

**Craigholme Estates Development
Transportation Study
Belmont, ON**

Craigholme Estates Ltd.



BURNSIDE

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Transportation Study
Belmont, ON**

Craigholme Estates Ltd.

**R.J. Burnside & Associates Limited
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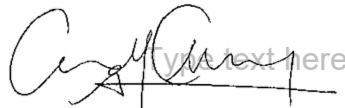
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0	May 21, 2019	Initial Draft Submission to Craigholme Estates Ltd.
1	May 31, 2019	Final Submission to Craigholme Estates Ltd.
2	June 1, 2021	Revised Draft Submission to Craigholme Estates Ltd.
3	June 7, 2021	Final Report to Craigholme Estates Ltd.
4	July 7, 2021	Updated Report to Craigholme Estates Ltd.

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Executive Summary

Craigholme Estates Ltd. (the Client) is proposing to develop a residential development in the Community of Belmont, Municipality of Central Elgin, Ontario. The site is located south of Seventh Avenue, west of Snyders Avenue. There will be three accesses on Seventh Avenue to the development, as well as an extension of Landon Lane. The development is anticipated to be mainly residential homes, however, one block (Block 183) may be developed for a new elementary school (Thames Valley District School Board (TVDSB)) or as residential. Excluding Block 183, the proposed development will consist of 157 single detached residential homes, 18 semi-detached residential homes and 16 street townhomes for a total of 191 residential units. Block 183 is anticipated to be either one of the following:

- Scenario 1: 56 semi-detached residential homes.
 - With two Proposed Roads (B and C) on Seventh Avenue.
- Scenario 2: Elementary School with 354 students and 25 staff members.
 - With two proposed driveways (B and C) on Seventh Avenue.

R.J. Burnside & Associates Limited (Burnside) has been retained to undertake a Transportation Impact Study (TIS) which reviews the transportation impacts associated with both scenarios.

Burnside previously submitted a Transportation Study, dated May 2019 (“2019 TIS”), as part of the application, which considered 260 residential units in this development. Peer review comments were provided by Stantec on behalf of the County of Elgin (dated December 6, 2019). Burnside provided a response to those comments in a memorandum dated December 13, 2019.

This current TIS is provided to consider the changes that have occurred to the proposed draft plan, including the consideration of the alternatives associated with the development of Block 183. If the development proceeds under Scenario 1 (i.e., total of 247 residential units) the overall traffic impacts will be reduced from the previously proposed 260 units. If the project proceeds under Scenario 2 (i.e., total of 191 residential units plus an elementary school), the traffic impacts are assessed to respond to the changes to the traffic volumes and distribution that will result from this changed land use.

Traffic Operations

In general, there are no traffic operational concerns forecasted under existing, background or total conditions; all study intersections are forecasted to operate with excess capacity and level of service (LOS) C or better, with one exception. Under 2032 total conditions, the eastbound movement at the Belmont Road / Seventh Avenue intersection (afternoon peak hour) is forecasted to experience a delay resulting in a LOS F (i.e., 59 to 61 second delay for the eastbound left-right movement, depending on the

scenario). A signal warrant analysis was conducted for this intersection, based on Justification 7 (Projected Volumes) in the *Ontario Traffic Manual Book 12* (OTM Book 12), published by Ministry of Transportation (MTO). The analysis shows that a signal is not warranted. The eastbound left-right movement is forecasted to have excess capacity to beyond horizon 2032 and therefore is considered to have acceptable operations, even with consideration of the longer delays during the PM peak period.

Scenario 1 and Scenario 2 Comparison

Overall, there will be a minimal difference in traffic operations for Scenario 1 and Scenario 2 for the majority of the intersections, with the exception of the Belmont Road / Seventh Avenue intersection. During the morning peak hour, Scenario 1 (all residential) will have more capacity in the movements and experience marginally lower delays in comparison to Scenario 2 (with school). However, under both scenarios there will be sufficient capacity on the roadway to accommodate for the projected volumes.

Geometric Considerations

Sight Distance

All of the intersections and accesses in the study area will meet the minimum sight distance requirements specified by the *Geometric Design Guide for Canadian Roads* (Transportation Association of Canada, June 2017).

Left Turn Warrant Analysis

Based on the information contained in the *MTO Design Supplement for TAC Geometric Design Guide for Canadian Roads* (MTO, April 2020), the warrant is met for a northbound left-turn lane at the Belmont Road / Seventh Avenue intersection, to accommodate background traffic conditions (i.e., left-turn storage of 15 m). Under 2032 Total Traffic Conditions (regardless of the scenario), the left-turn storage requirement increases to 25 m. The asphalt widths are sufficient to accommodate a left turn lane at this location, through adjustment of the lane markings. The provision of a northbound left turn lane at this intersection is a long-term requirement, since the warrants are not currently met under existing 2021 traffic volumes. Considering the timeframe for the warrants being met, it is suggested that the traffic continue to be monitored as development is completed, to confirm the ultimate timing for these lane marking adjustments.

Right Turn Considerations

Under 2032 total conditions, during the afternoon peak hour at the Belmont Road / Seventh Avenue intersection, the southbound right turn volume is forecasted to be 105 vehicles per hour (vph) for Scenario 1 and 103 vph for Scenario 2. The existing asphalt widening along Belmont Road provides for deceleration of southbound right turn movements at this intersection and also facilitates the wider turn requirements for school

buses. Therefore, no improvements are required to accommodate the forecasted right turn movements at this location.

Speed Considerations on Seventh Avenue

The current posted speed limit on Seventh Avenue is 50 km/h between Belmont Road to approximately Snyders Avenue. To the west of Snyders Avenue the posted speed limit is 80 km/h. Under both scenarios it is recommended that the Municipality consider a reduction of the posted speed on Seventh Avenue across the frontage of the subject site, as an added safety measure for pedestrian / cyclist travel and to facilitate turning movements. If Block 83 is developed as a school site, the adjusted posted speed should be consistent with this section of Seventh Avenue being within a school zone.

Traffic Control

Traffic controls within the development are recommended to have two-way stop control on the minor road at intersections.

Proposed Pedestrian and Cyclist Accommodation

The site is well designed to accommodate access by all modes of travel.

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Abbreviations

The following summarizes abbreviations that are utilized within this report:

Operations Analyses

- LOS—level of service
- v/c—volume to capacity ratio

Traffic Movements

- EB—Eastbound
- SB—Southbound
- NB—Northbound
- WB—Westbound
- L—left turn
- T—through
- R—right turn
- LT—shared left-through movement
- LTR—shared left-through-right movement
- TR—shared through-right movement

Other

- ITE—Institute of Transportation Engineers
- LUC—Land Use Code
- TVDSB—Thames Valley District School Board
- OP—Official Plan

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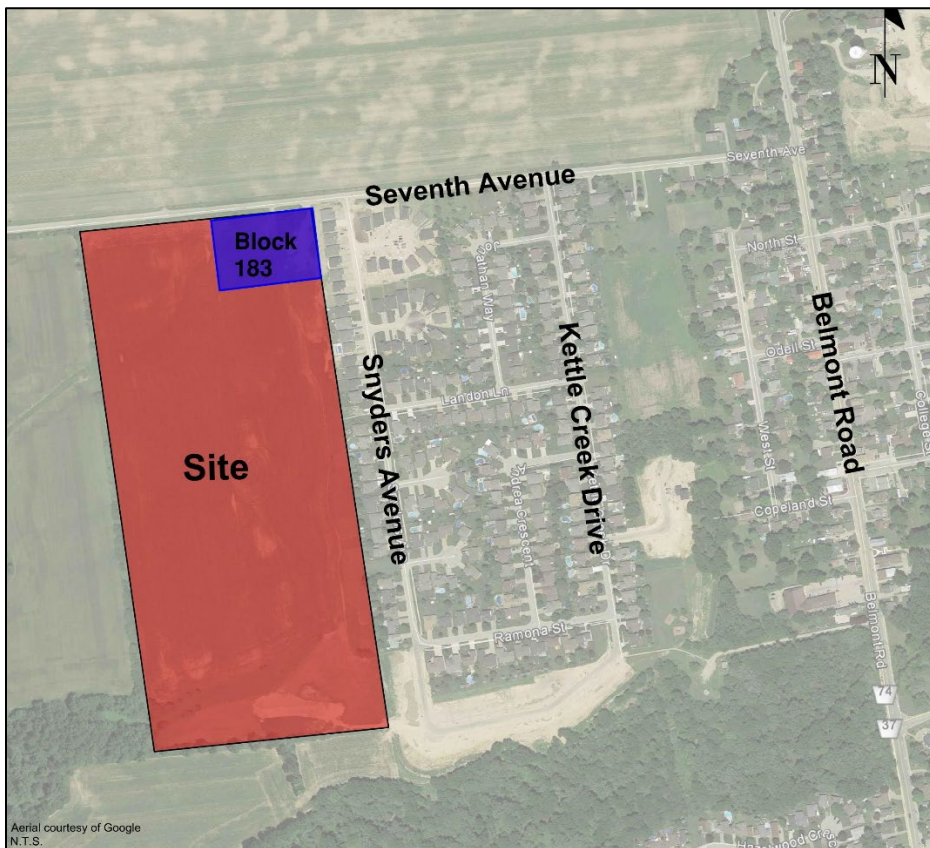
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1.0 Introduction

1.1 Background

Craigholme Estates Ltd. (the Client) is proposing to develop a residential development in the Community of Belmont, Municipality of Central Elgin, Ontario. The site is located south of Seventh Avenue, west of Snyders Avenue. There will be three accesses to the development on Seventh Avenue, as well as an extension of Landon Lane. The location of the proposed development is illustrated in Figure 1.

Figure 1: Site Location



The development is anticipated to be mainly residential homes. However, one block (i.e., Block 183), has potential for the development of a new elementary school by the TVDSB. If the elementary school does not get developed, residential homes would be proposed for this block. Burnside has been retained to undertake a TIS which reviews the transportation impacts associated with both scenarios.

Burnside previously submitted a Transportation Study, dated May 2019 ("2019 TIS"), as part of the application, which considered 260 residential units in this development. Peer review comments were provided by Stantec on behalf of the County of Elgin (dated

December 6, 2019). Burnside provided a response to those comments in a memorandum dated December 13, 2019. Following these submissions, Burnside had submitted an updated Transportation Study, dated June 2021 (“June TIS”). Stantec had provided another peer review on behalf of the County dated June 30, 2021. Overall, Stantec had stated that the study was completed using industry standards and adequately considers forecasted impacts by the proposed development. There were minor clarifications needed and Burnside has addressed these within this report. All comments received and Burnside’s 2019 responses are provided in Appendix A.

This current TIS is provided to consider the changes that have occurred to the proposed draft plan, including the consideration of the alternatives associated with the development of Block 183. If the development proceeds under Scenario 1 (i.e., total of 247 residential units) the overall traffic impacts will be reduced from the previously proposed 260 units. If the project proceeds under Scenario 2 (i.e., total of 191 residential units plus an elementary school), the traffic impacts are assessed to respond to the changes to the traffic volumes and distribution that will result from this changed land use.

1.2 Scope of work

The study scope of work is summarized as the following:

Analysis Scenarios	<ul style="list-style-type: none">Existing traffic conditions2032 background and total traffic conditions
Analysis Time Periods	<ul style="list-style-type: none">Weekday AM peak hour (7:00 AM – 9:00 AM)Weekday PM peak hour (4:00 PM – 6:00 PM)
Analysis Intersections (Study Area)	<ul style="list-style-type: none">Belmont Road & Seventh AvenueKettle Creek Drive & Seventh AvenueSnyders Avenue & Seventh AvenueProposed Access & Seventh Avenue

As the build-out for this development is anticipated to be very slow (i.e., possibly horizon year 2035, depending on market conditions), a time horizon of 2032 was considered to be a reasonable planning horizon for the establishment of traffic impacts.

1.3 Intersection Analysis Methodology

Stop controlled intersection operations were assessed for intersections in the study area using the software program Synchro 11, which employs methodology from the *Highway Capacity Manual* (HCM), published by the Transportation Research Board National Research Council.

Synchro 11 can analyze both signalized and unsignalized intersections in a road corridor or network taking into account the spacing, interaction, queues and operations between intersections. The analysis has utilized the HCM2000 methodology.

Stop controlled intersection analysis considers two separate measures of performance:

- The capacity of the intersection's critical movements, which is based on a volume to capacity ratio.
- The LOS for the critical movements, which is based on the average control delay per vehicle for the various critical movements within the intersection. The link between LOS and delay (in seconds) for stop-controlled intersections is summarized below.

Level of Service	Control Delay per Vehicle(s)
A	0 – 10
B	> 10 – 15
C	> 15 – 25
D	> 25 – 35
E	> 35 – 50
F	> 50

2.0 Existing Conditions

2.1 Site Context

The proposed development is situated in the Community of Belmont. The Community of Belmont had a population of 1,140 as of 2016. The Municipality of Central Elgin had a population of 12,607 as of 2016 (Statistics Canada, 2016).

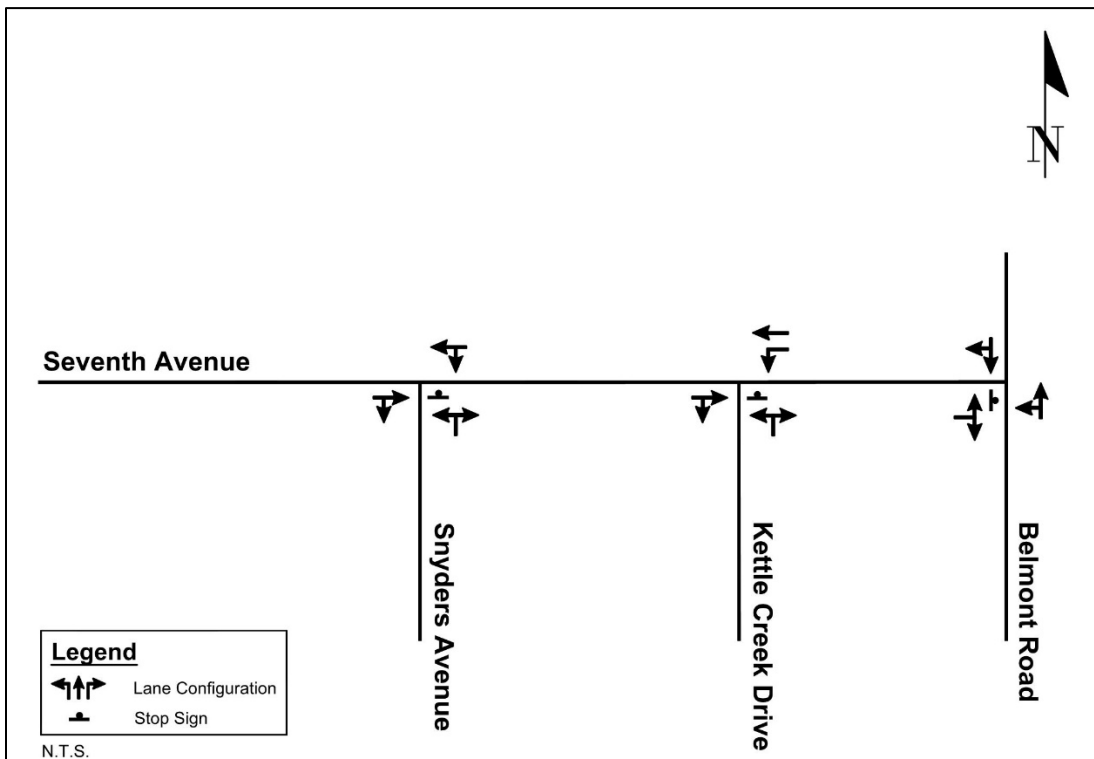
The site is currently occupied by agricultural lands. The site is classified as “Vacant Residential Land” in the Central Elgin Official Plan Planning Report (Central Elgin Planning Office and Dillon Consulting, February 2012).

To the north, the property is bounded by Seventh Avenue. To the south and west, the property is bounded by agricultural lands. To the east, the property is bounded by an existing subdivision, which the proposed subdivision will be connected to via Landon Lane.

2.2 Existing Road Network

The existing road network is described below and is illustrated in Figure 2 , including existing traffic controls.

Figure 2: Existing Road Network



Belmont Road (County Road 74)	Belmont Road is classified as a “County Minor Arterial” road under the jurisdiction of the County of Elgin (the County). For the purposes of this study, it is assumed that Belmont Road runs north-south. Through the Community of Belmont, Belmont Road has a posted speed limit of 50 km/h and consists of a two-lane urban cross section. Between Union Street and Seventh Avenue, sidewalks and parking lanes exist along both sides of Belmont Road. The parking lanes continue to the north of Seventh Avenue, with a sidewalk on the east side only.
Seventh Avenue	Seventh Avenue is classified as a “Collector” road under the jurisdiction of the Municipality of Central Elgin (the Municipality). For the purposes of this study, it is assumed that Seventh Avenue runs east-west. Seventh Avenue has a posted speed limit of 50 km/h between 20 m west of Snyders Avenue and Belmont Road. Between Kettle Creek Drive and Belmont Road, Seventh Avenue consists of a two-lane urban cross section with a sidewalk along the south side of the road. To the west of Kettle Creek Drive, Seventh Avenue consists of a two-lane rural cross section.
Kettle Creek Drive	Kettle Creek Drive is classified as a “Collector” road under the jurisdiction of the Municipality. Kettle Creek Drive has a posted speed limit of 50 km/h and consists of a two-lane urban cross section. A sidewalk extends along the east side of the road.
Snyders Avenue	Snyders Avenue is classified as a “Collector” road under the jurisdiction of the Municipality. Snyders Avenue has a posted speed limit of 50 km/h and consists of two-lane urban cross section. A sidewalk extends along the east side of the road.

2.3 Existing Traffic Volumes

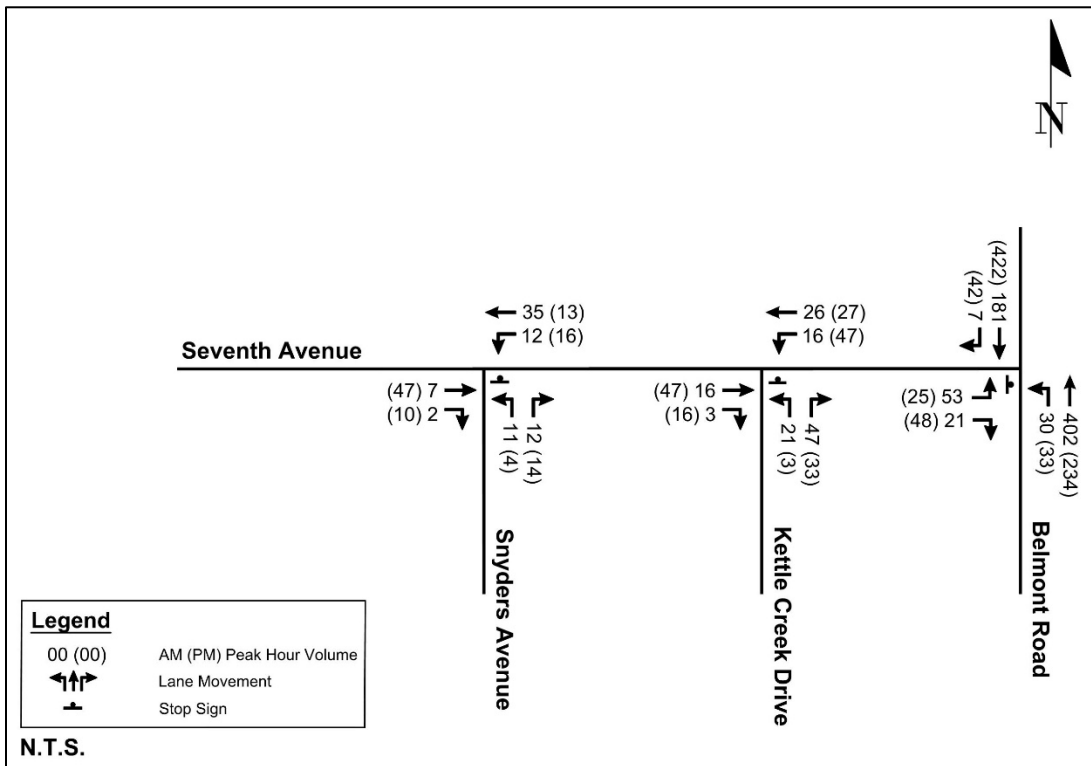
Due to the COVID-19 pandemic, no new counts were collected for the study intersections. Turning movement counts were conducted by Accu-Traffic on behalf of Burnside at all intersections on Wednesday, May 1, 2019. The traffic counts were conducted in the morning from 7:00 AM to 9:00 AM and in the afternoon from 4:00 PM to 6:00 PM. The weekday AM and PM peak hours were selected as these are the typical peak traffic periods for residential developments.

