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MEMO

TO:	File
FROM:	Mark VanderSluis, Keyur Shah
DATE:	October 26, 2009
COPIES:	Jack Thompson
OUR FILE:	W:\7k\7359 City Center BRT Functional Planning\7359.500 Transport\7359.505 Technical Memos\7359-mv-PM PK Future Sq One- Memo - 09-08-2009.doc
SUBJECT:	Afternoon peak hour traffic analysis for City Centre Mississauga BRT

Background:

The City of Mississauga, in conjunction with the Province of Ontario and Government of Canada, is preparing for the construction of the Mississauga Bus Rapid Transit (BRT) Project. The proposed BRT facility will extend from Winston Churchill Boulevard in the west to Renforth Drive in the east, running parallel to Highway 403, Eastgate Parkway and Eglinton Avenue. Through the Mississauga City Centre, the proposed BRT facility will include a median dedicated bus right-of-way on Rathburn Road between approximately Duke of York Boulevard and Shipp Drive.

MRC previously conducted a Traffic Impact Analysis to assess the potential impact of the BRT operation to traffic conditions on Rathburn Road for the morning peak hour. It is noted that the traffic volumes along Rathburn Road with the proposed BRT network and assumed diversion are higher in the morning peak hour and thus presented the worst case analysis in assessing the 2 GPL + BRT concept operations.

The existing signalized intersection at Hammerson Drive (Square One north entrance) and Rathburn Road was proposed in the preliminary design to be converted to a right-in–right–out intersection (RIRO). This design has conflict with Stakeholder's development interest; therefore a traffic analysis was requested in order to assess the impact the signalized intersection would have on BRT operations.

At Square One-Mississauga City Centre, two major developments were recently proposed in the vicinity of the Hammerson Drive/Rathburn Road intersection (the received details are presented in Appendix A). These developments include:

- Whole-foods Grocery Store (40,000 sq.ft)
- Crate & Barrel (24,128 sq.ft)

To measure the impact of the proposed development and associated in-bound traffic destined to the retail market from the signalised intersection at Hammerson Drive/Rathburn Road, a p.m. peak hour analysis was undertaken to reflect the afternoon retail and commuter trips.

This memorandum documents the traffic analysis undertaken to assess the potential impact to traffic operations that may arise from BRT facility in the City Centre with the proposed development and intersection design at City Centre during p.m. peak hour. This memorandum also presents results for the sensitivity analysis for BRT operations with the signalized intersection vs. right-in-right-out intersection at Hammerson Drive/Rathburn Road.

1. Analysis Introduction

This study makes use of the VISSIM micro-simulation software for various scenarios relating to the proposed BRT route through the City Centre. The following lists the p.m. peak hour scenarios that were analyzed using the VISSIM model:

Scenario 1: Existing Traffic Conditions (2008 Volume) on existing road network

Scenario 2: Opening day traffic analysis (Existing Traffic+ Site Traffic) on existing road network (overview analysis only)

Scenario 3: Existing traffic volume (2008) on Proposed BRT Network

Scenario 4: Background traffic conditions (Existing traffic + 30% growth) on existing road network.

Scenario 5: Background traffic scenario - (Existing traffic + 30% growth) on BRT network. This scenario involves a sensitivity analysis relating to two different intersection configurations at Hammerson Drive and Rathburn Road.

- 5.1 - Signalized Intersection at Hammerson Drive and Rathburn Road
- 5.2 –Right-in-right–out (un-signalized) intersection at Hammerson Drive (Square One North Entrance) and Rathburn Road.

Scenario 6: Total traffic scenario (Background +Site Traffic -Whole Foods Market, Crate and Barrel) on BRT network. This scenario involves an analysis relating to two different intersection configurations at Hammerson Drive and Rathburn Road.

- 6.1 – Signalized T-Intersection, this includes sensitivity analysis with:

  A: 300 vehicles on westbound left turn on Rathburn Road to Hammerson Drive.

  B: 350 vehicles on westbound left turn on Rathburn Road to Hammerson Drive.

- 6.2 - Four-leg signalized intersection at Rathburn Road and Hammerson Drive

The projected 30% growth represents a 2% growth per annum over a fifteen year period. This memorandum gives a detailed description of each of the scenarios including volume assumptions and calculations, levels of service for intersections and BRT travel times for the future scenarios.

2. PM Peak Hour Analysis

Scenario 1: Existing Traffic Conditions (2008 Traffic Volume on Existing Road Network)

Road Network: The existing road network at City Center was coded into the VISSIM model.

Traffic Volume Balancing:

The existing traffic counts reflect the weekday traffic counts undertaken by the City of Mississauga during 2007 and 2008. These traffic counts were balanced using the 2008 traffic counts as the control point. The balanced volumes can be found in Appendix B. The intersections included for the analysis are:

- Station Gate Road with Centre View Drive,
- Station Gate Road with Rathburn Road,
- Hammerson Drive with Rathburn Road,
- City Centre/Centre View Drive with Rathburn Road.

Transit Network: The 2008 bus operations were coded into the VISSIM model.

Signal Timings: The existing pm peak hour signal timing plans were used for the traffic analysis.

Results: The intersection Levels of Service (LOS) and Delay for the existing operational analysis are presented in Table 1. Only four of the intersections are included as they are most relevant to the area of study.

Table 1: **Intersection Capacity Analysis Results – Existing Traffic on Existing Network**

	Intersection		Critical Movement		
	LOS	Delay (Sec)	LOS	Queue Length 95%	Movement
Rathburn and Station Gate	B	10.05	A	30	EBT
Rathburn and Hammerson Dr	B	11.88	B	15	WBL
Rathburn and City Centre	E	59.12	B	56	WBT
Centre View and Station Gate	B	13.44	A	13	WBT

The results show that the Rathburn Road and City Centre Drive intersection is operating at a saturated Level of Service ‘E’. The other three intersections are operating at an acceptable level of service, and with relatively small queue lengths. The results of the intersection operational analysis for this scenario are presented in Appendix C.

Scenario 2: Opening day Traffic Conditions on Existing Road Network

Traffic Volume Balancing:

As per information received, Crate & Barrel is proposed to open before commencement of the BRT operation.

The p.m. peak hour trip generation for Crate & Barrel was estimated using rates outlined for a Furniture Showroom in the *ITE Trip Generation* guide. We note that for the p.m. peak hour, the trip generation rate is 0.53 trips / 1000 sq.ft. Crate & Barrel is proposed to be 24,128 sq.ft. – which results in 12.78 trips. With a rate of 50% entrance and 50% exit, there will only be six to seven vehicles added to those entering/existing the Square One area. With two entrances and exits in the vicinity, the generated traffic will not adversely affect the traffic operations at Square One-City Centre.

Therefore, it was not necessary to use a VISSIM model to analyse this operational scenario.

Scenario 3: Existing Traffic on Proposed BRT Network

The third analysis consisted of 2008 traffic volume on the proposed BRT network.

Road Network:

As per the preliminary design for the BRT facility, Rathburn Road was proposed to be reduced to 1 lane for the general traffic between Duke of York Boulevard and Hurontario Road. The proposed BRT facility in the Mississauga City Centre is shown in Appendix D. It should be noted that for this scenario, the intersection at Hammerson Drive (Square-One north entrance) /Rathburn Road is analyzed with a signalized intersection instead of a right-in-right-out as identified in the Preliminary Design.

The Preliminary Design indicated that Station Gate Road be turned into an exclusive bus only area, and the ramp from Hurontario Street to the intersection at Centre View Drive and Rathburn Road be altered so the ramp turned north onto Centre View and only allowed vehicles to travel in that direction. The coded network in VISSIM for the proposed BRT facility is presented in Figure 1.

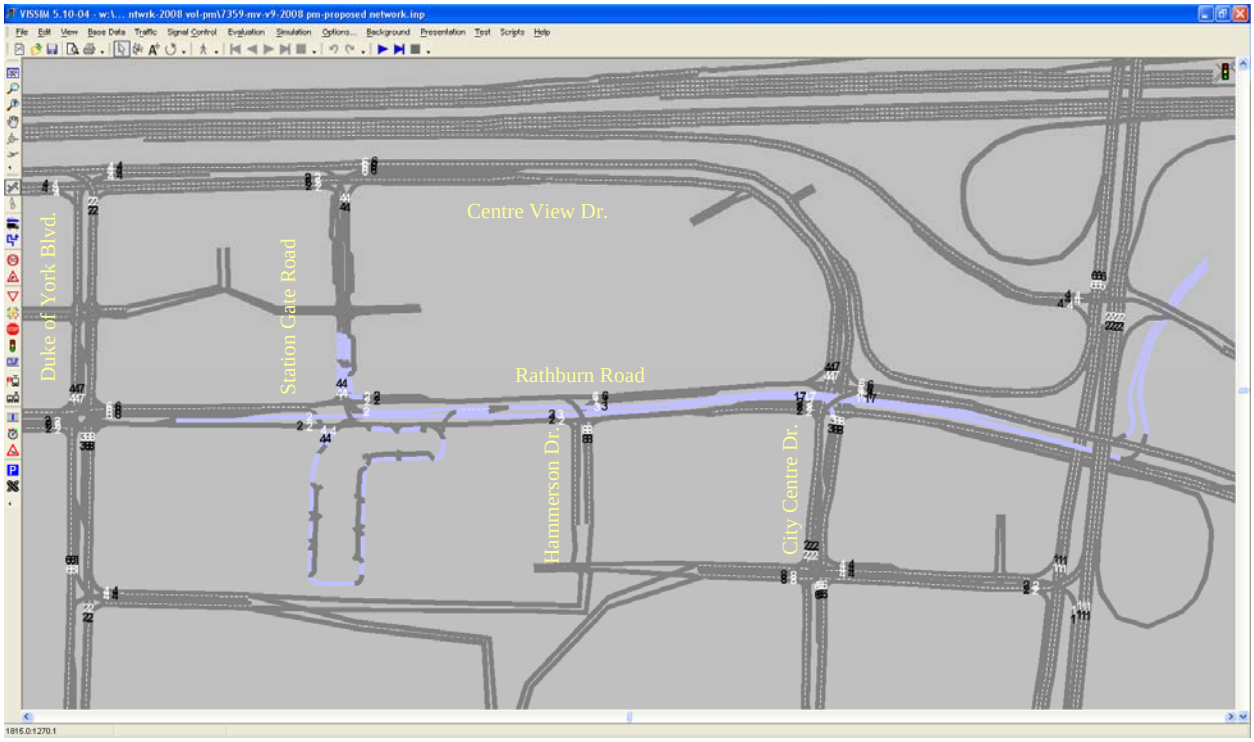


Figure 1: **Proposed BRT Network coded in VISSIM**

Traffic Volume Balancing:

To assess the impact of the traffic diversion to alternative routes due to the BRT network, further intersections were added for the analysis. These intersections include:

- Rathburn Road and Duke of York Boulevard,
- City Centre Drive and the East entrance of Square One Drive,
- Centre View Drive and Duke of York Boulevard,
- Duke of York Boulevard and the West entrance of Square-One Drive.

The volumes at these intersections were then balanced to match with the previous balanced traffic flows. The adjusted 2008 traffic volume with BRT road network is presented in Appendix B.

The majority of the through traffic and all of the right turning traffic initially coming from the Hurontario Street off-ramp was assigned to travel north-west along Centre View Drive.

A portion of the through traffic originally coming from Hurontario Street was determined to be turning left onto Hammerson Drive off of Rathburn. This traffic was reassigned along with the Hurontario ramp left turning traffic to travel south down Hurontario Street. Then this volume was diverted westbound onto Square One Drive. The traffic was then split between left turn and through movements at WB Square One Drive E. and City Centre Drive.

Since BRT lanes are provided along Rathburn Road, all vehicle traffic assigned to Station Gate Road were diverted. The right and left turns from Rathburn Road onto Station Gate Road and from Station Gate Road onto Rathburn Road were revised to right and left turns onto and out of Duke of York Boulevard. Similarly, the right and left turns from Centre View Drive onto Station Gate Road and from Station Gate Road onto Centre View Drive were revised to right and left turns onto and out of Duke of York Boulevard at Centre View Drive.

Transit Network: The existing 2008 bus operations were coded into the VISSIM model.

Signal Timings: Volumes were inputted into a Synchro model of the City Centre area and signal timings were optimized with the effect of the proposed BRT network.

Results: The results were simulated using VISSIM. The intersection Levels of Service (LOS) and Delay are presented in Table 2. The LOS and Queue Lengths for the critical movements at each intersection are also included.

The results of the intersection analysis for this scenario are presented in the Appendix C – Analysis Results.

Table 2: Intersection Capacity Analysis Results - Existing Traffic on BRT Network

	Intersection		Critical Movement		
	LOS	Delay (Sec)	LOS	Queue Length 95%	Movement
Rathburn and DOY Blvd	C	24.81	C	39	NBL
Rathburn and Station Gate	B	10.65	B	54	EBT
Rathburn and Hammerson Dr	B	14.99	B	10	WBL
Rathburn and City Centre	C	25.71	B	106	WBT
City Centre and Square One East	B	16.64	B	47	NBT
Centre View and Station Gate	A	0.34	A	0	WBT
Centre View and DOY Blvd	A	9.44	B	42	NBL

Changing the configuration of the Rathburn Road and City Centre Drive intersection positively affects the performance of the intersection with less average delay with the Level of Service improving to 'C' from the existing Level of Service 'E'. This is due to the removal of one phase in the cycle which frees up time for all the other movements.

Although the queue length for the westbound through movement increases, this increase can be attributed to the fact that the receiving lanes on the other side shrink from two to one thereby reducing the capacity of the through movement. All other intersections operate at acceptable levels with minimal queues and without significant change in average delay.

Scenario 4: Background Traffic Conditions on Existing Road Network

Road Network: The existing road network was used for this Scenario.

Traffic Volume Balancing:

The balanced traffic from Scenario 1 was increased by 30% for the future traffic growth to obtain the background traffic**.**

Transit Network: The existing bus operations were coded into the VISSIM model as the BRT network and BRT transit service are not operational.

Signal Timings: The existing p.m. peak hour signal timing plans were used for the traffic analysis.

Results: The intersection Levels of Service (LOS) and Delay for the future operational analysis are presented in Table 3. Only four of the intersections are included as they are most relevant to the area of study.

Table 3: Intersection Capacity Analysis Results – Future Traffic on Existing Road Network

	Intersection		Critical Movement		
	LOS	Delay (Sec)	LOS	Queue Length 95%	Movement
Rathburn and Station Gate	B	11.2	B	38	EBT
Rathburn and Hammerson Dr	B	12.73	B	17	WBL
Rathburn and City Centre	F	85.74	C	234	WBT
Centre View and Station Gate	B	13.39	A	14	WBT

The results indicate a “Do-Nothing Scenario” at the Rathburn Road and City Centre Drive intersection will degrade the level of service from ‘E’ to ‘F’. The queue lengths and average delay will also increase significantly at this intersection.

The other three intersections will still operate at acceptable levels of service, have roughly the same delays and have relatively small queue lengths at the critical movements. The results of the future operational analysis are presented in Appendix C.

Scenario 5: Background Traffic Conditions on Proposed BRT Network

Road Network:

For Scenario 5, two sub-scenarios were analysed.

Scenario 5.1: T-intersection (signalized) at Hammerson Drive and Rathburn Road

This scenario used the same road network as Scenario 3.

Scenario 5.2: RIRO (un-signalized) at Hammerson Drive and Rathburn Road

In this scenario, the signalized t-intersection at Hammerson Drive (Square One North Entrance) and Rathburn Road was converted into a right-in-right-out intersection. Therefore, the in-bound and out-bound left turning movements from Hammerson Drive were banned with a right-in-right-out (RIRO) as per preliminary design.

Figure 2 shows a VISSIM representation of this intersection.

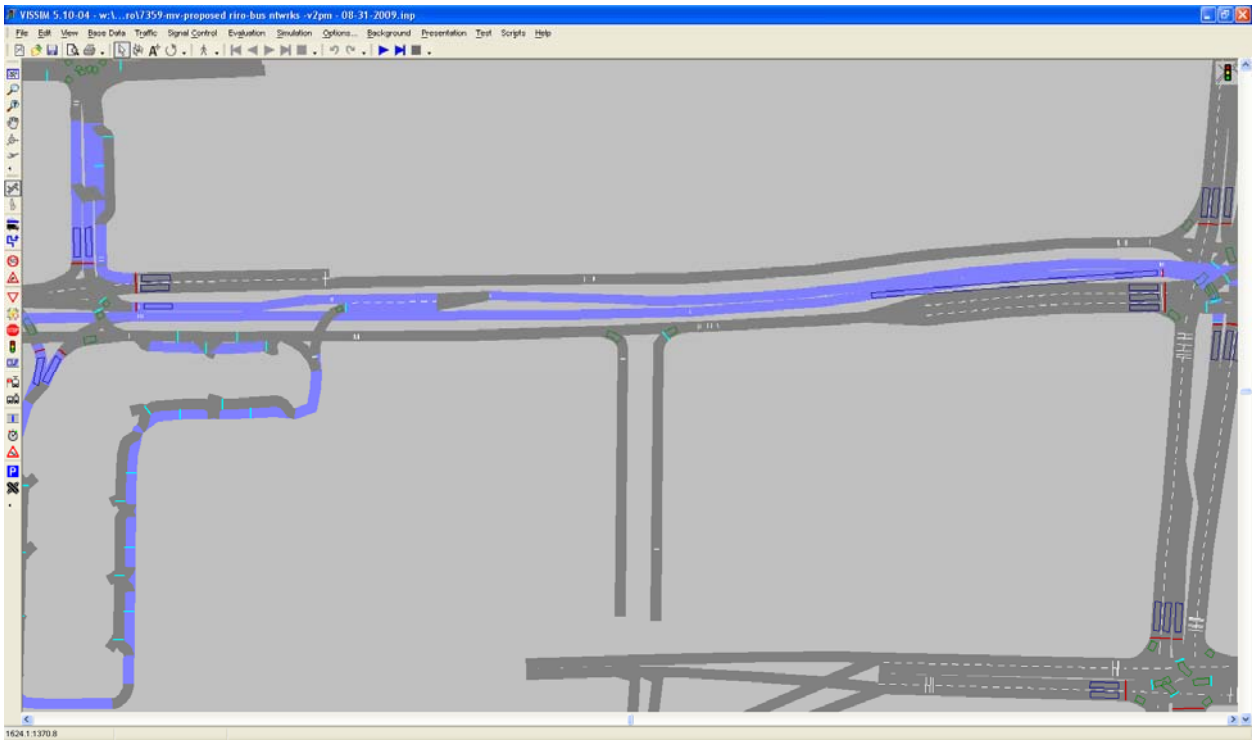


Figure 2: RIRO Intersection at Rathburn Road and Hammerson Drive

Traffic Volume Balancing:

Traffic Volume Balancing for Scenario 5.1:

To estimate background traffic, the traffic volume for Scenario 3 was used and an additional 30% additional traffic was added to each movement. The WB left turning movement at Rathburn Road and City Centre Drive was reduced to 350 vehicles from 446 as experience suggest to be the maximum volume that a single left turn lane could provide before significant delay results (Highway Capacity Manual 2000 suggests Double exclusive left turns for traffic volume greater than 300). This adjustment provided the balanced volume distribution for the future scenario with a signalized Hammerson Drive and Rathburn Road intersection.

Traffic Volume Balancing for Scenario 5.2:

The northbound left turning movement out of Hammerson Drive was redistributed to a right turning movement at Square One Drive West with Duke of York Boulevard. This additional volume was then split proportionally between northbound through and left turning movements at the Duke of York Boulevard/Rathburn Road intersection. The split was proportional to westbound through and right turning traffic at the same intersection.

For the future analysis, the 200 vehicles forecast to be turning left from Rathburn Road to Hammerson Drive were reassigned. Due to limited capacity at Rathburn Road and City Centre Drive, the 50 of the vehicles were assigned to the westbound left turning movement at the intersection of City Centre Drive and Rathburn Road. The other 150 vehicles were assumed to turning left at Rathburn Road and Shipp Drive, travelling south to Robert Speck Parkway and then west towards Centre View Drive. The 150 vehicles were then diverted north where the vehicles were assigned to a north bound left turning movement at the intersection of Square One Drive East entrance and City Centre Drive.

Transit Network: The a.m. peak hour BRT and local bus operation assumptions were utilised for the p.m. peak hour VISSIM analysis.

Signal Timings: Traffic volumes were input into a Synchro model of the City Centre area and signal timings were optimized. For both of the options considered in this scenario, BRT lanes were given an exclusive phase at the end of the signal cycle. The phase for the buses were 18 seconds and buses coded such that they cannot travel through the intersections outside of their exclusive phase.

Results: The results were simulated using VISSIM. The intersection Levels of Service (LOS) and Delay for Scenario 5.1 and Scenario 5.2 are presented in Table 4 and Table 5 respectively. The LOS and Queue Lengths for the critical movements at each intersection are also included.

