	782	34
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		3.0	4.0	4.0	4.0	4.0	4.0	0.0	4.0	4.0
Lane Util. Factor	1.00	0.95		0.97	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.89		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1785	3167		3395	1879	1566	1785	3336	1536	1750	3433	1597
Flt Permitted	0.70	1.00		0.95	1.00	1.00	0.33	1.00	1.00	0.08	1.00	1.00
Satd. Flow (perm)	1319	3167		3395	1879	1566	625	3336	1536	143	3433	1597
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	18	34	103	200	85	253	149	1574	326	225	850	37
RTOR Reduction (vph)	0	94	0	0	0	157	0	0	81	0	0	9
Lane Group Flow (vph)	18	43	0	200	85	96	149	1574	245	225	850	28
Heavy Vehicles (%)	0%	0%	0%	2%	0%	2%	0%	7%	4%	2%	4%	0%
Turn Type	Perm			Prot		Perm	Perm		Perm	pm+pt		Perm
Protected Phases		4		3	8			2		1	6	
Permitted Phases	4					8	2		2	6		6
Actuated Green, G (s)	7.3	7.3		7.0	19.3	19.3	68.7	68.7	68.7	86.7	86.7	86.7
Effective Green, g (s)	10.3	10.3		9.0	22.3	22.3	71.7	71.7	71.7	89.7	89.7	89.7
Actuated g/C Ratio	0.09	0.09		0.08	0.19	0.19	0.60	0.60	0.60	0.75	0.75	0.75
Clearance Time (s)	7.0	7.0		5.0	7.0	7.0	7.0	7.0	7.0	3.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	113	272		255	349	291	373	1993	918	348	2566	1194
v/s Ratio Prot		0.01		c0.06	0.05			c0.47		c0.10	0.25	
v/s Ratio Perm	0.01					c0.06	0.24		0.16	0.39		0.02
v/c Ratio	0.16	0.16		0.78	0.24	0.33	0.40	0.79	0.27	0.65	0.33	0.02
Uniform Delay, d1	50.8	50.8		54.5	41.7	42.4	12.8	18.4	11.6	27.3	5.1	3.9
Progression Factor	1.00	1.00		0.71	0.76	1.07	0.43	0.56	0.32	1.00	1.00	1.00
Incremental Delay, d2	0.7	0.3		14.1	0.4	0.6	2.4	2.5	0.5	4.1	0.3	0.0
Delay (s)	51.5	51.1		52.8	31.8	45.9	7.9	12.7	4.2	31.4	5.4	3.9
Level of Service	D	D		D	C	D	A	B	A	C	A	A
Approach Delay (s)		51.1			46.2			11.0			10.6	
Approach LOS		D			D			B			B	

Intersection Summary		
HCM Average Control Delay	17.4	HCM Level of Service
HCM Volume to Capacity ratio	0.69	B
Actuated Cycle Length (s)	120.0	Sum of lost time (s)
Intersection Capacity Utilization	74.0%	7.0
Analysis Period (min)	15	ICU Level of Service
		D

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis  
 15: WOODLANDS & BRONTE

2019 BACKGROUND  
 PM PEAK HOUR



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	22	62	1814	2	10	1049
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1566	1521	3400	1597	1785	3400
Flt Permitted	0.95	1.00	1.00	1.00	0.08	1.00
Satd. Flow (perm)	1566	1521	3400	1597	159	3400
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	24	67	1972	2	11	1140
RTOR Reduction (vph)	0	32	0	0	0	0
Lane Group Flow (vph)	24	35	1972	2	11	1140
Heavy Vehicles (%)	14%	5%	5%	0%	0%	5%
Turn Type	custom			Perm	Perm	
Protected Phases			2			6
Permitted Phases	8	8		2	6	
Actuated Green, G (s)	7.3	7.3	98.7	98.7	98.7	98.7
Effective Green, g (s)	10.3	10.3	101.7	101.7	101.7	101.7
Actuated g/C Ratio	0.09	0.09	0.85	0.85	0.85	0.85
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	134	131	2882	1353	135	2882
v/s Ratio Prot			c0.58			0.34
v/s Ratio Perm	0.02	c0.02		0.00	0.07	
v/c Ratio	0.18	0.27	0.68	0.00	0.08	0.40
Uniform Delay, d1	50.9	51.3	3.3	1.4	1.5	2.1
Progression Factor	1.00	1.00	0.35	0.53	0.73	0.74
Incremental Delay, d2	0.6	1.1	0.9	0.0	1.1	0.4
Delay (s)	51.6	52.4	2.1	0.7	2.2	1.9
Level of Service	D	D	A	A	A	A
Approach Delay (s)	52.2		2.1			1.9
Approach LOS	D		A			A

**Intersection Summary**

HCM Average Control Delay	3.5	HCM Level of Service	A
HCM Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	60.6%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group



# HCM Signalized Intersection Capacity Analysis

## 8: NSR & BRONTE

2019 BACKGROUND  
PM PEAK HOUR



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕		↙	↖	↗	↘	↕	↗	↘	↕	↖
Volume (vph)	1	0	0	124	0	107	1	1745	46	23	1034	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		3.0	4.0	4.0	4.0	4.0	0.0	4.0	4.0	
Lane Util. Factor		1.00		0.95	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Frt		1.00		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.95		0.95	0.95	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1785		1615	1615	1439	1785	3275	1566	1733	3368	
Flt Permitted		0.71		0.88	0.76	1.00	0.23	1.00	1.00	0.08	1.00	
Satd. Flow (perm)		1335		1494	1287	1439	423	3275	1566	137	3368	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1	0	0	135	0	116	1	1897	50	25	1124	0
RTOR Reduction (vph)	0	0	0	0	0	21	0	0	6	0	0	0
Lane Group Flow (vph)	0	1	0	67	68	95	1	1897	44	25	1124	0
Heavy Vehicles (%)	0%	0%	0%	5%	0%	11%	0%	9%	2%	3%	6%	0%
Turn Type	Perm			pm+pt		Perm	Perm		pm+ov	Perm		
Protected Phases		4		3	8			2	3		6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)		3.0		17.8	17.8	17.8	88.2	88.2	100.0	88.2	88.2	
Effective Green, g (s)		6.0		17.8	20.8	20.8	91.2	91.2	106.0	91.2	91.2	
Actuated g/C Ratio		0.05		0.15	0.17	0.17	0.76	0.76	0.88	0.76	0.76	
Clearance Time (s)		7.0		3.0	7.0	7.0	7.0	7.0	3.0	7.0	7.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		67		234	264	249	321	2489	1383	104	2560	
v/s Ratio Prot				0.03	0.03			c0.58	0.00		0.33	
v/s Ratio Perm		0.00		0.01	0.01	c0.07	0.00		0.02	0.18		
v/c Ratio		0.01		0.29	0.26	0.38	0.00	0.76	0.03	0.24	0.44	
Uniform Delay, d1		54.2		45.4	42.9	43.9	3.5	8.2	0.8	4.2	5.2	
Progression Factor		1.00		0.96	0.96	0.95	0.80	0.79	0.31	0.71	0.69	
Incremental Delay, d2		0.1		0.7	0.5	1.0	0.0	1.4	0.0	5.1	0.5	
Delay (s)		54.3		44.3	41.9	42.8	2.8	7.9	0.3	8.1	4.1	
Level of Service		D		D	D	D	A	A	A	A	A	
Approach Delay (s)		54.3			42.9			7.7			4.2	
Approach LOS		D			D			A			A	

