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April 13, 2012 Our Ref.: 8871/220

Mr. Tim Harris
Abode Varsity Living
1301 Fewster Drive,
Mississauga, ON
L4W 1A2

Subject: Updated Traffic Impact
716 Gordon Street, Guelph, Ontario

Dear Mr. Harris,

LEA Consulting Ltd. (LEA) offers this letter in regards to the proposed student housing development located on the southeast corner of the Stone Road and Gordon Street intersection in the City of Guelph. Based on our understanding, Abode Varsity Living Development is seeking to file a revised development concept to address comments provided by city staff.

LEA has been requested to update the original Transportation Impact Study conducted by *Paradigm Transportation Solutions Limited dated October 2010* (herein refer to as the Paradigm Report) and to revise the original report accordingly. Based on the review of the original transportation impact study, it was determined that further analysis is required to address City comments provided by City of Guelph staff dated May 11, 2011.

In reviewing the Paradigm Report and comments provided by the City, LEA provided additional analysis for the following items for clarification:

1) Additional information regarding off peak hour analysis;
2) Revised trip generation based on proxy surveys;
3) Revisit trip distribution assumptions;
4) Conduct updated capacity analysis;
5) Provide detailed analysis on the northbound left-turn queuing at the intersection of Stone Road and Gordon Street to address Staff comments on the impact of this queue may have on the proposed access on Gordon Road.
6) Provide review of pedestrian movement given the nature of the development and its proximity to the University of Guelph.

This letter will focus on the determination of peak travel patterns and trip generations, with discussion regarding deliveries to the site, and pedestrian patterns.

Additional Trip Generation Information

Proxy surveys of existing student apartment style housing in Waterloo and London Ontario were conducted in order to gain further understanding of the travel patterns and to obtain trip generations of similar student residential apartments. As there are limited opportunities in Guelph to obtain local proxy survey information of off-campus student housings, proxy locations in Waterloo and London were selected. A total of five sites were selected for proxy survey to capture a relatively stable sample size[1]. The sites are listed below in **Table 1**:

Table 1: London and Waterloo Proxy Sites

London Ontario		
Varisty Commons	75 Ann Street	499 Bedrooms
Bayfield Hall	291 Windermere Road	299 Bedrooms
Waterloo Ontario		
KW4Rent Building	202 Lester Street	340 Bedrooms
Luxe Waterloo	333 King Street	504 Bedrooms
Columbia Crossing	110 Columbia Street	87 Bedrooms

These five sites were ideal because they are all student residences located near university campuses; the sites are all privately owned with the exception of Bayfield Hall. It is expected that a large number of students living near a campus will have different travel patterns compared to typical apartment buildings; specifically, car ownership and modal splits favouring the use of transit and active transport may not be properly represented using typical standards. Additionally, all of these sites are operated by different owners, and therefore building or parking management should not pose any bias on the results.

It is important to note that all of these sites contain one bed per bedroom with the exception of 333 King Street North which contain a small number of shared bedrooms with two beds. It is assumed that one resident stays in each bed. To be comparable, all trips are converted into a rate of trips/bed. The total number of beds at 333 King Street and 716 Gordon Street are 536 and 1236 respectively.

Two of the proxy sites were initially selected; 75 Ann Street in London, and 202 Lester Street in Waterloo. The purpose of choosing 2 proxy sites is two-fold. Firstly, extensive surveying can be conducted to determine the travel patterns and traffic profiles that student residential apartments generate; secondly, it can be determined whether there are any differences between the travel characteristics of the student population in different cities.

An extensive survey program was conducted on various days of the week to understand the travel patterns of off campus student residences. A Tuesday survey between the hours of 7:00 a.m. to 12:00 a.m. (17 hours) was conducted on March 13th, 2012 to capture typical school travel patterns of a regular school day; a Friday survey between the hours of 7:00 a.m. to 12:00 a.m. (17-hours) on March 16th, 2012 to capture

[1] The Institute of Transportation Engineer's Trip Generation Handbook: An ITE Recommended Practice recommends 5 suitable sites to yield a stable sample.

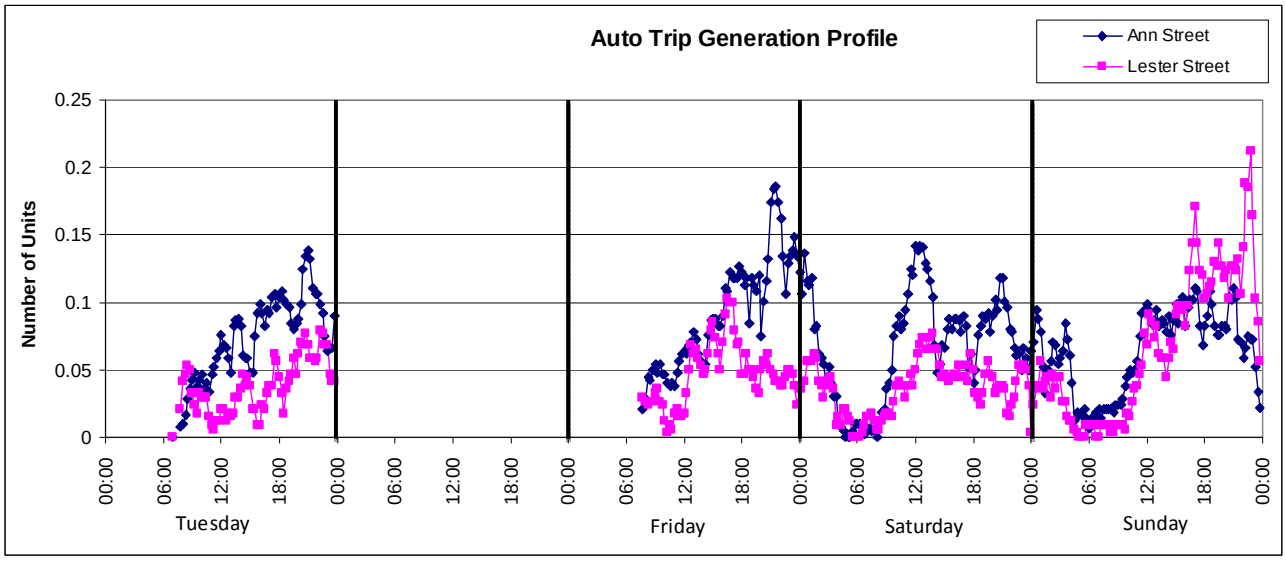
school and other external trips (such as work, recreational and returning to home trips); a Saturday survey between 12:00 a.m. to 12:00 a.m. (24-hours) on March 17th, 2012 to capture work trips and recreational trips; and a Sunday survey between 12:00 a.m. to 12:00 a.m. (24-hours) on March 18th, 2012 to capture work trips, recreational trips, and returning to campus trips. The purpose of these extensive trip generation surveys (pedestrian and automobile) was to provide comprehensive data of 24 hours trip making characteristics of a student apartment.

Various different type of trips from were recorded during the survey to gain a better understanding of the trip making characteristics associated with the student apartment :

- **Delivery**; food deliveries, products/appliances delivered, courier (UPS, FedEx)
- **Taxis**; all marked cabs (drop off/pick up)
- **Vehicles**: Drop-Off and Parking; passenger drop offs and parking. If a vehicle dropped off a passenger then parks, this was counted as vehicle parking.
- **Bicycles**; all bicycles that enter/exit the site
- **Pedestrians**; all pedestrians that enter/exit the site

Composite totals were created by combining all of the inbound and outbound vehicles (deliveries, taxis, vehicle drop-offs and parking) and all of the active modes of transportation (bicycles and pedestrians); these totals were named Total IB/OB Vehicles and IB/OB Active Transport. The combined total of the two was named Combined Total IB/OB. For the purpose of examining auto traffic impacts, the Tuesday, Friday, Saturday and Sunday trip generation characteristics is illustrated in **Figure 1**.

Figure 1: Auto Trip Generation Profile



Generally, it is observed that the auto trip generation rate is noticeably higher during Tuesday, Friday and Saturday at the Ann Street site when compared to the Lester Street site. Excluding the Sunday observation, the Lester Street site displayed a non-auto modal split of 78% compared to 74% observed at the Ann Street site. This can be contributed to the fact that Ann Street site is approximately 3 km from the University of Western Ontario where as Lester Street site is only 300 meters from the Wildred Laurier University campus. Due to the further distance away from campus,

there is a higher dependency on auto usage. The increase in auto trip generation at the Lester Street site during Sunday evening can be contributed to students returning back to campus after the weekend which is less predominate at the Ann Street site. Wilfred Laurier University is (approximately) one hour closer (driving) to the GTA than is the University of Western Ontario and this may well have an effect on the frequency of students returning to their family homes on weekends.

Tuesday Trends

The Tuesday data for the 75 Ann Street and 202 Lester Street sites (see **Figure 2** and **Figure 3** for Total IB/OB Vehicles and IB/OB Active Transport rates, respectively) suggests that students leave their residences relatively late in the morning, with morning peaks happening closer to the afternoon. However, there are relatively smaller peaks happening around 8:00 to10:00 a.m. as well.

Trip profiles stay relatively constant throughout the afternoon/evening, with a decrease in trips around 3:00 to 5:00 p.m.; this decrease may be due to meals, working hours, and being in class.

There were more active transport users compared to vehicles at both sites, due to the proximity of the sites to the school and the general travel characteristics of students. In general, the Lester Street site has a greater active transportation trips in the morning around 8:00 to 9:00 a.m., whereas the London site grew continuously throughout the morning until the eventual peak around 11:00 a.m. to 12:00 p.m. The Ann Street site also displays a higher auto trip generation rate that can be contributed to its distance from the University Campus.

Figure 2 – Tuesday Total Inbound + Outbound Vehicular Rate Profile

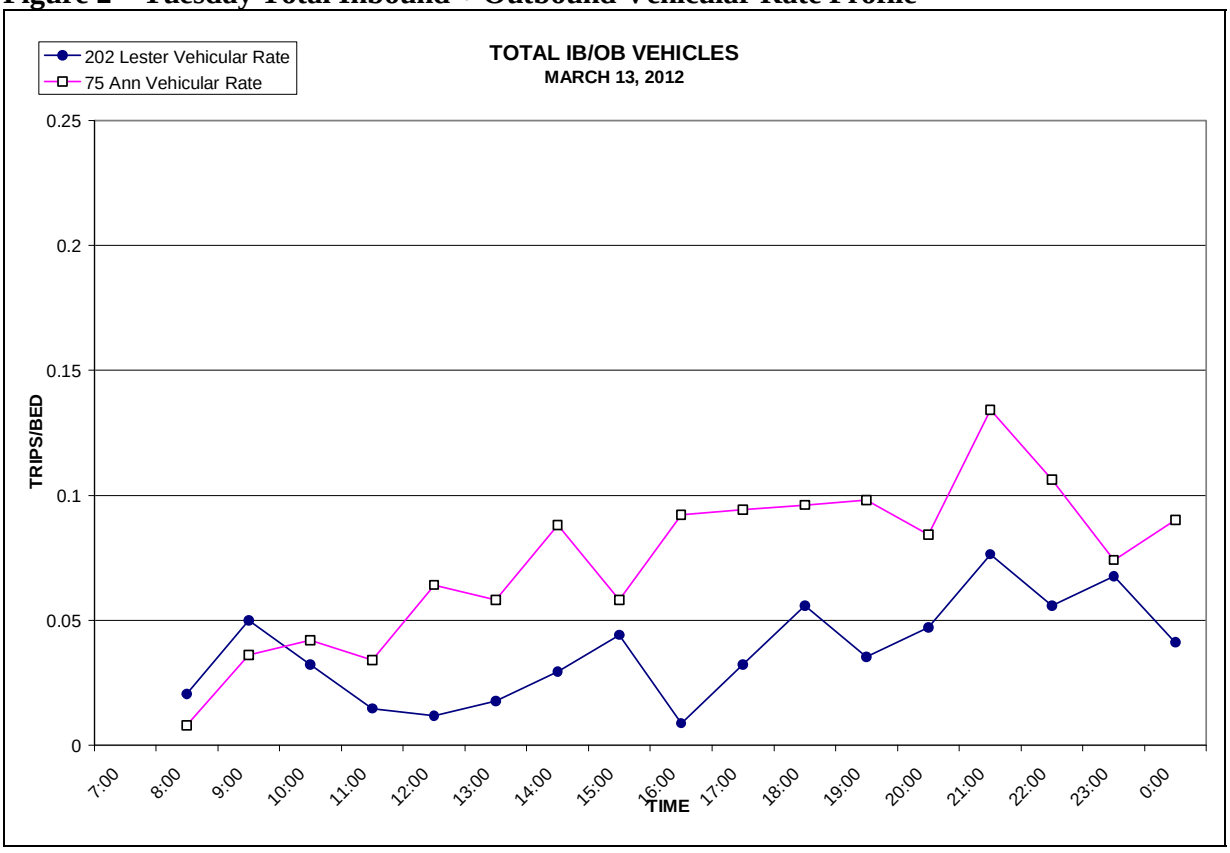
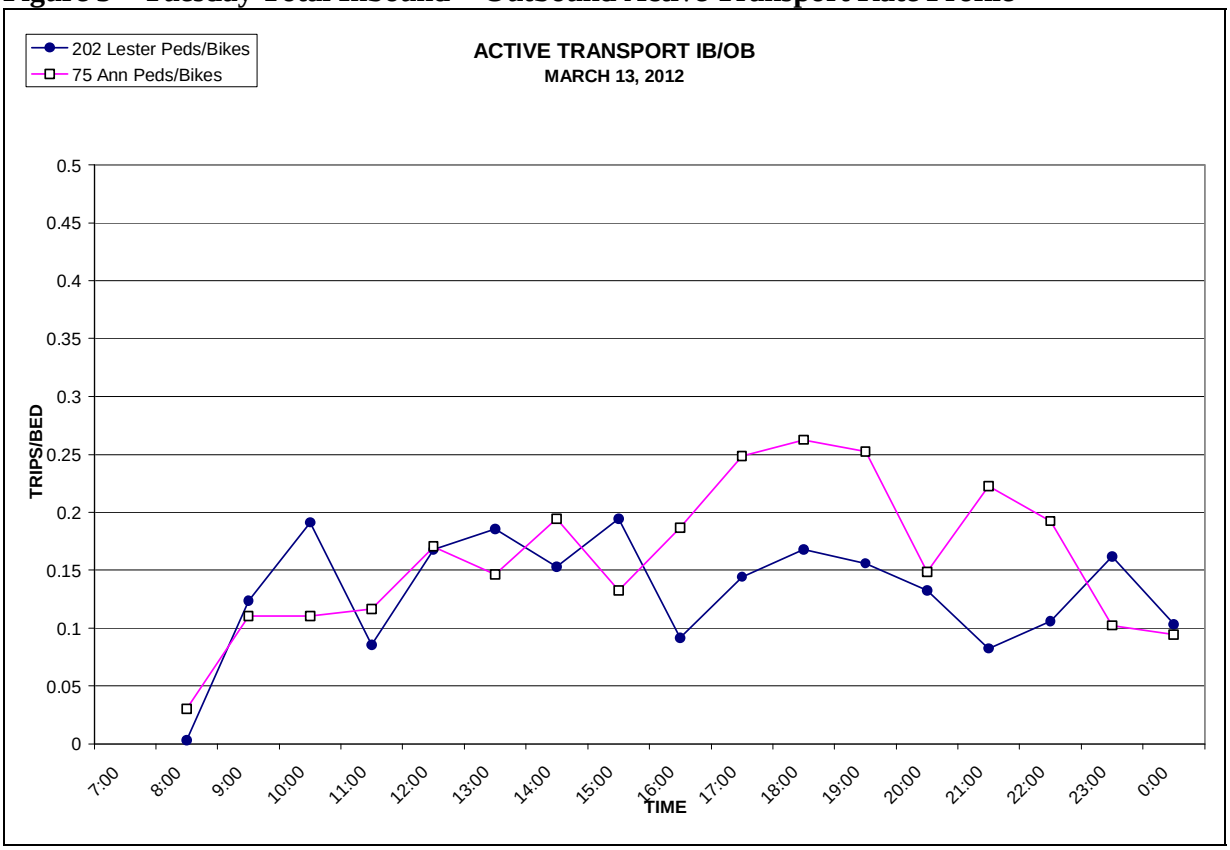


Figure 3 – Tuesday Total Inbound + Outbound Active Transport Rate Profile



See **Appendix A** and **Appendix B** for all of the observed vehicular and active transport trip rates (respectively) at 77 Ann Street and 202 Lester Street from Friday March 16th through Sunday March 18th, 2012.

Friday Trends

The Friday data for the 75 Ann Street and 202 Lester Street sites continue to show a late morning progression of trips generated from the site; morning peaks do not occur until past noon. Trip profiles stay relatively constant throughout the afternoon and evening.

In general, the Ann Street site showed more site traffic later into the evening/night compared to the Lester Street site. This may be representative of more Waterloo students leaving town for the weekend, resulting in less in-town trips late Friday evening.

Saturday Trends

The Saturday data for the 75 Ann Street and 202 Lester Street sites showed a similar morning trend to Friday, with peak traffic occurring in the late morning/early afternoon. Trip profiles stay relatively constant throughout the afternoon and evening. The auto trip generation observed at the Ann Street site is higher by 86.8% when compared to the Lester Street site. Coupled with the distance of the Ann Street site to the university campus and the distance of London to the Greater Toronto Area

(GTA), it is observed that the auto trip rate during Saturday is significantly higher than those observed at the Lester site.

Furthermore, it should be noted the percentage of observed taxis at the Ann Street site was 33% while it was only 6% at the Lester Street site. Therefore, despite the higher auto trip rate observed at Ann Street, it is not all related to private automobiles but it is via the use of taxis.

Sunday Trends

The Sunday data for the 75 Ann Street and 202 Lester Street sites showed a similar morning trend to Saturday with peak traffic occurring in the late morning/early afternoon. Trip profiles stay relatively constant throughout the early afternoon with a noticeable auto trip increase occurring after 4:00 p.m. and reaching its peak at 10:45 p.m. at the Lester Street site. This can be contributed to the students returning back to the residences after spending the weekend at home as the drive from Waterloo to the GTA is within 1.5 hours one-way. The typical drive from London is 2.5 hours one-way. The influx in late evening Sunday trips at the Lester Street site can explain the lower auto trip generation rates observed at the Lester Street site during Saturday.

Auto Peak Hour Analysis

City comments indicated that off peak hour analysis may be required to capture off-peak hour traffic operation at the subject site. Off peak analysis is unusual but was examined in this case to respond to staff. In reviewing the observed Tuesday, Friday, Saturday and Sunday trip profiles, there was only one distinct peak during the weekend period observed at the Ann Street site that may warrant an off-peak hour analysis.