Table 4: Intersection Capacity Analysis Results for Scenario 5.1

Signalized Square One Dr	Intersection		Critical Movement		
	LOS	Delay (Sec)	LOS	Queue Length 95%	Movement
Rathburn and DOY Blvd	D	39.79	D	123	NBL
Rathburn and Station Gate	C	24.83	D	314	EBT
Rathburn and Hammerson Dr	C	23.01	E	59	WBL
Rathburn and City Centre	D	54.33	E	309	WBT
City Centre and Square One East	E	58.66	F	107	NBT
Centre View and Station Gate	A	2.52	A	11	WBT
Centre View and DOY Blvd	B	14.15	B	62	NBL
Square One West and DOY Blvd	B	17.71	D	51	WBL

Table 5: Intersection Capacity Analysis Results for Scenario 5.2

RIRO Square One Dr	Intersection		Critical Movement		
	LOS	Delay (Sec)	LOS	Queue Length 95%	Movement
Rathburn and DOY Blvd	D	40.21	D	154	NBL
Rathburn and Station Gate	B	18.04	C	215	EBT
Rathburn and Hammerson Dr	A	6.4	N/A	N/A	WBL
Rathburn and City Centre	D	52.14	E	270	WBT
City Centre and Square One East	D	39.01	C	90	NBT
Centre View and Station Gate	A	2.07	A	12	WBT
Centre View and DOY Blvd	B	13.44	B	52	NBL
Square One West and DOY Blvd	B	14.76	C	50	WBL

All the intersections' Levels of Service increase by one grade compared to existing traffic on BRT network, with the exception of City Centre and Square One East which goes from 'B' to 'E' and Centre View and Station Gate which remains at a LOS 'A'.

Changing the Rathburn Road/ Hammerson Drive intersection to an unsignalized RIRO improves the LOS, Delay and Queue Lengths for all intersections except Rathburn Road and Duke of York Boulevard. However, this intersection only experiences a minor degradation in Delay and Queue Lengths, while Levels of Service remain the same.

The comparison of background traffic without the BRT network and with the BRT network is presented in Table 6. The intersection at Rathburn Road/Hammerson Drive is assumed to be a Signalized T-intersection for this comparison.

Table 6: Comparison of Intersection Operation Analysis with and without BRT network

	Without BRT Network – Scenario 4		With BRT Network- Scenario 5	
	LOS	Delay (Sec)	LOS	Delay (Sec)
Rathburn and Station Gate	B	11.2	C	24.83
Rathburn and Hammerson Dr	B	12.73	C	23.01
Rathburn and City Centre	F	85.74	D	54.33
Centre View and Station Gate	B	13.39	A	2.52

Scenario 6: Future Traffic with Additional Volume from Proposed Developments

Road Network:

For Scenario 6, two sub-scenarios were analysed.

- **Scenario 6.1 – T-Intersection at Hammerson Drive with Rathburn Road**

  This scenario used the same base road network as Scenario 3 modified to undertake the following operational sensitivity tests.

  6.1 A: 300 vehicles on westbound left turn at Rathburn Road/ Hammerson Drive

  6.1 B: 350 vehicles on westbound left turn at Rathburn Road/ Hammerson Drive

- **Scenario 6.2 – Four-Leg Intersection at Rathburn Road/ Hammerson Drive**

  This scenario used the same road network as Scenario 3 with an additional leg northbound at Rathburn Road and Hammerson Drive.

Traffic Volume Balancing:

This scenario dealt with the additional traffic volume that would be produced as a result of the proposed Whole Foods development added to the background traffic growth. For this scenario, MRC conducted a traffic count survey at a 'Whole Foods' market in Oakville to observe traffic entering and exiting the plaza. A memo was created which presented the results of this study called '*Whole Foods – Traffic Counts/Trip Generation Analysis'* found in Appendix E.

This memo presents trip rates along with the other findings of the study. To calculate the additional volumes, the trip rates for the road peak hour were used. For vehicles coming into the Whole Foods parking lot, a trip generation rate of 3.29 vehicles/1000 square feet of building space was used. For vehicles exiting the Whole Foods parking lot, a trip generation rate of 2.98 vehicles/1000 square feet was used. For the purposes of this study, we assumed the Whole Foods market to be built at Square One would be approximately the same size as the other Whole Foods market in Oakville.

The Whole Foods Market in Oakville (Cornwall Road and Reynolds St) was measured in Google Earth to be approximately 38,200 square feet. Subsequent to the analysis presented in Appendix E, we have received a plan of the proposed City Centre Whole Foods market which shows it to be 40,000 square feet. Since the difference is minimal, an updated analysis using this number was not completed. Using the same trip generation rates, the estimated vehicle trip attraction was 126 vehicles and the estimated vehicle trip origin was 114 vehicles each hour.

Two analysis Scenarios include:

Scenario 6.1 A: 300 vehicles on westbound left turn at Rathburn Road/Hammerson Drive

The first Scenario assumes 100 vehicles added to the WB left turning movement at Rathburn Road and Hammerson Drive (to obtain 300 left turning vehicles) and the other 26 vehicles added to the EB right turning movement. The additional 114 vehicles departing the new development were split proportionally between right and left turns at this intersection.

Scenario 6.1 B: 350 vehicles on westbound left turn at Rathburn Road/ Hammerson Drive

The second scenario was similar, however instead of 300 left turning vehicles; the volume was increased to 350, the increased left turns provided a sensitivity analysis to account for higher trips and proposed development of 'Crate and Barrel' .

Scenario 6.2: Four leg intersection at Rathburn Road/ Hammerson Drive

Scenario 6.2 included assessing the Rathburn Road/Hammerson Drive intersection as a four-leg intersection. This intersection design was proposed given the possibility of a new condominium building being built on the north east corner of this area. To successfully complete the analysis, additional volumes were added to the six new movements (EB left, NB through, WB right, SB left, through and right).

It should be noted that vehicles going into the new roadway are much higher then those exiting due to the nature of the analysis, more people will generally be coming home from work then leaving the complex for a work or shopping purpose. The balanced volumes used in these scenarios can be found in Appendix B.

Road Network:

For Scenario 6.1 A and Scenario 6.1 B, the same road network as Scenario 3 was used.

For Scenario 6.2, the T-intersection at Rathburn Road and Hammerson Drive is converted into a four-leg intersection. An additional leg added north of Rathburn Road will simulate an entranceway to the proposed condominium building. A VISSIM image of this is shown in Figure 3.

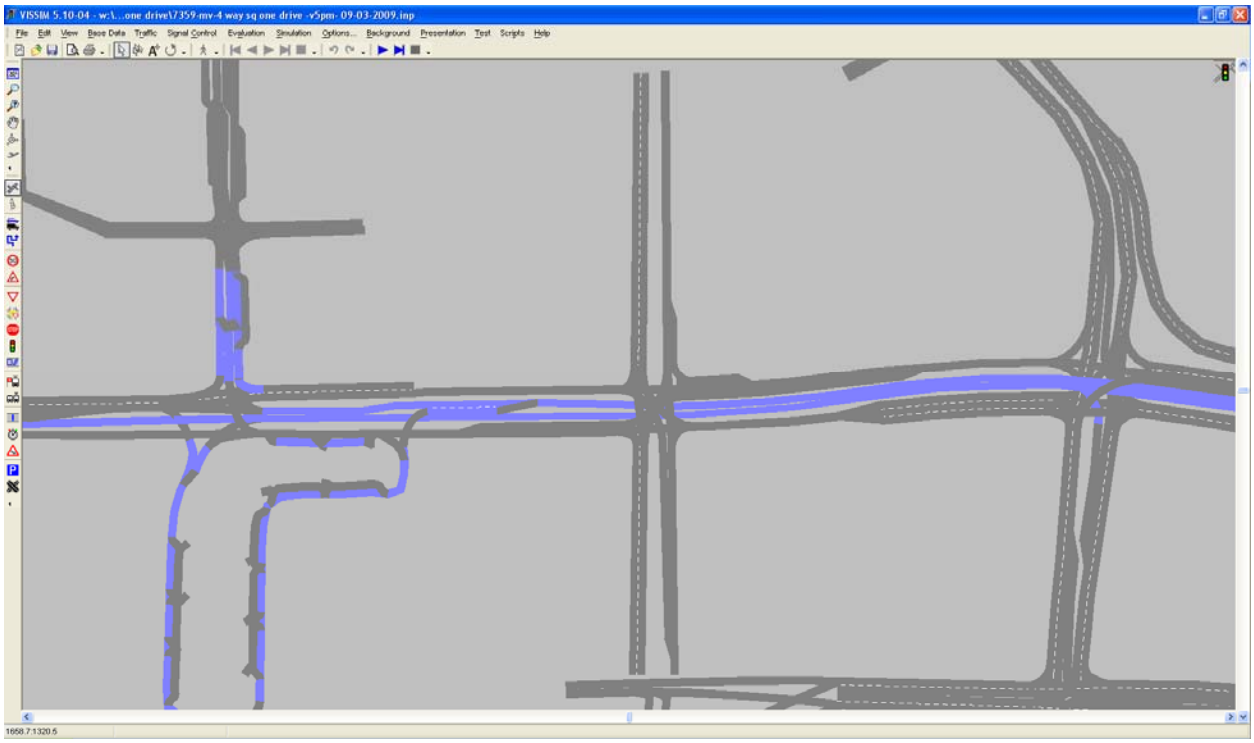


Figure 3: **Four Way Intersection at Rathburn Road and Hammerson Drive**

Transit Network: The future bus operations as used in Scenario 5 was used for the BRT network analysis.

Signal Timings: Volumes were input into a Synchro model of the City Centre area and signal timings were optimized. For both of the options in this scenario, BRT lanes were given an exclusive phase at the end of the cycles. Phase times of 18 seconds were assigned to the buses. The buses were restricted from traveling through the intersections outside of their exclusive phase.

Results: The results were simulated using VISSIM. The intersection Levels of Service (LOS) and Delay for Scenario 6.1 A and 6.1 B are presented in Table 7 and Table 8. The LOS and Queue Lengths for the critical movements at each intersection are also included.

Table 7: **Intersection Capacity Analysis Results for Scenario 6.1 A**

300 Left Turns into Square One	Intersection		Critical Movement		
	LOS	Delay (Sec)	LOS	Queue Length 95%	Movement
Rathburn and DOY Blvd	D	53.6	D	151	NBL
Rathburn and Station Gate	C	30.03	E	335	EBT
Rathburn and Hammerson Dr	D	37.43	F	180	WBL
Rathburn and City Centre	F	99.31	F	444	WBT
City Centre and Square One East	E	61.57	F	105	NBT
Centre View and Station Gate	A	2.14	A	8	WBT
Centre View and DOY Blvd	B	13.54	B	51	NBL
Square One West and DOY Blvd	C	25.98	D	60	WBL

Table 8: Intersection Capacity Analysis Results for Scenario 6.1 B

350 Left Turns Into Square One	Intersection		Critical Movement		
	LOS	Delay (Sec)	LOS	Queue Length 95%	Movement
Rathburn and DOY Blvd	E	61.69	D	187	NBL
Rathburn and Station Gate	C	34.3	E	372	EBT
Rathburn and Hammerson Dr	D	42.9	F	209	WBL
Rathburn and City Centre	F	102.2	F	445	WBT
City Centre and Square One East	E	63.3	F	107	NBT
Centre View and Station Gate	A	2.53	A	13	WBT
Centre View and DOY Blvd	B	13.59	B	48	NBL
Square One West and DOY Blvd	C	30.92	D	62	WBL

Referencing back to the results from Scenario 3, increasing the Rathburn Road WB left turn volume at Hammerson Drive affects the LOS and Queue Lengths of both the Rathburn Road/Hammerson Drive intersection and the Rathburn Road/City Centre Drive intersection. The other intersections experience slight increase in Queue Lengths which correspond to the minimal increase in volume coming through.

Table 9: Intersection Capacity Analysis Results for Scenario 6.2

	Intersection		Critical Movement		
	LOS	Delay (Sec)	LOS	Queue Length 95%	Movement
Rathburn and DOY Blvd	E	72.22	E	159	NBL
Rathburn and Station Gate	D	35.39	E	344	EBT
Rathburn and Hammerson Dr	E	55.02	F	188	WBL
Rathburn and City Centre	F	117.66	F	445	WBT
City Centre and Square One East	E	71.09	F	146	NBT
Centre View and Station Gate	A	2.5	A	12	WBT
Centre View and DOY Blvd	C	21.27	B	46	NBL
Square One West and DOY Blvd	C	29.15	E	N/A	WBL

The results for Scenario 6.2, shows a decrease in Queue Length for the WB left turn movement at Rathburn Road and Hammerson Drive from the previous analysis for Scenario 6.1 A. To accommodate the new movement the signal timings were revised.

Although the WB left turn movement reflects a decreased Queue Length, the overall LOS increases to LOS ‘E’ as the average Delay increased from 43 seconds to 55 seconds. This indicates that any additional developments will results in more delay to the existing intersections. The critical movements at the intersection experienced only minor increases or decreases in Queue Lengths, as these movements were operating in a congested state. The detailed analysis results can be found in Appendix C.

3: BRT Travel Times

The BRT bus travel time results from Scenario 5 and Scenario 6 are summarized in Table 10, providing a summary of all BRT bus travel times going between points A and B (EB) and going between points B and A (WB). Point A is located on the Eastern edge of Station Gate Road on Rathburn Road. Point B is located on the Western edge of City Centre Drive on Rathburn Road. Figure 4 shows a VISSIM image indicating the placement of these points.

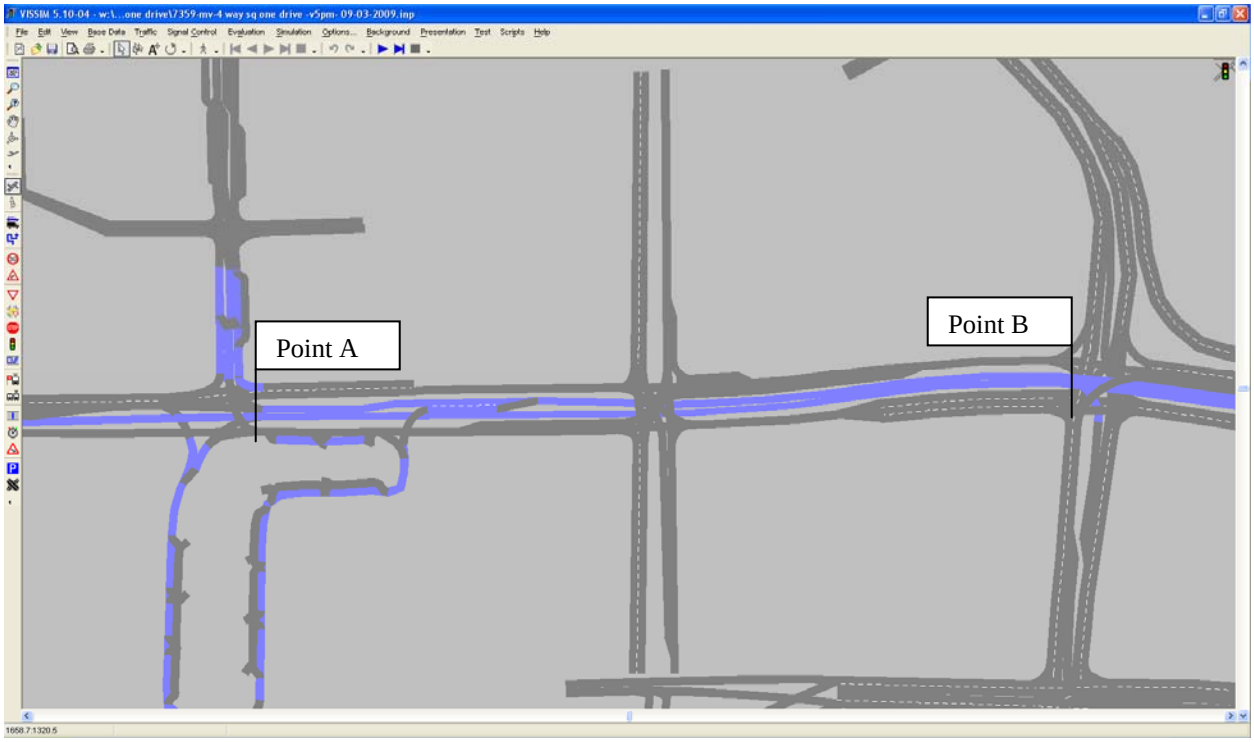


Figure 4: BRT Travel Time Point

Table 10: Summary of BRT Bus Travel Times between Points A and B (EB) and Points B and A (WB)

Scenario	EB BRT		WB BRT		Total BRT Bus Volume	Average
	BRT Bus Volume	Travel Time (Sec)	BRT Bus Volume	Travel Time (Sec)		Weighted Travel Time (Sec)
Future Volume – Signalized (Scenario 5.1)	48	185	27	204	75	191.84
Future Volume – RIRO (Scenario 5.2)	47	104	29	106	76	104.76
Future With Development (300 LT – Scenario 6.1A)	48	233	27	228	75	231.20
Future With Development (350 LT– Scenario 6.1 B)	49	233	27	242	76	236.20
Future With Development (4 leg Int. – Scenario 6.2)	48	274	28	241	76	261.84

The results of the BRT bus travel time analysis show a steady decrease in travel time as additional development occurs along the roadway with a signalized intersection at Hammerson Drive/ Rathburn Road. Scenario 5.1 ('Future Volume – Signalized') represents results from the future volume on the proposed BRT network with a T-Intersection at Hammerson Drive and Rathburn Road. This is the base scenario against which the others are measured.

Table 10 indicates that revising the intersection design at Rathburn Road/Hammerson Drive to an RIRO (right in-right out) will provide less delay to the BRT line. The average travel time is decreased by 87 seconds. This decrease in time results as the buses no longer have to wait for their phase in the cycle to cross through the intersection.

Conversely, adding the additional volume that the Whole Foods Market development will produce increased bus travel time. By adding an additional 100 left turning vehicles into the development, and increasing the vehicles leaving by 114, more time must be allocated to those turning movements resulting in decreased amount of time given to the buses and increasing the average travel time per bus by 39 seconds.

It is also noted that adding 50 additional in-bound left turning vehicles for the proposed development results in bus time increasing by an average time of 44 seconds.

The last scenario involves revising the T-intersection design at Rathburn Road and Hammerson Drive into a four-leg signalized intersection. The four-leg signalized intersection design results in the bus phases receiving a smaller percentage of green time. Thus bus travel times will increase from 192 seconds to 262 seconds. This difference of 70 seconds is very significant in that more then an extra minute is added to the travel time for each bus over a very small distance.

Conclusion:

Buses travelling through the study area (Rathburn Road from Station Gate Road to City Centre Drive) will experience increased travel times due to the development of both the Whole Foods Market development and the possible residential development on the north east corner of the intersection. With the Whole Foods Market and Crate and Barrel development, travel times for buses increase on average by 44 seconds per bus. With these two developments, and the possible residential development, bus travel time will increased by 70 seconds per bus.

