108, 116 & 122 Harvie Road

City of Barrie

Traffic Impact Study for

ASA Development Inc.

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Executive Summary

This report summarizes the traffic impact study prepared for a proposed development municipally known as 108, 116 & 122 Harvie Road, located at the northwest corner of the intersection of Harvie Road and Beacon Road, in the City of Barrie [City]. The report assesses the impact of traffic related to the development on the adjacent roadway and provides recommendations to accommodate this traffic in a safe and efficient manner.

The proposed development is anticipated to consist of 12 freehold single detached units, 65 townhouse units and a four-storey condominium (50 units).

The proposed development will have a one full-movement access [Street A] onto the extension of Beacon Road onto Harvie Road [Beacon Road Extension]. Street A will bisect the property and will provide future connection to the property to the west. There will be four private laneway access connections to Street A [Access A, Access B, Access C and Access D] that will be used to access the townhouse units. The single detached units will front the Beacon Road Extension.

The scope of this analysis includes a review of the following intersections:

- Essa Road / Beacon Road & Loggers Run;
- Beacon Road / Street A;
- Street A / Access A;
- Street A / Access B;
- Street A / Access C; and
- Street A / Access D.

Conclusions

1. The proposed development is expected to generate a total of 65 AM and 79 PM peak hour trips.
2. Detailed turning movement traffic and pedestrian counts were commissioned by JD Engineering for the existing Essa Road / Beacon Road & Loggers Run intersection.
3. An estimate of the amount of traffic that would be generated by the proposed development was prepared and assigned to the study area streets and intersections.
4. An intersection operation analysis was completed at the study area intersections, using the existing (2021) and background (2023, 2031 & 2033) traffic volumes without the proposed development traffic. This enabled a review of existing and future traffic deficiencies that would be present without the influence of the proposed development. No geometric lane improvements or traffic signal improvements are recommended within the study area.
5. An estimate of the amount of traffic that would be generated by the Subject Site was prepared and assigned to the study area streets and intersections.
6. An intersection operation analysis was completed under total (2023, 2031 & 2033) traffic volumes with the proposed development operational at the study area intersections. No geometric lane improvements or traffic signal improvements are recommended within the study area.
7. Street A will operate efficiently as a full-movement access roadway with one-way stop control for eastbound movements. No lane improvements are recommended on Beacon Road at Street A. A single eastbound and westbound lane at Street A will provide the necessary capacity to service the proposed development.

8. The proposed Access A, Access B, Access C and Access D driveways will operate efficiently as full-movement driveways with two-way stop control for northbound and southbound traffic. A single lane for ingress and egress movements at the Access A, Access B, Access C and Access D driveways will provide the necessary capacity to convey the traffic volume generated by the proposed development.
9. There are no issues with the sight distance available for the proposed Access A, Access B, Access C and Access D driveways at Street A and the Street A intersection at the Beacon Road Extension. An additional review will be required once vertical profiles are established for Beacon Road and Street A.
10. It is recommended that a raised intersection is provided at the Street A / Beacon Road intersection. It is also recommended that the City consider installing another speed control device on Beacon Road, between Montserrand Street and Essa Road.
11. A supplementary pedestrian crossing review will be completed at the Beacon Road Extension & Thrushwood Drive / Harvie Road intersection by JD Engineering in a letter by Fall 2021. Traffic counts will be completed at this intersection in September 2021.
12. It is recommended that the Beacon Road Extension include the construction of a sidewalk on the west side of the road and painted bicycle lanes.
13. The proposed parking supply meets the parking required identified in the City's Zoning By-law 2009-141.
14. In summary, the proposed development will not cause any operational issues and will not add significant delay or congestion to the local roadway network.

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1 Introduction

1.1 Background

ASA Development Inc. [The Developer] is proposing to develop a site municipally known as 108, 116 & 122 Harvie Road, located at the northwest corner of the Harvie Road / Thrushwood Drive intersection, in the City of Barrie [City].

The proposed development is anticipated to consist of 12 freehold single detached units, 65 townhouse units and a four-storey condominium (50 units).

The proposed development will have a one full-movement access [Street A] onto the extension of Beacon Road onto Harvie Road [Beacon Road Extension]. Street A will bisect the property and will provide future connection to the property to the west. There will be four private laneway access connections to Street A [Access A, Access B, Access C and Access D] that will be used to access the townhouse units. The single detached units will front the Beacon Road Extension.

The Developer has retained **JD Engineering Inc.** [JD Engineering] to prepare this traffic impact study in support of the proposed development.

1.2 Study Area

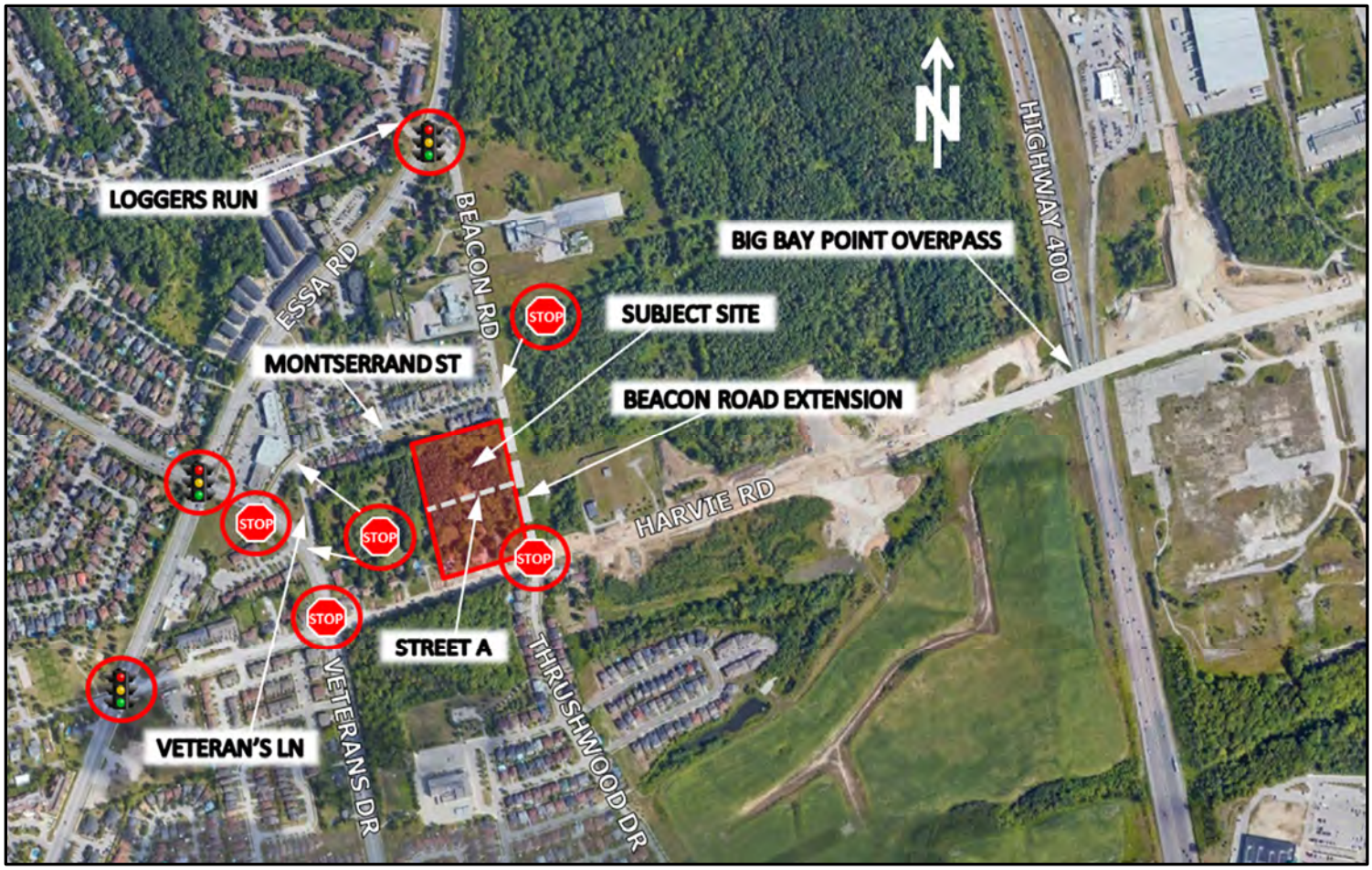
Figure 1 illustrates the location of the proposed development and study area intersections, in relation to the surrounding area. The Site Plan by Jones Consulting Group Ltd. is provided in **Appendix A**.

The subject site is bound by Harvie Road to the south, the Beacon Road Extension to the east, existing residential developments to the north and future residential lands to the west.

The following intersections will be analysed as part of the study:

- Essa Road / Beacon Road & Loggers Run;
- Beacon Road / Street A;
- Street A / Access A (functional review only);
- Street A / Access B (functional review only);
- Street A / Access C (functional review only); and
- Street A / Access D (functional review only).

Figure 1 – Proposed Site Location and Study Area



1.3 Study Scope and Objectives

The purpose of this study is to identify the potential impacts to traffic flow at the access driveways / roadway and on the surrounding roadway network. The study analysis includes the following tasks:

- Determine existing traffic volumes and circulation patterns;
- Estimate future traffic volumes if the proposed development was not constructed, including the impact of additional proposed developments in the area;
- Complete level-of-service [LOS] analysis of horizon year (without the proposed development) traffic conditions and identify operational deficiencies;
- Estimate the amount of traffic that would be generated by the proposed development and assign to the roadway network;
- Complete LOS analysis of horizon year (with the proposed development) traffic conditions and identify additional operational deficiencies;
- Provide an assessment of the impact of the additional traffic on the local road network;
- Identify improvement options to address operational deficiencies;
- Calculate lane improvements for the site access roadways based on the Transportation Association of Canada [TAC] and Ontario Ministry of Transportation guidelines;
- Complete a review of traffic operations of the site access roadways;
- Review the proposed configuration of the Street A intersection and the site access driveways;
- Review the proposed parking supply; and
- Document findings and recommendations in a final report.

1.4 Horizon Year and Analysis Periods

Traffic scenarios for the existing (2021) year and horizon years (2023, 2031 & 2033) were selected for analysis of traffic operations in the study area. The weekday morning [AM] and weekday afternoon [PM] peak hours have been selected as the analysis periods for this study.

2 Information Gathering

2.1 Street and Intersection Characteristics

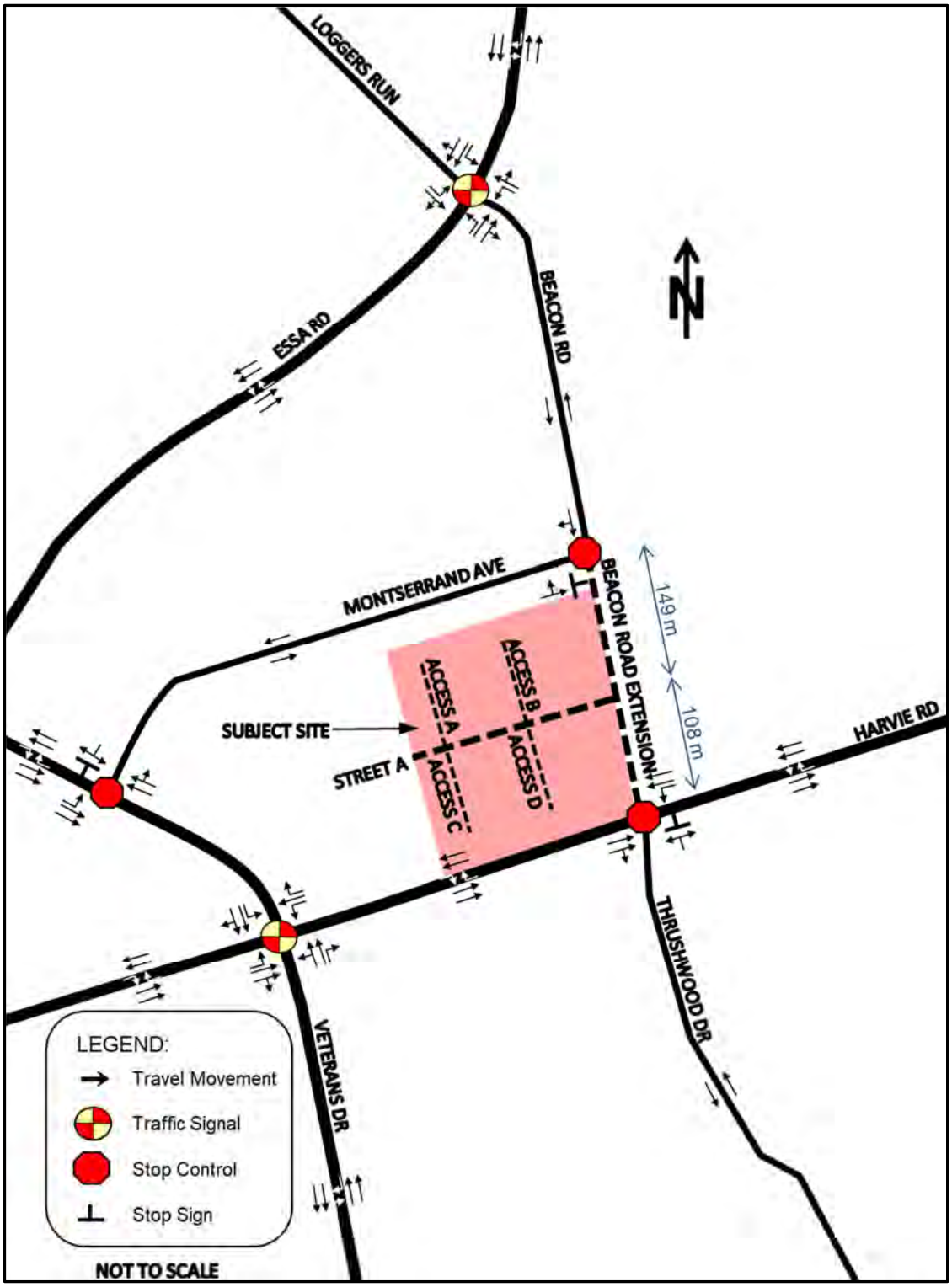
Essa Road is a five-lane arterial road with an urban cross-section and sidewalks on both sides of the road within the study area. Essa Road has a posted speed limit of 50 km/h and is under jurisdiction of the City.

Loggers Run is a two-lane private road with an urban cross-section. Loggers Run west of Essa Road has sidewalks on both sides of the road which ends at Meadow Lane and transitions with a single sidewalk on the north side of the road. Loggers Run has a posted speed limit of 15 km/h and is under jurisdiction of the Timberwalk Condo Corporation.

Beacon Road is a two-lane local road with an urban cross-section and a sidewalk on the west side of the road. Beacon Road has a posted speed limit of 50 km/h and is under jurisdiction of the City.

The existing lane configuration within the study area is illustrated in **Figure 2**.

Figure 2 – Existing Lane Configuration within Study Area



2.2 Local Transportation Infrastructure Improvements

Based on the City's Transportation Master Plan (dated April 2019) [City TMP], the following improvements have recently been constructed (June 2021) outside the study area:

- Harvie Road (between Essa Road and Future Bryne Drive)
  - Widen roadway to include an extrta lane along both directions;
  - An addition of a two-way left turn lane [TWLTL]; and
  - Buffered bike lanes and sidewalks along both sides of the road

- Big Bay Point Road Overpass (Bayview Drive to Future Bryne Drive)
  - Construction of a new five-lane Highway 400 crossing, connecting with Harvie Road [Big Bay Point Overpass]; and
  - Buffered bike lanes and sidewalks along both sides of the road.

The following improvement is anticipated to be constructed upon meeting the traffic volume signalization warrant (further details are outlined in Section 5.7):

- Beacon Road Extension & Thrushwood Drive / Harvie Road Signalization
  - Signalization of intersection.

The City TMP also identified the following active transportation improvements planned in the long-term (2032 – 2041) on Essa Road between Ferndale Drive South and Ardagh Road:

- Construct an in-boulevard pathway on the north side of the road.

2.3 Transit Access

Barrie Transit provides two bus routes in the study area. No. 2A-2B (Dunlop-Park Place) bus route provides service along Ferndale Drive South and Veterans Drive. No. 8A-8B (RVH / Yonge-Crosstown / Essa) bus route provides service along Essa Road.

The No. 2A-2B bus routes operate from 06:15 – 22:15 on weekdays with service every hour, from 07:15 – 22:15 on Saturday with service every hour and from 09:15 – 21:15 on Sunday with service every hour. The closest bus stop for the No. 2A bus route is located on the northeast corner of the Essa Road / Ferndale Drive South & Veterans Drive intersection (565 metres from the subject site). The closest bus stop for the No. 2B bus route is located on the southwest corner of the Essa Road / Ferndale Drive South & Veterans Drive intersection (615 metres from the subject site).

The No. 8A-8B bus routes operate from 04:34 – 23:34 on weekdays with service every half-hour, from 06:50 – 23:34 on Saturday with service every hour and from 08:50 – 21:34 on Sunday with service every hour. The closest bus stop for the No. 8A bus route is located on the southeast corner of the Essa Road / Ferndale Drive South & Veterans Drive intersection (615 metres from the subject site). The closest bus stop for the No. 2B bus route is located on the northwest corner of the Essa Road / Ferndale Drive South & Veterans Drive intersection (665 metres from the subject site).

The City is planning an adjustment and expansion of transit service in the study area, associated with the planned infrastructure improvements in the City and the development of the Hewitt Secondary Plan Area at the south limits of the City. The future service (which is subject to change), will provide a route along Harvie Road crossing the Big Bay Point Overpass.

2.4 Other Developments within the Study Area

Based on a review of the City's Proposed Developments webpage a number of developments are planned in the study area and will have a notable impact on the local traffic volumes. The future developments near the study area include:

- 339 & 341 Veterans Development;
- 430 Essa Development;
- 440 Essa Development;
- 368 Essa Development;
- 390 Essa Development; and
- 405 Essa Development.

The above noted developments are in various stages of development and are further described in the sections below. To be conservative in our analysis, we have assumed all of the developments will be built-out by the 2023 horizon year.

Figure 3 illustrates the location of these development relative to the study area.

Figure 3 – Adjacent Development Locations

2.4.1 Traffic Generation for the Other Developments in the Study Area

For the purposes of this study, it has been assumed that all traffic generated by the adjacent developments within the study area will be new traffic and would not be in the study area if the developments were not constructed.

The traffic generated by the adjacent developments have been estimated based on the data provided in the Institute of Transportation Engineers [ITE] Trip generation Manual (10th Edition) [ITE Trip Generation Manual].

The following ITE land use has been applied to estimate the traffic for the adjacent developments:

- ITE land use 220 (Multifamily Housing (Low-Rise)) – General Urban/Suburban Setting
- ITE land use 221 (Multifamily Housing (Mid-Rise)) – General Urban/Suburban Setting
- ITE land use 231 (Mid-Rise Residential with 1st floor Commercial) – Dense Multi-Use Urban[1]

The AM and PM peak traffic generation for the adjacent developments is not expected to exactly align with the AM and PM peak hour in the traffic counts; consequently, we have applied the peak hour of adjacent street traffic values provided in the ITE Trip Generation Manual.

2.4.2 Traffic Distribution for the Other Developments in the Study Area

The traffic distribution for the adjacent developments is based on data provided by the ITE. The distribution of traffic outside of the study area has been calculated based on the 2016 TTS data for traffic zone 8523 and 8524 retrieved using the TTS IDRS (output attached as **Appendix D**). TTS data provides historical origin and destination work trip percentages for specific areas within the City and southern Ontario.

Traffic distribution for the trips generated by the proposed development during the AM and PM peak hour is expected to generally follow commuter travel patterns. Our analysis is based on egress traffic during the AM peak hour. Logically, the distribution of ingress traffic will follow the inverse of the exiting traffic distribution. For each of the individual areas identified in the TTS data, we have selected the probable route of travel, assuming that people will select their route primarily based on travel time.

Table 1 illustrates the traffic distribution for the future residential developments in the study area, using the methodology outlined above.

Table 1 – Residential Development Traffic Distribution

Travel Direction (to/from)	Percent of Total Traffic Generation
North via Essa Road	39%
West via Harvie Road / Essa Road / Veterans Drive	45%
East via Big Bay Point Overpass	16%
Total	**100%**

[1] The study area is not currently located in an area that would be defined as a dense multi-use urban setting; however, ITE Trip Generation data not available for a suburban setting. Based on our review of the planned development in the area, the ITE Trip Generation data for the dense multi-use urban is appropriate for the future developments.

The majority of the traffic generated by the adjacent developments are expected to travel along Essa Road and Veteran's Drive in the study area; however, for the purpose of our analysis we have conservatively assigned trips to Beacon Road, which will create a more critical condition for the intersections we are reviewing in this study.

2.4.3 339 & 341 Veterans Development

A future residential development is planned municipally known as 339 & 341 Veterans Drive, located on the southeast corner of the Veterans Drive / Montserrand Street intersection [339 & 341 Veterans Development]. The 339 & 341 Veterans Development is anticipated to consist of a maximum of 35 townhouse units and 38 walk-up apartment units. The 339 & 341 Veterans Development is pending site plan submission. The estimated trip generation of the 339 & 341 Veterans Development is based on the methodology noted in Section 2.4.1 and is illustrated below in **Table 2**.

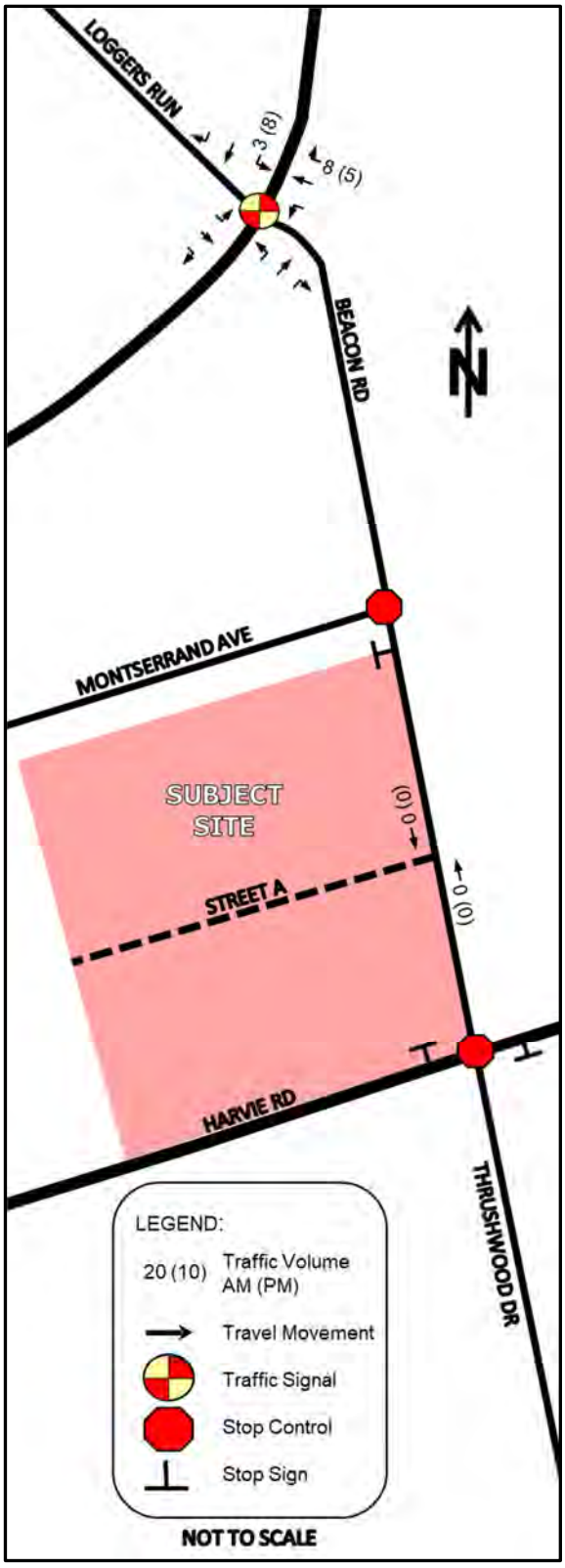
Table 2 - Estimated Traffic Generation – 339 & 341 Veterans Development

Land Use	Size	AM Peak Hour			PM Peak Hour		
		IN	OUT	TOTAL	IN	OUT	TOTAL
Multifamily Housing (Low-Rise) ITE Land Use: 220	35 units	4	14	18	15	9	24
Multifamily Housing (Mid-Rise) ITE Land Use: 221	38 units	4	10	14	10	7	17
TOTAL TRIP GENERATION		**8**	**24**	**32**	**25**	**16**	**41**

No transportation modal split has been applied to the above-noted traffic generation calculation.

Using the residential traffic distribution noted in Table 1 in Section 2.4.2, the traffic assignment for the 339 & 341 Veterans Development (2023) was calculated for the AM and PM peak hour and is illustrated in **Figure 4**.

Figure 4 – Adjacent Development Traffic Volumes – 339 & 341 Veterans Development (2023)



2.4.4 430 Essa Development

A future residential development is planned municipally known as 430 Essa Road, located on the southeast corner of the Essa Road / Veterans Drive intersection [430 Essa Development]. The 430 Essa Development is anticipated to consist of 71 apartment units and ground floor commercial space. The 430 Essa Development is currently being constructed and is assumed in the existing (2021) scenario. The estimated trip generation of the 430 Essa Development is based on the methodology noted in Section 2.4.1 and is illustrated below in **Table 3**.

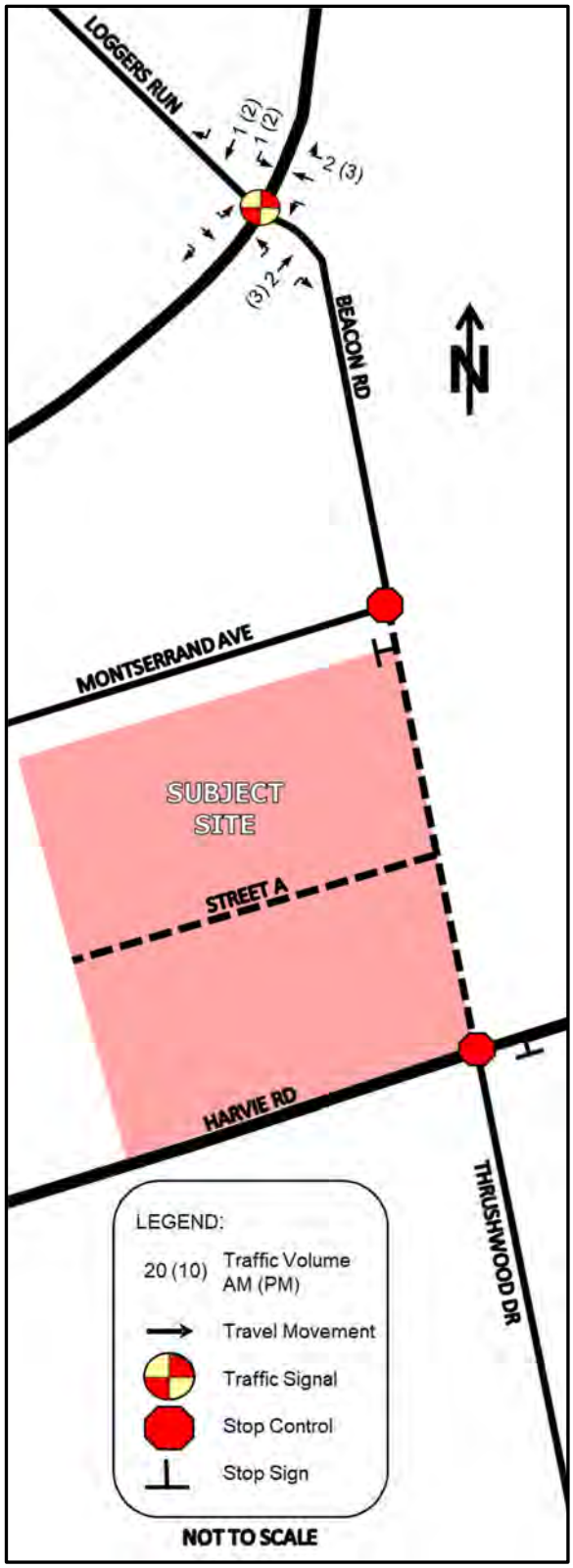
Table 3 - Estimated Traffic Generation – 430 Essa Development

Land Use	Size	AM Peak Hour			PM Peak Hour		
		IN	OUT	TOTAL	IN	OUT	TOTAL
Mid-Rise Residential with 1st floor Commercial ITE Land Use: 231	71 units	9	14	23	15	19	34

No transportation modal split has been applied to the above-noted traffic generation calculation.

Using the residential traffic distribution noted in Table 1 in Section 2.4.2, the traffic assignment for the 430 Essa Development (2021) was calculated for the AM and PM peak hour and is illustrated in **Figure 5**.