### Intersection Summary

HCM Average Control Delay	9.2	HCM Level of Service	A
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	68.2%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis  
11: NSR-EW & NSR-Halton

2019 BACKGROUND  
PM PEAK HOUR



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	52	2	15	1	26	0	80	25	0	0	31	227
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0			4.0	4.0
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00			1.00	1.00
Frt	1.00	0.87		1.00	1.00		1.00	1.00			1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00			1.00	1.00
Satd. Flow (prot)	1785	1614		1785	1879		1716	1879			1879	1597
Flt Permitted	0.74	1.00		0.75	1.00		0.73	1.00			1.00	1.00
Satd. Flow (perm)	1388	1614		1401	1879		1328	1879			1879	1597
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	57	2	16	1	28	0	87	27	0	0	34	247
RTOR Reduction (vph)	0	11	0	0	0	0	0	0	0	0	0	99
Lane Group Flow (vph)	57	7	0	1	28	0	87	27	0	0	34	148
Heavy Vehicles (%)	0%	0%	1%	0%	0%	0%	4%	0%	0%	0%	0%	0%
Turn Type	Perm			Perm			Perm			Perm		Perm
Protected Phases		2			6			8				4
Permitted Phases	2			6			8			4		4
Actuated Green, G (s)	37.0	37.0		37.0	37.0		69.0	69.0			69.0	69.0
Effective Green, g (s)	40.0	40.0		40.0	40.0		72.0	72.0			72.0	72.0
Actuated g/C Ratio	0.33	0.33		0.33	0.33		0.60	0.60			0.60	0.60
Clearance Time (s)	7.0	7.0		7.0	7.0		7.0	7.0			7.0	7.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0			3.0	3.0
Lane Grp Cap (vph)	463	538		467	626		797	1127			1127	958
v/s Ratio Prot		0.00			0.01			0.01			0.02	
v/s Ratio Perm	c0.04			0.00			0.07					c0.09
v/c Ratio	0.12	0.01		0.00	0.04		0.11	0.02			0.03	0.15
Uniform Delay, d1	27.8	26.8		26.7	27.1		10.3	9.7			9.8	10.6
Progression Factor	0.95	0.89		1.00	1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2	0.5	0.0		0.0	0.1		0.3	0.0			0.0	0.3
Delay (s)	27.1	24.0		26.7	27.2		10.5	9.8			9.8	10.9
Level of Service	C	C		C	C		B	A			A	B
Approach Delay (s)		26.4			27.2			10.4			10.8	
Approach LOS		C			C			B			B	

Intersection Summary

HCM Average Control Delay	14.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.14		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	31.8%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis  
6: WB OFF RAMP & BRONTE

2019 BACKGROUND  
PM PEAK HOUR



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	259	408	1731	0	0	699
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0			4.0
Lane Util. Factor	0.97	0.91	0.95			0.95
Frt	0.94	0.85	1.00			1.00
Flt Protected	0.97	1.00	1.00			1.00
Satd. Flow (prot)	3094	1321	3336			3400
Flt Permitted	0.97	1.00	1.00			1.00
Satd. Flow (perm)	3094	1321	3336			3400
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	282	443	1882	0	0	760
RTOR Reduction (vph)	20	20	0	0	0	0
Lane Group Flow (vph)	475	210	1882	0	0	760
Heavy Vehicles (%)	5%	10%	7%	2%	2%	5%
Turn Type	Perm					
Protected Phases	8		2			6
Permitted Phases	8					
Actuated Green, G (s)	23.3	23.3	82.7			82.7
Effective Green, g (s)	26.3	26.3	85.7			85.7
Actuated g/C Ratio	0.22	0.22	0.71			0.71
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)	678	290	2382			2428
v/s Ratio Prot	0.15		c0.56			0.22
v/s Ratio Perm	c0.16					
v/c Ratio	0.70	0.72	0.79			0.31
Uniform Delay, d1	43.2	43.5	11.2			6.3
Progression Factor	1.00	1.00	0.32			1.17
Incremental Delay, d2	3.3	8.6	1.8			0.3
Delay (s)	46.5	52.1	5.4			7.7
Level of Service	D	D	A			A
Approach Delay (s)	48.3		5.4			7.7
Approach LOS	D		A			A

Intersection Summary			
HCM Average Control Delay		15.2	HCM Level of Service B
HCM Volume to Capacity ratio		0.77	
Actuated Cycle Length (s)		120.0	Sum of lost time (s) 8.0
Intersection Capacity Utilization		71.4%	ICU Level of Service C
Analysis Period (min)		15	