Based on the methodology outlined in Section 3.3, growth was applied to the traffic volumes to represent the existing year (2021). A minor imbalance was observed in the

traffic data along Seventh Avenue between Synders Avenue and Kettle Creek Drive. The through volumes were adjusted to the higher traffic volume to be conservative.

The resulting existing 2021 traffic volumes are illustrated in Figure 3. The historical traffic counts are provided in Appendix B.

Figure 3: Existing 2021 Traffic Volumes



3.0 Future Background Conditions

Future background traffic consists of existing traffic, background traffic growth, and traffic from other developments within the vicinity of the proposed development (if any). For the purposes of this study, an eleven-year horizon (i.e., 2032) was selected for future traffic projections and analysis.

3.1 Future Transit and Active Transportation

Based on the *Elgin-St. Thomas Cycling Master Plan*, prepared by MMM Group (now part of WSP Group), dated September 2014, the following potential cycling network improvements are identified:

- a signed bicycle route with sharrows is proposed on Belmont Road between Seventh Avenue and Union Street (long-term, 20+ years).
- a bicycle lane is proposed on Belmont Road between Union Street and Borden Avenue (long-term, 20+ years).
- a proposed multi-use trail is proposed to connect Kettle Creek Drive to Belmont Road, along the south side of Meadows Park (medium-term, 11-20 years).

In addition, based on the *Municipality of Central Elgin 10 Years Trails Master Plan & Implementation Strategy*, prepared by WSP Group, dated April 2017, a signed bicycle route is also proposed on Seventh Avenue and sidewalks south of Seventh Avenue will be extended from Kettle Creek Drive to the west of Snyders Avenue (beyond 10-year horizon). There is also a proposed sidewalk connection between West Street and the proposed Helen Court Subdivision (details for this subdivision are in the following section), which could be accessed by residents of the proposed development via Landon Lane.

There are currently no planned transit route and improvements in the Community of Belmont. Given the Community's rural nature and relatively low population, it is not anticipated that transit services will be offered in the next 10 years, nor that the demand for transit services will be high enough to justify such services.

3.2 Background Development

A terms-of-reference for the 2019 TIS was circulated to both Central Elgin and Elgin County for comment, requesting comment on both future road networks and nearby developments that should be taken into consideration in this study. This is provided in Appendix C. The background development identified to be within the vicinity of the site and anticipated to be built within the study horizon years (i.e., after the 2019 traffic counts were taken) is provided below.

Helen Court Subdivision

- Located at the southeast quadrant of the Seventh Avenue and Kettle Creek Drive intersection.
- Proposed to consist of 32 residential lots.
- An extension of Landon Lane (from Kettle Creek Drive) is proposed to form a cul-de-sac named Helen Court, which would provide direct access to 28 of the 32 lots. Two lots will be provided direct access to West Street, however one of the lots on West Street will retain the existing house and detached garage with a new walkway added on the lot (i.e., only one new detached home will be added on West Street). The remaining 2 new residential lots will be provided with direct access to Seventh Avenue.
- Weekday AM and PM peak hour site volumes were based on *Proposed Residential Subdivision, Helen Court Traffic Impact Assessment* (Helen Court TIS), prepared by F.R. Berry & Associates, dated April 2018.

In addition, at the time of the traffic count survey, it appears that there were several homes under constructions and / or not occupied. This is also included as part of background development. Trips generated for those homes are based on information in the *Trip Generation Manual, 10th Edition (Trip Generation Manual)* published by the Institute of Transportation Engineers (ITE). The land use code (LUC) for Single-Family Detached Housing (LUC 210) based on a general urban / suburban environment was used in the generation of trips for the single-family homes. Trip distribution is based on existing travel patterns and details are provided in Section 4 of this report. The unbuilt homes include the following:

- 39 homes south of Ramona Lane between Kettle Creek Drive and Snyders Avenue.
- 12 homes east of Kettle Creek Drive on Joanna Crescent.

The related background traffic figures are provided in Appendix D.

3.3 Background Traffic Growth

A growth rate of 1.5% compounded annually was applied to all through volumes on Seventh Avenue as well as to all movements at the Belmont Road / Seventh Avenue intersection.

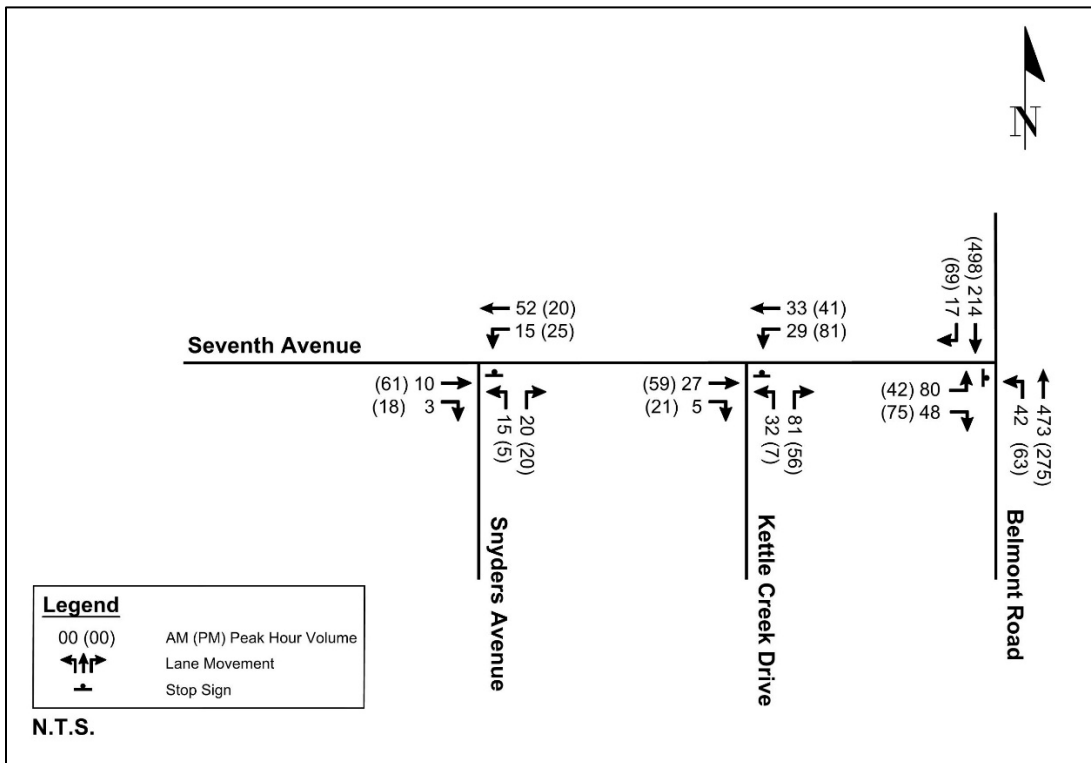
For comparison purposes, Helen Court TIS also applied an annual traffic growth rate of 1.5% to the through volumes on Seventh Avenue and all movements at the Belmont Road / Seventh Avenue intersection. Based on the County of Middlesex website, Middlesex Road 74 between Highway 401 and Belmont (Middlesex Road 74 converts to Belmont Road in the County of Elgin jurisdiction) had volumes of 7,195 and 7,359 in 2015 and 2017, respectively, which translates to approximately a 1.13% CAGR over the two-year period. Between 2011 and 2016, the Municipality of Central Elgin's population decreased by 1.1% (Statistics Canada, 2016).

No growth was applied on any other movements for the other roadway in the study areas.

3.4 Background Traffic Volumes

Background traffic volumes consist of the application of traffic growth per annum (up to horizon year 2032) to existing traffic volumes, in addition to traffic generated from background developments. The resulting traffic volumes are illustrated in Figure 4.

Figure 4: 2032 Background Traffic Volumes



4.0 Proposed Development

According to the latest concept plan prepared by MTE Ontario Land Surveyors Ltd., dated June 1, 2021 (excluding Block 183), the proposed development will consist of 157 single detached residential homes, 18 semi-detached residential homes and 16 street townhomes for a total of 191 residential units. Access to the site is anticipated via the Proposed Road A to Seventh Avenue and extension of Landon Lane. Block 183 is anticipated to be either one of the following:

- Scenario 1: 56 semi-detached residential homes.
 - With two Proposed Roads (B and C) on Seventh Avenue.
- Scenario 2: Elementary School with 354 students and 25 staff members.
 - With two proposed driveways (B and C) on Seventh Avenue.

The draft plans for the overall subdivision, scenario 1 and scenario 2 are provided in Figure 5, Figure 6 and Figure 7, respectively.

Figure 5: Overall Draft Plan

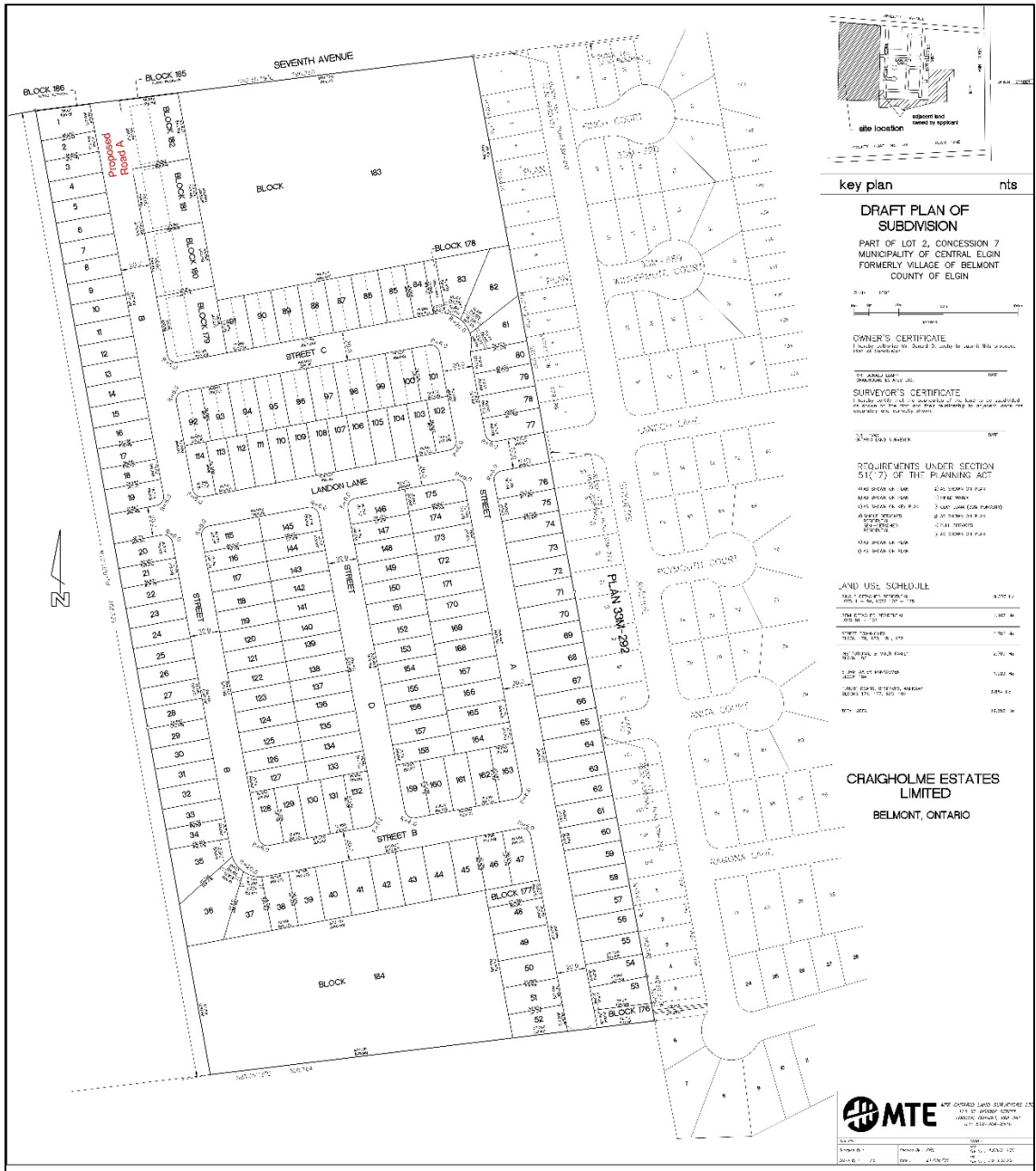


Figure 6: Block 183 Scenario 1 - Residential Homes

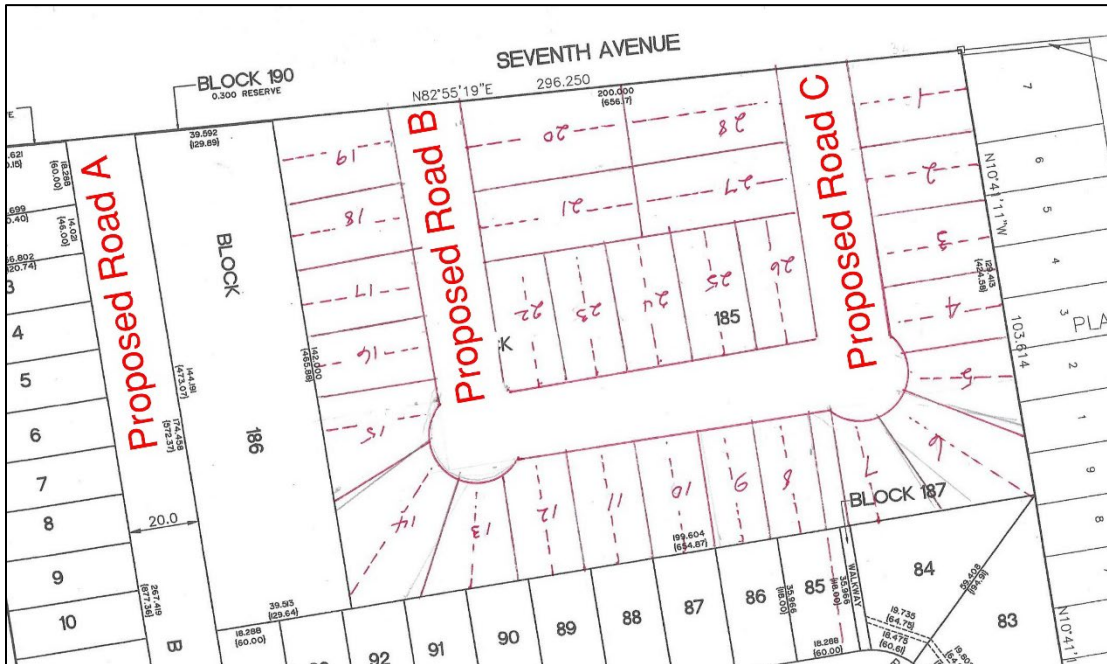
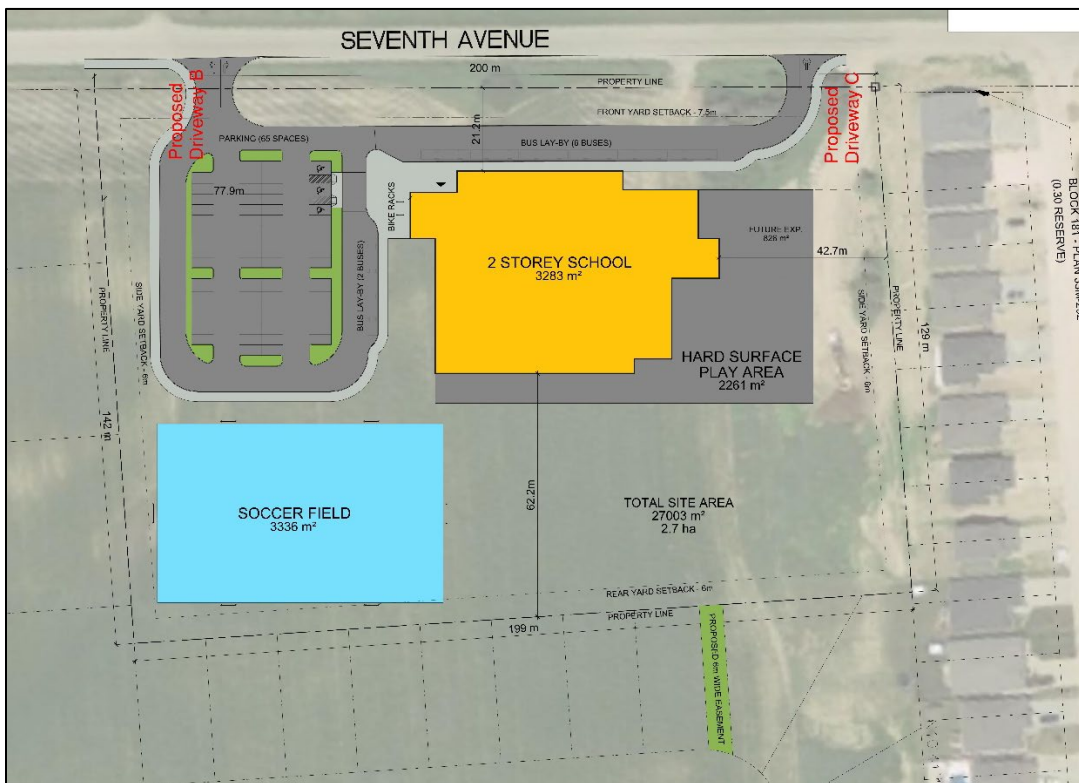


Figure 7: Block 183 Scenario 2 - Elementary School



4.1 Traffic Generation

Trip generation for Scenario 1 and 2 were based upon the information contained in the publication *Trip Generation Manual, 10 Edition* (Institute of Transportation Engineers). The following land use codes were used in the generation of trips based on a general urban / suburban environment:

- Single detached and semi-detached residential homes: Single-Family Detached Housing (LUC 210).
- Street townhomes: Multifamily Housing – Low-Rise (LUC 220).
- Elementary School: Elementary School (LUC 520).

The elementary school's morning peak hour traffic will coincide with the morning adjacent street peak hour traffic. However, the school's afternoon peak hour traffic will be different from the afternoon adjacent street peak hour traffic and residential afternoon peak hour traffic. According to the TVDSB, students will be dismissed by 3:30 PM and school buses will depart by 3:40 PM. As a result, the afternoon peak hour for school will be around 3:15 PM to 4:15 PM. This is earlier than the afternoon adjacent street peak hour and residential afternoon peak hour which usually starts at 4:00 PM. As a comparison, the ITE PM Peak Hour of Generator for the school was also taken into consideration (termed as Scenario 2B). To ensure consistency of peak hour timing, the trip generation for the residential component was based on Burnside's traffic data on Seventh Avenue at the Snyders Avenue and Kettle Creek Drive intersections for 4:00 PM to 4:30 PM time (closest time to the school peak). The counts will be doubled to obtain the hourly volume. At the time of the count, there were a total of 199 single-family homes. The resulting afternoon trip rate that coincide with the school peak generator is 0.56 trips / unit (Inbound 64% and Outbound 36%). Note that we are assuming the townhouse component will follow the same trip rate.

In addition, it is expected that students will be encouraged to walk to school if they live within 300 m to 350 m walking radius (approximately 5-minute walk), or to cycle to school if they are within 1 km. This will reduce the vehicular trips generated by the school.

For Scenario 2 the residential and school uses will be complementary with each other. For example, parents who travel from their home to work may also drop their kids at school and students / staff at the school may also live in the subdivision. A 10% reduction in the number of vehicular trips has been assumed for the school site to reflect this on-site synergy.

The resulting trip generation is summarized in Table 1.

Table 1: Site Trip Generation

Land Use	AM Street Peak Hour			PM Peak Hour		
	In	Out	Total	In	Out	Total
Scenario 1						
Single Family Trips (LUC 210) – 231 Units	42	127	169	143	84	227
Multifamily Low-Rise Trips (LUC 220) – 16 Units	2	6	8	8	4	12
Scenario 1 Total Trips	44	133	177	151	88	239
Scenario 2A (Adjacent Street Peak)						
Single Family Trips (LUC 210) – 175 Units	32	97	129	110	64	174
Multifamily Low-Rise Trips (LUC 220) – 16 Units	2	6	8	8	4	12
Elementary School (LUC 520) – 354 Students	128	109	237	29	31	60
Interaction (10%)	-12	-12	-24	-3	-3	-6
Scenario 2A Total Trips	150	200	350	144	96	240
Scenario 2B (PM Peak Hour Generator)						
Residential Component (Existing Trip Generation) – 191 units	N / A			68	39	107
Elementary School (LUC 520) – 354 Students				54	66	120
Interaction (10%)				-6	-6	-12
Scenario 2B Total Trips				116	99	215

As the afternoon peak hour for Scenario 2A generates more trips than Scenario 2B, Scenario 2A was carried forward in the remaining analysis.