Figure 5 – Adjacent Development Traffic Volumes – 430 Essa Development (2021)



2.4.5 440 Essa Development

A future residential development is planned municipally known as 440 Essa Road, located southeast of the Essa Road / Veterans Drive intersection west of the 430 Essa Development [440 Essa Development]. The 440 Essa Development is anticipated to consist of an eight storey 195 unit apartment and ground floor commercial space. The 440 Essa Development is pending site plan approval. The estimated trip generation of the 440 Essa Development is based on the methodology noted in Section 2.4.1 and is illustrated below in **Table 4**.

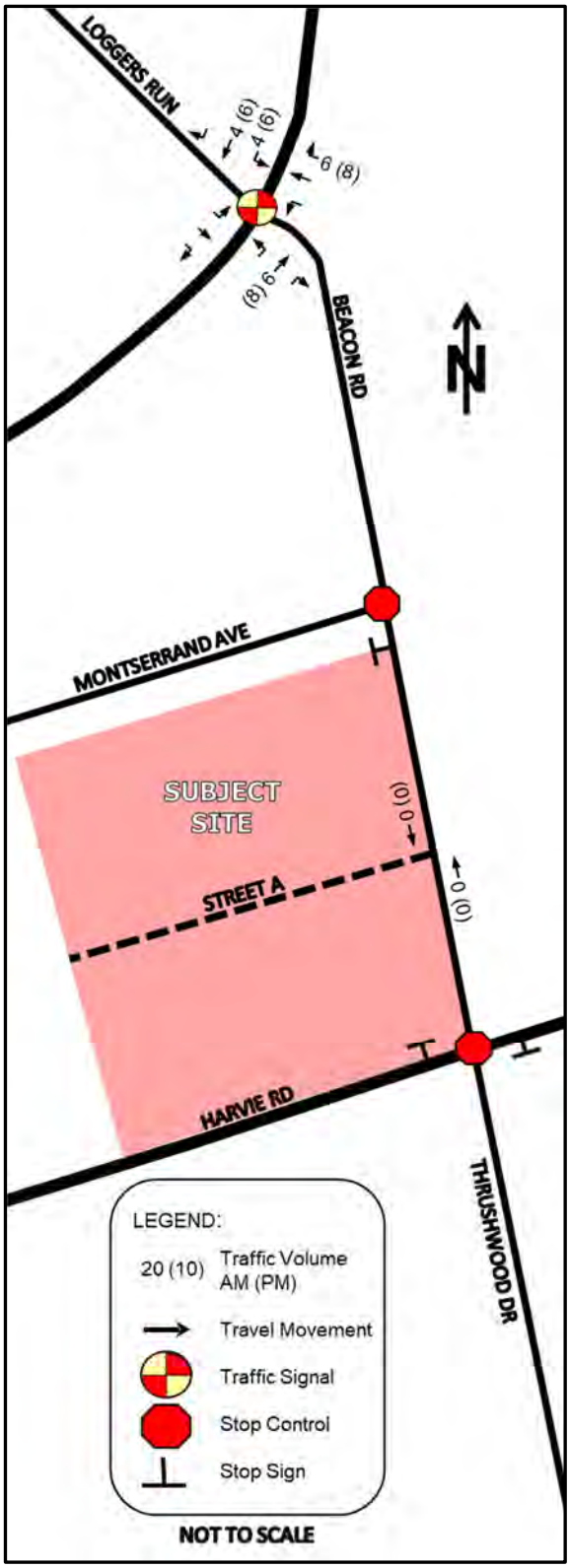
Table 4 - Estimated Traffic Generation – 440 Essa Development

Land Use	Size	AM Peak Hour			PM Peak Hour		
		IN	OUT	TOTAL	IN	OUT	TOTAL
Mid-Rise Residential with 1st floor Commercial ITE Land Use: 231	195 units	25	36	61	40	52	92

No transportation modal split has been applied to the above-noted traffic generation calculation.

Using the residential traffic distribution noted in Table 1 in Section 2.4.2, the traffic assignment for the 440 Essa Development (2023) was calculated for the AM and PM peak hour and is illustrated in **Figure 6**.

Figure 6 – Adjacent Development Traffic Volumes – 440 Essa Development (2023)



2.4.6 368 Essa Development

A future residential development is planned municipally known as 368 Essa Road, located southwest of the Essa Road / Beacon Road & Loggers Run intersection [368 Essa Development]. The 368 Essa Development is anticipated to consist of a six storey 69 unit condominium. The 368 Essa Development is pending site plan approval. The estimated trip generation of the 368 Essa Development is based on the methodology noted in Section 2.4.1 and is illustrated below in **Table 5**.

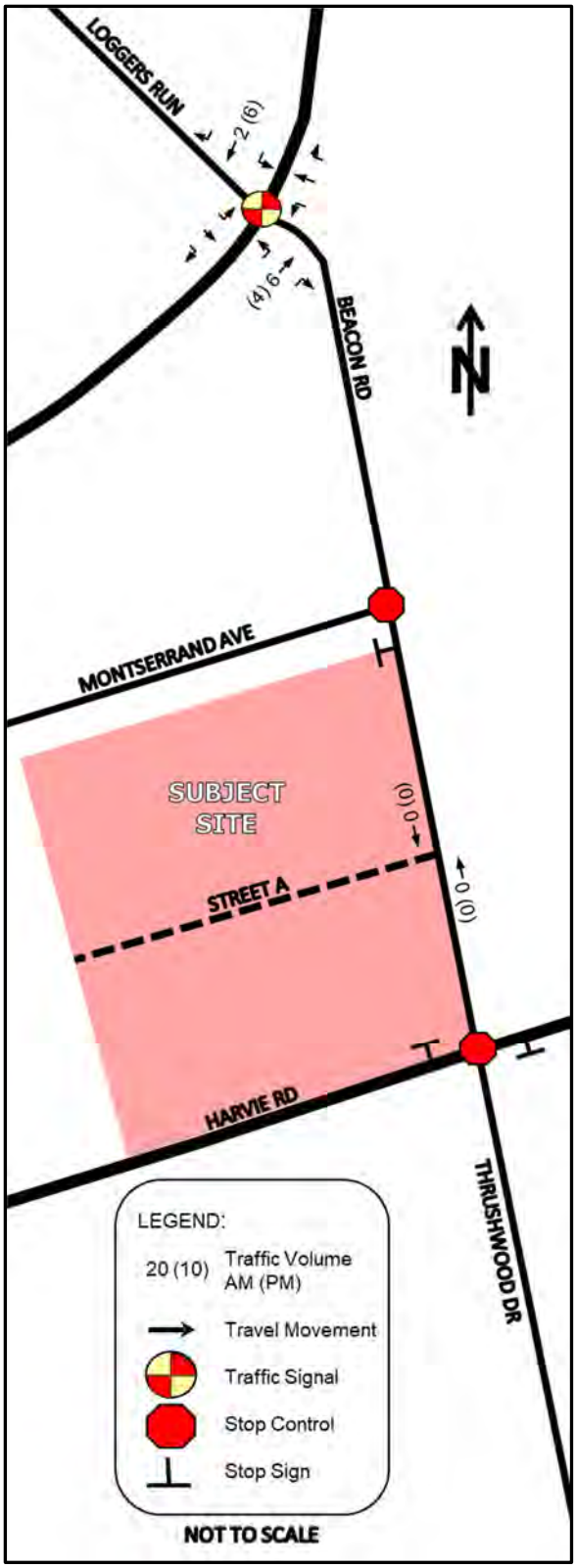
Table 5 - Estimated Traffic Generation – 368 Essa Development

Land Use	Size	AM Peak Hour			PM Peak Hour		
		IN	OUT	TOTAL	IN	OUT	TOTAL
Multifamily Housing (Mid-Rise) ITE Land Use: 221	69 units	7	18	25	19	12	31

No transportation modal split has been applied to the above-noted traffic generation calculation.

Using the residential traffic distribution noted in Table 1 in Section 2.4.2, the traffic assignment for the 368 Essa Development (2023) was calculated for the AM and PM peak hour and is illustrated in **Figure 7**.

Figure 7 – Adjacent Development Traffic Volumes – 368 Essa Development (2023)



2.4.7 390 Essa Development

A future residential development is planned municipally known as 390 Essa Road, located on the southeast side of Essa Road midblock between Veterans Drive and Beacon Road [390 Essa Development]. The 390 Essa Development is anticipated to consist of a 75 unit apartment. The 390 Essa Development is pending site plan submission. The estimated trip generation of the 390 Essa Development is based on the methodology noted in Section 2.4.1 and is illustrated below in **Table 6**.

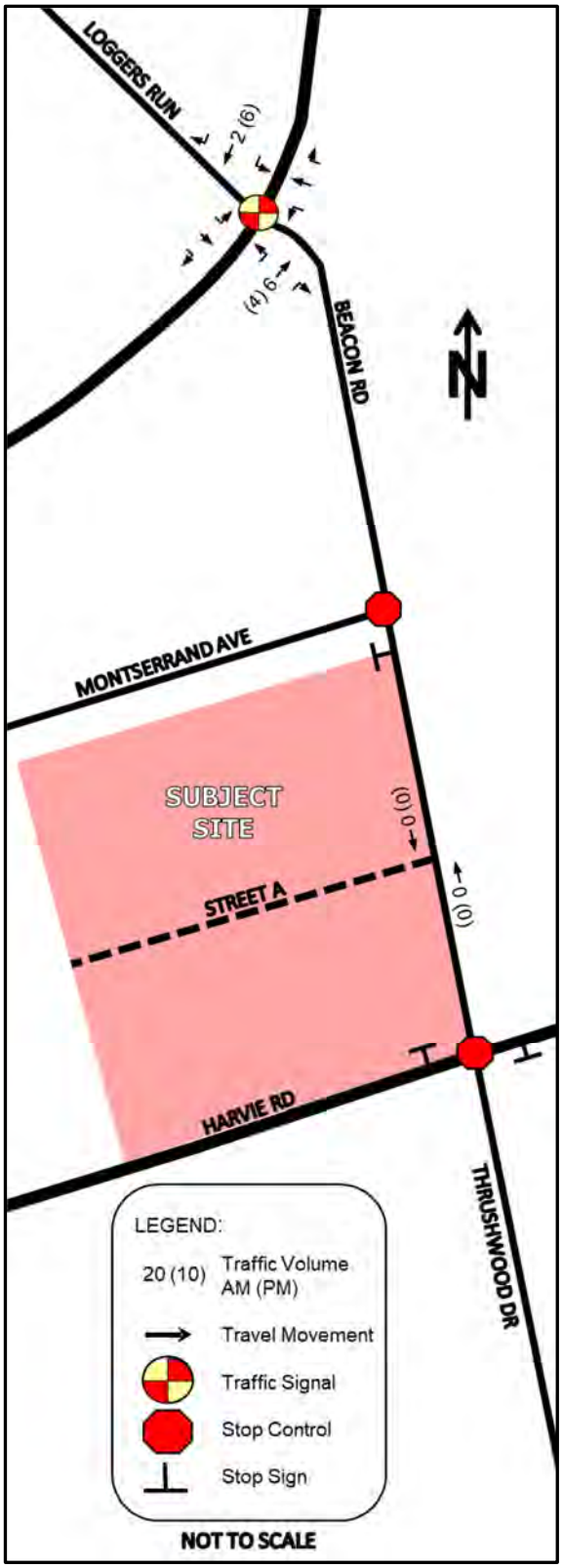
Table 6 - Estimated Traffic Generation – 390 Essa Development

Land Use	Size	AM Peak Hour			PM Peak Hour		
		IN	OUT	TOTAL	IN	OUT	TOTAL
Multifamily Housing (Mid-Rise) ITE Land Use: 221	75 units	7	20	27	20	13	33

No transportation modal split has been applied to the above-noted traffic generation calculation.

Using the residential traffic distribution noted in Table 1 in Section 2.4.2, the traffic assignment for the 390 Essa Development (2023) was calculated for the AM and PM peak hour and is illustrated in **Figure 8**.

Figure 8 – Adjacent Development Traffic Volumes – 390 Essa Development (2023)



2.4.8 405 Essa Development

A future residential development is planned municipally known as 405 Essa Road, located on the northwest side of Essa Road midblock between Veterans Drive and Beacon Road [405 Essa Development]. The 405 Essa Development is anticipated to consist of an eight storey 103 unit condominium, 6 townhouse units and 6 mixed-use units. The 405 Essa Development is pending site plan submission. The estimated trip generation of the 405 Essa Development is based on the methodology noted in Section 2.4.1 and is illustrated below in **Table 7**.

Table 7 - Estimated Traffic Generation – 405 Essa Development

Land Use	Size	AM Peak Hour			PM Peak Hour		
		IN	OUT	TOTAL	IN	OUT	TOTAL
Multifamily Housing (Low-Rise) ITE Land Use: 220	103 units	12	39	50	38	23	61
Multifamily Housing (Mid-Rise) ITE Land Use: 221	6 units	1	2	3	2	1	3
Mid-Rise Residential with 1st floor Commercial ITE Land Use: 231	6 units	1	1	2	1	2	3
TOTAL TRIP GENERATION		**14**	**41**	**55**	**41**	**26**	**67**

No transportation modal split has been applied to the above-noted traffic generation calculation.

Using the residential traffic distribution noted in Table 1 in Section 2.4.2, the traffic assignment for the 405 Essa Development (2023) was calculated for the AM and PM peak hour and is illustrated in **Figure 9**.

Figure 10 illustrates the traffic assignment during the AM and PM peak hour for all the adjacent developments (2023) within the study area.

Figure 9 – Adjacent Development Traffic Volumes – 405 Essa Development (2023)

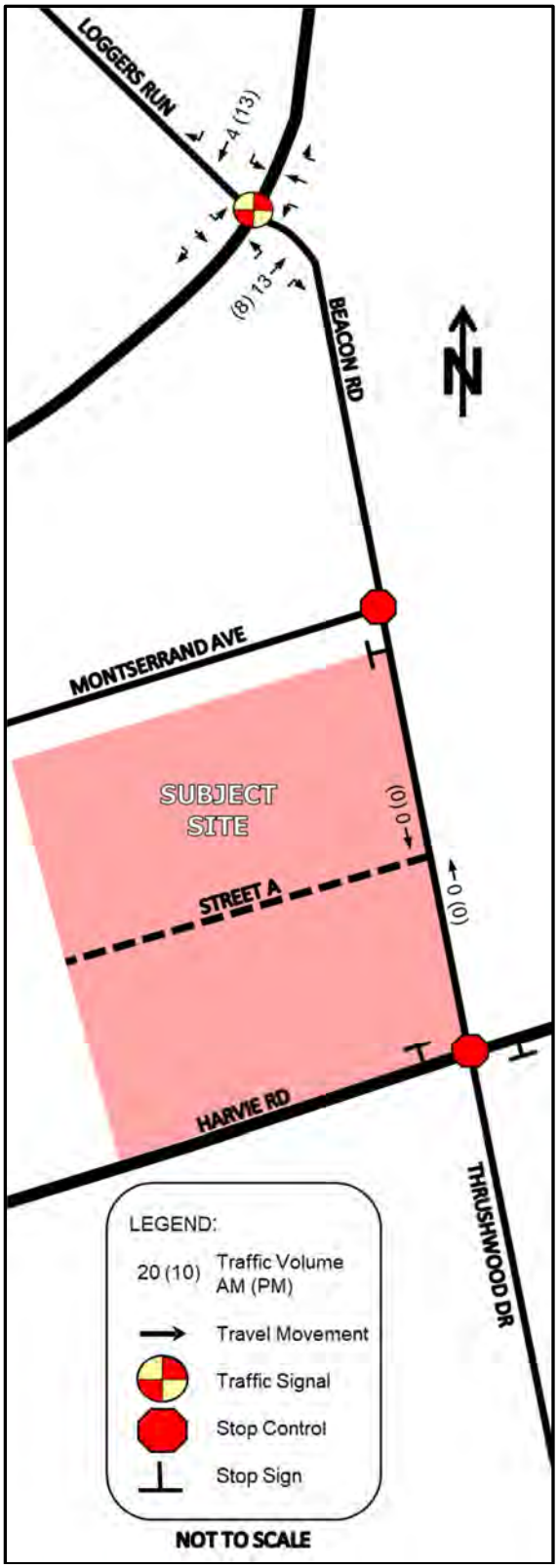
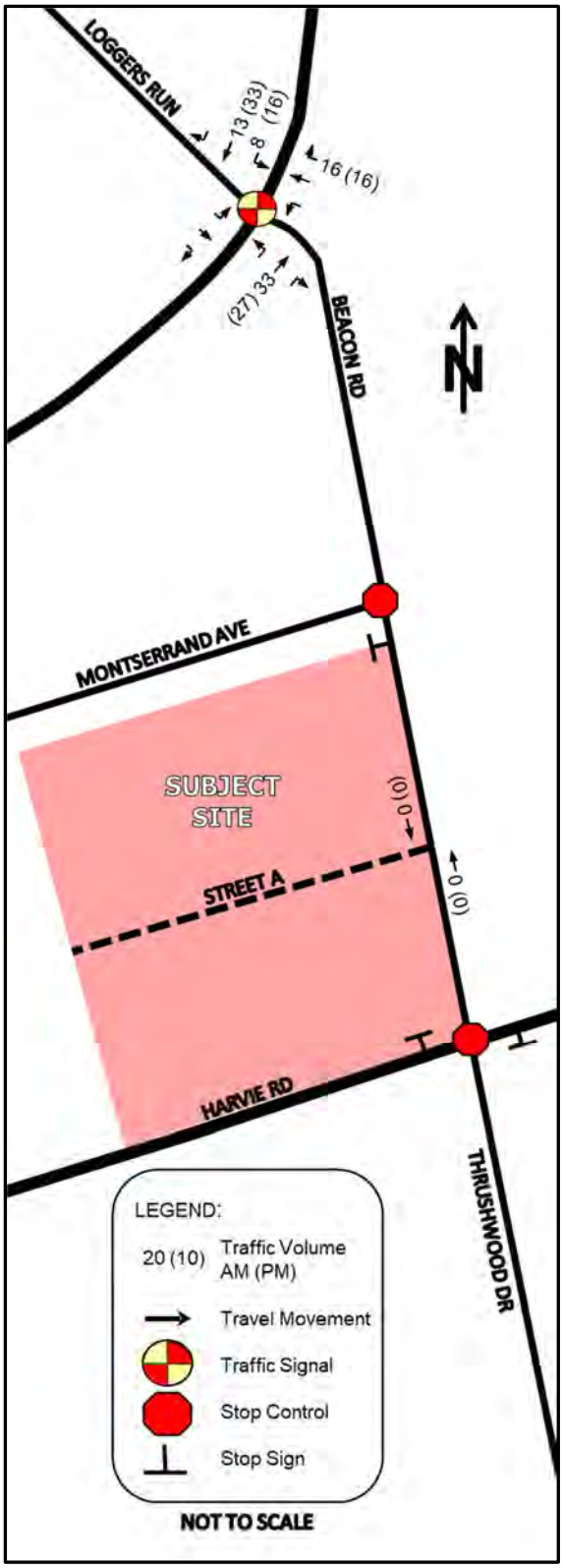


Figure 10 – Total Adjacent Development Traffic Volumes (2023)



2.5 Background Growth Rate

The background traffic growth rate applied in the 2021 / 2023 horizon year is based on the 2021 traffic projections from the City's Emme traffic model in the Multi-Modal Active Transportation Master Plan (dated January 2014) [2021 Emme Model] and the 2031 traffic projections from the City's Emme traffic model in the City's Transportation Master Plan (dated April 2019) [2031 Emme Model].

The background traffic growth rate applied to the 2031 / 2033 horizon year is based on the 2031 and 2041 traffic projections from the City's Emme traffic model in the City's Transportation Master Plan (dated April 2019) [2031 Emme Model] and [2041 Emme Model].

In addition to the variation in calculation of the background traffic growth rate noted above, the traffic volume for the 2021 / 2023 horizon years has been calculated using a different methodology than the traffic volume for the 2031 / 2033 horizon years. This is explained further in Section 2.7.

The methodology for calculating the background traffic growth rate for Pre-2031 and Post-2031 is provided below. The Pre-2031 background traffic growth rate is used for the 2021 / 2023 horizon year and the Post-2031 rate is used for the 2031 / 2033 horizon year.

2.5.1 Pre-2031 Background Traffic Growth

The background traffic growth rate for the 2021 / 2023 horizon years are based on the 2021 Emme Model and 2031 Emme Model. The background traffic growth rate calculated and applied is illustrated in **Table 8.**

Table 8 – Background Traffic Growth Rate in the Study Area (Pre-2031)

Street	Background Traffic Growth Rate Calculated		Background Traffic Growth Rate Applied	
	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
Essa Road	4.70%	2.96%	4.70%	2.96%

It is noted the Big Bay Point Overpass was assumed to be constructed in both the 2021 Emme Model and the 2031 Emme Model.

2.5.2 Post-2031 Background Traffic Growth

The background traffic growth rate for the 2031 / 2033 horizon year are based on the 2031 and 2041 traffic model.

The background traffic growth rate calculated and applied is illustrated in **Table 9.**

Table 9 – Background Traffic Growth Rate in the Study Area (Post-2031)

Street	Background Traffic Growth Rate Calculated		Background Traffic Growth Rate Applied	
	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
Essa Road	-2.56%	-3.88%	1.00%	1.00%

Although a negative background growth rate is anticipated on Essa Road between 2031 and 2041; for the purpose of this analysis, a conservative 1.00% background traffic growth rate has been applied to Essa Road for this period.

2.6 Traffic Counts

Detailed turning movement traffic and pedestrian counts were obtained from the City for the Essa Road / Beacon Road & Loggers Run intersection.

Table 10 summarizes the traffic count data collection information.

Table 10 – Traffic Count Data

Intersection (N-S Street / E-W Street)	Count Date	AM Peak Hour	PM Peak Hour	Source
Essa Road / Beacon Road & Loggers Run	Tuesday, November 27, 2018	08:00 – 09:00	16:00 – 17:00	City.

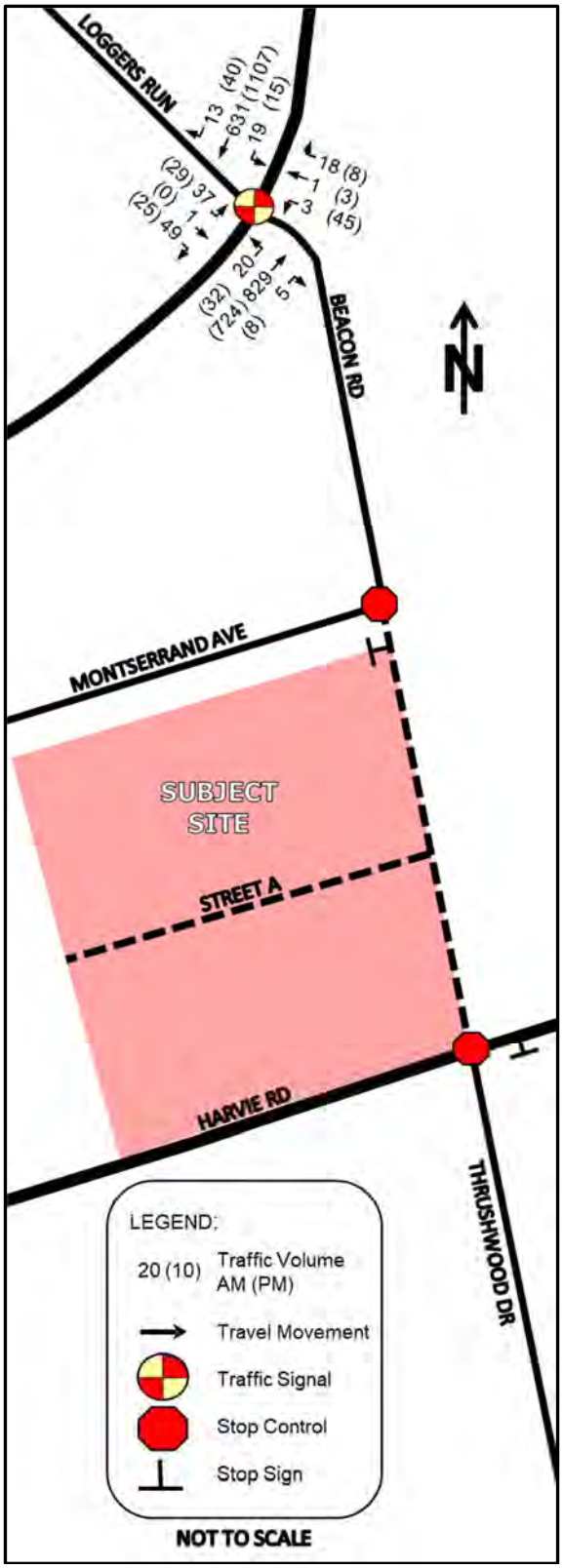
Detailed traffic count data can be found in **Appendix B**. The peak hours of traffic generation for the study area intersections generally aligned with the anticipated peak hour of traffic generation by the proposed development.

Heavy vehicle percentages from the traffic count data have also been included in the Synchro analysis.

The background traffic growth rates discussed in Section 2.5.1 has been applied to the traffic count data to estimate the existing (2021) horizon year traffic volumes.

Figure 11 illustrates the existing (2021) AM and PM peak hour traffic volumes within the study area.

Figure 11 – Existing (2021) Traffic Volumes



2.7 Horizon Year Traffic Volumes

Two different methodologies have been applied, to estimate the traffic volumes for the background (2023) and background (2031 & 2033) horizon years. The total 2023 traffic volume is based on the 2018 traffic counts, the background traffic growth rate outlined in section 2.5.2, and cut-through traffic calculated using traffic projections in the Harvie Road, Essa Road and Bryne Drive Environmental Study Report (Phases 3 and 4) (2017) [Harvie ESR]. The total (2031 & 2033) traffic volumes are based on the 2018 traffic counts, the background traffic growth rate outlined in Section 2.5.2 and cut-through traffic calculated using the 2031 Emme Model and the 2041 Emme Model.

The traffic generated by the adjacent developments are included in the long-term traffic projections provided in the City's Emme model. However, the exact timing for each development cannot be specifically identified in the City's Emme model. Consequently, the adjacent traffic volumes calculated in Section 2.4 have been added to the 2023 horizon year traffic, which is expected to result in a slightly conservative estimate of the traffic volume for that year. Since the long-term traffic projections provided in the City's Emme model includes the planned development in the area, the adjacent traffic calculated in Section 2.4 was not applied to the through traffic on Essa Road for the 2031 and 2033 horizon year scenarios.

2.7.1 Background 2023 Traffic Volumes

2.7.1.1 Essa Road / Beacon Road & Loggers Run

The background (2023) AM and PM peak hour traffic volumes at the Essa Road / Beacon Road & Loggers Run intersection was estimated by applying the background traffic growth rates (discussed in Section 2.5.1) to the existing (2021) traffic volumes, then adding the total adjacent development traffic assignment – 2023 (Figure 10).

As discussed in Section 5.6 traffic calming is recommended on Beacon Road to control cut-through traffic between Harvie Road and Essa Road. However, for the purpose of the traffic analysis completed in this report, we have conservatively assumed that there will be some cut-through traffic. This approach ensures that the analysis accounts for the most critical case. The traffic that would use the Beacon Road Extension was estimated using traffic data provided in the Harvie ESR. It is noted, the Harvie ESR did not assume the construction of the Beacon Road Extension. Utilizing the 2021 traffic projections[2] in the Harvie ESR (excerpts provided in **Appendix C**), we have assumed 10% of the westbound right and southbound left movements at the Veterans Drive / Harvie Road intersection would cut-through via the Beacon Road Extension. This traffic was added as westbound right and southbound left traffic at the Essa Road / Beacon Road & Loggers Run intersection[3].

2.7.1.2 Beacon Road / Street A

The background (2023) AM and PM peak hour traffic volumes at the Beacon Road / Street A intersection is based on the east leg traffic at the Essa Road / Beacon Road & Loggers Run intersection noted in Section 2.7.1.1. It is anticipated some traffic would be captured via the existing developments between the Essa Road / Beacon Road & Loggers Run and Beacon Road / Street A intersections;

[2] It is noted the 2021 traffic projections in the Harvie ESR includes the construction of the Big Bay Point Road Overpass and the Bryne Drive Extension. Furthermore, the Harvie ESR utilized two different traffic methodologies from other reports completed (Morrsion Hershfiled and Ainley Traffic Projections); the conservative (higher) traffic volume projections for each peak hour were applied in our analysis.

[3] A 2% background traffic growth rate has been applied to the 2021 traffic volumes in the Harvie ESR to estimate the 2023 volume for the noted movements.

however, we have conservatively assumed the traffic volume on Beacon Road at Street A would be the same as the traffic on Beacon Road at Essa Road.