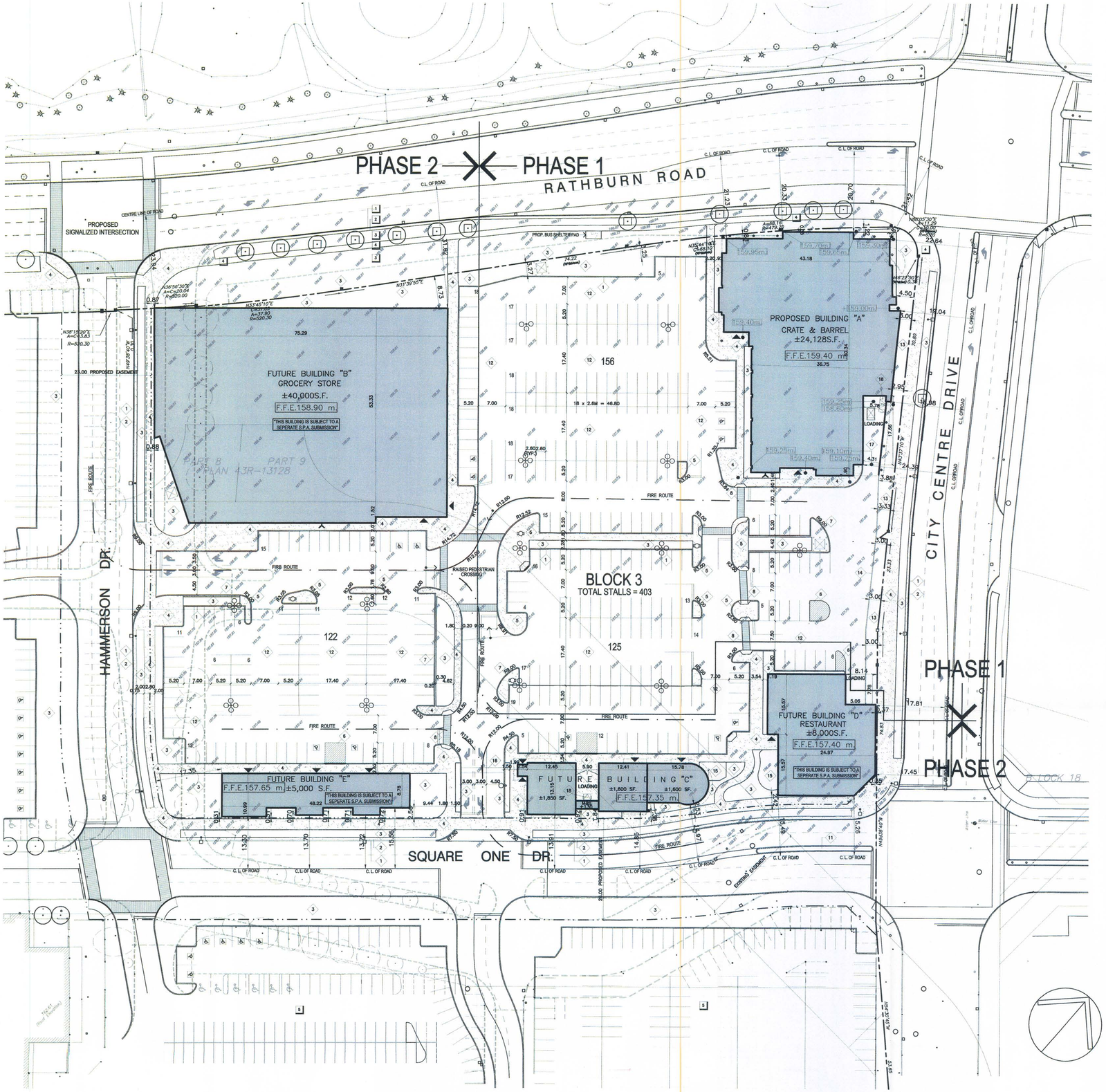
It should be noted that revising the intersection design at Rathburn Road/Hammerson Drive from a T-intersection to an un-signalized RIRO intersection reduces bus travel time by 87 seconds and increases in conjunction with increased development levels.

The intersection analyses' indicate that significant delays are to be expected at the Rathburn Road/City Centre Drive intersection and the Rathburn Road/Hammerson Drive intersection after development of the Whole Foods Market and Crate & Barrel showroom.

With the implementation of the BRT network, the intersection average delay at Rathburn Road/City Centre Drive/Centre View Drive was estimated to be reduced for the existing and background traffic scenarios. Thus, the proposed design would not adversely affect the traffic operational analysis.

APPENDIX A

PROPOSED DEVELOPMENT AT SQUARE ONE



SYMBOL LEGEND:

- PROPERTY LINE
- FIRE ROUTE WITH HEAVY DUTY PAVING
- PROPOSED EASEMENT
- EXIST CURB TO BE REMOVED
- EXIST CURB TO REMAIN
- DROPPED CURB FOR BARRIER FREE ACCESS
- TRAFFIC SIGN
- PAINTED LINES
- CONC. SIDEWALK (NEW)
- FH — FIRE HYDRANT
- MH — MANHOLE
- CB — CATCH BASIN
- LS — LIGHT STANDARD
- LSTP — LIGHT STANDARD/TRAFFIC POLE
- HP — HYDRO POLE
- NEW LIGHT POLE
- SIB — FOUND SURVEY MONUMENT
- SC — SIAMESE CONNECTION
- EXISTING ELEVATION
- PROPOSED ELEVATION
- PARKING FOR DISABILITY
- BUILDING ENTRANCE
- EXISTING TREE TO REMAIN
- EXISTING TREE TO BE REMOVED
- NEW TRANSFORMER PAD WITH BOLLARDS (SEE ELEC. DWG.)

NOTE LEGEND:

BE ADVISED THIS IS A STANDARD LEGENDS AND ONLY FOR THOSE KEYED FROM PLANS APPLY.

EXISTING

1. EXISTING CONC. CURB TO REMAIN
2. EXISTING CONC. SPLASH PAD TO REMAIN
3. EXISTING PLANTER/LANDSCAPED AREA TO REMAIN
4. EXISTING WALKWAY TO REMAIN
5. EXISTING SIGN TO REMAIN
6. EXISTING PARKING LOT TO REMAIN (RE-STRIPE PARKING LINES)
7. EXISTING BUS STOP TO REMAIN

NEW WORK

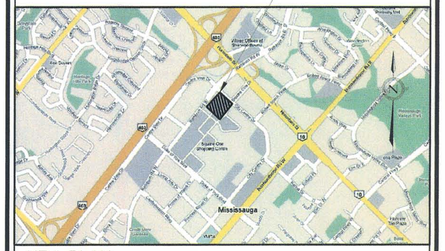
1. NEW CONCRETE CURB
2. NEW CONCRETE SPLASH PAD
3. NEW LANDSCAPED AREA
4. NEW CONCRETE WALKWAY
5. NEW CONCRETE CURB/ISLAND
6. NEW PAINTED TRAFFIC ISLAND
7. NEW CONC. CURB & APRON
8. NEW PEDESTRIAN CROSSING (PAINTED LINES) WITH H/C RAMPS
9. NEW PEDESTRIAN CROSSING (CONCRETE) WITH CURB BREAKS
10. NEW STOP SIGN
11. NEW CONCRETE MEDIAN
12. NEW ASPHALT PAVING
13. NEW LANDSCAPED BERM
14. NEW RETAINING WALL
15. NEW PATIO
16. NEW SPEED BUMP
17. NEW CONCRETE APRON
18. GARBAGE FACILITY

SITE PLAN DRAWING NOTES:

1. CONFORMITY TO SITE PLAN

I HEREBY CERTIFY THAT THIS CONFORMS IN ALL RESPECTS TO THE SITE DEVELOPMENT PLANS AS APPROVED BY THE CITY OF MISSISSAUGA UNDER THE FILE NUMBER SP—
ARCHITECT'S OR ENGINEER'S SIGNATURE———————

SITE LOCATION



KEY PLAN

2. BUILDING PERMIT ISSUANCE

THE CITY OF MISSISSAUGA REQUIRES THAT ALL WORKING DRAWINGS SUBMITTED TO THE BUILDING DIVISION, PLANNING AND BUILDING DEPARTMENT AS PART OF AN APPLICATION FOR THE ISSUANCE OF A BUILDING PERMIT SHALL BE CERTIFIED BY THE ARCHITECT OR ENGINEER AS BEING IN CONFORMITY WITH THE SITE DEVELOPMENT PLANS AS APPROVED BY THE CITY OF MISSISSAUGA.

3. EXTERIOR LIGHTING

ALL EXTERIOR LIGHTING WILL BE DIRECTED ONTO THE SITE AND WILL NOT INFRINGE UPON THE ADJACENT PROPERTIES.

4. GRADING

GRADES WILL BE MET WITHIN 33% MAXIMUM SLOPE AT THE PROPERTY LINES AND WITHIN THE SITE.

A. DISABLED PERSONS PARKING

PARKING SPACE(S) RESERVED FOR THE PHYSICALLY HANDICAPPED MUST BE IDENTIFIED BY A SIGN, INSTALLED AT THE APPLICANT'S EXPENSE, IN ACCORDANCE WITH THE DESIGN SPECIFICATIONS OF FIGURE 1 TO SCHEDULE 1 OF BY-LAW 134-83.

B. CONCRETE CURBING

CONTINUOUS 15 cm HIGH BARRIER TYPE POURED CONCRETE CURBING WILL BE PROVIDED BETWEEN ALL ASPHALT AND LANDSCAPED ARES THROUGHOUT THE SITE.

C. ROOF TOP MECHANICAL

ALL ROOF TOP MECHANICAL UNITS WILL BE SCREENED FROM VIEW.

MMC ARCHITECTURE

MMC INTERNATIONAL ARCHITECTS LTD.
519 Yonge Street, Toronto, Ontario, Canada, M4W 2G9
Tel:(416) 972-1901 mmc@mmcinternational.ca

ONTARIO ASSOCIATION OF ARCHITECTS
CHRISTOPHER P. BROWN
LICENCE 4309

No.	REVISIONS/ISSUED	DATE	BY	CITY
	ISSUED FOR S.P.A.	MAY 25, 2009		

counterpoint ENGINEERING
COUNTERPOINT ENGINEERING INC.
8395 Jane St., Suite 100, Vaughan, ON L4K 5Y2 Phone 905.326.1404 Fax 905.326.1405

ENGINEER'S STAMP

APPLICANT:
OXFORD PROPERTY GROUP
SUITE 1100, 130 ADELAIDE STREET WEST
TORONTO, ON M5H 3P5
Phone: 416-865-5374
Fax: 416-865-8307
CONTACT: MICHAEL DUFF

SITE LOCATION:
SQUARE ONE SHOPPING CENTRE, BLOCK 3
SQUARE ONE – BLOCK 3
RATHBURN ROAD & CITY CENTRE DRIVE
MISSISSAUGA ONTARIO

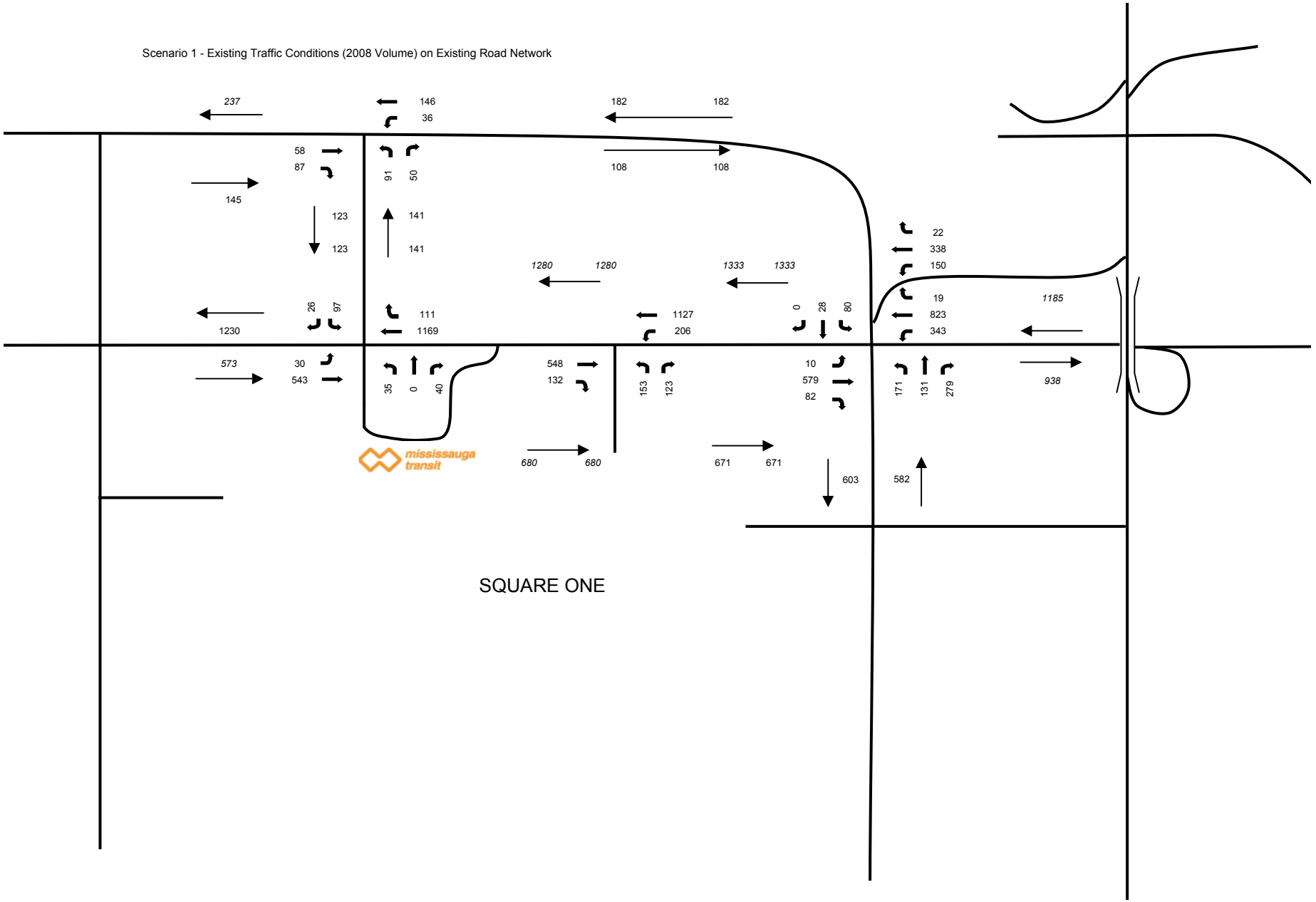
MASTER SITE PLAN

DESIGNED BY:	CHECKED BY:	DATE: MAY 2009
DRAWING BY: PDM	CHECKED BY: V.W.	PROJECT No. 09011
SWM BY:	CHECKED BY:	
SCALE: AS SHOWN		DRAWING No. MP-01

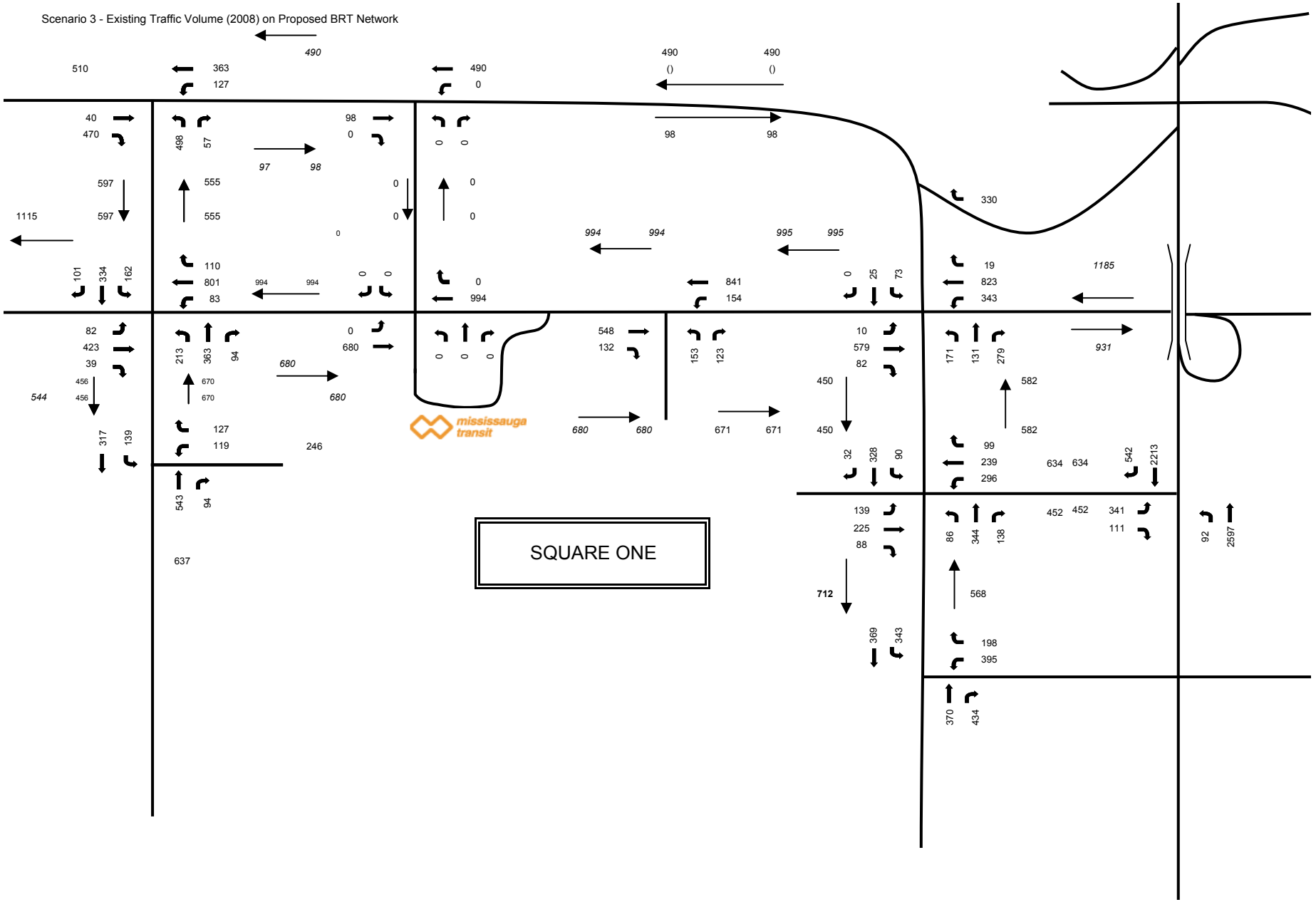
APPENDIX B

VOLUME BALANCING SUMMARY

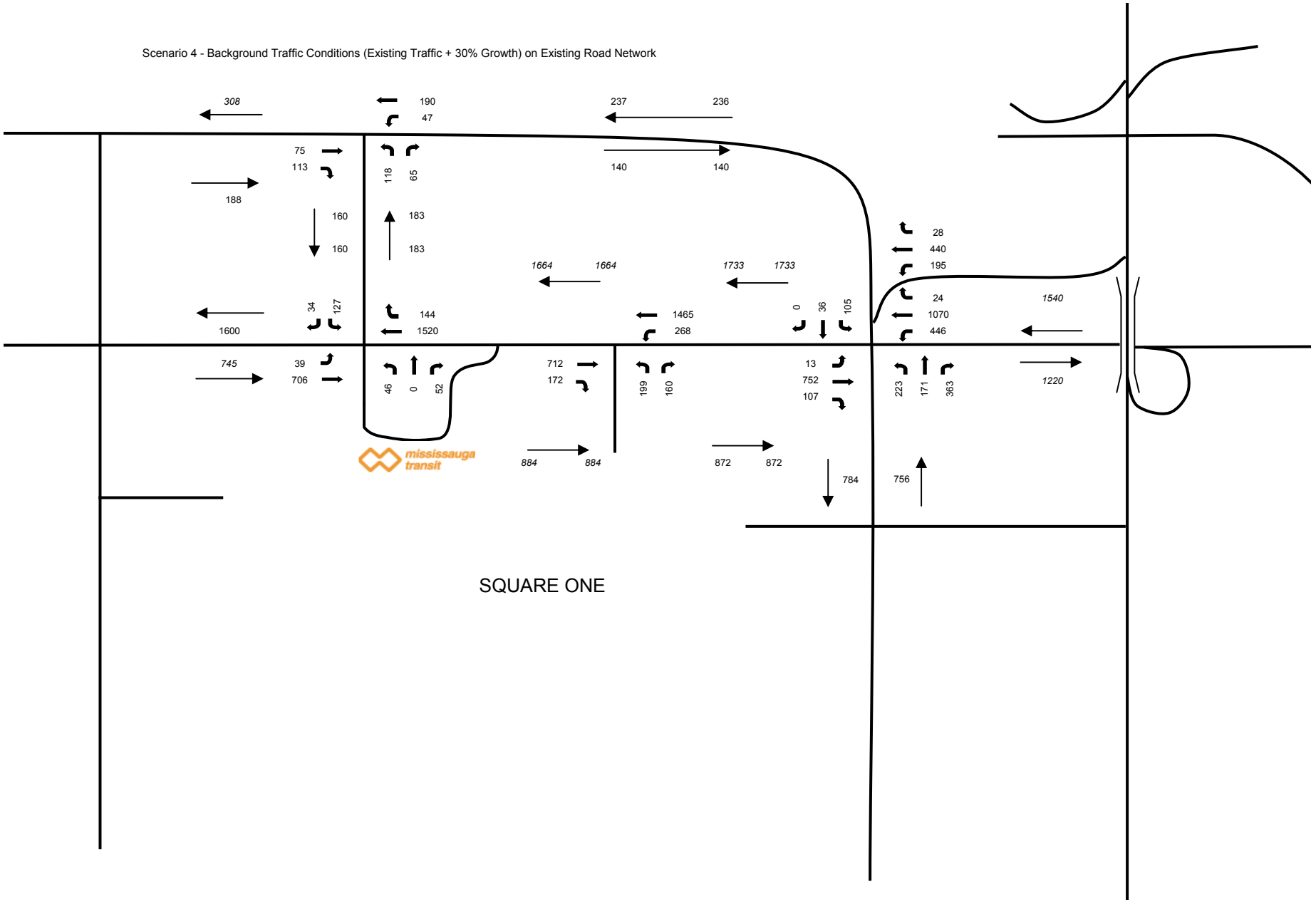
Scenario 1 - Existing Traffic Conditions (2008 Volume) on Existing Road Network