4.2 Trip Distribution and Assignment

The residential trip distribution and assignment were derived from the existing traffic patterns and the available road network.

School distribution was based upon the potential catchment area of the school. The new elementary school in the community will help consolidate three elementary schools (South Dorchester and New Sarum Public Schools to the south, Westminster Central Public School to the east) as they will be closed. In addition, the proposed elementary school will help to mitigate the over-capacity situation in the two public schools to the north, Northdale Central and River Heights Public Schools. As a result, it is projected that a significant percentage of students will travel to/from the South. Belmont Road is classed as a minor arterial road and provides more direct access for students to / from the west and north in comparison to Seventh Avenue.

Based on the above considerations, the estimated distribution / assignment of traffic for the residential units and for the school is summarized in Table 2.

Table 2: Site Traffic Distribution

To / From	Via	Residential				School
		AM Peak		PM Peak		
		In	Out	In	Out	In/Out
North	Belmont Road	61%	13%	24%	49%	20%
South	Belmont Road	24%	52%	47%	38%	70%
West	Seventh Avenue	15%	35%	29%	13%	10%
Total		100%	100%	100%	100%	100%

The resulting site traffic volumes for Scenario 1 and Scenario 2 are illustrated in Figure 8 and Figure 9, respectively.

Figure 8: Scenario 1 Site Traffic Volumes

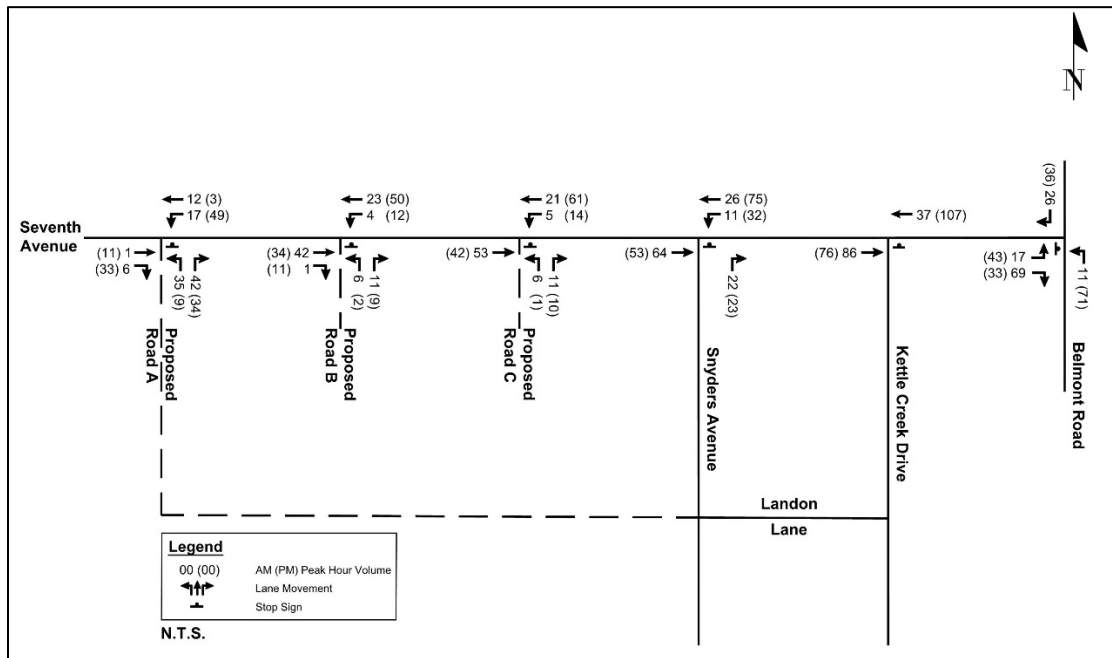
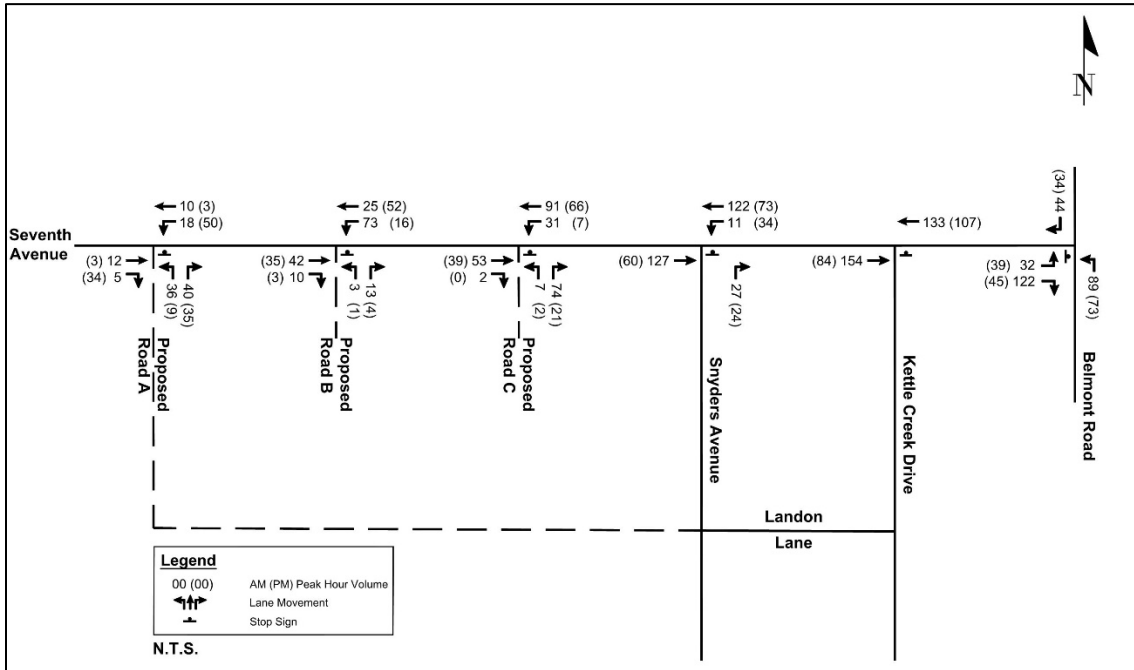


Figure 9: Scenario 2 Site Traffic Volumes



5.0 Total Traffic Conditions

5.1 Total Traffic Volumes

Total traffic volumes consist of background traffic volumes plus the site trips (Scenario 1 or Scenario 2). The resulting Scenario 1 and Scenario 2 2032 total traffic volumes are shown in Figure 10 and Figure 11, respectively.

Figure 10: Scenario 1 2032 Total Traffic Volumes

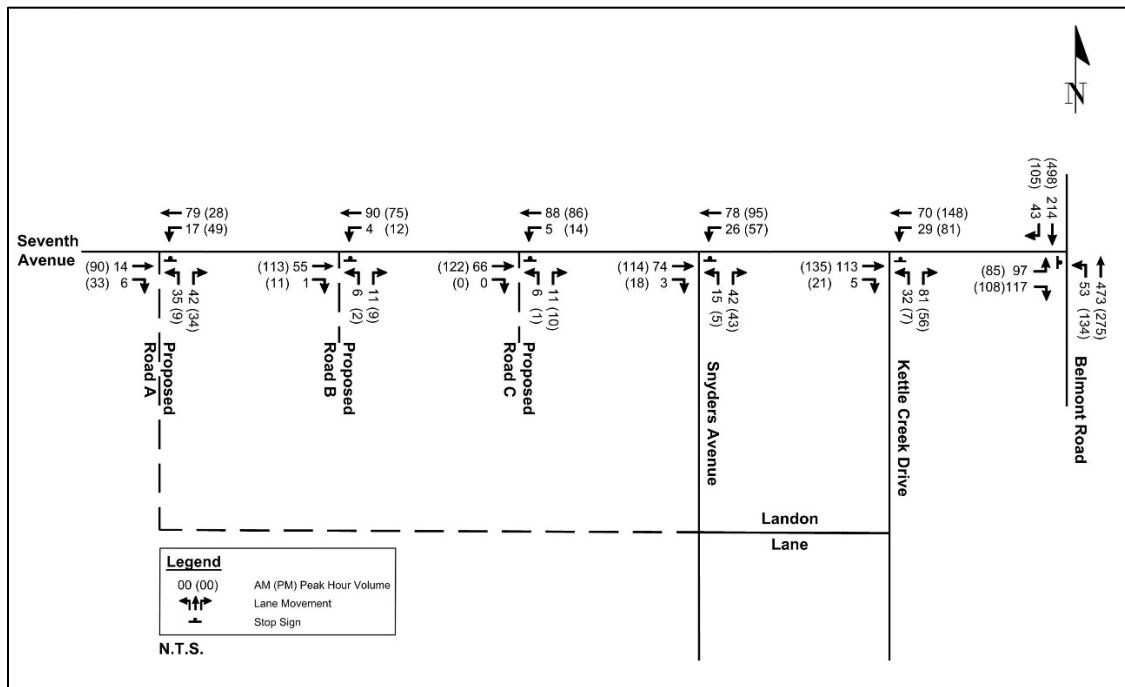
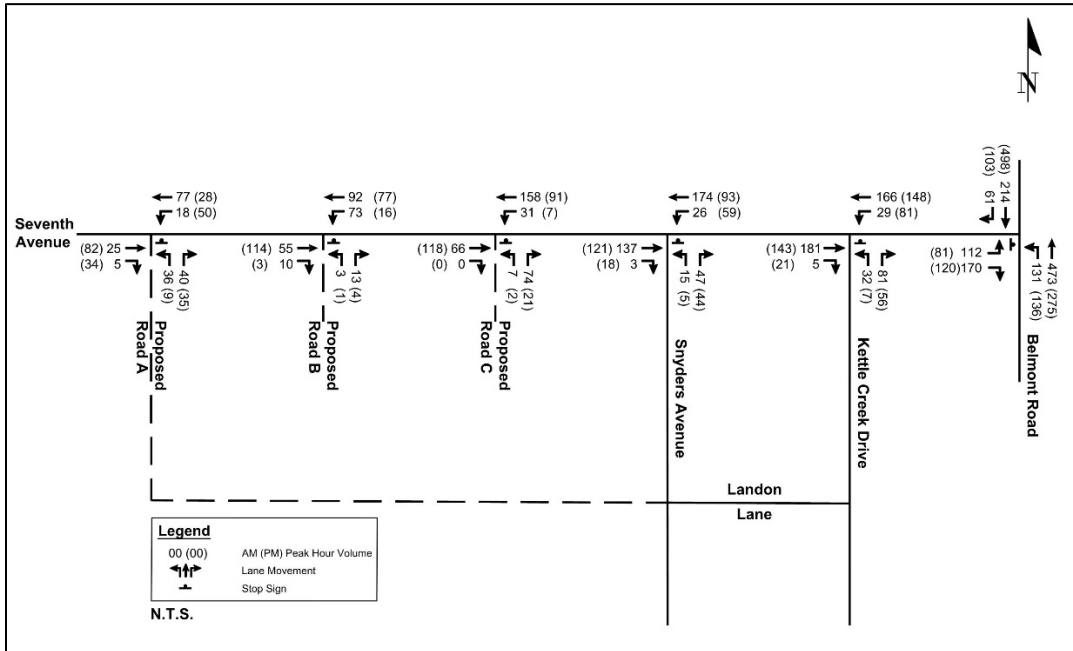


Figure 11: Scenario 2 2032 Total Traffic Volumes



6.0 Traffic Operations Analysis

Traffic operational analyses were conducted under existing and future traffic conditions for the weekday AM and PM peak hours at all study intersections. Queueing was reviewed using Synchro's 95th percentile queue. Comparisons of the existing storage and projected queues are also summarized. Detailed Synchro reports are provided in Appendices E through H.

6.1 Belmont Road / Seventh Avenue

Existing and future traffic operations are summarized in Table 3.

Table 3: Belmont Road / Seventh Avenue Operations

Movement	Existing Storage / Link Distance (m)	Weekday AM Peak Hour			Weekday PM Peak Hour		
		v/c	LOS (delay, sec.)	95 th Queue (m)	v/c	LOS (delay, sec.)	95 th Queue (m)
Existing Conditions							
EBLR	200+	0.17	B	5	0.18	B	5
NBLT	102	0.02	A	1	0.04	A	1
Background 2032 Conditions							
EBLR	200+	0.34	C	11	0.37	C	13
NBLT	102	0.04	A	1	0.07	A	2
Scenario 1 Total 2032 Conditions							
EBLR	200+	0.52	C	22	0.83	F (61)	50
NBLT	102	0.05	A	1	0.16	A	4
Scenario 2 Total 2032 Conditions							
EBLR	200+	0.80	E	53	0.83	F (59)	51
NBLT	102	0.12	A	3	0.17	A	4

Under existing and background conditions, all movements are forecast to operate with excess capacity and a LOS C or better. Existing queues and projected queues are and will be within existing storage.

For 2032 total conditions, there will be excess capacity for all movements in both scenarios. During the morning peak hour, Scenario 1 (all residential) will have greater excess capacity in the movements and experience lower delays in comparison to Scenario 2 (with school). During the afternoon peak, the operations will be very similar. The eastbound movement will experience a delay resulting in a LOS F (59 to 61 sec. delay, depending on the scenario). A signal warrant analysis was conducted for this intersection, based on Justification 7 (Projected Volumes) in the *Ontario Traffic Manual Book 12* (OTM Book 12), published by Ministry of Transportation (MTO). There are currently no pedestrians utilizing this intersection during both peak hours. The increase in pedestrian crossing volumes due to the school was not considered as part of Justification 2B. It is expected that the school will attract primarily outside of the

community; as a result, vehicular traffic would be more predominate. The increase of pedestrians walking at this intersection within this community will not be significant to trigger an effect to the warrant analysis. The analysis shows that a signal is not warranted. The eastbound left-right movement is forecasted to have excess capacity to beyond horizon 2032 and therefore is considered to have acceptable operations, even with consideration of the longer delays during the PM peak period. The results of the signal warrant analysis are summarized in Table 4. Detailed analyses are provided in Appendix I.

Table 4: 2032 Total Traffic Signal Warrant Analysis at Belmont Road / Seventh Avenue

Justification	Justification 1 Minimum Vehicular Volume ¹		Justification 2 Delay to Cross Traffic 1		The Lower Percent of Each Justification	
	1A	1B	2A	2B	1	2
Scenario 1						
Numerical	551	102	449	46	-	-
Compliance	115%	57%	94%	92%	57%	92%
Justified	No		No		No	
Scenario 2						
Numerical	594	121	473	48	-	-
Compliance	124%	67%	99%	96%	67%	99%
Justified	No		No		No	

Note: 1. 1A and 2A are total intersection volumes while 1B and 2B are crossing (of the main road) volumes.
 2. 3A is Justification 1, while 3B is Justification 2.

For each justification, the lower percentage governs the warrant. A signal can be warranted by just one of the justifications, provided that it meets the threshold for both categories. The threshold required for each justification is 120% for projected volumes. Therefore, a traffic signal is not warranted based upon the OTM. However, it is noted that Justification 7 requires a higher threshold value to be met, due to the uncertainty of future traffic forecasts to estimate 8-hour conditions.

6.2 Seventh Avenue / Kettle Creek Drive

Existing and future traffic operations at the intersection of Seventh Avenue / Kettle Creek Drive are summarized in Table 5.

Table 5: Seventh Avenue / Kettle Creek Drive Operations

Movement	Existing Storage / Link Distance (m)	Weekday AM Peak Hour			Weekday PM Peak Hour		
		v/c	LOS (delay, sec.)	95 th Queue (m)	v/c	LOS (delay, sec.)	95 th Queue (m)
Existing Conditions							
WBL	55	0.01	A	1	0.03	A	1
NBLR	58	0.09	A	2	0.04	A	1
Background 2032 Conditions							
WBL	55	0.02	A	1	0.06	A	1
NBLR	58	0.15	A	4	0.07	A	2
Scenario 1 Total 2032 Conditions							
WBL	55	0.03	A	1	0.06	A	2
NBLR	58	0.17	B	5	0.09	A	2
Scenario 2 Total 2032 Conditions							
WBL	55	0.03	A	1	0.06	A	2
NBLR	58	0.21	B	6	0.09	A	2

Under existing, background and total conditions for both scenario and during both peak hours, all movements are forecasted to operate with excess capacity and a LOS B or better. All queues and projected queues are forecasted to be within existing storage. There will be minimum difference in operations for Scenario 1 and Scenario 2.

6.3 Seventh Avenue / Snyders Avenue

The existing, background and total traffic operations at the Seventh Avenue / Snyders Avenue intersection are summarized in Table 6.

Table 6: Seventh Avenue / Snyders Avenue Operations

Movement	Existing Storage / Link Distance (m)	Weekday AM Peak Hour			Weekday PM Peak Hour		
		v/c	LOS (delay, sec.)	95 th Queue (m)	v/c	LOS (delay, sec.)	95 th Queue (m)
Existing Conditions							
WBLT	200+	0.01	A	1	0.01	A	1
NBLR	51	0.03	A	1	0.02	A	1
Background 2032 Conditions							
WBLT	200+	0.01	A	1	0.02	A	1
NBLR	51	0.05	A	1	0.03	A	1
Scenario 1 Total 2032 Conditions							
WBLT	200+	0.03	A	1	0.05	A	1
NBLR	51	0.09	A	2	0.07	A	2
Scenario 2 Total 2032 Conditions							
WBLT	200+	0.03	A	1	0.05	A	1
NBLR	51	0.12	B	3	0.07	A	2

Under existing, background and total conditions, for both scenarios and during both peak hours, all movements are forecasted to operate with excess capacity and a LOS A. All queues and projected queues are forecasted to be within existing storage. There will be minimum difference in operations for Scenario 1 and Scenario 2. Based on the operational analysis, no exclusive turning lanes are recommended at this time.

6.4 Seventh Avenue / Proposed Roads / Proposed Driveways

The future traffic operations for the Proposed Roads / Driveways to Block 183 are summarized in Table 7.

Table 7: Seventh Avenue / Proposed Roads / Proposed Driveways

Movement	Existing Storage / Link Distance (m)	Weekday AM Peak Hour			Weekday PM Peak Hour		
		v/c	LOS (delay, sec.)	95 th Queue (m)	v/c	LOS (delay, sec.)	95 th Queue (m)
Scenario 1							
Seventh Avenue / Proposed Road A							
WBLT	80	0.01	A	1	0.04	A	1
NBLR	120	0.09	A	3	0.05	A	1
Seventh Avenue / Proposed Road B							
WBLT	100	0.00	A	1	0.01	A	1
NBLR	80	0.02	A	1	0.01	A	1
Seventh Avenue / Proposed Road C							
WBLT	88	0.00	A	1	0.01	A	1
NBLR	80	0.02	A	1	0.01	A	1
Scenario 2							
Seventh Avenue / Proposed Driveway A							
WBLT	80	0.01	A	1	0.04	A	1
NBLR	120	0.09	A	3	0.05	A	1
Seventh Avenue / Proposed Driveway B							
WBLT	100	0.05	A	1	0.01	A	1
NBLR	30	0.02	A	1	0.01	A	1
Seventh Avenue / Proposed Driveway C							
WBLT	88	0.02	A	1	0.01	A	1
NBLR	30	0.09	A	2	0.03	A	1

Under existing, background and total conditions for both scenarios and during both peak hours, all movements are forecasted to operate with excess capacity and a LOS A. All queues and projected queues are forecasted to be within existing storage. During the morning peak hour, Scenario 1 (all residential) will have greater excess capacity in the movements in comparison to Scenario 2 (with school). During the afternoon peak hour, there will be minimal difference in operations for Scenario 1 and Scenario 2. Based on the analysis, no turning lanes are required at these accesses.

7.0 Geometric Considerations

7.1 Sight Distance Review

All accesses will be on a relatively straight and flat section of Seventh Avenue. The current speed limit on Seventh Avenue in the area of the subject site is 80 km/h, therefore, all geometric considerations were based on a design speed of 100 km/h.

Based on criteria in the *Geometric Design Guide for Canadian Roads* (TAC guideline), prepared by Transportation Association of Canada, dated June 2017 the following minimum sight distances should be provided at all accesses on Seventh Avenue:

- minimum stopping sight distance of 185 m.
- minimum intersection sight distance of 210 m for left-turn from stop.
- minimum intersection sight distance of 185 m for right-turn from stop.