It is anticipated upon construction of the Beacon Road Extension, additional traffic from the existing residential developments west of the Beacon Road / Montserrand Street intersection would travel via the Beacon Road Extension. It is assumed 39 semi-detached units currently on Montserrand Street would be redirected to use the Beacon Road Extension. The traffic generated by the semi-detached units were estimated based on the ITE Trip Generation Manual. The following ITE land use has been applied to estimate the traffic from the proposed development:

- ITE land use 210 (Single-Family Detached Housing) – General Urban / Suburban Setting

The percent of traffic redirected was assumed based on the residential traffic distribution illustrated in Table 1 in Section 2.4.2 and assigned east via Big Bay Point Overpass.

Figure 12 illustrates the background (2023) horizon year traffic volumes for the AM and PM peak hour, in the study area.

2.7.2 Background 2031 Traffic Volumes

2.7.2.1 Essa Road / Beacon Road & Loggers Run

The background (2031) AM and PM peak hour traffic volumes at the Essa Road / Beacon Road & Loggers Run intersection was estimated by modifying the 2018 traffic counts at this intersection to match the northbound and southbound traffic volumes on Essa Road, between Veteran's Drive and Beacon Road, in the 2031 Emme Traffic Model. The adjacent developments noted in Section 2.4 are included as intensification developments in the 2031 Emme Model traffic projections; consequently, the northbound and southbound through movements at the Essa Road / Beacon Road & Loggers Run (illustrated in Figure 10) was not added at the intersection.

The methodology noted in Section 2.7.1.1. has been used to calculate the traffic volume on Beacon Road and Loggers Run at Essa Road.

As discussed in Section 5.6 traffic calming is recommended on Beacon Road to control cut-through traffic between Harvie Road and Essa Road. However, for the purpose of the traffic analysis completed in this report, we have conservatively assumed that there will be some cut-through traffic. This approach ensures that the analysis accounts for the most critical case. The traffic that would use the Beacon Road Extension was estimated using same methodology outlined in Section 2.7.1.1, however, the traffic projections at the Harvie Road / Veteran's Drive intersection were based on the 2031 Emme Model, rather than the Harvie ESR, which was used in the 2023 traffic projection[4].

2.7.2.2 Beacon Road / Street A

The background (2031) AM and PM peak hour traffic volumes at the Beacon Road / Street A intersection is based on the east leg traffic at the Essa Road / Beacon Road & Loggers Run intersection noted in Section 2.7.2.1. It is anticipated some traffic would be captured via the existing developments between the Essa Road / Beacon Road & Loggers Run and Beacon Road / Street A intersections; however, we have conservatively assumed the traffic volume on Beacon Road at Street A would be the same as the traffic on Beacon Road at Essa Road.

[4] A background traffic growth rate of 6% and 4% has been applied on Harvie Road in the AM and PM peak hour, respectively to account for traffic growth on Harvie Road. These rates are based on the anticipated traffic growth on Harvie Road in the 2031 Emme Model and the 2041 Emme Model.

The additional traffic added from the existing developments west of the Beacon Road / Montserrand Street intersection will follow the same methodology noted in Section 2.7.1.2.

Figure 13 illustrates the background (2031) horizon year traffic volumes respectively, for the AM and PM peak hour traffic volumes in the study area.

2.7.3 Background 2033 Traffic Volumes

To determine the background (2033) traffic volumes, the background traffic growth rates discussed in Section 2.5.2 were applied to the background (2031) traffic volumes (in Section 2.7.2). The background traffic growth between 2031 and 2041 best reflect the future traffic projections in the background (2033) scenario.

Figure 14 illustrates the background (2033) horizon year traffic volumes respectively, for the AM and PM peak hour traffic volumes in the study area.

Figure 12 – Background (2023) Traffic Volumes

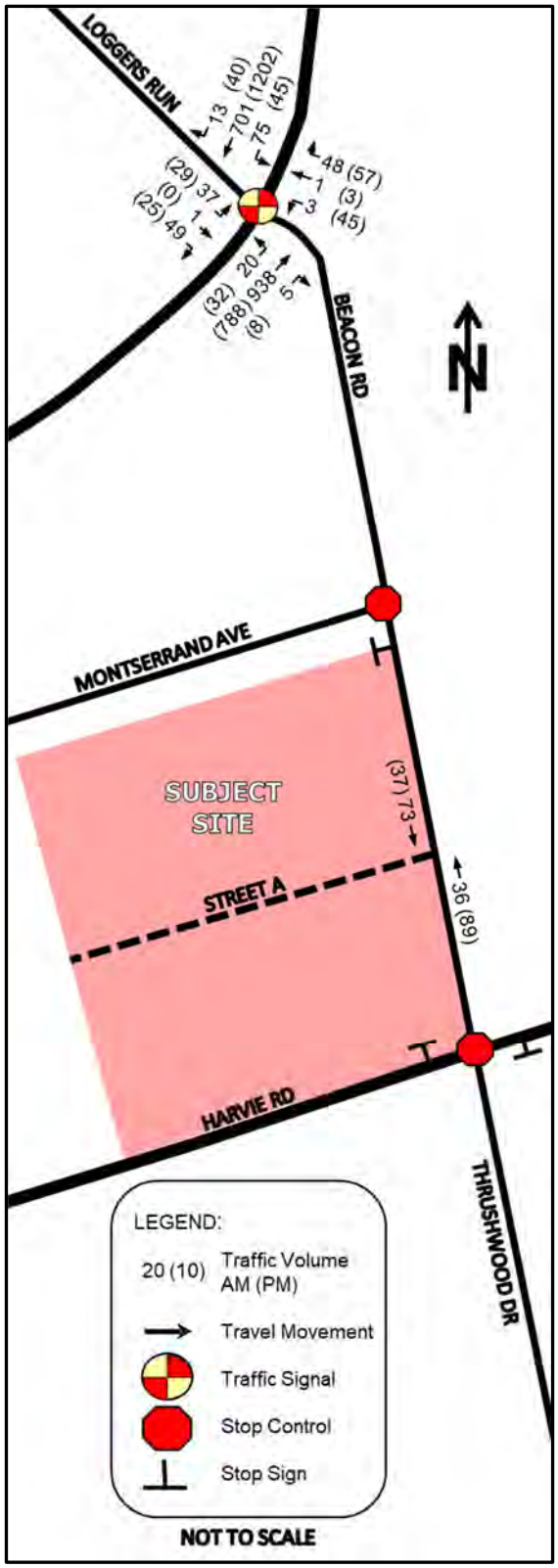


Figure 13 – Background (2031) Traffic Volumes

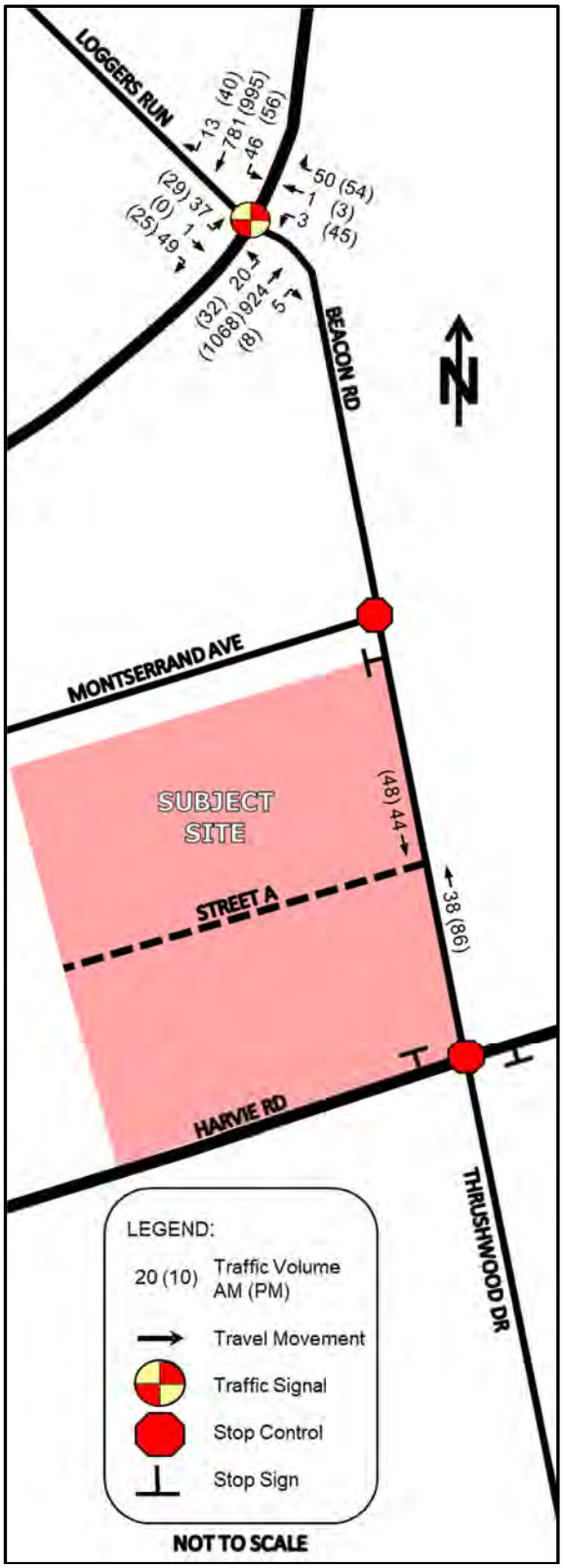
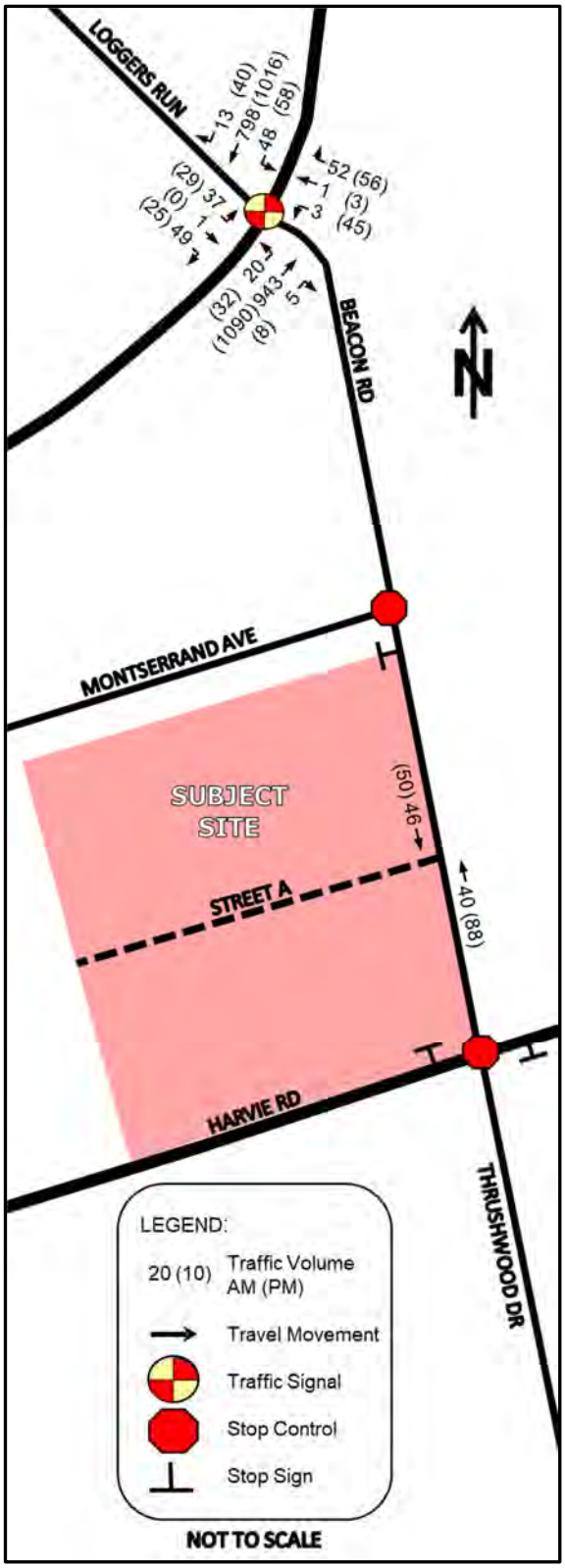


Figure 14 – Background (2033) Traffic Volumes



3 Intersection Operation without Proposed Development

3.1 Introduction

Intersection performance was measured using the traffic analysis software, Synchro 11, a deterministic model that employs Highway Capacity Manual and Intersection Capacity Utilization methodologies for analysing intersection operations. These procedures are accepted by provincial and municipal agencies throughout North America.

Synchro 11 enables the study area to be graphically defined in terms of streets and intersections, along with their geometric and traffic control characteristics. The user is able to evaluate both signalized and unsignalized intersections in relation to each other, thus not only providing level of service for the individual intersections, but also enabling an assessment of the impact the various intersections in a network have on each other in terms of spacing, traffic congestion, delay, and queuing.

The intersection operations were also evaluated in terms of the LOS. LOS is a common measure of the quality of performance at an intersection and is defined in terms of vehicular delay. This delay includes deceleration delay, queue move-up time, stopped delay, and acceleration delay. LOS is expressed on a scale of A through F, where LOS A represents very little delay (i.e. less than 10 seconds per vehicle) and LOS F represents very high delay (i.e. greater than 50 seconds per vehicle for a stop sign controlled intersection and greater than 80 seconds per vehicle for a signalized intersection).

The design limits outlined in the City's TIS Guidelines are highlighted in this report. At signalized intersections overall intersection operation exceeding LOS D and intersection and individual turning movements with a volume-to-capacity [V/C] ratio of 0.85 or greater are considered to be critical. At unsignalized intersections individual turning movements operating at LOS E or greater are considered to be critical movements. Values approaching these thresholds have been highlighted in the LOS tables.

The LOS criteria for signalized and stop sign controlled intersections are shown in **Table 11.** description of traffic performance characteristics is included for each LOS.

Table 11 – Level of Service Criteria for Intersections

LOS	LOS Description	Control Delay (seconds per vehicle)	
		Signalized Intersections	**Stop Controlled Intersections**
A	Very low delay; most vehicles do not stop (**Excellent**)	less than 10.0	less than 10.0
B	Higher delay; more vehicles stop (**Very Good**)	between 10.0 and 20.0	between 10.0 and 15.0
C	Higher level of congestion; number of vehicles stopping is significant, although many still pass through intersection without stopping **(Good**)	between 20.0 and 35.0	between 15.0 and 25.0
D	Congestion becomes noticeable; vehicles must sometimes wait through more than one red light; many vehicles stop (**Satisfactory**)	between 35.0 and 55.0	between 25.0 and 35.0
E	Vehicles must often wait through more than one red light; considered by many agencies to be the limit of **acceptable** delay	between 55.0 and 80.0	between 35.0 and 50.0
F	This level is considered to be unacceptable to most drivers; occurs when arrival flow rates exceed the capacity of the intersection (**Unacceptable**)	greater than 80.0	greater than 50.0

3.2 Existing (2021) Intersection Operation

The results of the LOS analysis under existing (2021) traffic volumes during the AM and PM peak hour can be found below in **Table 12**. Existing intersection geometry and traffic control have been utilized for this scenario. Detailed output of the Synchro analysis can be found in **Appendix E**.

Table 12 – Existing (2021) LOS

Location (N-S Street / E-W Street)	Weekday AM Peak Hour					Weekday PM Peak Hour				
	V/C	Delay (s)	LOS	95th Percentile Queue		V/C	Delay (s)	LOS	95th Percentile Queue	
				Model	Storage				Model	Storage
Essa Road / Loggers Run & Beacon Road (signalized)	0.37	6.7	A	-	-	0.48	7.4	A	-	-
EBL	0.40	49.2	D	18	12	0.30	47.5	D	15	12
EBTR	0.05	45.7	D	10	-	0.02	45.0	D	0	-
WBL	0.05	45.8	D	4	17	0.44	49.2	D	22	17
WBTR	0.02	45.5	D	7	-	0.03	45.1	D	6	-
NBL	0.04	2.2	A	2	TWLTL	0.11	3.4	A	4	TWLTL
NBTR	0.35	3.1	A	32	-	0.28	2.8	A	28	-
SBL	0.06	3.9	A	4	TWLTL	0.04	4.1	A	4	TWLTL
SBTR	0.30	4.8	A	38	-	0.49	6.7	A	81	-

The results of the LOS analysis indicate that the Essa Road / Loggers Run & Beacon Road intersection is operating within the typical design limits noted in Section 3.1.

The anticipated queue for the eastbound left and westbound left movements marginally exceeds the existing storage length; however, the existing taper length for each respective movement will accommodate the excess queue.

There are no issues regarding the anticipated queue for all other movements in the study area.

No other infrastructure improvements are recommended within the study area.

3.3 Background (2023) Intersection Operation

The results of the LOS analysis under background (2023) traffic volumes during the AM and PM peak hour can be found below in **Table 13**. Existing intersection geometry and traffic control have been utilized for this scenario. Detailed output of the Synchro analysis can be found in **Appendix F**.

Table 13 – Background (2023) LOS

Location (N-S Street / E-W Street)	Weekday AM Peak Hour					Weekday PM Peak Hour				
	V/C	Delay (s)	LOS	95th Percentile Queue		V/C	Delay (s)	LOS	95th Percentile Queue	
				Model	Storage				Model	Storage
Essa Road / Loggers Run & Beacon Road (signalized)	0.42	7.2	A	-	-	0.51	8.3	A	-	-
EBL	0.41	49.4	D	18	12	0.31	47.8	D	16	12
EBTR	0.05	45.7	D	10	-	0.02	45.0	D	0	-
WBL	0.05	45.8	D	4	17	0.44	49.2	D	22	17
WBTR	0.05	45.7	D	10	-	0.07	45.4	D	13	-
NBL	0.05	2.4	A	3	TWLTL	0.12	3.8	A	4	TWLTL
NBTR	0.40	3.3	A	38	-	0.30	2.9	A	31	-
SBL	0.26	6.1	A	14	TWLTL	0.11	4.7	A	9	TWLTL
SBTR	0.33	5.0	A	43	-	0.53	7.1	A	91	-

The results of the LOS analysis indicate that the Essa Road / Loggers Run & Beacon Road intersection is operating within the typical design limits noted in Section 3.1.

The anticipated queue for the eastbound left and westbound left movements marginally exceeds the existing storage length; however, the existing taper length for each respective movement will accommodate the excess queue.

There are no issues regarding the anticipated queue for all other movements in the study area.

No other infrastructure improvements are recommended within the study area.

3.4 Background (2031) Intersection Operation

The results of the LOS analysis under background (2031) traffic volumes during the AM and PM peak hour can be found below in **Table 14**. Existing intersection geometry and traffic control have been utilized for this scenario. Detailed output of the Synchro analysis can be found in **Appendix F**.

Table 14 – Background (2031) LOS

Location (N-S Street / E-W Street)	Weekday AM Peak Hour					Weekday PM Peak Hour				
	V/C	Delay (s)	LOS	95th Percentile Queue		V/C	Delay (s)	LOS	95th Percentile Queue	
				Model	Storage				Model	Storage
Essa Road / Loggers Run & Beacon Road (signalized)	0.41	7.3	A	-	-	0.44	7.6	A	-	-
EBL	0.41	49.4	D	18	12	0.31	47.8	D	16	12
EBTR	0.05	45.7	D	10	-	0.02	45.0	D	0	-
WBL	0.05	45.8	D	4	17	0.44	49.2	D	22	17
WBTR	0.05	45.7	D	10	-	0.06	45.4	D	13	-
NBL	0.05	2.4	A	3	TWLTL	0.09	3.0	A	4	TWLTL
NBTR	0.39	3.3	A	37	-	0.41	3.4	A	47	-
SBL	0.16	4.9	A	9	TWLTL	0.19	5.8	A	11	TWLTL
SBTR	0.37	5.2	A	49	-	0.44	6.3	A	70	-

The results of the LOS analysis indicate that the Essa Road / Loggers Run & Beacon Road intersection is operating within the typical design limits noted in Section 3.1.

The anticipated queue for the eastbound left and westbound left movements marginally exceeds the existing storage length; however, the existing taper length for each respective movement will accommodate the excess queue.

There are no issues regarding the anticipated queue for all other movements in the study area.

No other infrastructure improvements are recommended within the study area.

3.5 Background (2033) Intersection Operation

The results of the LOS analysis under background (2033) traffic volumes during the AM and PM peak hour can be found below in **Table 15**. Existing intersection geometry and traffic control have been utilized for this scenario. Detailed output of the Synchro analysis can be found in **Appendix F**.

Table 15 – Background (2033) LOS

Location (N-S Street / E-W Street)	Weekday AM Peak Hour					Weekday PM Peak Hour				
	V/C	Delay (s)	LOS	95th Percentile Queue		V/C	Delay (s)	LOS	95th Percentile Queue	
				Model	Storage				Model	Storage
Essa Road / Loggers Run & Beacon Road (signalized)	0.42	7.3	A	-	-	0.45	7.6	A	-	-
EBL	0.41	49.4	D	18	12	0.31	47.8	D	16	12
EBTR	0.05	45.7	D	10	-	0.02	45.0	D	0	-
WBL	0.05	45.8	D	4	17	0.44	49.2	D	22	17
WBTR	0.07	45.7	D	11	-	0.07	45.4	D	13	-
NBL	0.06	2.4	A	3	TWLTL	0.10	3.0	A	4	TWLTL
NBTR	0.40	3.3	A	38	-	0.42	3.5	A	48	-
SBL	0.17	5.0	A	9	TWLTL	0.20	5.9	A	12	TWLTL
SBTR	0.38	5.3	A	50	-	0.45	6.3	A	72	-

The results of the LOS analysis indicate that the Essa Road / Loggers Run & Beacon Road intersection is operating within the typical design limits noted in Section 3.1.

The anticipated queue for the eastbound left and westbound left movements marginally exceeds the existing storage length; however, the existing taper length for each respective movement will accommodate the excess queue.

There are no issues regarding the anticipated queue for all other movements in the study area.

No other infrastructure improvements are recommended within the study area.

4 Proposed Development Traffic Generation and Assignment

4.1 Traffic Generation

The traffic generation for the proposed development has been based on the ITE Trip Generation Manual. The following ITE land use has been applied to estimate the traffic from the proposed development:

- ITE land use 210 (Single-Family Detached Housing) – General Urban/Suburban Setting
- ITE land use 220 (Multifamily Housing (Low-Rise)) – General Urban / Suburban Setting
- ITE land use 221 (Multifamily Housing (Mid-Rise)) – General Urban / Suburban Setting

The estimated trip generation of the proposed development is illustrated below in **Table 16**. The AM and PM peak traffic generation for the proposed development is not expected to exactly align with the AM and PM peak hour in the traffic counts; consequently, we have applied the peak hour of adjacent street traffic values provided in the ITE Trip Generation Manual.

Table 16 - Estimated Traffic Generation Proposed Development

Land Use	Size	AM Peak Hour			PM Peak Hour		
		IN	OUT	TOTAL	IN	OUT	TOTAL
Single-Family Detached Housing ITE Land Use: 210	12 units	4	11	14	9	6	15
Multifamily Housing (Low-Rise) ITE Land Use: 220	65 units*	7	25	32	26	15	41
Multifamily Housing (Mid-Rise) ITE Land Use: 221	50 units*	5	13	18	14	9	23
TOTAL TRIP GENERATION		**16**	**49**	**65**	**49**	**30**	**79**

* The analysis is based on a previous version of the site plan which had a slightly different unit breakdown (64 freehold townhouse and 51 condominium units) which result in a slightly higher traffic generation. For the purposes of this report, we have not changed the traffic generation in the analysis to be conservative.

In order to be conservative, no transportation modal split has been applied to the above-noted traffic generation calculation.

4.2 Traffic Assignment

For the purposes of this study, it has been assumed that all traffic generated by the proposed development will be new traffic and would not be in the study area if the development was not constructed.

The traffic distribution for the proposed development will follow the residential traffic distribution illustrated in Table 1 in Section 2.4.2.

To be conservative, the proposed single detached units fronting the Beacon Road Extension were assumed as internal trips via Street A.

Using the traffic distributions pattern noted above, the traffic assignment for the proposed development was calculated for the AM and PM peak hour and is illustrated in **Figure 15**.

4.3 Total Horizon Year Traffic Volumes with the Proposed Development

For the total (2023, 2031 & 2033) horizon year traffic volumes, the proposed development traffic was added to the background (2023, 2031 & 2033) traffic volumes (methodology explained in Section 2.7). **Figures 16, 17** and **18** illustrate the resulting total (2023, 2031 & 2033) horizon year traffic volumes for the AM and PM peak hour.