c Critical Lane Group

# HCM Signalized Intersection Capacity Analysis

## 3: EB OFF RAMP & BRONTE

2019 BACKGROUND  
PM PEAK HOUR






























Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	6	7	4	295	4	634	4	1373	254	238	850	4
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		3.0	4.0	4.0	4.0	4.0	4.0	3.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	0.95	0.95	1.00	0.95	1.00	1.00	0.95	
Frbp, ped/bikes	1.00	1.00		1.00	0.99	0.99	1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.95		1.00	0.85	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1782	1785		1700	1340	1335	1785	3336	1551	1653	3398	
Flt Permitted	0.69	1.00		0.59	1.00	1.00	0.31	1.00	1.00	0.06	1.00	
Satd. Flow (perm)	1294	1785		1053	1340	1335	578	3336	1551	112	3398	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	7	8	4	321	4	689	4	1492	276	259	924	4
RTOR Reduction (vph)	0	4	0	0	182	182	0	0	93	0	0	0
Lane Group Flow (vph)	7	8	0	321	167	162	4	1492	183	259	928	0
Confl. Peds. (#/hr)	1					1						
Heavy Vehicles (%)	0%	0%	0%	5%	0%	12%	0%	7%	3%	8%	5%	0%
Turn Type	Perm			pm+pt		Perm	Perm		Perm	pm+pt		
Protected Phases		4		3	8			2		1	6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)	2.8	2.8		26.2	26.2	26.2	59.3	59.3	59.3	79.8	79.8	
Effective Green, g (s)	5.8	5.8		27.2	29.2	29.2	62.3	62.3	62.3	79.8	82.8	
Actuated g/C Ratio	0.05	0.05		0.23	0.24	0.24	0.52	0.52	0.52	0.66	0.69	
Clearance Time (s)	7.0	7.0		4.0	7.0	7.0	7.0	7.0	7.0	3.0	7.0	
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)	63	86		349	326	325	300	1732	805	299	2345	
v/s Ratio Prot		0.00		c0.16	0.12			c0.45		c0.13	0.27	
v/s Ratio Perm	0.01			c0.05		0.12	0.01		0.12	0.45		
v/c Ratio	0.11	0.10		0.92	0.51	0.50	0.01	0.86	0.23	0.87	0.40	
Uniform Delay, d1	54.6	54.6		44.4	39.3	39.1	14.0	25.1	15.7	37.1	7.9	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.22	0.66	
Incremental Delay, d2	0.8	0.5		28.4	1.4	1.2	0.1	5.9	0.7	21.3	0.5	
Delay (s)	55.4	55.1		72.8	40.6	40.3	14.0	31.0	16.4	66.4	5.7	
Level of Service	E	E		E	D	D	B	C	B	E	A	
Approach Delay (s)		55.2			50.7			28.7			19.0	
Approach LOS		E			D			C			B	

### Intersection Summary

HCM Average Control Delay	31.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	84.1%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis  
18: UPPER MIDDLE & BRONTE

2019 TOTAL  
AM PEAK HOUR

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations				 				 			 	
Volume (vph)	14	123	228	314	47	160	46	752	257	316	1489	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0	0.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1785	1879	1597	3395	1879	1566	1785	3336	1536	1750	3433	1597
Flt Permitted	0.72	1.00	1.00	0.95	1.00	1.00	0.10	1.00	1.00	0.25	1.00	1.00
Satd. Flow (perm)	1360	1879	1597	3395	1879	1566	180	3336	1536	465	3433	1597
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	15	134	248	341	51	174	50	817	279	343	1618	12
RTOR Reduction (vph)	0	0	24	0	0	118	0	0	144	0	0	4
Lane Group Flow (vph)	15	134	224	341	51	56	50	817	135	343	1618	8
Heavy Vehicles (%)	0%	0%	0%	2%	0%	2%	0%	7%	4%	2%	4%	0%
Turn Type	Perm		Perm	Prot		Perm	Perm		Perm	pm+pt		Perm
Protected Phases		4		3	8			2		1	6	
Permitted Phases	4		4			8	2		2	6		6
Actuated Green, G (s)	17.3	17.3	17.3	13.0	35.3	35.3	55.1	55.1	55.1	70.7	70.7	70.7
Effective Green, g (s)	20.3	20.3	20.3	15.0	38.3	38.3	58.1	58.1	58.1	73.7	73.7	73.7
Actuated g/C Ratio	0.17	0.17	0.17	0.12	0.32	0.32	0.48	0.48	0.48	0.61	0.61	0.61
Clearance Time (s)	7.0	7.0	7.0	5.0	7.0	7.0	7.0	7.0	7.0	3.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	230	318	270	424	600	500	87	1615	744	453	2108	981
v/s Ratio Prot		0.07		c0.10	0.03			0.24		0.10	c0.47	
v/s Ratio Perm	0.01		c0.14			0.04	0.28		0.09	0.37		0.01
v/c Ratio	0.07	0.42	0.83	0.80	0.08	0.11	0.57	0.51	0.18	0.76	0.77	0.01
Uniform Delay, d1	41.9	44.6	48.2	51.1	28.6	28.8	22.1	21.1	17.5	13.3	16.9	9.0
Progression Factor	1.00	1.00	1.00	0.75	0.75	0.62	1.30	1.37	5.71	1.00	1.00	1.00
Incremental Delay, d2	0.1	0.9	18.6	10.4	0.1	0.1	23.6	1.1	0.5	7.1	2.7	0.0
Delay (s)	42.0	45.5	66.7	48.5	21.6	18.1	52.3	30.1	100.4	20.4	19.6	9.0
Level of Service	D	D	E	D	C	B	D	C	F	C	B	A
Approach Delay (s)		58.6			36.7			48.2			19.7	
Approach LOS		E			D			D			B	
<b>Intersection Summary</b>												
HCM Average Control Delay			33.8								HCM Level of Service	C
HCM Volume to Capacity ratio			0.78									
Actuated Cycle Length (s)			120.0								Sum of lost time (s)	11.0
Intersection Capacity Utilization			74.2%								ICU Level of Service	D
Analysis Period (min)			15									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis  
27: NORTH ACCESS & BRONTE

2019 TOTAL  
AM PEAK HOUR



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	35	43	1012	11	14	2017
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1750	1566	3368	1566	1750	3368
Flt Permitted	0.95	1.00	1.00	1.00	0.25	1.00
Satd. Flow (perm)	1750	1566	3368	1566	457	3368
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	38	47	1100	12	15	2192
RTOR Reduction (vph)	0	43	0	2	0	0
Lane Group Flow (vph)	38	4	1100	10	15	2192
Heavy Vehicles (%)	2%	2%	6%	2%	2%	6%
Turn Type		Perm		Perm	Perm	
Protected Phases	8		2			6
Permitted Phases		8		2	6	
Actuated Green, G (s)	7.0	7.0	99.0	99.0	99.0	99.0
Effective Green, g (s)	10.0	10.0	102.0	102.0	102.0	102.0
Actuated g/C Ratio	0.08	0.08	0.85	0.85	0.85	0.85
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	146	131	2863	1331	388	2863
v/s Ratio Prot	c0.02		0.33			c0.65
v/s Ratio Perm		0.00		0.01	0.03	
v/c Ratio	0.26	0.03	0.38	0.01	0.04	0.77
Uniform Delay, d1	51.5	50.5	2.0	1.4	1.4	3.9
Progression Factor	1.00	1.00	0.94	1.26	0.57	0.87
Incremental Delay, d2	1.0	0.1	0.4	0.0	0.1	1.2
Delay (s)	52.5	50.6	2.2	1.7	0.9	4.6
Level of Service	D	D	A	A	A	A
Approach Delay (s)	51.5		2.2			4.6
Approach LOS	D		A			A