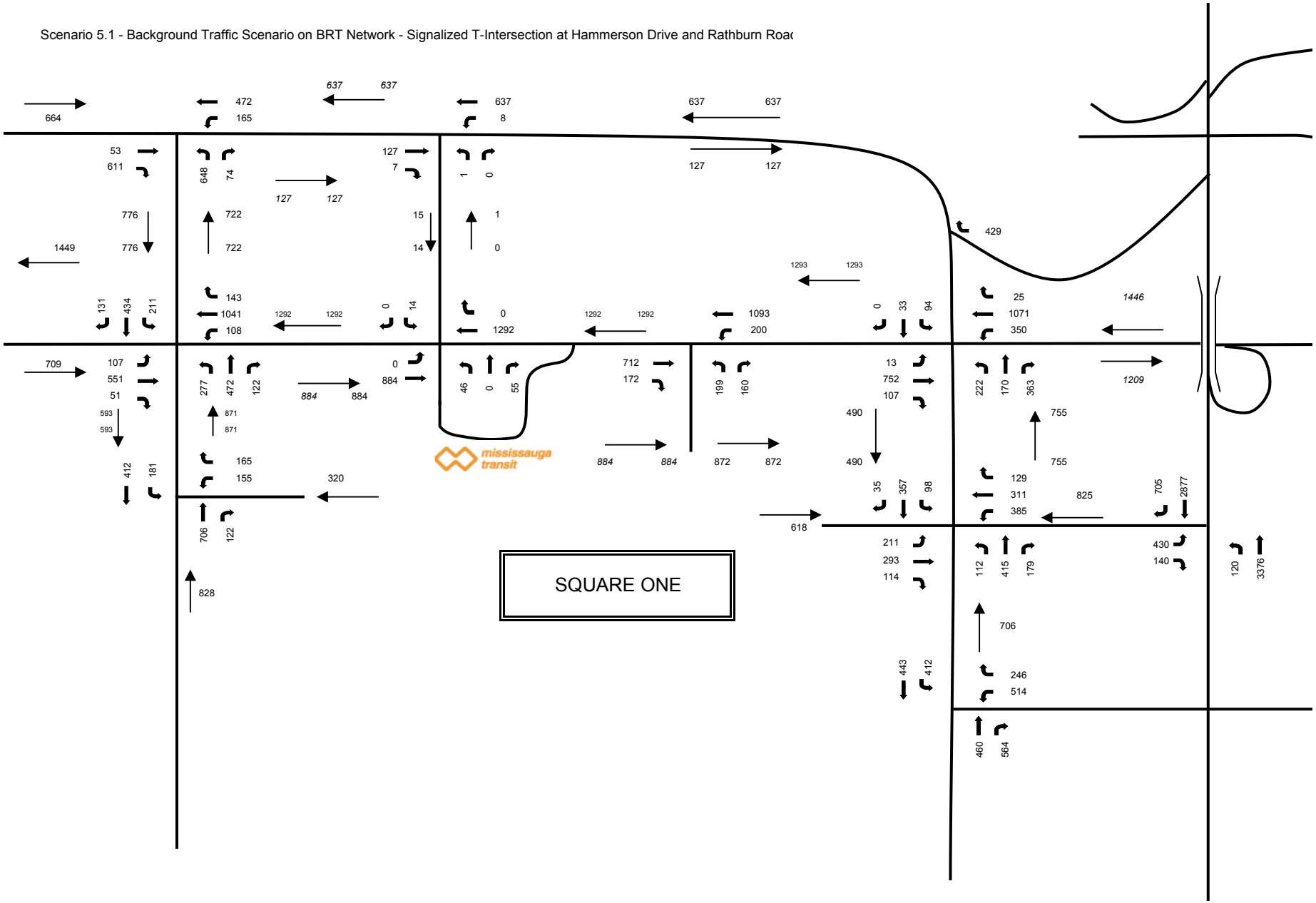
Scenario 3 - Existing Traffic Volume (2008) on Proposed BRT Network



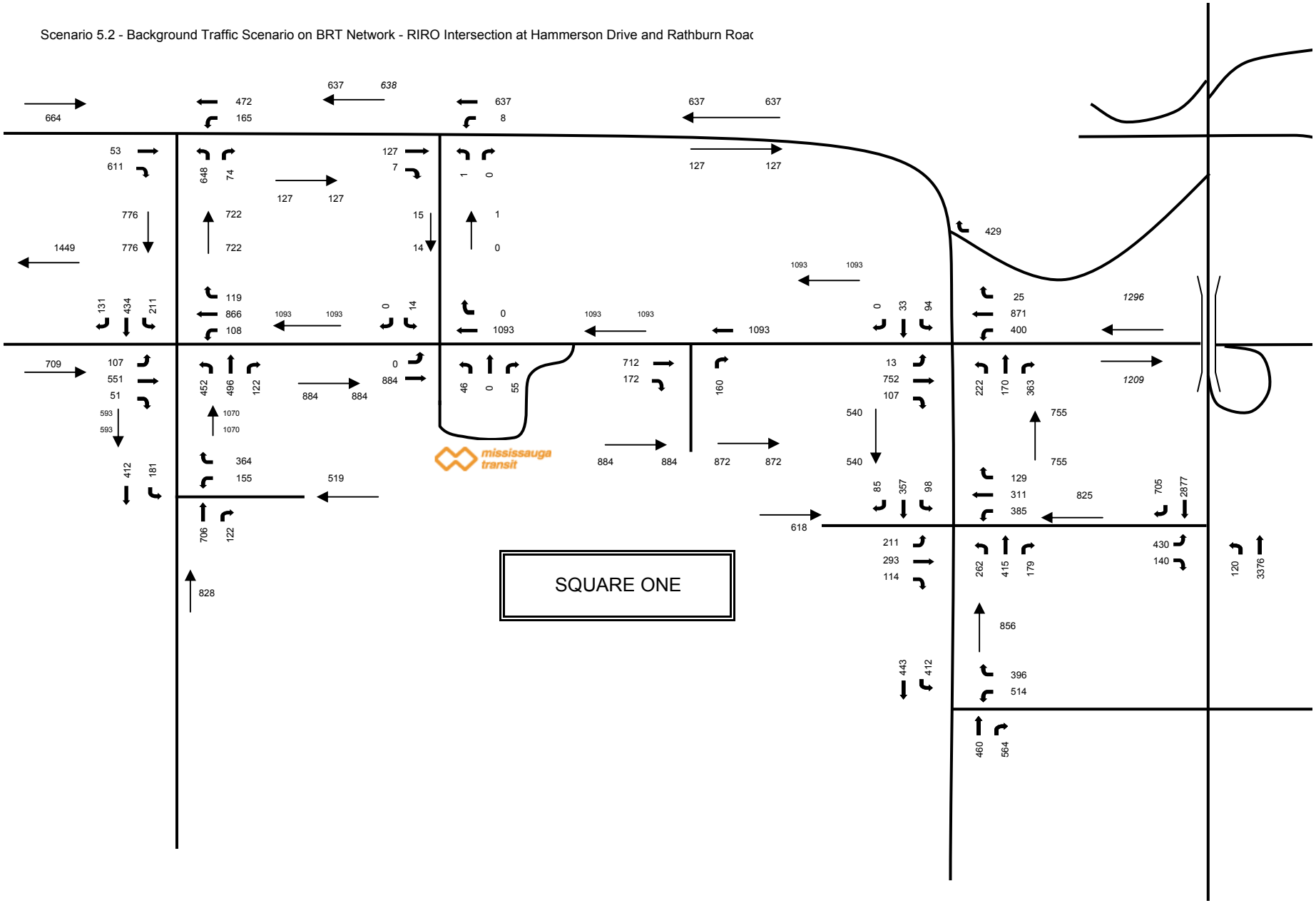
Scenario 4 - Background Traffic Conditions (Existing Traffic + 30% Growth) on Existing Road Network



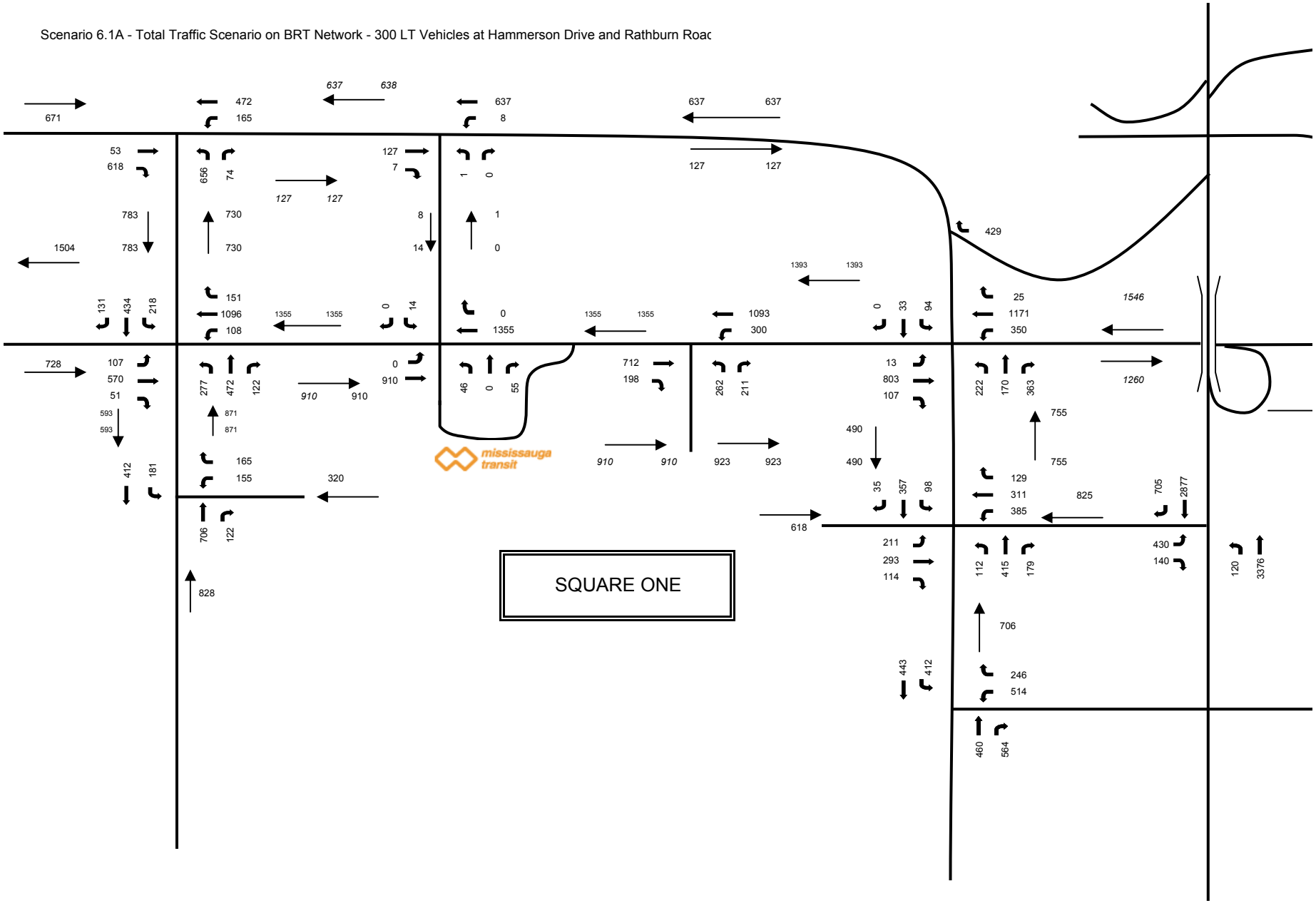
Scenario 5.1 - Background Traffic Scenario on BRT Network - Signalized T-Intersection at Hammerson Drive and Rathburn Roac



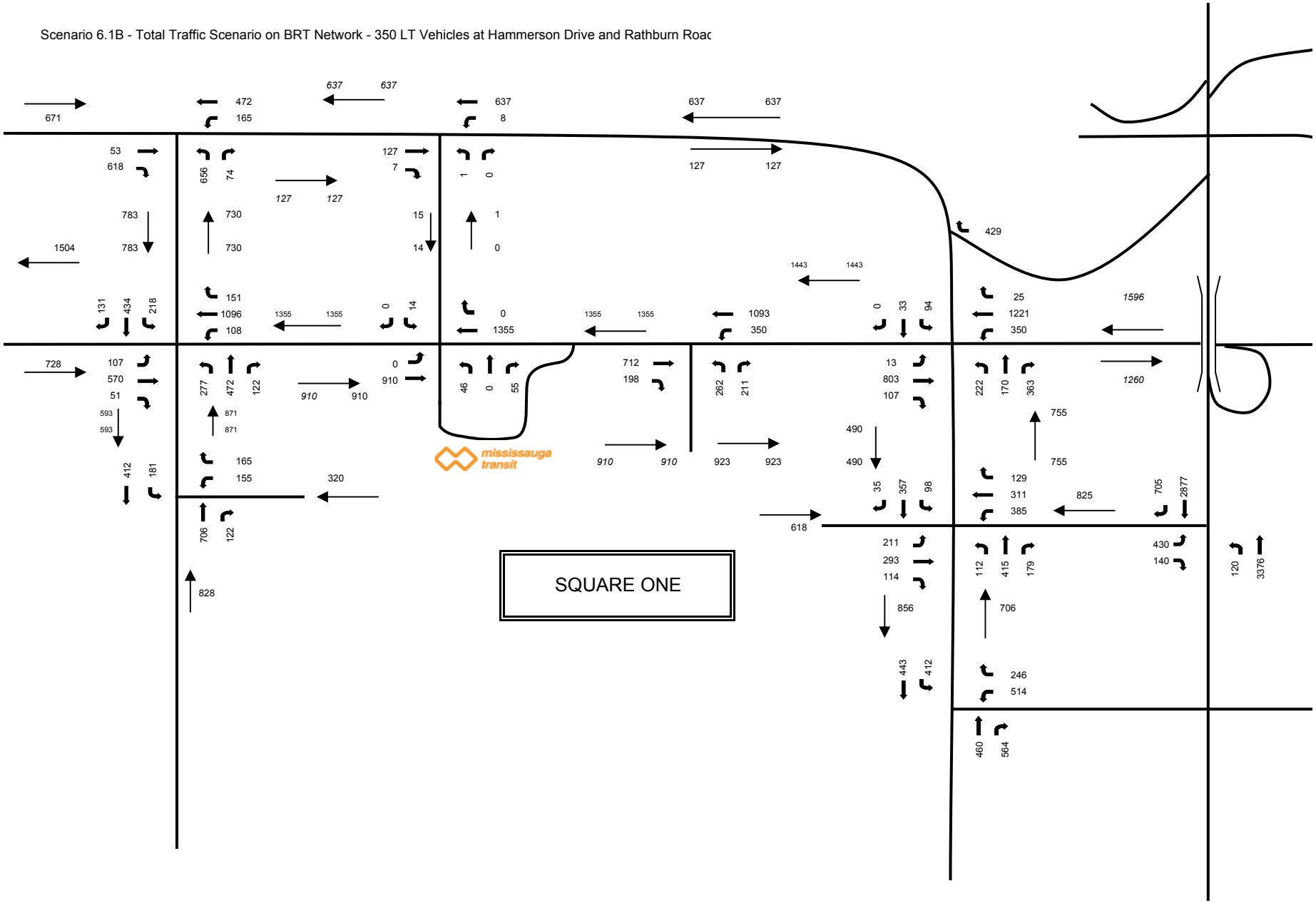
Scenario 5.2 - Background Traffic Scenario on BRT Network - RIRO Intersection at Hammerson Drive and Rathburn Roac



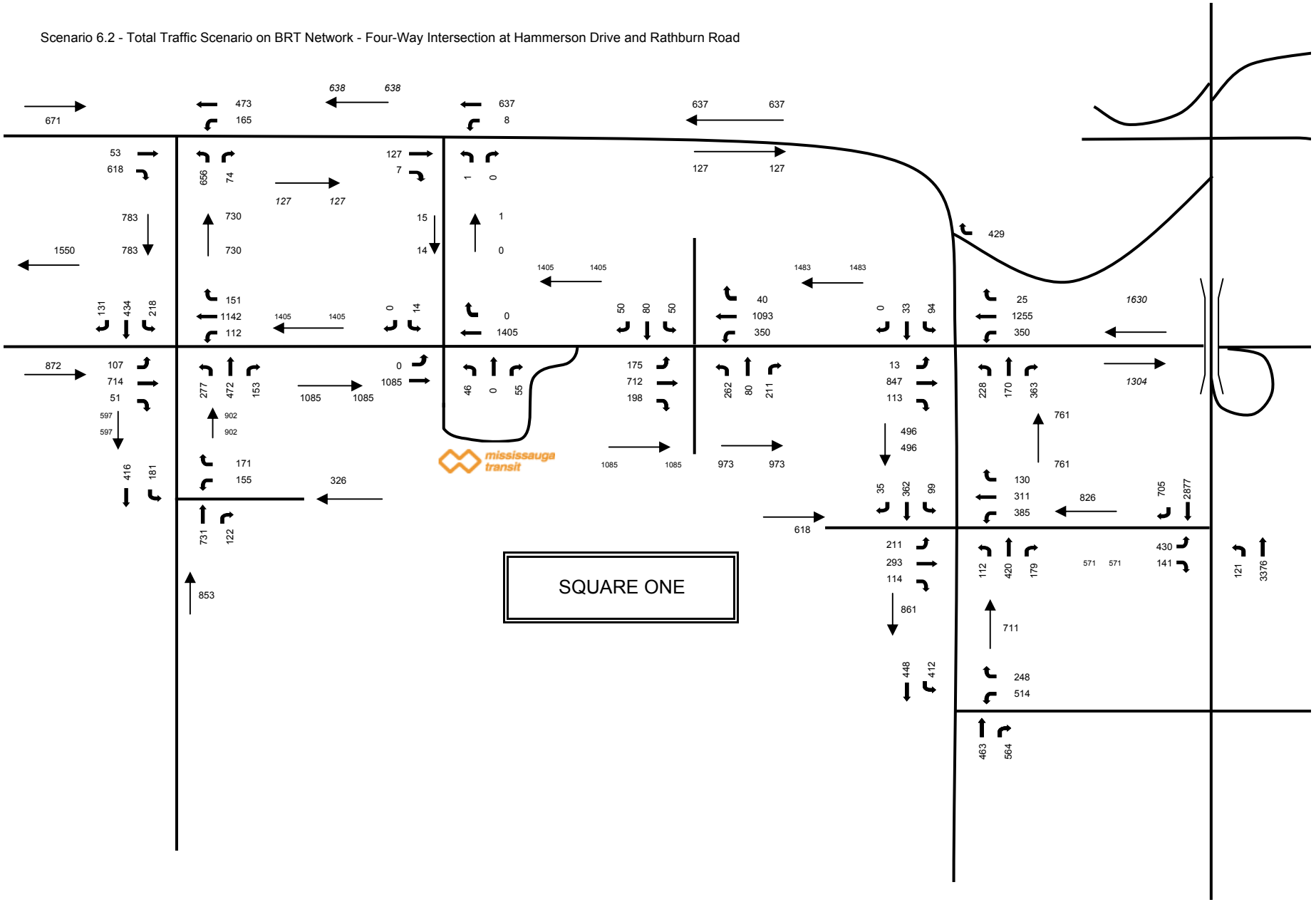
Scenario 6.1A - Total Traffic Scenario on BRT Network - 300 LT Vehicles at Hammerson Drive and Rathburn Roac



Scenario 6.1B - Total Traffic Scenario on BRT Network - 350 LT Vehicles at Hammerson Drive and Rathburn Roac



Scenario 6.2 - Total Traffic Scenario on BRT Network - Four-Way Intersection at Hammerson Drive and Rathburn Road



APPENDIX C

INTERSECTION ANALYSIS RESULTS

Operational Anaylsis
Level of Service, Vehicle Delay, Queue
PM Peak Hour Analysis
Scenario 1: Existing Traffic Conditions (2008 Volume) on existing road network

Rathburn Road at Station Gate Road				Control Type:	Signalized												
Movements	EBL	EBT		WBL	WBT	WBR	NBL		NBR	SBL		SBR					OVERALL
Travel Time Segment	701	702		704	705	706	707		708	709		710					
Queue Counter	701	702		704	705	705	707		708	709		710					
Hourly Volume (vph)	26	541		45	1119	105	24		52	99		23					2034
Vehicle Delay (s)	20	9		7	6	5	42		37	37		12					10.05
Queue Length 95th (m)	0	30		0	35	35	17		32	30		0					
Level of Service (LOS)	C	A		A	A	A	D		D	D		B					**B**