Figure 15 – Proposed Development Traffic Assignment

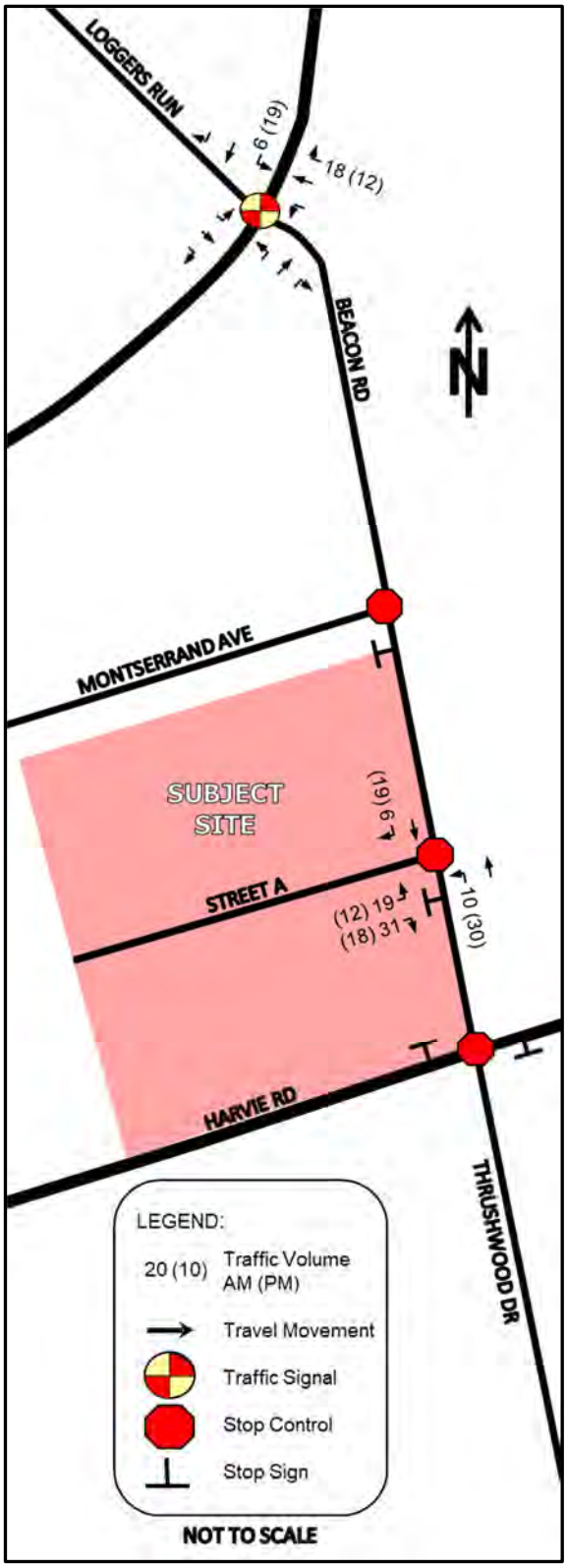


Figure 16 – Total (2023) Traffic Volumes

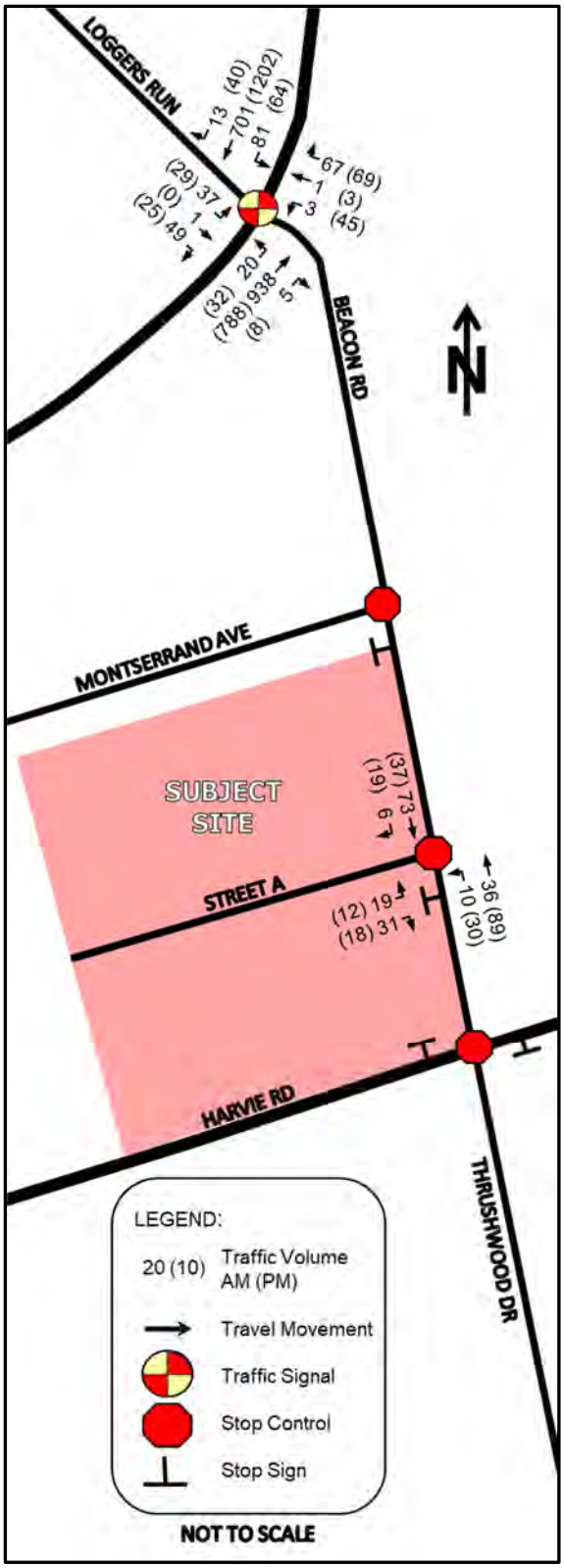


Figure 17 – Total (2031) Traffic Volumes

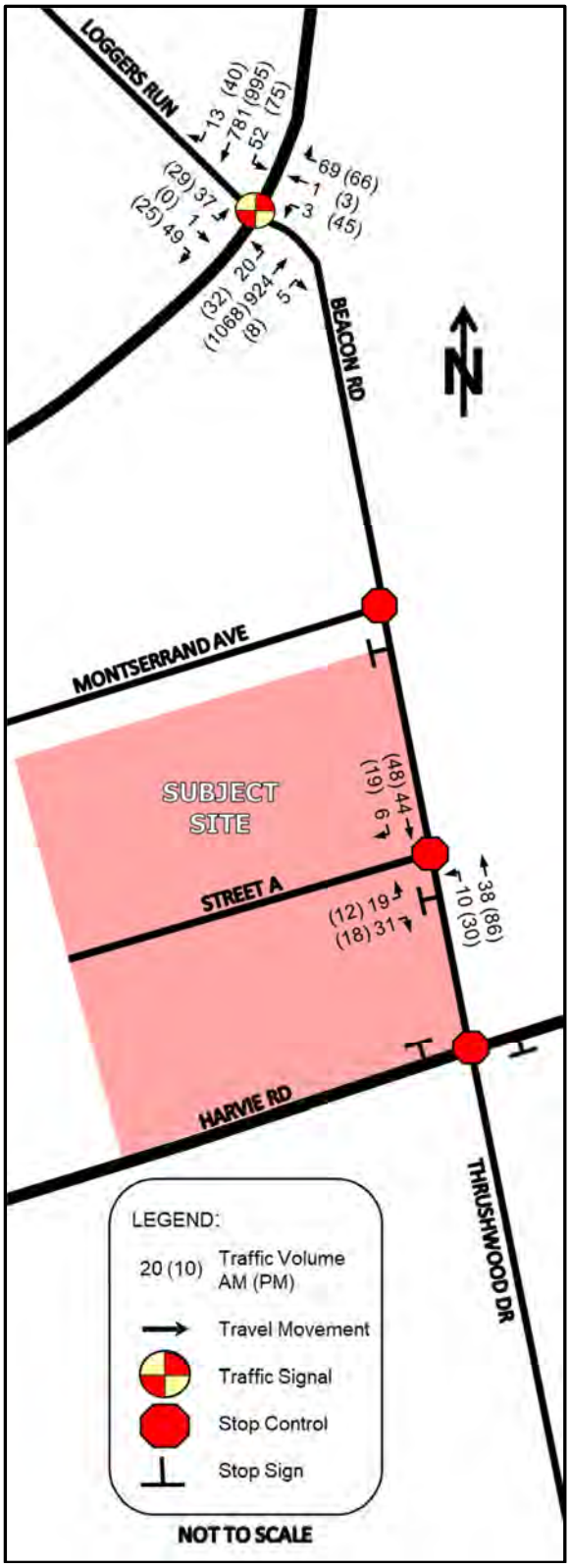
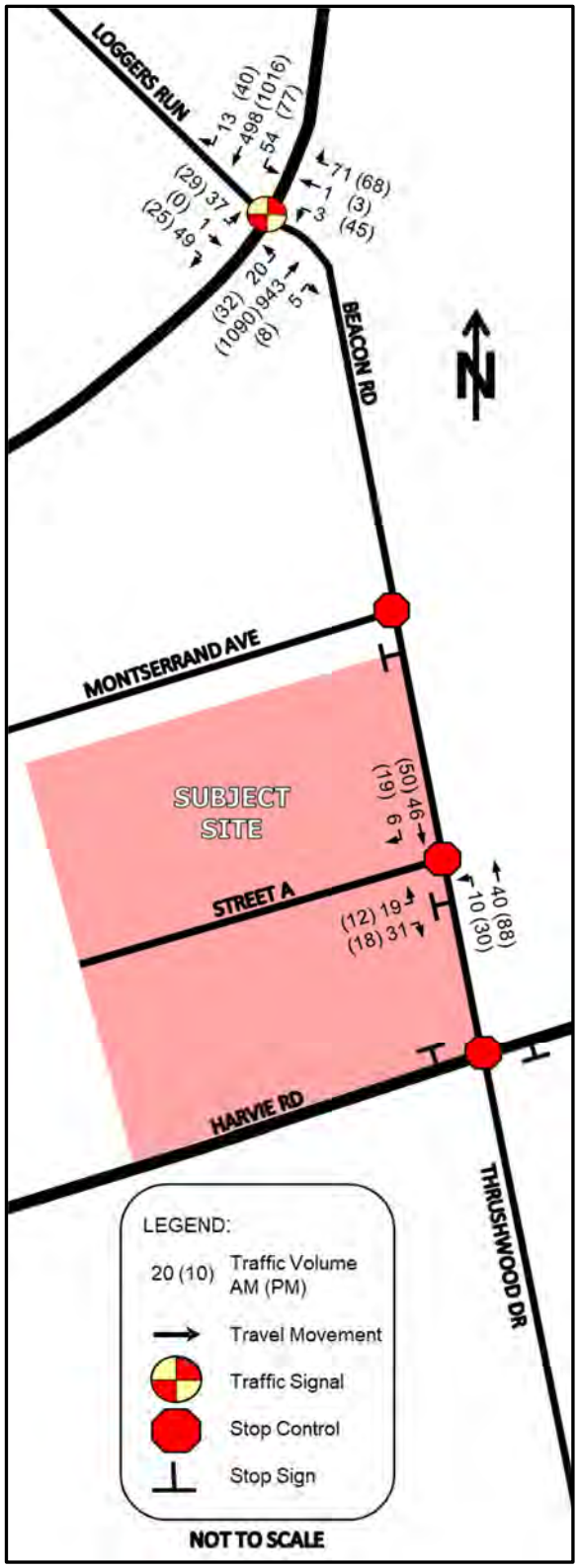


Figure 18 – Total (2033) Traffic Volumes



5 Intersection Operation with Proposed Development

5.1 Total (2023) Intersection Operation

The results of the LOS analysis under total (2023) traffic volumes during the AM and PM peak hour can be found below in **Table 17**. Existing intersection geometry and traffic control have been utilized for this scenario. Detailed output of the Synchro analysis can be found in **Appendix F**.

Table 17 – Total (2023) LOS

Location (N-S Street / E-W Street)	Weekday AM Peak Hour					Weekday PM Peak Hour				
	V/C	Delay (s)	LOS	95th Percentile Queue		V/C	Delay (s)	LOS	95th Percentile Queue	
				Model	Storage				Model	Storage
Essa Road / Loggers Run & Beacon Road (signalized)	0.42	7.6	A	-	-	0.51	8.5	A	-	-
EBL	0.42	49.6	D	18	12	0.31	47.8	D	16	12
EBTR	0.05	45.7	D	10	-	0.02	45.0	D	0	-
WBL	0.05	45.8	D	4	17	0.44	49.2	D	22	17
WBTR	0.06	45.8	D	12	-	0.08	45.4	D	14	-
NBL	0.05	2.3	A	3	TWLTL	0.12	3.8	A	4	TWLTL
NBTR	0.40	3.3	A	38	-	0.30	2.9	A	31	-
SBL	0.28	6.4	A	16	TWLTL	0.16	5.1	A	11	TWLTL
SBTR	0.33	5.0	A	43	-	0.53	7.1	A	91	-
Beacon Road / Street A (unsignalized)	-	3.1	A	-	-	-	2.5	A	-	-
EB	0.06	9.1	A	2	-	0.04	9.1	A	1	-

The results of the LOS analysis indicate that all study area intersections are operating within the typical design limits noted in Section 3.1.

The anticipated queue for the eastbound left and westbound left movements marginally exceeds the existing storage length; however, the existing taper length for each respective movement will accommodate the excess queue.

There are no issues regarding the anticipated queue for all other movements in the study area.

An analysis was completed for left turn movements at the Beacon Road / Street A intersection, based on the criteria outlined in Appendix 9A of the Ontario Ministry of Transportation Design Supplement for TAC Geometric Design Guide for Canadian Roads June 2017 [MTO DS]. Based off the above noted criteria a left-turn lane is not warranted at the Beacon Road / Street A intersection (results provided in **Appendix H**).

A review of the need for an auxiliary right turn lane at the unsignalized intersections in the study area was completed as part of our analysis. The results of the Synchro analysis indicate that there is excess capacity for all movements; consequently, auxiliary right turn lanes are not recommended.

Based on the Ontario Traffic Manual Book 12 *Signal Justification*, traffic signals are not warranted at the Beacon Road / Street A intersection (results are provided in **Appendix I**).

No other infrastructure improvements are recommended within the study area.

5.2 Total (2031) Intersection Operation

The results of the LOS analysis under total (2031) traffic volumes during the AM and PM peak hour can be found below in **Table 18**. Existing intersection geometry and traffic control have been utilized for this scenario. Detailed output of the Synchro analysis can be found in **Appendix G**.

Table 18 – Total (2031) LOS

Location (N-S Street / E-W Street)	Weekday AM Peak Hour					Weekday PM Peak Hour				
	V/C	Delay (s)	LOS	95th Percentile Queue		V/C	Delay (s)	LOS	95th Percentile Queue	
				Model	Storage				Model	Storage
Essa Road / Loggers Run & Beacon Road (signalized)	0.41	7.7	A	-	-	0.44	7.8	A	-	-
EBL	0.42	49.6	D	18	12	0.31	47.8	D	16	12
EBTR	0.05	45.7	D	10	-	0.02	45.0	D	0	-
WBL	0.05	45.8	D	4	17	0.44	49.2	D	22	17
WBTR	0.07	45.8	D	12	-	0.07	45.4	D	14	-
NBL	0.06	2.4	A	3	TWLTL	0.09	3.0	A	4	TWLTL
NBTR	0.39	3.3	A	37	-	0.41	3.4	A	47	-
SBL	0.18	5.1	A	10	TWLTL	0.25	6.6	A	15	TWLTL
SBTR	0.37	5.2	A	49	-	0.44	6.3	A	70	-
Beacon Road / Street A (unsignalized)	-	3.6	A	-	-	-	2.4	A	-	-
EB	0.06	9.0	A	2	-	0.04	9.2	A	1	-

The results of the LOS analysis indicate that all study area intersections are operating within the typical design limits noted in Section 3.1.

The anticipated queue for the eastbound left and westbound left movements marginally exceeds the existing storage length; however, the existing taper length for each respective movement will accommodate the excess queue.

There are no issues regarding the anticipated queue for all other movements in the study area.

An analysis was completed for left turn movements at the Beacon Road / Street A intersection, based on the criteria outlined in Appendix 9A of the MTO DS. Based off the above noted criteria a left-turn lane is not warranted at the Beacon Road / Street A intersection (results provided in **Appendix H**).

A review of the need for an auxiliary right turn lane at the unsignalized intersections in the study area was completed as part of our analysis. The results of the Synchro analysis indicate that there is excess capacity for all movements; consequently, auxiliary right turn lanes are not recommended.

Based on the Ontario Traffic Manual Book 12 *Signal Justification*, traffic signals are not warranted at at the Beacon Road / Street A intersection (results are provided in **Appendix I**).

No other infrastructure improvements are recommended within the study area.

5.3 Total (2033) Intersection Operation

The results of the LOS analysis under total (2023) traffic volumes during the AM and PM peak hour can be found below in **Table 19**. Existing intersection geometry and traffic control have been utilized for this scenario. Detailed output of the Synchro analysis can be found in **Appendix G**.

Table 19 – Total (2033) LOS

Location (N-S Street / E-W Street)	Weekday AM Peak Hour					Weekday PM Peak Hour				
	V/C	Delay (s)	LOS	95th Percentile Queue		V/C	Delay (s)	LOS	95th Percentile Queue	
				Model	Storage				Model	Storage
Essa Road / Loggers Run & Beacon Road (signalized)	0.42	7.7	A	-	-	0.45	7.8	A	-	-
EBL	0.42	49.6	D	18	12	0.31	47.8	D	16	12
EBTR	0.05	45.7	D	10	-	0.02	45.0	D	0	-
WBL	0.05	45.8	D	4	17	0.44	49.2	D	22	17
WBTR	0.07	45.8	D	12	-	0.07	45.4	D	14	-
NBL	0.06	2.4	A	3	TWLTL	0.10	3.0	A	4	TWLTL
NBTR	0.40	3.3	A	38	-	0.42	3.5	A	48	-
SBL	0.19	5.2	A	10	TWLTL	0.27	6.9	A	16	TWLTL
SBTR	0.38	5.3	A	50	-	0.45	6.3	A	72	-
Beacon Road / Street A (unsignalized)	-	3.5	A	-	-	-	2.4	A	-	-
EB	0.06	9.0	A	2	-	0.04	9.2	A	1	-

The results of the LOS analysis indicate that all study area intersections are operating within the typical design limits noted in Section 3.1.

The anticipated queue for the eastbound left and westbound left movements marginally exceeds the existing storage length; however, the existing taper length for each respective movement will accommodate the excess queue.

There are no issues regarding the anticipated queue for all other movements in the study area.

An analysis was completed for left turn movements at the Beacon Road / Street A intersection, based on the criteria outlined in Appendix 9A of the MTO DS. Based off the above noted criteria a left-turn lane is not warranted at the Beacon Road / Street A intersection (results provided in **Appendix H**).

A review of the need for an auxiliary right turn lane at the unsignalized intersections in the study area was completed as part of our analysis. The results of the Synchro analysis indicate that there is excess capacity for all movements; consequently, auxiliary right turn lanes are not recommended.

Based on the Ontario Traffic Manual Book 12 *Signal Justification*, traffic signals are not warranted at at the Beacon Road / Street A intersection (results are provided in **Appendix I**).

No other infrastructure improvements are recommended within the study area.

5.4 Site Access

Street A will operate efficiently as a full-movement access, with one-way stop control for eastbound movements. A single ingress and egress lane at Street A will provide the necessary capacity to service the proposed development.

Access A, Access B, Access C and Access D driveways will operate efficiently as full-movement access driveways, with two-way stop control for northbound and southbound traffic. A single ingress and egress lane at Access A, Access B, Access C and Access D driveways will provide the necessary capacity to service the proposed development.

The proposed spacing between Street A and Montserrand Street (136 metres – measured centre to centre of roadway) and between Street A and Harvie Road (90 metres – measured centre to centre of roadway) are greater than the minimum spacing between adjacent intersections on a local or collector road (60 metres) identified in Section 9.4.2.3 of the TAC *Design Guide for Canadian Roads* (2017) [TAC Guidelines].

The proposed spacing between Access A and Access B (44 metres – measured edge to edge of driveway), between Access B and Beacon Road (52 metres – measured edge of driveway to edge of roadway), between Access C and Access D (44 metres – measured edge to edge of driveway) and between Access D and Beacon Road (51 metres – measured edge of driveway to edge of roadway) is greater than the suggested minimum corner clearance requirements for an access driveway as identified in the TAC Guidelines – Figure 8.8.2 (Suggested Minimum Corner Clearances to Accesses or Public Lanes at Major Intersections) – 15 metres.

5.5 Sight Distance Review

A review of the available sight distance for the proposed site access driveways / roadways was completed as part of this analysis.

Based on a review of the sight distance triangles on the site plan, the sight distance north of Street A (greater than 140 metres), south of Street A (95 metres), east of Access A (101 metres) and east of Access C (101 metres) are greater than the stopping sight distance requirements as identified in the TAC Guidelines for a design speed of 60km/h (85 metres).

Based on a review of the sight distance triangles on the site plan, the sight distance east of Access B (51 metres) and east of Access D (51 metres) is less than the stopping sight distance requirements as identified in the TAC Guidelines for a design speed of 60km/h (85 metres); however, vehicles turning onto Street A will be travelling at much slower speeds, consequently, there are no issues with the sight distance east of Access B and Access D.

There are no issues with the sight distance available for the proposed access driveways and Beacon Road / Street A intersection.

Additional review will be required once vertical profiles are established for Beacon Road and Street A.

5.6 Beacon Road Traffic Calming

The construction of the Beacon Road Extension provides a new link between Harvie Road and Essa Road which provides an opportunity for cut-through traffic. In the long-term, with the Bryne Drive extension, the potential for cut-through traffic on Beacon Road is not expected to be an issue. This is based on our review of the surrounding road network, destinations and a review of the potential points of congestion. Regardless, it is recommended that traffic calming is incorporated in the design of the Beacon Road Extension to provide an additional deterrent for cut-though traffic.

It is recommended that a raised intersection is provided at the Street A / Beacon Road intersection. It is also recommended that the City consider installing another speed control device on Beacon Road, between Montserrand Street and Essa Road.

5.7 Beacon Road Extension & Thrushwood Drive / Harvie Road

As noted in Section 2.2, signalization is planned at the Beacon Road Extension & Thrushwood Drive / Harvie Road intersection. The City has installed electrical ducts in anticipation of signalization at the intersection and will be constructed upon the traffic volumes[5] meeting the signalization warrant based on Ontario Traffic Manual Book 12 *Signal Justification*.

A supplementary pedestrian crossing review will be completed at the Beacon Road Extension & Thrushwood Drive / Harvie Road intersection by JD Engineering in a letter by Fall 2021. Traffic counts will be completed at this intersection in September 2021. The pedestrian crossing review will assess traffic counts to be completed at the intersection to determine if a pedestrian crossing is recommended in the interim and at various stages of occupancy of the proposed development.

5.8 Active Transportation Review

As noted in Section 2.2, active transportation improvements on Harvie Road (between Essa Road and Fairview Road) have recently been completed and include the construction of sidewalks and buffered bike lanes on both sides of the road. This will connect to the existing in-boulevard pathway on the west side of Essa Road. Furthermore, the future construction of an in-boulevard pathway on Essa Road between Ferndale Drive South and Ardagh Road will further provide connections to the City's greater active transportation network.

The construction of Street A and the Beacon Road Extension will connect to the recently constructed active transportation improvements on Harvie Road. An internal sidewalk network at the access driveways and Street A will provide pedestrian connection onto the Beacon Road Extension. It is recommended the Beacon Road Extension include the construction of a sidewalk on the west side of the road, to provide pedestrian connection to the existing sidewalk network on Beacon Road and Harvie Road.

Painted bicycle lanes are recommended on Beacon Road to provide a cycling connection between Harvie Road and Essa Road.

5.9 Parking Review

The proposed parking supply for the subject site meets the parking requirements specified in the City's Zoning By-law 2009-141. The single detached units are anticipated to have tandem parking. The proposed parking breakdown is provided in **Table 20**.

Table 20 – Parking Statistics

Category	Zoning By-Law Section	Parking Standard	Size	Parking	
				Required	Provided
Single Detached	4.6.1	1.5 spaces per dwelling unit	12 units	18 spaces	24 spaces
Townhouse / Condo			115 units	173 spaces	184 spaces
TOTAL PARKING				191 spaces	208 spaces
Accessibility Parking	4.6.4	1 spaces plus 3% of required parking spaces	173 spaces	Type A: 3 spaces Type B: 3 spaces	Type A: 3 spaces Type B: 4 spaces

[5] The City will complete traffic counts at the intersection at a future time following the connection of Beacon Road to Harvie Road, when traffic patterns have adjusted.

5.10 Construction Parking

Based on our correspondence with the design team for this project, the Developer is committed to the following arrangement for construction parking:

The parking of construction vehicles and vehicles owned by staff and subcontractors employed by the Developer will be formally directed (in writing where possible) to avoid parking on municipal streets surrounding the subject site and avoid parking within private parking lots surrounding the subject site, without consent from the owner of the parking lots.

6 Transportation Demand Management

The following transportation demand management measures are recommended as part of the proposed development:

- Construct a sidewalk on the west side of the road at the Beacon Road Extension, providing an accessible pedestrian link between Harvie Road and Essa Road;
- Construction of painted bike lanes on Beacon Road Extension, providing a shortened cycling link between Harvie Road and Essa Road;
- The proposed development includes an internal sidewalk network at the access driveways and Street A to provide pedestrian connections to the proposed and existing sidewalk network on Beacon Road, Harvie Road and Essa Road; and
- Information packages will be distributed to new residents including transit and cycling maps.

7 Summary

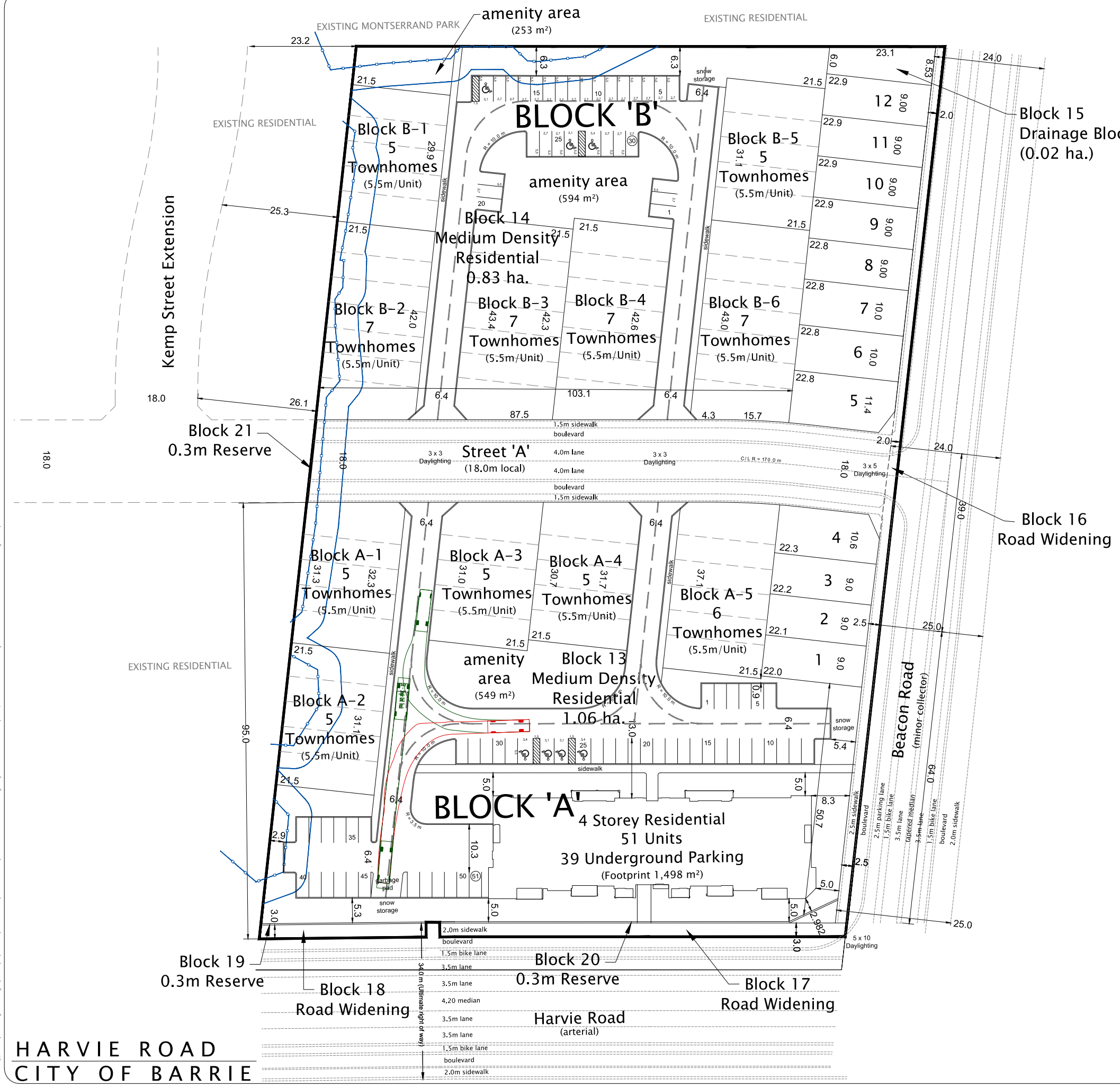
ASA Development Inc. retained **JD Engineering** to prepare this traffic impact study in support of the proposed development municipally known as 108, 116 & 122 Harvie Road, located at the northwest corner of the intersection of Harvie Road and Beacon Road, in the City of Barrie [City]. The proposed Site Plan is shown in **Appendix A**. This chapter summarizes the conclusions and recommendations from the study.

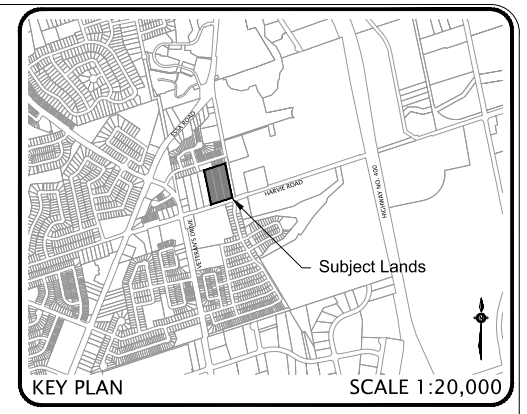
The proposed development is anticipated to consist of 12 freehold single detached units, 65 townhouse units and a four-storey condominium (50 units).

1. The proposed development is expected to generate a total of 65 AM and 79 PM peak hour trips.
2. Detailed turning movement traffic and pedestrian counts were commissioned by JD Engineering for the existing Essa Road / Beacon Road & Loggers Run intersection.
3. An estimate of the amount of traffic that would be generated by the proposed development was prepared and assigned to the study area streets and intersections.
4. An intersection operation analysis was completed at the study area intersections, using the existing (2021) and background (2023, 2031 & 2033) traffic volumes without the proposed development traffic. This enabled a review of existing and future traffic deficiencies that would be present without the influence of the proposed development. No geometric lane improvements or traffic signal improvements are recommended within the study area.
5. An estimate of the amount of traffic that would be generated by the Subject Site was prepared and assigned to the study area streets and intersections.

6. An intersection operation analysis was completed under total (2023, 2031 & 2033) traffic volumes with the proposed development operational at the study area intersections. No geometric lane improvements or traffic signal improvements are recommended within the study area.
7. Street A will operate efficiently as a full-movement access roadway with one-way stop control for eastbound movements. No lane improvements are recommended on Beacon Road at Street A. A single eastbound and westbound lane at Street A will provide the necessary capacity to service the proposed development.
8. The proposed Access A, Access B, Access C and Access D driveways will operate efficiently as full-movement driveways with two-way stop control for northbound and southbound traffic. A single lane for ingress and egress movements at the Access A, Access B, Access C and Access D driveways will provide the necessary capacity to convey the traffic volume generated by the proposed development.
9. There are no issues with the sight distance available for the proposed Access A, Access B, Access C and Access D driveways at Street A and the Street A intersection at the Beacon Road Extension. An additional review will be required once vertical profiles are established for Beacon Road and Street A.
10. It is recommended that a raised intersection is provided at the Street A / Beacon Road intersection. It is also recommended that the City consider installing another speed control device on Beacon Road, between Montserrand Street and Essa Road.
11. A supplementary pedestrian crossing review will be completed at the Beacon Road Extension & Thrushwood Drive / Harvie Road intersection by JD Engineering in a letter by Fall 2021. Traffic counts will be completed at this intersection in September 2021.
12. It is recommended that the Beacon Road Extension include the construction of a sidewalk on the west side of the road and painted bicycle lanes.
13. The proposed parking supply meets the parking required identified in the City's Zoning By-law 2009-141.
14. In summary, the proposed development will not cause any operational issues and will not add significant delay or congestion to the local roadway network.