Intersection Summary

HCM Average Control Delay	5.0	HCM Level of Service	A
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	65.8%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

# HCM Signalized Intersection Capacity Analysis

## 25: SOUTH ACCESS & BRONTE

2019 TOTAL  
AM PEAK HOUR



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	269	95	931	90	36	2022
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1750	1566	3368	1566	1750	3466
Flt Permitted	0.95	1.00	1.00	1.00	0.25	1.00
Satd. Flow (perm)	1750	1566	3368	1566	462	3466
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	292	103	1012	98	39	2198
RTOR Reduction (vph)	0	81	0	27	0	0
Lane Group Flow (vph)	292	22	1012	71	39	2198
Heavy Vehicles (%)	2%	2%	6%	2%	2%	3%
Turn Type		Perm		Perm	Perm	
Protected Phases	8		2			6
Permitted Phases		8		2	6	
Actuated Green, G (s)	22.3	22.3	83.7	83.7	83.7	83.7
Effective Green, g (s)	25.3	25.3	86.7	86.7	86.7	86.7
Actuated g/C Ratio	0.21	0.21	0.72	0.72	0.72	0.72
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	369	330	2433	1131	334	2504
v/s Ratio Prot	c0.17		0.30			c0.63
v/s Ratio Perm		0.01		0.05	0.08	
v/c Ratio	0.79	0.07	0.42	0.06	0.12	0.88
Uniform Delay, d1	44.8	37.9	6.6	4.8	5.0	12.6
Progression Factor	1.00	1.00	1.64	3.57	0.89	0.53
Incremental Delay, d2	11.0	0.1	0.5	0.1	0.5	3.2
Delay (s)	55.9	38.0	11.3	17.4	4.9	9.8
Level of Service	E	D	B	B	A	A
Approach Delay (s)	51.2		11.9			9.8
Approach LOS	D		B			A

### Intersection Summary

HCM Average Control Delay	14.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	77.5%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis  
 15: WOODLANDS & BRONTE

2019 TOTAL  
 AM PEAK HOUR



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	23	19	996	18	121	2145
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1566	1521	3400	1597	1785	3400
Flt Permitted	0.95	1.00	1.00	1.00	0.26	1.00
Satd. Flow (perm)	1566	1521	3400	1597	479	3400
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	25	21	1083	20	132	2332
RTOR Reduction (vph)	0	20	0	3	0	0
Lane Group Flow (vph)	25	1	1083	17	132	2332
Heavy Vehicles (%)	14%	5%	5%	0%	0%	5%
Turn Type	custom			Perm	Perm	
Protected Phases			2			6
Permitted Phases	8	8		2	6	
Actuated Green, G (s)	5.1	5.1	100.9	100.9	100.9	100.9
Effective Green, g (s)	8.1	8.1	103.9	103.9	103.9	103.9
Actuated g/C Ratio	0.07	0.07	0.87	0.87	0.87	0.87
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	106	103	2944	1383	415	2944
v/s Ratio Prot			0.32			c0.69
v/s Ratio Perm	c0.02	0.00		0.01	0.28	
v/c Ratio	0.24	0.01	0.37	0.01	0.32	0.79
Uniform Delay, d1	53.0	52.2	1.6	1.1	1.5	3.4
Progression Factor	1.00	1.00	1.69	2.53	1.04	0.61
Incremental Delay, d2	1.1	0.1	0.3	0.0	1.0	1.1
Delay (s)	54.2	52.3	3.0	2.8	2.5	3.2
Level of Service	D	D	A	A	A	A
Approach Delay (s)	53.3		3.0			3.2
Approach LOS	D		A			A

Intersection Summary			
HCM Average Control Delay	3.8	HCM Level of Service	A
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	69.3%	ICU Level of Service	C
Analysis Period (min)	15		























c Critical Lane Group



# HCM Signalized Intersection Capacity Analysis

## 8: NSR & BRONTE

2019 TOTAL  
AM PEAK HOUR

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Volume (vph)	2	0	2	32	2	40	3	1098	143	123	1771	2	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)		4.0		3.0	4.0	4.0	4.0	4.0	3.0	4.0	4.0		
Lane Util. Factor		1.00		0.95	0.95	1.00	1.00	0.95	1.00	1.00	0.95		
Frt		0.93		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00		
Flt Protected		0.98		0.95	0.96	1.00	0.95	1.00	1.00	0.95	1.00		
Satd. Flow (prot)		1709		1615	1636	1439	1785	3275	1566	1733	3367		
Flt Permitted		0.83		0.77	0.94	1.00	0.08	1.00	1.00	0.21	1.00		
Satd. Flow (perm)		1458		1301	1604	1439	147	3275	1566	388	3367		
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	
Adj. Flow (vph)	2	0	2	35	2	43	3	1193	155	134	1925	2	
RTOR Reduction (vph)	0	2	0	0	0	37	0	0	22	0	0	0	
Lane Group Flow (vph)	0	2	0	19	18	6	3	1193	133	134	1927	0	
Heavy Vehicles (%)	0%	0%	0%	5%	0%	11%	0%	9%	2%	3%	6%	0%	
Turn Type	Perm			pm+pt		Perm	Perm		pm+ov	Perm			
Protected Phases		4		3	8			2	3		6		
Permitted Phases	4			8		8	2		2		6		
Actuated Green, G (s)		1.3		14.3	14.3	14.3	91.7	91.7	100.7	91.7	91.7		
Effective Green, g (s)		4.3		15.3	17.3	17.3	94.7	94.7	102.7	94.7	94.7		
Actuated g/C Ratio		0.04		0.13	0.14	0.14	0.79	0.79	0.86	0.79	0.79		
Clearance Time (s)		7.0		4.0	7.0	7.0	7.0	7.0	4.0	7.0	7.0		
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
Lane Grp Cap (vph)		52		192	234	207	116	2585	1340	306	2657		
v/s Ratio Prot				c0.01	c0.01			0.36	0.01		c0.57		
v/s Ratio Perm		0.00		0.00	0.00	0.00	0.02		0.08	0.35			
v/c Ratio		0.04		0.10	0.08	0.03	0.03	0.46	0.10	0.44	0.73		
Uniform Delay, d1		55.9		46.2	44.4	44.1	2.7	4.2	1.4	4.1	6.2		
Progression Factor		1.00		0.72	0.71	1.31	0.40	0.39	0.37	0.25	0.25		
Incremental Delay, d2		0.3		0.2	0.1	0.1	0.4	0.6	0.0	2.9	1.1		
Delay (s)		56.2		33.5	31.9	58.0	1.5	2.2	0.5	3.9	2.7		
Level of Service		E		C	C	E	A	A	A	A	A		
Approach Delay (s)		56.2			46.3			2.0			2.8		
Approach LOS		E			D			A			A		
<b>Intersection Summary</b>													
HCM Average Control Delay			3.5									HCM Level of Service	A
HCM Volume to Capacity ratio			0.62										
Actuated Cycle Length (s)			120.0									Sum of lost time (s)	7.0
Intersection Capacity Utilization			65.7%									ICU Level of Service	C
Analysis Period (min)			15										