On the Saturday, there was a noticeable peak of vehicular traffic at the Ann Street site from 11:00 a.m. to 12:00 p.m. with a peak auto trip generation rate of 0.142 trips per bed. However, when compared to the peak midday trip making characteristics at the Lester Street site, the vehicle trip generation rate was at 0.074 trips per bed observed at 11:45 a.m. to 12:45 p.m. As discussed in the earlier section, this significant reduction in auto trips observed at the Lester Street site can be attributed to its proximity to the campus and the GTA. In general, during the entire Saturday, the Lester Street site generates 54% less auto trips than the Ann Street Site.

Given the proximity of the proposed site to the university campus and the GTA, it is anticipated that the proposed student residence in Guelph will behave similar to the Lester Street site. When the trip making characteristics at the Lester Street site during the Saturday mid-day is applied to the proposed development, it is projected that the proposed development will generate 91 two-way trips. Generally, a intersection capacity analysis of two-way trips less than 100 trips is not required, as generated traffic would have minimal impacts to the existing road network when compared to the weekday peak periods. At this time, LEA does not have any traffic volume based on a typical Saturday that would indicate the through volumes on Stone Road or Gordon Street will be higher when compared to the weekday a.m. and p.m. peak periods. Typically, the weekend peak traffic flow volumes are lower than those observed during the a.m. and p.m. peak period.

The observed weekday morning peak hour typically occurs during the late morning, closer to 11:30 a.m. when the roadway traffic volume is relatively lower. However, based on comments provided by Staff regarding potential driveway blockage along Gordon Road, LEA decided to provide a detailed capacity analysis despite a low trip generation rate expected between 7:00 a.m. to 9:00 a.m. Based on the auto trip data collected at the Ann Street and Lester Street sites, the maximum observed a.m. peak period occurred between the hours of 7:00 a.m. to 9:00 a.m; the trip rate was 0.053 trips per bed. Due to the expected low trip rates, additional trip generation survey data was not collected to determine a more refined trip generation estimation. Based on a trip generation rate of 0.053 trips per bed, the proposed development will generate 66 two-way trips during the morning peak hour. Detailed trip generation results are summarized in **Table 2**.

Table 2 – Vehicular AM Peak Hour Trip Generation Rates

Site	Date	Two-way Trip Rate	
		Time	Trips/Bed
75 Ann St, London	Tuesday March 13, 2012	8:00	0.036
	Friday March 16, 2012	8:00	0.050
202 Lester St, Waterloo	Tuesday March 13, 2012	7:45	0.053
	Friday March 16, 2012	7:00	0.029
		Maxed Observed	**0.053**

Between 4:00 p.m. and 6:00 p.m., the observed Tuesday p.m. peak hour rates for 75 Ann Street and 202 Lester Street were noticeably different. Therefore, to verify the p.m. auto trip generation rate, 3 additional off-campus student residences were surveyed during this time period to determine a more refined p.m. peak hour trip generation rate. The additional sites surveyed were: 110 Columbia Street and 333 King Street north in Waterloo and 291 Windermere Road in London. The detailed survey summary results are tabulated in **Table 3**.

Table 3 – Vehicular PM Peak Hour Trip Generation Rates

Site	Date	Two-way Trip Rate	
		Time	Trips/Bed
75 Ann St, London	Tuesday March 13, 2012	17:30	0.106
	Friday March 16, 2012	17:45	0.127
202 Lester St, Waterloo	Tuesday March 13, 2012	17:30	0.062
	Friday March 16, 2012	16:30	0.103
110 Columbia St, Waterloo	Tuesday March 27, 2012	17:45	0.069
333 King St, Waterloo	Thursday March 29, 2012	17:45	0.170
291 Windermere Rd, London	Tuesday April 3, 2012	17:45	0.085
		Average	0.103
		85th Percentile	**0.127**

The vehicular trip generation rates at these sites range from 0.062 to 0.170 trips/bed, with an average rate of 0.103 trips/bed. The 85th percentile data point was chosen which produced a rate of 0.127 trips/bed. To be conservative in our analysis, the 85th percentile data point is used for auto trip generation. Based on the selected p.m. peak hour trip generation rate, the proposed development will generate 156 two-way trips.

Active Transport Peak

During the same periods in which vehicular surveys took place, pedestrian and bicyclist information was also collected. See **Table 4** for a summary of the p.m. daily site peaks at 77 Ann Street in London, and 202 Lester Street in Waterloo.

Table 4 – PM Total Active Transport Peak Hour

Site	Date	Active Transport	
		Time	Trips/Bed
75 Ann St, London	Tuesday March 13, 2012	18:30	0.29
	Friday March 16, 2012	18:00	0.35
	Saturday March 17, 2012	21:15	0.61
	Sunday March 18, 2012	2:15	0.29
202 Lester St, Waterloo	Tuesday March 13, 2012	13:30	0.20
	Friday March 16, 2012	15:15	0.27
	Saturday March 17, 2012	16:45	0.35
	Sunday March 18, 2012	0:45	0.26

In general, the peaks for the London site occurred later in the day compared to the Lester Street site, and the Ann Street site produced higher rates on all of the days. The weekday (Tuesday) peak occurred at 6:30 p.m. for the Ann Street site, and at 1:30 p.m. at the Lester Street site, neither of which occurs during the typical a.m. or p.m. peak periods of 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m., respectively.

The Friday peaks however, occurred at 6:00 p.m. and 3:15 p.m., which is closer to the typical p.m. peak hours of 4:00 p.m. to 6:00 p.m. Saturday saw the highest active transportation rates compared to any other time period, and these peaks occurred at 9:15pm in London and at 4:45pm in Waterloo. Additionally, the peaks on Sunday occurred at 2:15am in London, and 12:45am in Waterloo, consisting mostly of inbound trips; this suggests that these are actually return trips from Saturday.

In order to assess the impact which active transport could have on the network during the p.m. peak, the hours of 4:00 p.m. to 6:00 p.m. were investigated for all sites. **Table 5** shows the peaked hourly active transportation trip generation rate during the p.m. peak period.

Table 5 – Active Transport PM Peak Hour Trip Generation Rates

Site	Date	Active Transport	
		Time	Trips/Bed
75 Ann St, London	Tuesday March 13, 2012	17:15	0.29
	Friday March 16, 2012	17:45	0.33
202 Lester St, Waterloo	Tuesday March 13, 2012	17:45	0.17
	Friday March 16, 2012	17:30	0.23
110 Columbia St, Waterloo	Tuesday March 27, 2012	16:45	0.21
333 King St, Waterloo	Thursday March 29, 2012	17:30	0.26
291 Windermere Rd, London	Tuesday April 3, 2012	17:45	0.24
		Average	0.25
		85th Percentile	**0.29**

The active transport trip generation rates at these sites range from 0.17 to 0.33 trips/bed, with an average rate of 0.25 trips/bed, and an 85th percentile rate of 0.29 trips/bed.

During the time period of 8:00 to 10:00 a.m., we can assess the active transportation a.m. peak trip generation. **Table 6** shows the time periods and rates for the a.m. peak period.

Table 6 – AM Total Active Transport Peak Hour

Site	Date	Active Transport	
		Time	Trips/Bed
75 Ann St, London	Tuesday March 13, 2012	9:15	0.14
	Friday March 16, 2012	9:30	0.15
202 Lester St, Waterloo	Tuesday March 13, 2012	9:45	0.19
	Friday March 16, 2012	9:45	0.16
		Average	0.16
		85th Percentile	**0.16**

The vehicular trip generation rates at these sites range from 0.14 to 0.19 trips/bed. The 85th percentile and the average active transportation trip rates are found to be the same at 0.16 trips/bed.

Trip Generation

Based on the proxy site survey data collected, an updated trip generation analysis is provided for the proposed development. The a.m. trip generation rates for vehicles and active transportation are 0.053 trips/bed and 0.16 trips/bed, respectively. This will result in 62 vehicular trips and 198 active trips during the a.m. peak hour.

The p.m. trip generation rates for vehicles and active transportation are 0.126 trips/bed and 0.29 trips/bed, respectively. The total number of units at the proposed development site is 264, which consists of 1216 bedrooms and 1236 beds. The proposed development will generate a total of 161 vehicular trips and 358 active trips during the p.m. peak hour. The detailed trip generation for the proposed development is tabulated in **Table 7.** These updated trip generation values are used for future capacity analysis in this report.

Table 7 – Vehicular Volume Summary

Peak Period	Inbound Rate	Outbound Rate	Inbound Volume	Outbound Volume
AM (7:00a.m.-9:00 a.m.)	0.021	0.032	26	40
PM (4:00 p.m. -6:00 p.m.)	0.062	0.064	77	79

Comparatively, the auto trip generation for the proposed development is less than those projected in the Paradigm report (29 inbound, 115 outbound for the a.m. peak, and 113 inbound, 72 outbound for the p.m. peak) which was an adjusted value based on ITE Apartment trip generation. LEA is of the opinion that the trip generation rates presented are more reflective of the proposed use.

Trip Distribution

In the review of the trip distribution used in the initial report, LEA has re-visited and determined that the same trip distribution is applicable to the updated analysis for both the a.m. and p.m. peak periods.

The trip distribution was derived based on the locations of potential origins and destinations that would attract automobile trips by students. Provided below is the trip distribution.

- North on Gordon Street (University of Guelph, Downtown Guelph, and Old Quebec Street Shoppes) – 35%
- West on Stone Road West (Stone Road Mall, Metro Supermarket, and Highway 6) – 50%
- South on Gordon Street (No Frills Supermarket, and Retail Plaza) – 10%
- East on Stone Road East – 5%

As most of the trips to the university will be by walking and cycling, we expect most of the automobile trips will be destined elsewhere for other uses. During the a.m. and p.m. peak hours we expect the general inbound and outbound distribution is mainly to/from the west direction (Stone Road Mall) and the north (Downtown Guelph). These areas provide a variety of services to the student community that includes a variety of soft services, supermarkets and retail establishments. In addition, with the flexibility of student schedules, we see these destinations to draw students as both customers and employees, hence the same distribution as been used for both peak periods.

Additional Surveys and Capacity Analysis

LEA conducted additional manual survey counts on Tuesday April 10th 2012 to further analyze the northbound queue concerns expressed by City Staff at the intersection of Gordon Street and Stone Road. The detailed traffic count locations are tabulated in **Table 8**.

Table 8 – Locations and Type of Surveys conducted

Surveyed Date	Location	Control Type	Survey Type
Tuesday April 10, 2012 (LEA Consulting Ltd.)	Gordon Street and Stone Road	Signalized	TMC
	Northbound Queue at Gordon Street & Stone Road		Queue Survey
	Gordon Street & Delta Hotel Driveway	Unsignalized	TMC
	Gordon Street & Monticello Crescent	Unsignalized	TMC/ Trace Survey
	Stone Road & Existing Driveway	Unsignalized	TMC
	Stone Road & Evergreen Drive	Unsignalized	Trace Survey

The resultant traffic survey summaries for the a.m. and p.m. peak hour are illustrated in **Figures 4 and 5**, respectively. These figures are located at the end of this document.

Existing Traffic Conditions

Abiding to the same capacity methodologies used in the Paradigm report, revised capacity analysis under existing traffic conditions are conducted using the Synchro 8.0 software adhering to the HCM 2000 capacity analysis methodologies. The resultant capacity analyses are summarized in **Table 9**. The signalized intersection of Gordon Street and Stone Road is operating at an acceptable level of service with some capacity constraints for the northbound left-turn movement during the p.m. peak hour. Detailed capacity analysis outputs can be found in **Appendix C**

Table 9 – Signalized Intersection – Existing Traffic Conditions

Weekday AM Peak Hour									
Intersection	Overall			Movements of Interest (LOS > D or V/C > 0.85)					
	V/C	Delay (s)	LOS	Movement	V/C	Delay (s)	LOS	Queue (m)	
								50th	95th
Gordon Street & Stone Road	0.48	23.8	C	-	-	-	-	-	-
Weekday PM Peak Hour									
Intersection	Overall			Movements of Interest (LOS > D or V/C > 0.85)					
	V/C	Delay (s)	LOS	Movement	V/C	Delay (s)	LOS	Queue (m)	
								50th	95th
Gordon Street & Stone Road	0.59	27.4	C	NBL	0.95	61.8	E	31.2	75.2

Future background Conditions

The future background traffic condition is forecasted by increasing the 2012 turning movement annually by 2% for 5 years. The resultant traffic volumes are presented in **Figures 6** and **7** for the a.m. and p.m. peak hour respectively. Due to the increase in background traffic growth, a minor signal timing adjustment was made to increase the north/south capacity by shifting one-second of green time from Stone Road. On the east/west 2 seconds have been shifted from the protected eastbound left to the eastbound through and 4 seconds from the protected westbound left to the westbound through phase. The resultant background traffic capacity analysis indicates the intersection of Gordon Street & Stone Road is expected to operate at acceptable levels of service in both the weekday a.m. and p.m. peak hour. Analysis summaries are shown in **Table 10**, and detailed capacity analysis outputs can be found in **Appendix D**.

Due to the reduction in east/west green time, the westbound left turn movement will be operating at near capacity. However, the projected 50th queue will continue to be accommodated within existing westbound queue storage. Similar to existing operating conditions, there will be occurrence where the westbound left-turn queue will exceed the existing storage area. However, due to minimum pedestrian cross-time requirements, opportunities to improve this turning movement are limited without increasing the overall intersection cycle length.

Table 10 – Signalized Intersection – Future Background Traffic Conditions

Weekday AM Peak Hour									
Intersection	Overall			Movements of Interest (LOS > D or V/C > 0.85)					
	V/C	Delay (s)	LOS	Movement	V/C	Delay (s)	LOS	Queue (m)	
								50th	95th
Gordon Street & Stone Road	0.53	23.4	C	-	-	-	-	-	-
Weekday PM Peak Hour									
Intersection	Overall			Movements of Interest (LOS > D or V/C > 0.85)					
	V/C	Delay (s)	LOS	Movement	V/C	Delay (s)	LOS	Queue (m)	
								50th	95th
Gordon Street & Stone Road	0.70	30.4	C	WBL	0.94	57.5	E	45.6	89.1

Future Total Traffic Condition

Site traffic generated by the proposed development is shown in **Figures 8** and **9** for the a.m. and p.m. peak hour, respectively. Future total traffic is calculated by the summation of future background and site traffic. The resultant future total traffic volumes are shown in **Figures 10** and **11** for the a.m. and p.m. peak hour, respectively.

Under future total traffic conditions, the intersection of Gordon Street & Stone Road is expected to operate at acceptable overall levels of service. **Table 11** shows the movements of interest with detailed capacity outputs attached in **Appendix E**.

The increase in site traffic will marginally increase the westbound left-turn delay during the p.m. peak hour; however, it will continue to operate at an acceptable level of service.

Table 11 – Signalized Intersection – Future Total Traffic Conditions

Weekday AM Peak Hour									
Intersection	Overall			Movements of Interest (LOS > D or V/C > 0.85)					
	V/C	Delay (s)	LOS	Movement	V/C	Delay (s)	LOS	Queue (m)	
								50th	95th
Gordon Street & Stone Road	0.55	23.7	C	WBT	0.56	35.0	D	39.7	54.0
Weekday PM Peak Hour									
Intersection	Overall			Movements of Interest (LOS > D or V/C > 0.85)					
	V/C	Delay (s)	LOS	Movement	V/C	Delay (s)	LOS	Queue (m)	
								50th	95th
Gordon Street & Stone Road	0.76	31.9	C	WBL	0.96	63.7	E	46.6	92.1

Unsignalized capacity analysis is also conducted at the existing driveway on Stone Road and the proposed driveway on Gordon Road using the Synchro 8 software based on HCM 2000 capacity analysis

methodologies. During the a.m. and p.m. peak hours, all unsignalized intersections will operate at acceptable levels of service with some minor delay expected at the Stone Road driveway during the p.m. peak hour. **Table 12** shows the movements of interest. Due to the heavy east/west through volume along Stone Road, some reasonable delays can be expected for vehicles conducting the northbound left-turn onto Stone Road. However, this movement will also operate well below capacity with a v/c ratio of 0.29.

Table 12 – Unsignalized Intersection – Future Total Traffic Conditions

Intersection	Movements of Interest	Weekday AM Peak Hour					Weekday PM Peak Hour				
		Movements of Interest (LOS > D or V/C > 0.85)									
		Flow Rate (vph)	Capacity (vph)	Control Delay (s)	Vol/Cap Ratio (v/c)	LOS	Flow Rate (vph)	Capacity (vph)	Control Delay (s)	Vol/Cap Ratio (v/c)	LOS
Stone Road & Driveway 1	WBTL	259	995	0.0	0.00	A	306	796	0.1	0.00	A
	NBLR	25	266	19.9	0.09	C	49	166	35.4	0.29	E
Gordon Street & Driveway 2	WBLR	18	507	12.4	0.04	B	37	496	12.8	0.07	B
	SBTL	249	474	0.9	0.02	A	545	589	1.5	0.06	A

Northbound Queuing at Gordon Street and Stone Road Intersection

The City of Guelph has requested that a queue analysis at the intersection of Gordon Street and Stone Road be conducted to determine whether the northbound left queue will interfere with the proposed full movement access into the subject site.

In order to assess the future queues at Gordon Street and Stone Road, an updated traffic survey was conducted on April 10th, 2012 during the a.m. and p.m. peak periods (from 07:00 to 9:00 a.m. and 4:00 to 6:00 p.m.). All turning movement volumes were collected, as were the queues lengths for the northbound left, and the two northbound through lanes. Using the established peak hours (08:00 to 9:00 a.m. and 4:30-5:30 p.m.), the existing queue lengths are shown **Table 13** and the detailed survey summary are shown in **Appendix F**.

Table 13 – Existing Queue Lengths at Gordon Street and Stone Road

	AM Peak Hour (meters)			PM Peak Hour (meters)		
	NBL	NBT(center)	NBT(curb)	NBL	NBT(center)	NBT(curb)
Average	30.8	66.3	24.5	29.8	34.9	17.6
Max	78.0	143.0	53.7	78.0	84.5	45.5

The center northbound through lane experienced longer queues than the northbound through lane, due to the downstream merge after the intersection of Gordon Street and South Ring Road; therefore, drivers are preemptively queuing rather than choosing to merge further down the street.

Although the existing northbound left-turn queue would extend beyond the existing queue storage area, no negative operational impacts were observed along Gordon Street as through traffic can easily by-pass the left-turn vehicles using the curb lane. This was an infrequent occurrence that was only observed two and four times during the a.m. and p.m. survey periods, respectively.

The typical back of queue in SYNCHRO is represented as 50th percentile queue length (m). The 95th percentile queue length is based on a statistical manipulation of the observed traffic volumes. Therefore, it should be noted that the 95th percentile queue projection does not necessarily represent the actual traffic conditions. In order to verify the SYNCHRO model, queue results to field surveys was compared the 50th percentile queue length from SYNCHRO. A summary of the SYNCHRO 8 queue results for the existing conditions is shown Table 14.

Table 14 – Existing SYNCHRO Queue Results

	AM Peak Queue (m)		PM Peak Queue (m)	
	NBL	NBT	NBL	NBT
Queue Length 50th	35.3	76.4	31.2	49.8
Queue Length 95th	53.6	98.7	75.2	65.3

In general, the calculated 50th percentile northbound queue lengths are larger than those observed; the difference is relatively minor for the northbound left movements but larger for the northbound through movements. The SYNCHRO results are thus considered to be comparable.

