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2023-03-08
Project: (230055)

Pols Enterprises Ltd.
c/o Ron Pols
52009 Regional Road 24
Wainfleet, ON L0S 1V0

RE: RESIDENTIAL DEVELOPMENT – 53814 ZION ROAD, WAINFLEET TRAFFIC BRIEF

Paradigm Transportation Solutions Limited has been retained to prepare a traffic brief to support the proposed residential development of 53814 Zion Road in the township of Wainfleet, Niagara Region. **Figure 1** (attached) illustrates the subject site's location and existing lane configuration and traffic control at the study area intersections. This letter includes the following:

- ▶ Summarized existing volumes at the unsignalized intersection of Highway 3 & Zion Road/Flanagan Road
- ▶ Forecasts of weekday AM and PM peak hour vehicle traffic volumes generated by the proposed development based on data found in the Institute of Transportation Engineers (ITE) Trip Generation Manual (11th Edition).
- ▶ Trip distribution based on the existing study area volumes.
- ▶ Documentation of the findings and conclusions regarding the proposed development and its anticipated impact on the study area intersection.

Appendix A contains the pre-study consultation material. The study scope was developed in consultation with the Ministry of Transportation Ontario (MTO) in January 2023.

Roadway Characteristics

The roadways that form the study area include:

- ▶ **Highway 3** is an east-west provincial highway from Fort Erie to Windsor. Through the study area of interest, the roadway has a basic two-lane cross-section with a posted speed limit of 80 km/h. Sidewalks are not provided on either side of the road.
- ▶ **Zion Road** is a north-south local road that runs from the north side of Highway 3 to Concession 6 Road. The roadway has a basic two-lane cross-section. Based on the

roadway width and design of the road, a statutory speed limit of 60 km/h is assumed. Posted load restrictions of 5 tonnes per axle are in effect from March 1st to April 30th. Sidewalks are not provided on either side of the road.

- ▶ **Flanagan Road** is a north-south local road from the south side of Highway 3 to Wainfleet/Dunnville Townline Road. The roadway has a basic two-lane cross-section. Based on the roadway width and design of the road, a statutory speed limit of 60 km/h is assumed. Posted load restrictions of 5 tonnes per axle are in effect from March 1st to April 30th. Sidewalks are not provided on either side of the road.

Existing Traffic Volumes

Turning movement counts are used to quantify the movement of vehicles. Existing traffic data at an intersection or on a road section forms the foundation for analysis. The counts are usually taken during peak periods to complete the level of service analysis. Traffic count data at the Highway 3 and Zion Road/Flanagan Road intersection was collected in February 2023.

Figure 2 illustrates the existing peak-hour traffic at the study area intersection. **Appendix B** contains the traffic data.

Development Proposal

The property owner proposes developing the lands to include six (6) single-family detached houses. Vehicle access is proposed via individual private driveways to Zion Road. No access is proposed to Highway 3. **Figure 3** illustrates the site concept plan.

The development is expected to be completed and occupied by 2028.

Trip Generation

The developments trips were estimated using trip generation rates provided by ITE's Trip Generation 11th Edition¹, applicable Land Use Code (LUC) 210 – Single-Family Detached Housing and corresponding to adjacent street traffic's AM and PM peak hours.

A total of six new AM peak hour vehicle trips and seven new PM peak hour vehicle trips are forecast to be generated by the proposed development. **Table 1** summarizes the trip generation estimates for the weekday peak hours.

¹ Trip Generation Eleventh Edition, Institute of Transportation Engineers, Washington D.C., 2021



TABLE 1: TRIP GENERATION

Land Use Code	Units	AM Peak Hour			PM Peak Hour		
		In	Out	Total	In	Out	Total
LUC 210 - Single-Family Detached Housing	6	1	5	6	4	3	7

LUC 220 Eqn per Unit AM: $T = 0.91Ln(x) + 0.12$ | PM: $T = 0.94Ln(x) + 0.27$

Trip Distribution

The directional distribution of traffic approaching and departing the development is a function of several variables: population densities, employment locations, existing travel patterns, and the efficiency of the site's roadways. **Table 2** summarizes the estimated trip distribution for site-generated traffic volumes. The estimated distribution was developed based on existing patterns as the urban area of Highway 3 and Zion Road/Flanagan Road mainly comprise of residential and agricultural land uses. **Figure 4** illustrates the weekday peak hour site-generated traffic volumes.