Rathburn Road at Hammerson Drive				Control Type:	Signalized												
Movements		EBT	EBR	WBL	WBT		NBL		NBR								OVERALL
Travel Time Segment		802	803	804	805		807		809								
Queue Counter		802	802	804	804		807		807								
Hourly Volume (vph)		586	120	124	1114		156		122								2222
Vehicle Delay (s)		10	7	13	10		37		9								11.88
Queue Length 95th (m)		49	49	15	15		37		37								
Level of Service (LOS)		B	A	B	B		D		A								**B**

Rathburn Road at City Centre Drive				Control Type:	Signalized												
Movements	EBL	EBT	EBR	WBL1	WBT1	WBR1	NBL	NBT	NBR	SBL	SBT	SBR	WBL2	WBT2	WBR2		OVERALL
Travel Time Segment	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915		
Queue Counter	901	902	902	904	905	905	907	908	908	910	911	911	913	913	913		
Hourly Volume (vph)	9	580	108	346	797	18	170	141	286	70	28	0	159	344	22		2553
Vehicle Delay (s)	42	40	34	30	18	17	156	96	87	115	41	0	55	42	31		59.12
Queue Length 95th (m)	0	64	64	56	56	56	119	118	118	40	11	11	63	63	63		
Level of Service (LOS)	D	D	C	C	B	B	F	F	F	F	D		D	D	C		**E**

Centre View Drive at Station Gate Road				Control Type:	Signalized												
Movements		EBT	EBR	WBL	WBT		NBL		NBR								OVERALL
Travel Time Segment		1201	1202	1203	1204		1205		1206								
Queue Counter		1201	1201	1203	1203		1205		1206								
Hourly Volume (vph)		56	87	36	151		85		45								460
Vehicle Delay (s)		2	2	7	8		49		7								13.44
Queue Length 95th (m)		1	1	13	13		30		0								
Level of Service (LOS)		A	A	A	A		D		A								**B**

Operational Anaylsis
Level of Service, Vehicle Delay, Queue
PM Peak Hour Analysis - Future Network
Scenario 3: Existing Traffic Volume (2008) on Proposed BRT Network

Rathburn Road at Duke of York Blvd.				Control Type:	Signalized												
Movements	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR					OVERALL
Travel Time Segment	601	602	603	604	605	606	607	608	609	610	611	612					
Queue Counter	601	602	602	604	605	605	607	608	608	610	611	611					
Hourly Volume (vph)	82	415	43	24	826	108	204	358	106	121	332	96					2715
Vehicle Delay (s)	32	19	15	25	16	14	32	30	27	31	41	35					24.81
Queue Length 95th (m)	16	63	63	6	65	65	39	54	54	18	47	47					
Level of Service (LOS)	C	B	B	C	B	B	C	C	C	C	D	C					**C**

Rathburn Road at Station Gate Road				Control Type:	Signalized												
Movements		EBT		WBL	WBT	WBR	NBL		NBR	SBL		SBR					OVERALL
Travel Time Segment		702		704	705	706	707		708	709		710					
Queue Counter		702		704	705	705	707		708	709		710					
Hourly Volume (vph)		609		0	991	0	28		52	11		0					1691
Vehicle Delay (s)		12		0	8	0	42		24	48		0					10.65
Queue Length 95th (m)		54		11	98	98	14		0	12		0					
Level of Service (LOS)		B			A		D		C	D							**B**

Rathburn Road at Hammerson Drive				Control Type:	Signalized												
Movements		EBT	EBR	WBL	WBT		NBL		NBR								OVERALL
Travel Time Segment		802	803	804	805		807		809								
Queue Counter		802	802	804	804		807		807								
Hourly Volume (vph)		572	117	143	854		138		130								1954
Vehicle Delay (s)		18	15	18	7		49		16								14.99
Queue Length 95th (m)		114	114	10	46		44		44								
Level of Service (LOS)		B	B	B	A		D		B								**B**

Rathburn Road at City Centre Drive				Control Type:	Signalized												
Movements	EBL	EBT	EBR	WBL1	WBT1	WBR1	NBL	NBT	NBR	SBL	SBT	SBR	WBL2	WBT2	WBR2		OVERALL
Travel Time Segment	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	
Queue Counter	901	902	902	904	905	905	907	908	908	910	911	911	913	913	913	916	
Hourly Volume (vph)	9	565	106	344	831	21	166	131	268	65	24	0	0	0	0	333	2530
Vehicle Delay (s)	26	31	38	23	15	3	13	49	40	40	54	0	0	0	0	1	25.71
Queue Length 95th (m)	0	75	75	1	106	106	51	58	58	12	0	0	0	0	0	24	
Level of Service (LOS)	C	C	D	C	B	A	B	D	D	D	D					A	**C**

City Centre Drive at Square One West Entrance				Control Type:	Signalized												
Movements	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR					OVERALL
Travel Time Segment	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112					
Queue Counter	1101	1101	1101	1104	1104	1106	1107	1108	1108	1110	1110	1110					
Hourly Volume (vph)	122	237	87	295	235	110	83	364	119	87	341	34					2114
Vehicle Delay (s)	15	9	7	29	11	7	18	19	17	30	16	14					16.64
Queue Length 95th (m)	24	24	24	41	41	0	12	47	47	30	30	30					
Level of Service (LOS)	B	A	A	C	B	A	B	B	B	C	B	B					**B**

Centre View Drive at Station Gate Road				Control Type:	Signalized												
Movements		EBT	EBR	WBL	WBT		NBL		NBR								OVERALL
Travel Time Segment		1201	1202	1203	1204		1205		1206								
Queue Counter		1201	1201	1203	1203		1205		1206								
Hourly Volume (vph)		89	5	6	482		1		0								583
Vehicle Delay (s)		0	2	2	0		60		0								0.34
Queue Length 95th (m)		0	0	0	0		0		0								
Level of Service (LOS)		A	A	A	A		E										**A**

Centre View Drive at Duke of York Blvd.				Control Type:	Signalized												
Movements		EBT	EBR	WBL	WBT		NBL		NBR								OVERALL
Travel Time Segment		1301	1302	1303	1304		1305		1306								
Queue Counter		1301	1301	1303	1303		1305		1305								
Hourly Volume (vph)		43	472	134	349		495		50								1543
Vehicle Delay (s)		6	6	6	6		16		13								9.44
Queue Length 95th (m)		16	16	17	17		42		42								
Level of Service (LOS)		A	A	A	A		B		B								**A**

Operational Anaylsis
Level of Service, Vehicle Delay, Queue
2008 PM Peak Hour Analysis
Scenario 4: Background Traffic Conditions (Existing Traffic + 30% Growth) on Existing Road Network

Rathburn Road at City Center Transit Terminal				Control Type:	Signalized												
Movements	EBL	EBT		WBL	WBT	WBR	NBL		NBR	SBL		SBR					OVERALL
Travel Time Segment	701	702		704	705	706	707		708	709		710					
Queue Counter	701	702		704	705	705	707		708	709		710					
Hourly Volume (vph)	38	706		45	1439	137	24		51	122		30					2592
Vehicle Delay (s)	29	12		10	8	7	45		37	35		11					11.20
Queue Length 95th (m)	2	38		0	49	49	23		35	36		0					
Level of Service (LOS)	C	B		B	A	A	D		D	C		B					**B**

Rathburn Road at Square One North Entrance				Control Type:	Signalized												
Movements		EBT	EBR	WBL	WBT		NBL		NBR								OVERALL
Travel Time Segment		802	803	804	805		807		809								
Queue Counter		802	802	804	804		807		807								
Hourly Volume (vph)		738	156	148	1420		202		153								2817
Vehicle Delay (s)		12	7	15	11		36		10								12.73
Queue Length 95th (m)		61	61	17	17		42		42								
Level of Service (LOS)		B	A	B	B		D		B								**B**

Rathburn Road at City Centre Drive				Control Type:	Signalized												
Movements	EBL	EBT	EBR	WBL1	WBT1	WBR1	NBL	NBT	NBR	SBL	SBT	SBR	WBL2	WBT2	WBR2		OVERALL
Travel Time Segment	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915		
Queue Counter	901	902	902	904	905	905	907	908	908	910	911	911	913	913	913		
Hourly Volume (vph)	13	728	127	433	1055	23	157	148	292	86	35	0	199	441	29		3097
Vehicle Delay (s)	59	40	36	97	34	29	218	124	110	254	43	0	77	63	56		85.74
Queue Length 95th (m)	3	74	74	270	234	234	128	127	127	110	12	12	107	107	107		
Level of Service (LOS)	E	D	D	F	C	C	F	F	F	F	D		E	E	E		**F**

Centre View Drive at Station Gate Road				Control Type:	Signalized												
Movements		EBT	EBR	WBL	WBT		NBL		NBR								OVERALL
Travel Time Segment		1201	1202	1203	1204		1205		1206								
Queue Counter		1201	1201	1203	1203		1205		1206								
Hourly Volume (vph)		75	111	41	170		114		58								569
Vehicle Delay (s)		3	1	6	8		46		8								13.39
Queue Length 95th (m)		5	5	14	14		36		0								
Level of Service (LOS)		A	A	A	A		D		A								**B**

Operational Anaylsis
Level of Service, Vehicle Delay, Queue
2031 PM Peak Hour Analysis
Scenario 5.1 - Background Traffic Scenario (Existing Traffic + 30% Growth) on BRT Network - Signalized Intersection at Hammerson Drive and Rathburn Road

Rathburn Road at Duke of York Blvd.					Control Type:	Signalized											
Movements	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR					OVERALL
Travel Time Segment	601	602	603	604	605	606	607	608	609	610	611	612					
Queue Counter	601	602	602	604	605	605	607	608	608	610	611	611					
Hourly Volume (vph)	104	543	54	90	1029	144	259	444	126	221	408	120					3542
Vehicle Delay (s)	49	65	77	39	19	14	41	49	60	53	46	10					39.79
Queue Length 95th (m)	27	131	131	27	92	92	123	164	164	61	65	65					
Level of Service (LOS)	D	E	E	D	B	B	D	D	E	D	D	A					**D**

Rathburn Road at Station Gate					Control Type:	Signalized											
Movements	EBT	EBBusT	WBT	WBBusL	WBBusT	WBBusR		NBBusL	NBusR	SBBusL		SBBusR					OVERALL
Travel Time Segment	702	703	705	704	711	706		707	708	709		710					
Queue Counter	702	703	705	704	706	706		707	708	709		710					
Hourly Volume (vph)	837	5	1251	42	4	24		30	49	47		0					2289
Vehicle Delay (s)	45	9	6	41	101	104		70	32	75		0					24.83
Queue Length 95th (m)	314	0	6	38	19	19		41	0	41		0					
Level of Service (LOS)	D	A	A	D	F	F		E	C	E							**C**

Rathburn Road at Hammerson					Control Type:	Signalized											
Movements		EBT	EBR	WBL	WBT		NBL		NBR								OVERALL
Travel Time Segment		802	803	804	805		807		809								
Queue Counter		802	802	804	805		807		807								
Hourly Volume (vph)		726	174	190	1057		183		165								2495
Vehicle Delay (s)		20	21	55	13		56		27								23.01
Queue Length 95th (m)		210	210	59	110		53		54								
Level of Service (LOS)		C	C	E	B		E		C								**C**

Rathburn Road at City Centre Drive					Control Type:	Signalized											
Movements	EBL	EBT	EBR	WBL1	WBT1	WBR1	NBL	NBT	NBR	SBL	SBT	SBR	WBBusT	EBBusT			OVERALL
Travel Time Segment	901	902	903	904	905	906	907	908	909	910	911	912	913	917			
Queue Counter	902	902	902	904	905	905	907	908	908	910	911	911	913	914			
Hourly Volume (vph)	12	747	130	330	1050	25	171	140	345	94	32	0	30	48			3154
Vehicle Delay (s)	17	25	23	52	57	57	141	101	63	56	58	0	64	49			54.33
Queue Length 95th (m)	117	117	117	50	309	309	186	163	163	39	9	9	26	30			
Level of Service (LOS)	B	C	C	D	E	E	F	F	E	E	E		E	D			**D**

City Centre Drive at Square One West Entrance					Control Type:	Signalized											
Movements	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR					OVERALL
Travel Time Segment	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112					
Queue Counter	1101	1101	1101	1104	1104	1106	1107	1108	1108	1110	1110	1110					
Hourly Volume (vph)	196	280	113	371	323	147	85	351	149	98	358	33					2504
Vehicle Delay (s)	68	44	36	66	29	51	52	129	92	43	23	17					58.66
Queue Length 95th (m)	89	89	89	60	60	60	47	107	107	40	40	40					
Level of Service (LOS)	E	D	D	E	C	D	D	F	F	D	C	B					**E**

Centre View Drive at Station Gate Road					Control Type:	Signalized											
Movements		EBT	EBR	WBL	WBT		NBL		NBR								OVERALL
Travel Time Segment		1201	1202	1203	1204		1205		1206								
Queue Counter		1201	1201	1203	1203		1205		1206								
Hourly Volume (vph)		126	36	22	599		17		7								807
Vehicle Delay (s)		0	6	5	1		50		15								2.52
Queue Length 95th (m)		2	2	11	11		14		0								
Level of Service (LOS)		A	A	A	A		D		B								**A**

Centre View Drive at Duke of York Blvd.					Control Type:	Signalized											
Movements		EBT	EBR	WBL	WBT		NBL		NBR								OVERALL
Travel Time Segment		1301	1302	1303	1304		1305		1306								
Queue Counter		1301	1301	1303	1303		1305		1305								
Hourly Volume (vph)		84	596	160	458		620		76								1994
Vehicle Delay (s)		11	15	10	9		19		17								14.15
Queue Length 95th (m)		64	64	25	25		62		62								
Level of Service (LOS)		B	B	A	A		B		B								**B**

Square One Drive at Duke of York Blvd.					Control Type:	Signalized											
Movements		SBT	SBL		WBL	WBR		NBR	NBT								OVERALL
Travel Time Segment		1452	1453		1451	1450		1455	1454								
Queue Counter		1452	1453		1450	1450		1455	1455								
Hourly Volume (vph)		389	161		158	151		712	712								2283
Vehicle Delay (s)		4	24		51	19		15	19								17.71
Queue Length 95th (m)		15	32		51	51		32	32								
Level of Service (LOS)		A	C		D	B		B	B								**B**

BRT Lane - Rathburn					Control Type:	Signalized											
Movements		EBBus	WBBus	WBBusL	EBGPL	WBGPL											OVERALL
Travel Time Segment		1	2	5	3	4											
Queue Counter		1	2	704	3	4											
Hourly Volume (vph)		48	27	42	608	1055											1780
Vehicle Delay (s)		150	164	85	49	14											33.61
Queue Length 95th (m)		4	53	38	11	33											
Travel Time (Sec)		185	204	102	74	38											
Level of Service (LOS)		F	F	F	D	B											**C**

Operational Anaylsis
Level of Service, Vehicle Delay, Queue
2031 PM Peak Hour Analysis
Scenario 5.2 - Background Traffic Scenario (Existing Traffic + 30% Growth) on BRT Network - Right-In-Right-Out Intersection at Hammerson Drive and Rathburn Road

Rathburn Road at Duke of York Blvd.				Control Type:	Signalized												
Movements	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR					OVERALL
Travel Time Segment	601	602	603	604	605	606	607	608	609	610	611	612					
Queue Counter	601	602	602	604	605	605	607	608	608	610	611	611					
Hourly Volume (vph)	100	541	52	95	887	116	433	483	130	228	420	125					3610
Vehicle Delay (s)	44	84	91	32	24	19	45	33	35	38	34	8					40.21
Queue Length 95th (m)	22	148	148	24	78	78	154	59	59	56	42	42					
Level of Service (LOS)	D	F	F	C	C	B	D	C	D	D	C	A					**D**

Rathburn Road at Station Gate				Control Type:	Signalized												
Movements	EBT	EBBusT	WBT	WBBusL	WBBusT	WBBusR		NBBusL	NBusR	SBBusL		SBBusR					OVERALL
Travel Time Segment	702	703	705	704	711	706		707	708	709		710					
Queue Counter	702	703	705	704	706	706		707	708	709		710					
Hourly Volume (vph)	854	5	1084	47	4	25		32	53	47		0					2151
Vehicle Delay (s)	27	12	9	7	67	68		35	15	47		0					18.04
Queue Length 95th (m)	215	0	6	8	12	12		26	0	31		0					
Level of Service (LOS)	C	B	A	A	E	E		C	B	D							**B**

Rathburn Road at Hammerson				Control Type:	Unsignalized RIRO												
Movements		EBT	EBR		WBT				NBR								OVERALL
Travel Time Segment		802	803		805				809								
Queue Counter		802	802		805				807								
Hourly Volume (vph)		756	174		1087				161								2178
Vehicle Delay (s)		5	4		1				51								6.40
Queue Length 95th (m)		30	30		0				75								
Level of Service (LOS)		A	A		A				D								**A**

Rathburn Road at City Centre Drive				Control Type:	Signalized												
Movements	EBL	EBT	EBR	WBL1	WBT1	WBR1	NBL	NBT	NBR	SBL	SBT	SBR	WBBusT	EBBusT			OVERALL
Travel Time Segment	901	902	903	904	905	906	907	908	909	910	911	912	913	917			
Queue Counter	902	902	902	904	905	905	907	908	908	910	911	911	913	914			
Hourly Volume (vph)	12	751	130	373	857	27	209	157	388	95	31	0	0	52			3082
Vehicle Delay (s)	17	54	45	67	59	48	53	46	32	26	34	0	0	55			52.14
Queue Length 95th (m)	254	254	254	95	270	270	108	66	66	22	8	8	23	37			
Level of Service (LOS)	B	D	D	E	E	D	D	D	C	C	C			E			**D**

City Centre Drive at Square One West Entrance				Control Type:	Signalized												
Movements	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR					OVERALL
Travel Time Segment	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112					
Queue Counter	1101	1101	1101	1104	1104	1106	1107	1108	1108	1110	1110	1110					
Hourly Volume (vph)	190	293	112	366	322	154	265	422	182	98	365	74					2843
Vehicle Delay (s)	62	49	42	75	29	27	30	33	34	26	19	18					39.01
Queue Length 95th (m)	85	85	85	73	73	73	81	90	90	38	38	38					
Level of Service (LOS)	E	D	D	E	C	C	C	C	C	C	B	B					**D**

Centre View Drive at Station Gate Road				Control Type:	Signalized												
Movements		EBT	EBR	WBL	WBT		NBL		NBR								OVERALL
Travel Time Segment		1201	1202	1203	1204		1205		1206								
Queue Counter		1201	1201	1203	1203		1205		1206								
Hourly Volume (vph)		126	35	22	621		15		7								826
Vehicle Delay (s)		0	5	7	1		37		15								2.07
Queue Length 95th (m)		1	1	12	12		20		0								
Level of Service (LOS)		A	A	A	A		D		B								**A**

Centre View Drive at Duke of York Blvd.				Control Type:	Signalized												
Movements		EBT	EBR	WBL	WBT		NBL		NBR								OVERALL
Travel Time Segment		1301	1302	1303	1304		1305		1306								
Queue Counter		1301	1301	1303	1303		1305		1305								
Hourly Volume (vph)		85	588	168	466		618		77								2002
Vehicle Delay (s)		9	16	13	10		15		11								13.44
Queue Length 95th (m)		67	67	27	27		52		52								
Level of Service (LOS)		A	B	B	A		B		B								**B**

Square One Drive at Duke of York Blvd.				Control Type:	Signalized												
Movements		SBT	SBL		WBL	WBR		NBR	NBT								OVERALL
Travel Time Segment		1452	1453		1451	1450		1455	1454								
Queue Counter		1452	1453		1450	1450		1455	1455								
Hourly Volume (vph)		396	161		155	350		711	711								2484
Vehicle Delay (s)		2	18		35	21		12	17								14.76
Queue Length 95th (m)		13	24		50	50		47	47								
Level of Service (LOS)		A	B		C	C		B	B								**B**

BRT Lane - Rathburn				Control Type:	RIRO												
Movements		EBBus	WBBus	WBBusL	EBGPL	WBGPL											OVERALL
Travel Time Segment		1	2	5	3	4											
Queue Counter		1	2	704	3	4											
Hourly Volume (vph)		47	29	47	624	1082											1829
Vehicle Delay (s)		62	67	11	58	8											27.55
Queue Length 95th (m)		12	41	8	7	41											
Travel Time (Sec)		104	106	29	82	33											
Level of Service (LOS)		E	E	B	E	A											**C**

Operational Anaylsis
Level of Service, Vehicle Delay, Queue
2031 PM Peak Hour Analysis
Scenario 6.1A - Total Traffic Scenario (Background + Site Traffic) on BRT Network - 300 LT Vehicles at Rathburn & Hammerson T-Intersection