Future Background NB Queuing at Gordon Street and Stone Road

The SYNCHRO 8 queue results for the future background conditions are shown below in **Table 15**. The detailed analysis summary is attached in **Appendix D**.

Table 15 – Future Background SYNCHRO Queue Results

	AM Peak Queue (m)		PM Peak Queue (m)	
	NBL	NBT	NBL	NBT
Queue Length 50th	31.8	74.1	35.1	47.8
Queue Length 95th	45.4	90.9	98.3	71.5

The future background results (shown above) show that northbound through queues grow by approximately 3% during the p.m. peak period, and decrease by 5% during the a.m. peak period, due to the optimized signal timing plan.

Future Total NB Queuing at Gordon Street and Stone Road

The SYNCHRO 8 queue results for the future total traffic conditions are shown in **Table 16**. The detailed analysis summary is attached in **Appendix E**.

Table 16 – Future Total SYNCHRO Queue Results

	AM Peak Queue (m)		PM Peak Queue (m)	
	NBL	NBT	NBL	NBT
Queue Length 50th	32.8	74.4	39.6	49.7
Queue Length 95th	47.6	93.2	110.3	73.2

The future total results show that northbound through queues grow by approximately 6% during the p.m. peak hour, and decrease by 4% during the a.m. peak period, due to the optimized signal timing plan.

The 50th percentile queue length for the northbound through traffic is not expected to interfere with the proposed full movement access on Gordon Street (located 95 meters south of Stone Road). The 50th percentile queue length for the northbound left turn lane is not expected to exceed the available left turn storage of 65 meters. Similar to existing conditions, it can be expected that on some occasionally the northbound left queue will exceed the available left turn storage during the a.m. and p.m. peak hour.

Based on the 95th percentile queue projection, the northbound through queues may approach the proposed Gordon Street driveway during the a.m. peak hour. However, during this peak time frame only 10 southbound left turn vehicles are expected to make this movement, and the infrequency of this blockage will not result in a negative impact to the traffic flow along Gordon Street.

During the p.m. peak hour, the northbound left queue may exceed the left turn storage capacity and obstruct the proposed Gordon Street driveway by two vehicles. This will create minor interference to the northbound through and southbound left-turn traffic into the subject site. However, during the p.m. peak hour, the northbound through traffic is generally lower when compared to the a.m. peak hour and northbound vehicles will not be significantly impacted by this queue. Based on our on-site observations, the longest northbound queue is always observed at the end of the red phase. During this time, the northbound and southbound through traffic on Gordon Street are stopped at Stone Road and significant southbound through traffic along Gordon Street is not expected. Since a protected northbound left-turn phase is always present, in the event that there is an existing northbound queue south of Stone Road obstructing the southbound left inbound movement at the site access, the northbound left-turn queue will discharge prior to the arrival of the main southbound through traffic.

Pedestrian Patterns

The location of the site makes it an ideal location for students to walk to campus. Furthermore, the proximity to amenities and to the transit loop on campus, also lead this location to be more dependent on walking and transit use. **Figure 12** shows walking paths and distances from the site at 716 Gordon Street in Guelph to major destinations, and the university centre which represents the location of the transit loop.

Entrances to Building 1 are located at the northeast corner of Stone Road East and Gordon Street, with additionally entrances further south along Gordon Street, and along the side edge of the site parking lot.

Entrances to Building 2 are located south of Building 1 along Gordon Street, with additional entrances to access the site parking lots.

As the majority of the site entrances are located along Gordon Street, it is expected that pedestrians will access the University of Guelph campus by crossing at the pedestrian crosswalks located at the intersection of Stone Road East and Gordon Street. Interior walkways within the campus would allow easy access to the transit loop and various classrooms.

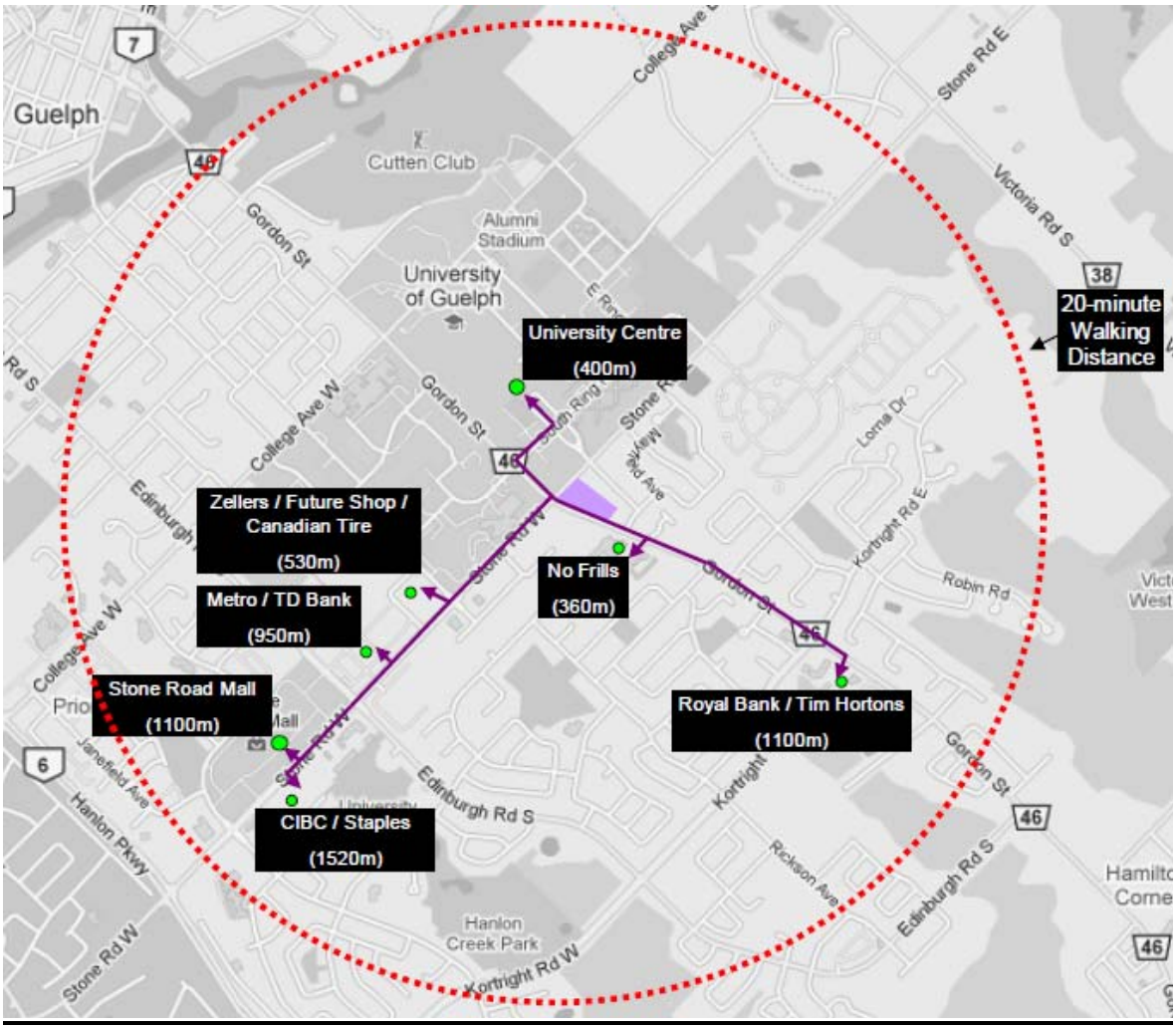


Figure 12 – Locations of and Walking Paths to Major Destinations from 716 Gordon Street

Pedestrian Walkway Level of Service (LOS)

From on-site observations LEA established that the sidewalks along Gordon Street and Stone Road East are a constant width, with no visible obstructions along the path. There are many pedestrian only walkways within the University of Guelph campus. These walkways are typically wider than the walkways around the site, which are estimated at 1.6m wide.

The largest peak hour for active transport is 358 trips. Assuming the most conservative of cases where this is entirely made up of pedestrians, and assuming a peak hour factor of 1, it can be determined that the 15

minute pedestrian flow rate is 89.5 pedestrians (using equation 23-2 in HCM 2010). We can convert this into a unit flow by using the existing effective sidewalk width (1.6m) and equation 23-3 in HCM 2010, resulting in a unit flow of 3.73 pedestrians/meter/minute. Using equation 23-4, and assuming a pedestrian speed of 1m/s, we can estimate a pedestrian spacing of 16.1 m^2 per pedestrian; or 173 ft^2/ped. terms of sidewalk volumes, since bike lanes are provided on Gordon Street for bicycle traffic, and since this is significantly larger than 60 ft^2/ped, the sidewalks along Stone Road East and Gordon Street will operate at a level of service of A.

Conclusions

LEA has been requested to update the original Transportation Impact Study of the proposed student housing development located on the southeast corner of the Stone Road/Gordon Street intersection conducted by *Paradigm Transportation Solutions Limited*, and to revise the original report based on City comments. The findings from the additional analysis undertaken by LEA confirms the findings in the Paradigm report that the existing roadway network can accommodate the proposed development.

Pedestrian trips to campus will use the crosswalks at Stone Road East and Gordon Street. All major attractions within a 20 minute walking radius are accessible via Stone Road East, Gordon Street, and the intersection of the sidewalks around site will operate at a LOS of A.

Should you have any further questions or concerns regarding the information provided, please do not hesitate to contact me at 905-470-0015 ext. 292.

Best regards,

LEA Consulting Ltd.

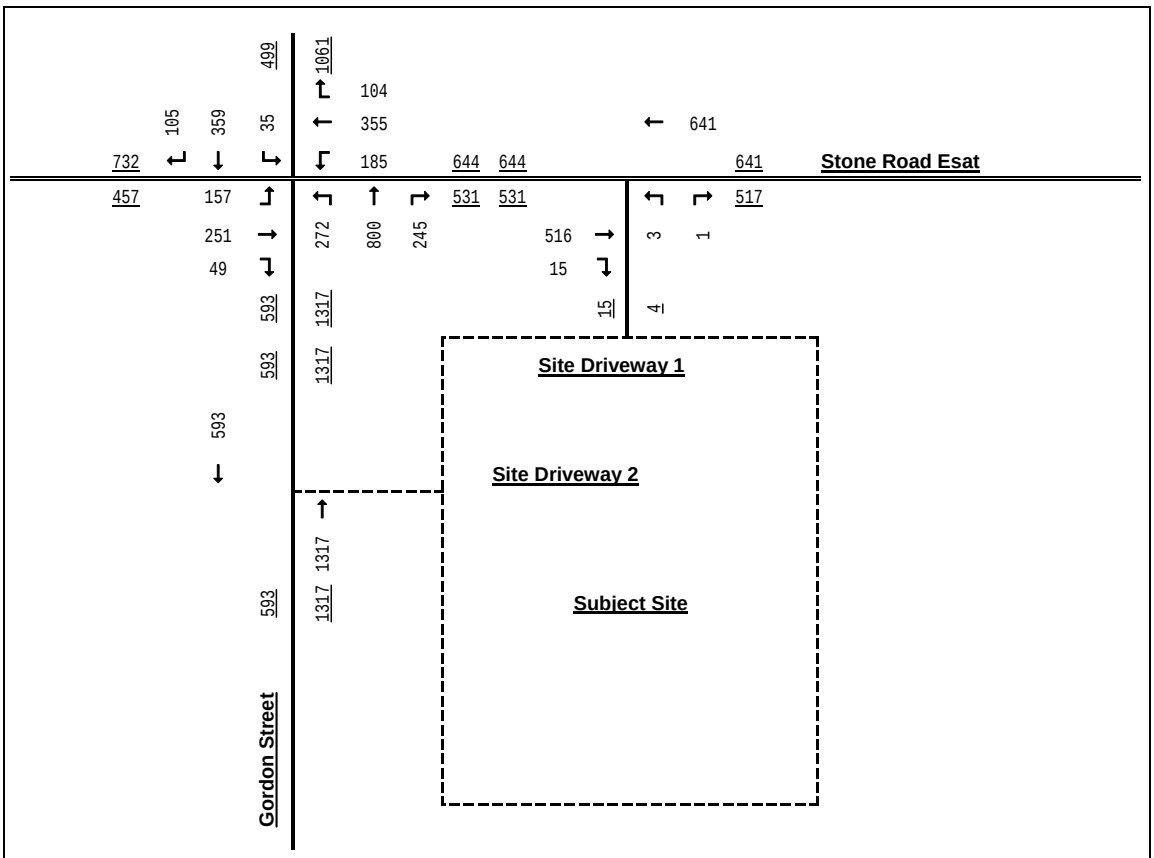
Kenneth Chan, P. Eng., PTOE
Transportation Engineer

:jd/kc

Encl.: **Figures 4 to 11**

cc: Christopher Sidlar – LEA Consulting
cc: Ira T. Kagan – Kagan Shastri LLP Lawyers
cc: Chris Pidgeon – GSP Group Inc.

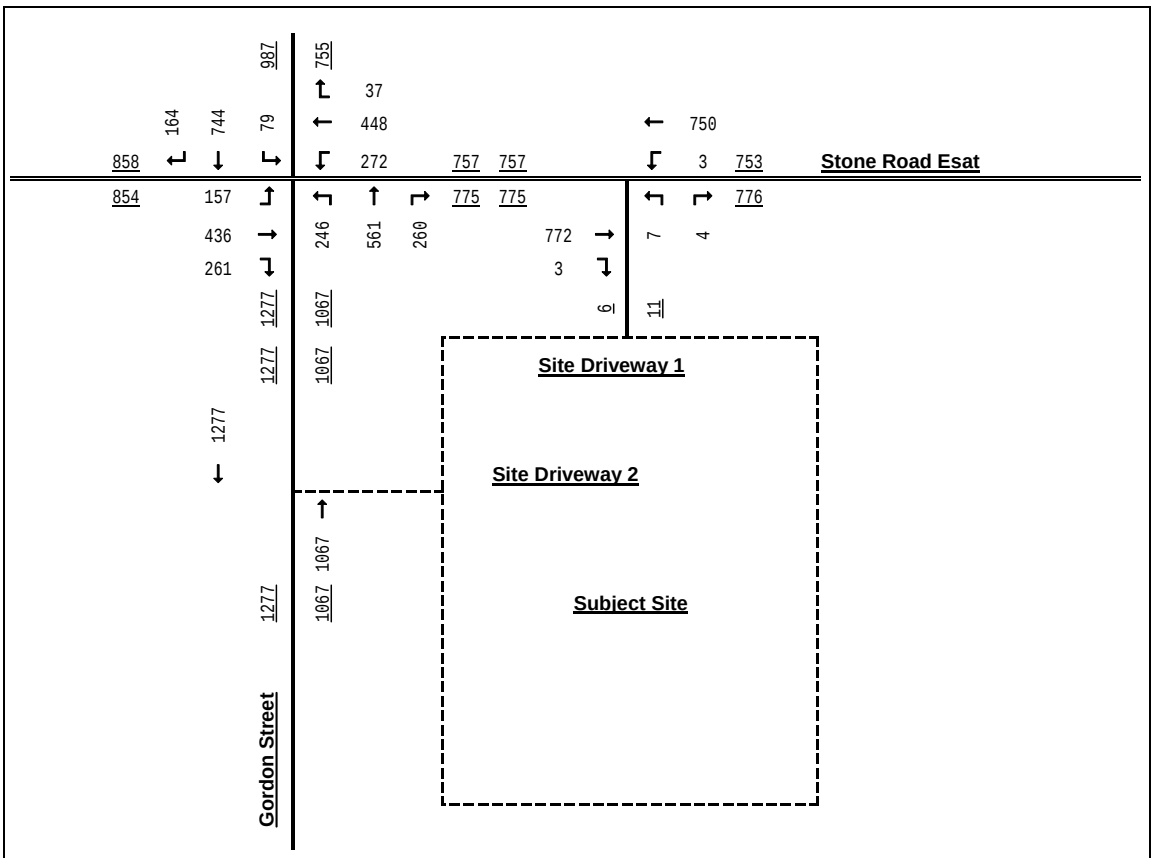
FIGURES



Proposed Development at 716 Gordon Road

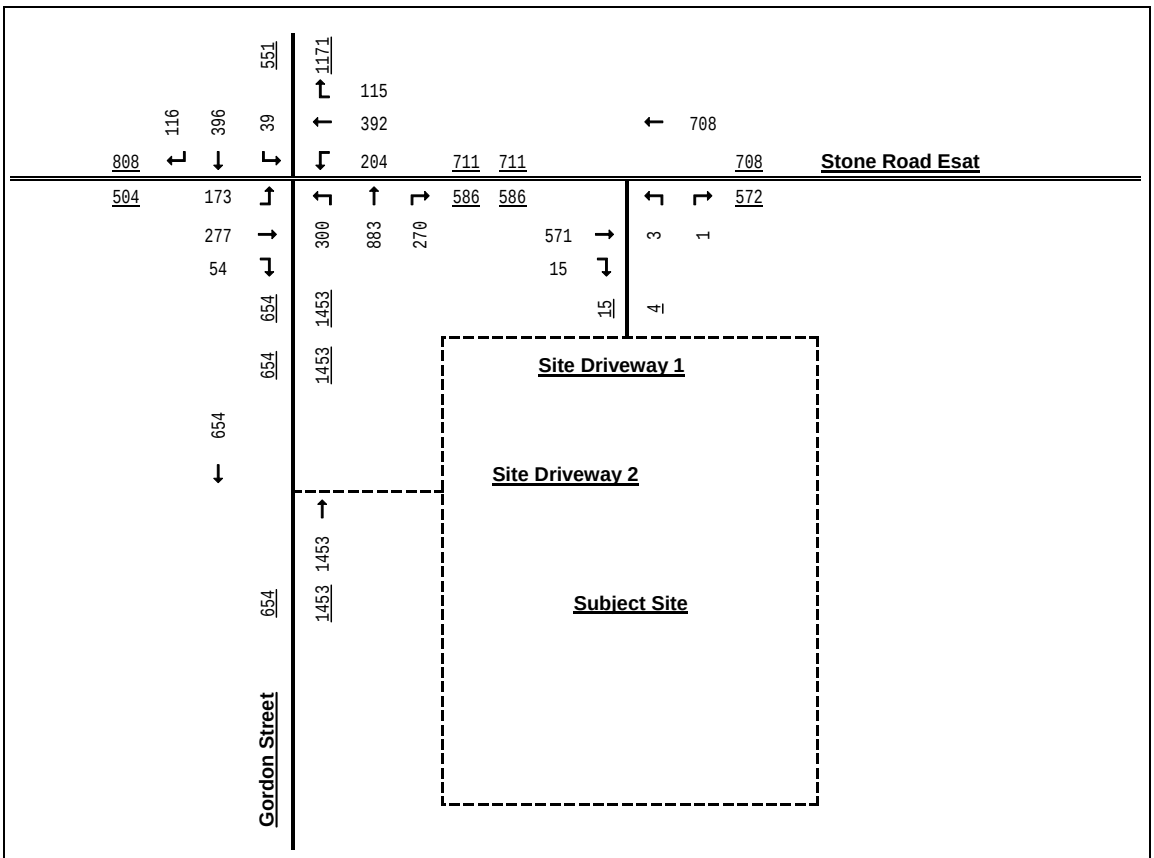
FIGURE **4**
EXISTING BALANCED TRAFFIC
Weekday AM