All of the intersections and accesses in the study area will meet the minimum sight distance requirements specified by the TAC guideline.

7.2 Left turn Warrant Analysis

The warrants for a northbound left turn lane, under 2032 background and total traffic conditions at the Belmont Road / Seventh Avenue intersection, were assessed based on the information contained in the *MTO Design Supplement for TAC Geometric Design Guide for Canadian Roads* (MTO, April 2020). A design speed of 60 km/h was considered. The results of the left-turn lane warrant analysis are summarized in Table 8.

Table 8: Northbound Left Turn Warrant at the Belmont / Seventh Intersection (2032 horizon)

Traffic Volume	Background Conditions		Scenario 1 Total Conditions		Scenario 2 Total Conditions	
	AM Peak hour	PM Peak Hour	AM Peak hour	PM Peak Hour	AM Peak hour	PM Peak Hour
Advancing	515	338	526	409	604	411
Opposing	231	567	257	603	275	601
Left Turn	42	63	53	134	131	136
% Left Turn	8.1%	18.6%	10%	32.7%	22%	33%
Figure from MTO Geometric Standards	EA-6	EA-7	EA-6	EA-9	EA-8	EA-9
Storage Length (m)	15		25		25	

Based on the above analysis, the left-turn lane warrant is met under background traffic conditions by horizon 2032. With the traffic from the subject development (regardless of

Scenario 1 or 2), the left turn storage requirement increases to 25 m. The asphalt widths are sufficient to accommodate a left turn lane through adjustment of the lane markings and reduction of the parking. The provision of a northbound left turn lane at this intersection is a long-term requirement, since the warrants are not currently met under existing 2021 traffic volumes. Considering the timeframe for the warrants being met, it is suggested that the traffic continue to be monitored as development is completed, to confirm the ultimate timing for these adjustments. Implementation of parking prohibitions do not appear to be required at this time.

7.3 Right-Turn Warrant Analysis

Under 2032 total conditions, during the afternoon peak hour at the Belmont Road / Seventh Avenue intersection, the southbound right turn volume is 105 vph for Scenario 1 and 103 vph for Scenario 2. The existing asphalt widening along Belmont Road provides for deceleration of southbound right turn movements at this intersection and also facilitates the wider turn requirements for school buses. Therefore, no improvements are required to accommodate the forecasted right turn movements at this location.

8.0 Concept Plan Review

8.1 Speed Considerations

The current posted speed limit on Seventh Avenue is 50 km/h between Belmont Road to approximately Snyders Avenue. To the west of Snyders Avenue the posted speed limit is 80 km/h. Under both scenarios it is recommended that the Municipality consider a reduction of the posted speed on Seventh Avenue across the frontage of the subject site, as an added safety measure for pedestrian / cyclist travel and to facilitate turning movements. If Block 83 is developed as a school site, the adjusted posted speed should be consistent with this section of Seventh Avenue being within a school zone.

8.2 Traffic Control

All of the intersections and accesses in the study area will meet the minimum sight distance requirements specified by the *Geometric Design Guide for Canadian Roads* (Transportation Association of Canada, June 2017).

8.3 Proposed Pedestrian and Cyclist Accommodation

Similar to the subdivision to the east, pedestrian accommodation will be provided by sidewalks on one side of the roads within the subdivision. It is recommended that the Municipality extend the sidewalks south of Seventh Avenue from Kettle Creek Drive to the frontage of the proposed development. Sidewalks in the development will connect with this future sidewalk on Seventh Avenue. In addition, the proposed sidewalk will extend and connect to the existing sidewalk on Landon Lane. This acts as a connection to both subdivisions. A proposed walkway south of Block 183 will also provide a connection between Block 183 to the remaining development.

With the proposed signed bike routes on Seventh Avenue, cyclists will also have easy access to the road network via the proposed roadways / driveways.

9.0 Conclusions

9.1 Traffic Operations

Under existing, background and total conditions, all study intersections are forecasted to operate with excess capacity and LOS C or better with the exception of the Belmont Road / Seventh Avenue intersection. Under 2032 total conditions, the eastbound movement at the Belmont Road / Seventh Avenue intersection (afternoon peak hour) is forecasted to experience a delay resulting in a LOS F (i.e., 59 to 61 second delay for the eastbound left-right movement, depending on the scenario). A signal warrant analysis was conducted for this intersection, based on Justification 7 (Projected Volumes) in the *Ontario Traffic Manual Book 12* (OTM Book 12), published by Ministry of Transportation (MTO). The analysis shows that a signal is not warranted. The eastbound left-right movement is forecasted to have excess capacity to beyond horizon 2032 and therefore is considered to have acceptable operations, even with consideration of the longer delays during the PM peak period.

9.2 Scenario 1 and Scenario 2 Comparison

Overall, there will be a minimal difference in traffic operations for Scenario 1 and Scenario 2 for the majority of the intersections, with the exception of the Belmont Road / Seventh Avenue intersection. During the morning peak hour, Scenario 1 (all residential) will have more capacity in the movements and experience marginally lower delays in comparison to Scenario 2 (with school). However, under both scenarios there will be sufficient capacity on the roadway to accommodate for the projected volumes.

9.3 Geometric Considerations

Sight Distance

All proposed roads and driveways will meet the TAC minimum sight distance.

Left Turn Warrant Analysis

The northbound left-turn lane warrant at the Belmont Road / Seventh Avenue intersection is met under background conditions. If the traffic from the subject development is included (regardless of Scenario 1 or 2), the left turn storage requirement increases to 25 m (i.e., under 2032 Total Traffic Conditions). The provision of a northbound left turn lane at this intersection is a long-term requirement, since the warrants are not currently met under existing 2021 traffic volumes. Considering the timeframe for the warrants being met, it is suggested that the traffic continue to be monitored as development is completed, to confirm the ultimate timing for these lane marking adjustments.

Right Turn Lane Considerations

Under 2032 total conditions, during the afternoon peak hour at the Belmont Road / Seventh Avenue intersection, the southbound right turn volume is forecasted to be 105 vph for Scenario 1 and 103 vph for Scenario 2. The existing asphalt widening along Belmont Road provides for deceleration of southbound right turn movements at this intersection and also facilitates the wider turn requirements for school buses. Therefore, no improvements are required to accommodate the forecasted right turn movements at this location.

9.4 Concept Plan Review

Speed Considerations

The current posted speed limit on Seventh Avenue is 50 km/h between Belmont Road to approximately Snyders Avenue. To the west of Snyders Avenue the posted speed limit is 80 km/h. Under both scenarios it is recommended that the Municipality consider a reduction of the posted speed on Seventh Avenue across the frontage of the subject site, as an added safety measure for pedestrian / cyclist travel and to facilitate turning movements. If Block 83 is developed as a school site, the adjusted posted speed should be consistent with this section of Seventh Avenue being within a school zone.

Traffic Control

Traffic controls within the development are recommended to have two-way stop control on the minor roads at intersections.

Proposed Pedestrian and Cyclist Accommodation

The site is well designed to accommodate access by all modes of travel.



BURNSIDE

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Appendix A

Municipality's Comments and Burnside's Response

<p>To: Brian Lima Elgin County 450 Sunset Drive St. Thomas, ON N5R 5V1</p> <p>File: 160500030</p>	<p>From: Martin B. Kaczmarek Stantec Consulting Ltd. 100-401 Wellington Street West Toronto, ON M5V 1E7</p> <p>Date: December 6, 2019</p>
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Reference: Residential Development Transportation Impact Study Belmont, ON Peer Review

1 INTRODUCTION

The purpose of this memorandum is to peer review the *Residential Development Transportation Impact Study Belmont, ON* completed by R.J. Burnside & Associates Ltd. in May of 2019 for the Craigholme Estates Ltd. residential subdivision in the Community of Belmont in the Municipality of Central Elgin, Ontario. The review and assessment include a peer review of the study's findings in relation to potential impacts to the surrounding transportation network and intersections. The development is proposed to comprise a total of 260 single detached residential lots.

The location of the proposed development as illustrated in the TIS is shown in **Figure 1**.



Figure 1 - Subject Site Location (Source: Residential Development TIS Belmont, ON, Burnside, May 2019)

December 6, 2019

Brian Lima

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Reference: Residential Development Transportation Impact Study Belmont, ON Peer Review

2 SUMMARY OF STUDY REVIEW

The findings of the peer review are summarized in the following subsections.

2.1 FUTURE BACKGROUND CONDITIONS

Section 3.0 Future Background Conditions: Please identify why the 2030 horizon year was selected, along with when the expected build-out of the proposed development will be.

Section 3.1 Background Developments: Please identify whether the Municipality of Central Elgin or Elgin County were consulted on the future network improvements and nearby developments to be included in the study.

Section 3.1 Background Developments: It is not immediately clear how the trips from the remaining unoccupied homes were assigned to the network as an assignment figure isn't available. Please provide a study area network figure with the combined assigned trips from both the remaining unoccupied homes and the Helen Court subdivision for reference.

Section 3.2 Background Traffic Growth: The second paragraph refers to "online data" that was used to identify historical traffic volumes along Belmont Road and the annual growth rate resulting from those volumes. Please provide a reference for the source of the data used.

2.2 PROPOSED DEVELOPMENT

Section 4.1 Draft Plan of Subdivision: Please identify when it is expected that the development will be completed and occupied.

2.3 TRAFFIC OPERATIONS ANALYSIS

6.0 Traffic Operations Analysis: Please identify thresholds for the evaluation measures of effectiveness (LOS, v/c, queueing) that will be used to identify the potential need for mitigation measures. This will help readers that are unfamiliar with the industry standards to understand when measures of effectiveness signify a deficiency in the network.

6.3 Total Traffic Operations: In light of the LOS "F" operations during the PM peak hour on the eastbound left / right movement at the intersection of Belmont Road with Seventh Avenue, please provide a signal warrant for the intersection to confirm whether the projected 2030 future total traffic demand warrants signalization.

2.4 GEOMETRIC CONSIDERATIONS

Section 7.2 Left-Turn Lane Warrant Analysis: It is recommended to consider whether parking prohibitions should be implemented for the on-street parking at the intersection of Belmont Road with Seventh Avenue, as it is mentioned that this northbound parking lane can be used to move around queued northbound left turning vehicles. If any parked vehicles are present on this segment, vehicles would be unable to move around the queue.

December 6, 2019

Brian Lima

Page 3 of 3

Reference: Residential Development Transportation Impact Study Belmont, ON Peer Review

2.5 CONCLUSIONS AND RECOMMENDATIONS

Section 9.0 Conclusions and Recommendations: In bullet point four, please identify that the operations discussed are in relation to the future total traffic conditions.

2.6 APPENDICES

Appendix B: Please reference the source of the attached figure in Appendix B.

3 CONCLUSIONS

The peer review of the *Residential Development Transportation Impact Study Belmont, ON* completed by R.J. Burnside & Associates Ltd. identified that the study was completed using industry standards and adequately considers forecasted impacts by the proposed development. Minor clarifications were requested in the preceding comments with a request to conduct a signal warrant at the intersection of Belmont Road and Seventh Avenue, however, no errors in the methodology or calculations were identified.

Stantec Consulting Ltd.



Martin B. Kaczmarek P.Eng.
Transportation Engineer

Phone: 416 507 3443

Martin.Kaczmarek@Stantec.com

Attachment: Residential Development Transportation Impact Study Belmont, ON

- c. Naji Alimam (Stantec)
- Brandon Orr (Stantec)



Memorandum

Date: December 13, 2019 **Project No.:** 300044342.0000
Project Name: Belmont Residential Development - Transportation Impact Study
Client Name: Craigholme Estates Ltd.
To: Nelson Guiot, P. Eng. – Strik Baldinelli Moniz
From: Henry Centen, P. Eng.

Burnside prepared a Traffic Impact Study (TIS), dated May 2019, for the above noted project. A peer review was completed of Burnside's TIS by Stantec (dated December 6, 2019) on behalf of Elgin County. As noted in the peer review, minor clarifications were requested along with a request to complete a traffic signal warrant analysis at the intersection of Belmont Road / Seventh Avenue. This memorandum responds to the clarifications and additional analysis requested, which are paraphrased and shown in italics, for reference.

1. *Section 3.0 Future Background Conditions: Please identify why the 2030 horizon year was selected, along with when the expected build-out of the proposed development will be.*

Response:

The industry standard for TIS studies is consideration of 5 or 10 years after build-out, depending on the growth in the area, the size of the development and assuming normal build-out rates apply. This appears to be the standard applied for the adjacent development on Helen Court, which considered a 2024 horizon period (*Traffic Impact Assessment, Proposed Residential Subdivision, Helen Court, Belmont – F. R. Berry & Associates, August 2017, Revised April 2018*).

The Terms of Reference, that Burnside circulated for this study, suggested a time horizon of 5 years after build-out. Subsequently our client noted that build-out is anticipated to be very slow in this area (i.e., possibly horizon year 2035, depending on market conditions). A time horizon of 2030 was considered to be a reasonable planning period for the establishment of traffic impacts from this development, considering this very slow build-out period as well as the greater relative impact from normal traffic growth from the broader area during the longer term.

2. *Section 3.1 Background Developments: Please identify whether the Municipality of Central Elgin or Elgin County were consulted on the future network improvements and nearby developments to be included in the study.*

Response:

A terms-of-reference for this study was circulated to both Central Elgin and Elgin County for comment, requesting comment on both future road networks and nearby developments that should be taken into consideration in this study.

3. *Section 3.1 Background Developments: It is not immediately clear how the trips from the remaining unoccupied homes were assigned to the network as an assignment figure isn't available. Please provide a study area network figure with the combined assigned trips from both the remaining unoccupied homes and the Helen Court subdivision for reference.*

Response:

The background developments that were included in the analysis included 32 units on Helen Court and the remaining 39 unoccupied units in the existing subdivision (i.e., total of 71 units). The traffic distribution for the Helen Court subdivision is shown on the figure in Appendix B of the TIS, taken from the *Traffic Impact Assessment, Proposed Residential Subdivision, Helen Court, Belmont* (F. R. Berry & Associates, August 2017, Revised April 2018). As requested, an additional figure is attached to this memorandum (Exhibit A) to show the combined assignment trips from both the remaining unoccupied homes and the Helen Court subdivision.

4. *Section 3.2 Background Traffic Growth: The second paragraph refers to "online data" that was used to identify historical traffic volumes along Belmont Road and the annual growth rate resulting from those volumes. Please provide a reference for the source of the data used.*

Response:

The references for the online data are the following Middlesex County websites:

<https://www.middlesex.ca/sites/default/files/documents/TRAFFIC%20COUNTS%20SPR EADSHEET%202015.pdf>

<https://www.middlesex.ca/sites/default/files/documents/TRAFFIC%20COUNTS%20SPR EADSHEET%202017.pdf>

5. *Section 6.0 Traffic Operations Analysis: Please identify thresholds for the evaluation measures of effectiveness (LOS, v/c, queuing) that will be used to identify the potential need for mitigation measures. This will help readers that are unfamiliar with the industry standards to understand when measures of effectiveness signify a deficiency in the network.*

Response:

The measures of effectiveness for unsignalized intersections (i.e., under stop sign control) considers three performance metrics, as follows:

- The capacities of the intersection's critical movements, which are based on a volume-to-capacity ratio (i.e., "v/c ratio"), that measures the degree of capacity utilized. When an individual movement has a v/c ratio that exceeds 0.85 it is termed a "critical movement", typically where road improvements may begin to be considered. An at-capacity condition is represented by a v/c ratio of 1.00 (i.e., volume demand equals capacity).
- The level of service ("LOS") for the critical movements, which is based on the average control delay per vehicle for the various critical movements within the intersection. Delay is an indicator of how long a vehicle must wait to complete a movement and is represented by a letter between A and F, with F the longest delay. The relationship between LOS and delay (in seconds) for unsignalized intersections is summarized in the following table:

Level of Service	Control Delay per Vehicle (sec)
A	0 – 10
B	> 10 – 15
C	> 15 – 25
D	> 25 – 35
E	> 35 – 50
F	> 50

Movements with LOS F reflect very long traffic delays, however where v/c ratios are also low it is generally an indication that there would be sufficient gaps in the traffic to serve the demand, although drivers would have to wait some time for the gaps to occur. LOS F may be acceptable for left-turn movements at peak times, depending on capacity and safety considerations.

- Where the forecasted 95th percentile queues for turning movements result in queues exceeding the available storage space, or cause other operational concerns, then road improvements or operational improvements may be considered.
6. *Section 6.3 Total Traffic Operations: In light of the LOS "F" operations during the PM peak hour on the eastbound left / right movements at the intersection of Belmont Road*

with Seventh Avenue, please provide a signal warrant for the intersection to confirm whether the projected 2030 future total traffic demand warrants signalization.

Response:

Justification 7 (“Projected Volumes”) of *Ontario Traffic Manual Book 12: Traffic Signals* (MTO, March 2012), was used to determine if traffic signals will be warranted for the intersection of Belmont Road with Seventh Avenue, under 2030 future total traffic demand. With forecasted volumes at an existing intersection, Justification 7 from OTM Book 12 requires that 120% of the warrant threshold be met. The following warrant percentages were forecasted:

- Minimum volume warrant – 57% met
- Delay to cross traffic warrant – 91% met

The signal warrant analysis is attached to this memorandum (Exhibit B). It is concluded that signals do not meet the 120% warrant threshold required to justify signalization at this location.

7. *Section 7.2 Left-Turn Lane Warrant Analysis: It is recommended to consider whether parking prohibitions should be implemented for the on-street parking at the intersection of Belmont Road with Seventh Avenue, as it is mentioned that this northbound parking lane can be used to move around queued northbound left turning vehicles. If any parked vehicles are present on this segment, vehicles would be unable to move around the queue.*

Response:

The TIS concluded that the warrants for a left turn lane are not currently met at this intersection, however that these warrants may be met by 2030 to accommodate background traffic growth (i.e., 15 m storage required). If the traffic from the subject development is included, the left turn storage requirement increases to 25 m (i.e., under 2030 Total Traffic Conditions). The asphalt widths are sufficient to accommodate a left turn lane through adjustment of the lane markings and reduction of the parking. Considering the timeframe for the warrants being met, the TIS suggested that the traffic continue to be monitored as development is completed, to confirm the ultimate timing for these adjustments. Implementation of parking prohibitions do not appear to be required at this time.

8. *Section 9.0 Conclusions and Recommendations: In bullet point four, please identify that the operations discussed are in relation to the future total traffic conditions.*

Response:

We acknowledge that the operations discussed are in relation to the future total traffic conditions.

9. *Appendix B: Please reference the source of the attached figure in Appendix B.*

Response:

As noted in Section 3.1 of the TIS this figure is from the report *Proposed Residential Subdivision, Helen Court, Belmont, Traffic Impact Assessment* (F.R. Berry Associates, April 2018).