Rathburn Road at Duke of York Blvd.					Control Type:	Signalized											
Movements	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR					OVERALL
Travel Time Segment	601	602	603	604	605	606	607	608	609	610	611	612					
Queue Counter	601	602	602	604	605	605	607	608	608	610	611	611					
Hourly Volume (vph)	93	531	45	83	1011	134	258	448	123	226	417	125					3494
Vehicle Delay (s)	78	122	141	39	21	16	45	60	85	60	45	11					53.60
Queue Length 95th (m)	27	190	190	20	109	109	151	162	162	73	62	62					
Level of Service (LOS)	E	F	F	D	C	B	D	E	F	E	D	B					**D**

Rathburn Road at Station Gate					Control Type:	Signalized											
Movements	EBT	EBBusT	WBT	WBBusL	WBBusT	WBBusR		NBBusL	NBusR	SBBusL		SBBusR					OVERALL
Travel Time Segment	702	703	705	704	711	706		707	708	709		710					
Queue Counter	702	703	705	704	706	706		707	708	709		710					
Hourly Volume (vph)	837	7	1216	40	4	23		26	43	52		0					2248
Vehicle Delay (s)	57	17	7	51	98	99		70	40	68		0					30.03
Queue Length 95th (m)	335	0	6	38	18	18		49	0	41		0					
Level of Service (LOS)	E	B	A	D	F	F		E	D	E							**C**

Rathburn Road at Hammerson					Control Type:	Signalized											
Movements		EBT	EBR	WBL	WBT		NBL		NBR								OVERALL
Travel Time Segment		802	803	804	805		807		809								
Queue Counter		802	802	804	805		807		807								
Hourly Volume (vph)		719	183	297	949		263		197								2608
Vehicle Delay (s)		23	21	90	14		121		29								37.43
Queue Length 95th (m)		211	211	180	99		110		110								
Level of Service (LOS)		C	C	F	B		F		C								**D**

Rathburn Road at City Centre Drive					Control Type:	Signalized											
Movements	EBL	EBT	EBR	WBL1	WBT1	WBR1	NBL	NBT	NBR	SBL	SBT	SBR	WBBusT	EBBusT			OVERALL
Travel Time Segment	901	902	903	904	905	906	907	908	909	910	911	912	913	917			
Queue Counter	902	902	902	904	905	905	907	908	908	910	911	911	913	914			
Hourly Volume (vph)	12	779	127	297	1033	23	173	136	347	94	26	0	32	56			3135
Vehicle Delay (s)	29	28	24	136	156	162	154	110	71	53	55	0	76	98			99.31
Queue Length 95th (m)	146	146	146	52	444	444	175	165	165	36	9	9	40	41			
Level of Service (LOS)	C	C	C	F	F	F	F	F	E	D	E		E	F			**F**

City Centre Drive at Square One West Entrance					Control Type:	Signalized											
Movements	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR					OVERALL
Travel Time Segment	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112					
Queue Counter	1101	1101	1101	1104	1104	1106	1107	1108	1108	1110	1110	1110					
Hourly Volume (vph)	197	287	111	370	321	148	75	347	139	94	338	34					2461
Vehicle Delay (s)	73	52	46	51	25	42	64	144	112	50	24	21					61.57
Queue Length 95th (m)	90	90	90	50	50	50	26	105	105	38	38	38					
Level of Service (LOS)	E	D	D	D	C	D	E	F	F	D	C	C					**E**

Centre View Drive at Station Gate Road					Control Type:	Signalized											
Movements		EBT	EBR	WBL	WBT		NBL		NBR								OVERALL
Travel Time Segment		1201	1202	1203	1204		1205		1206								
Queue Counter		1201	1201	1203	1203		1205		1206								
Hourly Volume (vph)		123	39	22	600		16		6								806
Vehicle Delay (s)		0	5	4	1		49		15								2.14
Queue Length 95th (m)		0	0	8	8		26		0								
Level of Service (LOS)			A	A	A		D		B								**A**

Centre View Drive at Duke of York Blvd.					Control Type:	Signalized											
Movements		EBT	EBR	WBL	WBT		NBL		NBR								OVERALL
Travel Time Segment		1301	1302	1303	1304		1305		1306								
Queue Counter		1301	1301	1303	1303		1305		1305								
Hourly Volume (vph)		88	612	161	460		604		73								1998
Vehicle Delay (s)		11	15	12	10		16		14								13.54
Queue Length 95th (m)		65	65	26	26		51		51								
Level of Service (LOS)		B	B	B	A		B		B								**B**

Square One Drive at Duke of York Blvd.					Control Type:	Signalized											
Movements		SBT	SBL		WBL	WBR		NBR	NBT								OVERALL
Travel Time Segment		1452	1453		1451	1450		1455	1454								
Queue Counter		1452	1453		1450	1450		1455	1455								
Hourly Volume (vph)		381	160		156	158		703	703								2261
Vehicle Delay (s)		6	51		49	43		20	28								25.98
Queue Length 95th (m)		14	133		60	60		133	133								
Level of Service (LOS)		A	D		D	D		C	C								**C**

BRT Lane - Rathburn					Control Type:	Signalized											
Movements		EBBus	WBBus	WBBusL	EBGPL	WBGPL											OVERALL
Travel Time Segment		1	2	5	3	4											
Queue Counter		1	2	704	3	4											
Hourly Volume (vph)		48	27	40	601	949											1665
Vehicle Delay (s)		200	189	123	57	16											41.54
Queue Length 95th (m)		12	47	40	12	46											
Travel Time (Sec)		233	228	141	82	40											
Level of Service (LOS)		F	F	F	E	B											**D**

Operational Anaylsis
Level of Service, Vehicle Delay, Queue
2031 PM Peak Hour Analysis
Scenario 6.1B - Total Traffic Scenario (Background + Site Traffic) on BRT Network - 350 LT Vehicles at Rathburn & Hammerson T-Intersection

Rathburn Road at Duke of York Blvd.				Control Type:	Signalized												
Movements	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR					OVERALL
Travel Time Segment	601	602	603	604	605	606	607	608	609	610	611	612					
Queue Counter	601	602	602	604	605	605	607	608	608	610	611	611					
Hourly Volume (vph)	83	505	44	77	928	121	258	443	123	225	418	126					3351
Vehicle Delay (s)	89	154	185	45	21	17	53	68	103	60	42	10					61.69
Queue Length 95th (m)	21	191	191	21	104	104	187	192	192	73	61	61					
Level of Service (LOS)	F	F	F	D	C	B	D	E	F	E	D	A					**E**

Rathburn Road at Station Gate				Control Type:	Signalized												
Movements	EBT	EBBusT	WBT	WBBusL	WBBusT	WBBusR		NBBusL	NBusR	SBBusL		SBBusR					OVERALL
Travel Time Segment	702	703	705	704	711	706		707	708	709		710					
Queue Counter	702	703	705	704	706	706		707	708	709		710					
Hourly Volume (vph)	815	7	1115	40	4	26		27	43	52		0					2129
Vehicle Delay (s)	64	28	7	73	99	99		81	37	68		0					34.30
Queue Length 95th (m)	372	0	6	43	19	19		44	0	41		0					
Level of Service (LOS)	E	C	A	E	F	F		F	D	E							**C**

Rathburn Road at Hammerson				Control Type:	Signalized												
Movements		EBT	EBR	WBL	WBT		NBL		NBR								OVERALL
Travel Time Segment		802	803	804	805		807		809								
Queue Counter		802	802	804	805		807		807								
Hourly Volume (vph)		708	178	355	850		260		200								2551
Vehicle Delay (s)		24	26	104	15		126		28								42.90
Queue Length 95th (m)		212	212	209	90		111		111								
Level of Service (LOS)		C	C	F	B		F		C								**D**

Rathburn Road at City Centre Drive				Control Type:	Signalized												
Movements	EBL	EBT	EBR	WBL1	WBT1	WBR1	NBL	NBT	NBR	SBL	SBT	SBR	WBBusT	EBBusT			OVERALL
Travel Time Segment	901	902	903	904	905	906	907	908	909	910	911	912	913	917			
Queue Counter	902	902	902	904	905	905	907	908	908	910	911	911	913	914			
Hourly Volume (vph)	14	770	128	278	994	23	175	136	343	90	26	0	32	56			3065
Vehicle Delay (s)	22	27	23	141	166	171	152	105	73	58	56	0	86	96			102.20
Queue Length 95th (m)	86	86	86	50	445	445	192	169	169	40	8	8	44	45			
Level of Service (LOS)	C	C	C	F	F	F	F	F	E	E	E		F	F			**F**

City Centre Drive at Square One West Entrance				Control Type:	Signalized												
Movements	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR					OVERALL
Travel Time Segment	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112					
Queue Counter	1101	1101	1101	1104	1104	1106	1107	1108	1108	1110	1110	1110					
Hourly Volume (vph)	196	287	119	380	314	150	76	345	138	85	328	30					2448
Vehicle Delay (s)	71	49	40	63	26	54	58	146	111	45	24	17					63.31
Queue Length 95th (m)	84	84	84	66	66	66	17	107	107	38	38	38					
Level of Service (LOS)	E	D	D	E	C	D	E	F	F	D	C	B					**E**

Centre View Drive at Station Gate Road					Control Type:	Signalized											
Movements		EBT	EBR	WBL	WBT		NBL		NBR								OVERALL
Travel Time Segment		1201	1202	1203	1204		1205		1206								
Queue Counter		1201	1201	1203	1203		1205		1206								
Hourly Volume (vph)		119	39	22	594		17		8								799
Vehicle Delay (s)		0	6	5	1		49		15								2.53
Queue Length 95th (m)		1	1	13	13		23		0								
Level of Service (LOS)		A	A	A	A		D		B								**A**

Centre View Drive at Duke of York Blvd.					Control Type:	Signalized											
Movements		EBT	EBR	WBL	WBT		NBL		NBR								OVERALL
Travel Time Segment		1301	1302	1303	1304		1305		1306								
Queue Counter		1301	1301	1303	1303		1305		1305								
Hourly Volume (vph)		86	612	157	456		581		72								1964
Vehicle Delay (s)		11	16	10	10		15		13								13.59
Queue Length 95th (m)		68	68	26	26		48		48								
Level of Service (LOS)		B	B	B	B		B		B								**B**

Square One Drive at Duke of York Blvd.					Control Type:	Signalized											
Movements		SBT	SBL		WBL	WBR		NBR	NBT								OVERALL
Travel Time Segment		1452	1453		1451	1450		1455	1454								
Queue Counter		1452	1453		1450	1450		1455	1455								
Hourly Volume (vph)		375	158		147	160		118	693								1651
Vehicle Delay (s)		4	41		54	48		21	36								30.92
Queue Length 95th (m)		15	49		62	62		49	49								
Level of Service (LOS)		A	D		D	D		C	D								**C**

BRT Lane - Rathburn					Control Type:	Signalized											
Movements		EBBus	WBBus	WBBusL	EBGPL	WBGPL											OVERALL
Travel Time Segment		1	2	5	3	4											
Queue Counter		1	2	704	3	4											
Hourly Volume (vph)		49	27	39	589	831											1535
Vehicle Delay (s)		199	203	145	57	17											44.76
Queue Length 95th (m)		12	51	40	12	44											
Travel Time (Sec)		233	242	162	81	42											
Level of Service (LOS)		F	F	F	E	B											**D**

Operational Anaylsis
Level of Service, Vehicle Delay, Queue
2031 PM Peak Hour Analysis
Scenario 6.2 - Total Traffic Scenario (Background + Site Traffic) on BRT Network - Four-Way Intersection at Rathburn & Hammerson

Rathburn Road at Duke of York Blvd.					Control Type:	Signalized											
Movements	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR					OVERALL
Travel Time Segment	601	602	603	604	605	606	607	608	609	610	611	612					
Queue Counter	601	602	602	604	605	605	607	608	608	610	611	611					
Hourly Volume (vph)	77	524	35	70	872	109	267	460	127	215	423	119					3298
Vehicle Delay (s)	105	166	175	55	21	16	61	59	63	102	86	31					72.22
Queue Length 95th (m)	20	183	183	23	85	85	159	166	166	132	134	134					
Level of Service (LOS)	F	F	F	E	C	B	E	E	E	F	F	C					**E**

Rathburn Road at Station Gate					Control Type:	Signalized											
Movements	EBT	EBBusT	WBT	WBBusL	WBBusT	WBBusR		NBBusL	NBusR	SBBusL		SBBusR					OVERALL
Travel Time Segment	702	703	705	704	711	706		707	708	709		710					
Queue Counter	702	703	705	704	706	706		707	708	709		710					
Hourly Volume (vph)	849	5	1049	37	4	25		21	40	50		0					2080
Vehicle Delay (s)	63	19	7	80	96	106		88	39	73		0					35.39
Queue Length 95th (m)	344	0	6	47	18	18		30	0	47		0					
Level of Service (LOS)	E	B	A	F	F	F		F	D	E							**D**

Rathburn Road at Hammerson					Control Type:	Signalized											
Movements	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR					OVERALL
Travel Time Segment	1465	802	803	804	805	1464	807	1463	809	1462	1461	1460					
Queue Counter	13	802	802	804	805	12	807	11	11	10	10	10					
Hourly Volume (vph)	135	625	148	323	755	24	229	57	148	55	72	51					2622
Vehicle Delay (s)	32	29	32	85	27	15	184	97	64	80	68	41					55.02
Queue Length 95th (m)	26	211	211	188	218	0	110	91	91	45	45	45					
Level of Service (LOS)	C	C	C	F	C	B	F	F	E	F	E	D					**E**

Rathburn Road at City Centre Drive					Control Type:	Signalized											
Movements	EBL	EBT	EBR	WBL1	WBT1	WBR1	NBL	NBT	NBR	SBL	SBT	SBR	WBBusT	EBBusT			OVERALL
Travel Time Segment	901	902	903	904	905	906	907	908	909	910	911	912	913	917			
Queue Counter	902	902	902	904	905	905	907	908	908	910	911	911	913	914			
Hourly Volume (vph)	12	698	119	237	887	24	164	119	315	88	26	0	31	53			2773
Vehicle Delay (s)	27	27	21	153	202	217	168	117	81	71	64	0	98	119			117.66
Queue Length 95th (m)	68	68	68	43	445	445	190	176	176	43	11	11	44	42			
Level of Service (LOS)	C	C	C	F	F	F	F	F	F	E	E		F	F			**F**

City Centre Drive at Square One West Entrance					Control Type:	Signalized											
Movements	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR					OVERALL
Travel Time Segment	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112					
Queue Counter	1101	1101	1101	1104	1104	1106	1107	1108	1108	1110	1110	1110					
Hourly Volume (vph)	196	290	113	374	320	145	72	293	113	80	288	27					2311
Vehicle Delay (s)	71	47	39	66	29	66	72	191	141	56	24	19					71.09
Queue Length 95th (m)	84	84	84	63	63	63	15	146	146	35	35	35					
Level of Service (LOS)	E	D	D	E	C	E	E	F	F	E	C	B					**E**

Centre View Drive at Station Gate Road	Control Type: Signalized									
Movements	EBT	EBR	WBL	WBT	NBL	NBR	OVERALL
Travel Time Segment	1201	1202	1203	1204	1205	1206	
Queue Counter	1201	1201	1203	1203	1205	1206	
Hourly Volume (vph)	117	39	22	587	17	7	789
Vehicle Delay (s)	0	4	4	1	46	15	2.50
Queue Length 95th (m)	0	0	12	12	23	0	
Level of Service (LOS)		A	A	A	D	B	**A**

Centre View Drive at Duke of York Blvd.	Control Type: Signalized									
Movements	EBT	EBR	WBL	WBT	NBL	NBR	OVERALL
Travel Time Segment	1301	1302	1303	1304	1305	1306	
Queue Counter	1301	1301	1303	1303	1305	1305	
Hourly Volume (vph)	87	611	157	449	584	67	1955
Vehicle Delay (s)	36	36	11	10	16	14	21.27
Queue Length 95th (m)	104	104	25	25	46	46	
Level of Service (LOS)	D	D	B	B	B	B	**C**

Square One Drive at Duke of York Blvd.	Control Type: Signalized									
Movements	SBT	SBL		WBL	WBR		NBR	NBT		OVERALL
Travel Time Segment	1452	1453		1451	1450		1455	1454		
Queue Counter	1452	1453		1450	1450		1455	1455		
Hourly Volume (vph)	245	279		145	164		120	715		1668
Vehicle Delay (s)	16	60		56	24		12	20		29.15
Queue Length 95th (m)	0	0		0	0		0	0		
Level of Service (LOS)	B	E		E	C		B	C		**C**

BRT Lane - Rathburn	Control Type: Signalized									
Movements	EBBus	WBBus	WBBusL	EBGPL	WBGPL					OVERALL
Travel Time Segment	1	2	5	3	4					
Queue Counter	1	2	704	3	4					
Hourly Volume (vph)	48	28	38	509	760					1383
Vehicle Delay (s)	240	201	152	62	28					54.99
Queue Length 95th (m)	12	48	57	12	45					
Travel Time (Sec)	274	241	169	84	53					
Level of Service (LOS)	F	F	F	E	C					**D**

APPENDIX D

PRELIMINARY DESIGN PLAN FOR PROPOSED BRT FACILITY


MAVIS ROAD
CONFEDERATION PARKWAY
COLISEUM THEATRE
HIGHWAY 403
DUKE OF YORK BOULEVARD
JACK ASTOR'S
ALICE FAZOOLI'S
COAST MOUNTAIN SPORTS
CHAPTERS
SQUARE ONE SHOPPING CENTRE
CITY CENTRE TRANSIT TERMINAL
CENTRE VIEW DRIVE
STATION GATE ROAD
RATHBURN ROAD
CITY CENTRE DRIVE
SQUARE ONE DRIVE
HURONTARIO STREET

APPENDIX E

MEMORANDUM ON WHOLE FOODS TRIP GENERATION

McCORMICK RANKIN CORPORATION
A member of MMM GROUP

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MEMO

TO:	File
FROM:	Alex Mereu
DATE:	August 28, 2009
COPIES:	
OUR FILE:	WO. 107359
SUBJECT:	Whole Foods – Traffic Counts/ Trip Generation Analysis
	W:\7k\7359 City Center BRT Functional Planning\7359.500 Transport\7359.505 Technical Memos\107359_am_Whole Foods Traffic Count Memo august28.doc

Purpose/Location

A traffic count survey was conducted on Thursday, August 13, 2009 to determine the automobile trip generation of the shopping centre east of Trafalgar road on Cornwall Road in Oakville. These counts were undertaken from 7:30 AM to 9:30 AM, from 10:00 AM to 1:00 PM, and from 2:00 PM to 5:30 PM. The temperature was 30ºC and the sky was clear. The data that was collected includes all vehicle traffic movements from all directions for three different access points to the shopping centre (refer to Figure 1 on page 2):

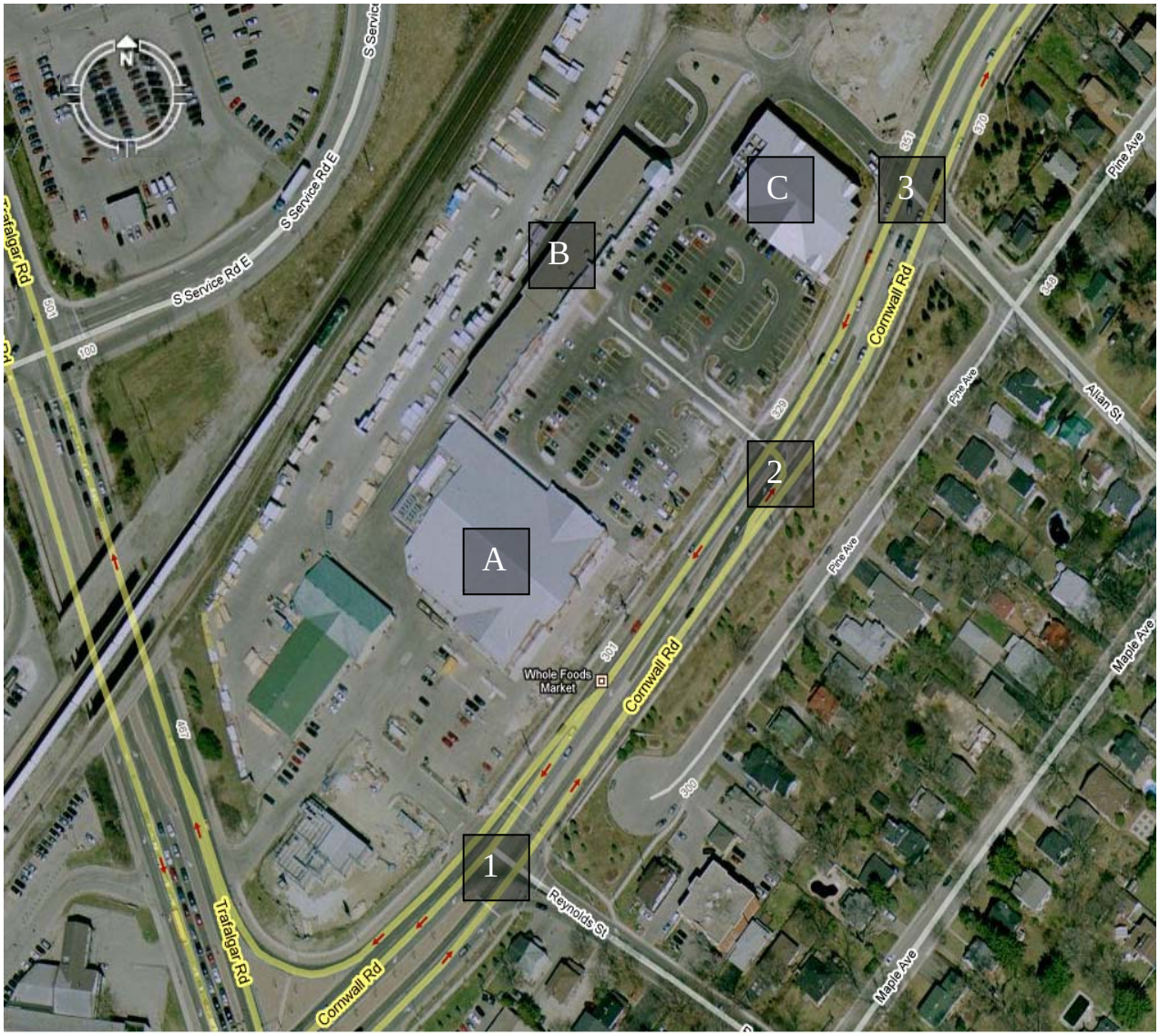
1. The intersection of Reynolds Street and Cornwall Road
2. The main entrance to the shopping centre from Cornwall Road
3. The intersection of Allan Street and Cornwall Road

The Shopping centre has three different retail destinations. It has been assumed that the traffic entering the shopping centre at the three access points are arriving at one of these three retail destinations (refer to Figure 1 on page 2).