Appendix A – Site Plan





Concept Plan

Surveyor's Real Property Report
Part 1 Plan of Survey of Lots 2, 3, 4, 5, 6 and 7
Registered Plan 1200 City of Barrie
(Geographic Township of Innisfil)
County of Simcoe
2021

PRELIMINARY
STATISTICS

Subject Lands Area	2.48 ha.
– Freehold Singles (1 – 12)	12 units
Condominium Block 'A' Area	1.06 ha.
– 4 Storey Residential	50 units
– Townhomes (A-1 – A-5)	27 units
Total Block 'A'	77 units
Condominium Block 'B' Area	0.83 ha.
– Townhomes (B-1 – B-6)	38 units
Total Block 'B'	38 units
Combined Total Units	127 units

R4 (Single Lots 1 – 12)	Required	Provided
Lot Area (min.)	335 m²	198 m² *
Lot Frontage (min.)	10.0 m	9.0 m *
Front Yard (min.)	4.5 m	5.5 m min.
Interior Side Yard	1.2 m	>0.6 m
Exterior Side Yard	3.0 m	2.0 m *
Rear Yard	7.0 m	3.2 m *
Lot Coverage (max)	45 %	<45 m²
Height (max.)	10.0 m	<10.0 m

RM2 Block A	Required	Provided
Lot Area (min.)	720 m²	1.06 ha.
Lot Frontage (min.)	21.0 m	50.7 m
Unit Frontage (min.)	4.5 m	5.5 m
Front Yard (min.)	7.0 m	5.0 m *
Exterior Side Yard	3.0 m	1.8 m *
Rear Yard	7.0 m	5.0 m *
Landscaped Area (min.)	35 %	>35 m²
Lot Coverage (max)	45 %	<45 m²
Gross Floor Area (max.)	60 %	60 %
Height (max.) – Townhome	10.0 m	<10 m
Height (max.) – Apartment	10.0 m	<13 m
Parking Setback	3.0 m	0.9 m *

RM2 Block B	Required	Provided
Lot Area (min.)	720 m²	0.83 ha.
Lot Frontage (min.)	21.0 m	103.1 m
Front Yard (min.)	4.5 m	2.0 m *
Interior Side Yard	1.8 m	5.0 m
Rear Yard	7.0 m	8.6 m
Landscaped Area (min.)	35 %	>35 m²
Lot Coverage (max)	45 %	<45 m²
Gross Floor Area (max.)	60 %	60 %
Height (max.)	10.0 m	<10 m

Private Amenity Calculations

Block 'A'		
12 m² / Unit (77 Units)	924 m²	1,770 m²
Amenity Area		549 m²
Private Lot Amenity		715 m²
Private Balcony Amenity		506 m²
Sub Total		1,770 m²

Block 'B'		
12 m² / Unit (38 Units)	456 m²	1,892 m²
Amenity Area		847 m²
Private Lot Amenity		1,045 m²
Sub Total		1,892 m²

Combined Totals ('A' & 'B')		
12 m² / Unit (115 Units)	1,380 m²	1,770 m²
Amenity Area		1,396 m²
Private Lot Amenity		1,760 m²
Private Balcony Amenity		506 m²
Sub Total		3,662 m²

Parking Calculations

Required Parking (1.5/Unit)

Freehold Singles	18 spaces	24 spaces
– 12 Driveway spaces		
– 12 Garage spaces		
24 Total Freehold spaces		
Block 'A' (77 units)	116 spaces	142 spaces
– 26 unit spaces		
– 26 unit garage spaces		
– 47 on street spaces		
– 4 on street barrier free spaces		
(2 @ Type A (3.4 m)		
(2 @ Type B (3.1 m)		
– 38 undergound typical spaces		
– 1 underground barrier free space		
142 Total spaces Block 'A'		
Block 'B' (38 units)	57 spaces	106 spaces
– 38 unit spaces		
– 38 unit garage spaces		
– 27 on street spaces		
– 3 Barrier Free Spaces		
(1 @ Type A (3.4 m)		
(2 @ Type B (3.1 m)		
106 Total spaces Block 'B'		
Total Required & Provided	191 spaces	272 spaces

Fire Route — — —

NOTE
* Indicates a zoning by-law amendment is required.

Tree Preservation Fence as per JD Bell Landscape Architect.
Tree Preservation Fence 5.0m Buffer Limit.

0 5 10 20 30M
SCALE 1 : 400 (A1)

HARVIE ROAD
CONCEPT PLAN

Raymond J. Dubanet
REGISTERED PROFESSIONAL PLANNER
R.P.P.

Date Issued:	AUG. 31, 2021
Checked By:	RD
Project No.:	ASA-20533
Drawn By:	m.c.r.
Drawing Name:	ASA-20533-CP-19.dwg

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PLANNERS & ENGINEERS
220 Maplecrow Drive East, Unit 1, Barrie, Ontario, L4N 0W5
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HARVIE ROAD
CITY OF BARRIE

Appendix B –
Traffic Count Data

Trans-Plan Transportation Inc.

Site ID Code:
Intersection Location: Essa Road at Loggers Run / Beacon Road
Municipality: Barrie, Ontario
Count Date: Tuesday, November 27, 2018
Weather and Temperature: Cloudy, -1 Degree
Surveyor: TP

AM	NORTH APPROACH											EAST APPROACH											SOUTH APPROACH											WEST APPROACH											Grand Total
	CAR			TRUCKS			CYCLISTS			Peds	Total	CAR			TRUCKS			CYCLISTS			Peds	Total	CAR			TRUCKS			CYCLISTS			Peds	Total	CAR			TRUCKS			CYCLISTS			Peds	Total	
	L	T	R	L	T	R	L	T	R			L	T	R	L	T	R	L	T	R			L	T	R	L	T	R	L	T	R			L	T	R	L	T	R	L	T	R			
7:00	10	0	5	0	0	0	0	0	0	2	17	2	82	2	0	3	0	0	0	0	0	89	0	0	3	0	0	0	0	0	0	0	3	1	112	0	0	2	0	0	0	0	0	115	224
7:15	9	0	5	0	0	0	0	0	0	1	15	3	87	3	0	0	0	0	0	0	0	93	0	0	2	0	0	0	0	0	0	0	2	4	129	0	1	4	0	0	0	0	3	141	251
7:30	12	0	8	1	0	1	0	0	0	0	22	5	105	4	0	6	0	0	0	0	0	120	1	1	1	0	1	0	0	0	0	1	5	5	156	0	0	8	1	0	0	0	0	170	317
7:45	11	0	13	0	0	1	0	0	0	0	25	6	145	1	0	7	0	0	0	0	0	159	0	0	5	0	0	0	0	0	0	2	7	3	160	1	1	3	0	0	0	0	4	172	363
8:00	7	0	7	0	0	0	0	0	0	1	15	4	127	4	0	4	0	0	0	0	0	139	0	0	3	0	0	1	0	0	0	0	4	4	154	1	0	1	0	0	0	0	5	165	323
8:15	8	0	15	0	0	1	0	0	0	0	24	7	149	3	0	5	0	0	0	0	0	164	0	0	4	0	0	0	0	0	0	1	5	5	162	1	0	1	0	0	0	0	2	171	364
8:30	13	0	14	0	1	0	0	0	0	0	28	3	110	5	0	6	0	0	0	0	0	124	2	1	4	1	0	0	0	0	0	0	8	8	214	2	0	6	0	0	0	0	0	230	390
8:45	9	0	12	0	0	0	0	0	0	0	21	5	140	1	0	6	0	0	0	0	0	152	0	0	5	0	0	1	0	0	0	0	6	3	178	1	0	3	0	0	0	0	3	188	367
MD																																													
11:00	6	0	4	0	0	0	0	0	0	0	10	4	152	7	0	5	0	0	0	0	1	169	3	0	3	0	0	1	0	0	0	0	7	3	107	1	0	3	0	0	0	0	0	114	300
11:15	7	0	6	1	0	0	0	0	0	1	15	3	145	6	0	6	0	0	1	0	0	161	1	0	1	0	0	0	0	0	0	0	2	8	118	0	0	2	0	0	0	0	2	130	308
11:30	6	0	4	0	0	0	0	0	0	3	13	3	157	8	0	5	0	0	0	0	0	173	0	0	7	0	0	0	0	0	0	0	7	8	144	1	0	2	0	0	0	0	0	155	348
11:45	6	0	10	0	0	0	0	0	0	3	19	8	159	8	0	4	0	0	0	0	0	179	1	0	6	0	0	0	0	0	0	1	8	7	129	2	0	4	0	0	0	0	3	145	351
12:00	4	0	1	0	0	0	0	0	0	1	6	6	142	9	0	5	0	0	0	0	0	162	2	1	7	0	0	0	0	0	0	0	10	7	128	2	0	5	0	0	0	0	0	142	320
12:15	5	0	4	0	0	0	0	0	0	0	9	6	138	2	0	1	0	0	0	0	0	147	2	1	7	0	0	0	0	0	0	1	11	12	119	1	0	3	0	0	0	0	2	137	304
12:30	7	0	9	0	0	0	0	0	0	0	16	5	156	5	0	5	0	0	0	0	0	171	1	0	2	0	0	1	0	0	0	0	4	6	138	1	0	5	0	0	0	0	0	150	341
12:45	10	0	9	0	0	0	0	0	0	1	20	9	135	5	1	2	0	0	0	0	2	154	1	1	13	1	0	0	0	0	0	0	16	1	164	2	0	5	0	0	0	0	1	173	363
13:00	8	0	4	0	0	0	0	0	0	1	13	7	154	8	0	1	0	0	0	0	1	171	1	0	3	0	0	0	0	0	0	2	6	4	124	3	0	8	0	0	0	0	1	140	330
13:15	10	0	6	0	0	0	0	0	0	0	16	3	135	7	0	5	0	0	0	0	1	151	0	0	9	0	0	0	0	0	0	2	11	7	140	0	0	4	0	0	0	0	0	151	329
13:30	7	0	3	0	0	0	0	0	0	0	10	4	144	5	0	3	0	0	0	0	0	156	1	0	3	0	0	0	0	0	0	0	4	5	143	0	0	4	0	0	0	0	1	153	323
13:45	6	0	6	1	0	0	0	0	0	0	13	4	149	6	0	4	1	0	0	0	1	165	3	0	4	0	0	0	0	0	0	1	8	5	168	3	0	6	0	0	0	0	0	182	368
PM																																													
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15:30	8	0	11	0	0	0	0	0	0	3	22	5	187	4	0	5	0	0	0	1	0	202	2	1	6	0	0	0	0	0	0	2	11	5	185	1	0	5	0	0	0	0	4	200	435
15:45	6	0	5	0	1	1	0	0	0	0	13	6	208	9	0	3	0	0	0	0	0	226	1	0	10	0	0	0	0	0	0	0	11	9	164	0	0	3	0	0	0	0	4	180	430
16:00	7	0	5	2	0	0	0	0	0	0	14	4	218	12	0	4	0	0	0	0	1	239	1	1	9	0	0	0	0	0	0	0	11	10	181	2	0	1	0	0	0	0	0	194	458
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16:45	7	0	4	0	0	0	0	0	0	0	11	4	252	8	0	2	0	0	0	0	0	266	2	2	14	0	0	2	0	0	0	0	20	9	163	4	0	1	1	0	0	0	3	181	478
17:00	8	0	6	0	0	1	0	0	0	0	15	6	220	12	0	3	1	0	0	0	1	243	2	3	19	0	0	0	0	0	0	0	24	10	133	2	0	1	0	0	0	0	0	146	428
17:15	5	0	2	0	0	0	0	0	0	3	10	10	235	8	0	1	0	0	0	0	0	254	3	6	44	0	0	1	0	0	0	0	54	4	99	25	0	0	0	0	0	0	0	128	446
17:30	8	3	3	0	0	0	0	0	0	1	15	32	183	18	0	1	0	0	0	0	0	234	0	5	40	0	0	0	0	0	0	0	45	8	108	23	0	2	0	0	0	0	1	142	436
17:45	9	3	1	0	0	0	0	0	0	0	13	14	176	13	0	1	0	0	0	0	0	204	0	10	48	0	0	1	0	0	0	0	59	11	160	9	0	2	0	0	0	0	3	185	461

TRANS-PLAN
transportation engineering

Turning Movement Count Diagram

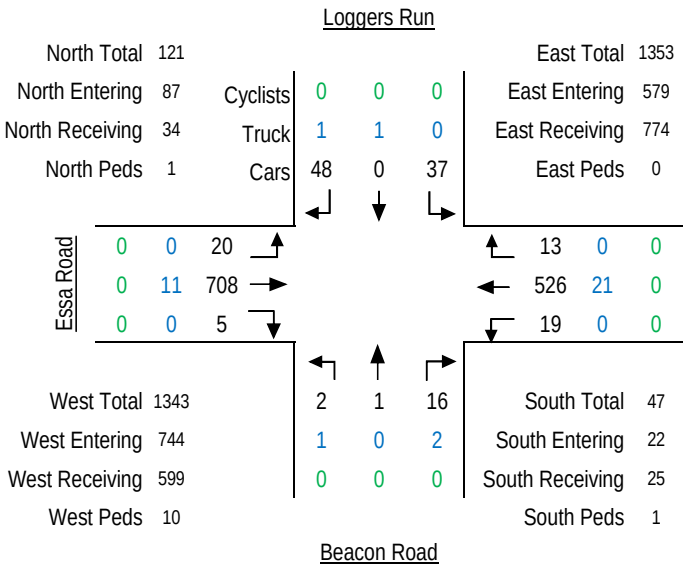
Intersection: Essa Road at Loggers Run / Beacon Road

Intersection ID:

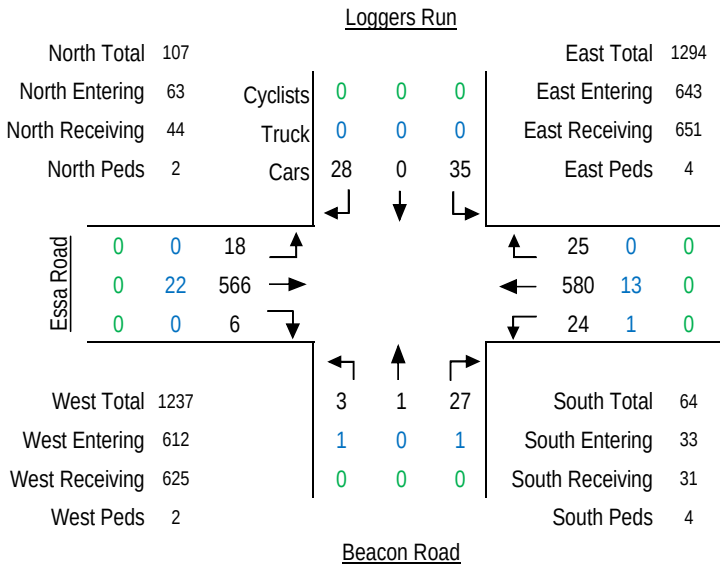
Municipality: Barrie, Ontario

Date: Tuesday, November 27, 2018

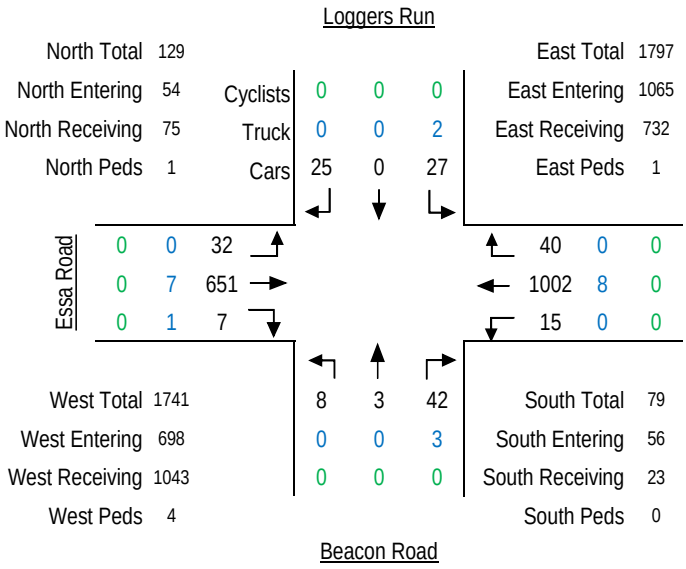
AM Peak Hour: 8:00 to 9:00



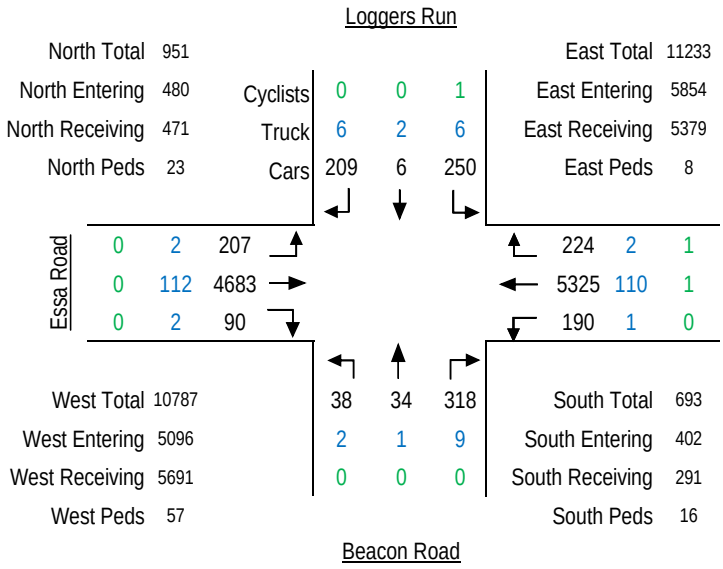
MD Peak Hour: 12:30 to 13:30



PM Peak Hour: 16:00 to 17:00



Total 8-Hour Count



THE CORPORATION OF THE CITY OF BARRIE

May 07, 2021 File: T07-SI

John Northcote
JD Engineering
86 Cumberland Street
Barrie, ON L4N 2P6

Dear Mr. Northcote,

RE: **Traffic Signal Timings**

With respect to your inquiry on March 16, 2021, attached are the Signal Timings for Essa Road & Beacon Road/ Loggers Run.

The intersection operates as a semi-actuated signalized intersection; meaning the signals remain green on the major road until a vehicle is detected on the minor road or a pedestrian pushes the pushbutton to activate the pedestrian phase.

Vehicles on the minor road are detected by electromagnetic wires, which are embedded in the pavement on the side street near the stop bar. Vehicle presence only on the side street would result in a possible green time of between the minimum and maximum times, as noted, depending on vehicle demand detected.

Pedestrians must push the pedestrian push button to be detected. Pedestrian “Walk” and “Flashing Don’t Walk” times on the side street, as noted, would be used in the event that the pedestrian push button was activated. Should there be no demand on the actuated phases; the signals would rest in a green indication for the main street.

If you require any further information please feel free to contact me at (705) 739-4220 ext. 4937.

Sincerely,

Stephen Salis, C.E.T.
Transportation Systems Technologist

Essa Road & Beacon Road/ Loggers Run

		Vehicular Indications				Pedestrian Indications	
Roadway	**Direction**	**Minimum Green**	**Maximum Green**	**Amber**	**All Red**	**Walk**	**Flashing Don't Walk**
Essa Road (main street)	Northbound	70	70	4	2	55	15
Essa Road (main street)	Southbound	70	70	4	2	55	15
Essa Road (main street)	Advanced Southbound Left Turn	7	7	3	1	N/A	N/A
Loggers Run (side street)	Eastbound	10	20	4	2	10	15
Beacon Road (side street)	Westbound	10	20	4	2	10	15

NOTE: All times are recorded in seconds, based on full demand.

Appendix C –
Hewitt ESR Excerpts

Appendix A
Transportation and Traffic Reports

2. A partial interchange with Highway 400 at Harvie Road / Big Bay Point Road to improve the operations of both the Essa Road and Mapleview Drive interchanges with Highway 400. The proposed interchange is subject to a future Class EA.
3. Connection of Bryne Drive, from south of Essa Road to north of Caplan Drive. The City is currently undertaking a Municipal Class EA for this Bryne Drive connection.

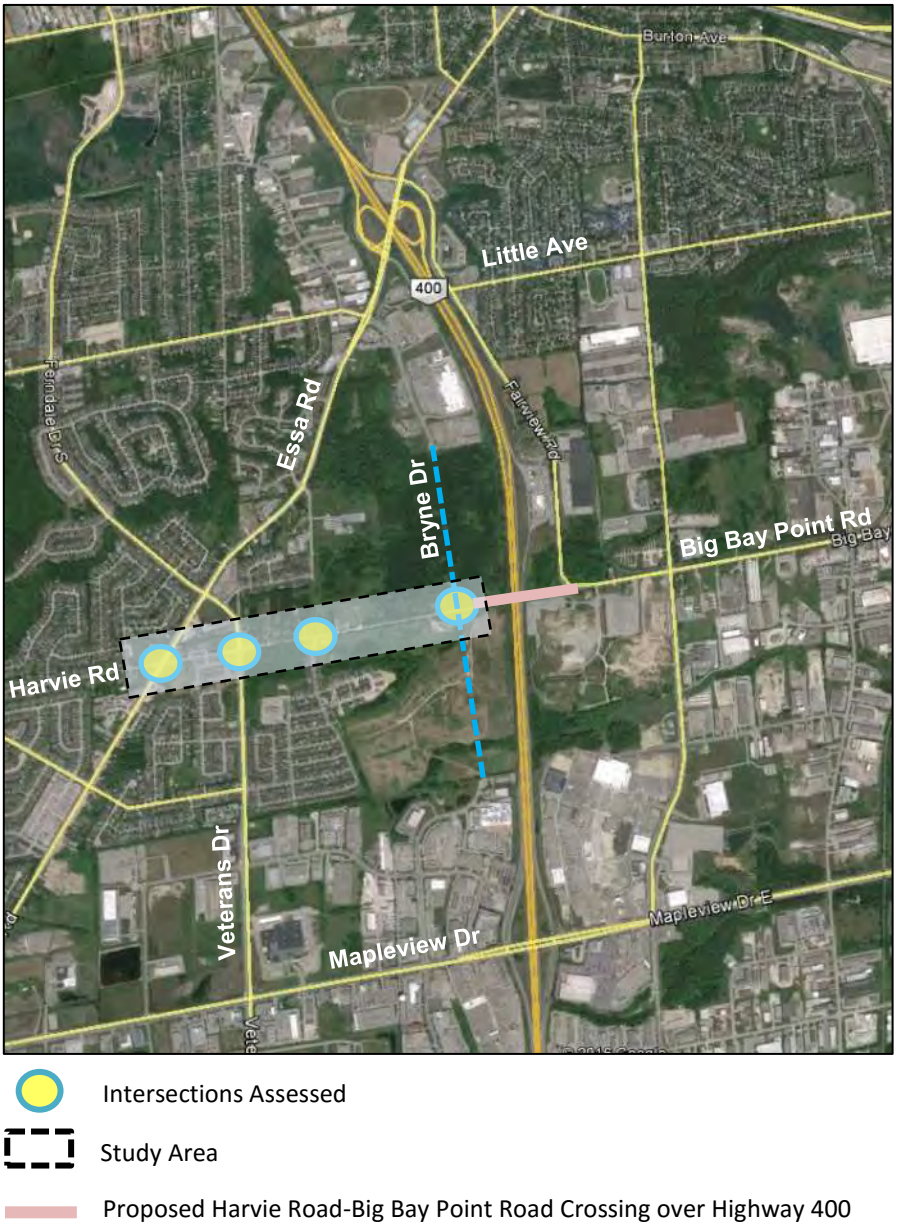


Figure 2-1: Study Area

2. The Harvie Road / Big Bay Point Road partial interchange with Highway 400. The MMATMP recommended that the interchange be constructed in the 2017-2021 timeframe.

3. The extension and widening of Bryne Drive from its current terminus south of Essa Road to north of Caplan Avenue. The MMATMP recommended that Bryne Drive be extended and widened in the 2013-2016 timeframe.

4.1.1 2021 Horizon Year

For the purposes of this study it was assumed that for the 2021 horizon year, the Harvie Road / Big Bay Point Road partial interchange with Highway 400 will not have been constructed yet. For the new intersection of Harvie Road and Bryne Drive, the traffic volume forecasts prepared as part of the Harvie / Big Bay Point crossing project (based on the Morrison Hershfield forecasts) as well as those in Ainley's Bryne Drive EA Study were used in the traffic analysis.

Based on the Morrison Hershfield's 2031 traffic volumes forecasts, 2021 volumes were derived assuming the following:

1. The Harvie Road / Big Bay Point Road crossing of Highway 400 is in place.

2. Bryne Drive is extended and widened from its current terminus south of Essa Road to north of Caplan Avenue.

3. The partial interchange at Highway 400 and Harvie Road is not in place. As highlighted in the traffic study for the Harvie Road / Big Bay Point Road crossing, the following adjustments were made to reflect anticipated travel patterns without the interchange:

    a. The southbound right turning movements from Highway 400 N-E/W Off-ramp were removed from entering Harvie Road/Big Bay Point Road. This resulted in reduced westbound through movements at the intersection of Harvie Road and Bryne Drive.

    b. The northbound left turning movements from Highway 400 S-E/W Off-ramp were removed from entering Harvie Road/Big Bay Point Road. This resulted in reduced westbound through movements at the intersection of Harvie Road and Bryne Drive.

    c. The eastbound right turns on the E/W-S On-Ramp were removed by a combined reduction of traffic from the westbound through, northbound right and southbound left turns at the intersection of Harvie Road and Bryne Drive.

    d. Predicted traffic volumes without the interchange were estimated to be approximately half of what they would be if the interchange was in place.

A comparison of the forecasted traffic volumes for the 2021 (without interchange) from the adjusted Morrison Hershfield forecast and from the Ainley Forecast is presented in **Figures 4-1** and **4-2**.