TABLE 2: TRIP DISTRIBUTION

From/To	AM		PM	
	Inbound	Outbound	Inbound	Outbound
East via Hwy 3	45%	56%	52%	49%
West via Hwy 3	55%	44%	48%	51%
TOTAL	100%	100%	100%	100%

Future Traffic Volumes

Three horizon years have been assessed: build-out date (2028), five years after build-out (2033), and ten years after build-out (2038). The likely future volumes near the subject site are estimated to consist of the following:

- ▶ Increased non-site traffic (generalized background traffic growth). A growth rate of 2% per annum was applied to existing traffic volumes;
- ▶ Background traffic generated by nearby developments; and
- ▶ Traffic generated by the subject site.

Growth Summary

The future traffic volumes within the study area are estimated to consist of the following:

- ▶ Generalized background traffic growth of 2% per annum; and
- ▶ Traffic generated by the subject site.



Figures 5 - 7 illustrate the future background traffic, while Figures 8 - 10 show the total traffic for 2028, 2033, and 2038 horizon years, respectively.

Future Traffic Operations

Intersection level of service (LOS) is a recognized method of quantifying the average delay experienced by drivers at intersections. It is based on the delay related to the number of vehicles desiring to move compared to the estimated capacity. The LOS A (little delay) to LOS F (extended delay) range provides an understanding of the relative time a motorist may have to wait to complete a turn at an unsignalized intersection or driveway. LOS A to E typically represents acceptable conditions in an urban context, whereas LOS F represents situations where more significant delays may be experienced.

Table 3 contains the level of service criteria for intersections.

TABLE 3: VEHICLE LEVEL OF SERVICE DEFINITIONS

Level of Service	Signalized Intersections Average Total Delay (sec/veh)	Unsignalized Intersections Average Total Delay (sec/veh)
A	< = 10	< = 10
B	> 10 & < = 20	> 10 & < = 15
C	> 20 & < = 35	> 15 & < = 25
D	> 35 & < = 55	> 25 & < = 35
E	> 55 & < = 80	> 35 & < = 50
F	> 80	> 50

The intersections' operations in the study area were evaluated using Synchro 11 with HCM 2000 procedures. The intersection analysis considered the following measures of performance:

- ▶ The volume-to-capacity ratio for each intersection;
- ▶ The LOS, based on the average control delay for each vehicle, for each turning movement; and
- ▶ The estimated 95th percentile queue length.

As outlined in MTO's TIS guidelines, movements are considered critical under the following conditions for signalized intersections:

- ▶ Volume/capacity (V/C) ratios for overall intersection operations, through movements or shared through/turning movements increased to 0.85 or above;
- ▶ V/C ratios for exclusive turning movements increased to 0.95 or above;
- ▶ V/C ratios for terminal ramp approaches increased to 0.75 or above; or



- ▶ Queues for an individual movement are projected to exceed available turning lane storage.

As outlined in the Region's TIS guidelines, movements are considered critical under the following conditions for unsignalized intersections:

- ▶ Level of Service (LOS), based on the average delay per vehicle on individual movements, operates at LOS "D" or worse; or
- ▶ An individual movement's estimated 95th percentile queue length exceeds the available queue storage.

Tables 4 - 5 summarize the base year, background and total traffic operations for the 2028, 2033, and 2038 horizon years. **Appendix C** contains the Synchro reports.

The intersection of Highway 3 at Zion Road/Flanagan Road currently operates with delays in the LOS B range during the weekday peak hours. The future background and total scenarios are forecast to operate with similar operations (i.e., LOS B or better) during the weekday peak hours.