A. Supermarket (Whole Foods)
B. Strip Plaza (Includes Starbucks, and Blockbuster)
C. Drug Store (Shoppers Drug Mart)

The Google Earth image on the following page indicates the locations of the three intersections and the three retail destinations.

Figure 1: Location Map



Source: Google Earth 2009-08-18

Traffic Movements

The traffic movements illustrated in the following diagrams (Figure 2 – Figure 10) reflect site peak travel characteristics. Note that southbound refers to traffic exiting the shopping centre.

Figure 2: Intersection 1 from 8:15-9:15 AM

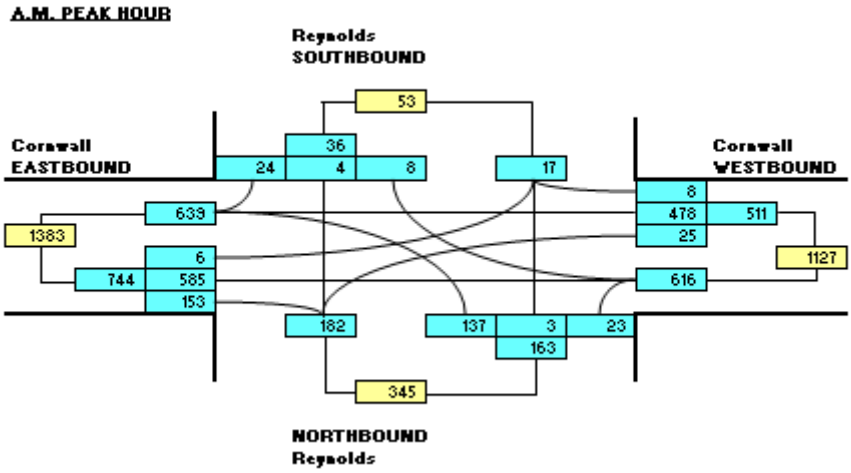


Figure 3: Intersection 1 from 11:45 AM to 12:45 PM

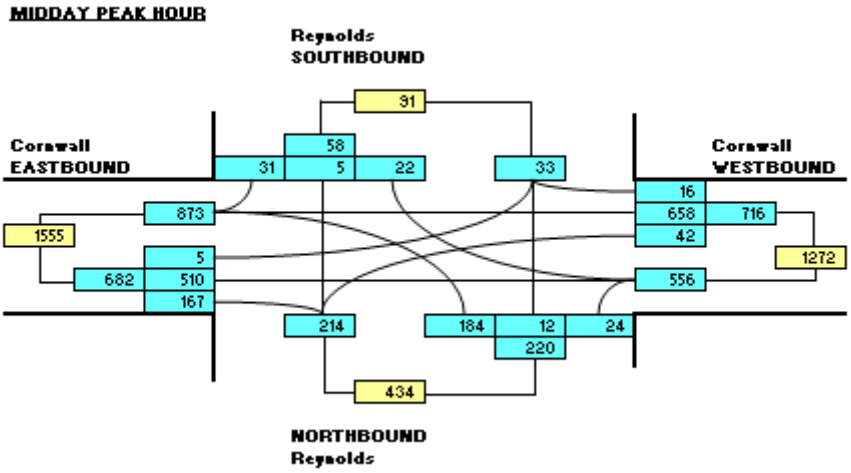


Figure 4: Intersection 1 from 2:15 PM to 3:15 PM

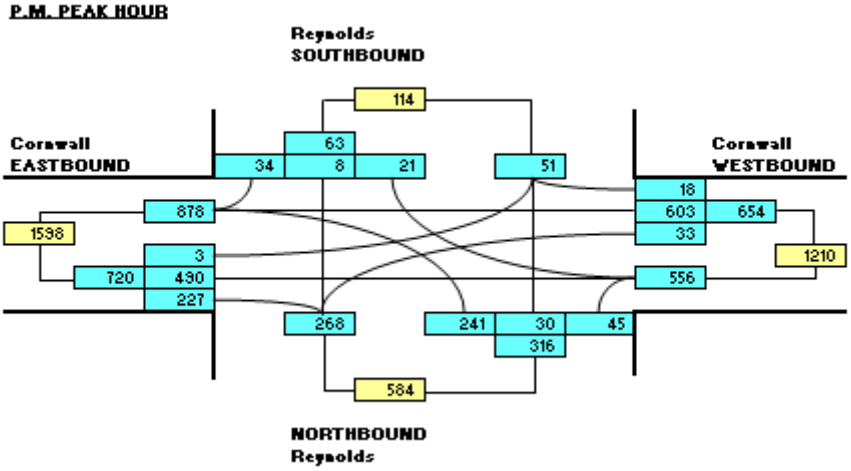


Figure 5: Intersection 2 from 8:15 AM to 9:15 AM

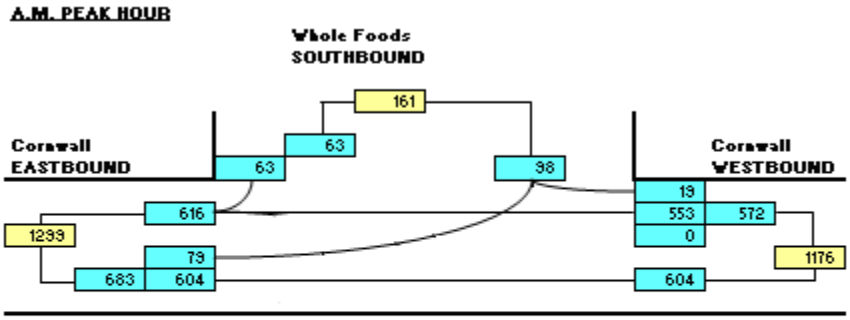


Figure 6: Intersection 2 from 12:00 PM to 1:00 PM

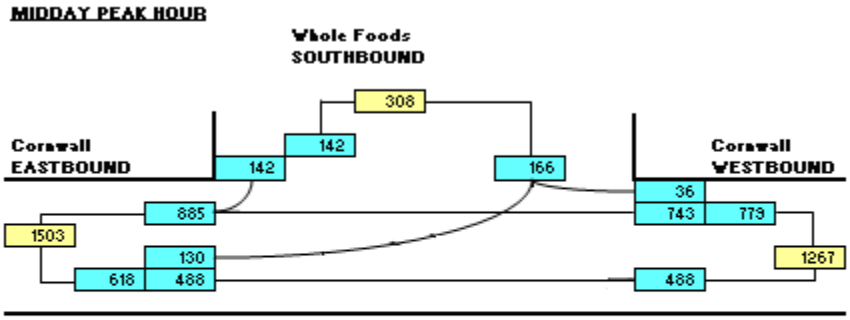


Figure 7: Intersection 2 from 3:00 PM to 4:00 PM

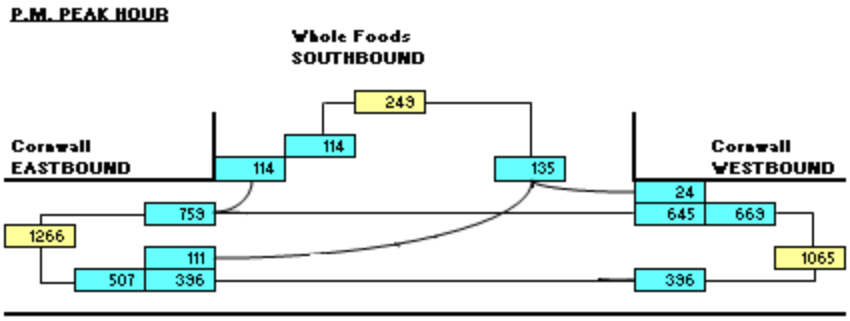


Figure 8: Intersection 3 from 8:15 AM to 9:15 AM

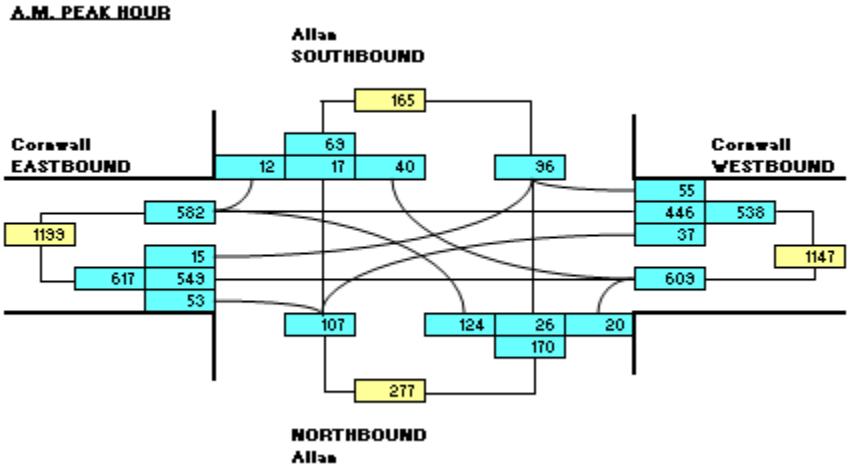


Figure 9: Intersection 3 from 11:45 AM to 12:45 PM

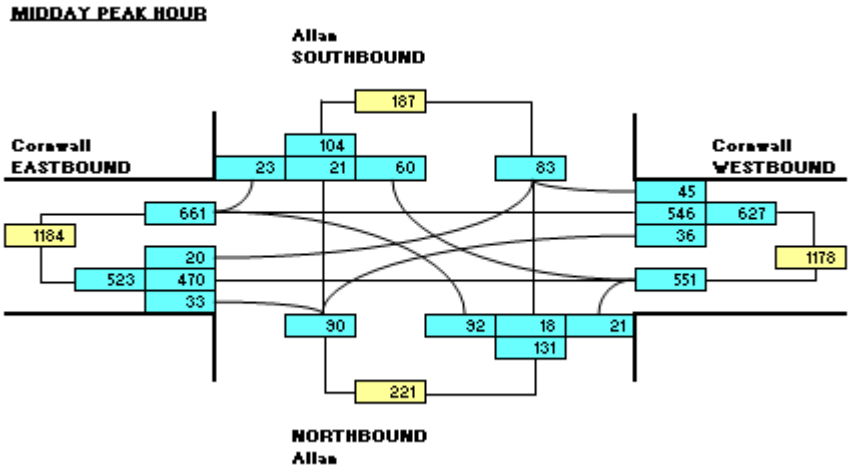
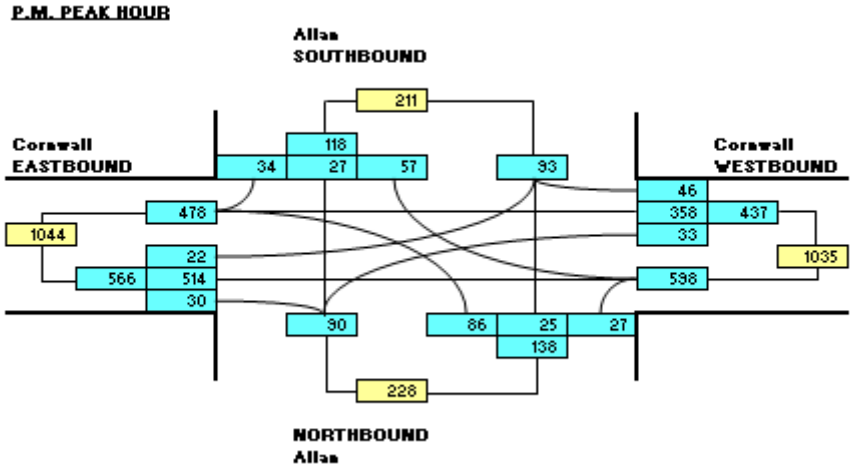


Figure 10: Intersection 3 from 2:00 PM to 3:00 PM



To compliment, figure 11-13 represent the Road PM Peak hours at each intersection.

Figure 11: Intersection 1 from 4:30PM to 5:30 PM

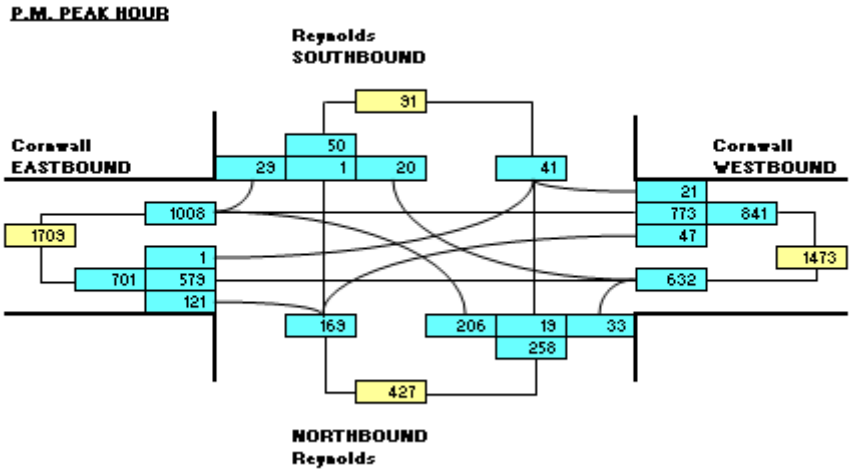


Figure 12: Intersection 2 from 4:30PM to 5:30 PM

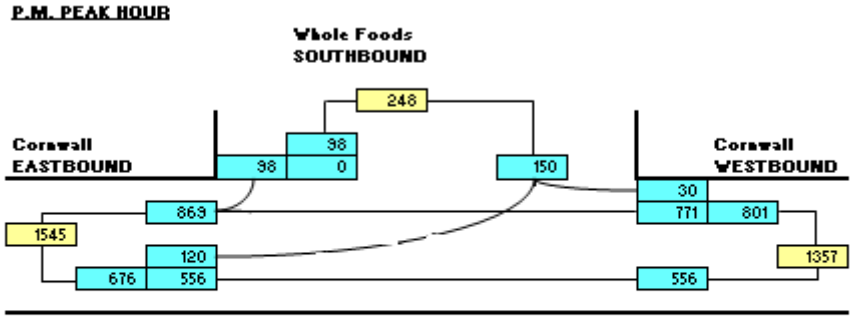
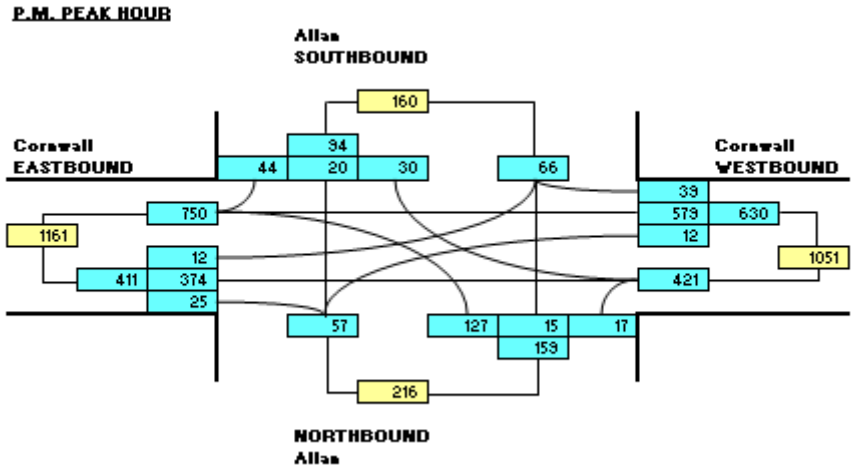


Figure 13: Intersection 3 from 4:30PM to 5:30 PM



Shopping Centre Trip Generation

Figure 14 summarizes the traffic movements entering and exiting the shopping centre during the three peak generator hours and the PM Peak Road Hour.

Figure 14

Trip Generator Counts and PM Peak Road Count				
	Time Period	**In**	**Out**	**Total**
Main Entrance	Midday Peak Gen Hour (12:00 pm – 1:00 pm)	166	142	308
	AM Peak Gen Hour (8:15 am – 9:15 am)	38	63	161
	PM Peak Gen. Hour (3:00 pm – 4:00 pm)	135	114	249
	PM Peak Road (4:30 pm-5:30 pm)	150	98	248
	8 hour Total	1107	854	1961
Reynolds Entrance	Midday Peak Hour (11:45 am – 12:45 pm)	33	58	91
	AM Peak Hour (8:15 am – 9:15 am)	17	36	53
	PM Peak Hour (2:15 pm – 3:15 pm)	51	63	114
	PM Peak Road (4:30 pm-5:30 pm)	41	50	91
	8 hour Total	249	407	656
Allan Entrance	Midday Peak Hour (11:45 am – 12:45 pm)	83	104	187
	AM Peak Hour (8:15 am – 9:15 am)	96	69	165
	PM Peak Hour (2:00 pm – 3:00 pm)	93	118	211
	PM Peak Road (4:30 pm-5:30 pm)	66	94	160
	8 hour Total	643	798	1441

Retail Destination Split

The trip generator totals from figure 14 have been divided amongst the three destinations. Destination split assumptions are based on the size of the relative destination, the location of the access points in relation to the destination, and the trip generation sample averages for the respective land uses as exemplified in the ITE Trip Generation Report. The values in figure 15 show the number of traffic movements that have been allocated to the given destination during a destination peak hour and the PM peak road hour.

Figure 15

Two-way Trip Generation Split Between 3 facilities (%of Total)					
	Time Period	**Whole Foods Share**	**Share Strip Plaza**	**Share Pharmacy**	**Entire Centre**
Main Entrance	Midday Peak Hour	147 (50%)	73.5 (25%)	73.5 (25%)	294 (100%)
	AM Peak Hour	80.5 (50%)	40.25 (25%)	40.25 (25%)	161 (100%)
	PM Peak Hour	120 (50%)	60 (25%)	60 (25%)	240 (100%)
	PM Peak road	124(50%)	62(25%)	62(25%)	248
	Daily Total	980.5 (50%)	490.25 (25%)	490.25 (25%)	1961 (100%)
Reynolds Entrance	Midday Peak Hour	80.1 (90%)			89 (100%)
	AM Peak Hour	47.7 (90%)			53 (100%)
	PM Peak Hour	102.6 (90%)			114 (100%)
	PM Peak road	81.9(90%)			91 (100%)
	Daily Total	590.4 (90%)			656 (100%)
Allan Entrance	Midday Peak Hour	35.07 (21%)	40.195 (24.5%)	40.915 (24.5%)	116.9 (70%)
	AM Peak Hour	30.66 (21%)	35.77 (24.5%)	35.77 (24.5%)	102.2 (70%)
	PM Peak Hour	36.54 (21%)	42.63 (24.5%)	42.63 (24.5%)	121.8 (70%)
	PM Peak Road	33.6 (21%)	39.2 (24.5%)	39.2 (24.5%)	160 (70%)
	Daily Total	302.61 (21%)	353.045 (24.5%)	353 (24.5%)	1008 (70%)

One-way (in) Trip Generation Split Between 3 facilities (%of Total)					
	Time Period	**Whole Foods Share**	**Share Strip Plaza**	**Share Pharmacy**	**Entire Centre**
Main Entrance	Midday Peak Hour	79 (50%)	39.5 (25%)	39.5 (25%)	158 (100%)
	AM Peak Hour	19 (50%)	9.5 (25%)	9.5 (25%)	38 (100%)
	PM Peak Hour	73.5 (50%)	36.75 (25%)	36.75 (25%)	147 (100%)
	PM Peak road	75 (50%)	37.5 (25%)	37.5 (25%)	150
	Daily Total	553.5 (50%)	276.75 (25%)	276.75 (25%)	1107 (100%)
Reynolds Entrance	Midday Peak Hour	22.5 (90%)			25 (100%)
	AM Peak Hour	15.3 (90%)			17 (100%)
	PM Peak Hour	45.9 (90%)			51 (100%)
	PM Peak Road	36.9 (90%)			41 (100%)
	Daily Total	224.1 (90%)			249 (100%)
Allan Entrance	Midday Peak Hour	13.65 (21%)	15.925 (24.5%)	15.925 (24.5%)	65 (70%)
	AM Peak Hour	18.48 (21%)	21.56 (24.5%)	21.56 (24.5%)	88 (70%)
	PM Peak Hour	13.23 (21%)	15.435 (24.5%)	15.435 (24.5%)	63 (70%)
	PM Peak Road	13.86 (21%)	16.17 (21%)	16.17 (24.5%)	66 (70%)
	Daily Total	135.03 (21%)	157.535 (24.5%)	157.535 (24.5%)	643 (70%)

Trip Generation Rates

Peak-hour trip generation rates for each of the retail destinations have been calculated and are summarized in the following table (Figure 16). These values are a function of the gross floor area of the retail destination and the traffic movements that have been allocated to that destination.