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis  
 11: NSR-EW & NSR-Halton

2019 TOTAL  
 AM PEAK HOUR

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	183	10	116	1	0	0	68	57	6	1	9	46
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0			4.0	4.0			4.0	4.0
Lane Util. Factor	1.00	1.00		1.00			1.00	1.00			1.00	1.00
Frt	1.00	0.86		1.00			1.00	0.98			1.00	0.85
Flt Protected	0.95	1.00		0.95			0.95	1.00			1.00	1.00
Satd. Flow (prot)	1785	1605		1785			1716	1850			1870	1597
Flt Permitted	0.76	1.00		0.67			0.75	1.00			0.99	1.00
Satd. Flow (perm)	1423	1605		1258			1356	1850			1858	1597
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	199	11	126	1	0	0	74	62	7	1	10	50
RTOR Reduction (vph)	0	50	0	0	0	0	0	3	0	0	0	33
Lane Group Flow (vph)	199	87	0	1	0	0	74	66	0	0	11	17
Heavy Vehicles (%)	0%	0%	1%	0%	0%	0%	4%	0%	0%	0%	0%	0%
Turn Type	Perm			Perm			Perm			Perm		Perm
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		4
Actuated Green, G (s)	69.0	69.0		69.0			37.0	37.0			37.0	37.0
Effective Green, g (s)	72.0	72.0		72.0			40.0	40.0			40.0	40.0
Actuated g/C Ratio	0.60	0.60		0.60			0.33	0.33			0.33	0.33
Clearance Time (s)	7.0	7.0		7.0			7.0	7.0			7.0	7.0
Vehicle Extension (s)	3.0	3.0		3.0			3.0	3.0			3.0	3.0
Lane Grp Cap (vph)	854	963		755			452	617			619	532
v/s Ratio Prot		0.05						0.04				
v/s Ratio Perm	c0.14			0.00			c0.05				0.01	0.01
v/c Ratio	0.23	0.09		0.00			0.16	0.11			0.02	0.03
Uniform Delay, d1	11.2	10.1		9.6			28.2	27.6			26.8	26.9
Progression Factor	1.37	2.46		1.00			1.00	1.00			1.00	1.00
Incremental Delay, d2	0.6	0.2		0.0			0.8	0.3			0.1	0.1
Delay (s)	15.9	25.1		9.6			29.0	28.0			26.9	27.1
Level of Service	B	C		A			C	C			C	C
Approach Delay (s)		19.7			9.6			28.5			27.0	
Approach LOS		B			A			C			C	














Intersection Summary

HCM Average Control Delay	22.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.21		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	33.9%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis  
6: WB OFF RAMP & BRONTE
























2019 TOTAL  
AM PEAK HOUR

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	 		 			 
Volume (vph)	198	284	921	0	0	1068
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0			4.0
Lane Util. Factor	0.97	0.91	0.95			0.95
Frt	0.94	0.85	1.00			1.00
Flt Protected	0.97	1.00	1.00			1.00
Satd. Flow (prot)	3110	1321	3336			3400
Flt Permitted	0.97	1.00	1.00			1.00
Satd. Flow (perm)	3110	1321	3336			3400
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	215	309	1001	0	0	1161
RTOR Reduction (vph)	116	129	0	0	0	0
Lane Group Flow (vph)	241	38	1001	0	0	1161
Heavy Vehicles (%)	5%	10%	7%	2%	2%	5%
Turn Type	Perm					
Protected Phases	8		2			6
Permitted Phases	8					
Actuated Green, G (s)	14.3	14.3	91.7			91.7
Effective Green, g (s)	17.3	17.3	94.7			94.7
Actuated g/C Ratio	0.14	0.14	0.79			0.79
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)	448	190	2633			2683
v/s Ratio Prot	c0.08		0.30			c0.34
v/s Ratio Perm		0.03				
v/c Ratio	0.54	0.20	0.38			0.43
Uniform Delay, d1	47.6	45.2	3.8			4.1
Progression Factor	1.00	1.00	0.51			0.91
Incremental Delay, d2	1.3	0.5	0.3			0.4
Delay (s)	48.9	45.8	2.3			4.0
Level of Service	D	D	A			A
Approach Delay (s)	47.9		2.3			4.0
Approach LOS	D		A			A
<b>Intersection Summary</b>						
HCM Average Control Delay			11.9	HCM Level of Service		B
HCM Volume to Capacity ratio			0.45			
Actuated Cycle Length (s)			120.0	Sum of lost time (s)		8.0
Intersection Capacity Utilization			44.8%	ICU Level of Service		A
Analysis Period (min)			15			
c Critical Lane Group						

# HCM Signalized Intersection Capacity Analysis

## 3: EB OFF RAMP & BRONTE

2019 TOTAL  
AM PEAK HOUR
























												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	9	10	3	482	6	551	1	762	312	556	1086	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	3.0		2.0	3.0	0.0	4.0	4.0	4.0	3.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	0.95	0.95	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Fr t	1.00	0.97		1.00	0.85	0.85	1.00	1.00	0.85	1.00	1.00	
Fl t Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1785	1818		1668	1413	1405	1785	3305	1529	1750	3428	
Fl t Permitted	0.56	1.00		0.55	1.00	1.00	0.24	1.00	1.00	0.14	1.00	
Satd. Flow (perm)	1061	1818		959	1413	1405	444	3305	1529	249	3428	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	10	11	3	524	7	599	1	828	339	604	1180	14
RTOR Reduction (vph)	0	3	0	0	192	5	0	0	215	0	1	0
Lane Group Flow (vph)	10	11	0	524	116	294	1	828	124	604	1193	0
Confl. Peds. (#/hr)									1	1		
Heavy Vehicles (%)	0%	0%	0%	7%	0%	8%	0%	8%	2%	2%	4%	0%
Turn Type	Perm			pm+pt		pm+ov	Perm		Perm	pm+pt		
Protected Phases		4		3	8	1		2		1	6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)	4.4	4.4		40.4	40.4	77.4	26.6	26.6	26.6	66.6	66.6	
Effective Green, g (s)	7.4	7.4		41.4	43.4	83.4	29.6	29.6	29.6	66.6	69.6	
Actuated g/C Ratio	0.06	0.06		0.34	0.36	0.70	0.25	0.25	0.25	0.55	0.58	
Clearance Time (s)	6.0	6.0		3.0	6.0	3.0	7.0	7.0	7.0	3.0	7.0	
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)	65	112		532	511	976	110	815	377	601	1988	
v/s Ratio Prot		0.01		c0.28	0.08	0.10		c0.25		c0.31	0.35	
v/s Ratio Perm	0.01			0.06		0.11	0.00		0.08	0.25		
v/c Ratio	0.15	0.10		0.98	0.23	0.30	0.01	1.02	0.33	1.00	0.60	
Uniform Delay, d1	53.3	53.2		37.7	26.6	7.1	34.1	45.2	37.0	34.0	16.2	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.99	
Incremental Delay, d2	1.1	0.4		34.9	0.2	0.2	0.2	35.6	2.3	37.2	1.3	
Delay (s)	54.4	53.5		72.6	26.9	7.2	34.3	80.8	39.4	69.6	17.3	
Level of Service	D	D		E	C	A	C	F	D	E	B	
Approach Delay (s)		53.9			42.9			68.7			34.9	
Approach LOS		D			D			E			C	