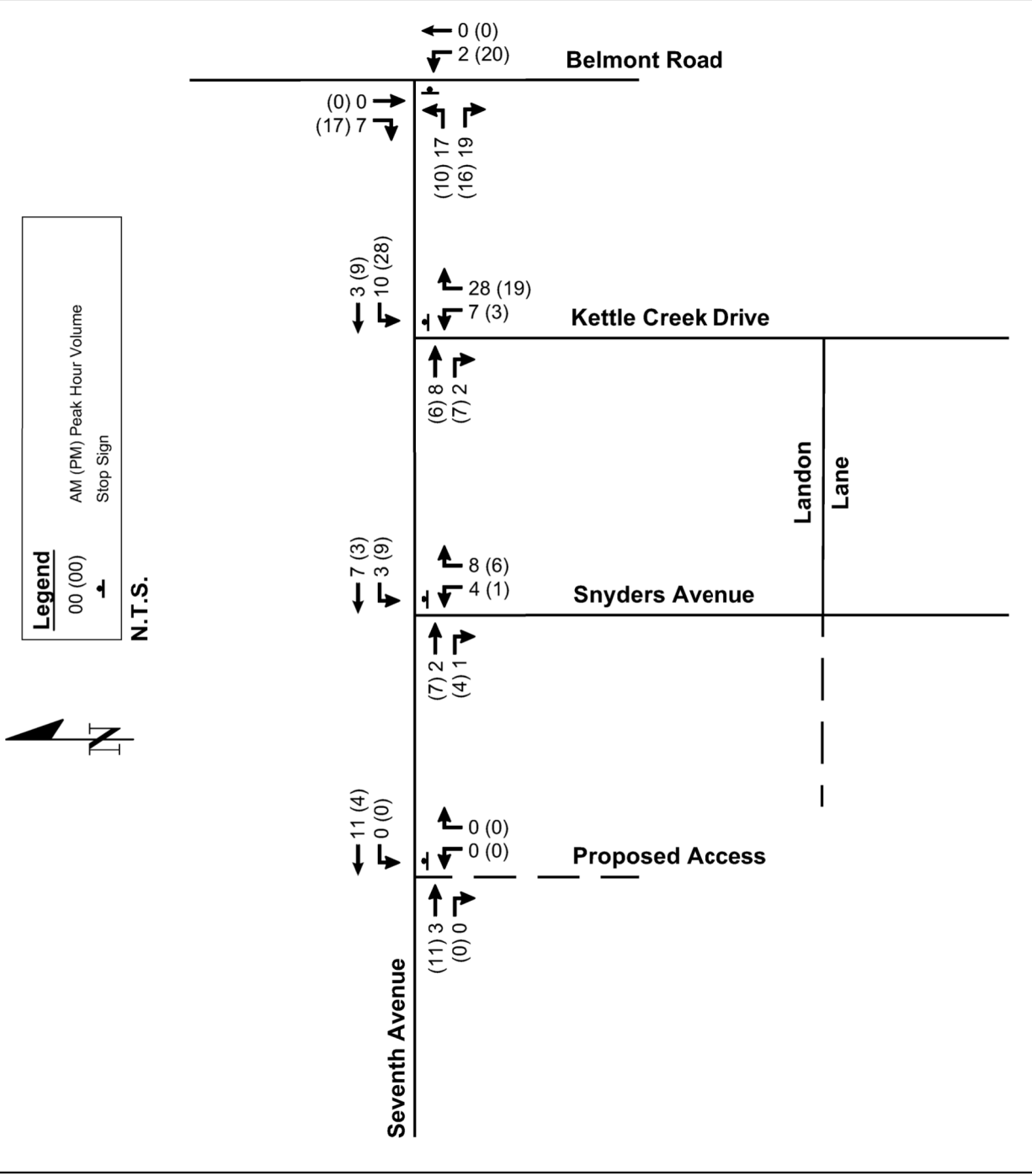
HBC:

Enclosure(s) Exhibit A – Combined Trip Assignment From External Development
 Exhibit B – Signal Warrant Analysis

cc: Don Leahy (donleahy@rogers.com)
 Joe Snyders (snyders46798@gmail.com)

044342 Traffic Reponse.docx
12/13/2019 2:20 PM

Exhibit A
Forecast External Development Traffic Volumes



2030 Total Traffic

Input Sheet

Main Road Belmont Road
Minor Road Seventh Avenue
Direction of Main Road North / South
Date: 13-Dec-19
No. of Lanes on Main 1
T-Intersection Yes
Operating Environment Rural
Scenario Forecasted Traffic Volumes (Existing Intersection)

Analysis Sheet

Justification 1: Minimum Vehicle Volumes

Justification	Guidance Approach Lanes				Total	Section Percent
	1 Lanes		2 or More Lanes			
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW		
1A (All Approach Lanes)	480	720	600	900		
	X					
	COMPLIANCE %				540	113%
1B (Minor Street Both Approaches)	180	255	180	255		
	X					
	COMPLIANCE %				102	57%
Signal Justification 1:						

Justification 2: Delay to Cross Traffic

Justification	Guidance Approach Lanes				Total	Section Percent
	1 lanes		2 or More lanes			
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW		
2A (Major Street Both Approaches)	480	720	600	900		
	X					
	COMPLIANCE %				438	91%
2B (Traffic Crossing Major Street)	50	75	50	75		
	X					
	COMPLIANCE %				62	124%
Signal Justification 2:						

Justification 3: Combination (Justification 1 and 2)

Justification Satisfied 80% or More	
Justification 1	Minimum Vehicular Volume
Justification 2	Delay Cross Traffic

Results Sheet

	Justification	Compliance	Minimum Target	Signal Justified?	
				YES	NO
1. Minimum Vehicular Volume	A. Total Volume	113%	120%		NO
	B. Crossing Volume	57%	120%		NO
2. Delay to Cross Traffic	A. Main Road	91%	120%		NO
	B. Crossing Road	124%	120%		NO
3. Combination	A. Justification 1	57%	120%		NO
	B. Justification 2	91%	120%		NO





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Appendix B

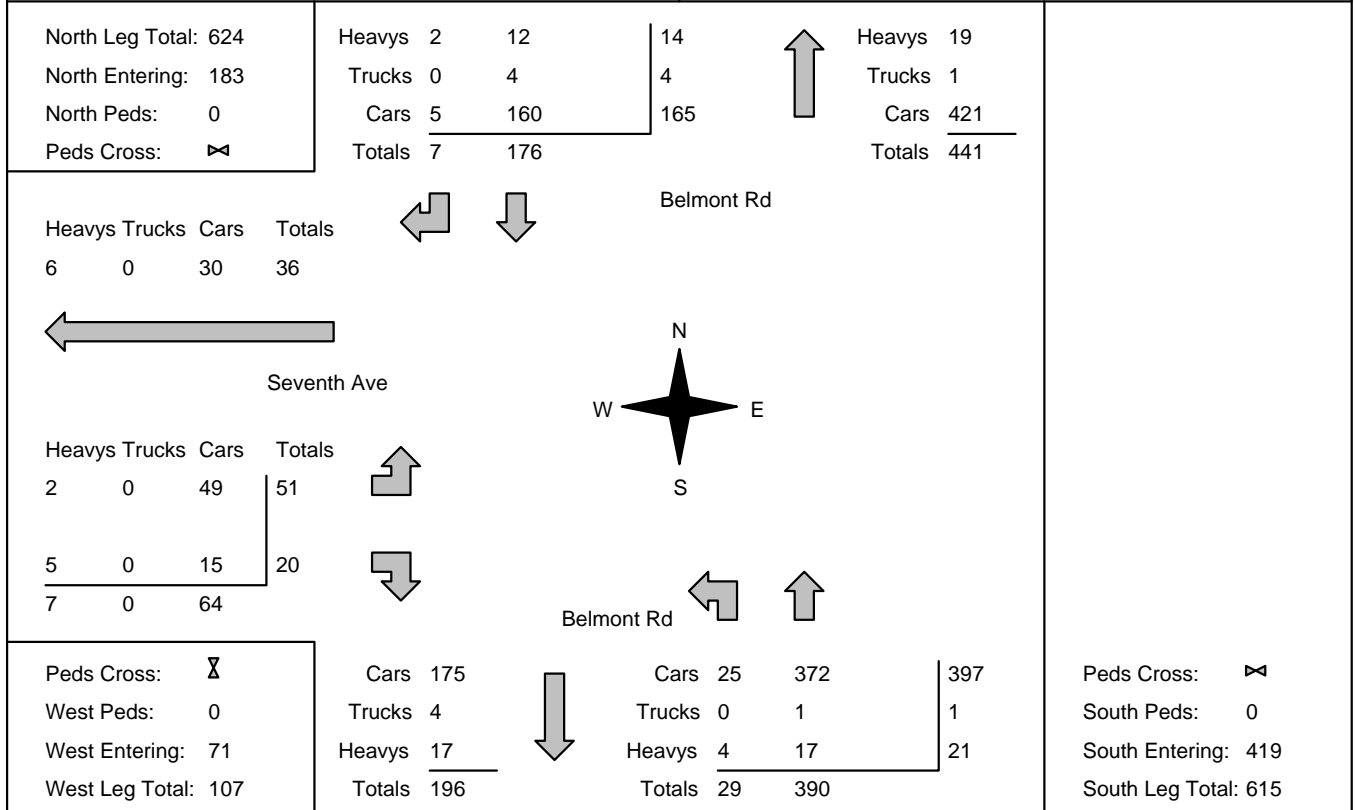
Existing Traffic Counts

Accu-Traffic Inc.

Morning Peak Diagram	Specified Period From: 7:00:00 To: 9:00:00	One Hour Peak From: 7:15:00 To: 8:15:00
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Municipality: Belmont Site #: 1907300001 Intersection: Belmont Rd & Seventh Ave TFR File #: 1 Count date: 1-May-19	Weather conditions: Person counted: Person prepared: Person checked:
---	---

** Non-Signalized Intersection **	Major Road: Belmont Rd runs N/S
--	--



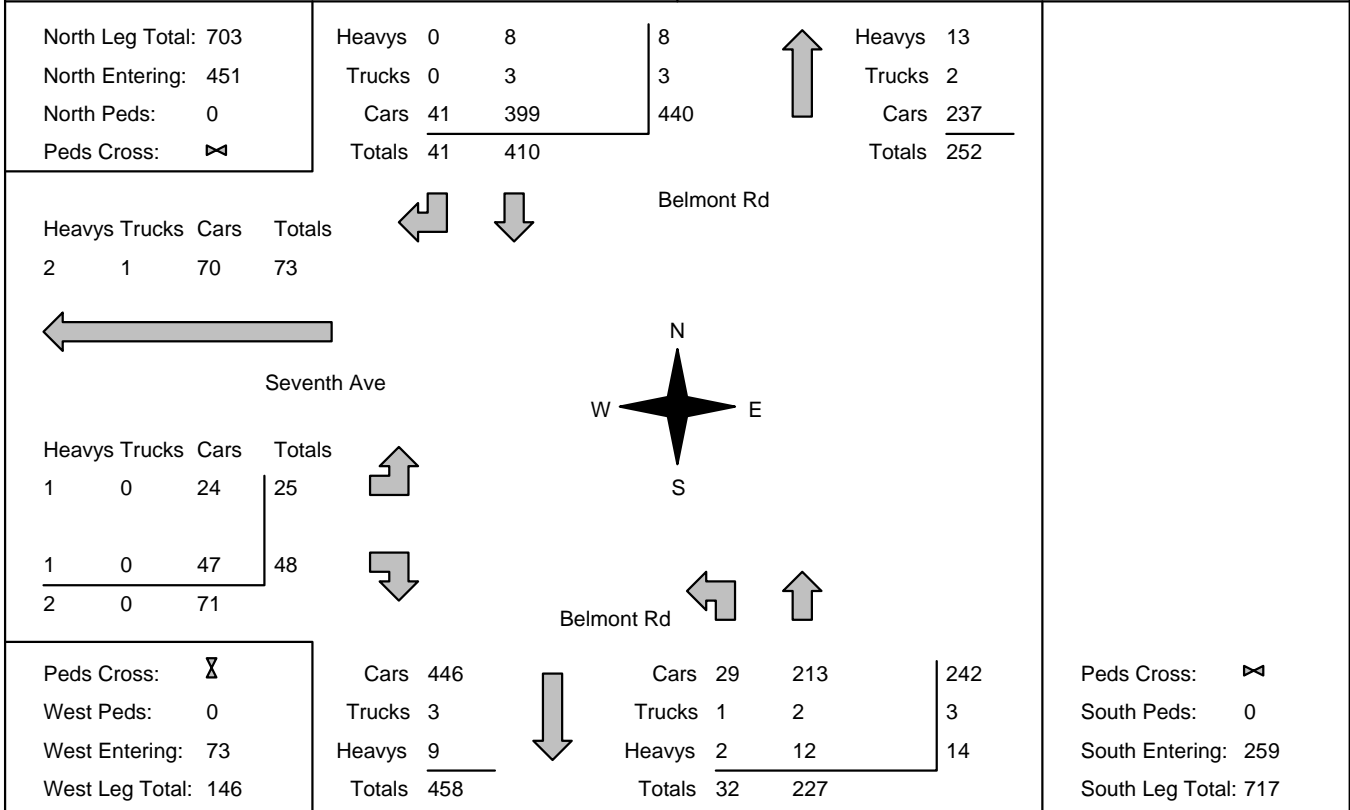
Comments

Accu-Traffic Inc.

Afternoon Peak Diagram	Specified Period From: 16:00:00 To: 18:00:00	One Hour Peak From: 16:15:00 To: 17:15:00
-------------------------------	---	--

Municipality: Belmont Site #: 1907300001 Intersection: Belmont Rd & Seventh Ave TFR File #: 1 Count date: 1-May-19	Weather conditions: Person counted: Person prepared: Person checked:
---	---

** Non-Signalized Intersection **	Major Road: Belmont Rd runs N/S
--	--

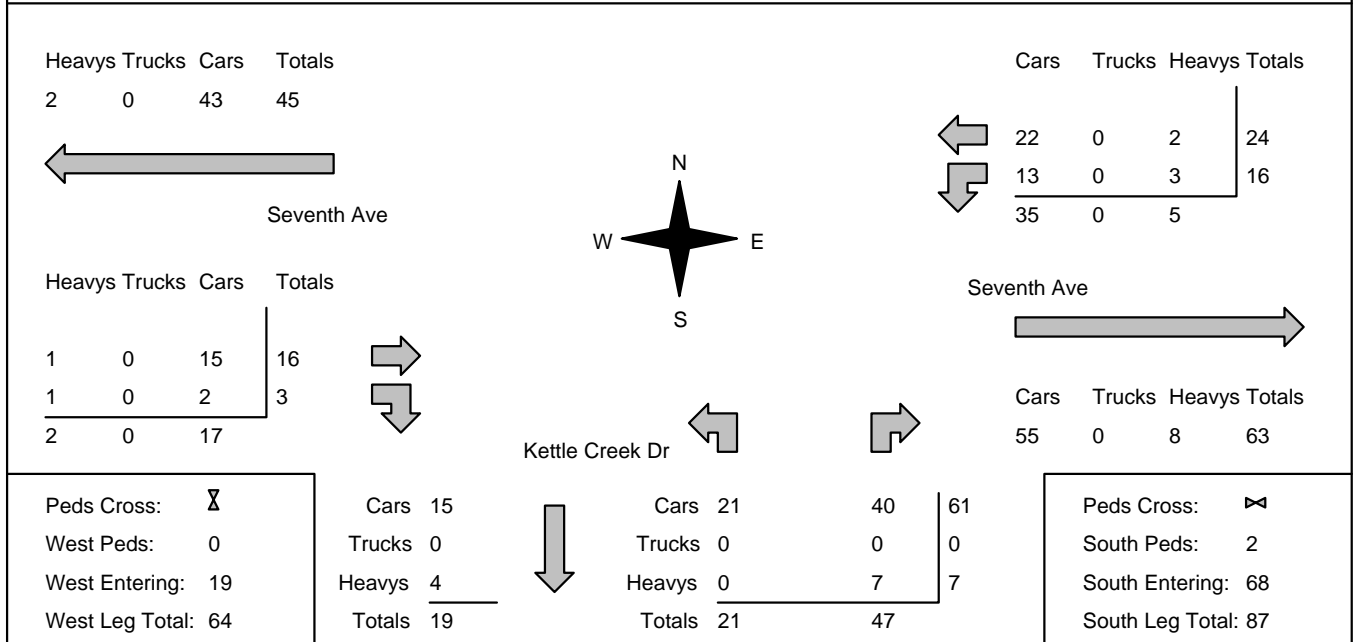


Comments

Accu-Traffic Inc.

Morning Peak Diagram	Specified Period From: 7:00:00 To: 9:00:00	One Hour Peak From: 7:45:00 To: 8:45:00
Municipality: Belmont Site #: 1907300002 Intersection: Seventh Ave & Kettle Creek Dr TFR File #: 1 Count date: 1-May-19	Weather conditions: Person counted: Person prepared: Person checked:	
** Non-Signalized Intersection **	Major Road: Seventh Ave runs W/E	

	East Leg Total: 103 East Entering: 40 East Peds: 0 Peds Cross: 8
--	---

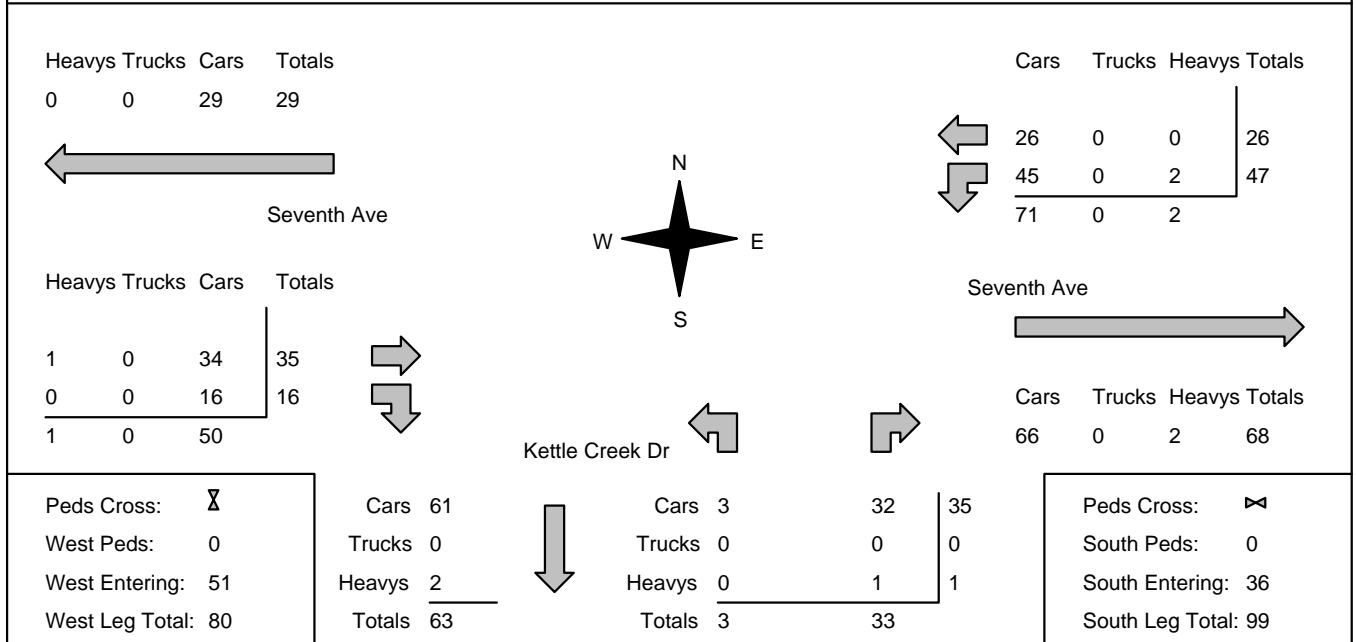


Comments

Accu-Traffic Inc.

Afternoon Peak Diagram	Specified Period From: 16:00:00 To: 18:00:00	One Hour Peak From: 16:15:00 To: 17:15:00
Municipality: Belmont Site #: 1907300002 Intersection: Seventh Ave & Kettle Creek Dr TFR File #: 1 Count date: 1-May-19	Weather conditions: Person counted: Person prepared: Person checked:	
** Non-Signalized Intersection **	Major Road: Seventh Ave runs W/E	

	East Leg Total: 141 East Entering: 73 East Peds: 0 Peds Cross: X
--	---

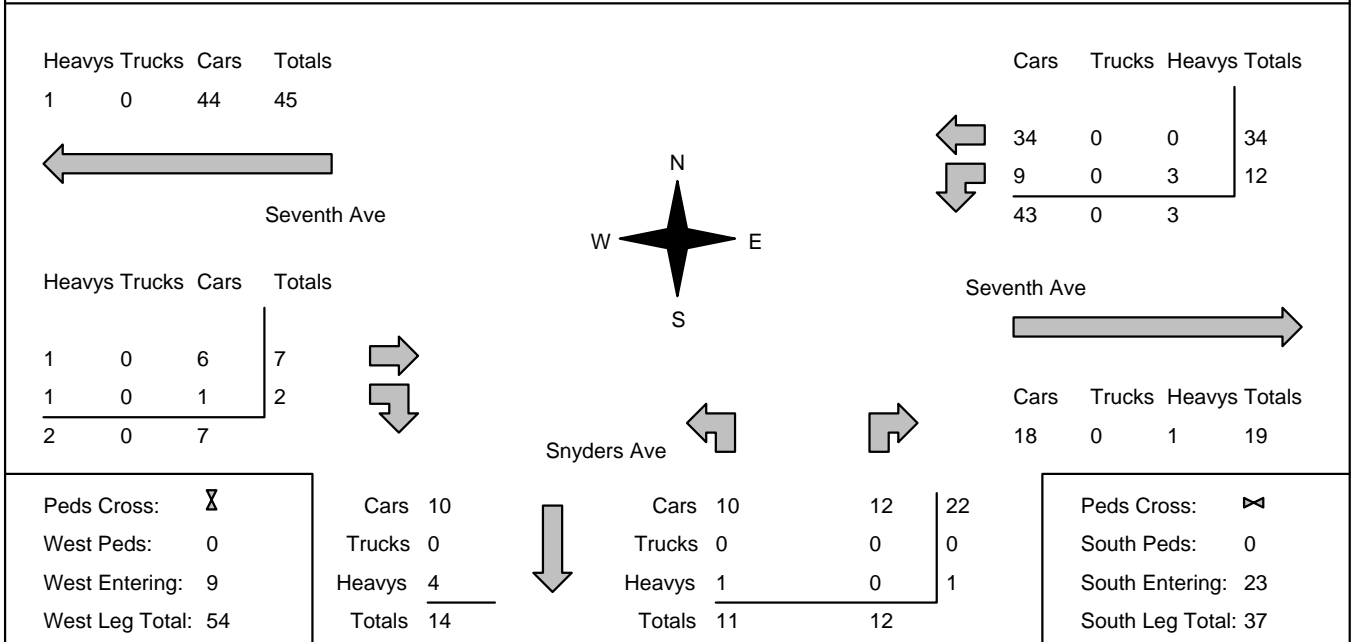


Comments

Accu-Traffic Inc.