4.1.2 2031 Horizon Year

For the 2031 horizon year, the traffic volumes at the new intersection of Bryne Drive and Harvie Road were extracted from the previously completed Harvie Road / Big Bay Point Road

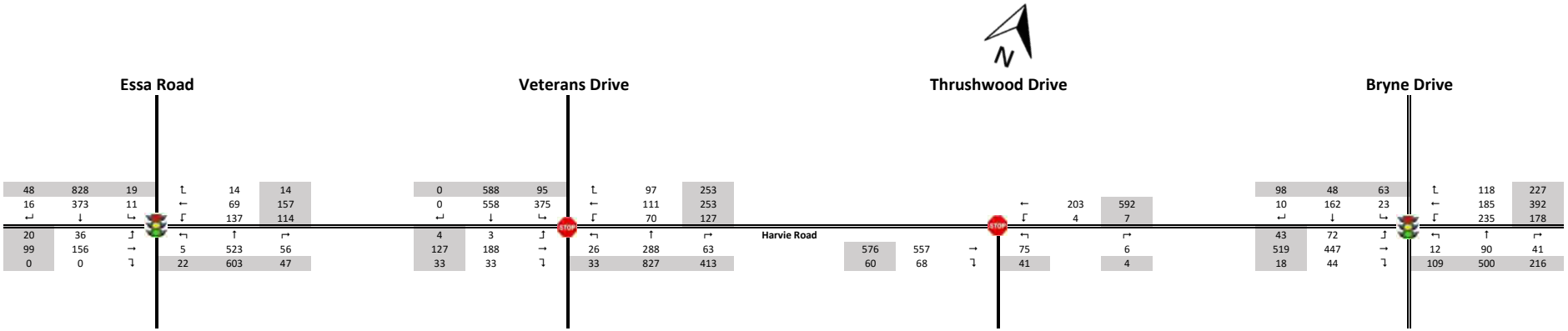


Figure 4-1: 2021 Morrison Hershfield's Forecasted Traffic Volumes (without Interchange)

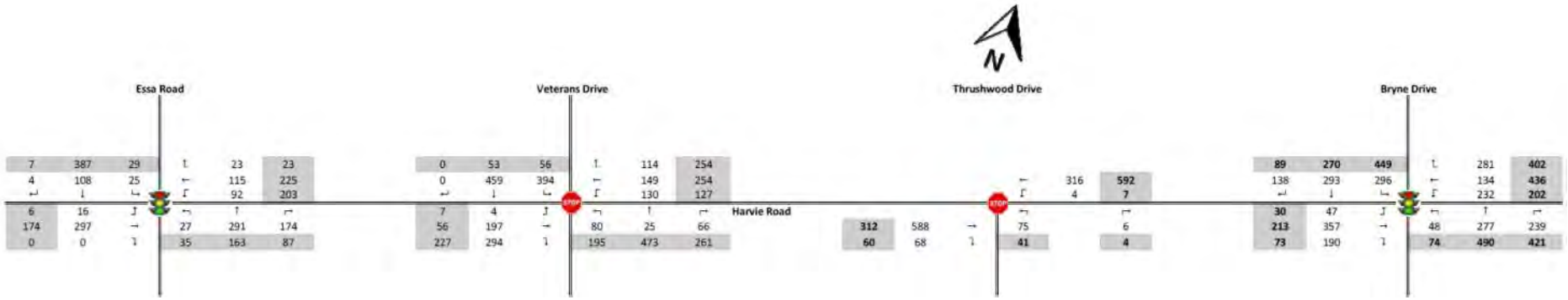


Figure 4-2: 2021 Ainley's Forecasted Traffic Volumes (without Interchange)

Appendix D –
Transportation Tomorrow Survey - Excerpt

Mon Jun 28 2021 16:18:58 GMT-0400 (Eastern Daylight Time) - Run Time: 2051ms Cross Tabulation Query Form - Trip - 2016 v1.1 Row: Planning district of destination - pd_dest Column: 2006 GTA zone of household - gta06_hhld Filters: (2006 GTA zone of household - gta06_hhld In 8523, 8524); and (Start time of trip - start_time In 700 - 900); and (Trip purpose of destination - purp_dest In W, R) Trip 2016 ROW : pd_dest COLUMN : gta06_hhld	Mon Jun 28 2021 16:22:15 GMT-0400 (Eastern Daylight Time) - Run Time: 2147ms Cross Tabulation Query Form - Trip - 2016 v1.1 Row: 2006 GTA zone of household - gta06_hhld Column: 2006 GTA zone of destination - gta06_dest Filters: (2006 GTA zone of destination - gta06_dest In 8523, 8524); and (Start time of trip - start_time In 700 - 900); (Trip purpose of destination - purp_dest In W, R); and (Planning district of destination - pd_dest In 81)

TTS Cross Tabulation

Cross Tabulation Query Form - Trip - 2016 v1.1

Filter Variables

Planning district of desti... × | 2006 GTA zone of hous... × | (Optional) Table Attribute

Group Attributes

Row Grouping | Column Grouping | Table Grouping

Grouping file: Choose File No file chosen

Filter Selection +

2006 GTA zone of household | In

8523, 8524

And

Start time of trip | In

700 - 900

And

Trip purpose of destination | In

W, R

Add Delete

Output

Comma-delimited table | Column format | Expansion Factor On | Click to Select Load | Load

Execute Query | Select All | Save As

```
Thu Sep 23 2021 11:10:34 GMT-0400 (Eastern Daylight Time) - Run Time: 2315ms

Cross Tabulation Query Form - Trip - 2016 v1.1

Row: Planning district of destination - pd_dest
Column: 2006 GTA zone of household - gta06_hhld


Filters:
2006 GTA zone of household - gta06_hhld In 8523, 8524
and
Start time of trip - start_time In 700 - 900
and
Trip purpose of destination - purp_dest In W, R

Trip 2016
Table:

,8523,8524
PD 1 of Toronto,7,0
PD 3 of Toronto,0,26
PD 4 of Toronto,68,0
PD 5 of Toronto,39,0
PD 9 of Toronto,65,0
PD 10 of Toronto,24,0
Newmarket,97,22
Richmond Hill,83,0
Markham,29,0
King,40,0
Vaughan,129,0
Brampton,6,0
Mississauga,22,46
Halton Hills,8,0
Barrie,1533,128
Innisfil,25,0
Bradford-West Gwillimbury,29,22
New Tecumseth,174,0
Essa,62,41
Springwater,150,0
Muskoka,10,0
Collingwood,50,0
Oro-Medonte,40,0
Orillia,48,26
```

TTS Cross Tabulation

Cross Tabulation Query Form - Trip - 2016 v1.1

Filter Variables

2006 GTA zone of desti... | 2006 GTA zone of hous... | (Optional) Table Attribute

Group Attributes

Row Grouping | Column Grouping | Table Grouping

Grouping file: Choose File No file chosen

Filter Selection +

2006 GTA zone of household | In

8523, 8524

And

Start time of trip | In

700 - 900

And

Trip purpose of destination | In

W, R

And

Planning district of destination | In

81

Add Delete

Output

Comma-delimited table | Column format | Expansion Factor On | Click to Select Load | Load

Execute Query | Select All | Save As

```
Thu Sep 23 2021 11:11:41 GMT-0400 (Eastern Daylight Time) - Run Time: 1837ms

Cross Tabulation Query Form - Trip - 2016 v1.1

Row: 2006 GTA zone of destination - gta06_dest
Column: 2006 GTA zone of household - gta06_hhld


Filters:
2006 GTA zone of household - gta06_hhld In 8523, 8524
and
Start time of trip - start_time In 700 - 900
and
Trip purpose of destination - purp_dest In W, R
and
Planning district of destination - pd_dest In 81

Trip 2016
Table:

,8523,8524
8501,88,0
8502,14,0
8504,36,0
8506,37,0
8508,24,0
8509,89,0
8510,142,0
8511,32,0
8514,19,26
8515,7,0
8517,9,0
8520,48,0
8521,112,59
8523,105,0
8524,249,21
8526,10,0
8527,431,22
8528,21,0
8529,20,0
8530,21,0
8532,17,0
```

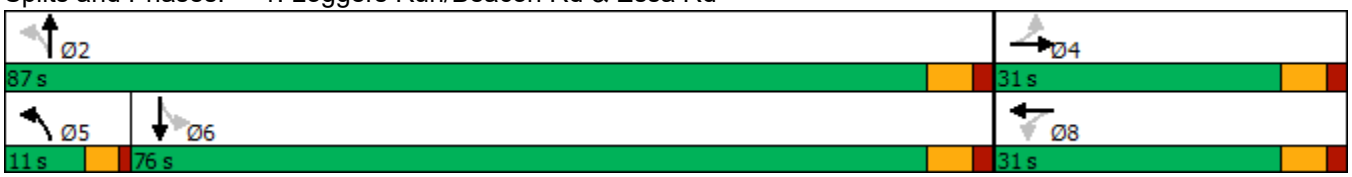
Appendix E –
Synchro Analysis Output –
Existing Traffic Volumes

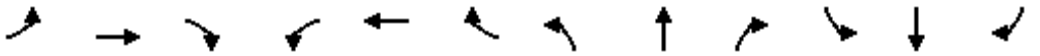
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	37	1	3	1	20	829	19	631
Future Volume (vph)	37	1	3	1	20	829	19	631
Lane Group Flow (vph)	45	61	4	23	24	1017	23	786
Turn Type	Perm	NA	Perm	NA	pm+pt	NA	Perm	NA
Protected Phases		4		8	5	2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	5	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	7.0	70.0	70.0	70.0
Minimum Split (s)	31.0	31.0	31.0	31.0	11.0	76.0	76.0	76.0
Total Split (s)	31.0	31.0	31.0	31.0	11.0	87.0	76.0	76.0
Total Split (%)	26.3%	26.3%	26.3%	26.3%	9.3%	73.7%	64.4%	64.4%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	4.0	6.0	6.0	6.0
Lead/Lag					Lead		Lag	Lag
Lead-Lag Optimize?					Yes		Yes	Yes
Recall Mode	None	None	None	None	None	Max	Max	Max
v/c Ratio	0.31	0.29	0.04	0.14	0.04	0.34	0.05	0.29
Control Delay	49.4	15.6	42.7	19.5	2.3	3.3	5.5	5.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	49.4	15.6	42.7	19.5	2.3	3.3	5.5	5.0
Queue Length 50th (m)	8.6	0.2	0.7	0.2	0.7	25.3	0.8	18.0
Queue Length 95th (m)	17.6	9.9	3.6	6.6	2.0	31.4	3.9	37.1
Internal Link Dist (m)		266.7		536.9		367.6		358.1
Turn Bay Length (m)	12.0		17.0		18.0		20.0	
Base Capacity (vph)	344	418	247	377	606	2953	424	2743
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.13	0.15	0.02	0.06	0.04	0.34	0.05	0.29

Intersection Summary

Cycle Length: 118
Actuated Cycle Length: 103.2
Natural Cycle: 120
Control Type: Semi Act-Uncoord

Splits and Phases: 1: Loggers Run/Beacon Rd & Essa Rd





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	37	1	49	3	1	18	20	829	5	19	631	13
Future Volume (vph)	37	1	49	3	1	18	20	829	5	19	631	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		4.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.98		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		0.99	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	0.86		1.00	1.00		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1825	1542		1356	1489		1825	3575		1825	3500	
Flt Permitted	0.74	1.00		0.72	1.00		0.33	1.00		0.28	1.00	
Satd. Flow (perm)	1426	1542		1024	1489		631	3575		541	3500	
Peak-hour factor, PHF	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Adj. Flow (vph)	45	1	60	4	1	22	24	1011	6	23	770	16
RTOR Reduction (vph)	0	55	0	0	20	0	0	0	0	0	1	0
Lane Group Flow (vph)	45	6	0	4	3	0	24	1017	0	23	785	0
Confl. Peds. (#/hr)			10	10			1		1	1		1
Heavy Vehicles (%)	0%	100%	2%	33%	0%	11%	0%	2%	0%	0%	4%	0%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	8.4	8.4		8.4	8.4		86.5	86.5		79.7	79.7	
Effective Green, g (s)	8.4	8.4		8.4	8.4		86.5	86.5		79.7	79.7	
Actuated g/C Ratio	0.08	0.08		0.08	0.08		0.81	0.81		0.75	0.75	
Clearance Time (s)	6.0	6.0		6.0	6.0		4.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	112	121		80	117		541	2892		403	2609	
v/s Ratio Prot		0.00			0.00		0.00	c0.28			0.22	
v/s Ratio Perm	c0.03			0.00			0.03			0.04		
v/c Ratio	0.40	0.05		0.05	0.02		0.04	0.35		0.06	0.30	
Uniform Delay, d1	46.9	45.5		45.6	45.5		2.2	2.7		3.6	4.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.4	0.2		0.3	0.1		0.0	0.3		0.3	0.3	
Delay (s)	49.2	45.7		45.8	45.5		2.2	3.1		3.9	4.8	
Level of Service	D	D		D	D		A	A		A	A	
Approach Delay (s)		47.2			45.6			3.0			4.7	
Approach LOS		D			D			A			A	

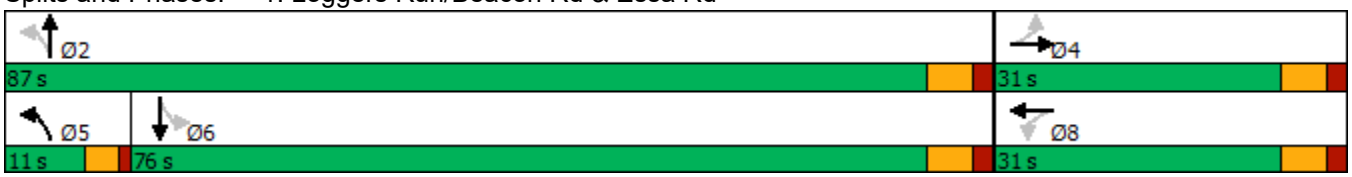
Intersection Summary			
HCM 2000 Control Delay	6.7	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.37		
Actuated Cycle Length (s)	106.9	Sum of lost time (s)	16.0
Intersection Capacity Utilization	80.5%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	29	0	45	3	32	724	15	1107
Future Volume (vph)	29	0	45	3	32	724	15	1107
Lane Group Flow (vph)	32	28	50	12	36	813	17	1274
Turn Type	Perm	NA	Perm	NA	pm+pt	NA	Perm	NA
Protected Phases		4		8	5	2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	5	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	7.0	70.0	70.0	70.0
Minimum Split (s)	31.0	31.0	31.0	31.0	11.0	76.0	76.0	76.0
Total Split (s)	31.0	31.0	31.0	31.0	11.0	87.0	76.0	76.0
Total Split (%)	26.3%	26.3%	26.3%	26.3%	9.3%	73.7%	64.4%	64.4%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	4.0	6.0	6.0	6.0
Lead/Lag					Lead		Lag	Lag
Lead-Lag Optimize?					Yes		Yes	Yes
Recall Mode	None	None	None	None	None	Max	Max	Max
v/c Ratio	0.23	0.09	0.34	0.07	0.09	0.27	0.03	0.47
Control Delay	47.1	0.6	50.2	26.8	2.7	3.1	6.0	7.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	47.1	0.6	50.2	26.8	2.7	3.1	6.0	7.3
Queue Length 50th (m)	6.0	0.0	9.5	0.6	1.1	18.6	1.0	59.0
Queue Length 95th (m)	15.0	0.0	21.1	6.0	3.1	27.8	3.5	80.2
Internal Link Dist (m)		266.7		536.9		367.6		358.1
Turn Bay Length (m)	12.0		17.0		18.0		20.0	
Base Capacity (vph)	325	509	341	394	384	2969	504	2736
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.06	0.15	0.03	0.09	0.27	0.03	0.47

Intersection Summary
Cycle Length: 118
Actuated Cycle Length: 103.4
Natural Cycle: 120
Control Type: Semi Act-Uncoord

Splits and Phases: 1: Loggers Run/Beacon Rd & Essa Rd



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	29	0	25	45	3	8	32	724	8	15	1107	40
Future Volume (vph)	29	0	25	45	3	8	32	724	8	15	1107	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		4.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.98		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	0.89		1.00	1.00		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1704	1605		1816	1604		1825	3603		1825	3594	
Flt Permitted	0.75	1.00		0.74	1.00		0.18	1.00		0.34	1.00	
Satd. Flow (perm)	1344	1605		1413	1604		341	3603		663	3594	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	32	0	28	50	3	9	36	804	9	17	1230	44
RTOR Reduction (vph)	0	26	0	0	8	0	0	0	0	0	1	0
Lane Group Flow (vph)	32	2	0	50	4	0	36	813	0	17	1273	0
Confl. Peds. (#/hr)	1		4	4		1	1					1
Heavy Vehicles (%)	7%	0%	0%	0%	0%	7%	0%	1%	13%	0%	1%	0%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	8.6	8.6		8.6	8.6		85.7	85.7		77.5	77.5	
Effective Green, g (s)	8.6	8.6		8.6	8.6		85.7	85.7		77.5	77.5	
Actuated g/C Ratio	0.08	0.08		0.08	0.08		0.81	0.81		0.73	0.73	
Clearance Time (s)	6.0	6.0		6.0	6.0		4.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	108	129		114	129		333	2904		483	2620	
v/s Ratio Prot		0.00			0.00		0.00	c0.23			c0.35	
v/s Ratio Perm	0.02			c0.04			0.08			0.03		
v/c Ratio	0.30	0.02		0.44	0.03		0.11	0.28		0.04	0.49	
Uniform Delay, d1	46.0	45.0		46.5	45.0		3.2	2.6		4.0	6.0	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.5	0.1		2.7	0.1		0.1	0.2		0.1	0.6	
Delay (s)	47.5	45.0		49.2	45.1		3.4	2.8		4.1	6.7	
Level of Service	D	D		D	D		A	A		A	A	
Approach Delay (s)		46.4			48.4			2.8			6.7	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	7.4	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.48		
Actuated Cycle Length (s)	106.3	Sum of lost time (s)	16.0
Intersection Capacity Utilization	78.2%	ICU Level of Service	D
Analysis Period (min)	15		

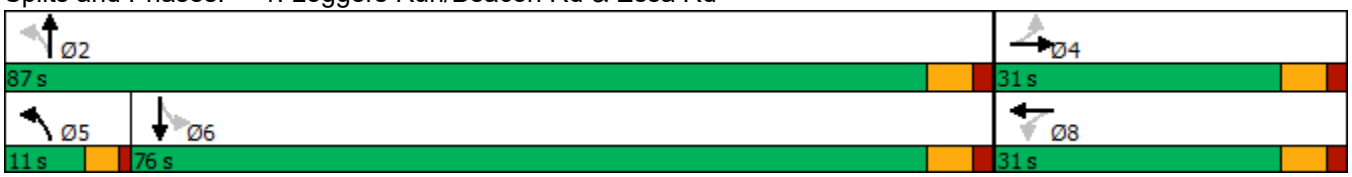
c Critical Lane Group

Appendix F –
Synchro Analysis Output –
Background Traffic Volumes

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	37	1	3	1	20	938	75	701
Future Volume (vph)	37	1	3	1	20	938	75	701
Lane Group Flow (vph)	45	61	4	60	24	1150	91	871
Turn Type	Perm	NA	Perm	NA	pm+pt	NA	Perm	NA
Protected Phases		4		8	5	2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	5	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	7.0	70.0	70.0	70.0
Minimum Split (s)	31.0	31.0	31.0	31.0	11.0	76.0	76.0	76.0
Total Split (s)	31.0	31.0	31.0	31.0	11.0	87.0	76.0	76.0
Total Split (%)	26.3%	26.3%	26.3%	26.3%	9.3%	73.7%	64.4%	64.4%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	4.0	6.0	6.0	6.0
Lead/Lag					Lead		Lag	Lag
Lead-Lag Optimize?					Yes		Yes	Yes
Recall Mode	None	None	None	None	None	Max	Max	Max
v/c Ratio	0.32	0.29	0.04	0.30	0.04	0.39	0.25	0.32
Control Delay	49.8	15.5	42.7	15.9	2.4	3.6	7.6	5.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	49.8	15.5	42.7	15.9	2.4	3.6	7.6	5.2
Queue Length 50th (m)	8.6	0.2	0.7	0.2	0.7	30.2	3.8	20.5
Queue Length 95th (m)	17.5	9.9	3.6	9.7	2.1	37.4	13.6	42.2
Internal Link Dist (m)		266.7		536.9		367.6		358.1
Turn Bay Length (m)	12.0		17.0		18.0		20.0	
Base Capacity (vph)	333	418	247	402	559	2950	371	2742
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.15	0.02	0.15	0.04	0.39	0.25	0.32

Intersection Summary
Cycle Length: 118
Actuated Cycle Length: 103.3
Natural Cycle: 120
Control Type: Semi Act-Uncoord

Splits and Phases: 1: Loggers Run/Beacon Rd & Essa Rd



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	37	1	49	3	1	48	20	938	5	75	701	13
Future Volume (vph)	37	1	49	3	1	48	20	938	5	75	701	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		4.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.98		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		0.99	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	0.85		1.00	1.00		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1825	1542		1356	1478		1825	3576		1825	3501	
Flt Permitted	0.72	1.00		0.72	1.00		0.30	1.00		0.25	1.00	
Satd. Flow (perm)	1379	1542		1024	1478		571	3576		474	3501	
Peak-hour factor, PHF	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Adj. Flow (vph)	45	1	60	4	1	59	24	1144	6	91	855	16
RTOR Reduction (vph)	0	55	0	0	54	0	0	0	0	0	1	0
Lane Group Flow (vph)	45	6	0	4	6	0	24	1150	0	91	870	0
Confl. Peds. (#/hr)			10	10			1		1	1		1
Heavy Vehicles (%)	0%	100%	2%	33%	0%	11%	0%	2%	0%	0%	4%	0%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	8.5	8.5		8.5	8.5		86.5	86.5		79.7	79.7	
Effective Green, g (s)	8.5	8.5		8.5	8.5		86.5	86.5		79.7	79.7	
Actuated g/C Ratio	0.08	0.08		0.08	0.08		0.81	0.81		0.74	0.74	
Clearance Time (s)	6.0	6.0		6.0	6.0		4.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	109	122		81	117		494	2890		353	2607	
v/s Ratio Prot		0.00			0.00		0.00	c0.32			0.25	
v/s Ratio Perm	c0.03			0.00			0.04			0.19		
v/c Ratio	0.41	0.05		0.05	0.05		0.05	0.40		0.26	0.33	
Uniform Delay, d1	46.9	45.5		45.5	45.5		2.3	2.9		4.3	4.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.5	0.2		0.3	0.2		0.0	0.4		1.8	0.3	
Delay (s)	49.4	45.7		45.8	45.7		2.3	3.3		6.1	5.0	
Level of Service	D	D		D	D		A	A		A	A	
Approach Delay (s)		47.3			45.7			3.3			5.1	
Approach LOS		D			D			A			A	

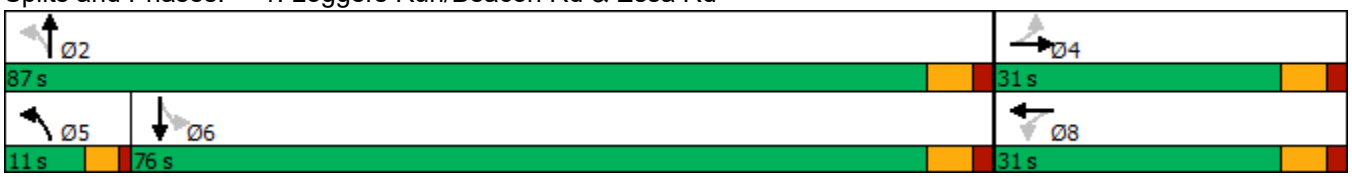
Intersection Summary			
HCM 2000 Control Delay	7.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	107.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	84.5%	ICU Level of Service	E
Analysis Period (min)	15		

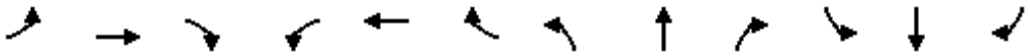
c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	29	0	45	3	32	788	45	1202
Future Volume (vph)	29	0	45	3	32	788	45	1202
Lane Group Flow (vph)	32	28	50	66	36	885	50	1380
Turn Type	Perm	NA	Perm	NA	pm+pt	NA	Perm	NA
Protected Phases		4		8	5	2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	5	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	7.0	70.0	70.0	70.0
Minimum Split (s)	31.0	31.0	31.0	31.0	11.0	76.0	76.0	76.0
Total Split (s)	31.0	31.0	31.0	31.0	11.0	87.0	76.0	76.0
Total Split (%)	26.3%	26.3%	26.3%	26.3%	9.3%	73.7%	64.4%	64.4%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	4.0	6.0	6.0	6.0
Lead/Lag					Lead		Lag	Lag
Lead-Lag Optimize?					Yes		Yes	Yes
Recall Mode	None	None	None	None	None	Max	Max	Max
v/c Ratio	0.24	0.09	0.34	0.31	0.10	0.30	0.11	0.50
Control Delay	47.7	0.6	50.2	16.1	2.8	3.2	6.6	7.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	47.7	0.6	50.2	16.1	2.8	3.2	6.6	7.7
Queue Length 50th (m)	6.0	0.0	9.5	0.6	1.1	20.8	3.1	66.8
Queue Length 95th (m)	15.1	0.0	21.1	12.9	3.1	30.9	8.1	90.8
Internal Link Dist (m)		266.7		536.9		367.6		358.1
Turn Bay Length (m)	12.0		17.0		18.0		20.0	
Base Capacity (vph)	309	499	341	416	349	2969	469	2736
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.06	0.15	0.16	0.10	0.30	0.11	0.50

Intersection Summary
Cycle Length: 118
Actuated Cycle Length: 103.4
Natural Cycle: 120
Control Type: Semi Act-Uncoord

Splits and Phases: 1: Loggers Run/Beacon Rd & Essa Rd





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	29	0	25	45	3	57	32	788	8	45	1202	40
Future Volume (vph)	29	0	25	45	3	57	32	788	8	45	1202	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		4.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.98		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	0.86		1.00	1.00		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1704	1605		1816	1523		1825	3604		1825	3595	
Flt Permitted	0.71	1.00		0.74	1.00		0.15	1.00		0.32	1.00	
Satd. Flow (perm)	1280	1605		1413	1523		295	3604		617	3595	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	32	0	28	50	3	63	36	876	9	50	1336	44
RTOR Reduction (vph)	0	26	0	0	58	0	0	0	0	0	1	0
Lane Group Flow (vph)	32	2	0	50	8	0	36	885	0	50	1379	0
Confl. Peds. (#/hr)	1		4	4		1	1					1
Heavy Vehicles (%)	7%	0%	0%	0%	0%	7%	0%	1%	13%	0%	1%	0%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	8.6	8.6		8.6	8.6		85.7	85.7		77.5	77.5	
Effective Green, g (s)	8.6	8.6		8.6	8.6		85.7	85.7		77.5	77.5	
Actuated g/C Ratio	0.08	0.08		0.08	0.08		0.81	0.81		0.73	0.73	
Clearance Time (s)	6.0	6.0		6.0	6.0		4.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	103	129		114	123		298	2905		449	2621	
v/s Ratio Prot		0.00			0.01		0.00	c0.25			c0.38	
v/s Ratio Perm	0.02			c0.04			0.09			0.08		
v/c Ratio	0.31	0.02		0.44	0.07		0.12	0.30		0.11	0.53	
Uniform Delay, d1	46.1	45.0		46.5	45.1		3.6	2.6		4.2	6.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.7	0.1		2.7	0.2		0.2	0.3		0.5	0.8	
Delay (s)	47.8	45.0		49.2	45.4		3.8	2.9		4.7	7.1	
Level of Service	D	D		D	D		A	A		A	A	
Approach Delay (s)		46.5			47.0			3.0			7.0	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	8.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	106.3	Sum of lost time (s)	16.0
Intersection Capacity Utilization	78.2%	ICU Level of Service	D
Analysis Period (min)	15		

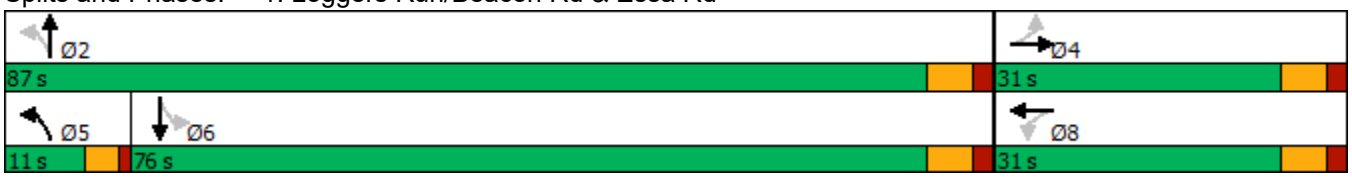
c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	37	1	3	1	20	924	46	781
Future Volume (vph)	37	1	3	1	20	924	46	781
Lane Group Flow (vph)	45	61	4	62	24	1133	56	968
Turn Type	Perm	NA	Perm	NA	pm+pt	NA	Perm	NA
Protected Phases		4		8	5	2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	5	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	7.0	70.0	70.0	70.0
Minimum Split (s)	31.0	31.0	31.0	31.0	11.0	76.0	76.0	76.0
Total Split (s)	31.0	31.0	31.0	31.0	11.0	87.0	76.0	76.0
Total Split (%)	26.3%	26.3%	26.3%	26.3%	9.3%	73.7%	64.4%	64.4%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	4.0	6.0	6.0	6.0
Lead/Lag					Lead		Lag	Lag
Lead-Lag Optimize?					Yes		Yes	Yes
Recall Mode	None	None	None	None	None	Max	Max	Max
v/c Ratio	0.32	0.29	0.04	0.30	0.05	0.38	0.15	0.35
Control Delay	49.8	15.5	42.7	15.7	2.4	3.6	6.5	5.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	49.8	15.5	42.7	15.7	2.4	3.6	6.5	5.5
Queue Length 50th (m)	8.6	0.2	0.7	0.2	0.7	29.4	2.1	23.7
Queue Length 95th (m)	17.5	9.9	3.6	9.9	2.1	36.6	8.3	48.1
Internal Link Dist (m)		266.7		536.9		367.6		358.1
Turn Bay Length (m)	12.0		17.0		18.0		20.0	
Base Capacity (vph)	333	418	247	403	513	2950	377	2744
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.15	0.02	0.15	0.05	0.38	0.15	0.35

Intersection Summary

Cycle Length: 118
Actuated Cycle Length: 103.3
Natural Cycle: 120
Control Type: Semi Act-Uncoord