### Intersection Summary

HCM Average Control Delay	46.8	HCM Level of Service	D
HCM Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	95.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis  
18: UPPER MIDDLE & BRONTE

2019 TOTAL  
PM PEAK HOUR

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	17	31	95	233	78	233	137	1506	329	207	879	34
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		3.0	4.0	4.0	4.0	4.0	4.0	0.0	4.0	4.0
Lane Util. Factor	1.00	0.95		0.97	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.89		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1785	3167		3395	1879	1566	1785	3336	1536	1750	3433	1597
Flt Permitted	0.70	1.00		0.95	1.00	1.00	0.30	1.00	1.00	0.06	1.00	1.00
Satd. Flow (perm)	1319	3167		3395	1879	1566	563	3336	1536	115	3433	1597
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	18	34	103	253	85	253	149	1637	358	225	955	37
RTOR Reduction (vph)	0	94	0	0	0	143	0	0	87	0	0	10
Lane Group Flow (vph)	18	43	0	253	85	110	149	1637	271	225	955	27
Heavy Vehicles (%)	0%	0%	0%	2%	0%	2%	0%	7%	4%	2%	4%	0%
Turn Type	Perm			Prot		Perm	Perm		Perm	pm+pt		Perm
Protected Phases		4		3	8			2		1	6	
Permitted Phases	4					8	2		2	6		6
Actuated Green, G (s)	7.3	7.3		8.0	20.3	20.3	67.6	67.6	67.6	85.7	85.7	85.7
Effective Green, g (s)	10.3	10.3		10.0	23.3	23.3	70.6	70.6	70.6	88.7	88.7	88.7
Actuated g/C Ratio	0.09	0.09		0.08	0.19	0.19	0.59	0.59	0.59	0.74	0.74	0.74
Clearance Time (s)	7.0	7.0		5.0	7.0	7.0	7.0	7.0	7.0	3.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	113	272		283	365	304	331	1963	904	332	2538	1180
v/s Ratio Prot		0.01		c0.07	0.05			c0.49		c0.10	0.28	
v/s Ratio Perm	0.01					c0.07	0.26		0.18	0.40		0.02
v/c Ratio	0.16	0.16		0.89	0.23	0.36	0.45	0.83	0.30	0.68	0.38	0.02
Uniform Delay, d1	50.8	50.8		54.5	40.8	41.9	13.8	20.0	12.3	32.1	5.7	4.2
Progression Factor	1.00	1.00		0.72	0.76	0.96	0.95	0.82	1.12	1.00	1.00	1.00
Incremental Delay, d2	0.7	0.3		27.1	0.3	0.7	3.0	3.1	0.6	5.4	0.4	0.0
Delay (s)	51.5	51.1		66.5	31.5	41.0	16.2	19.4	14.4	37.5	6.1	4.2
Level of Service	D	D		E	C	D	B	B	B	D	A	A
Approach Delay (s)		51.1			50.6			18.4			11.8	
Approach LOS		D			D			B			B	
<b>Intersection Summary</b>												
HCM Average Control Delay			22.3									HCM Level of Service C
HCM Volume to Capacity ratio			0.73									
Actuated Cycle Length (s)			120.0									Sum of lost time (s) 7.0
Intersection Capacity Utilization			77.0%									ICU Level of Service D
Analysis Period (min)			15									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis  
27: NORTH ACCESS & BRONTE

2019 TOTAL  
PM PEAK HOUR



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	23	28	1943	36	46	1160
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1750	1566	3368	1566	1750	3368
Flt Permitted	0.95	1.00	1.00	1.00	0.07	1.00
Satd. Flow (perm)	1750	1566	3368	1566	131	3368
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	25	30	2112	39	50	1261
RTOR Reduction (vph)	0	25	0	6	0	0
Lane Group Flow (vph)	25	5	2112	33	50	1261
Heavy Vehicles (%)	2%	2%	6%	2%	2%	6%
Turn Type		Perm		Perm	Perm	
Protected Phases	8		2			6
Permitted Phases		8		2	6	
Actuated Green, G (s)	6.2	6.2	99.8	99.8	99.8	99.8
Effective Green, g (s)	9.2	9.2	102.8	102.8	102.8	102.8
Actuated g/C Ratio	0.08	0.08	0.86	0.86	0.86	0.86
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	134	120	2885	1342	112	2885
v/s Ratio Prot	c0.01		c0.63			0.37
v/s Ratio Perm		0.00		0.02	0.38	
v/c Ratio	0.19	0.04	0.73	0.02	0.45	0.44
Uniform Delay, d1	51.9	51.3	3.3	1.3	2.0	2.0
Progression Factor	1.00	1.00	0.51	1.12	0.96	0.71
Incremental Delay, d2	0.7	0.1	0.8	0.0	11.2	0.4
Delay (s)	52.6	51.5	2.5	1.4	13.1	1.8
Level of Service	D	D	A	A	B	A
Approach Delay (s)	52.0		2.4			2.3
Approach LOS	D		A			A

Intersection Summary

HCM Average Control Delay	3.1	HCM Level of Service	A
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	63.7%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis  
 25: SOUTH ACCESS & BRONTE