F:\8871\Traffic\Turn\[TURNV3.xls]Table 12:36 Column 6 13-Apr-12



Proposed Development at 716 Gordon Road

FIGURE **5**
EXISTING BALANCED TRAFFIC
Weekday PM



Proposed Development at 716 Gordon Road

FIGURE **6**
FUTURE BACKGROUND TRAFFIC (2017)
Weekday AM

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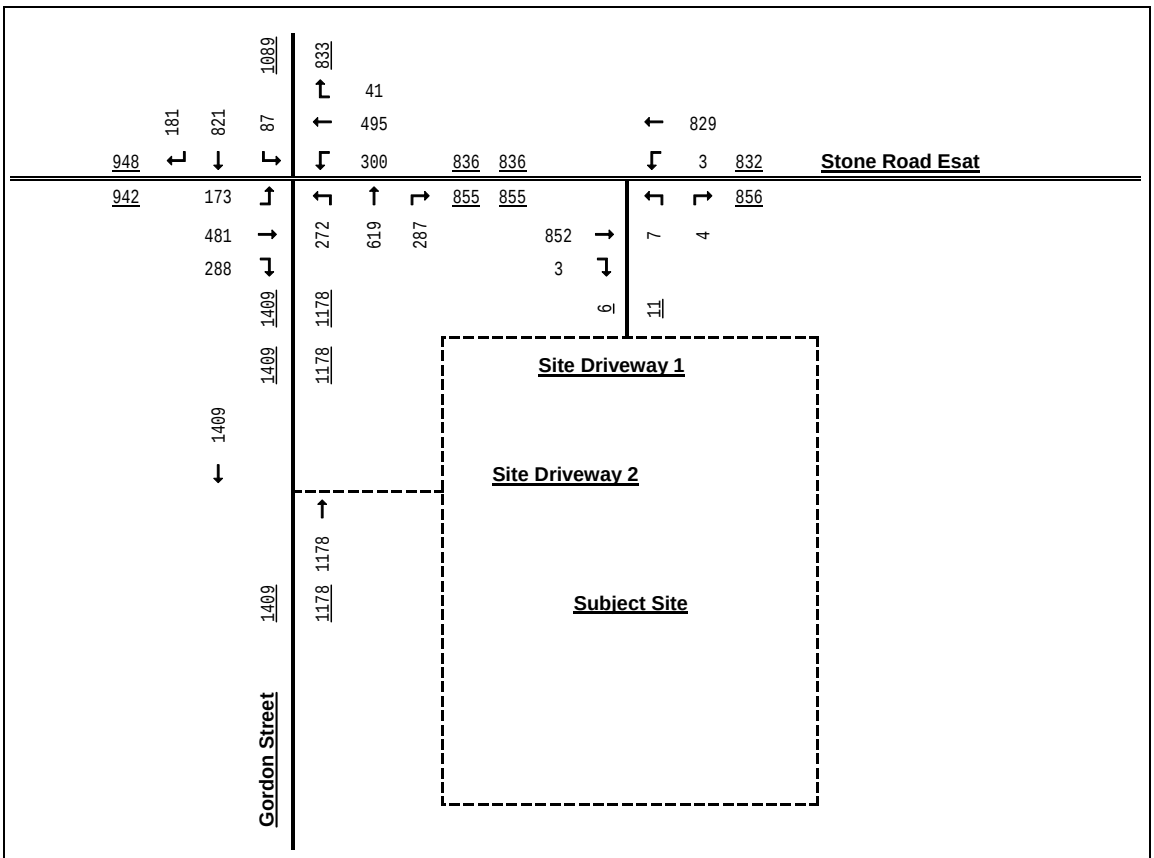
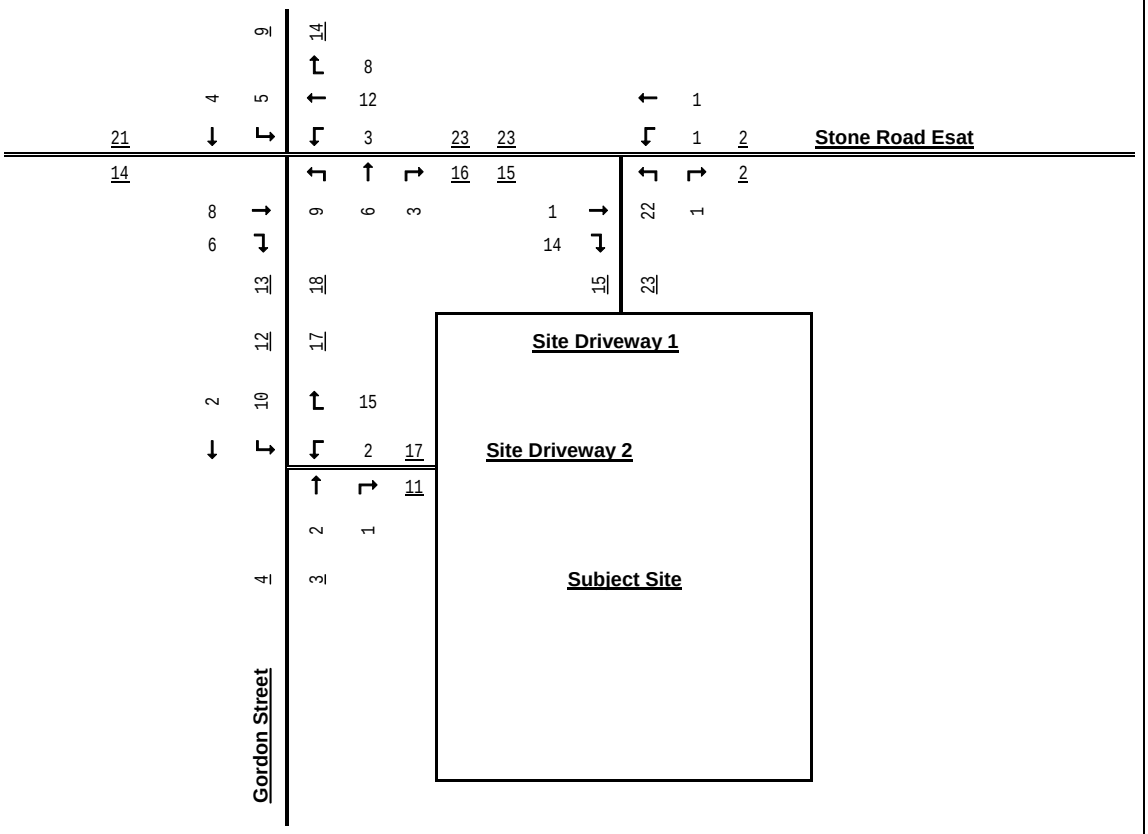


Proposed Development at 716 Gordon Road

FIGURE **7**
FUTURE BACKGROUND TRAFFIC (2017)
Weekday PM

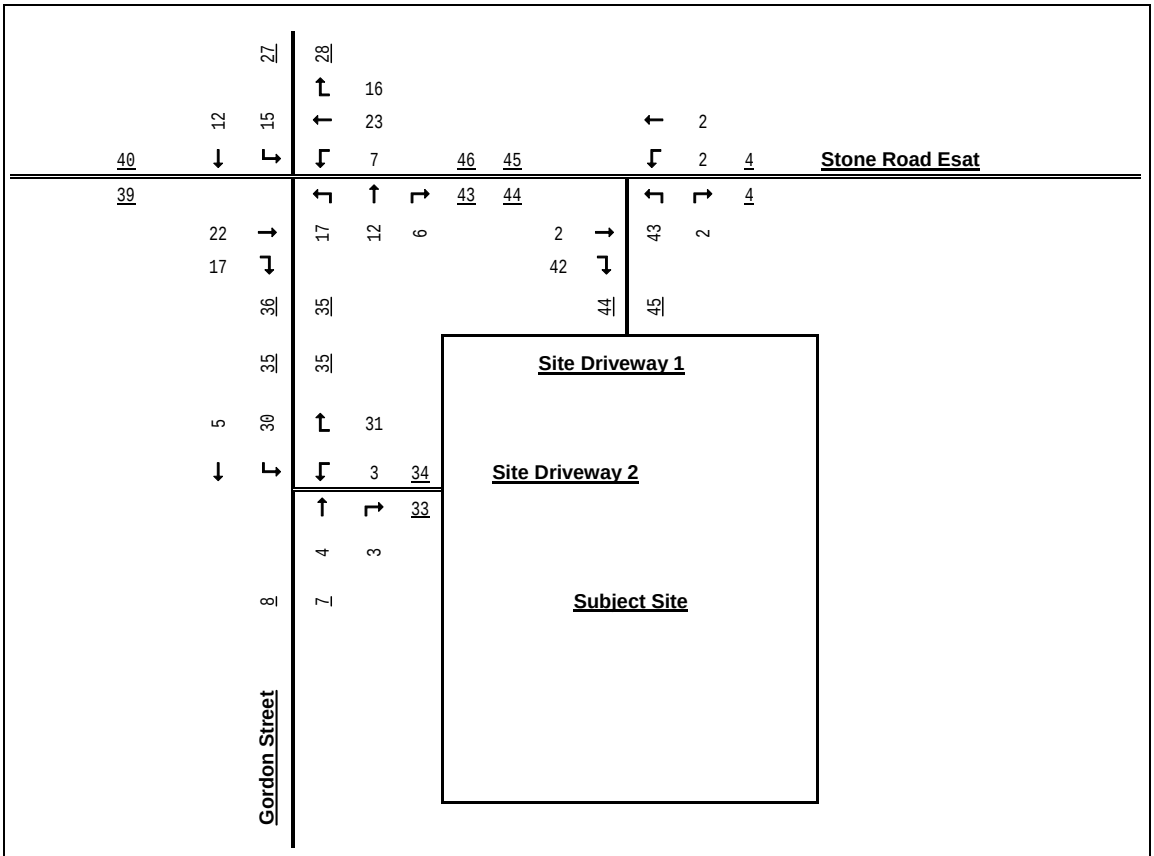
Column 11

F:\8871\Traffic\Turn\[TURNV3.xls]Volumes final 12:40 13-Apr-12



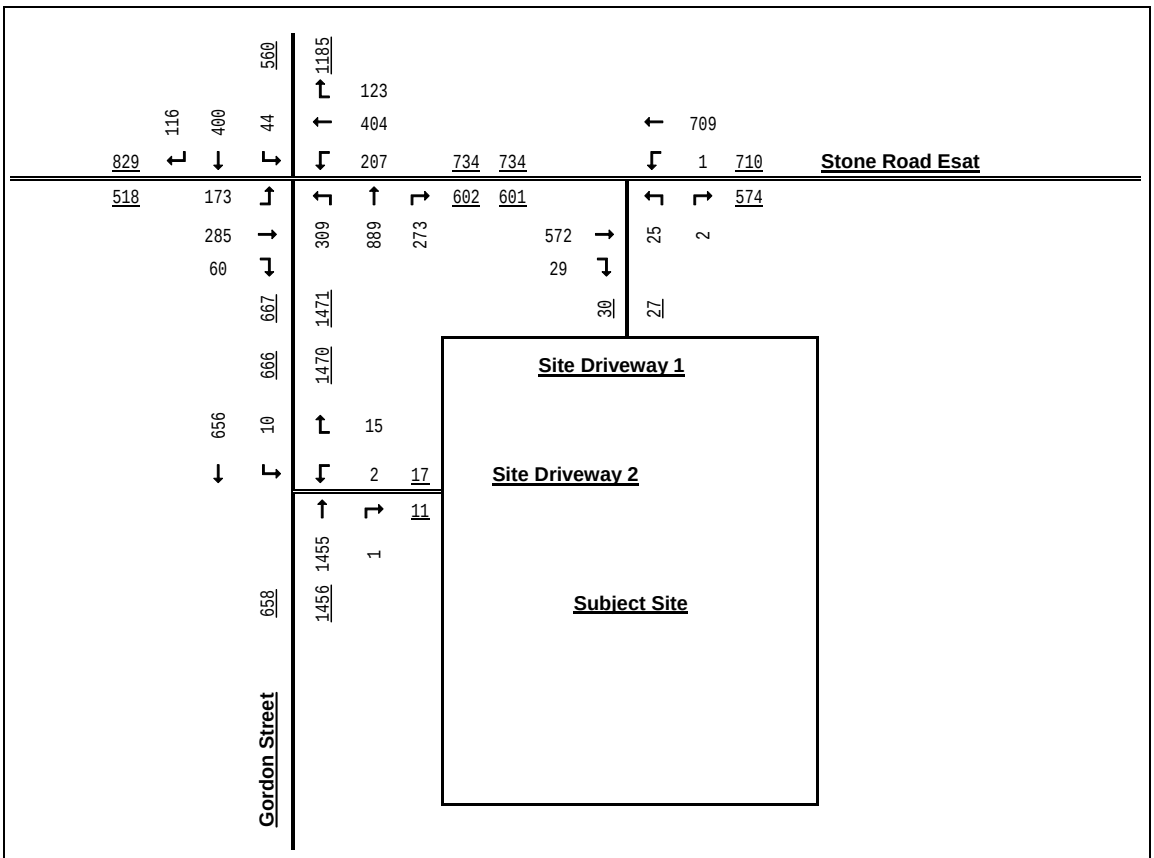
Proposed Development at 716 Gordon Road

FIGURE **8**
Site Traffic Total
Weekday AM



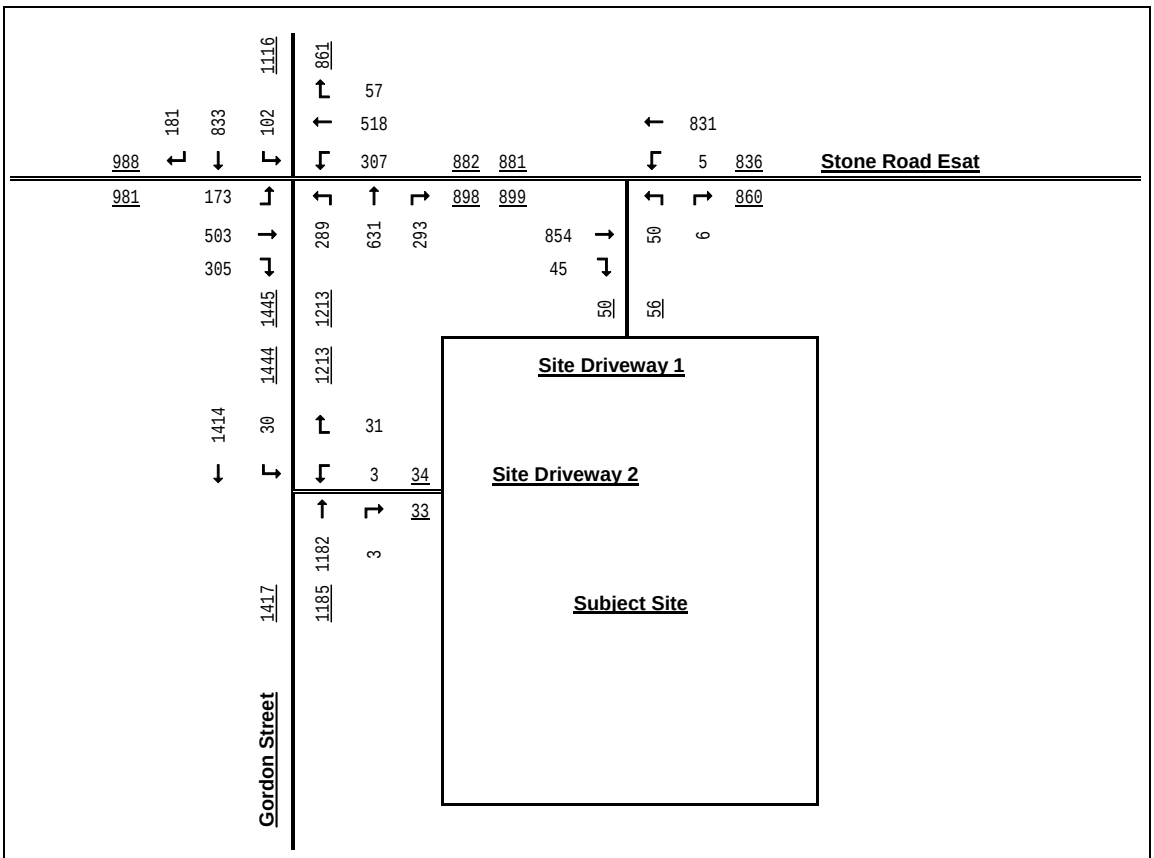
Proposed Development at 716 Gordon Road

FIGURE **9**
Site Traffic Total
Weekday PM



Proposed Development at 716 Gordon Road

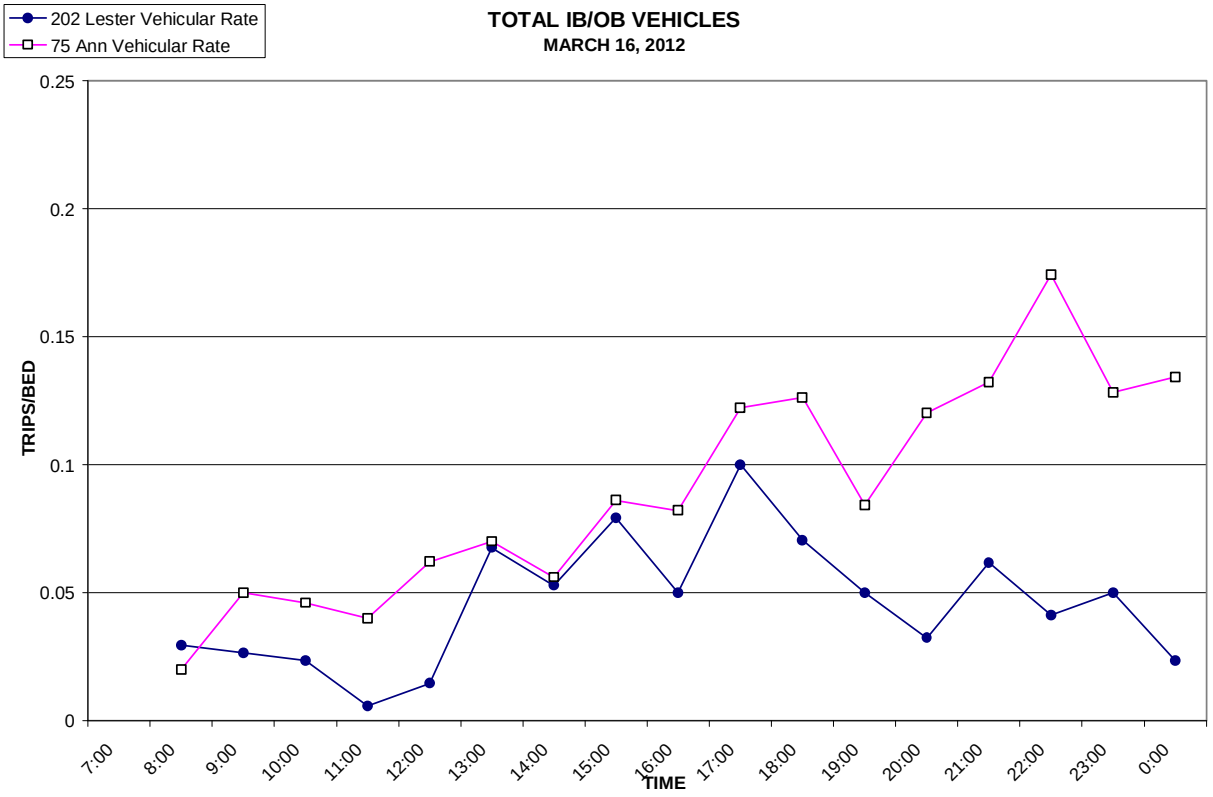
FIGURE **10**
Future Total Traffic (2017)
Weekday AM