Morning Peak Diagram	Specified Period From: 7:00:00 To: 9:00:00	One Hour Peak From: 7:45:00 To: 8:45:00
Municipality: Belmont Site #: 1907300003 Intersection: Seventh Ave & Snyders Ave TFR File #: 1 Count date: 1-May-19	Weather conditions: Person counted: Person prepared: Person checked:	
** Non-Signalized Intersection **	Major Road: Seventh Ave runs W/E	

	East Leg Total: 65 East Entering: 46 East Peds: 0 Peds Cross: 8
--	--

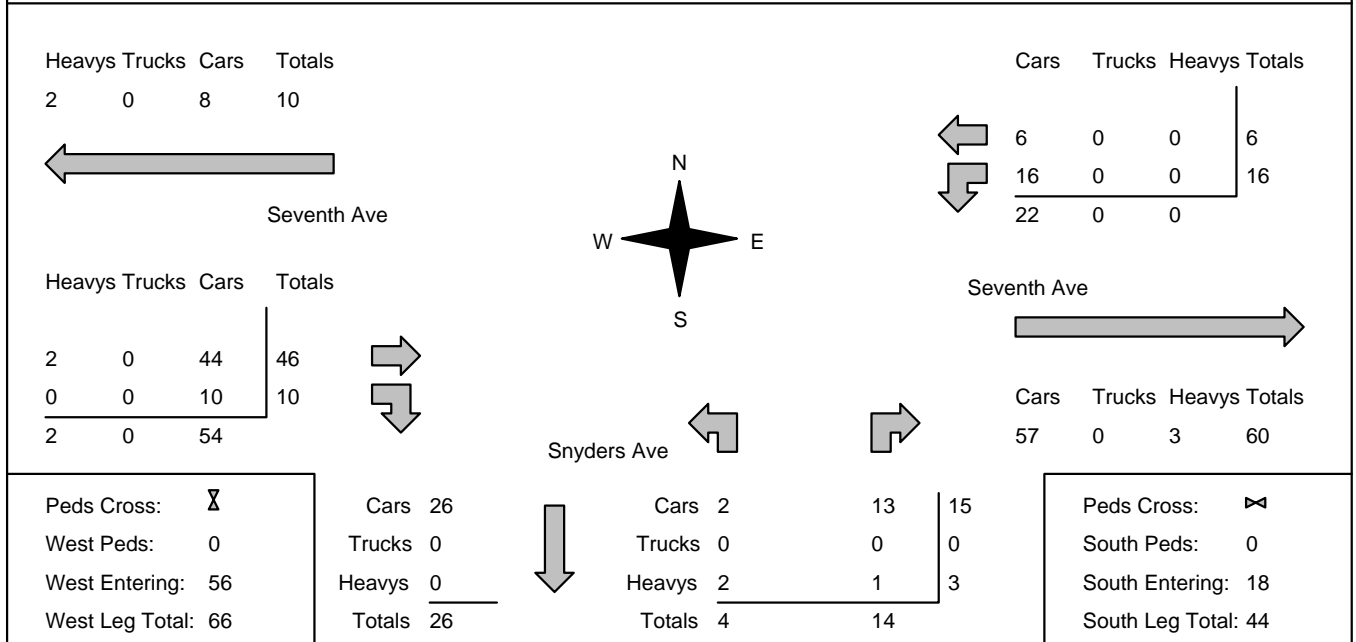


Comments

Accu-Traffic Inc.

Afternoon Peak Diagram	Specified Period From: 16:00:00 To: 18:00:00	One Hour Peak From: 16:00:00 To: 17:00:00
Municipality: Belmont Site #: 1907300003 Intersection: Seventh Ave & Snyders Ave TFR File #: 1 Count date: 1-May-19	Weather conditions: Person counted: Person prepared: Person checked:	
** Non-Signalized Intersection **	Major Road: Seventh Ave runs W/E	

	East Leg Total: 82 East Entering: 22 East Peds: 0 Peds Cross: X
--	--



Comments



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Appendix C

2019 Terms of Reference

From: Cody Raposo
Sent: April 18, 2019 3:04 PM
To: bpeynenburg@centralelgin.org <bpeynenburg@centralelgin.org>
Cc: gbrooks@centralelgin.org <gbrooks@centralelgin.org>; Henry Centen <Henry.Centen@rjburnside.com>
Subject: FW: Belmont Subdivision - TIS Terms of Reference - 044342

Hi Birdie,

I originally sent the email below to Geoff Brooks, however I got an automatic reply indicating that he will be away until April 29th. In Geoff's absence, would you be able to comment on the Terms of Reference (ToR) below, or forward my email to someone at Central Elgin who may be able to?

Thanks,

From: Cody Raposo
Sent: Thursday, April 18, 2019 2:56 PM
To: gbrooks@centralelgin.org
Cc: Henry Centen <Henry.Centen@rjburnside.com>
Subject: Belmont Subdivision - TIS Terms of Reference - 044342

Hi Geoff,

R.J. Burnside & Associates Limited is preparing a Transportation Impact Study (TIS) for a proposed 260-unit detached home development in Belmont. The draft plan of subdivision is illustrated in the following image:



SEVENTH AVENUE

LONDON LANE



Proposed Terms of Reference (ToR) for our study are provided below for your review. If you could confirm acceptance and provide comments regarding any revised or additional requirements, it would be appreciated. I have outlined specific data requests below using **yellow highlights**. Please note that the County of Elgin was sent a similar email, concerning intersections and roads under their jurisdiction.

Study Intersections:

1. Belmont Road & Seventh Avenue → County jurisdiction
2. Kettle Creek Drive & Seventh Avenue
3. Snyders Avenue & Seventh Avenue
4. Proposed Access & Seventh Avenue

Turning Movement Counts (TMCs) are required at the three (3) existing study intersections. **Can you please let me know if the Municipality has TMC data available at the Kettle Creek Drive / Seventh Avenue and Snyders Avenue / Seventh Avenue intersections?** If not, Burnside intends to collect weekday TMCs at these intersections between 7-10 AM and 4-6 PM.

Analysis Periods:

Weekday AM peak period (between 7:00 to 10:00 AM) and weekday PM peak period (between 4:00 to 6:00 PM).

Analysis Horizon Years:

1. Existing (2019)
2. 5-years after the assumed completion of the development

Background Traffic Growth:

Background traffic growth rates on roads in the study area will be based on historical growth rates and/or estimation of future background growth. Growth rates in area transportation studies may also be used.

Background Developments:

If there are any specific proposed developments nearby that the Municipality believes should be included as additional background traffic in our study, could you please provide us with the transportation studies for all such developments?

Future Road Network:

We are not aware of any proposed changes (e.g., road widening, installation of bicycle lanes, signals, etc.) to any roads in the study area. **If there are plans for any improvements in the study area, we ask that this information be provided to us so that it can be incorporated into our analysis as necessary.**

Trip Generation & Distribution:

Trip generation estimates will be based on information in the *Trip Generation Manual 10th Edition* (Institute of Transportation Engineers). Trip distribution will be based on existing travel patterns.

Traffic Operations Analysis:

Traffic operations will be assessed using Synchro 9 software. If deficiencies are identified, further analysis will be performed to determine required improvements to maintain adequate levels of service.

Geometrics Review:

Burnside will identify geometric constraints (i.e., sight distances and alignments) at the proposed site access location on Seventh Avenue.

Please feel free to call to discuss if you have any questions.

Thanks,

From: Cody Raposo
Sent: April 18, 2019 2:17 PM
To: pdutchak@elgin.ca <pdutchak@elgin.ca>
Cc: Henry Centen <Henry.Centen@rjburnside.com>
Subject: Belmont Subdivision - TIS Terms of Reference - 044342

Hi Peter,

As discussed, R.J. Burnside & Associates Limited is preparing a Transportation Impact Study (TIS) for a proposed 260-unit detached home development in Belmont (Central Elgin). Please note that the Municipality of Central Elgin will be sent a similar email, concerning intersections and roads under their jurisdiction. The draft plan of subdivision is illustrated in the following image:



Proposed Terms of Reference (ToR) for our study are provided below for your review. If you could confirm acceptance and provide comments regarding any revised or additional requirements, it would be appreciated. I have outlined specific data requests below using **yellow highlights**.

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Future Road Network:

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Geometrics Review:

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Thanks,



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Appendix D

Background Development Site Traffic

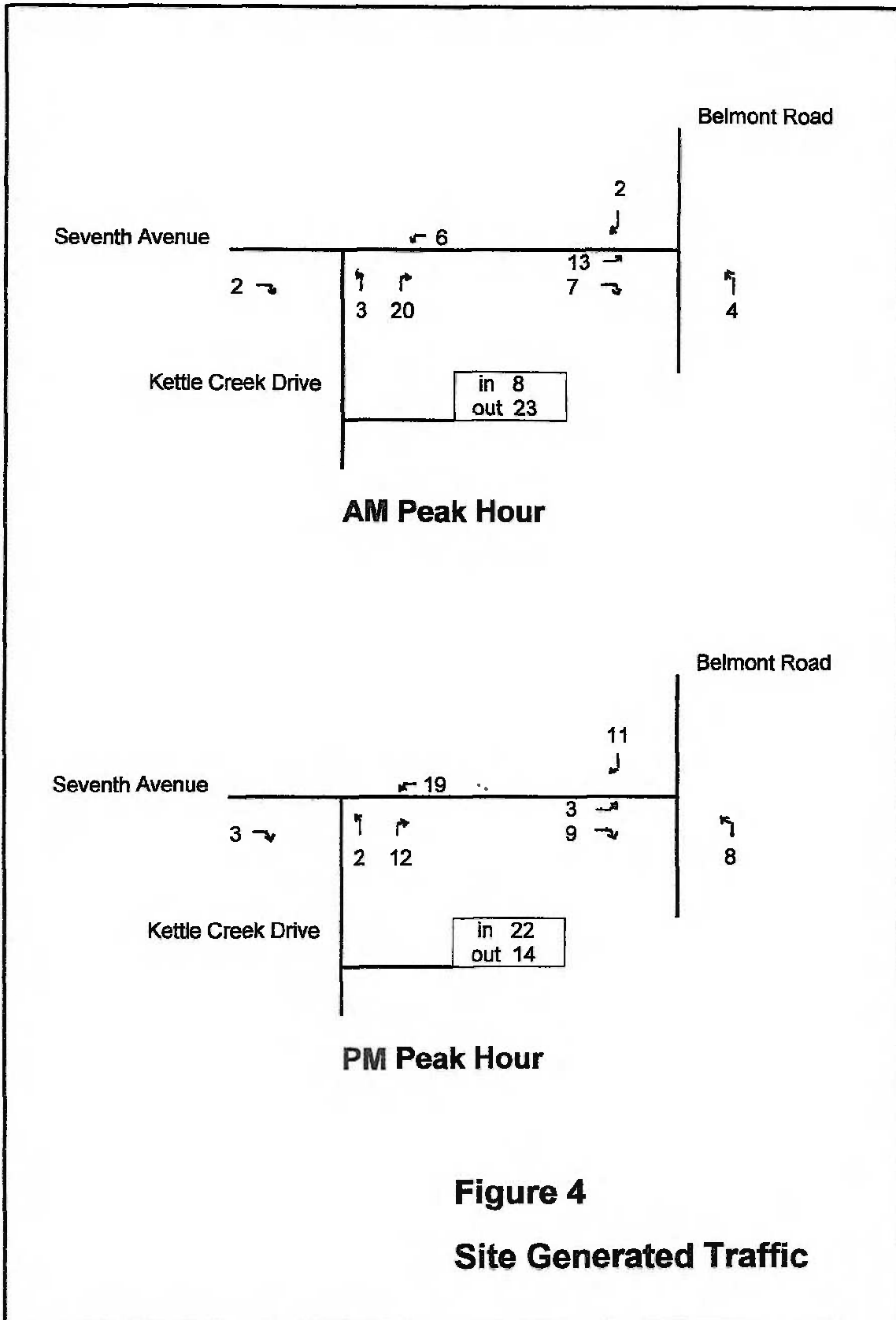
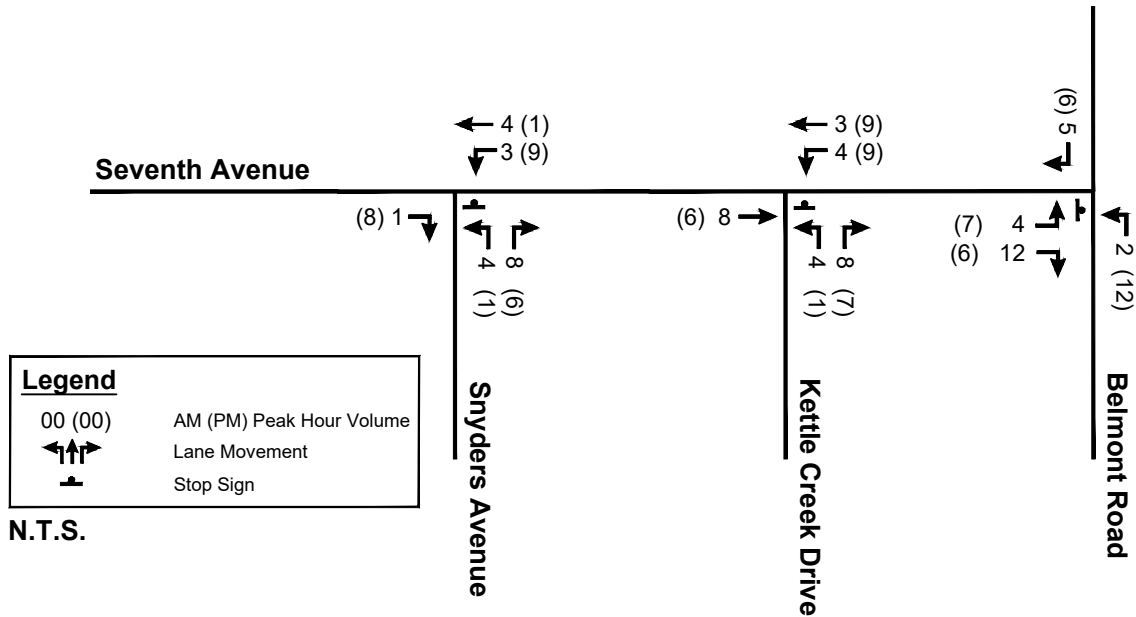
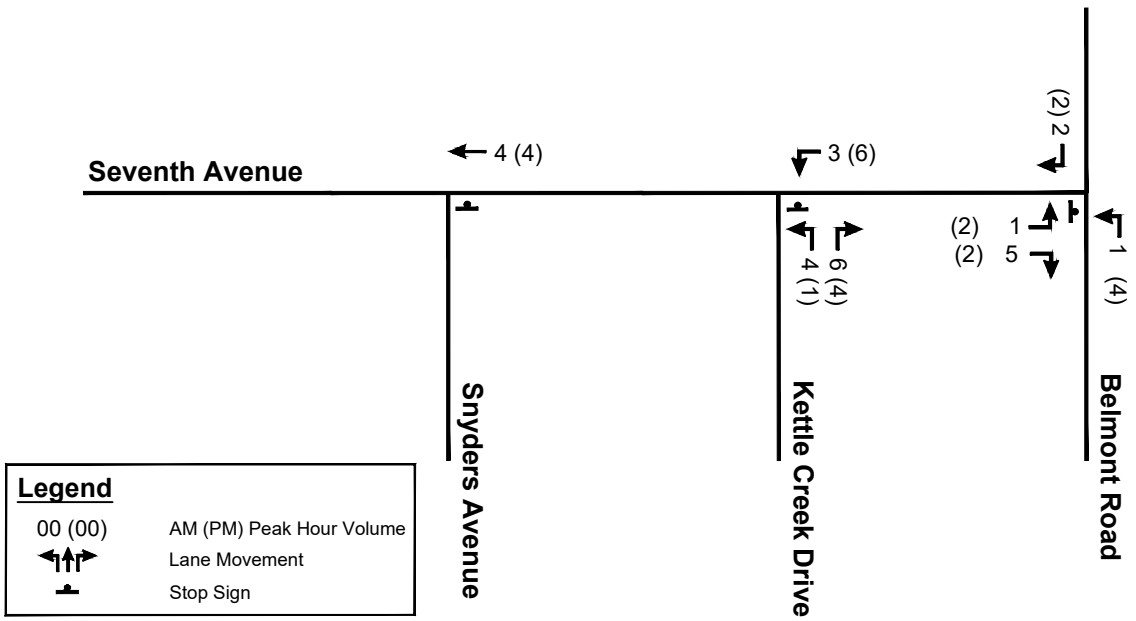


Figure 4
Site Generated Traffic

BG Development - Unbuilt homes south of Ramano Lane



BG Development - Unbuilt homes on Joanne Crescent





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Appendix E

Existing Traffic Operations

HCM Unsignalized Intersection Capacity Analysis
4: Snyders Avenue & Seventh Avenue

Existing AM

	→	↖	↙	←	↘	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↖			↗	↘	↙
Traffic Volume (veh/h)	7	2	12	35	11	12
Future Volume (Veh/h)	7	2	12	35	11	12
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.70	0.70	0.70	0.70	0.70	0.70
Hourly flow rate (vph)	10	3	17	50	16	17
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			13		96	12
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			13		96	12
tC, single (s)			4.3		6.5	6.2
tC, 2 stage (s)						
tF (s)			2.4		3.6	3.3
p0 queue free %			99		98	98
cM capacity (veh/h)			1468		877	1075
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	13	67	33			
Volume Left	0	17	16			
Volume Right	3	0	17			
cSH	1700	1468	969			
Volume to Capacity	0.01	0.01	0.03			
Queue Length 95th (m)	0.0	0.3	0.8			
Control Delay (s)	0.0	2.0	8.8			
Lane LOS		A	A			
Approach Delay (s)	0.0	2.0	8.8			
Approach LOS			A			
Intersection Summary						
Average Delay		3.7				
Intersection Capacity Utilization		19.2%		ICU Level of Service	A	
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
5: Kettle Creek Drive & Seventh Avenue

Existing AM

	→	↖	↙	←	↘	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↖			↗	↘	↙
Traffic Volume (veh/h)	16	3	16	26	21	47
Future Volume (Veh/h)	16	3	16	26	21	47
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.81	0.81	0.81	0.81	0.81	0.81
Hourly flow rate (vph)	20	4	20	32	26	58
Pedestrians					2	
Lane Width (m)					3.7	
Walking Speed (m/s)					1.1	
Percent Blockage					0	
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			26		96	24
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			26		96	24
tC, single (s)			4.3		6.4	6.4
tC, 2 stage (s)						
tF (s)			2.4		3.5	3.4
p0 queue free %			99		97	94
cM capacity (veh/h)			1482		894	1014
Direction, Lane #	EB 1	WB 1	WB 2	NB 1		
Volume Total	24	20	32	84		
Volume Left	0	20	0	26		
Volume Right	4	0	0	58		
cSH	1700	1482	1700	974		
Volume to Capacity	0.01	0.01	0.02	0.09		
Queue Length 95th (m)	0.0	0.3	0.0	2.1		
Control Delay (s)	0.0	7.5	0.0	9.0		
Lane LOS		A		A		
Approach Delay (s)	0.0	2.9		9.0		
Approach LOS				A		
Intersection Summary						
Average Delay		5.7				
Intersection Capacity Utilization		18.3%		ICU Level of Service	A	
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
6: Belmont Road & Seventh Avenue