Overall, the intersection of Highway 3 at Zion Road/Flanagan Road is forecast to continue to operate without issue; traffic generated by the subject site will not impact traffic operations along Highway 3.



TABLE 4: HIGHWAY 3 & ZION ROAD TRAFFIC OPERATIONS – AM PEAK HOUR

Analysis Period	Scenario	Control Type	MOE	Direction / Movement / Approach																Overall
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Base	TWSC	LOS Delay V/C Q Ex Avail.	< < < < <	A 0 0.00 0 -	> > > > >	A 0 0 -	> > > > >	A 0 0 -	< < < < <	A 0 0.00 0 -	> > > > >	A 9 0.01 0 -	> > > > >	A 9 0 -	< < < < <	B 11 0.00 0 -	> > > > >	B 11 0 -	> > > > >
	Build-Out Background 2028	TWSC	LOS Delay V/C Q Ex Avail.	< < < < <	A 0 0.00 0 -	> > > > >	A 0 0 -	> > > > >	A 0 0 -	< < < < <	A 0 0.00 0 -	> > > > >	A 9 0.01 0 -	> > > > >	A 9 0 -	< < < < <	B 11 0.00 0 -	> > > > >	B 11 0 -	> > > > >
	Future Background 2033	TWSC	LOS Delay V/C Q Ex Avail.	< < < < <	A 0 0.00 0 -	> > > > >	A 0 0 -	> > > > >	A 0 0 -	< < < < <	A 0 0.00 0 -	> > > > >	A 10 0.01 0 -	> > > > >	A 10 0 -	< < < < <	B 11 0.00 0 -	> > > > >	B 11 0 -	> > > > >
	Future Background 2038	TWSC	LOS Delay V/C Q Ex Avail.	< < < < <	A 0 0.00 0 -	> > > > >	A 0 0 -	> > > > >	A 0 0 -	< < < < <	A 0 0.00 0 -	> > > > >	A 10 0.01 0 -	> > > > >	A 10 0 -	< < < < <	B 12 0.01 0 -	> > > > >	B 12 0 -	> > > > >
	Build-Out Total 2028	TWSC	LOS Delay V/C Q Ex Avail.	< < < < <	A 0 0.00 0 -	> > > > >	A 0 0 -	> > > > >	A 0 0 -	< < < < <	A 0 0.00 0 -	> > > > >	A 9 0.01 0 -	> > > > >	A 9 0 -	< < < < <	B 11 0.01 0 -	> > > > >	B 11 0 -	> > > > >
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	Future Total 2038	TWSC	LOS Delay V/C Q Ex Avail.	< < < < <	A 0 0.00 0 -	> > > > >	A 0 0 -	> > > > >	A 0 0 -	< < < < <	A 0 0.00 0 -	> > > > >	A 10 0.01 0 -	> > > > >	A 10 0 -	< < < < <	B 11 0.02 0 -	> > > > >	B 11 0 -	> > > > >

MOE - Measure of Effectiveness
 LOS - Level of Service
 Delay - Average Delay per Vehicle in Seconds
 Q - 95th Percentile Queue Length
 Ex. - Existing Available Storage
 Avail. - Available Storage
 TCS - Traffic Control Signal
 TWSC - Two-Way Stop Control
 AWSC - All-Way Stop Control
 RBT - Roundabout
 < - Shared Left-turn
 > - Shared Right-turn