Figure 16

Trips/1000 Sq.ft. of floor area - Two way					
	Time Period	**Whole Foods**	**Strip Plaza**	**Pharmacy**	**Entire Shopping Centre**
Main Entrance	Midday Peak Hour	3.85	3.97	4.31	3.99
	AM Peak Hour	2.11	2.18	2.36	2.18
	PM Peak Hour	3.14	3.24	3.52	3.26
	PM Peak Road hr.	3.25	3.35	3.64	3.36
Reynolds Entrance	Midday Peak Hour	2.10	0.00	0.00	1.21
	AM Peak Hour	1.25	0.00	0.00	0.72
	PM Peak Hour	3.14	0.00	0.00	1.39
	PM Peak Road hr.	2.15			1.23
Allan Entrance	Midday Peak Hour	0.92	2.17	2.40	1.59
	AM Peak Hour	0.80	1.93	2.10	1.39
	PM Peak Hour	0.96	2.30	2.50	1.65
	PM Peak Road hr.	0.88	2.12	2.30	2.17
Total	Total Midday Peak	6.87	6.15	6.71	6.78
	Total AM Peak	4.16	4.11	4.46	4.29
	Total PM Peak	7.24	5.55	6.02	6.14
	PM Peak Road hr.	6.28	5.47	5.94	6.76

Trips/1000 Sq.ft. of floor area - One-way (In)					
	Time Period	**Whole Foods**	**Strip Plaza**	**Pharmacy**	**Entire Shopping Centre**
Main Entrance	Midday Peak Hour	2.07	2.14	2.32	2.14
	AM Peak Hour	0.50	0.51	0.56	0.52
	PM Peak Hour	1.93	1.99	2.16	1.99
	PM Peak Road hr.	1.96	2.03	2.20	
Reynolds Entrance	Midday Peak Hour	0.59	0.00	0.00	0.34
	AM Peak Hour	0.40	0.00	0.00	0.23
	PM Peak Hour	1.20	0.00	0.00	0.69
	PM Peak Road hr.	0.97			0.56
Allan Entrance	Midday Peak Hour	0.36	0.86	0.93	0.88
	AM Peak Hour	0.48	1.17	1.26	1.19
	PM Peak Hour	0.35	0.82	0.91	0.85
	PM Peak Road hr.	0.36	0.87	0.95	0.9
Total	Total Midday Peak	3.02	3.00	3.25	2.48
	Total AM Peak	1.38	1.68	1.82	1.94
	Total PM Peak	3.24	2.80	3.06	3.53
	PM Peak Road hr	3.29	2.90	3.15	3.45

ITE Comparison/Conclusion

The values in Figure 17 are the Institute of Transportation Engineers (ITE) sample averages for a series of trip generation studies for three different retail land uses.

Figure 17

ITE Study						
	Supermarket		**Strip Plaza**		**Drug Store**	
Time Period	Sample Mean	Standard Deviation	Sample Mean	Standard Deviation	Sample Mean	Standard Deviation
AM Peak	**10.05**	3.96	**6.84**	3.55	**7.64**	2.84
PM Peak	**11.85**	4.72	**5.02**	2.31	**11.07**	6.63

APPENDIX F

MEMORANDUM ON TRAFFIC PROJECTION AT CITY CENTRE, MISSISSAUGA

McCORMICK RANKIN CORPORATION

A member of MMM GROUP

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MEMO

TO:	File
FROM:	Keyur Shah
DATE:	September 1, 2009
COPIES:	Jack Thompson
OUR FILE:	W:\7k\7359 City Center BRT Functional Planning\7359.500 Transport\7359.505 Technical Memos\7359-ks-traffic projections comparisons.doc
SUBJECT:	Comparisons of Traffic Projections

This memorandum presents comparisons of traffic projections for the future employment and population at City Centre considered by McCormick Rankin Corporation and presented by City of Mississauga.

The City of Mississauga presented 'City Centre Transportation Analysis and Discussion' on August 25, 2009. This presentation presents the existing (2006) and future (2031) employment and population forecast for the City Center. The key details from the presentation are presented below in Table 1.

Table 1 Key Detail from Presentation on 'City Centre Transportation Analysis'

Year/ Description	**2006**	**2031**
Population	5,241	21,279
Employment	11,049	16,980
Population to Employment Ratio	0.47	1.25
Transit Mode Split		
- Originating	5 %	27 %
- Destined	10 %	22 %

Based on the information provided, the growth in traffic resulting from population and employment growth are estimated. It is assumed that growth in population will result in increase in out-bound trips and growth in employment will result in additional in-bound trips for the morning peak hours.

1. Anticipated Traffic Growth due to Population:

The number of Dwelling Units

- For year 2006 (assuming 1.5 population./ Unit): 3,494
- For year 2031 (assuming 1.8 population/ Unit): 11,822

Average Vehicle Trip Rate (ITE) for High- Rise Apartment during morning peak hour: 0.34

Estimated Vehicle Trips:

- For year 2006: 1,188
- For year 2031: 4,019

As per projection, the transit mode split is expected to increase from 5% to 27%. That will result in 22% less vehicle trips due to transit. That will result in vehicle trips: 3,135

The population to employment ratio is going to grow radically from 0.47 to 1.25 in future that may result in more internal trips to work. These trips may be conducted by walking/ using local roads/ cycle. Considering 13% trips would be local trips, that result in additional future trips due to population in 25 year: 2,775

Considering the same growth, the future trips for next 15 years: 1, 636

Total Growth in Traffic due to population (out-bound) in 15 years: 138 %
MRC considered out-bound traffic growth (2 % for next 15 year): 130 %

This represents that MRC estimated traffic growth due to population is almost in the similar range with the growth projected by the City of Mississauga.

2. Anticipated Traffic Growth due to Employment:

2006 Total Employment:	11,049
• Existing Transit mode share (10% for destined trips):	1,105
• Therefore, Existing Vehicle Trips:	9,944
For year 2031 – Total Employment:	16,980
• Future Transit mode share (22% for destined trips):	3,736
• Future Vehicle Trips:	13,244
Additional Vehicle Trips in 25 years:	2,195
Additional Vehicle Trips in 15 years:	1,317
That results in Total Vehicle Trips (15 years):	12,366
Total Growth in Traffic (in-bound) due to Employment for next 15 years:	112 %
MRC considered (in-bound) Traffic Growth:	130 %

This represents that MRC estimated traffic growth due to employment is more conservative than City of Mississauga projection.

APPENDIX G

SIGNAL TIMING OPTIONS FOR BRT NETWORK

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MEMO

TO:	File
FROM:	Keyur Shah
DATE:	October 27, 2009
COPIES:	Jack Thompson
OUR FILE:	W:\7k\7359 City Center BRT Functional Planning\7359.500 Transport\7359.505 Technical Memos\PM peak hour analysis\7359-ks-signal timing options-v4.doc
SUBJECT:	Proposed Signal Timing for BRT at City Centre, Mississauga

During the traffic operational analysis conducted for morning and afternoon peak hours, signal timings at the Rathburn Road with City Centre Drive intersection and Rathburn Road with Hammerson Drive intersection were analyzed using the following criteria:

- Westbound left turns operate with Protected + Permitted phasing,
- BRT lines operate on a dedicated signal phase.

To address additional technical issues with respect to the traffic signal operations for the intersections noted above, a sensitivity analysis was undertaken. The analysis utilized the Synchro software to compute average delays for the Background traffic (Scenario 5.1) at the Rathburn Road and City Centre/Centre View Drive intersection for the afternoon peak hour considering the two signal timing options described below:

Option 1: BRT lines travel on dedicated traffic signal phasing (as assumed in the traffic operational analysis)

- Westbound left turns operate with Protected (Phase 1),+ Permitted (Phase 6) Eastbound left turns with permitted phase (Phase 2);
- BRT lines operate on a dedicated signal phase (Phase 9).

Option 2: BRT lines travel with the through traffic

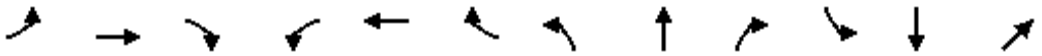
- Eastbound and Westbound left turns operate with a Protected Phase only (Phase 1 and Phase 5 respectively);
- BRT lines as well as General traffic (eastbound and westbound) operate during the same phases (Phase 2 and Phase 6).

The average delays for the two options are presented below:

Options	**Average Intersection Delay**
Option 1	54.3 Seconds
Option 2	45.1 Seconds

The Synchro signal timing plans and Synchro Results for average delay for Option 1 and Option 2 are attached.

The above results show that the signal timing plan without a dedicated phase for BRT (Option 2) reduced the average delay. Therefore the Background and Total (future) traffic operational analysis with the BRT network may experience a reduction in estimated delay if the signal timings used in Option 2 are considered. This signal timing option would be used for the Rathburn Road/ City Centre/Centre View Drive intersection and for the Rathburn Road/ Hammerson Drive intersection.



Movement	EBL2	EBT	EBR	WBL2	WBT	WBR	NBL	NBT	NBR2	SBL	SBT	NET
Lane Configurations												
Volume (vph)	10	579	82	269	824	19	171	131	279	72	25	20
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.0	7.0		3.0	7.0	7.0	3.0	7.0	7.0	3.0	7.0	7.0
Lane Util. Factor	1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	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	1.00
Satd. Flow (prot)	1789	3512		1789	1883	1601	1789	1883	1601	1789	3579	1883
Flt Permitted	0.08	1.00		0.16	1.00	1.00	0.56	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	145	3512		310	1883	1601	1046	1883	1601	1794	3579	1883
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
Growth Factor (vph)	130%	130%	130%	130%	130%	130%	130%	130%	130%	130%	130%	130%
Adj. Flow (vph)	14	818	116	380	1164	27	242	185	394	102	35	28
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	339	0	0	0
Lane Group Flow (vph)	14	934	0	380	1164	27	242	185	55	102	35	28
Turn Type	Perm			pm+pt		Perm	pm+pt		Perm	pm+pt		
Protected Phases		2		1	6		3	8		7	4	9
Permitted Phases	2			6		6	8		8	4		
Actuated Green, G (s)	51.9	51.9		76.7	76.7	76.7	25.1	18.1	18.1	8.2	4.2	7.2
Effective Green, g (s)	51.9	51.9		76.7	76.7	76.7	25.1	18.1	18.1	8.2	4.2	7.2
Actuated g/C Ratio	0.40	0.40		0.59	0.59	0.59	0.19	0.14	0.14	0.06	0.03	0.06
Clearance Time (s)	7.0	7.0		3.0	7.0	7.0	3.0	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)	58	1402		431	1111	945	304	262	223	113	116	104
v/s Ratio Prot		0.27		0.15	c0.62		c0.11	0.10		c0.03	0.01	0.01
v/s Ratio Perm	0.10			0.37		0.02	c0.04		0.03	0.03		
v/c Ratio	0.24	0.67		0.88	1.05	0.03	0.80	0.71	0.25	0.90	0.30	0.27
Uniform Delay, d1	26.0	32.0		25.7	26.7	11.1	49.0	53.4	49.9	60.5	61.5	58.9
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	9.6	2.5		18.6	40.4	0.1	13.4	8.4	0.6	55.0	1.5	1.4
Delay (s)	35.6	34.5		44.3	67.0	11.2	62.4	61.8	50.4	115.5	62.9	60.3
Level of Service	D	C		D	E	B	E	E	D	F	E	E
Approach Delay (s)		34.5			60.6			56.5			102.1	59.5
Approach LOS		C			E			E			F	E

Intersection Summary			
HCM Average Control Delay	54.3	HCM Level of Service	D
HCM Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	105.4%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

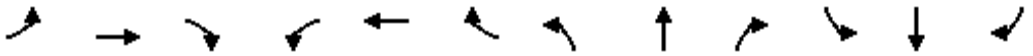
Movement	NER2	SWT
Lane Configurations		
Volume (vph)	10	30
Ideal Flow (vphpl)	1900	1900
Total Lost time (s)	7.0	7.0
Lane Util. Factor	1.00	1.00
Frt	0.85	1.00
Flt Protected	1.00	1.00
Satd. Flow (prot)	1601	1883
Flt Permitted	1.00	1.00
Satd. Flow (perm)	1601	1883
Peak-hour factor, PHF	0.92	0.92
Growth Factor (vph)	130%	130%
Adj. Flow (vph)	14	42
RTOR Reduction (vph)	13	0
Lane Group Flow (vph)	1	42
Turn Type	Perm	
Protected Phases		9
Permitted Phases	9	
Actuated Green, G (s)	7.2	7.2
Effective Green, g (s)	7.2	7.2
Actuated g/C Ratio	0.06	0.06
Clearance Time (s)	7.0	7.0
Vehicle Extension (s)	3.0	3.0
Lane Grp Cap (vph)	89	104
v/s Ratio Prot		c0.02
v/s Ratio Perm	0.00	
v/c Ratio	0.01	0.40
Uniform Delay, d1	58.0	59.3
Progression Factor	1.00	1.00
Incremental Delay, d2	0.0	2.6
Delay (s)	58.1	61.9
Level of Service	E	E
Approach Delay (s)		61.9
Approach LOS		E

Intersection Summary

Phase Number	1	2	3	4	6	7	8	9
Movement	WBL	EBTL	NBL	SBTL	WBTL	SBL	NBTL	NESW
Lead/Lag	Lead	Lag	Lead	Lag		Lead	Lag	
Lead-Lag Optimize	Yes		Yes	Yes		Yes		
Recall Mode	None	C-Max	None	None	Max	None	None	None
Maximum Split (s)	28	54	16	14	82	7	23	18
Maximum Split (%)	21.5%	41.5%	12.3%	10.8%	63.1%	5.4%	17.7%	13.8%
Minimum Split (s)	11	23	11	19	23	7	23	18
Yellow Time (s)	3	4	3	4	4	3	4	4
All-Red Time (s)	0	3	0	3	3	0	3	3
Minimum Initial (s)	4	4	4	4	4	4	4	4
Vehicle Extension (s)	3	3	3	3	3	3	3	3
Minimum Gap (s)	3	3	3	3	3	3	3	3
Time Before Reduce (s)	0	0	0	0	0	0	0	0
Time To Reduce (s)	0	0	0	0	0	0	0	0
Walk Time (s)		5		2	5		5	
Flash Dont Walk (s)		11		10	11		11	
Dual Entry	No	Yes	No	Yes	Yes	No	Yes	Yes
Inhibit Max	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Start Time (s)	102	0	54	70	102	54	61	84
End Time (s)	0	54	70	84	54	61	84	102
Yield/Force Off (s)	127	47	67	77	47	58	77	95
Yield/Force Off 170(s)	127	36	67	67	36	58	66	95
Local Start Time (s)	102	0	54	70	102	54	61	84
Local Yield (s)	127	47	67	77	47	58	77	95
Local Yield 170(s)	127	36	67	67	36	58	66	95

Intersection Summary	
Cycle Length	130
Control Type	Actuated-Coordinated
Natural Cycle	135
Offset: 0 (0%), Referenced to phase 2:EBTL, Start of Green, Master Intersection	

Splits and Phases: 8: Rathburn Road &



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	10	579	100	269	824	19	171	131	279	72	25	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	7.0		3.0	7.0	7.0	3.0	7.0	7.0	3.0	7.0	
Lane Util. Factor	1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	
Frt	1.00	0.98		1.00	1.00	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)	1789	3500		1789	1883	1601	1789	1883	1601	1789	3579	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.52	1.00	1.00	0.64	1.00	
Satd. Flow (perm)	1789	3500		1789	1883	1601	975	1883	1601	1207	3579	
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
Growth Factor (vph)	130%	130%	130%	130%	130%	130%	130%	130%	130%	130%	130%	130%
Adj. Flow (vph)	14	818	141	380	1164	27	242	185	394	102	35	0
RTOR Reduction (vph)	0	11	0	0	0	7	0	0	335	0	0	0
Lane Group Flow (vph)	14	948	0	380	1164	20	242	185	59	102	35	0
Turn Type	Prot			Prot		Perm	pm+pt		Perm	pm+pt		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases						6	8		8	4		
Actuated Green, G (s)	3.0	47.6		30.5	75.1	75.1	24.9	17.9	17.9	11.2	7.2	
Effective Green, g (s)	3.0	47.6		30.5	75.1	75.1	24.9	17.9	17.9	11.2	7.2	
Actuated g/C Ratio	0.02	0.40		0.25	0.63	0.63	0.21	0.15	0.15	0.09	0.06	
Clearance Time (s)	3.0	7.0		3.0	7.0	7.0	3.0	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)	45	1388		455	1178	1002	302	281	239	132	215	
v/s Ratio Prot	0.01	0.27		c0.21	c0.62		c0.10	0.10		0.03	0.01	
v/s Ratio Perm						0.01	c0.07		0.04	0.05		
v/c Ratio	0.31	0.68		0.84	0.99	0.02	0.80	0.66	0.25	0.77	0.16	
Uniform Delay, d1	57.5	30.0		42.4	22.0	8.5	43.7	48.2	45.1	52.5	53.5	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	3.9	2.7		12.5	23.5	0.0	14.1	5.5	0.5	24.0	0.4	
Delay (s)	61.4	32.7		54.9	45.5	8.5	57.8	53.6	45.6	76.5	53.9	
Level of Service	E	C		D	D	A	E	D	D	E	D	
Approach Delay (s)		33.1			47.2			51.0			70.7	
Approach LOS		C			D			D			E	

Intersection Summary			
HCM Average Control Delay	45.1	HCM Level of Service	D
HCM Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	93.7%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Phase Number	1	2	3	4	5	6	7	8
Movement	WBL	EBT	NBL	SBTL	EBL	WBT	SBL	NBTL
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize	Yes		Yes	Yes	Yes	Yes	Yes	
Recall Mode	None	C-Max	None	None	None	Max	None	None
Maximum Split (s)	41	49	11	19	11	79	7	23
Maximum Split (%)	34.2%	40.8%	9.2%	15.8%	9.2%	65.8%	5.8%	19.2%
Minimum Split (s)	11	23	11	19	11	23	7	23
Yellow Time (s)	3	4	3	4	3	4	3	4
All-Red Time (s)	0	3	0	3	0	3	0	3
Minimum Initial (s)	4	4	4	4	4	4	4	4
Vehicle Extension (s)	3	3	3	3	3	3	3	3
Minimum Gap (s)	3	3	3	3	3	3	3	3
Time Before Reduce (s)	0	0	0	0	0	0	0	0
Time To Reduce (s)	0	0	0	0	0	0	0	0
Walk Time (s)		5		2		5		5
Flash Dont Walk (s)		11		10		11		11
Dual Entry	No	Yes	No	Yes	No	Yes	No	Yes
Inhibit Max	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Start Time (s)	79	0	49	60	79	90	49	56
End Time (s)	0	49	60	79	90	49	56	79
Yield/Force Off (s)	117	42	57	72	87	42	53	72
Yield/Force Off 170(s)	117	31	57	62	87	31	53	61
Local Start Time (s)	79	0	49	60	79	90	49	56
Local Yield (s)	117	42	57	72	87	42	53	72
Local Yield 170(s)	117	31	57	62	87	31	53	61

Intersection Summary		
Cycle Length	120	
Control Type	Actuated-Coordinated	
Natural Cycle	120	
Offset: 0 (0%), Referenced to phase 2:EBT, Start of Green, Master Intersection		

Splits and Phases: 8: City Center Dr &