Existing AM



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	T			T	T	
Traffic Volume (veh/h)	53	21	30	402	181	7
Future Volume (Veh/h)	53	21	30	402	181	7
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	57	23	32	432	195	8
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	695	199	203			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	695	199	203			
tC, single (s)	6.4	6.5	4.2			
tC, 2 stage (s)						
tF (s)	3.5	3.5	2.3			
p0 queue free %	86	97	98			
cM capacity (veh/h)	395	787	1300			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	80	464	203			
Volume Left	57	32	0			
Volume Right	23	0	8			
cSH	461	1300	1700			
Volume to Capacity	0.17	0.02	0.12			
Queue Length 95th (m)	4.7	0.6	0.0			
Control Delay (s)	14.4	0.8	0.0			
Lane LOS	B	A				
Approach Delay (s)	14.4	0.8	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay			2.0			
Intersection Capacity Utilization			47.0%	ICU Level of Service	A	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
4: Snyders Avenue & Seventh Avenue

Existing PM

	→	↖	↗	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↖			↖	↗	↗
Traffic Volume (veh/h)	47	10	16	13	4	14
Future Volume (Veh/h)	47	10	16	13	4	14
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86
Hourly flow rate (vph)	55	12	19	15	5	16
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			67		114	61
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			67		114	61
tC, single (s)			4.1		6.9	6.3
tC, 2 stage (s)						
tF (s)			2.2		4.0	3.4
p0 queue free %			99		99	98
cM capacity (veh/h)			1547		770	990
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	67	34	21			
Volume Left	0	19	5			
Volume Right	12	0	16			
cSH	1700	1547	927			
Volume to Capacity	0.04	0.01	0.02			
Queue Length 95th (m)	0.0	0.3	0.5			
Control Delay (s)	0.0	4.2	9.0			
Lane LOS		A	A			
Approach Delay (s)	0.0	4.2	9.0			
Approach LOS			A			
Intersection Summary						
Average Delay		2.7				
Intersection Capacity Utilization		18.2%		ICU Level of Service	A	
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
5: Kettle Creek Drive & Seventh Avenue

Existing PM

	→	↖	↗	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↖			↖	↗	↗
Traffic Volume (veh/h)	45	16	47	27	3	33
Future Volume (Veh/h)	45	16	47	27	3	33
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	49	18	52	30	3	36
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			67		192	58
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			67		192	58
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			97		100	96
cM capacity (veh/h)			1547		775	1014
Direction, Lane #	EB 1	WB 1	WB 2	NB 1		
Volume Total	67	52	30	39		
Volume Left	0	52	0	3		
Volume Right	18	0	0	36		
cSH	1700	1547	1700	990		
Volume to Capacity	0.04	0.03	0.02	0.04		
Queue Length 95th (m)	0.0	0.8	0.0	0.9		
Control Delay (s)	0.0	7.4	0.0	8.8		
Lane LOS		A		A		
Approach Delay (s)	0.0	4.7		8.8		
Approach LOS				A		
Intersection Summary						
Average Delay		3.9				
Intersection Capacity Utilization		19.3%		ICU Level of Service	A	
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
6: Belmont Road & Seventh Avenue

Existing PM

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	T			T		
Traffic Volume (veh/h)	26	49	33	234	422	42
Future Volume (Veh/h)	26	49	33	234	422	42
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89
Hourly flow rate (vph)	29	55	37	263	474	47
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	834	498	521			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	834	498	521			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	91	90	96			
cM capacity (veh/h)	329	577	1056			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	84	300	521			
Volume Left	29	37	0			
Volume Right	55	0	47			
cSH	458	1056	1700			
Volume to Capacity	0.18	0.04	0.31			
Queue Length 95th (m)	5.1	0.8	0.0			
Control Delay (s)	14.6	1.4	0.0			
Lane LOS	B	A				
Approach Delay (s)	14.6	1.4	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay			1.8			
Intersection Capacity Utilization			51.2%	ICU Level of Service	A	
Analysis Period (min)			15			



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Appendix F

2032 Background Traffic Operations

HCM Unsignalized Intersection Capacity Analysis
4: Snyders Avenue & Seventh Avenue

BG32 AM

	→	↖	↙	←	↘	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↖			↗	↘	↙
Traffic Volume (veh/h)	10	3	15	52	15	20
Future Volume (Veh/h)	10	3	15	52	15	20
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.70	0.70	0.70	0.70	0.70	0.70
Hourly flow rate (vph)	14	4	21	74	21	29
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			18		132	16
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			18		132	16
tC, single (s)			4.3		6.5	6.2
tC, 2 stage (s)						
tF (s)			2.4		3.6	3.3
p0 queue free %			99		97	97
cM capacity (veh/h)			1461		833	1069
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	18	95	50			
Volume Left	0	21	21			
Volume Right	4	0	29			
cSH	1700	1461	956			
Volume to Capacity	0.01	0.01	0.05			
Queue Length 95th (m)	0.0	0.3	1.3			
Control Delay (s)	0.0	1.7	9.0			
Lane LOS		A	A			
Approach Delay (s)	0.0	1.7	9.0			
Approach LOS			A			
Intersection Summary						
Average Delay		3.8				
Intersection Capacity Utilization		20.2%		ICU Level of Service	A	
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
5: Kettle Creek Drive & Seventh Avenue

BG32 AM

	→	↖	↙	←	↘	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↖			↗	↘	↙
Traffic Volume (veh/h)	27	5	29	33	32	81
Future Volume (Veh/h)	27	5	29	33	32	81
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.81	0.81	0.81	0.81	0.81	0.81
Hourly flow rate (vph)	33	6	36	41	40	100
Pedestrians					2	
Lane Width (m)					3.7	
Walking Speed (m/s)					1.1	
Percent Blockage					0	
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			41		151	38
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			41		151	38
tC, single (s)			4.3		6.4	6.4
tC, 2 stage (s)						
tF (s)			2.4		3.5	3.4
p0 queue free %			98		95	90
cM capacity (veh/h)			1463		823	996
Direction, Lane #	EB 1	WB 1	WB 2	NB 1		
Volume Total	39	36	41	140		
Volume Left	0	36	0	40		
Volume Right	6	0	0	100		
cSH	1700	1463	1700	940		
Volume to Capacity	0.02	0.02	0.02	0.15		
Queue Length 95th (m)	0.0	0.6	0.0	4.0		
Control Delay (s)	0.0	7.5	0.0	9.5		
Lane LOS		A		A		
Approach Delay (s)	0.0	3.5		9.5		
Approach LOS				A		
Intersection Summary						
Average Delay		6.3				
Intersection Capacity Utilization		21.7%		ICU Level of Service	A	
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis

BG32 AM

6: Belmont Road & Seventh Avenue



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	WT			WT	WT	
Traffic Volume (veh/h)	80	48	42	473	214	17
Future Volume (Veh/h)	80	48	42	473	214	17
Sign Control	Stop			Free		
Grade	0%			0%		
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	86	52	45	509	230	18
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	838	239	248			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	838	239	248			
tC, single (s)	6.4	6.5	4.2			
tC, 2 stage (s)						
tF (s)	3.5	3.5	2.3			
p0 queue free %	73	93	96			
cM capacity (veh/h)	322	746	1251			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	138	554	248			
Volume Left	86	45	0			
Volume Right	52	0	18			
cSH	409	1251	1700			
Volume to Capacity	0.34	0.04	0.15			
Queue Length 95th (m)	11.1	0.9	0.0			
Control Delay (s)	18.2	1.0	0.0			
Lane LOS	C	A				
Approach Delay (s)	18.2	1.0	0.0			
Approach LOS	C					
Intersection Summary						
Average Delay			3.3			
Intersection Capacity Utilization			56.9%	ICU Level of Service	B	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
4: Snyders Avenue & Seventh Avenue

BG32 PM

	→		↖		←		↗	
Movement	EBT	EBR	WBL	WBT	NBL	NBR		
Lane Configurations	↖		↖		↖			
Traffic Volume (veh/h)	61	18	25	20	5	20		
Future Volume (Veh/h)	61	18	25	20	5	20		
Sign Control	Free		Free		Stop			
Grade	0%		0%		0%			
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86		
Hourly flow rate (vph)	71	21	29	23	6	23		
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			92		162	82		
vC1, stage 1 conf vol								
vC2, stage 2 conf vol								
vCu, unblocked vol			92		162	82		
tC, single (s)			4.1		6.9	6.3		
tC, 2 stage (s)								
tF (s)			2.2		4.0	3.4		
p0 queue free %			98		99	98		
cM capacity (veh/h)			1515		715	965		
Direction, Lane #	EB 1	WB 1	NB 1					
Volume Total	92	52	29					
Volume Left	0	29	6					
Volume Right	21	0	23					
cSH	1700	1515	900					
Volume to Capacity	0.05	0.02	0.03					
Queue Length 95th (m)	0.0	0.4	0.8					
Control Delay (s)	0.0	4.2	9.1					
Lane LOS	A		A					
Approach Delay (s)	0.0	4.2	9.1					
Approach LOS	A		A					
Intersection Summary								
Average Delay			2.8					
Intersection Capacity Utilization			19.1%	ICU Level of Service	A			
Analysis Period (min)			15					

HCM Unsignalized Intersection Capacity Analysis
5: Kettle Creek Drive & Seventh Avenue

BG32 PM

	→		↖		←		↗	
Movement	EBT	EBR	WBL	WBT	NBL	NBR		
Lane Configurations	↖		↖		↖			
Traffic Volume (veh/h)	59	21	81	41	7	56		
Future Volume (Veh/h)	59	21	81	41	7	56		
Sign Control	Free		Free		Stop			
Grade	0%		0%		0%			
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91		
Hourly flow rate (vph)	65	23	89	45	8	62		
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			88		300	76		
vC1, stage 1 conf vol								
vC2, stage 2 conf vol								
vCu, unblocked vol			88		300	76		
tC, single (s)			4.1		6.4	6.2		
tC, 2 stage (s)								
tF (s)			2.2		3.5	3.3		
p0 queue free %			94		99	94		
cM capacity (veh/h)			1520		655	990		
Direction, Lane #	EB 1	WB 1	WB 2	NB 1				
Volume Total	88	89	45	70				
Volume Left	0	89	0	8				
Volume Right	23	0	0	62				
cSH	1700	1520	1700	936				
Volume to Capacity	0.05	0.06	0.03	0.07				
Queue Length 95th (m)	0.0	1.4	0.0	1.8				
Control Delay (s)	0.0	7.5	0.0	9.2				
Lane LOS	A		A	A				
Approach Delay (s)	0.0	5.0		9.2				
Approach LOS	A		A	A				
Intersection Summary								
Average Delay			4.5					
Intersection Capacity Utilization			21.7%	ICU Level of Service	A			
Analysis Period (min)			15					

HCM Unsignalized Intersection Capacity Analysis
6: Belmont Road & Seventh Avenue

BG32 PM



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔
Traffic Volume (veh/h)	42	75	63	275	498	69
Future Volume (Veh/h)	42	75	63	275	498	69
Sign Control	Stop			Free		
Grade	0%			0%		
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89
Hourly flow rate (vph)	47	84	71	309	560	78
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	1050	599	638			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1050	599	638			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	80	83	93			
cM capacity (veh/h)	235	505	956			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	131	380	638			
Volume Left	47	71	0			
Volume Right	84	0	78			
cSH	358	956	1700			
Volume to Capacity	0.37	0.07	0.38			
Queue Length 95th (m)	12.5	1.8	0.0			
Control Delay (s)	20.8	2.4	0.0			
Lane LOS	C	A				
Approach Delay (s)	20.8	2.4	0.0			
Approach LOS	C					
Intersection Summary						
Average Delay			3.1			
Intersection Capacity Utilization			65.3%	ICU Level of Service	C	
Analysis Period (min)			15			



BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]



Appendix G

Scenario 1 2032 Total Traffic Operations

HCM Unsignalized Intersection Capacity Analysis
1: Proposed Road A & Seventh Avenue

Tot32 AM
Scenario 1 All Residential

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↻			↻	↻	
Traffic Volume (veh/h)	14	6	17	79	35	42
Future Volume (Veh/h)	14	6	17	79	35	42
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	15	7	18	86	38	46
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			22	140	18	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			22	140	18	
tC, single (s)			4.1	6.4	6.2	
tC, 2 stage (s)						
tF (s)			2.2	3.5	3.3	
p0 queue free %			99	95	96	
cM capacity (veh/h)			1593	843	1060	
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	22	104	84			
Volume Left	0	18	38			
Volume Right	7	0	46			
cSH	1700	1593	949			
Volume to Capacity	0.01	0.01	0.09			
Queue Length 95th (m)	0.0	0.3	2.2			
Control Delay (s)	0.0	1.3	9.2			
Lane LOS		A	A			
Approach Delay (s)	0.0	1.3	9.2			
Approach LOS			A			
Intersection Summary						
Average Delay			4.3			
Intersection Capacity Utilization			22.9%	ICU Level of Service	A	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
2: Proposed Road B & Seventh Avenue

Tot32 AM
Scenario 1 All Residential

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↻			↻	↻	
Traffic Volume (veh/h)	55	1	4	90	6	11
Future Volume (Veh/h)	55	1	4	90	6	11
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	60	1	4	98	7	12
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			61	166	60	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			61	166	60	
tC, single (s)			4.1	6.4	6.2	
tC, 2 stage (s)						
tF (s)			2.2	3.5	3.3	
p0 queue free %			100	99	99	
cM capacity (veh/h)			1542	822	1005	
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	61	102	19			
Volume Left	0	4	7			
Volume Right	1	0	12			
cSH	1700	1542	929			
Volume to Capacity	0.04	0.00	0.02			
Queue Length 95th (m)	0.0	0.1	0.5			
Control Delay (s)	0.0	0.3	9.0			
Lane LOS		A	A			
Approach Delay (s)	0.0	0.3	9.0			
Approach LOS			A			
Intersection Summary						
Average Delay			1.1			
Intersection Capacity Utilization			18.0%	ICU Level of Service	A	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
3: Proposed Road C & Seventh Avenue

Tot32 AM
Scenario 1 All Residential

	→	↖	↗	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↖			↖	↗	↗
Traffic Volume (veh/h)	66	0	5	88	6	11
Future Volume (Veh/h)	66	0	5	88	6	11
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	72	0	5	96	7	12
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			72		178	72
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			72		178	72
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	99
cM capacity (veh/h)			1528		809	990
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	72	101	19			
Volume Left	0	5	7			
Volume Right	0	0	12			
cSH	1700	1528	915			
Volume to Capacity	0.04	0.00	0.02			
Queue Length 95th (m)	0.0	0.1	0.5			
Control Delay (s)	0.0	0.4	9.0			
Lane LOS		A	A			
Approach Delay (s)	0.0	0.4	9.0			
Approach LOS			A			
Intersection Summary						
Average Delay		1.1				
Intersection Capacity Utilization		18.7%		ICU Level of Service	A	
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
4: Snyders Avenue & Seventh Avenue

Tot32 AM
Scenario 1 All Residential

	→	↖	↗	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↖			↖	↗	↗
Traffic Volume (veh/h)	74	3	26	78	15	42
Future Volume (Veh/h)	74	3	26	78	15	42
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.70	0.70	0.70	0.70	0.70	0.70
Hourly flow rate (vph)	106	4	37	111	21	60
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			110		293	108
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			110		293	108
tC, single (s)			4.3		6.5	6.2
tC, 2 stage (s)						
tF (s)			2.4		3.6	3.3
p0 queue free %			97		97	94
cM capacity (veh/h)			1349		665	951
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	110	148	81			
Volume Left	0	37	21			
Volume Right	4	0	60			
cSH	1700	1349	856			
Volume to Capacity	0.06	0.03	0.09			
Queue Length 95th (m)	0.0	0.6	2.4			
Control Delay (s)	0.0	2.1	9.6			
Lane LOS		A	A			
Approach Delay (s)	0.0	2.1	9.6			
Approach LOS			A			
Intersection Summary						
Average Delay		3.2				
Intersection Capacity Utilization		22.3%		ICU Level of Service	A	
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
5: Kettle Creek Drive & Seventh Avenue

Tot32 AM
Scenario 1 All Residential

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔		↔		↔	
Traffic Volume (veh/h)	113	5	29	70	32	81
Future Volume (Veh/h)	113	5	29	70	32	81
Sign Control	Free		Free		Stop	
Grade	0%		0%		0%	
Peak Hour Factor	0.81	0.81	0.81	0.81	0.81	0.81
Hourly flow rate (vph)	140	6	36	86	40	100
Pedestrians	2					
Lane Width (m)	3.7					
Walking Speed (m/s)	1.1					
Percent Blockage	0					
Right turn flare (veh)						
Median type	None		None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			148	303	145	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			148	303	145	
tC, single (s)			4.3	6.4	6.4	
tC, 2 stage (s)						
tF (s)			2.4	3.5	3.4	
p0 queue free %			97	94	88	
cM capacity (veh/h)			1333	673	867	
Direction, Lane #	EB 1	WB 1	WB 2	NB 1		
Volume Total	146	36	86	140		
Volume Left	0	36	0	40		
Volume Right	6	0	0	100		
cSH	1700	1333	1700	801		
Volume to Capacity	0.09	0.03	0.05	0.17		
Queue Length 95th (m)	0.0	0.6	0.0	4.8		
Control Delay (s)	0.0	7.8	0.0	10.4		
Lane LOS	A		B			
Approach Delay (s)	0.0	2.3		10.4		
Approach LOS			B			
Intersection Summary						
Average Delay			4.3			
Intersection Capacity Utilization			21.7%		ICU Level of Service A	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
6: Belmont Road & Seventh Avenue

Tot32 AM
Scenario 1 All Residential

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔		↔		↔	
Traffic Volume (veh/h)	97	117	53	473	214	43
Future Volume (Veh/h)	97	117	53	473	214	43
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	104	126	57	509	230	46
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	876	253	276			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	876	253	276			
tC, single (s)	6.4	6.5	4.2			
tC, 2 stage (s)						
tF (s)	3.5	3.5	2.3			
p0 queue free %	66	83	95			
cM capacity (veh/h)	302	733	1221			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	230	566	276			
Volume Left	104	57	0			
Volume Right	126	0	46			
cSH	445	1221	1700			
Volume to Capacity	0.52	0.05	0.16			
Queue Length 95th (m)	22.0	1.1	0.0			
Control Delay (s)	21.4	1.3	0.0			
Lane LOS	C		A			
Approach Delay (s)	21.4	1.3	0.0			
Approach LOS	C					
Intersection Summary						
Average Delay			5.3			
Intersection Capacity Utilization			64.3%		ICU Level of Service C	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
1: Proposed Road A & Seventh Avenue

Tot32 PM
Scenario 1 All Residential

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔			↔	↔	
Traffic Volume (veh/h)	90	33	49	28	9	34
Future Volume (Veh/h)	90	33	49	28	9	34
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	98	36	53	30	10	37
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			134		252	116
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			134		252	116
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			96		99	96
cM capacity (veh/h)			1451		710	936
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	134	83	47			
Volume Left	0	53	10			
Volume Right	36	0	37			
cSH	1700	1451	877			
Volume to Capacity	0.08	0.04	0.05			
Queue Length 95th (m)	0.0	0.9	1.3			
Control Delay (s)	0.0	4.9	9.3			
Lane LOS		A	A			
Approach Delay (s)	0.0	4.9	9.3			
Approach LOS			A			
Intersection Summary						
Average Delay			3.2			
Intersection Capacity Utilization			24.3%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
2: Proposed Road B & Seventh Avenue

Tot32 PM
Scenario 1 All Residential

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔			↔	↔	
Traffic Volume (veh/h)	113	11	12	75	2	9
Future Volume (Veh/h)	113	11	12	75	2	9
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	123	12	13	82	2	10
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			135		237	129
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			135		237	129
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		100	99
cM capacity (veh/h)			1449		744	921
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	135	95	12			
Volume Left	0	13	2			
Volume Right	12	0	10			
cSH	1700	1449	886			
Volume to Capacity	0.08	0.01	0.01			
Queue Length 95th (m)	0.0	0.2	0.3			
Control Delay (s)	0.0	1.1	9.1			
Lane LOS		A	A			
Approach Delay (s)	0.0	1.1	9.1			
Approach LOS			A			
Intersection Summary						
Average Delay			0.9			
Intersection Capacity Utilization			24.1%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
3: Proposed Road C & Seventh Avenue

Tot32 PM
Scenario 1 All Residential

	→	↖	↙	←	↘	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↖			↗	↘	↗
Traffic Volume (veh/h)	122	0	14	86	1	10
Future Volume (Veh/h)	122	0	14	86	1	10
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	133	0	15	93	1	11
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			133		256	133
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			133		256	133
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		100	99
cM capacity (veh/h)			1452		725	916
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	133	108	12			
Volume Left	0	15	1			
Volume Right	0	0	11			
cSH	1700	1452	896			
Volume to Capacity	0.08	0.01	0.01			
Queue Length 95th (m)	0.0	0.2	0.3			
Control Delay (s)	0.0	1.1	9.1			
Lane LOS		A	A			
Approach Delay (s)	0.0	1.1	9.1			
Approach LOS			A			
Intersection Summary						
Average Delay		0.9				
Intersection Capacity Utilization		25.1%		ICU Level of Service	A	
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
4: Snyders Avenue & Seventh Avenue