TABLE 5: HIGHWAY 3 & ZION ROAD TRAFFIC OPERATIONS – PM PEAK HOUR

Analysis Period	Scenario	Control Type	MOE	Direction / Movement / Approach																Overall
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
PM Peak Hour	Base	TWSC	LOS Delay V/C Q Ex Avail.	< < < < <	A 0 0.00 0 - -	> > > > > >	A 0 0 0 - -	> > > > > >	A 0 0.00 0 - -	< < < < <	A 0 0.00 0 - -	> > > > > >	A 0 0.01 0 - -	> > > > > >	A 0 0.01 0 - -	> > > > > >	B 10 0 - - -	> > > > > >	B 10 0 - - -	
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	Future Background 2033	TWSC	LOS Delay V/C Q Ex Avail.	< < < < <	A 0 0.00 0 - -	> > > > > >	A 0 0 0 - -	> > > > > >	A 0 0.00 0 - -	< < < < <	A 0 0.00 0 - -	> > > > > >	A 0 0.01 0 - -	> > > > > >	A 0 0.01 0 - -	> > > > > >	B 11 0 - - -	> > > > > >	B 11 0 - - -	
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	Build-Out Total 2028	TWSC	LOS Delay V/C Q Ex Avail.	< < < < <	A 0 0.00 0 - -	> > > > > >	A 0 0 0 - -	> > > > > >	A 0 0.00 0 - -	< < < < <	A 0 0.00 0 - -	> > > > > >	A 0 0.01 0 - -	> > > > > >	A 0 0.01 0 - -	> > > > > >	B 11 0 - - -	> > > > > >	B 11 0 - - -	
	Future Total 2033	TWSC	LOS Delay V/C Q Ex Avail.	< < < < <	A 0 0.00 0 - -	> > > > > >	A 0 0 0 - -	> > > > > >	A 0 0.00 0 - -	< < < < <	A 0 0.00 0 - -	> > > > > >	A 0 0.01 0 - -	> > > > > >	A 0 0.01 0 - -	> > > > > >	B 11 0 - - -	> > > > > >	B 11 0 - - -	
	Future Total 2038	TWSC	LOS Delay V/C Q Ex Avail.	< < < < <	A 0 0.00 0 - -	> > > > > >	A 0 0 0 - -	> > > > > >	A 0 0.00 0 - -	< < < < <	A 0 0.00 0 - -	> > > > > >	A 0 0.01 0 - -	> > > > > >	A 0 0.01 0 - -	> > > > > >	B 11 0 - - -	> > > > > >	B 11 0 - - -	

MOE - Measure of Effectiveness
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 TCS - Traffic Control Signal
 TWSC - Two-Way Stop Control
 AWSC - All-Way Stop Control
 RBT - Roundabout
 < - Shared Left-turn
 > - Shared Right-turn



Remedial Measures

Auxiliary Turn Lanes

The need for an auxiliary left-turn lane for eastbound left-turn traffic from Highway 3 onto Zion Road was reviewed using the requirements in the MTO's Design Supplement for the TAC Geometric Design Guide for Canadian Roads² (TAC Guide). **Appendix D** contains the warrant analysis.

The 2038 Total Scenario eastbound left-turn traffic volumes at Zion Road do not meet the minimum 5% threshold for left-turning traffic. Analyzing the traffic at a 5% left-turn volume range for a design speed of 100 km/h (20 km/h above the posted speed limit), the warrant analysis shows that an eastbound left-turn lane is not warranted based on the 2038 Total Scenario traffic volumes.

A right-turn lane analysis has been undertaken for the westbound approach at the intersection of Highway 3 at Zion Road/Flanagan Road in the 2038 Total Scenario. A review of the Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads³ and the MTO right-turn lane guidelines shows that right-turn lanes are typically warranted when right-turn volumes exceed 60 vehicles per hour (vph) and makeup 10-20% of the through the volume; the speed limit of the road also needs to be considered.

The projected right-turn volumes are less than 10 vph and only 6% of the through volume. In addition, the westbound traffic volumes along Highway 3 are forecast to be less than 250 vehicles during the peak period in the 2038 Total Scenario horizon year. Though the speed limit along Highway 3 is 80 km/h, the low volume of right-turning vehicles onto Zion Road does not suggest a westbound right-turn lane be provided.

Signalization

An OTM⁴ signal warrant analysis has been conducted for the intersection of Highway 3 at Zion Road/Flanagan Road in the 2038 Total Scenario. Based on the analysis, a traffic signal is not warranted at the intersection. **Appendix D** contains the warrant analysis.