Proposed Development at 716 Gordon Road

FIGURE **11**
Future Total Traffic (2017)
Weekday PM

APPENDIX A – VEHICULAR RATES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75 Ann Vehicular Rate
TOTAL IB/OB VEHICLES
MARCH 16, 2012
TRIPS/BED
0.25
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0.05
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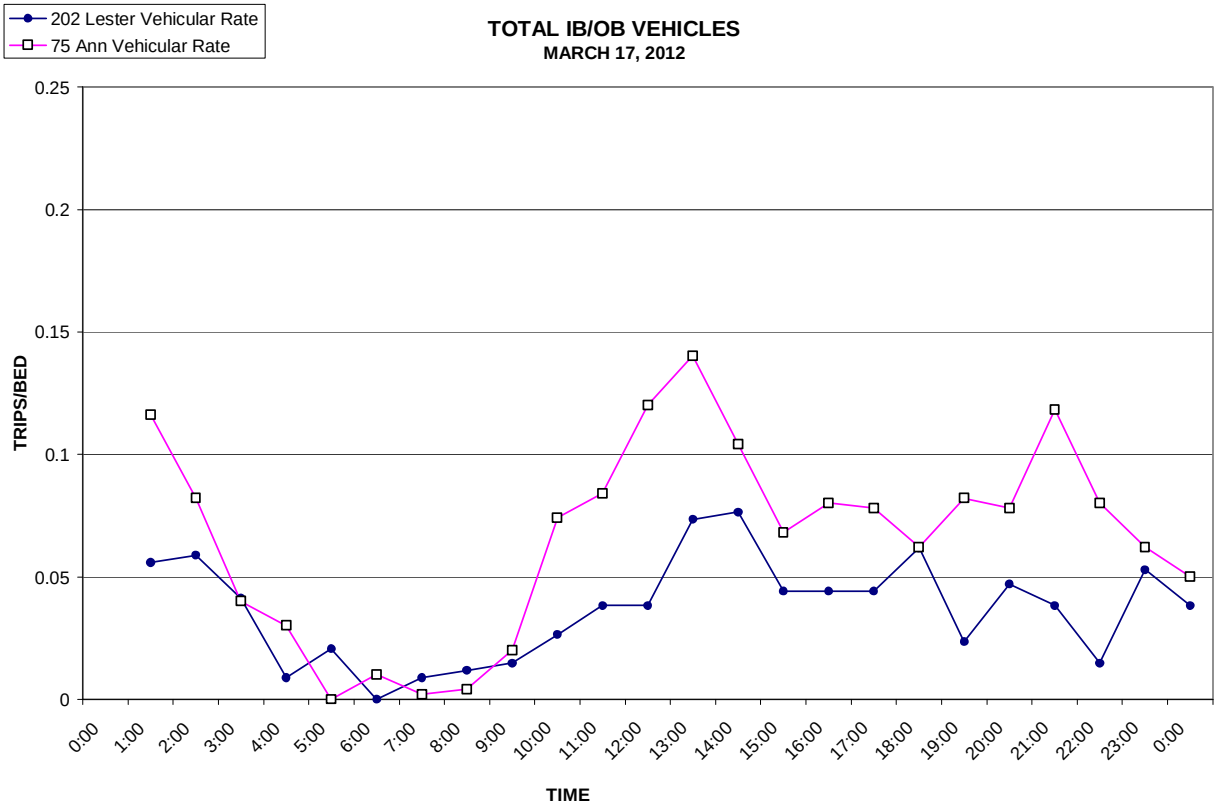
202 Lester Vehicular Rate
75 Ann Vehicular Rate
TOTAL IB/OB VEHICLES
MARCH 17, 2012
TRIPS/BED
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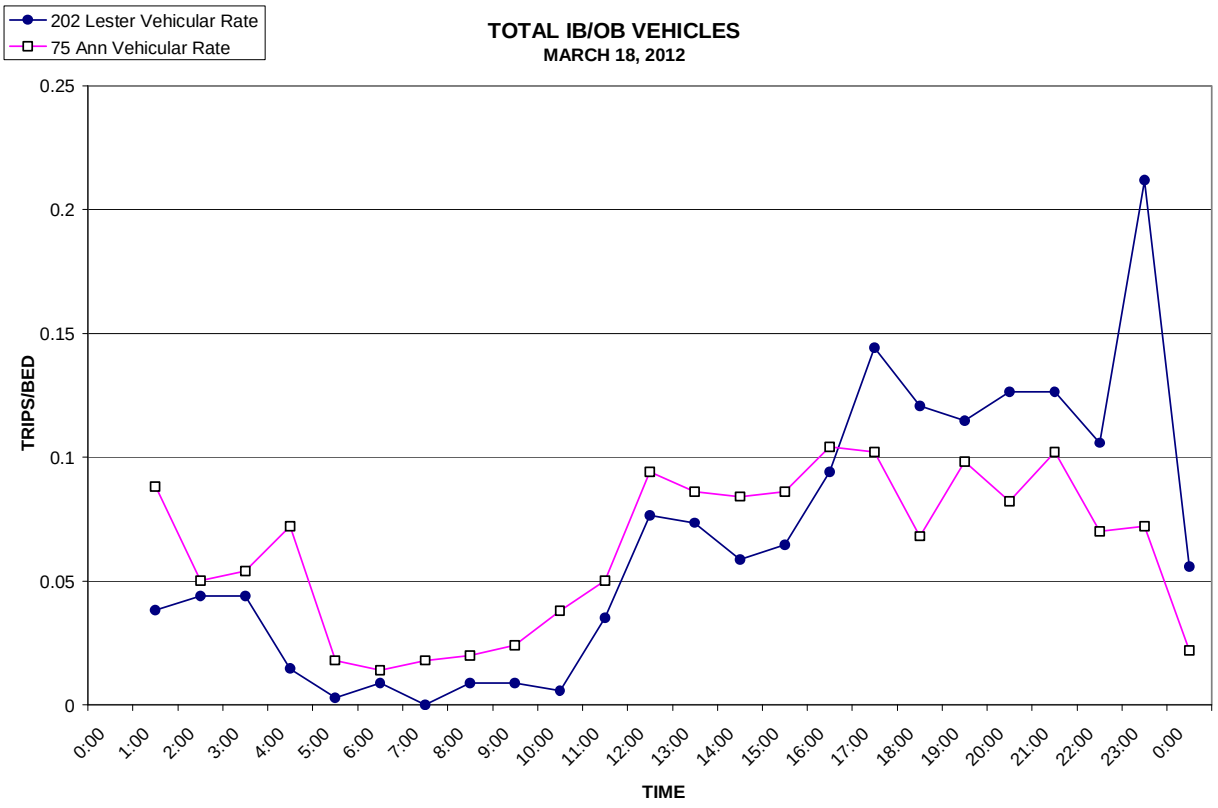
202 Lester Vehicular Rate
75 Ann Vehicular Rate
TOTAL IB/OB VEHICLES
MARCH 18, 2012
TRIPS/BED
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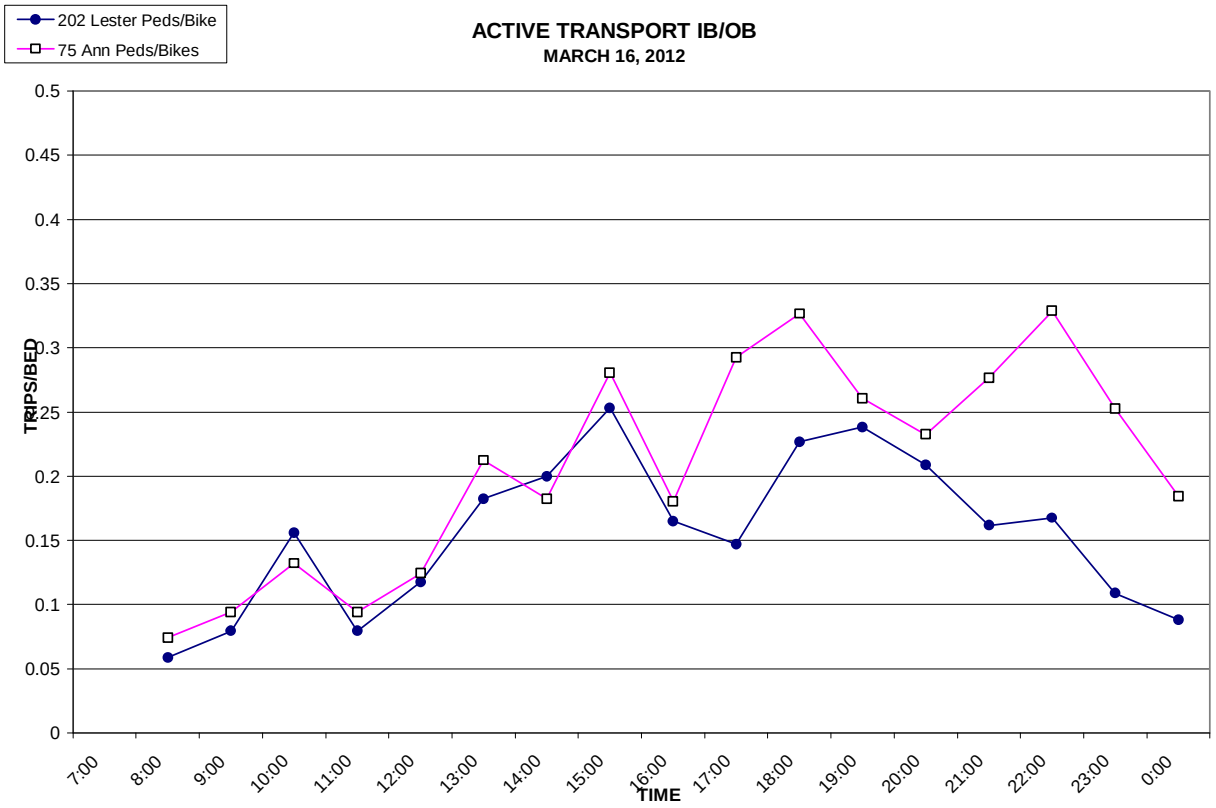
APPENDIX B – ACTIVE TRANSPORT RATES


202 Lester Peds/Bike
75 Ann Peds/Bikes
ACTIVE TRANSPORT IB/OB
MARCH 16, 2012
TRIPS/BED
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0.35
0.3
0.25
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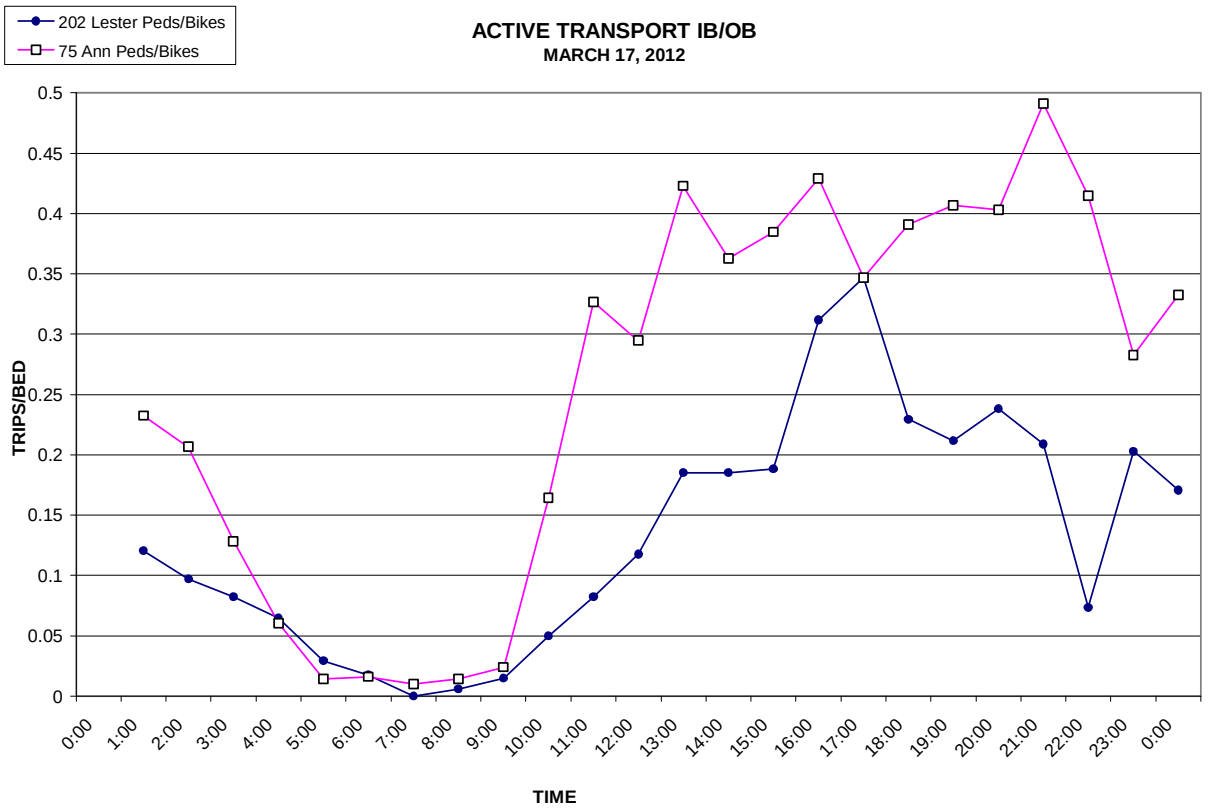
202 Lester Peds/Bikes
75 Ann Peds/Bikes
ACTIVE TRANSPORT IB/OB
MARCH 17, 2012
TRIPS/BED
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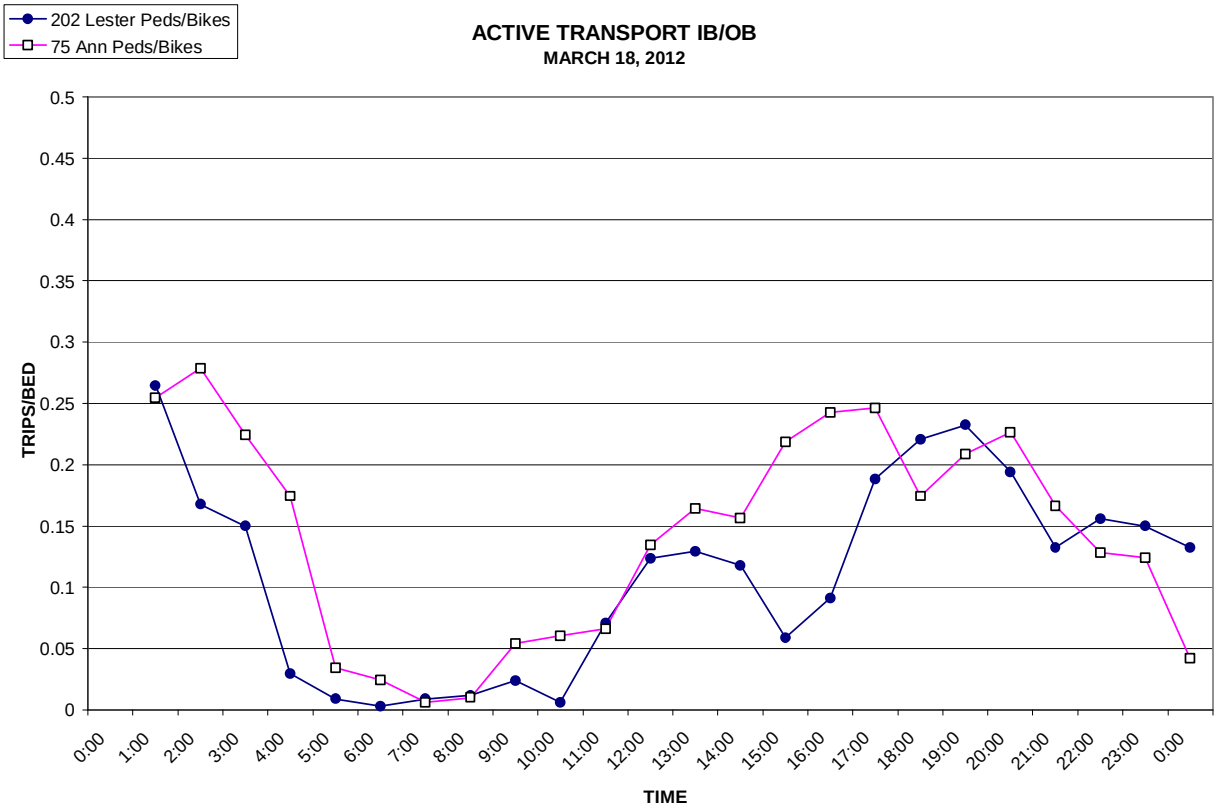
202 Lester Peds/Bikes
75 Ann Peds/Bikes
ACTIVE TRANSPORT IB/OB
MARCH 18, 2012
TRIPS/BED
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TIME