Tot32 PM
Scenario 1 All Residential

	→	↖	↙	←	↘	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↖			↗	↘	↗
Traffic Volume (veh/h)	114	18	57	95	5	43
Future Volume (Veh/h)	114	18	57	95	5	43
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86
Hourly flow rate (vph)	133	21	66	110	6	50
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			154		386	144
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			154		386	144
tC, single (s)			4.1		6.9	6.3
tC, 2 stage (s)						
tF (s)			2.2		4.0	3.4
p0 queue free %			95		99	94
cM capacity (veh/h)			1439		509	891
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	154	176	56			
Volume Left	0	66	6			
Volume Right	21	0	50			
cSH	1700	1439	825			
Volume to Capacity	0.09	0.05	0.07			
Queue Length 95th (m)	0.0	1.1	1.7			
Control Delay (s)	0.0	3.1	9.7			
Lane LOS		A	A			
Approach Delay (s)	0.0	3.1	9.7			
Approach LOS			A			
Intersection Summary						
Average Delay		2.8				
Intersection Capacity Utilization		28.6%		ICU Level of Service	A	
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
5: Kettle Creek Drive & Seventh Avenue

Tot32 PM
Scenario 1 All Residential

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔		↔		↔	
Traffic Volume (veh/h)	135	21	81	148	7	56
Future Volume (Veh/h)	135	21	81	148	7	56
Sign Control	Free		Free		Stop	
Grade	0%		0%		0%	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	148	23	89	163	8	62
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			171		500	160
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			171		500	160
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			94		98	93
cM capacity (veh/h)			1418		500	891
Direction, Lane #	EB 1	WB 1	WB 2	NB 1		
Volume Total	171	89	163	70		
Volume Left	0	89	0	8		
Volume Right	23	0	0	62		
cSH	1700	1418	1700	818		
Volume to Capacity	0.10	0.06	0.10	0.09		
Queue Length 95th (m)	0.0	1.5	0.0	2.1		
Control Delay (s)	0.0	7.7	0.0	9.8		
Lane LOS	A		A			
Approach Delay (s)	0.0		2.7		9.8	
Approach LOS			A			
Intersection Summary						
Average Delay			2.8			
Intersection Capacity Utilization			26.7%		ICU Level of Service A	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
6: Belmont Road & Seventh Avenue

Tot32 PM
Scenario 1 All Residential

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔		↔		↔	
Traffic Volume (veh/h)	85	108	134	275	498	105
Future Volume (Veh/h)	85	108	134	275	498	105
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89
Hourly flow rate (vph)	96	121	151	309	560	118
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	1230	619	678			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1230	619	678			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	42	75	84			
cM capacity (veh/h)	166	492	923			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	217	460	678			
Volume Left	96	151	0			
Volume Right	121	0	118			
cSH	263	923	1700			
Volume to Capacity	0.83	0.16	0.40			
Queue Length 95th (m)	50.1	4.4	0.0			
Control Delay (s)	60.8	4.5	0.0			
Lane LOS	F	A				
Approach Delay (s)	60.8	4.5	0.0			
Approach LOS	F					
Intersection Summary						
Average Delay			11.3			
Intersection Capacity Utilization			75.8%		ICU Level of Service D	
Analysis Period (min)			15			



BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]



Appendix H

Scenario 2 2032 Total Traffic Operations

HCM Unsignalized Intersection Capacity Analysis
1: Proposed Road A & Seventh Avenue

Tot32 AM
Scenario 2 Residential + School

	→	↖	↙	←	↘	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↖			↖	↘	↘
Traffic Volume (veh/h)	25	5	18	77	36	40
Future Volume (Veh/h)	25	5	18	77	36	40
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	27	5	20	84	39	43
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			32		154	30
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			32		154	30
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		95	96
cM capacity (veh/h)			1580		827	1045
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	32	104	82			
Volume Left	0	20	39			
Volume Right	5	0	43			
cSH	1700	1580	929			
Volume to Capacity	0.02	0.01	0.09			
Queue Length 95th (m)	0.0	0.3	2.2			
Control Delay (s)	0.0	1.5	9.3			
Lane LOS		A	A			
Approach Delay (s)	0.0	1.5	9.3			
Approach LOS			A			
Intersection Summary						
Average Delay		4.2				
Intersection Capacity Utilization		22.8%		ICU Level of Service	A	
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
2: Proposed Road B & Seventh Avenue

Tot32 AM
Scenario 2 Residential + School

	→	↖	↙	←	↘	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↖			↖	↘	↘
Traffic Volume (veh/h)	55	10	73	92	3	13
Future Volume (Veh/h)	55	10	73	92	3	13
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	60	11	79	100	3	14
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			71		324	66
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			71		324	66
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			95		100	99
cM capacity (veh/h)			1529		636	998
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	71	179	17			
Volume Left	0	79	3			
Volume Right	11	0	14			
cSH	1700	1529	907			
Volume to Capacity	0.04	0.05	0.02			
Queue Length 95th (m)	0.0	1.2	0.4			
Control Delay (s)	0.0	3.5	9.0			
Lane LOS		A	A			
Approach Delay (s)	0.0	3.5	9.0			
Approach LOS			A			
Intersection Summary						
Average Delay		2.9				
Intersection Capacity Utilization		25.5%		ICU Level of Service	A	
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
3: Proposed Road C & Seventh Avenue

Tot32 AM
Scenario 2 Residential + School

	→	↖	↗	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↖			↖	↗	↗
Traffic Volume (veh/h)	66	2	31	158	7	74
Future Volume (Veh/h)	66	2	31	158	7	74
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	72	2	34	172	8	80
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			74	313	73	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			74	313	73	
tC, single (s)			4.1	6.4	6.2	
tC, 2 stage (s)						
tF (s)			2.2	3.5	3.3	
p0 queue free %			98	99	92	
cM capacity (veh/h)			1526	665	989	
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	74	206	88			
Volume Left	0	34	8			
Volume Right	2	0	80			
cSH	1700	1526	947			
Volume to Capacity	0.04	0.02	0.09			
Queue Length 95th (m)	0.0	0.5	2.3			
Control Delay (s)	0.0	1.4	9.2			
Lane LOS		A	A			
Approach Delay (s)	0.0	1.4	9.2			
Approach LOS			A			
Intersection Summary						
Average Delay		3.0				
Intersection Capacity Utilization		28.3%	ICU Level of Service	A		
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
4: Snyders Avenue & Seventh Avenue

Tot32 AM
Scenario 2 Residential + School

	→	↖	↗	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↖			↖	↗	↗
Traffic Volume (veh/h)	137	3	26	174	15	47
Future Volume (Veh/h)	137	3	26	174	15	47
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.70	0.70	0.70	0.70	0.70	0.70
Hourly flow rate (vph)	196	4	37	249	21	67
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			200	521	198	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			200	521	198	
tC, single (s)			4.3	6.5	6.2	
tC, 2 stage (s)						
tF (s)			2.4	3.6	3.3	
p0 queue free %			97	96	92	
cM capacity (veh/h)			1246	489	848	
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	200	286	88			
Volume Left	0	37	21			
Volume Right	4	0	67			
cSH	1700	1246	722			
Volume to Capacity	0.12	0.03	0.12			
Queue Length 95th (m)	0.0	0.7	3.2			
Control Delay (s)	0.0	1.3	10.7			
Lane LOS		A	B			
Approach Delay (s)	0.0	1.3	10.7			
Approach LOS			B			
Intersection Summary						
Average Delay		2.3				
Intersection Capacity Utilization		31.7%	ICU Level of Service	A		
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
5: Kettle Creek Drive & Seventh Avenue

Tot32 AM
Scenario 2 Residential + School

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔		↔		↔	
Traffic Volume (veh/h)	181	5	29	166	32	81
Future Volume (Veh/h)	181	5	29	166	32	81
Sign Control	Free		Free		Stop	
Grade	0%		0%		0%	
Peak Hour Factor	0.81	0.81	0.81	0.81	0.81	0.81
Hourly flow rate (vph)	223	6	36	205	40	100
Pedestrians	2					
Lane Width (m)	3.7					
Walking Speed (m/s)	1.1					
Percent Blockage	0					
Right turn flare (veh)						
Median type	None		None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			231		505	228
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			231		505	228
tC, single (s)			4.3		6.4	6.4
tC, 2 stage (s)						
tF (s)			2.4		3.5	3.4
p0 queue free %			97		92	87
cM capacity (veh/h)			1241		514	779
Direction, Lane #	EB 1	WB 1	WB 2	NB 1		
Volume Total	229	36	205	140		
Volume Left	0	36	0	40		
Volume Right	6	0	0	100		
cSH	1700	1241	1700	679		
Volume to Capacity	0.13	0.03	0.12	0.21		
Queue Length 95th (m)	0.0	0.7	0.0	5.9		
Control Delay (s)	0.0	8.0	0.0	11.7		
Lane LOS	A		B			
Approach Delay (s)	0.0		1.2		11.7	
Approach LOS			B			
Intersection Summary						
Average Delay			3.2			
Intersection Capacity Utilization			30.2%		ICU Level of Service A	
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
6: Belmont Road & Seventh Avenue

Tot32 AM
Scenario 2 Residential + School

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔		↔		↔	
Traffic Volume (veh/h)	112	170	131	473	214	61
Future Volume (Veh/h)	112	170	131	473	214	61
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	120	183	141	509	230	66
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	1054	263	296			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1054	263	296			
tC, single (s)	6.4	6.5	4.2			
tC, 2 stage (s)						
tF (s)	3.5	3.5	2.3			
p0 queue free %	45	75	88			
cM capacity (veh/h)	219	723	1200			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	303	650	296			
Volume Left	120	141	0			
Volume Right	183	0	66			
cSH	378	1200	1700			
Volume to Capacity	0.80	0.12	0.17			
Queue Length 95th (m)	52.8	3.0	0.0			
Control Delay (s)	43.5	2.9	0.0			
Lane LOS	E	A				
Approach Delay (s)	43.5	2.9	0.0			
Approach LOS	E					
Intersection Summary						
Average Delay			12.1			
Intersection Capacity Utilization			73.8%		ICU Level of Service D	
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
1: Proposed Road A & Seventh Avenue

Tot32 PM
Scenario 2 Residential + School

	→	↖	↗	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↖			↗	↖	↗
Traffic Volume (veh/h)	82	34	50	28	9	35
Future Volume (Veh/h)	82	34	50	28	9	35
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	89	37	54	30	10	38
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			126	246	108	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			126	246	108	
tC, single (s)			4.1	6.4	6.2	
tC, 2 stage (s)						
tF (s)			2.2	3.5	3.3	
p0 queue free %			96	99	96	
cM capacity (veh/h)			1460	715	946	
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	126	84	48			
Volume Left	0	54	10			
Volume Right	37	0	38			
cSH	1700	1460	887			
Volume to Capacity	0.07	0.04	0.05			
Queue Length 95th (m)	0.0	0.9	1.3			
Control Delay (s)	0.0	5.0	9.3			
Lane LOS		A	A			
Approach Delay (s)	0.0	5.0	9.3			
Approach LOS			A			
Intersection Summary						
Average Delay		3.3				
Intersection Capacity Utilization		20.9%	ICU Level of Service	A		
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
2: Proposed Road B & Seventh Avenue

Tot32 PM
Scenario 2 Residential + School

	→	↖	↗	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↖			↗	↖	↗
Traffic Volume (veh/h)	114	3	16	77	1	4
Future Volume (Veh/h)	114	3	16	77	1	4
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	124	3	17	84	1	4
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None		None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			127	244	126	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			127	244	126	
tC, single (s)			4.1	6.4	6.2	
tC, 2 stage (s)						
tF (s)			2.2	3.5	3.3	
p0 queue free %			99	100	100	
cM capacity (veh/h)			1459	736	925	
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	127	101	5			
Volume Left	0	17	1			
Volume Right	3	0	4			
cSH	1700	1459	880			
Volume to Capacity	0.07	0.01	0.01			
Queue Length 95th (m)	0.0	0.3	0.1			
Control Delay (s)	0.0	1.3	9.1			
Lane LOS		A	A			
Approach Delay (s)	0.0	1.3	9.1			
Approach LOS			A			
Intersection Summary						
Average Delay		0.8				
Intersection Capacity Utilization		21.6%	ICU Level of Service	A		
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
3: Proposed Road C & Seventh Avenue

Tot32 PM
Scenario 2 Residential + School

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔		↔		↔	
Traffic Volume (veh/h)	118	0	7	91	2	21
Future Volume (Veh/h)	118	0	7	91	2	21
Sign Control	Free		Free		Stop	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	128	0	8	99	2	23
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			128	243	128	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			128	243	128	
tC, single (s)			4.1	6.4	6.2	
tC, 2 stage (s)						
tF (s)			2.2	3.5	3.3	
p0 queue free %			99	100	98	
cM capacity (veh/h)			1458	741	922	
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	128	107	25			
Volume Left	0	8	2			
Volume Right	0	0	23			
cSH	1700	1458	904			
Volume to Capacity	0.08	0.01	0.03			
Queue Length 95th (m)	0.0	0.1	0.6			
Control Delay (s)	0.0	0.6	9.1			
Lane LOS	A		A			
Approach Delay (s)	0.0	0.6	9.1			
Approach LOS	A					
Intersection Summary						
Average Delay			1.1			
Intersection Capacity Utilization			20.6%	ICU Level of Service		A
Analysis Period (min)	15					

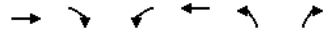
HCM Unsignalized Intersection Capacity Analysis
4: Snyders Avenue & Seventh Avenue

Tot32 PM
Scenario 2 Residential + School

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔		↔		↔	
Traffic Volume (veh/h)	121	18	59	93	5	44
Future Volume (Veh/h)	121	18	59	93	5	44
Sign Control	Free		Free		Stop	
Grade	0%		0%		0%	
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86
Hourly flow rate (vph)	141	21	69	108	6	51
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			162	398	152	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			162	398	152	
tC, single (s)			4.1	6.9	6.3	
tC, 2 stage (s)						
tF (s)			2.2	4.0	3.4	
p0 queue free %			95	99	94	
cM capacity (veh/h)			1429	500	882	
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	162	177	57			
Volume Left	0	69	6			
Volume Right	21	0	51			
cSH	1700	1429	816			
Volume to Capacity	0.10	0.05	0.07			
Queue Length 95th (m)	0.0	1.2	1.7			
Control Delay (s)	0.0	3.2	9.7			
Lane LOS	A		A			
Approach Delay (s)	0.0	3.2	9.7			
Approach LOS	A					
Intersection Summary						
Average Delay			2.8			
Intersection Capacity Utilization			29.0%	ICU Level of Service		A
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
5: Kettle Creek Drive & Seventh Avenue

Tot32 PM
Scenario 2 Residential + School



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔		↔		↔	
Traffic Volume (veh/h)	143	21	81	148	7	56
Future Volume (Veh/h)	143	21	81	148	7	56
Sign Control	Free		Free		Stop	
Grade	0%		0%		0%	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	157	23	89	163	8	62
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			180	510	168	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			180	510	168	
tC, single (s)			4.1	6.4	6.2	
tC, 2 stage (s)						
tF (s)			2.2	3.5	3.3	
p0 queue free %			94	98	93	
cM capacity (veh/h)			1408	494	881	
Direction, Lane #	EB 1	WB 1	WB 2	NB 1		
Volume Total	180	89	163	70		
Volume Left	0	89	0	8		
Volume Right	23	0	0	62		
cSH	1700	1408	1700	808		
Volume to Capacity	0.11	0.06	0.10	0.09		
Queue Length 95th (m)	0.0	1.5	0.0	2.2		
Control Delay (s)	0.0	7.7	0.0	9.9		
Lane LOS	A		A			
Approach Delay (s)	0.0	2.7	9.9			
Approach LOS			A			
Intersection Summary						
Average Delay			2.7			
Intersection Capacity Utilization			27.1%	ICU Level of Service	A	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
6: Belmont Road & Seventh Avenue

Tot32 PM
Scenario 2 Residential + School



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔		↔		↔	
Traffic Volume (veh/h)	81	120	136	275	498	103
Future Volume (Veh/h)	81	120	136	275	498	103
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89
Hourly flow rate (vph)	91	135	153	309	560	116
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	1233	618	676			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1233	618	676			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	45	73	83			
cM capacity (veh/h)	165	493	925			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	226	462	676			
Volume Left	91	153	0			
Volume Right	135	0	116			
cSH	273	925	1700			
Volume to Capacity	0.83	0.17	0.40			
Queue Length 95th (m)	51.0	4.5	0.0			
Control Delay (s)	59.3	4.5	0.0			
Lane LOS	F	A				
Approach Delay (s)	59.3	4.5	0.0			
Approach LOS	F					
Intersection Summary						
Average Delay			11.4			
Intersection Capacity Utilization			76.3%	ICU Level of Service	D	
Analysis Period (min)			15			



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Appendix I

Signal Warrant Analysis

Input Sheet

Main Road	Belmont Road
Minor Road	Seventh Avenue
Direction of Main Road	North / South
Date:	Scenario 1 2032 Total
No. of Lanes on Main	1
T-Intersection	Yes
Operating Environment	Rural
Scenario	Forecasted Traffic Volumes (Existing Intersection)

Analysis Sheet

Justification 1: Minimum Vehicle Volumes

Justification	Guidance Approach Lanes				Total	Section Percent
	1 Lanes		2 or More Lanes			
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW		
1A (All Approach Lanes)	480	720	600	900		
	X					
	COMPLIANCE %				551	115%
1B (Minor Street Both Approaches)	180	255	180	255		
	X					
	COMPLIANCE %				102	57%
Signal Justification 1:						

Justification 2: Delay to Cross Traffic

Justification	Guidance Approach Lanes				Total	Section Percent
	1 lanes		2 or More lanes			
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW		
2A (Major Street Both Approaches)	480	720	600	900		
	X					
	COMPLIANCE %				449	94%
2B (Traffic Crossing Major Street)	50	75	50	75		
	X					
	COMPLIANCE %				46	92%
Signal Justification 2:						

Justification 3: Combination (Justification 1 and 2)

Justification Satisfied 80% or More	
Justification 1	Minimum Vehicular Volume
Justification 2	Delay Cross Traffic

Results Sheet

Justification	Compliance	Minimum Target	Signal Justified?	
			YES	NO
1. Minimum Vehicular Volume	A. Total Volume	115%		NO
	B. Crossing Volume	57%	120%	
2. Delay to Cross Traffic	A. Main Road	94%		NO
	B. Crossing Road	92%	120%	
3. Combination	A. Justificaton 1	57%		NO
	B. Justification 2	92%	120%	

Input Sheet

Main Road	Belmont Road
Minor Road	Seventh Avenue
Direction of Main Road	North / South
Date:	Scenario 2 2032 Total
No. of Lanes on Main	1
T-Intersection	Yes
Operating Environment	Rural
Scenario	Forecasted Traffic Volumes (Existing Intersection)

Analysis Sheet

Justification 1: Minimum Vehicle Volumes

Justification	Guidance Approach Lanes				Total	Section Percent
	1 Lanes		2 or More Lanes			
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW		
1A (All Approach Lanes)	480	720	600	900		
	X					
	COMPLIANCE %				594	124%
1B (Minor Street Both Approaches)	180	255	180	255		
	X					
	COMPLIANCE %				121	67%
Signal Justification 1:						

Justification 2: Delay to Cross Traffic

Justification	Guidance Approach Lanes				Total	Section Percent
	1 lanes		2 or More lanes			
Flow Condition	FREE FLOW	RESTR. FLOW	FREE FLOW	RESTR. FLOW		
2A (Major Street Both Approaches)	480	720	600	900		
	X					
	COMPLIANCE %				473	99%
2B (Traffic Crossing Major Street)	50	75	50	75		
	X					
	COMPLIANCE %				48	96%
Signal Justification 2:						

Justification 3: Combination (Justification 1 and 2)

Justification Satisfied 80% or More	
Justification 1	Minimum Vehicular Volume
Justification 2	Delay Cross Traffic

Results Sheet

Justification	Compliance	Minimum Target	Signal Justified?	
			YES	NO
1. Minimum Vehicular Volume	A. Total Volume	124%		NO
	B. Crossing Volume	67%		
2. Delay to Cross Traffic	A. Main Road	99%		NO
	B. Crossing Road	96%		
3. Combination	A. Justificaton 1	67%		NO
	B. Justification 2	96%		



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