² Transportation Association of Canada, MTO Geometric Design Standards for Ontario Highways, Chapter E, (1976)

³ Transportation Association of Canada, "Geometric Design Guide for Canadian Roads – Chapter 9" (June 2017). 99

⁴ Ontario Ministry of Transportation, *Ontario Traffic Manual Book 12: Traffic Signals*, (Toronto: Queen's Printer for Ontario, 2012)



Conclusions

The property owner proposes developing the lands to include six (6) single-family detached houses. Vehicle access is proposed via individual private driveways to Zion Road. No access is proposed to Highway 3.

A total of six new AM peak hour vehicle trips and seven new PM peak hour vehicle trips are forecast to be generated by the proposed development.

The intersection of Highway 3 at Zion Road/Flanagan Road operates with delays in the LOS B range or better during Base Year AM and PM peak hours. The intersection is forecast to continue to operate without issue under the future background and total scenarios. Traffic generated by the subject site will not impact traffic operations along Highway 3. Remedial measures are not forecast to be required to accommodate future traffic.

Yours truly,

PARADIGM TRANSPORTATION SOLUTIONS LIMITED



Greg Lue
M.A.Sc., P.Eng.
Project Manager

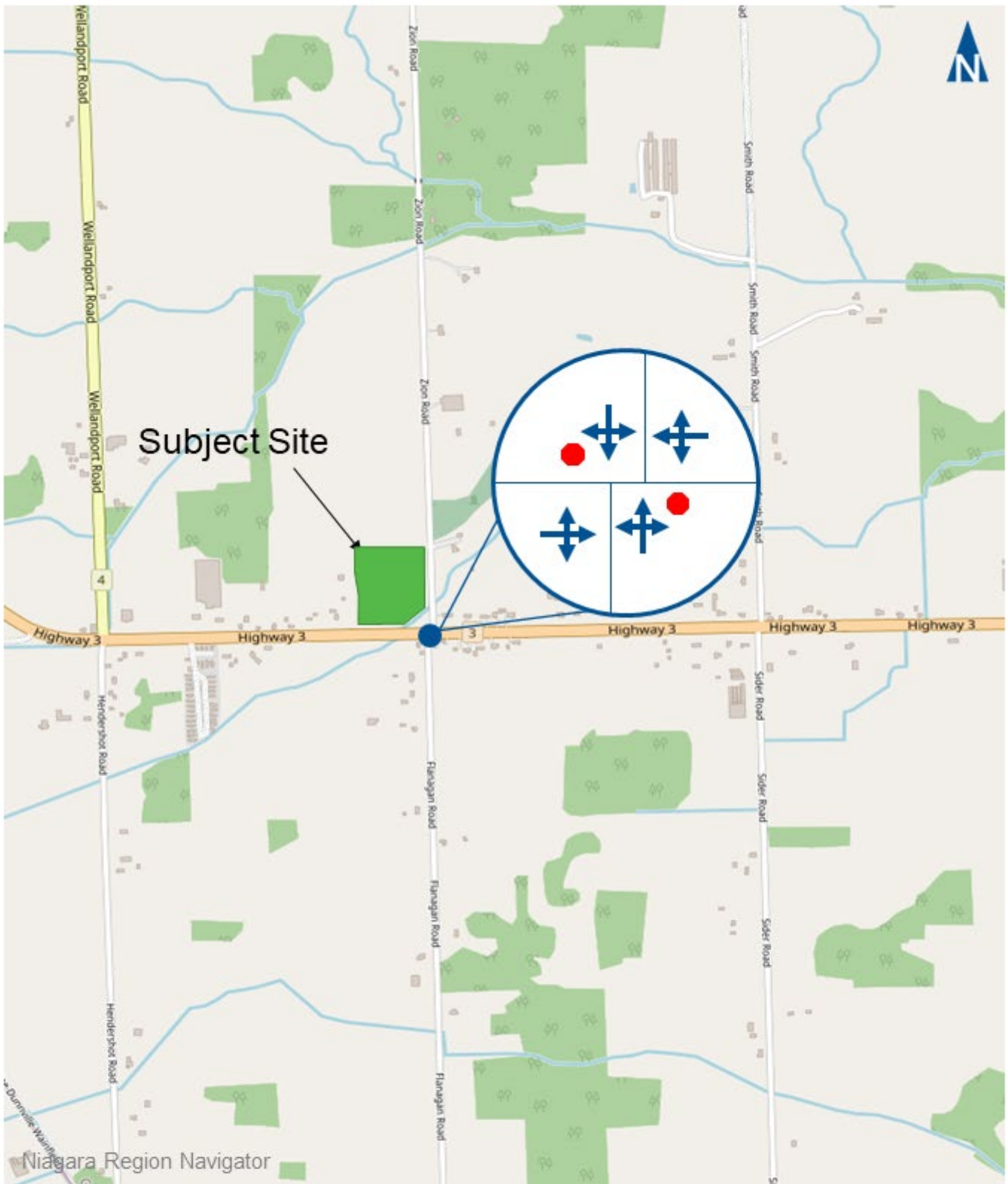


Stew Elkins
B.E.S., MITE
Vice President