2019 TOTAL  
 PM PEAK HOUR

















Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	178	75	1920	301	110	1083
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	3.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1750	1566	3368	1566	1750	3466
Flt Permitted	0.95	1.00	1.00	1.00	0.05	1.00
Satd. Flow (perm)	1750	1566	3368	1566	88	3466
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	193	82	2087	327	120	1177
RTOR Reduction (vph)	0	70	0	55	0	0
Lane Group Flow (vph)	193	12	2087	272	120	1177
Heavy Vehicles (%)	2%	2%	6%	2%	2%	3%
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	15.2	15.2	79.9	79.9	90.8	90.8
Effective Green, g (s)	18.2	18.2	82.9	82.9	91.8	93.8
Actuated g/C Ratio	0.15	0.15	0.69	0.69	0.76	0.78
Clearance Time (s)	7.0	7.0	7.0	7.0	4.0	7.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	265	238	2327	1082	177	2709
v/s Ratio Prot	c0.11		c0.62		c0.04	0.34
v/s Ratio Perm		0.01		0.17	0.48	
v/c Ratio	0.73	0.05	0.90	0.25	0.68	0.43
Uniform Delay, d1	48.5	43.5	15.1	6.9	31.9	4.3
Progression Factor	1.00	1.00	1.41	1.37	1.34	0.69
Incremental Delay, d2	9.6	0.1	3.8	0.3	9.2	0.5
Delay (s)	58.1	43.6	25.1	9.9	52.0	3.5
Level of Service	E	D	C	A	D	A
Approach Delay (s)	53.8		23.0			7.9
Approach LOS	D		C			A

Intersection Summary			
HCM Average Control Delay	20.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	11.0
Intersection Capacity Utilization	79.0%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis  
15: WOODLANDS & BRONTE

2019 TOTAL  
PM PEAK HOUR

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations			 			 
Volume (vph)	22	62	2135	2	10	1211
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1566	1521	3400	1597	1785	3400
Flt Permitted	0.95	1.00	1.00	1.00	0.05	1.00
Satd. Flow (perm)	1566	1521	3400	1597	89	3400
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	24	67	2321	2	11	1316
RTOR Reduction (vph)	0	16	0	0	0	0
Lane Group Flow (vph)	24	51	2321	2	11	1316
Heavy Vehicles (%)	14%	5%	5%	0%	0%	5%
Turn Type	custom			Perm	Perm	
Protected Phases			2			6
Permitted Phases	8	8		2	6	
Actuated Green, G (s)	8.3	8.3	97.7	97.7	97.7	97.7
Effective Green, g (s)	11.3	11.3	100.7	100.7	100.7	100.7
Actuated g/C Ratio	0.09	0.09	0.84	0.84	0.84	0.84
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	147	143	2853	1340	75	2853
v/s Ratio Prot			c0.68			0.39
v/s Ratio Perm	0.02	c0.03		0.00	0.12	
v/c Ratio	0.16	0.35	0.81	0.00	0.15	0.46
Uniform Delay, d1	50.0	50.9	4.9	1.6	1.8	2.5
Progression Factor	1.00	1.00	0.57	1.21	1.11	1.14
Incremental Delay, d2	0.5	1.5	1.3	0.0	3.7	0.5
Delay (s)	50.5	52.4	4.1	1.9	5.6	3.4
Level of Service	D	D	A	A	A	A
Approach Delay (s)	51.9		4.1			3.4
Approach LOS	D		A			A

Intersection Summary			
HCM Average Control Delay		5.0	HCM Level of Service A
HCM Volume to Capacity ratio		0.77	
Actuated Cycle Length (s)		120.0	Sum of lost time (s) 8.0
Intersection Capacity Utilization		69.5%	ICU Level of Service C
Analysis Period (min)		15	






















c Critical Lane Group



# HCM Signalized Intersection Capacity Analysis

## 8: NSR & BRONTE

2019 TOTAL  
PM PEAK HOUR

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	1	0	0	124	0	156	1	2017	46	52	1196	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		3.0	4.0	4.0	4.0	4.0	0.0	4.0	4.0	
Lane Util. Factor		1.00		0.95	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Frt		1.00		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.95		0.95	0.95	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1785		1615	1615	1439	1785	3275	1566	1733	3368	
Flt Permitted		0.71		0.85	0.76	1.00	0.17	1.00	1.00	0.05	1.00	
Satd. Flow (perm)		1335		1440	1287	1439	320	3275	1566	85	3368	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1	0	0	135	0	170	1	2192	50	57	1300	0
RTOR Reduction (vph)	0	0	0	0	0	11	0	0	7	0	0	0
Lane Group Flow (vph)	0	1	0	67	68	159	1	2192	43	57	1300	0
Heavy Vehicles (%)	0%	0%	0%	5%	0%	11%	0%	9%	2%	3%	6%	0%
Turn Type	Perm			pm+pt		Perm	Perm		pm+ov	Perm		
Protected Phases		4		3	8			2	3		6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)		5.1		23.1	23.1	23.1	82.9	82.9	97.9	82.9	82.9	
Effective Green, g (s)		8.1		23.1	26.1	26.1	85.9	85.9	103.9	85.9	85.9	
Actuated g/C Ratio		0.07		0.19	0.22	0.22	0.72	0.72	0.87	0.72	0.72	
Clearance Time (s)		7.0		3.0	7.0	7.0	7.0	7.0	3.0	7.0	7.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		90		299	329	313	229	2344	1356	61	2411	
v/s Ratio Prot				0.03	0.03			0.67	0.00		0.39	
v/s Ratio Perm		0.00		0.02	0.01	c0.11	0.00		0.02	c0.67		
v/c Ratio		0.01		0.22	0.21	0.51	0.00	0.94	0.03	0.93	0.54	
Uniform Delay, d1		52.2		40.9	38.5	41.3	4.9	14.7	1.1	14.6	7.9	
Progression Factor		1.00		0.96	0.96	0.96	0.88	0.92	0.47	0.88	0.64	
Incremental Delay, d2		0.0		0.4	0.3	1.3	0.0	4.6	0.0	92.8	0.8	
Delay (s)		52.3		39.7	37.3	40.9	4.3	18.1	0.5	105.6	5.8	
Level of Service		D		D	D	D	A	B	A	F	A	
Approach Delay (s)		52.3			39.8			17.7			10.0	
Approach LOS		D			D			B			B	





















### Intersection Summary

HCM Average Control Delay	16.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	78.7%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis  
11: NSR-EW & NSR-Halton