Splits and Phases: 1: Loggers Run/Beacon Rd & Essa Rd



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	37	1	49	3	1	50	20	924	5	46	781	13
Future Volume (vph)	37	1	49	3	1	50	20	924	5	46	781	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		4.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.98		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		0.99	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	0.85		1.00	1.00		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1825	1542		1356	1478		1825	3576		1825	3502	
Flt Permitted	0.72	1.00		0.72	1.00		0.26	1.00		0.25	1.00	
Satd. Flow (perm)	1377	1542		1024	1478		509	3576		482	3502	
Peak-hour factor, PHF	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Adj. Flow (vph)	45	1	60	4	1	61	24	1127	6	56	952	16
RTOR Reduction (vph)	0	55	0	0	56	0	0	0	0	0	1	0
Lane Group Flow (vph)	45	6	0	4	6	0	24	1133	0	56	967	0
Confl. Peds. (#/hr)			10	10			1		1	1		1
Heavy Vehicles (%)	0%	100%	2%	33%	0%	11%	0%	2%	0%	0%	4%	0%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	8.5	8.5		8.5	8.5		86.5	86.5		79.7	79.7	
Effective Green, g (s)	8.5	8.5		8.5	8.5		86.5	86.5		79.7	79.7	
Actuated g/C Ratio	0.08	0.08		0.08	0.08		0.81	0.81		0.74	0.74	
Clearance Time (s)	6.0	6.0		6.0	6.0		4.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	109	122		81	117		445	2890		359	2608	
v/s Ratio Prot		0.00			0.00		0.00	c0.32			0.28	
v/s Ratio Perm	c0.03			0.00			0.04			0.12		
v/c Ratio	0.41	0.05		0.05	0.05		0.05	0.39		0.16	0.37	
Uniform Delay, d1	46.9	45.5		45.5	45.5		2.4	2.9		3.9	4.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.5	0.2		0.3	0.2		0.1	0.4		0.9	0.4	
Delay (s)	49.4	45.7		45.8	45.7		2.4	3.3		4.9	5.2	
Level of Service	D	D		D	D		A	A		A	A	
Approach Delay (s)		47.3			45.7			3.3			5.2	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	7.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.41		
Actuated Cycle Length (s)	107.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	80.5%	ICU Level of Service	D
Analysis Period (min)	15		

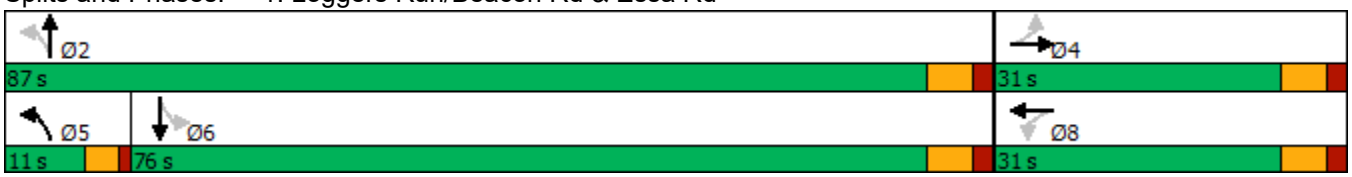
c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	29	0	45	3	32	1068	56	995
Future Volume (vph)	29	0	45	3	32	1068	56	995
Lane Group Flow (vph)	32	28	50	63	36	1196	62	1150
Turn Type	Perm	NA	Perm	NA	pm+pt	NA	Perm	NA
Protected Phases		4		8	5	2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	5	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	7.0	70.0	70.0	70.0
Minimum Split (s)	31.0	31.0	31.0	31.0	11.0	76.0	76.0	76.0
Total Split (s)	31.0	31.0	31.0	31.0	11.0	87.0	76.0	76.0
Total Split (%)	26.3%	26.3%	26.3%	26.3%	9.3%	73.7%	64.4%	64.4%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	4.0	6.0	6.0	6.0
Lead/Lag					Lead		Lag	Lag
Lead-Lag Optimize?					Yes		Yes	Yes
Recall Mode	None	None	None	None	None	Max	Max	Max
v/c Ratio	0.24	0.09	0.34	0.30	0.08	0.40	0.18	0.42
Control Delay	47.6	0.5	50.2	16.3	2.6	3.7	7.8	6.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	47.6	0.5	50.2	16.3	2.6	3.7	7.8	6.8
Queue Length 50th (m)	6.0	0.0	9.5	0.6	1.1	31.9	4.1	50.4
Queue Length 95th (m)	15.1	0.0	21.1	12.5	3.1	46.2	10.7	69.2
Internal Link Dist (m)		266.7		536.9		367.6		358.1
Turn Bay Length (m)	12.0		17.0		18.0		20.0	
Base Capacity (vph)	310	525	341	413	429	2973	344	2734
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.05	0.15	0.15	0.08	0.40	0.18	0.42

Intersection Summary

Cycle Length: 118
Actuated Cycle Length: 103.4
Natural Cycle: 120
Control Type: Semi Act-Uncoord

Splits and Phases: 1: Loggers Run/Beacon Rd & Essa Rd



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	29	0	25	45	3	54	32	1068	8	56	995	40
Future Volume (vph)	29	0	25	45	3	54	32	1068	8	56	995	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		4.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.98		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	0.86		1.00	1.00		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1704	1605		1816	1524		1825	3607		1825	3592	
Flt Permitted	0.72	1.00		0.74	1.00		0.21	1.00		0.24	1.00	
Satd. Flow (perm)	1284	1605		1413	1524		401	3607		453	3592	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	32	0	28	50	3	60	36	1187	9	62	1106	44
RTOR Reduction (vph)	0	26	0	0	55	0	0	0	0	0	2	0
Lane Group Flow (vph)	32	2	0	50	8	0	36	1196	0	62	1148	0
Confl. Peds. (#/hr)	1		4	4		1	1					1
Heavy Vehicles (%)	7%	0%	0%	0%	0%	7%	0%	1%	13%	0%	1%	0%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	8.6	8.6		8.6	8.6		85.7	85.7		77.5	77.5	
Effective Green, g (s)	8.6	8.6		8.6	8.6		85.7	85.7		77.5	77.5	
Actuated g/C Ratio	0.08	0.08		0.08	0.08		0.81	0.81		0.73	0.73	
Clearance Time (s)	6.0	6.0		6.0	6.0		4.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	103	129		114	123		379	2907		330	2618	
v/s Ratio Prot		0.00			0.01		0.00	c0.33			c0.32	
v/s Ratio Perm	0.02			c0.04			0.07			0.14		
v/c Ratio	0.31	0.02		0.44	0.06		0.09	0.41		0.19	0.44	
Uniform Delay, d1	46.1	45.0		46.5	45.1		2.8	3.0		4.5	5.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.7	0.1		2.7	0.2		0.1	0.4		1.3	0.5	
Delay (s)	47.8	45.0		49.2	45.4		3.0	3.4		5.8	6.3	
Level of Service	D	D		D	D		A	A		A	A	
Approach Delay (s)		46.5			47.1			3.4			6.2	
Approach LOS		D			D			A			A	

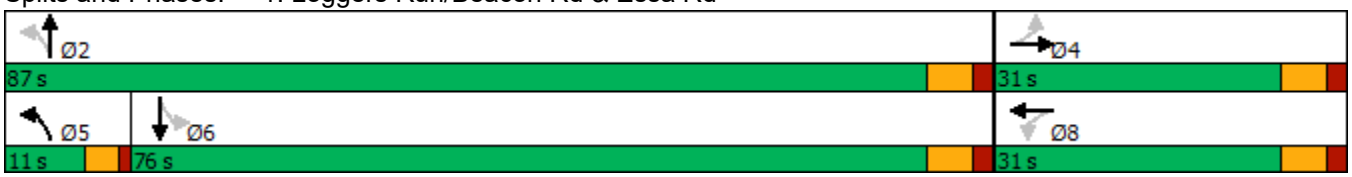
Intersection Summary			
HCM 2000 Control Delay	7.6	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.44		
Actuated Cycle Length (s)	106.3	Sum of lost time (s)	16.0
Intersection Capacity Utilization	78.2%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	37	1	3	1	20	943	48	798
Future Volume (vph)	37	1	3	1	20	943	48	798
Lane Group Flow (vph)	45	61	4	64	24	1156	59	989
Turn Type	Perm	NA	Perm	NA	pm+pt	NA	Perm	NA
Protected Phases		4		8	5	2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	5	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	7.0	70.0	70.0	70.0
Minimum Split (s)	31.0	31.0	31.0	31.0	11.0	76.0	76.0	76.0
Total Split (s)	31.0	31.0	31.0	31.0	11.0	87.0	76.0	76.0
Total Split (%)	26.3%	26.3%	26.3%	26.3%	9.3%	73.7%	64.4%	64.4%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	4.0	6.0	6.0	6.0
Lead/Lag					Lead		Lag	Lag
Lead-Lag Optimize?					Yes		Yes	Yes
Recall Mode	None	None	None	None	None	Max	Max	Max
v/c Ratio	0.32	0.29	0.04	0.31	0.05	0.39	0.16	0.36
Control Delay	49.9	15.5	42.7	15.7	2.4	3.6	6.7	5.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	49.9	15.5	42.7	15.7	2.4	3.6	6.7	5.5
Queue Length 50th (m)	8.6	0.2	0.7	0.2	0.7	30.3	2.3	24.5
Queue Length 95th (m)	17.5	9.9	3.6	10.1	2.1	37.6	8.8	49.5
Internal Link Dist (m)		266.7		536.9		367.6		358.1
Turn Bay Length (m)	12.0		17.0		18.0		20.0	
Base Capacity (vph)	332	418	247	405	503	2950	368	2744
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.15	0.02	0.16	0.05	0.39	0.16	0.36

Intersection Summary
Cycle Length: 118
Actuated Cycle Length: 103.3
Natural Cycle: 120
Control Type: Semi Act-Uncoord

Splits and Phases: 1: Loggers Run/Beacon Rd & Essa Rd



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	37	1	49	3	1	52	20	943	5	48	798	13
Future Volume (vph)	37	1	49	3	1	52	20	943	5	48	798	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		4.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.98		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		0.99	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	0.85		1.00	1.00		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1825	1542		1356	1477		1825	3576		1825	3502	
Flt Permitted	0.72	1.00		0.72	1.00		0.26	1.00		0.25	1.00	
Satd. Flow (perm)	1374	1542		1024	1477		496	3576		471	3502	
Peak-hour factor, PHF	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Adj. Flow (vph)	45	1	60	4	1	63	24	1150	6	59	973	16
RTOR Reduction (vph)	0	55	0	0	58	0	0	0	0	0	1	0
Lane Group Flow (vph)	45	6	0	4	6	0	24	1156	0	59	988	0
Confl. Peds. (#/hr)			10	10			1		1	1		1
Heavy Vehicles (%)	0%	100%	2%	33%	0%	11%	0%	2%	0%	0%	4%	0%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	8.5	8.5		8.5	8.5		86.5	86.5		79.7	79.7	
Effective Green, g (s)	8.5	8.5		8.5	8.5		86.5	86.5		79.7	79.7	
Actuated g/C Ratio	0.08	0.08		0.08	0.08		0.81	0.81		0.74	0.74	
Clearance Time (s)	6.0	6.0		6.0	6.0		4.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	109	122		81	117		435	2890		350	2608	
v/s Ratio Prot		0.00			0.00		0.00	c0.32			0.28	
v/s Ratio Perm	c0.03			0.00			0.04			0.13		
v/c Ratio	0.41	0.05		0.05	0.05		0.06	0.40		0.17	0.38	
Uniform Delay, d1	46.9	45.5		45.5	45.5		2.4	2.9		4.0	4.9	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.5	0.2		0.3	0.2		0.1	0.4		1.0	0.4	
Delay (s)	49.4	45.7		45.8	45.7		2.4	3.3		5.0	5.3	
Level of Service	D	D		D	D		A	A		A	A	
Approach Delay (s)		47.3			45.7			3.3			5.3	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	7.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	107.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	80.5%	ICU Level of Service	D
Analysis Period (min)	15		

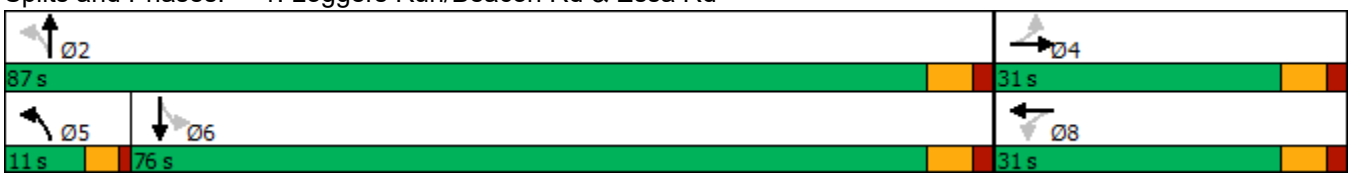
c Critical Lane Group

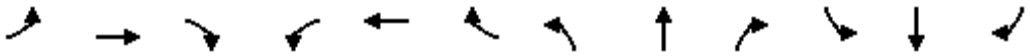
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	29	0	45	3	32	1090	58	1016
Future Volume (vph)	29	0	45	3	32	1090	58	1016
Lane Group Flow (vph)	32	28	50	65	36	1220	64	1173
Turn Type	Perm	NA	Perm	NA	pm+pt	NA	Perm	NA
Protected Phases		4		8	5	2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	5	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	7.0	70.0	70.0	70.0
Minimum Split (s)	31.0	31.0	31.0	31.0	11.0	76.0	76.0	76.0
Total Split (s)	31.0	31.0	31.0	31.0	11.0	87.0	76.0	76.0
Total Split (%)	26.3%	26.3%	26.3%	26.3%	9.3%	73.7%	64.4%	64.4%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	4.0	6.0	6.0	6.0
Lead/Lag					Lead		Lag	Lag
Lead-Lag Optimize?					Yes		Yes	Yes
Recall Mode	None	None	None	None	None	Max	Max	Max
v/c Ratio	0.24	0.09	0.34	0.31	0.09	0.41	0.19	0.43
Control Delay	47.6	0.5	50.2	16.1	2.7	3.8	8.0	6.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	47.6	0.5	50.2	16.1	2.7	3.8	8.0	6.9
Queue Length 50th (m)	6.0	0.0	9.5	0.6	1.1	32.8	4.3	52.0
Queue Length 95th (m)	15.1	0.0	21.1	12.7	3.1	47.4	11.2	71.2
Internal Link Dist (m)		266.7		536.9		367.6		358.1
Turn Bay Length (m)	12.0		17.0		18.0		20.0	
Base Capacity (vph)	310	522	341	415	421	2973	336	2734
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.05	0.15	0.16	0.09	0.41	0.19	0.43

Intersection Summary

Cycle Length: 118
Actuated Cycle Length: 103.4
Natural Cycle: 120
Control Type: Semi Act-Uncoord

Splits and Phases: 1: Loggers Run/Beacon Rd & Essa Rd





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	29	0	25	45	3	56	32	1090	8	58	1016	40
Future Volume (vph)	29	0	25	45	3	56	32	1090	8	58	1016	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		4.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.98		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	0.86		1.00	1.00		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1704	1605		1816	1524		1825	3607		1825	3592	
Flt Permitted	0.71	1.00		0.74	1.00		0.20	1.00		0.23	1.00	
Satd. Flow (perm)	1282	1605		1413	1524		389	3607		442	3592	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	32	0	28	50	3	62	36	1211	9	64	1129	44
RTOR Reduction (vph)	0	26	0	0	57	0	0	0	0	0	2	0
Lane Group Flow (vph)	32	2	0	50	8	0	36	1220	0	64	1171	0
Confl. Peds. (#/hr)	1		4	4		1	1					1
Heavy Vehicles (%)	7%	0%	0%	0%	0%	7%	0%	1%	13%	0%	1%	0%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	8.6	8.6		8.6	8.6		85.7	85.7		77.5	77.5	
Effective Green, g (s)	8.6	8.6		8.6	8.6		85.7	85.7		77.5	77.5	
Actuated g/C Ratio	0.08	0.08		0.08	0.08		0.81	0.81		0.73	0.73	
Clearance Time (s)	6.0	6.0		6.0	6.0		4.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	103	129		114	123		370	2907		322	2618	
v/s Ratio Prot		0.00			0.01		0.00	c0.34			c0.33	
v/s Ratio Perm	0.02			c0.04			0.07			0.14		
v/c Ratio	0.31	0.02		0.44	0.07		0.10	0.42		0.20	0.45	
Uniform Delay, d1	46.1	45.0		46.5	45.1		2.9	3.0		4.6	5.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.7	0.1		2.7	0.2		0.1	0.4		1.4	0.6	
Delay (s)	47.8	45.0		49.2	45.4		3.0	3.5		5.9	6.3	
Level of Service	D	D		D	D		A	A		A	A	
Approach Delay (s)		46.5			47.0			3.5			6.3	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	7.6	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	106.3	Sum of lost time (s)	16.0
Intersection Capacity Utilization	78.2%	ICU Level of Service	D
Analysis Period (min)	15		

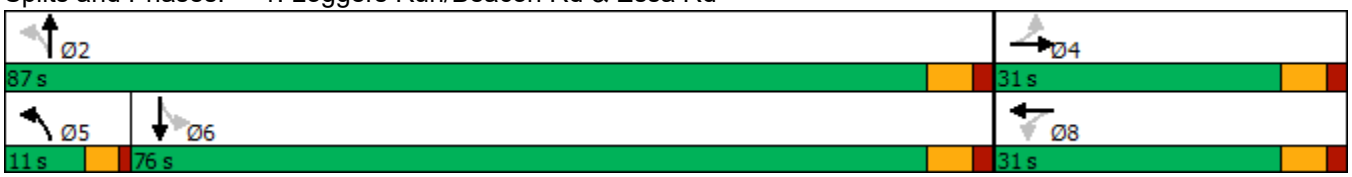
c Critical Lane Group

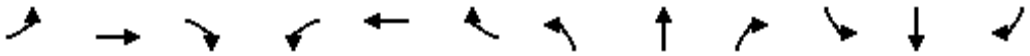
Appendix G –
Synchro Analysis Output –
Total Traffic Volumes

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	37	1	3	1	20	938	81	701
Future Volume (vph)	37	1	3	1	20	938	81	701
Lane Group Flow (vph)	45	61	4	83	24	1150	99	871
Turn Type	Perm	NA	Perm	NA	pm+pt	NA	Perm	NA
Protected Phases		4		8	5	2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	5	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	7.0	70.0	70.0	70.0
Minimum Split (s)	31.0	31.0	31.0	31.0	11.0	76.0	76.0	76.0
Total Split (s)	31.0	31.0	31.0	31.0	11.0	87.0	76.0	76.0
Total Split (%)	26.3%	26.3%	26.3%	26.3%	9.3%	73.7%	64.4%	64.4%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	4.0	6.0	6.0	6.0
Lead/Lag					Lead		Lag	Lag
Lead-Lag Optimize?					Yes		Yes	Yes
Recall Mode	None	None	None	None	None	Max	Max	Max
v/c Ratio	0.33	0.29	0.04	0.37	0.04	0.39	0.27	0.32
Control Delay	50.0	15.4	42.7	15.0	2.4	3.6	8.0	5.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	50.0	15.4	42.7	15.0	2.4	3.6	8.0	5.3
Queue Length 50th (m)	8.6	0.2	0.7	0.2	0.7	30.2	4.2	20.5
Queue Length 95th (m)	17.5	9.9	3.6	11.1	2.1	37.6	15.1	42.4
Internal Link Dist (m)		266.7		536.9		367.6		358.1
Turn Bay Length (m)	12.0		17.0		18.0		20.0	
Base Capacity (vph)	326	418	247	419	559	2950	371	2741
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.15	0.02	0.20	0.04	0.39	0.27	0.32

Intersection Summary
Cycle Length: 118
Actuated Cycle Length: 103.3
Natural Cycle: 120
Control Type: Semi Act-Uncoord

Splits and Phases: 1: Loggers Run/Beacon Rd & Essa Rd

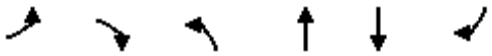




Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	37	1	49	3	1	67	20	938	5	81	701	13
Future Volume (vph)	37	1	49	3	1	67	20	938	5	81	701	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		4.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.98		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		0.99	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	0.85		1.00	1.00		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1825	1542		1356	1476		1825	3576		1825	3501	
Flt Permitted	0.70	1.00		0.72	1.00		0.30	1.00		0.25	1.00	
Satd. Flow (perm)	1351	1542		1024	1476		571	3576		474	3501	
Peak-hour factor, PHF	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Adj. Flow (vph)	45	1	60	4	1	82	24	1144	6	99	855	16
RTOR Reduction (vph)	0	55	0	0	75	0	0	0	0	0	1	0
Lane Group Flow (vph)	45	6	0	4	8	0	24	1150	0	99	870	0
Confl. Peds. (#/hr)			10	10			1		1	1		1
Heavy Vehicles (%)	0%	100%	2%	33%	0%	11%	0%	2%	0%	0%	4%	0%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	8.5	8.5		8.5	8.5		86.5	86.5		79.7	79.7	
Effective Green, g (s)	8.5	8.5		8.5	8.5		86.5	86.5		79.7	79.7	
Actuated g/C Ratio	0.08	0.08		0.08	0.08		0.81	0.81		0.74	0.74	
Clearance Time (s)	6.0	6.0		6.0	6.0		4.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	107	122		81	117		494	2890		353	2607	
v/s Ratio Prot		0.00			0.01		0.00	c0.32			0.25	
v/s Ratio Perm	c0.03			0.00			0.04			0.21		
v/c Ratio	0.42	0.05		0.05	0.06		0.05	0.40		0.28	0.33	
Uniform Delay, d1	46.9	45.5		45.5	45.6		2.3	2.9		4.4	4.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.7	0.2		0.3	0.2		0.0	0.4		2.0	0.3	
Delay (s)	49.6	45.7		45.8	45.8		2.3	3.3		6.4	5.0	
Level of Service	D	D		D	D		A	A		A	A	
Approach Delay (s)		47.3			45.8			3.3			5.1	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	7.6	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	107.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	89.5%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	19	31	10	36	73	6
Future Volume (Veh/h)	19	31	10	36	73	6
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)	21	34	11	39	79	7
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	144	82	86			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	144	82	86			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	97	99			
cM capacity (veh/h)	848	983	1523			

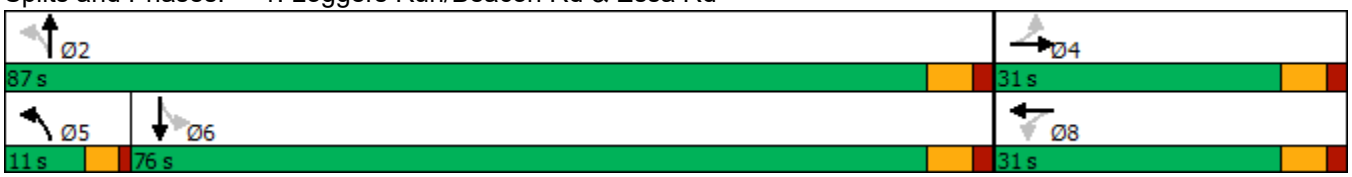
Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	55	50	86
Volume Left	21	11	0
Volume Right	34	0	7
cSH	926	1523	1700
Volume to Capacity	0.06	0.01	0.05
Queue Length 95th (m)	1.4	0.2	0.0
Control Delay (s)	9.1	1.7	0.0
Lane LOS	A	A	
Approach Delay (s)	9.1	1.7	0.0
Approach LOS	A		

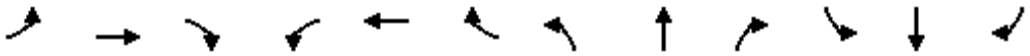
Intersection Summary			
Average Delay	3.1		
Intersection Capacity Utilization	19.1%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	29	0	45	3	32	788	64	1202
Future Volume (vph)	29	0	45	3	32	788	64	1202
Lane Group Flow (vph)	32	28	50	80	36	885	71	1380
Turn Type	Perm	NA	Perm	NA	pm+pt	NA	Perm	NA
Protected Phases		4		8	5	2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	5	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	7.0	70.0	70.0	70.0
Minimum Split (s)	31.0	31.0	31.0	31.0	11.0	76.0	76.0	76.0
Total Split (s)	31.0	31.0	31.0	31.0	11.0	87.0	76.0	76.0
Total Split (%)	26.3%	26.3%	26.3%	26.3%	9.3%	73.7%	64.4%	64.4%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	4.0	6.0	6.0	6.0
Lead/Lag					Lead		Lag	Lag
Lead-Lag Optimize?					Yes		Yes	Yes
Recall Mode	None	None	None	None	None	Max	Max	Max
v/c Ratio	0.25	0.09	0.34	0.36	0.10	0.30	0.15	0.50
Control Delay	47.8	0.6	50.2	15.5	2.8	3.2	6.9	7.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	47.8	0.6	50.2	15.5	2.8	3.2	6.9	7.7
Queue Length 50th (m)	6.0	0.0	9.5	0.6	1.1	20.8	4.6	66.8
Queue Length 95th (m)	15.1	0.0	21.1	13.9	3.1	30.9	11.0	90.8
Internal Link Dist (m)		266.7		536.9		367.6		358.1
Turn Bay Length (m)	12.0		17.0		18.0		20.0	
Base Capacity (vph)	305	499	341	425	349	2969	469	2736
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.06	0.15	0.19	0.10	0.30	0.15	0.50

Intersection Summary
Cycle Length: 118
Actuated Cycle Length: 103.4
Natural Cycle: 120
Control Type: Semi Act-Uncoord

Splits and Phases: 1: Loggers Run/Beacon Rd & Essa Rd

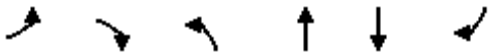




Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	29	0	25	45	3	69	32	788	8	64	1202	40
Future Volume (vph)	29	0	25	45	3	69	32	788	8	64	1202	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		4.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.98		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	0.86		1.00	1.00		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1704	1605		1816	1520		1825	3604		1825	3595	
Flt Permitted	0.70	1.00		0.74	1.00		0.15	1.00		0.32	1.00	
Satd. Flow (perm)	1264	1605		1413	1520		295	3604		617	3595	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	32	0	28	50	3	77	36	876	9	71	1336	44
RTOR Reduction (vph)	0	26	0	0	71	0	0	0	0	0	1	0
Lane Group Flow (vph)	32	2	0	50	9	0	36	885	0	71	1379	0
Confl. Peds. (#/hr)	1		4	4		1	1					1
Heavy Vehicles (%)	7%	0%	0%	0%	0%	7%	0%	1%	13%	0%	1%	0%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	8.6	8.6		8.6	8.6		85.7	85.7		77.5	77.5	
Effective Green, g (s)	8.6	8.6		8.6	8.6		85.7	85.7		77.5	77.5	
Actuated g/C Ratio	0.08	0.08		0.08	0.08		0.81	0.81		0.73	0.73	
Clearance Time (s)	6.0	6.0		6.0	6.0		4.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	102	129		114	122		298	2905		449	2621	
v/s Ratio Prot		0.00			0.01		0.00	c0.25			c0.38	
v/s Ratio Perm	0.03			c0.04			0.09			0.12		
v/c Ratio	0.31	0.02		0.44	0.08		0.12	0.30		0.16	0.53	
Uniform Delay, d1	46.1	45.0		46.5	45.2		3.6	2.6		4.4	6.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.8	0.1		2.7	0.3		0.2	0.3		0.8	0.8	
Delay (s)	47.8	45.0		49.2	45.4		3.8	2.9		5.2	7.1	
Level of Service	D	D		D	D		A	A		A	A	
Approach Delay (s)		46.5			46.9			3.0			7.0	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	8.5	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	106.3	Sum of lost time (s)	16.0
Intersection Capacity Utilization	78.2%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	12	18	30	89	37	19
Future Volume (Veh/h)	12	18	30	89	37	19
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)	13	20	33	97	40	21
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	214	50	61			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	214	50	61			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	98	98			
cM capacity (veh/h)	763	1023	1555			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	33	130	61
Volume Left	13	33	0
Volume Right	20	0	21
cSH	902	1555	1700
Volume to Capacity	0.04	0.02	0.04
Queue Length 95th (m)	0.9	0.5	0.0
Control Delay (s)	9.1	2.0	0.0
Lane LOS	A	A	
Approach Delay (s)	9.1	2.0	0.0
Approach LOS	A		

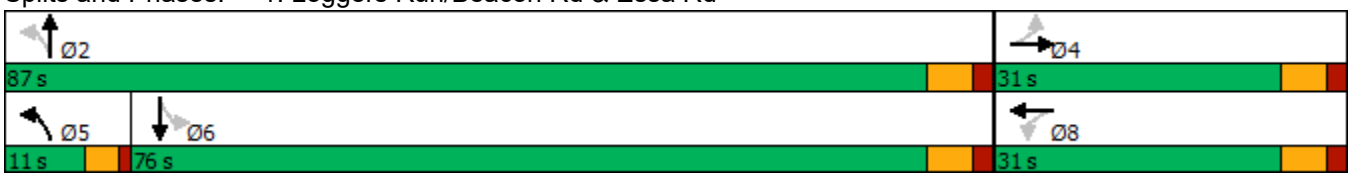
Intersection Summary			
Average Delay	2.5		
Intersection Capacity Utilization	23.0%	ICU Level of Service	A
Analysis Period (min)	15		