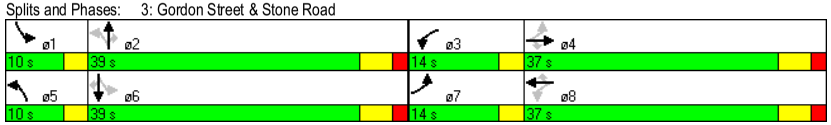
APPENDIX C – DETAILED CAPACITY ANALYSIS SUMMARY
EXISTING TRAFFIC

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	157	251	49	185	355	104	272	800	245	35	359	105
Lane Group Flow (vph)	171	273	53	201	386	113	296	870	266	38	390	114
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	10.0	30.0	30.0	10.0	30.0	30.0	6.0	32.0	32.0	6.0	32.0	32.0
Minimum Split (s)	13.0	36.0	36.0	13.0	36.0	36.0	9.0	38.0	38.0	9.0	38.0	38.0
Total Split (s)	14.0	37.0	37.0	14.0	37.0	37.0	10.0	39.0	39.0	10.0	39.0	39.0
Total Split (%)	14.0%	37.0%	37.0%	14.0%	37.0%	37.0%	10.0%	39.0%	39.0%	10.0%	39.0%	39.0%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	0.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0
Lost Time Adjust (s)	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Total Lost Time (s)	2.0	5.0	5.0	2.0	5.0	5.0	2.0	5.0	5.0	2.0	5.0	5.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	C-Min	C-Min	None	C-Min	C-Min
v/c Ratio	0.35	0.27	0.13	0.39	0.36	0.22	0.66	0.63	0.43	0.13	0.34	0.22
Control Delay	17.2	26.8	7.9	17.8	27.8	6.1	25.5	28.3	5.4	12.4	20.2	3.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.2	26.8	7.9	17.8	27.8	6.1	25.5	28.3	5.4	12.4	20.2	3.0
Queue Length 50th (m)	18.0	20.8	0.0	21.6	29.8	0.0	35.3	76.4	0.0	3.0	18.8	0.0
Queue Length 95th (m)	30.9	31.1	8.4	36.3	43.1	11.7	53.6	98.7	17.2	7.1	25.7	3.4
Internal Link Dist (m)		1017.7			119.8			95.1			161.2	
Turn Bay Length (m)	30.0		26.0	30.0		30.0	60.0		60.0	30.0		30.0
Base Capacity (vph)	495	1052	428	519	1093	528	451	1379	618	297	1171	530
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.35	0.26	0.12	0.39	0.35	0.21	0.66	0.63	0.43	0.13	0.33	0.22

Intersection Summary

Cycle Length: 100
Actuated Cycle Length: 100
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 100
Control Type: Actuated-Coordinated

Splits and Phases: 3: Gordon Street & Stone Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	157	251	49	185	355	104	272	800	245	35	359	105
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	2.0	5.0	5.0	2.0	5.0	5.0	2.0	5.0	5.0	2.0	5.0	5.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.82	1.00	1.00	0.87	1.00	1.00	0.76	1.00	1.00	0.84
Flpb, ped/bikes	0.97	1.00	1.00	0.94	1.00	1.00	0.97	1.00	1.00	0.99	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1740	3288	1224	1616	3411	1407	1701	3544	1171	1812	3444	1338
Flt Permitted	0.47	1.00	1.00	0.56	1.00	1.00	0.44	1.00	1.00	0.21	1.00	1.00
Satd. Flow (perm)	853	3288	1224	952	3411	1407	786	3544	1171	400	3444	1338
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	171	273	53	201	386	113	296	870	266	38	390	114
RTOR Reduction (vph)	0	0	37	0	0	78	0	0	166	0	0	76
Lane Group Flow (vph)	171	273	16	201	386	35	296	870	100	38	390	38
Confl. Peds. (#/hr)	64		93	93		64	83		124	124		83
Heavy Vehicles (%)	2%	11%	9%	6%	7%	1%	4%	3%	6%	0%	6%	2%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Actuated Green, G (s)	40.7	30.1	30.1	41.3	30.4	30.4	44.0	36.7	36.7	36.6	32.3	32.3
Effective Green, g (s)	42.7	31.1	31.1	43.3	31.4	31.4	45.0	37.7	37.7	38.6	33.3	33.3
Actuated g/C Ratio	0.43	0.31	0.31	0.43	0.31	0.31	0.45	0.38	0.38	0.39	0.33	0.33
Clearance Time (s)	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	467	1023	381	491	1071	442	442	1336	441	229	1147	446
v/s Ratio Prot	0.04	0.08		c0.05	c0.11		c0.06	c0.25		0.01	0.11	
v/s Ratio Perm	0.11		0.01	0.13		0.03	0.24		0.09	0.06		0.03
v/c Ratio	0.37	0.27	0.04	0.41	0.36	0.08	0.67	0.65	0.23	0.17	0.34	0.09
Uniform Delay, d1	18.3	25.9	24.1	18.4	26.5	24.1	19.4	25.7	21.2	20.0	25.1	22.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.81	0.77	0.45
Incremental Delay, d2	0.5	0.1	0.0	0.6	0.2	0.1	3.8	2.5	1.2	0.3	0.8	0.4
Delay (s)	18.8	26.0	24.1	18.9	26.7	24.2	23.2	28.2	22.4	16.6	20.2	10.7
Level of Service	B	C	C	B	C	C	C	C	C	B	C	B
Approach Delay (s)		23.3			24.1			26.1			17.9	
Approach LOS		C			C			C			B	

Intersection Summary

HCM Average Control Delay	23.8	HCM Level of Service		C	
HCM Volume to Capacity ratio	0.48				
Actuated Cycle Length (s)	100.0	Sum of lost time (s)		6.0	
Intersection Capacity Utilization	92.0%	ICU Level of Service		F	
Analysis Period (min)	15				

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
7: Driveway 1 & Stone Road

Existing
AM Peak Hour

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	531	15	0	644	3	1
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	577	16	0	700	3	1
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)	144					
pX, platoon unblocked			0.96		0.96	0.96
vC, conflicting volume			593		935	297
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			500		855	192
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	100
cM capacity (veh/h)			1021		286	787

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	385	209	350	350	4
Volume Left	0	0	0	0	3
Volume Right	0	16	0	0	1
cSH	1700	1700	1700	1700	340
Volume to Capacity	0.23	0.12	0.21	0.21	0.01
Queue Length 95th (m)	0.0	0.0	0.0	0.0	0.3
Control Delay (s)	0.0	0.0	0.0	0.0	15.7
Lane LOS					C
Approach Delay (s)	0.0		0.0		15.7
Approach LOS					C

Intersection Summary				
Average Delay		0.1		
Intersection Capacity Utilization		27.8%	ICU Level of Service	A
Analysis Period (min)		15		

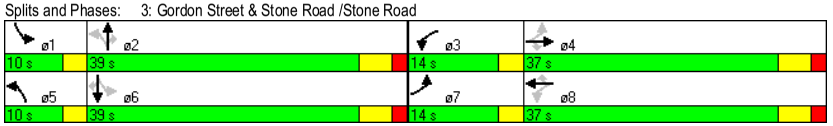
Queues
3: Gordon Street & Stone Road /Stone Road

Existing
PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	157	436	261	272	448	37	246	561	260	79	744	164
Lane Group Flow (vph)	171	474	284	296	487	40	267	610	283	86	809	178
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	10.0	30.0	30.0	10.0	30.0	30.0	6.0	32.0	32.0	6.0	32.0	32.0
Minimum Split (s)	13.0	36.0	36.0	13.0	36.0	36.0	9.0	38.0	38.0	9.0	38.0	38.0
Total Split (s)	14.0	37.0	37.0	14.0	37.0	37.0	10.0	39.0	39.0	10.0	39.0	39.0
Total Split (%)	14.0%	37.0%	37.0%	14.0%	37.0%	37.0%	10.0%	39.0%	39.0%	10.0%	39.0%	39.0%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	0.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0
Lost Time Adjust (s)	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Total Lost Time (s)	2.0	5.0	5.0	2.0	5.0	5.0	2.0	5.0	5.0	2.0	5.0	5.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	C-Min	C-Min	None	C-Min	C-Min
v/c Ratio	0.38	0.44	0.51	0.66	0.43	0.08	0.94	0.48	0.46	0.23	0.67	0.34
Control Delay	17.3	29.1	11.4	24.4	28.6	8.4	61.5	27.1	5.7	12.7	25.2	8.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.3	29.1	11.4	24.4	28.6	8.4	61.5	27.1	5.7	12.7	25.2	8.2
Queue Length 50th (m)	18.0	38.3	10.0	33.8	38.8	0.0	31.2	49.8	0.0	7.4	48.9	3.8
Queue Length 95th (m)	30.9	52.7	33.0	53.4	54.1	7.2	#75.2	65.3	17.7	m12.7	66.6	m17.5
Internal Link Dist (m)		1017.7			119.8			95.1			161.2	
Turn Bay Length (m)	30.0		26.0	30.0		30.0	60.0		60.0	30.0		30.0
Base Capacity (vph)	461	1123	568	449	1143	485	284	1297	617	372	1229	534
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.37	0.42	0.50	0.66	0.43	0.08	0.94	0.47	0.46	0.23	0.66	0.33

Intersection Summary
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 100
Control Type: Actuated-Coordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 3: Gordon Street & Stone Road /Stone Road



HCM Signalized Intersection Capacity Analysis
3: Gordon Street & Stone Road /Stone Road

Existing
PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	157	436	261	272	448	37	246	561	260	79	744	164
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	2.0	5.0	5.0	2.0	5.0	5.0	2.0	5.0	5.0	2.0	5.0	5.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.82	1.00	1.00	0.87	1.00	1.00	0.76	1.00	1.00	0.84
Flpb, ped/bikes	0.98	1.00	1.00	0.98	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1774	3510	1321	1729	3544	1421	1807	3579	1205	1783	3614	1351
Flt Permitted	0.39	1.00	1.00	0.38	1.00	1.00	0.17	1.00	1.00	0.33	1.00	1.00
Satd. Flow (perm)	728	3510	1321	685	3544	1421	327	3579	1205	622	3614	1351
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	171	474	284	296	487	40	267	610	283	86	809	178
RTOR Reduction (vph)	0	0	147	0	0	27	0	0	183	0	0	75
Lane Group Flow (vph)	171	474	137	296	487	13	267	610	100	86	809	103
Confl. Peds. (#/hr)	64		93	93		64	83		124	124		83
Heavy Vehicles (%)	1%	4%	1%	3%	3%	0%	1%	2%	3%	0%	1%	1%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Actuated Green, G (s)	40.8	30.0	30.0	42.4	30.8	30.8	42.4	34.2	34.2	38.4	32.2	32.2
Effective Green, g (s)	42.8	31.0	31.0	44.4	31.8	31.8	44.4	35.2	35.2	40.4	33.2	33.2
Actuated g/C Ratio	0.43	0.31	0.31	0.44	0.32	0.32	0.44	0.35	0.35	0.40	0.33	0.33
Clearance Time (s)	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	435	1088	410	436	1127	452	281	1260	424	335	1200	449
v/s Ratio Prot	0.05	0.14		c0.09	c0.14		c0.09	0.17		0.02	c0.22	
v/s Ratio Perm	0.12		0.10	0.22		0.01	0.33		0.08	0.09		0.08
v/c Ratio	0.39	0.44	0.33	0.68	0.43	0.03	0.95	0.48	0.23	0.26	0.67	0.23
Uniform Delay, d1	18.3	27.5	26.6	19.0	27.0	23.5	21.5	25.3	22.9	18.9	28.7	24.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.77	0.77	0.66
Incremental Delay, d2	0.6	0.3	0.5	4.2	0.3	0.0	40.2	1.3	1.3	0.4	2.8	1.1
Delay (s)	18.9	27.8	27.0	23.2	27.2	23.5	61.8	26.6	24.2	14.9	25.0	16.9
Level of Service	B	C	C	C	C	C	E	C	C	B	C	B
Approach Delay (s)		25.9			25.6			34.1			22.8	
Approach LOS		C			C			C			C	

Intersection Summary				
HCM Average Control Delay	27.4	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.59			
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	11.0	
Intersection Capacity Utilization	95.4%	ICU Level of Service	F	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Unsignalized Intersection Capacity Analysis
7: Driveway 1 & Stone Road /Stone Road

Existing
PM Peak Hour

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	775	3	3	760	7	4
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	842	3	3	826	8	4
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)	144					
pX, platoon unblocked			0.90		0.90	0.90
vC, conflicting volume			846		1264	423
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			610		1074	141
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		96	99
cM capacity (veh/h)			870		193	794

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	562	284	279	551	12
Volume Left	0	0	3	0	8
Volume Right	0	3	0	0	4
cSH	1700	1700	870	1700	266
Volume to Capacity	0.33	0.17	0.00	0.32	0.04
Queue Length 95th (m)	0.0	0.0	0.1	0.0	1.1
Control Delay (s)	0.0	0.0	0.1	0.0	19.2
Lane LOS			A		C
Approach Delay (s)	0.0		0.0		19.2
Approach LOS					C

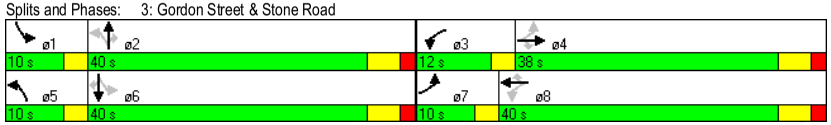
Intersection Summary				
Average Delay	0.2			
Intersection Capacity Utilization	33.1%	ICU Level of Service	A	
Analysis Period (min)	15			

APPENDIX D – DETAILED CAPACITY ANALYSIS SUMMARY FUTURE BACKGROUND TRAFFIC

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	173	277	54	204	392	115	300	883	270	39	396	116
Lane Group Flow (vph)	188	301	59	222	426	125	326	960	293	42	430	126
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	7.0	20.0	20.0	7.0	20.0	20.0	7.0	20.0	20.0	7.0	20.0	20.0
Minimum Split (s)	10.0	38.0	38.0	10.0	38.0	38.0	10.0	40.0	40.0	10.0	40.0	40.0
Total Split (s)	10.0	38.0	38.0	12.0	40.0	40.0	10.0	40.0	40.0	10.0	40.0	40.0
Total Split (%)	10.0%	38.0%	38.0%	12.0%	40.0%	40.0%	10.0%	40.0%	40.0%	10.0%	40.0%	40.0%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	0.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0
Lost Time Adjust (s)	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Total Lost Time (s)	2.0	5.0	5.0	2.0	5.0	5.0	2.0	5.0	5.0	2.0	5.0	5.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	C-Min	C-Min	None	C-Min	C-Min
v/c Ratio	0.54	0.43	0.19	0.57	0.55	0.30	0.55	0.55	0.41	0.12	0.34	0.22
Control Delay	29.4	36.3	10.4	29.2	37.0	7.8	14.5	19.9	4.1	8.6	21.1	3.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.4	36.3	10.4	29.2	37.0	7.8	14.5	19.9	4.1	8.6	21.1	3.5
Queue Length 50th (m)	24.1	26.8	0.0	29.3	38.4	0.0	31.8	74.1	0.8	3.1	20.6	0.0
Queue Length 95th (m)	41.8	39.0	10.1	49.4	52.8	13.7	45.4	90.9	15.2	6.3	28.1	4.6
Internal Link Dist (m)		1017.7			119.8			95.1			161.2	
Turn Bay Length (m)	30.0		26.0	30.0		30.0	60.0		60.0	30.0		30.0
Base Capacity (vph)	346	1085	443	391	1194	574	591	1748	723	351	1287	579
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.54	0.28	0.13	0.57	0.36	0.22	0.55	0.55	0.41	0.12	0.33	0.22

Intersection Summary
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 100
Control Type: Actuated-Coordinated

Splits and Phases: 3: Gordon Street & Stone Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	173	277	54	204	392	115	300	883	270	39	396	116
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	2.0	5.0	5.0	2.0	5.0	5.0	2.0	5.0	5.0	2.0	5.0	5.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.82	1.00	1.00	0.87	1.00	1.00	0.76	1.00	1.00	0.84
Flpb, ped/bikes	0.98	1.00	1.00	0.96	1.00	1.00	0.97	1.00	1.00	0.99	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1752	3288	1224	1646	3411	1407	1707	3544	1171	1803	3444	1338
Flt Permitted	0.40	1.00	1.00	0.47	1.00	1.00	0.42	1.00	1.00	0.26	1.00	1.00
Satd. Flow (perm)	733	3288	1224	808	3411	1407	763	3544	1171	500	3444	1338
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	188	301	59	222	426	125	326	960	293	42	430	126
RTOR Reduction (vph)	0	0	46	0	0	97	0	0	148	0	0	79
Lane Group Flow (vph)	188	301	13	222	426	29	326	960	145	42	430	47
Confl. Peds. (#/hr)	64		93	93		64	83		124	124		83
Heavy Vehicles (%)	2%	11%	9%	6%	7%	1%	4%	3%	6%	0%	6%	2%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Actuated Green, G (s)	29.1	20.3	20.3	32.1	21.8	21.8	54.4	47.1	47.1	40.5	36.2	36.2
Effective Green, g (s)	31.1	21.3	21.3	34.1	22.8	22.8	55.4	48.1	48.1	42.5	37.2	37.2
Actuated g/C Ratio	0.31	0.21	0.21	0.34	0.23	0.23	0.55	0.48	0.48	0.42	0.37	0.37
Clearance Time (s)	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	328	700	261	370	778	321	576	1705	563	282	1281	498
v/s Ratio Prot	0.06	0.09		c0.07	c0.12		c0.09	c0.27		0.01	0.12	
v/s Ratio Perm	0.12		0.01	0.14		0.02	0.22		0.12	0.06		0.04
v/c Ratio	0.57	0.43	0.05	0.60	0.55	0.09	0.57	0.56	0.26	0.15	0.34	0.09
Uniform Delay, d1	26.7	34.1	31.3	25.2	34.1	30.4	12.6	18.5	15.4	17.0	22.5	20.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.81	0.88	0.63
Incremental Delay, d2	2.4	0.4	0.1	2.6	0.8	0.1	1.3	1.4	1.1	0.2	0.7	0.4
Delay (s)	29.1	34.5	31.4	27.8	34.8	30.5	13.9	19.8	16.5	14.1	20.4	13.3
Level of Service	C	C	C	C	C	C	B	B	B	B	C	B
Approach Delay (s)		32.3			32.1			18.0			18.5	
Approach LOS		C			C			B			B	

Intersection Summary				
HCM Average Control Delay	23.4	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.53			
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	6.0	
Intersection Capacity Utilization	76.3%	ICU Level of Service	D	
Analysis Period (min)	15			
c Critical Lane Group				

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	586	15	0	711	3	1
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	637	16	0	773	3	1
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)	144					
pX, platoon unblocked			0.94		0.94	0.94
vC, conflicting volume			653		1032	327
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			508		910	161
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	100
cM capacity (veh/h)			992		258	805

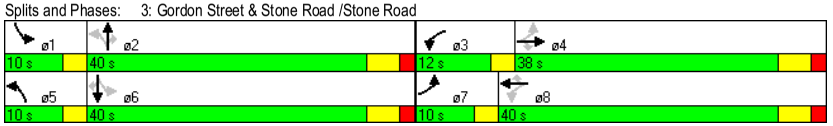
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	425	229	386	386	4
Volume Left	0	0	0	0	3
Volume Right	0	16	0	0	1
cSH	1700	1700	1700	1700	311
Volume to Capacity	0.25	0.13	0.23	0.23	0.01
Queue Length 95th (m)	0.0	0.0	0.0	0.0	0.3
Control Delay (s)	0.0	0.0	0.0	0.0	16.7
Lane LOS					C
Approach Delay (s)	0.0		0.0		16.7
Approach LOS					C