2019 TOTAL  
PM PEAK HOUR

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	52	2	44	1	26	0	129	25	0	0	31	227
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0			4.0	4.0
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00			1.00	1.00
Frt	1.00	0.86		1.00	1.00		1.00	1.00			1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00			1.00	1.00
Satd. Flow (prot)	1785	1593		1785	1879		1716	1879			1879	1597
Flt Permitted	0.74	1.00		0.72	1.00		0.73	1.00			1.00	1.00
Satd. Flow (perm)	1388	1593		1361	1879		1328	1879			1879	1597
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	57	2	48	1	28	0	140	27	0	0	34	247
RTOR Reduction (vph)	0	32	0	0	0	0	0	0	0	0	0	99
Lane Group Flow (vph)	57	18	0	1	28	0	140	27	0	0	34	148
Heavy Vehicles (%)	0%	0%	1%	0%	0%	0%	4%	0%	0%	0%	0%	0%
Turn Type	Perm			Perm			Perm			Perm		Perm
Protected Phases		2			6			8				4
Permitted Phases	2			6			8			4		4
Actuated Green, G (s)	37.0	37.0		37.0	37.0		69.0	69.0			69.0	69.0
Effective Green, g (s)	40.0	40.0		40.0	40.0		72.0	72.0			72.0	72.0
Actuated g/C Ratio	0.33	0.33		0.33	0.33		0.60	0.60			0.60	0.60
Clearance Time (s)	7.0	7.0		7.0	7.0		7.0	7.0			7.0	7.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0			3.0	3.0
Lane Grp Cap (vph)	463	531		454	626		797	1127			1127	958
v/s Ratio Prot		0.01			0.01			0.01			0.02	
v/s Ratio Perm	c0.04			0.00			c0.11					0.09
v/c Ratio	0.12	0.03		0.00	0.04		0.18	0.02			0.03	0.15
Uniform Delay, d1	27.8	27.0		26.7	27.1		10.7	9.7			9.8	10.6
Progression Factor	0.91	0.79		1.00	1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2	0.5	0.1		0.0	0.1		0.5	0.0			0.0	0.3
Delay (s)	25.8	21.3		26.7	27.2		11.2	9.8			9.8	10.9
Level of Service	C	C		C	C		B	A			A	B
Approach Delay (s)		23.7			27.2			11.0			10.8	
Approach LOS		C			C			B			B	

Intersection Summary

HCM Average Control Delay	14.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.16		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	34.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis  
6: WB OFF RAMP & BRONTE

2019 TOTAL  
PM PEAK HOUR



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	259	559	1853	0	0	818
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0			4.0
Lane Util. Factor	0.97	0.91	0.95			0.95
Frt	0.92	0.85	1.00			1.00
Flt Protected	0.98	1.00	1.00			1.00
Satd. Flow (prot)	3051	1321	3336			3400
Flt Permitted	0.98	1.00	1.00			1.00
Satd. Flow (perm)	3051	1321	3336			3400
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	282	608	2014	0	0	889
RTOR Reduction (vph)	13	13	0	0	0	0
Lane Group Flow (vph)	573	291	2014	0	0	889
Heavy Vehicles (%)	5%	10%	7%	2%	2%	5%
Turn Type	Perm					
Protected Phases	8		2			6
Permitted Phases	8					
Actuated Green, G (s)	27.4	27.4	78.6			78.6
Effective Green, g (s)	30.4	30.4	81.6			81.6
Actuated g/C Ratio	0.25	0.25	0.68			0.68
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)	773	335	2268			2312
v/s Ratio Prot	0.19		c0.60			0.26
v/s Ratio Perm	c0.22					
v/c Ratio	0.74	0.87	0.89			0.38
Uniform Delay, d1	41.2	42.9	15.5			8.3
Progression Factor	1.00	1.00	0.44			1.12
Incremental Delay, d2	3.8	20.3	3.0			0.4
Delay (s)	45.0	63.2	9.8			9.7
Level of Service	D	E	A			A
Approach Delay (s)	51.2		9.8			9.7
Approach LOS	D		A			A

Intersection Summary

HCM Average Control Delay	19.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	81.0%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

# HCM Signalized Intersection Capacity Analysis

## 3: EB OFF RAMP & BRONTE

2019 TOTAL  
PM PEAK HOUR



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗	↖	↖	↕	↖	↖	↕	↕
Volume (vph)	6	7	4	295	4	707	4	1422	254	328	879	4
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		3.0	4.0	4.0	4.0	4.0	4.0	3.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	0.95	0.95	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	0.99	0.99	1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.95		1.00	0.85	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1783	1785		1700	1340	1335	1785	3336	1551	1653	3398	
Flt Permitted	0.69	1.00		0.59	1.00	1.00	0.30	1.00	1.00	0.07	1.00	
Satd. Flow (perm)	1294	1785		1053	1340	1335	561	3336	1551	123	3398	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	7	8	4	321	4	768	4	1546	276	357	955	4
RTOR Reduction (vph)	0	4	0	0	178	178	0	0	98	0	0	0
Lane Group Flow (vph)	7	8	0	321	210	206	4	1546	178	357	959	0
Confl. Peds. (#/hr)	1					1						
Heavy Vehicles (%)	0%	0%	0%	5%	0%	12%	0%	7%	3%	8%	5%	0%
Turn Type	Perm			pm+pt		Perm	Perm		Perm	pm+pt		
Protected Phases		4		3	8			2		1	6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)	2.8	2.8		27.1	27.1	27.1	53.8	53.8	53.8	78.9	78.9	
Effective Green, g (s)	5.8	5.8		28.1	30.1	30.1	56.8	56.8	56.8	78.9	81.9	
Actuated g/C Ratio	0.05	0.05		0.23	0.25	0.25	0.47	0.47	0.47	0.66	0.68	
Clearance Time (s)	7.0	7.0		4.0	7.0	7.0	7.0	7.0	7.0	3.0	7.0	
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)	63	86		361	336	335	266	1579	734	363	2319	
v/s Ratio Prot		0.00		c0.16	0.16			c0.46		c0.18	0.28	
v/s Ratio Perm	0.01			c0.05		0.15	0.01		0.11	0.47		
v/c Ratio	0.11	0.10		0.89	0.62	0.61	0.02	0.98	0.24	0.98	0.41	
Uniform Delay, d1	54.6	54.6		43.4	39.9	39.8	16.8	31.0	18.8	39.9	8.4	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.04	0.62	
Incremental Delay, d2	0.8	0.5		22.3	3.6	3.3	0.1	18.2	0.8	40.8	0.5	
Delay (s)	55.4	55.1		65.8	43.5	43.1	16.9	49.2	19.6	82.3	5.7	
Level of Service	E	E		E	D	D	B	D	B	F	A	
Approach Delay (s)		55.2			49.9			44.7			26.5	
Approach LOS		E			D			D			C	

### Intersection Summary

HCM Average Control Delay	40.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	90.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			