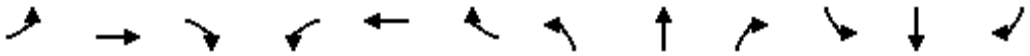
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	37	1	3	1	20	924	52	781
Future Volume (vph)	37	1	3	1	20	924	52	781
Lane Group Flow (vph)	45	61	4	85	24	1133	63	968
Turn Type	Perm	NA	Perm	NA	pm+pt	NA	Perm	NA
Protected Phases		4		8	5	2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	5	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	7.0	70.0	70.0	70.0
Minimum Split (s)	31.0	31.0	31.0	31.0	11.0	76.0	76.0	76.0
Total Split (s)	31.0	31.0	31.0	31.0	11.0	87.0	76.0	76.0
Total Split (%)	26.3%	26.3%	26.3%	26.3%	9.3%	73.7%	64.4%	64.4%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	4.0	6.0	6.0	6.0
Lead/Lag					Lead		Lag	Lag
Lead-Lag Optimize?					Yes		Yes	Yes
Recall Mode	None	None	None	None	None	Max	Max	Max
v/c Ratio	0.33	0.29	0.04	0.38	0.05	0.38	0.17	0.35
Control Delay	50.1	15.4	42.7	15.0	2.4	3.6	6.8	5.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	50.1	15.4	42.7	15.0	2.4	3.6	6.8	5.5
Queue Length 50th (m)	8.6	0.2	0.7	0.2	0.7	29.4	2.5	23.7
Queue Length 95th (m)	17.5	9.9	3.6	11.3	2.1	36.7	9.3	48.3
Internal Link Dist (m)		266.7		536.9		367.6		358.1
Turn Bay Length (m)	12.0		17.0		18.0		20.0	
Base Capacity (vph)	326	418	247	420	512	2950	377	2744
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.15	0.02	0.20	0.05	0.38	0.17	0.35

Intersection Summary

Cycle Length: 118
Actuated Cycle Length: 103.3
Natural Cycle: 120
Control Type: Semi Act-Uncoord

Splits and Phases: 1: Loggers Run/Beacon Rd & Essa Rd

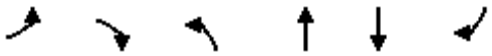




Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	37	1	49	3	1	69	20	924	5	52	781	13
Future Volume (vph)	37	1	49	3	1	69	20	924	5	52	781	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		4.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.98		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		0.99	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	0.85		1.00	1.00		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1825	1542		1356	1476		1825	3576		1825	3502	
Flt Permitted	0.70	1.00		0.72	1.00		0.26	1.00		0.25	1.00	
Satd. Flow (perm)	1348	1542		1024	1476		509	3576		482	3502	
Peak-hour factor, PHF	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Adj. Flow (vph)	45	1	60	4	1	84	24	1127	6	63	952	16
RTOR Reduction (vph)	0	55	0	0	77	0	0	0	0	0	1	0
Lane Group Flow (vph)	45	6	0	4	8	0	24	1133	0	63	967	0
Confl. Peds. (#/hr)			10	10			1		1	1		1
Heavy Vehicles (%)	0%	100%	2%	33%	0%	11%	0%	2%	0%	0%	4%	0%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	8.5	8.5		8.5	8.5		86.5	86.5		79.7	79.7	
Effective Green, g (s)	8.5	8.5		8.5	8.5		86.5	86.5		79.7	79.7	
Actuated g/C Ratio	0.08	0.08		0.08	0.08		0.81	0.81		0.74	0.74	
Clearance Time (s)	6.0	6.0		6.0	6.0		4.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	107	122		81	117		445	2890		359	2608	
v/s Ratio Prot		0.00			0.01		0.00	c0.32			0.28	
v/s Ratio Perm	c0.03			0.00			0.04			0.13		
v/c Ratio	0.42	0.05		0.05	0.07		0.05	0.39		0.18	0.37	
Uniform Delay, d1	46.9	45.5		45.5	45.6		2.4	2.9		4.0	4.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.7	0.2		0.3	0.2		0.1	0.4		1.1	0.4	
Delay (s)	49.6	45.7		45.8	45.8		2.4	3.3		5.1	5.2	
Level of Service	D	D		D	D		A	A		A	A	
Approach Delay (s)		47.3			45.8			3.3			5.2	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	7.7	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.41		
Actuated Cycle Length (s)	107.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	80.5%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	19	31	10	38	44	6
Future Volume (Veh/h)	19	31	10	38	44	6
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)	21	34	11	41	48	7
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	114	52	55			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	114	52	55			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	97	99			
cM capacity (veh/h)	880	1022	1563			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	55	52	55
Volume Left	21	11	0
Volume Right	34	0	7
cSH	963	1563	1700
Volume to Capacity	0.06	0.01	0.03
Queue Length 95th (m)	1.4	0.2	0.0
Control Delay (s)	9.0	1.6	0.0
Lane LOS	A	A	
Approach Delay (s)	9.0	1.6	0.0
Approach LOS	A		

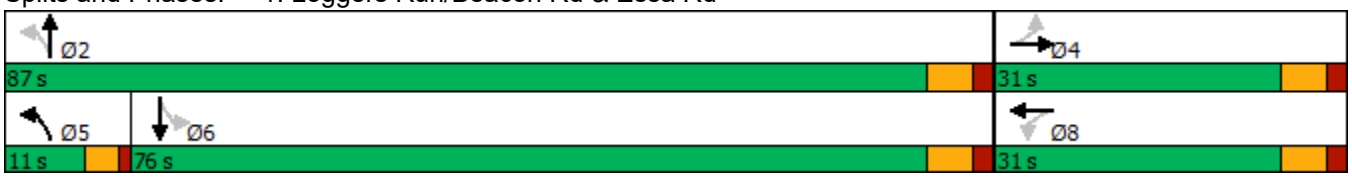
Intersection Summary			
Average Delay	3.6		
Intersection Capacity Utilization	19.2%	ICU Level of Service	A
Analysis Period (min)	15		

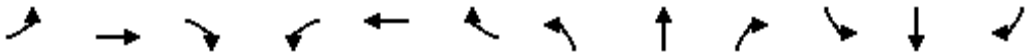
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	29	0	45	3	32	1068	75	995
Future Volume (vph)	29	0	45	3	32	1068	75	995
Lane Group Flow (vph)	32	28	50	76	36	1196	83	1150
Turn Type	Perm	NA	Perm	NA	pm+pt	NA	Perm	NA
Protected Phases		4		8	5	2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	5	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	7.0	70.0	70.0	70.0
Minimum Split (s)	31.0	31.0	31.0	31.0	11.0	76.0	76.0	76.0
Total Split (s)	31.0	31.0	31.0	31.0	11.0	87.0	76.0	76.0
Total Split (%)	26.3%	26.3%	26.3%	26.3%	9.3%	73.7%	64.4%	64.4%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	4.0	6.0	6.0	6.0
Lead/Lag					Lead		Lag	Lag
Lead-Lag Optimize?					Yes		Yes	Yes
Recall Mode	None	None	None	None	None	Max	Max	Max
v/c Ratio	0.25	0.09	0.34	0.34	0.08	0.40	0.24	0.42
Control Delay	47.8	0.5	50.2	15.6	2.6	3.7	8.5	6.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	47.8	0.5	50.2	15.6	2.6	3.7	8.5	6.8
Queue Length 50th (m)	6.0	0.0	9.5	0.6	1.1	31.9	5.8	50.4
Queue Length 95th (m)	15.1	0.0	21.1	13.7	3.1	46.2	14.5	69.2
Internal Link Dist (m)		266.7		536.9		367.6		358.1
Turn Bay Length (m)	12.0		17.0		18.0		20.0	
Base Capacity (vph)	307	525	341	422	429	2973	344	2734
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.05	0.15	0.18	0.08	0.40	0.24	0.42

Intersection Summary

Cycle Length: 118
Actuated Cycle Length: 103.4
Natural Cycle: 120
Control Type: Semi Act-Uncoord

Splits and Phases: 1: Loggers Run/Beacon Rd & Essa Rd

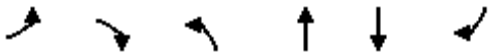




Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	29	0	25	45	3	66	32	1068	8	75	995	40
Future Volume (vph)	29	0	25	45	3	66	32	1068	8	75	995	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		4.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.98		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	0.86		1.00	1.00		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1704	1605		1816	1521		1825	3607		1825	3592	
Flt Permitted	0.71	1.00		0.74	1.00		0.21	1.00		0.24	1.00	
Satd. Flow (perm)	1269	1605		1413	1521		401	3607		453	3592	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	32	0	28	50	3	73	36	1187	9	83	1106	44
RTOR Reduction (vph)	0	26	0	0	67	0	0	0	0	0	2	0
Lane Group Flow (vph)	32	2	0	50	9	0	36	1196	0	83	1148	0
Confl. Peds. (#/hr)	1		4	4		1	1					1
Heavy Vehicles (%)	7%	0%	0%	0%	0%	7%	0%	1%	13%	0%	1%	0%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	8.6	8.6		8.6	8.6		85.7	85.7		77.5	77.5	
Effective Green, g (s)	8.6	8.6		8.6	8.6		85.7	85.7		77.5	77.5	
Actuated g/C Ratio	0.08	0.08		0.08	0.08		0.81	0.81		0.73	0.73	
Clearance Time (s)	6.0	6.0		6.0	6.0		4.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	102	129		114	123		379	2907		330	2618	
v/s Ratio Prot		0.00			0.01		0.00	c0.33			c0.32	
v/s Ratio Perm	0.03			c0.04			0.07			0.18		
v/c Ratio	0.31	0.02		0.44	0.07		0.09	0.41		0.25	0.44	
Uniform Delay, d1	46.1	45.0		46.5	45.2		2.8	3.0		4.8	5.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.8	0.1		2.7	0.3		0.1	0.4		1.8	0.5	
Delay (s)	47.8	45.0		49.2	45.4		3.0	3.4		6.6	6.3	
Level of Service	D	D		D	D		A	A		A	A	
Approach Delay (s)		46.5			46.9			3.4			6.3	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	7.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.44		
Actuated Cycle Length (s)	106.3	Sum of lost time (s)	16.0
Intersection Capacity Utilization	82.2%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	12	18	30	86	48	19
Future Volume (Veh/h)	12	18	30	86	48	19
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)	13	20	33	93	52	21
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	222	62	73			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	222	62	73			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	98	98			
cM capacity (veh/h)	755	1008	1540			

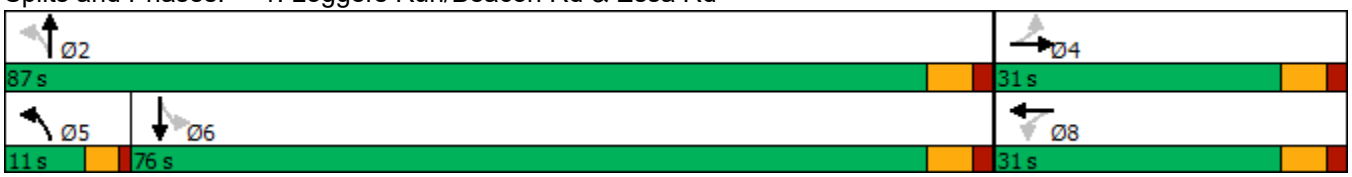
Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	33	126	73
Volume Left	13	33	0
Volume Right	20	0	21
cSH	890	1540	1700
Volume to Capacity	0.04	0.02	0.04
Queue Length 95th (m)	0.9	0.5	0.0
Control Delay (s)	9.2	2.1	0.0
Lane LOS	A	A	
Approach Delay (s)	9.2	2.1	0.0
Approach LOS	A		

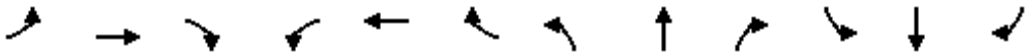
Intersection Summary			
Average Delay	2.4		
Intersection Capacity Utilization	22.9%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	37	1	3	1	20	943	54	798
Future Volume (vph)	37	1	3	1	20	943	54	798
Lane Group Flow (vph)	45	61	4	88	24	1156	66	989
Turn Type	Perm	NA	Perm	NA	pm+pt	NA	Perm	NA
Protected Phases		4		8	5	2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	5	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	7.0	70.0	70.0	70.0
Minimum Split (s)	31.0	31.0	31.0	31.0	11.0	76.0	76.0	76.0
Total Split (s)	31.0	31.0	31.0	31.0	11.0	87.0	76.0	76.0
Total Split (%)	26.3%	26.3%	26.3%	26.3%	9.3%	73.7%	64.4%	64.4%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	4.0	6.0	6.0	6.0
Lead/Lag					Lead		Lag	Lag
Lead-Lag Optimize?					Yes		Yes	Yes
Recall Mode	None	None	None	None	None	Max	Max	Max
v/c Ratio	0.33	0.29	0.04	0.39	0.05	0.39	0.18	0.36
Control Delay	50.2	15.4	42.7	14.9	2.4	3.6	6.9	5.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	50.2	15.4	42.7	14.9	2.4	3.6	6.9	5.6
Queue Length 50th (m)	8.6	0.2	0.7	0.2	0.7	30.3	2.6	24.5
Queue Length 95th (m)	17.5	9.9	3.6	11.3	2.1	37.8	9.8	49.6
Internal Link Dist (m)		266.7		536.9		367.6		358.1
Turn Bay Length (m)	12.0		17.0		18.0		20.0	
Base Capacity (vph)	325	418	247	423	503	2950	368	2744
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.15	0.02	0.21	0.05	0.39	0.18	0.36

Intersection Summary
Cycle Length: 118
Actuated Cycle Length: 103.3
Natural Cycle: 120
Control Type: Semi Act-Uncoord

Splits and Phases: 1: Loggers Run/Beacon Rd & Essa Rd

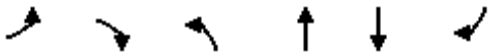




Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	37	1	49	3	1	71	20	943	5	54	798	13
Future Volume (vph)	37	1	49	3	1	71	20	943	5	54	798	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		4.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.98		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		0.99	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	0.85		1.00	1.00		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1825	1542		1356	1476		1825	3576		1825	3502	
Flt Permitted	0.70	1.00		0.72	1.00		0.26	1.00		0.25	1.00	
Satd. Flow (perm)	1345	1542		1024	1476		496	3576		471	3502	
Peak-hour factor, PHF	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Adj. Flow (vph)	45	1	60	4	1	87	24	1150	6	66	973	16
RTOR Reduction (vph)	0	55	0	0	80	0	0	0	0	0	1	0
Lane Group Flow (vph)	45	6	0	4	8	0	24	1156	0	66	988	0
Confl. Peds. (#/hr)			10	10			1		1	1		1
Heavy Vehicles (%)	0%	100%	2%	33%	0%	11%	0%	2%	0%	0%	4%	0%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	8.5	8.5		8.5	8.5		86.5	86.5		79.7	79.7	
Effective Green, g (s)	8.5	8.5		8.5	8.5		86.5	86.5		79.7	79.7	
Actuated g/C Ratio	0.08	0.08		0.08	0.08		0.81	0.81		0.74	0.74	
Clearance Time (s)	6.0	6.0		6.0	6.0		4.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	106	122		81	117		435	2890		350	2608	
v/s Ratio Prot		0.00			0.01		0.00	c0.32			0.28	
v/s Ratio Perm	c0.03			0.00			0.04			0.14		
v/c Ratio	0.42	0.05		0.05	0.07		0.06	0.40		0.19	0.38	
Uniform Delay, d1	46.9	45.5		45.5	45.6		2.4	2.9		4.1	4.9	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.7	0.2		0.3	0.2		0.1	0.4		1.2	0.4	
Delay (s)	49.6	45.7		45.8	45.8		2.4	3.3		5.2	5.3	
Level of Service	D	D		D	D		A	A		A	A	
Approach Delay (s)		47.4			45.8			3.3			5.3	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	7.7	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	107.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	80.5%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	19	31	10	40	46	6
Future Volume (Veh/h)	19	31	10	40	46	6
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)	21	34	11	43	50	7
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	118	54	57			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	118	54	57			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	97	99			
cM capacity (veh/h)	876	1019	1560			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	55	54	57
Volume Left	21	11	0
Volume Right	34	0	7
cSH	959	1560	1700
Volume to Capacity	0.06	0.01	0.03
Queue Length 95th (m)	1.4	0.2	0.0
Control Delay (s)	9.0	1.5	0.0
Lane LOS	A	A	
Approach Delay (s)	9.0	1.5	0.0
Approach LOS	A		

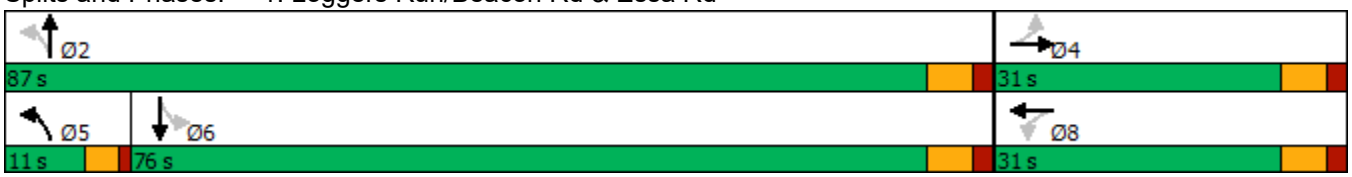
Intersection Summary			
Average Delay	3.5		
Intersection Capacity Utilization	19.3%	ICU Level of Service	A
Analysis Period (min)	15		

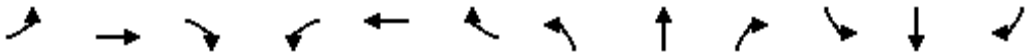
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	29	0	45	3	32	1090	77	1016
Future Volume (vph)	29	0	45	3	32	1090	77	1016
Lane Group Flow (vph)	32	28	50	79	36	1220	86	1173
Turn Type	Perm	NA	Perm	NA	pm+pt	NA	Perm	NA
Protected Phases		4		8	5	2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	5	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	7.0	70.0	70.0	70.0
Minimum Split (s)	31.0	31.0	31.0	31.0	11.0	76.0	76.0	76.0
Total Split (s)	31.0	31.0	31.0	31.0	11.0	87.0	76.0	76.0
Total Split (%)	26.3%	26.3%	26.3%	26.3%	9.3%	73.7%	64.4%	64.4%
Yellow Time (s)	4.0	4.0	4.0	4.0	3.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	1.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	4.0	6.0	6.0	6.0
Lead/Lag					Lead		Lag	Lag
Lead-Lag Optimize?					Yes		Yes	Yes
Recall Mode	None	None	None	None	None	Max	Max	Max
v/c Ratio	0.25	0.09	0.34	0.35	0.09	0.41	0.26	0.43
Control Delay	47.8	0.5	50.2	15.5	2.7	3.8	8.8	6.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	47.8	0.5	50.2	15.5	2.7	3.8	8.8	6.9
Queue Length 50th (m)	6.0	0.0	9.5	0.6	1.1	32.8	6.1	52.0
Queue Length 95th (m)	15.1	0.0	21.1	13.9	3.1	47.4	15.4	71.2
Internal Link Dist (m)		266.7		536.9		367.6		358.1
Turn Bay Length (m)	12.0		17.0		18.0		20.0	
Base Capacity (vph)	306	522	341	425	421	2973	336	2734
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.05	0.15	0.19	0.09	0.41	0.26	0.43

Intersection Summary

Cycle Length: 118
Actuated Cycle Length: 103.4
Natural Cycle: 120
Control Type: Semi Act-Uncoord

Splits and Phases: 1: Loggers Run/Beacon Rd & Essa Rd

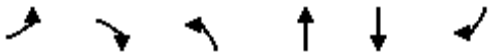




Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	29	0	25	45	3	68	32	1090	8	77	1016	40
Future Volume (vph)	29	0	25	45	3	68	32	1090	8	77	1016	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		4.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	0.98		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	0.86		1.00	1.00		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1704	1605		1816	1521		1825	3607		1825	3592	
Flt Permitted	0.71	1.00		0.74	1.00		0.20	1.00		0.23	1.00	
Satd. Flow (perm)	1265	1605		1413	1521		389	3607		442	3592	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	32	0	28	50	3	76	36	1211	9	86	1129	44
RTOR Reduction (vph)	0	26	0	0	70	0	0	0	0	0	2	0
Lane Group Flow (vph)	32	2	0	50	9	0	36	1220	0	86	1171	0
Confl. Peds. (#/hr)	1		4	4		1	1					1
Heavy Vehicles (%)	7%	0%	0%	0%	0%	7%	0%	1%	13%	0%	1%	0%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	8.6	8.6		8.6	8.6		85.7	85.7		77.5	77.5	
Effective Green, g (s)	8.6	8.6		8.6	8.6		85.7	85.7		77.5	77.5	
Actuated g/C Ratio	0.08	0.08		0.08	0.08		0.81	0.81		0.73	0.73	
Clearance Time (s)	6.0	6.0		6.0	6.0		4.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	102	129		114	123		370	2907		322	2618	
v/s Ratio Prot		0.00			0.01		0.00	c0.34			c0.33	
v/s Ratio Perm	0.03			c0.04			0.07			0.19		
v/c Ratio	0.31	0.02		0.44	0.07		0.10	0.42		0.27	0.45	
Uniform Delay, d1	46.1	45.0		46.5	45.2		2.9	3.0		4.8	5.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.8	0.1		2.7	0.3		0.1	0.4		2.0	0.6	
Delay (s)	47.8	45.0		49.2	45.4		3.0	3.5		6.9	6.3	
Level of Service	D	D		D	D		A	A		A	A	
Approach Delay (s)		46.5			46.9			3.5			6.4	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	7.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	106.3	Sum of lost time (s)	16.0
Intersection Capacity Utilization	83.9%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	12	18	30	88	50	19
Future Volume (Veh/h)	12	18	30	88	50	19
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)	13	20	33	96	54	21
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	226	64	75			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	226	64	75			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	98	98			
cM capacity (veh/h)	750	1005	1537			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	33	129	75
Volume Left	13	33	0
Volume Right	20	0	21
cSH	886	1537	1700
Volume to Capacity	0.04	0.02	0.04
Queue Length 95th (m)	0.9	0.5	0.0
Control Delay (s)	9.2	2.0	0.0
Lane LOS	A	A	
Approach Delay (s)	9.2	2.0	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	2.4		
Intersection Capacity Utilization	23.0%	ICU Level of Service	A
Analysis Period (min)	15		

Appendix H –
OTM Signal Justification Sheets

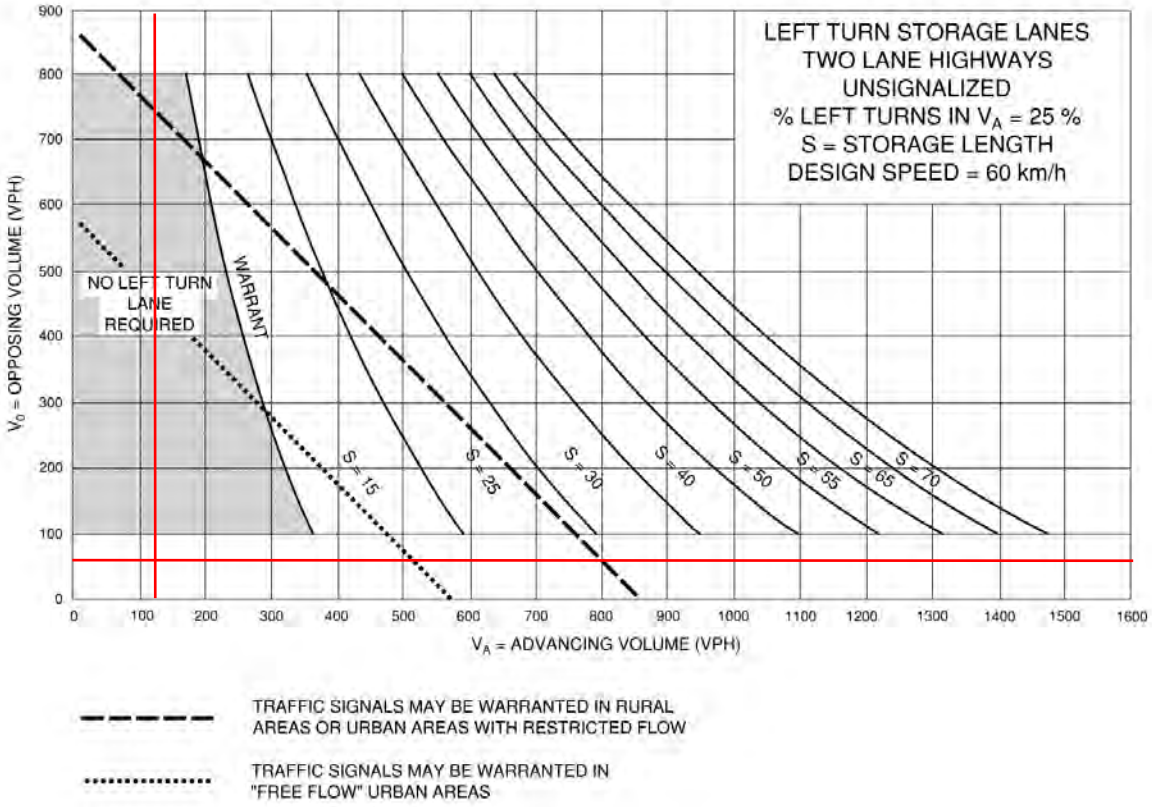
Justification No. 7 - 2033 Total Traffic (Critical Case)

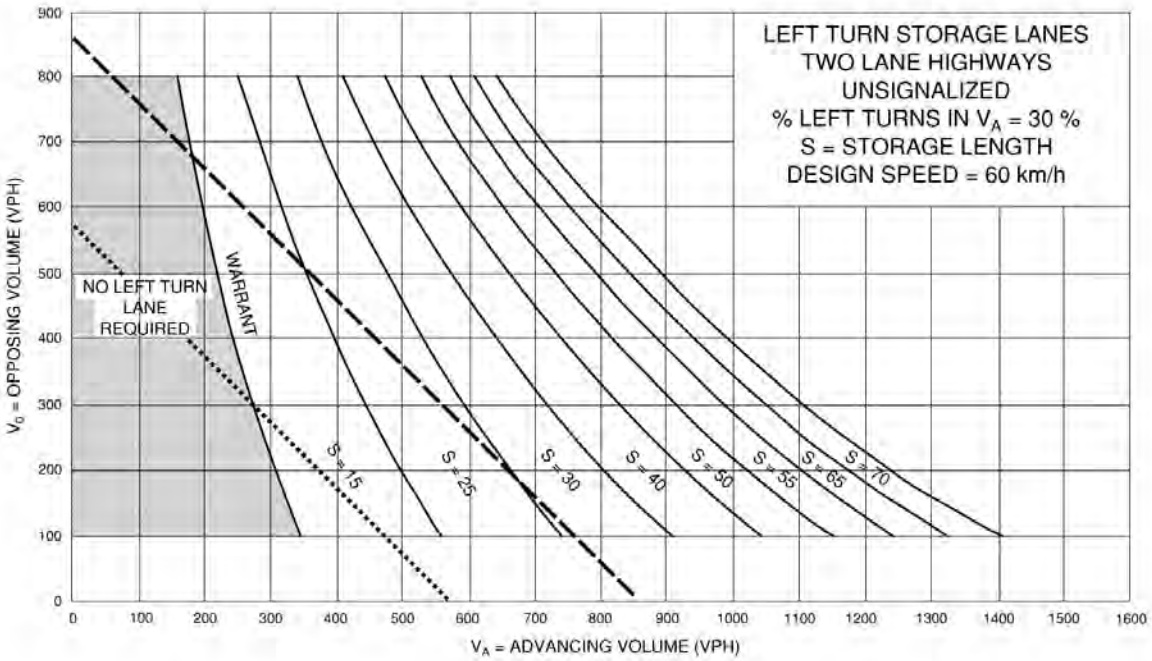
Beacon Road / Street A

Justification	Description		Compliance			Signal Warrant	Underground Provisions Warrant
			Sectional		Entire %		
		Rest. Flow	Numerical	%			
1. Minimum Vehicluar Volume	A. Vehicle volume, all aproaches (average hour)	720	92	13%	5%	NO	NO
	B. Vehicle volume, along minor streets (average hour)	255	20	8%		NO	NO
2. Delay to cross traffic	A. Vehicle volume, major street (average hour)	720	66	9%	6%	NO	NO
	B. Combined vehicle and pedestrian volume crossing artery from minor streets (average hour)	75	8	10%		NO	NO

Beacon Road / Street A
2033 Total - Northbound
Critical Case - PM Peak Hour

Exhibit 9A-8





Appendix I –
MTO Left-Turn Analysis