Intersection Summary				
Average Delay		0.1		
Intersection Capacity Utilization		29.7%	ICU Level of Service	A
Analysis Period (min)		15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	173	481	288	300	495	41	272	619	287	87	821	181
Lane Group Flow (vph)	188	523	313	326	538	45	296	673	312	95	892	197
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	7.0	20.0	20.0	7.0	20.0	20.0	7.0	20.0	20.0	7.0	20.0	20.0
Minimum Split (s)	10.0	38.0	38.0	10.0	38.0	38.0	10.0	40.0	40.0	10.0	40.0	40.0
Total Split (s)	10.0	38.0	38.0	12.0	40.0	40.0	10.0	40.0	40.0	10.0	40.0	40.0
Total Split (%)	10.0%	38.0%	38.0%	12.0%	40.0%	40.0%	10.0%	40.0%	40.0%	10.0%	40.0%	40.0%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	0.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0
Lost Time Adjust (s)	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Total Lost Time (s)	2.0	5.0	5.0	2.0	5.0	5.0	2.0	5.0	5.0	2.0	5.0	5.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	C-Min	C-Min	None	C-Min	C-Min
v/c Ratio	0.55	0.62	0.68	0.91	0.56	0.11	0.73	0.44	0.45	0.23	0.78	0.39
Control Delay	26.1	36.8	20.7	55.1	33.5	8.6	33.8	22.6	5.2	10.8	29.7	10.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	26.1	36.8	20.7	55.1	33.5	8.6	33.8	22.6	5.2	10.8	29.7	10.5
Queue Length 50th (m)	23.9	48.5	21.1	45.6	48.6	0.2	35.1	47.8	0.7	6.3	56.2	6.8
Queue Length 95th (m)	35.4	58.5	46.3	#89.1	58.3	7.5	#98.3	71.5	19.6	m14.4	73.2	m21.6
Internal Link Dist (m)		1017.7			119.8			95.1			161.2	
Turn Bay Length (m)	30.0		26.0	30.0		30.0	60.0		60.0	30.0		30.0
Base Capacity (vph)	340	1158	563	359	1240	526	405	1520	688	411	1265	548
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.55	0.45	0.56	0.91	0.43	0.09	0.73	0.44	0.45	0.23	0.71	0.36

Intersection Summary
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 100
Control Type: Actuated-Coordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 3: Gordon Street & Stone Road /Stone Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	173	481	288	300	495	41	272	619	287	87	821	181
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	2.0	5.0	5.0	2.0	5.0	5.0	2.0	5.0	5.0	2.0	5.0	5.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.82	1.00	1.00	0.87	1.00	1.00	0.76	1.00	1.00	0.84
Flpb, ped/bikes	0.99	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1780	3510	1321	1749	3544	1421	1807	3579	1205	1764	3614	1351
Flt Permitted	0.35	1.00	1.00	0.27	1.00	1.00	0.12	1.00	1.00	0.40	1.00	1.00
Satd. Flow (perm)	651	3510	1321	500	3544	1421	227	3579	1205	735	3614	1351
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	188	523	313	326	538	45	296	673	312	95	892	197
RTOR Reduction (vph)	0	0	144	0	0	32	0	0	178	0	0	79
Lane Group Flow (vph)	188	523	169	326	538	13	296	673	134	95	892	118
Confl. Peds. (#/hr)	64		93	93		64	83		124	124		83
Heavy Vehicles (%)	1%	4%	1%	3%	3%	0%	1%	2%	3%	0%	1%	1%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Actuated Green, G (s)	31.6	23.2	23.2	37.6	26.2	26.2	50.4	40.8	40.8	37.1	30.5	30.5
Effective Green, g (s)	33.6	24.2	24.2	38.6	27.2	27.2	51.4	41.8	41.8	39.1	31.5	31.5
Actuated g/C Ratio	0.34	0.24	0.24	0.39	0.27	0.27	0.51	0.42	0.42	0.39	0.32	0.32
Clearance Time (s)	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	325	849	320	348	964	387	399	1496	504	366	1138	426
v/s Ratio Prot	0.05	0.15		c0.12	c0.15		c0.13	0.19		0.02	c0.25	
v/s Ratio Perm	0.14		0.13	0.25		0.01	0.25		0.11	0.08		0.09
v/c Ratio	0.58	0.62	0.53	0.94	0.56	0.03	0.74	0.45	0.27	0.26	0.78	0.28
Uniform Delay, d1	24.8	33.8	32.9	25.5	31.2	26.7	22.7	20.9	19.1	19.6	31.2	25.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.80	0.80	0.79
Incremental Delay, d2	2.5	1.3	1.6	32.0	0.7	0.0	7.3	1.0	1.3	0.3	4.9	1.4
Delay (s)	27.3	35.1	34.5	57.5	31.9	26.8	30.0	21.8	20.3	16.0	29.9	21.7
Level of Service	C	D	C	E	C	C	C	C	C	B	C	C
Approach Delay (s)		33.5			40.9			23.4			27.5	
Approach LOS		C			D			C			C	

Intersection Summary				
HCM Average Control Delay	30.4	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.70			
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	9.0	
Intersection Capacity Utilization	86.1%	ICU Level of Service	E	
Analysis Period (min)	15			
c Critical Lane Group				

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	855	3	3	836	7	4
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	929	3	3	909	8	4
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)	144					
pX, platoon unblocked			0.87		0.87	0.87
vC, conflicting volume			933		1392	466
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			636		1161	102
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		95	99
cM capacity (veh/h)			825		164	816

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	620	313	306	606	12
Volume Left	0	0	3	0	8
Volume Right	0	3	0	0	4
cSH	1700	1700	825	1700	231
Volume to Capacity	0.36	0.18	0.00	0.36	0.05
Queue Length 95th (m)	0.0	0.0	0.1	0.0	1.2
Control Delay (s)	0.0	0.0	0.1	0.0	21.4
Lane LOS			A		C
Approach Delay (s)	0.0		0.0		21.4
Approach LOS					C

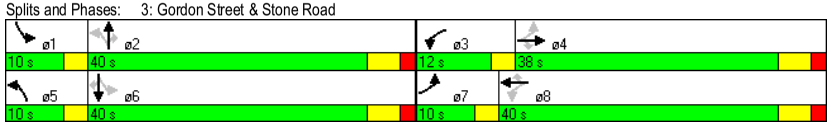
Intersection Summary				
Average Delay	0.2			
Intersection Capacity Utilization	35.2%	ICU Level of Service	A	
Analysis Period (min)	15			

APPENDIX E – DETAILED CAPACITY ANALYSIS SUMMARY
FUTURE TOTAL TRAFFIC

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	173	285	60	207	404	123	309	889	273	44	400	116
Lane Group Flow (vph)	188	310	65	225	439	134	336	966	297	48	435	126
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	7.0	20.0	20.0	7.0	20.0	20.0	7.0	20.0	20.0	7.0	20.0	20.0
Minimum Split (s)	10.0	38.0	38.0	10.0	38.0	38.0	10.0	40.0	40.0	10.0	40.0	40.0
Total Split (s)	10.0	38.0	38.0	12.0	40.0	40.0	10.0	40.0	40.0	10.0	40.0	40.0
Total Split (%)	10.0%	38.0%	38.0%	12.0%	40.0%	40.0%	10.0%	40.0%	40.0%	10.0%	40.0%	40.0%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	0.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0
Lost Time Adjust (s)	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Total Lost Time (s)	2.0	5.0	5.0	2.0	5.0	5.0	2.0	5.0	5.0	2.0	5.0	5.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	C-Min	C-Min	None	C-Min	C-Min
v/c Ratio	0.55	0.44	0.19	0.57	0.56	0.31	0.59	0.55	0.36	0.14	0.35	0.27
Control Delay	29.5	36.4	9.7	29.0	37.1	7.5	15.4	20.2	3.6	8.9	21.7	4.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.5	36.4	9.7	29.0	37.1	7.5	15.4	20.2	3.6	8.9	21.7	4.2
Queue Length 50th (m)	24.2	27.7	0.0	29.9	39.7	0.0	32.8	74.4	1.0	3.6	20.8	0.0
Queue Length 95th (m)	41.4	39.8	10.5	49.8	54.0	13.9	47.6	93.2	15.3	7.1	28.6	6.1
Internal Link Dist (m)		1017.7			119.8			95.1			161.2	
Turn Bay Length (m)	30.0		26.0	30.0		30.0	60.0		60.0	30.0		30.0
Base Capacity (vph)	343	1085	486	397	1194	594	570	1742	825	350	1262	477
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.55	0.29	0.13	0.57	0.37	0.23	0.59	0.55	0.36	0.14	0.34	0.26

Intersection Summary
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 100
Control Type: Actuated-Coordinated

Splits and Phases: 3: Gordon Street & Stone Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	173	285	60	207	404	123	309	889	273	44	400	116
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	2.0	5.0	5.0	2.0	5.0	5.0	2.0	5.0	5.0	2.0	5.0	5.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.90	1.00	1.00	0.90	1.00	1.00	0.90	1.00	1.00	0.68
Flpb, ped/bikes	0.98	1.00	1.00	0.98	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1762	3288	1342	1683	3411	1449	1660	3544	1380	1816	3444	1083
Flt Permitted	0.39	1.00	1.00	0.45	1.00	1.00	0.42	1.00	1.00	0.27	1.00	1.00
Satd. Flow (perm)	716	3288	1342	804	3411	1449	729	3544	1380	508	3444	1083
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	188	310	65	225	439	134	336	966	297	48	435	126
RTOR Reduction (vph)	0	0	51	0	0	103	0	0	150	0	0	80
Lane Group Flow (vph)	188	310	14	225	439	31	336	966	147	48	435	46
Confl. Peds. (#/hr)	50		50	50		50	208		50	50		208
Heavy Vehicles (%)	2%	11%	9%	6%	7%	1%	4%	3%	6%	0%	6%	2%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Actuated Green, G (s)	29.0	20.3	20.3	32.2	21.9	21.9	54.4	47.0	47.0	39.7	35.3	35.3
Effective Green, g (s)	31.0	21.3	21.3	34.2	22.9	22.9	55.4	48.0	48.0	41.7	36.3	36.3
Actuated g/C Ratio	0.31	0.21	0.21	0.34	0.23	0.23	0.55	0.48	0.48	0.42	0.36	0.36
Clearance Time (s)	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	323	700	286	374	781	332	563	1701	662	282	1250	393
v/s Ratio Prot	0.06	0.09		c0.07	c0.13		c0.10	c0.27		0.01	0.13	
v/s Ratio Perm	0.12		0.01	0.14		0.02	0.23		0.11	0.06		0.04
v/c Ratio	0.58	0.44	0.05	0.60	0.56	0.09	0.60	0.57	0.22	0.17	0.35	0.12
Uniform Delay, d1	26.8	34.2	31.3	25.1	34.1	30.4	12.8	18.6	15.1	17.5	23.2	21.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.82	0.88	0.65
Incremental Delay, d2	2.7	0.4	0.1	2.7	0.9	0.1	1.7	1.4	0.8	0.3	0.7	0.6
Delay (s)	29.5	34.6	31.4	27.8	35.0	30.5	14.5	20.0	15.9	14.6	21.1	14.4
Level of Service	C	C	C	C	D	C	B	B	B	B	C	B
Approach Delay (s)		32.5			32.2			18.1			19.2	
Approach LOS		C			C			B			B	

Intersection Summary					
HCM Average Control Delay	23.7	HCM Level of Service		C	
HCM Volume to Capacity ratio	0.55				
Actuated Cycle Length (s)	100.0	Sum of lost time (s)		6.0	
Intersection Capacity Utilization	76.9%	ICU Level of Service		D	
Analysis Period (min)	15				
c Critical Lane Group					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	2	15	1455	1	10	656
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	16	1582	1	11	713
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)			289			119
pX, platoon unblocked	0.78	0.74			0.74	
vC, conflicting volume	1960	791			1583	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1189	4			1077	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	98	98			98	
cM capacity (veh/h)	137	795			474	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	18	1054	528	249	475
Volume Left	2	0	0	11	0
Volume Right	16	0	1	0	0
cSH	509	1700	1700	474	1700
Volume to Capacity	0.04	0.62	0.31	0.02	0.28
Queue Length 95th (m)	0.9	0.0	0.0	0.5	0.0
Control Delay (s)	12.3	0.0	0.0	0.9	0.0
Lane LOS	B			A	
Approach Delay (s)	12.3	0.0		0.3	
Approach LOS	B				

Intersection Summary				
Average Delay	0.2			
Intersection Capacity Utilization	50.3%	ICU Level of Service		A
Analysis Period (min)	15			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	587	14	1	712	22	1
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	638	15	1	774	24	1
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)	144					
pX, platoon unblocked			0.94		0.94	0.94
vC, conflicting volume			653		1035	327
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			501		907	153
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		91	100
cM capacity (veh/h)			995		258	813

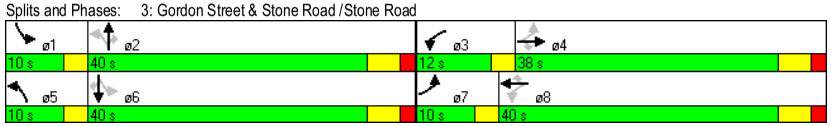
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	425	228	259	516	25
Volume Left	0	0	1	0	24
Volume Right	0	15	0	0	1
cSH	1700	1700	995	1700	266
Volume to Capacity	0.25	0.13	0.00	0.30	0.09
Queue Length 95th (m)	0.0	0.0	0.0	0.0	2.3
Control Delay (s)	0.0	0.0	0.0	0.0	19.9
Lane LOS			A		C
Approach Delay (s)	0.0		0.0		19.9
Approach LOS					C

Intersection Summary				
Average Delay	0.4			
Intersection Capacity Utilization	30.4%	ICU Level of Service		A
Analysis Period (min)	15			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	173	503	305	307	518	57	289	631	293	102	833	181
Lane Group Flow (vph)	188	547	332	334	563	62	314	686	318	111	905	197
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Detector Phase	7	4	4	3	8	8	5	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	7.0	20.0	20.0	7.0	20.0	20.0	7.0	20.0	20.0	7.0	20.0	20.0
Minimum Split (s)	10.0	38.0	38.0	10.0	38.0	38.0	10.0	40.0	40.0	10.0	40.0	40.0
Total Split (s)	10.0	38.0	38.0	12.0	40.0	40.0	10.0	40.0	40.0	10.0	40.0	40.0
Total Split (%)	10.0%	38.0%	38.0%	12.0%	40.0%	40.0%	10.0%	40.0%	40.0%	10.0%	40.0%	40.0%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	0.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0	0.0	2.0	2.0
Lost Time Adjust (s)	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Total Lost Time (s)	2.0	5.0	5.0	2.0	5.0	5.0	2.0	5.0	5.0	2.0	5.0	5.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	None	C-Min	C-Min	None	C-Min	C-Min
v/c Ratio	0.56	0.63	0.68	0.93	0.57	0.14	0.80	0.48	0.42	0.27	0.79	0.46
Control Delay	26.0	36.8	22.0	59.3	33.4	8.6	40.3	24.2	4.8	11.6	30.1	12.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	26.0	36.8	22.0	59.3	33.4	8.6	40.3	24.2	4.8	11.6	30.1	12.6
Queue Length 50th (m)	23.8	50.7	26.4	46.6	50.8	0.7	39.6	49.7	1.0	7.6	57.2	7.4
Queue Length 95th (m)	34.7	60.6	50.9	#92.1	60.3	9.2	#110.3	73.2	19.0	m17.3	75.3	m23.4
Internal Link Dist (m)		1017.7			119.8			95.1			161.2	
Turn Bay Length (m)	30.0		26.0	30.0		30.0	60.0		60.0	30.0		30.0
Base Capacity (vph)	337	1158	599	358	1240	549	391	1427	752	405	1265	456
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.56	0.47	0.55	0.93	0.45	0.11	0.80	0.48	0.42	0.27	0.72	0.43

Intersection Summary
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 100
Control Type: Actuated-Coordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 3: Gordon Street & Stone Road /Stone Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	173	503	305	307	518	57	289	631	293	102	833	181
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	2.0	5.0	5.0	2.0	5.0	5.0	2.0	5.0	5.0	2.0	5.0	5.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.90	1.00	1.00	0.90	1.00	1.00	0.90	1.00	1.00	0.68
Flpb, ped/bikes	0.99	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1788	3510	1449	1761	3544	1463	1807	3579	1421	1805	3614	1094
Flt Permitted	0.33	1.00	1.00	0.26	1.00	1.00	0.12	1.00	1.00	0.36	1.00	1.00
Satd. Flow (perm)	626	3510	1449	476	3544	1463	225	3579	1421	693	3614	1094
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	188	547	332	334	563	62	314	686	318	111	905	197
RTOR Reduction (vph)	0	0	136	0	0	41	0	0	186	0	0	77
Lane Group Flow (vph)	188	547	196	334	563	21	314	686	132	111	905	120
Confl. Peds. (#/hr)	50		50	50		50	208		50	50		208
Heavy Vehicles (%)	1%	4%	1%	3%	3%	0%	1%	2%	3%	0%	1%	1%
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Actuated Green, G (s)	31.9	23.6	23.6	38.1	26.8	26.8	49.9	38.8	38.8	38.9	30.8	30.8
Effective Green, g (s)	33.9	24.6	24.6	39.1	27.8	27.8	50.9	39.8	39.8	40.9	31.8	31.8
Actuated g/C Ratio	0.34	0.25	0.25	0.39	0.28	0.28	0.51	0.40	0.40	0.41	0.32	0.32
Clearance Time (s)	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0	3.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	320	863	356	347	985	407	385	1424	566	385	1149	348
v/s Ratio Prot	0.05	c0.16		c0.12	0.16		c0.14	0.19		0.03	c0.25	
v/s Ratio Perm	0.14		0.14	0.26		0.01	0.28		0.09	0.09		0.11
v/c Ratio	0.59	0.63	0.55	0.96	0.57	0.05	0.82	0.48	0.23	0.29	0.79	0.34
Uniform Delay, d1	24.6	33.7	32.9	25.5	31.0	26.4	24.6	22.4	20.0	18.6	31.0	26.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.82	0.82	0.83
Incremental Delay, d2	2.7	1.5	1.8	38.2	0.8	0.1	12.5	1.2	1.0	0.4	4.9	2.4
Delay (s)	27.4	35.2	34.7	63.7	31.8	26.5	37.1	23.6	20.9	15.7	30.3	24.0
Level of Service	C	D	C	E	C	C	D	C	C	B	C	C
Approach Delay (s)		33.7			42.6			26.2			28.0	
Approach LOS		C			D			C			C	

Intersection Summary					
HCM Average Control Delay	31.9	HCM Level of Service		C	
HCM Volume to Capacity ratio	0.76				
Actuated Cycle Length (s)	100.0	Sum of lost time (s)		14.0	
Intersection Capacity Utilization	87.7%	ICU Level of Service		E	
Analysis Period (min)	15				
c Critical Lane Group					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	3	31	1182	3	30	1414
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	3	34	1285	3	33	1537
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)			289			119
pX, platoon unblocked	0.84	0.85			0.85	
vC, conflicting volume	2120	644			1288	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1167	235			991	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	98	95			94	
cM capacity (veh/h)	149	653			591	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	37	857	432	545	1025
Volume Left	3	0	0	33	0
Volume Right	34	0	3	0	0
cSH	503	1700	1700	591	1700
Volume to Capacity	0.07	0.50	0.25	0.06	0.60
Queue Length 95th (m)	1.8	0.0	0.0	1.3	0.0
Control Delay (s)	12.7	0.0	0.0	1.5	0.0
Lane LOS	B			A	
Approach Delay (s)	12.7	0.0		0.5	
Approach LOS	B				

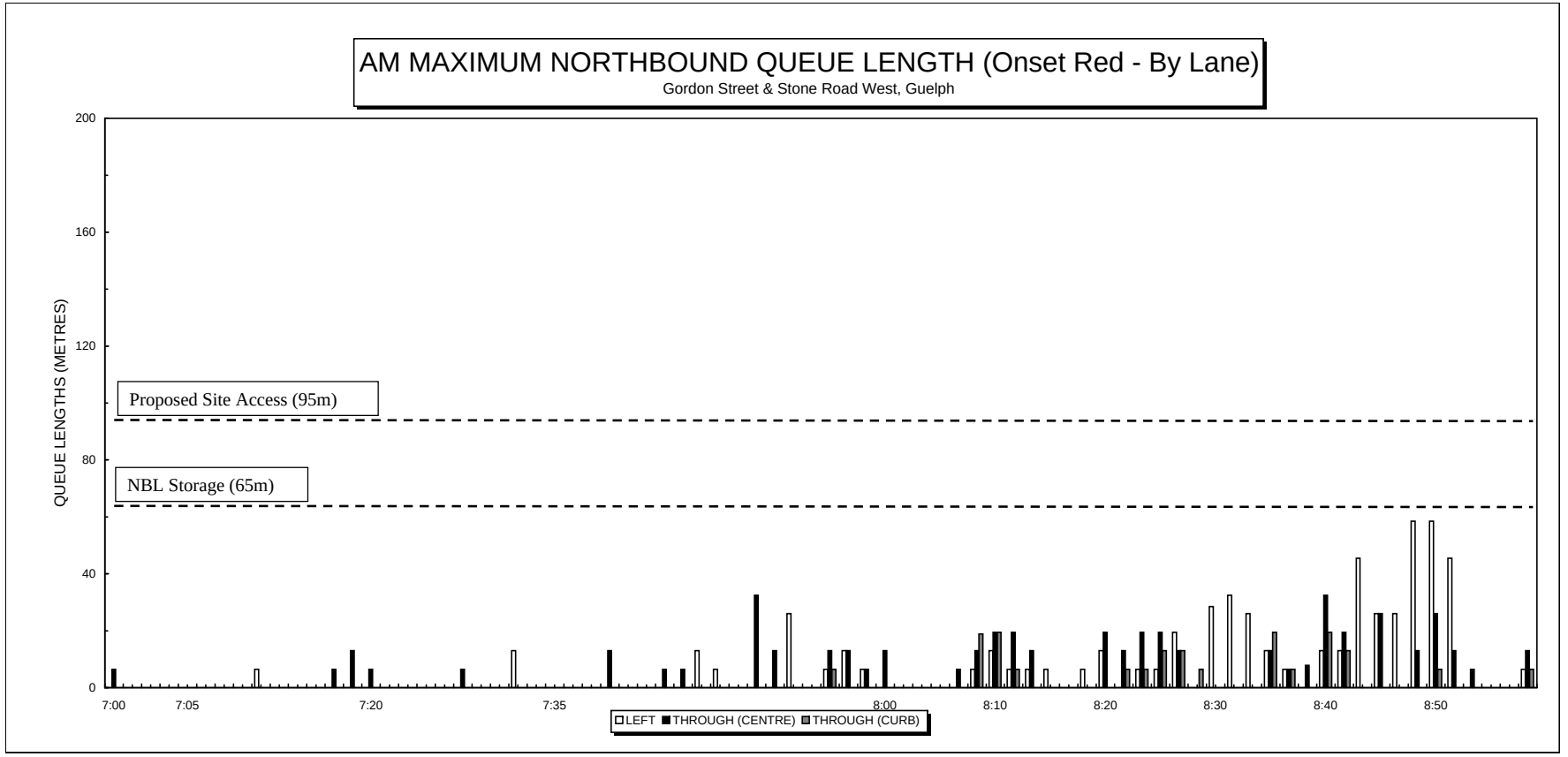
Intersection Summary				
Average Delay	0.5			
Intersection Capacity Utilization	70.5%	ICU Level of Service		C
Analysis Period (min)	15			

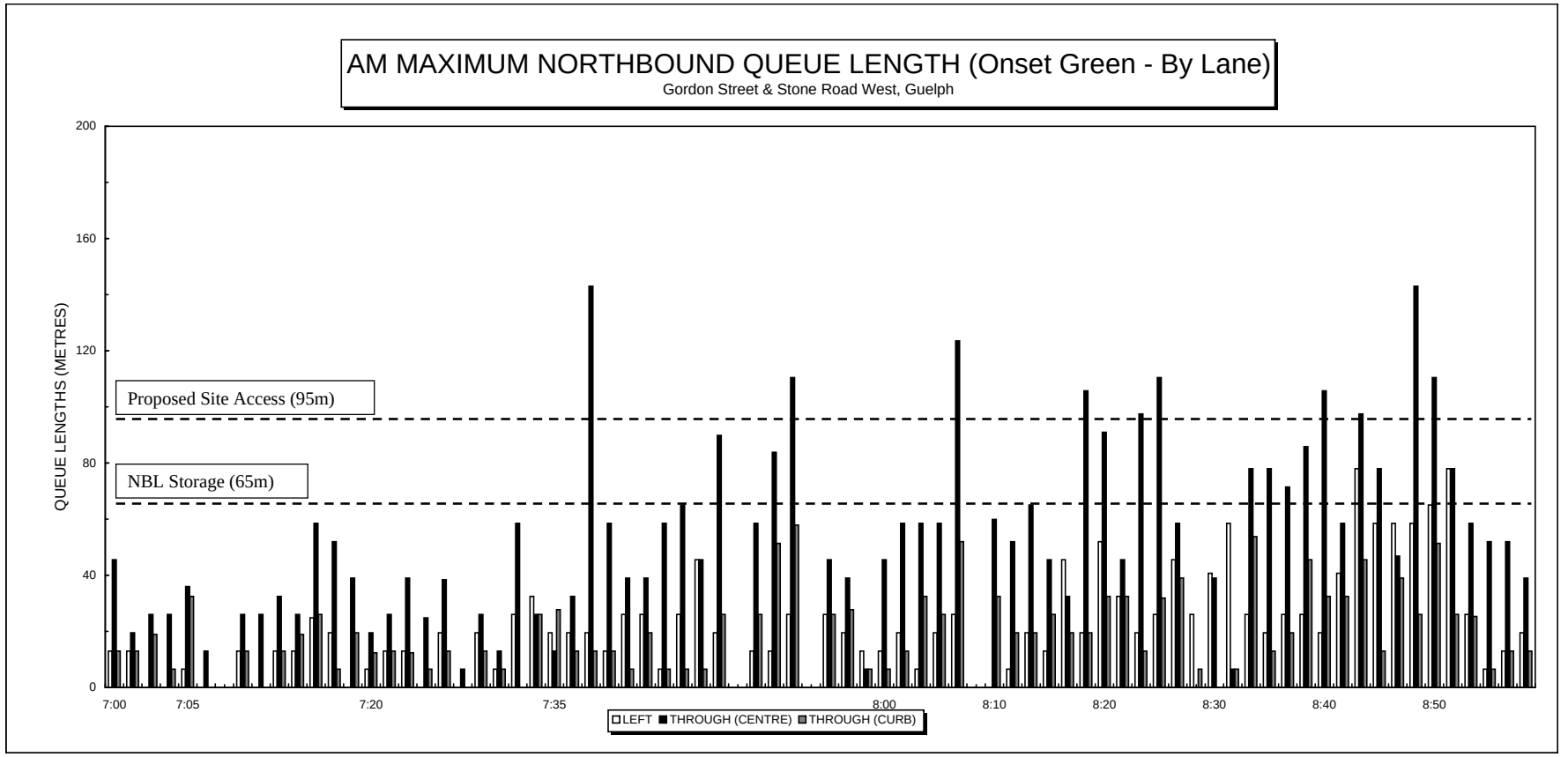
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	857	42	2	838	43	2
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	932	46	2	911	47	2
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)	144					
pX, platoon unblocked			0.87		0.87	0.87
vC, conflicting volume			977		1414	489
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			668		1172	105
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		71	100
cM capacity (veh/h)			796		160	806

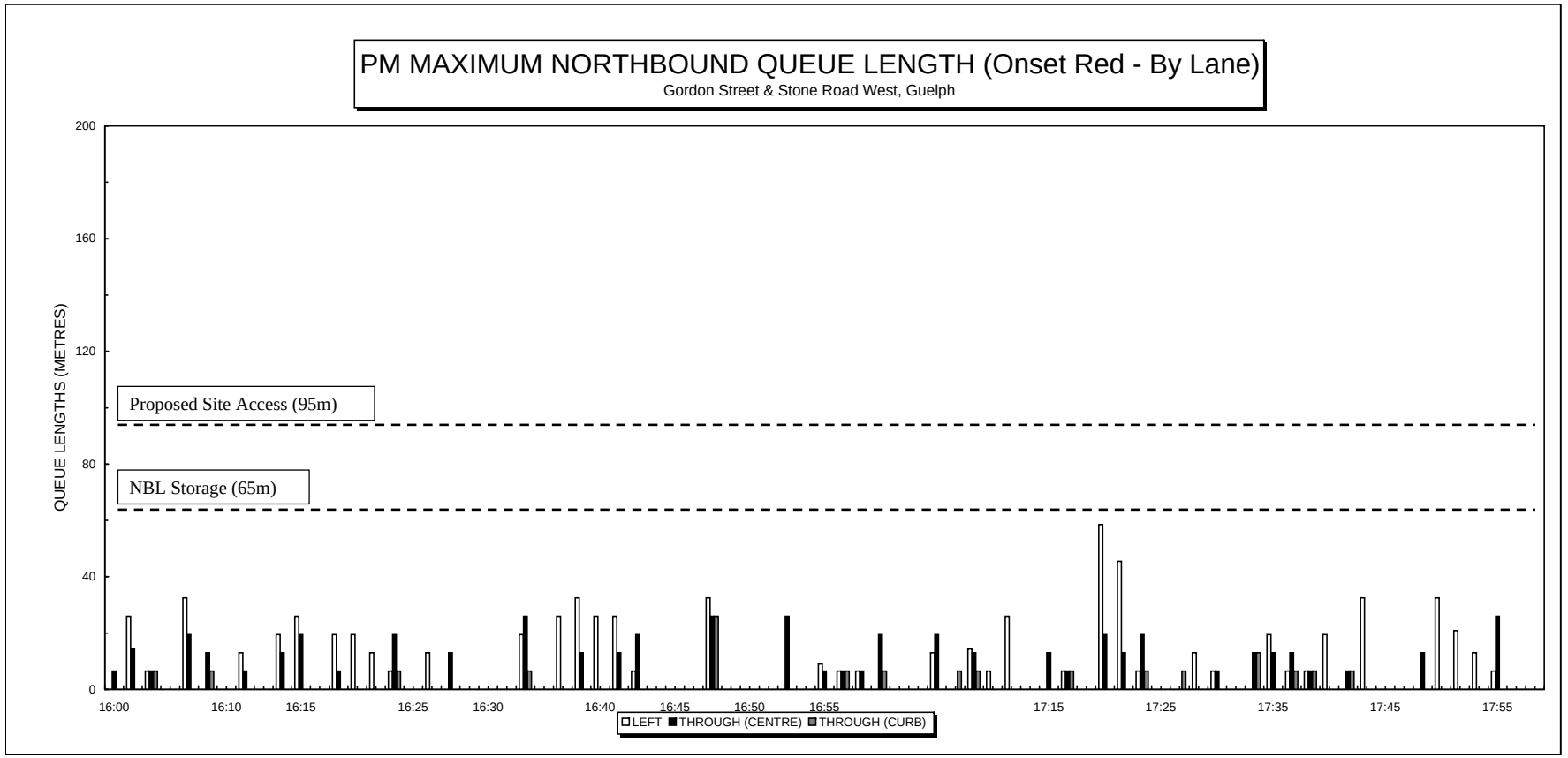
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	621	356	306	607	49
Volume Left	0	0	2	0	47
Volume Right	0	46	0	0	2
cSH	1700	1700	796	1700	166
Volume to Capacity	0.37	0.21	0.00	0.36	0.29
Queue Length 95th (m)	0.0	0.0	0.1	0.0	8.8
Control Delay (s)	0.0	0.0	0.1	0.0	35.4
Lane LOS			A		E
Approach Delay (s)	0.0		0.0		35.4
Approach LOS					E

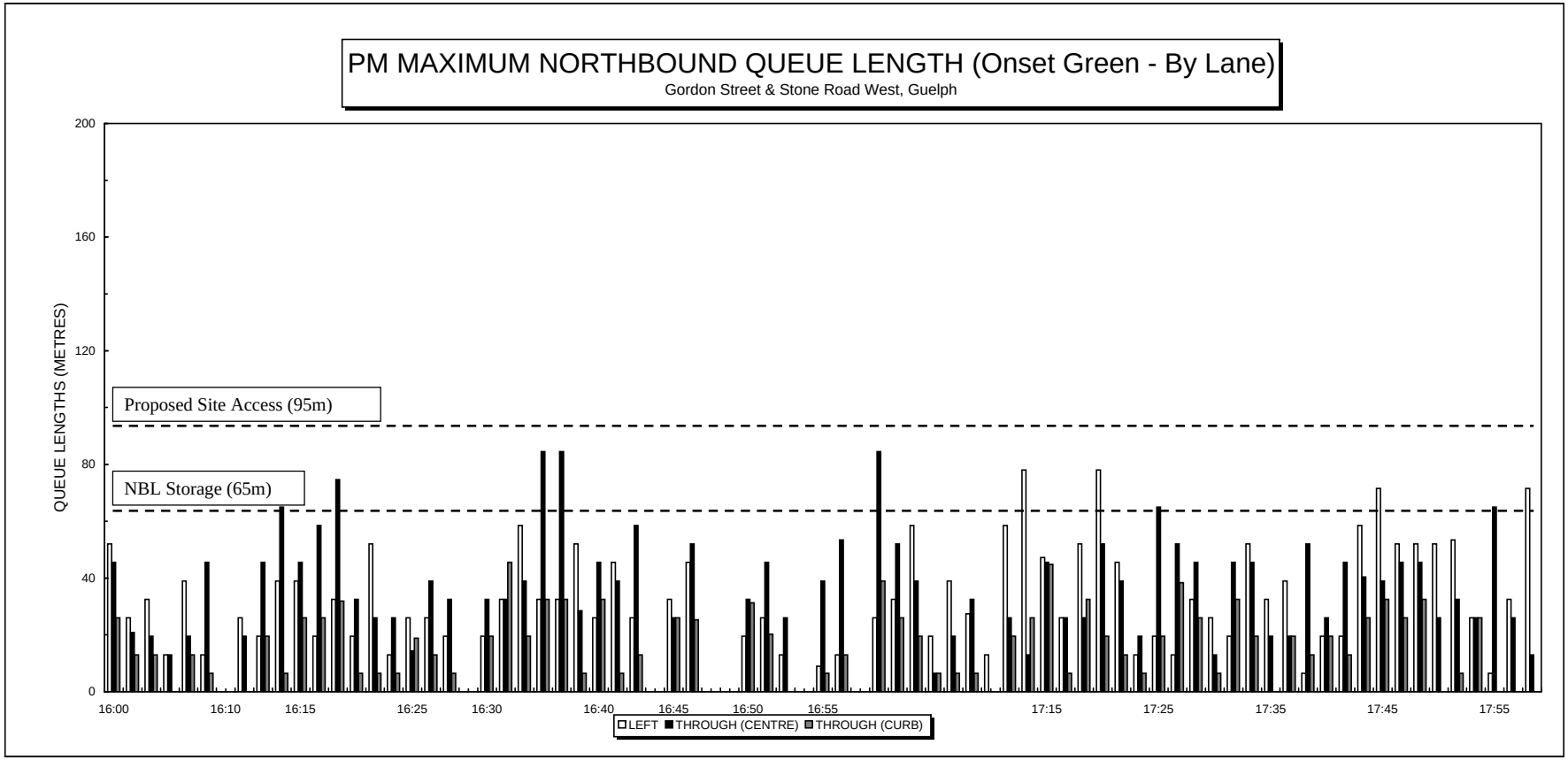
Intersection Summary				
Average Delay	0.9			
Intersection Capacity Utilization	35.0%	ICU Level of Service		A
Analysis Period (min)	15			

APPENDIX F – NORTHBOUND QUEUE SUMMARY
GORDON STREET AND STONE ROAD


AM MAXIMUM NORTHBOUND QUEUE LENGTH (Onset Red - By Lane)
Gordon Street & Stone Road West, Guelph
QUEUE LENGTHS (METRES)
200
160
120
80
40
0
Proposed Site Access (95m)
NBL Storage (65m)
7:00
7:05
7:20
7:35
8:00
8:10
8:20
8:30
8:40
8:50
LEFT
THROUGH (CENTRE)
THROUGH (CURB)


AM MAXIMUM NORTHBOUND QUEUE LENGTH (Onset Green - By Lane)
Gordon Street & Stone Road West, Guelph
QUEUE LENGTHS (METRES)
200
160
120
80
40
0
Proposed Site Access (95m)
NBL Storage (65m)
7:00
7:05
7:20
7:35
8:00
8:10
8:20
8:30
8:40
8:50
LEFT
THROUGH (CENTRE)
THROUGH (CURB)


PM MAXIMUM NORTHBOUND QUEUE LENGTH (Onset Red - By Lane)
Gordon Street & Stone Road West, Guelph
QUEUE LENGTHS (METRES)
200
160
120
80
40
0
Proposed Site Access (95m)
NBL Storage (65m)
16:00
16:10
16:15
16:25
16:30
16:40
16:45
16:50
16:55
17:15
17:25
17:35
17:45
17:55
LEFT
THROUGH (CENTRE)
THROUGH (CURB)


PM MAXIMUM NORTHBOUND QUEUE LENGTH (Onset Green - By Lane)
Gordon Street & Stone Road West, Guelph
QUEUE LENGTHS (METRES)
200
160
120
80
40
0
Proposed Site Access (95m)
NBL Storage (65m)
16:00
16:10
16:15
16:25
16:30
16:40
16:45
16:50
16:55
17:15
17:25
17:35
17:45
17:55
LEFT
THROUGH (CENTRE)
THROUGH (CURB)