Attachments



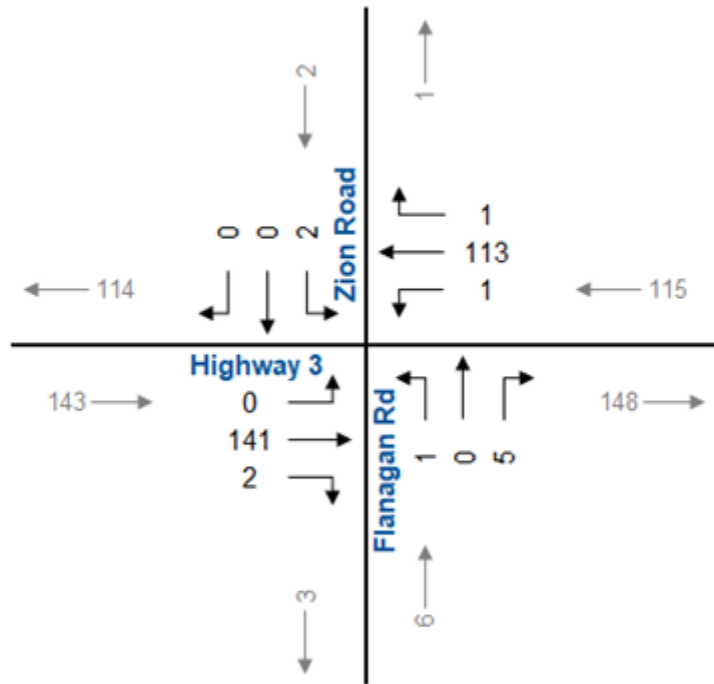


Location of Subject Site and Existing Lane Configurations

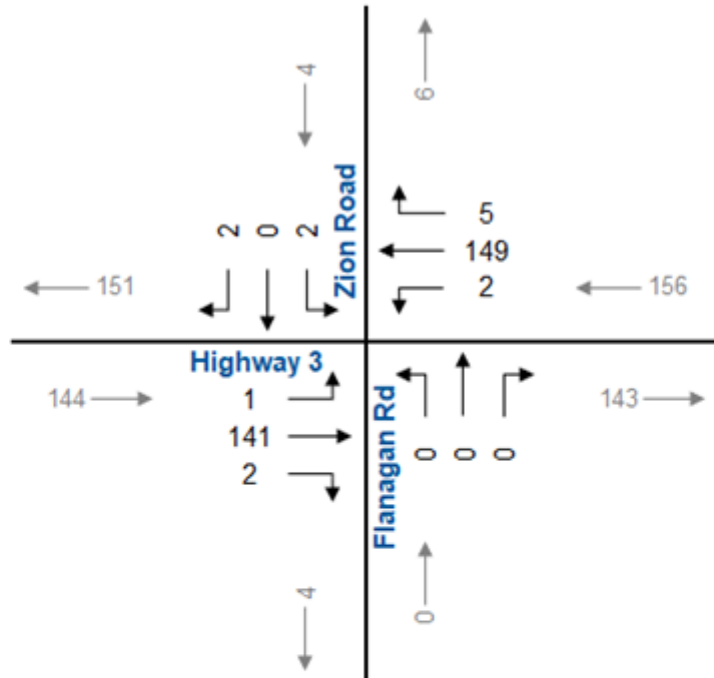
53814 Zion Rd
230055

Figure 1

AM Peak Hour



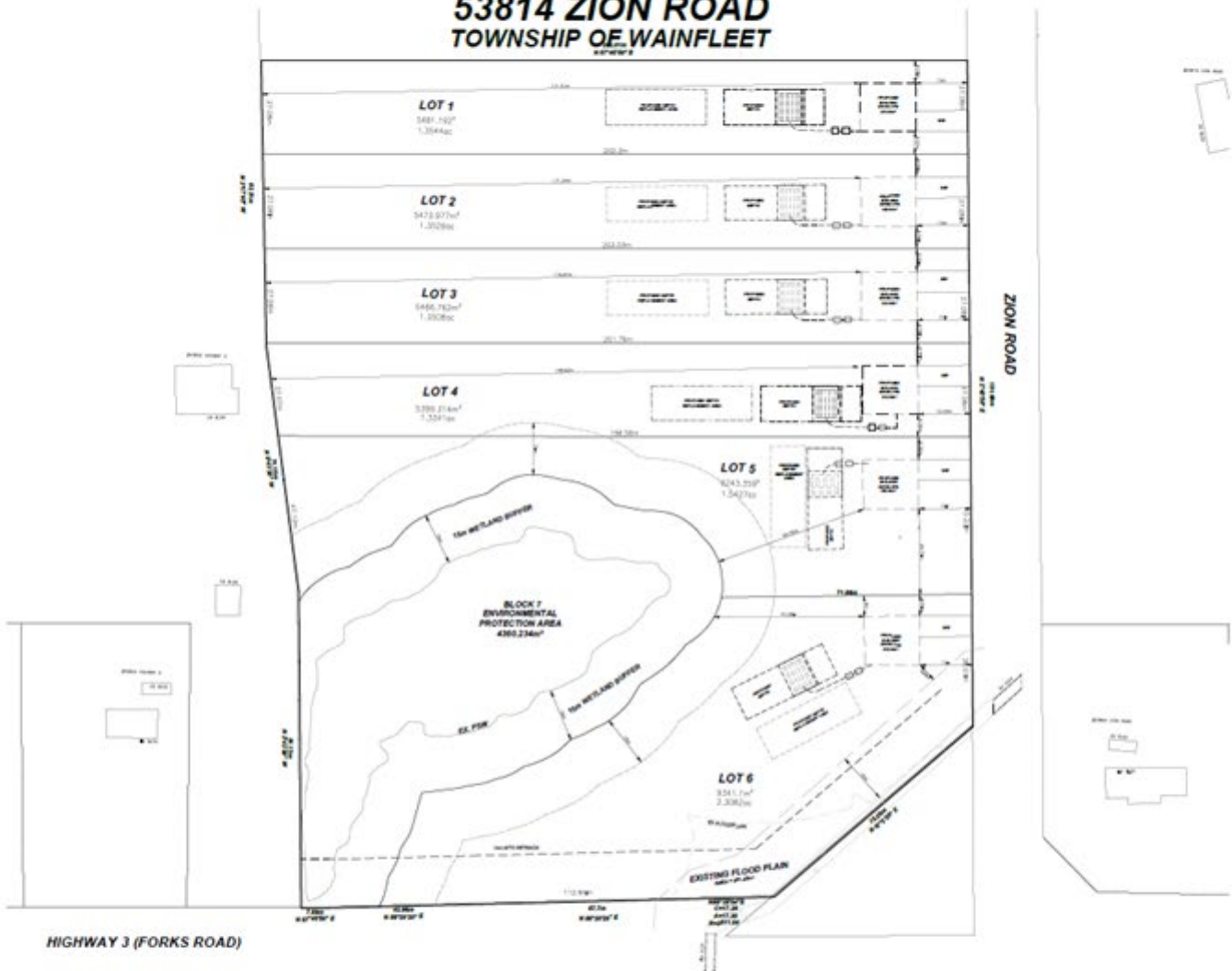
PM Peak Hour



Base Traffic Volumes - AM and PM Peak Hours



53814 ZION ROAD TOWNSHIP OF WAINFLEET

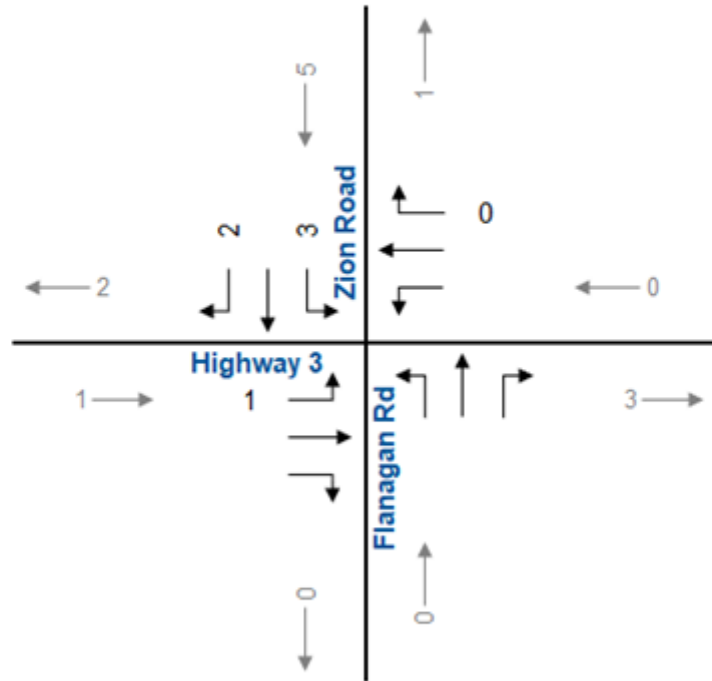


NTS

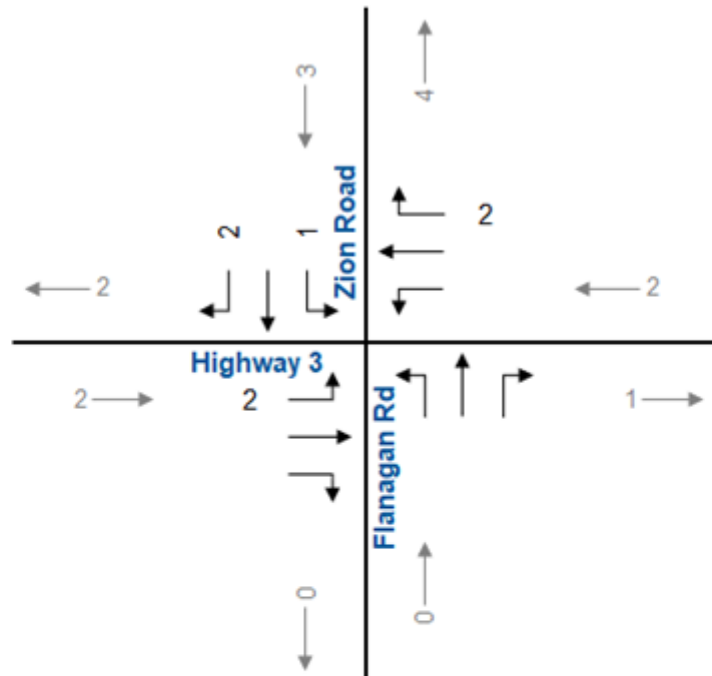


Site Concept Plan

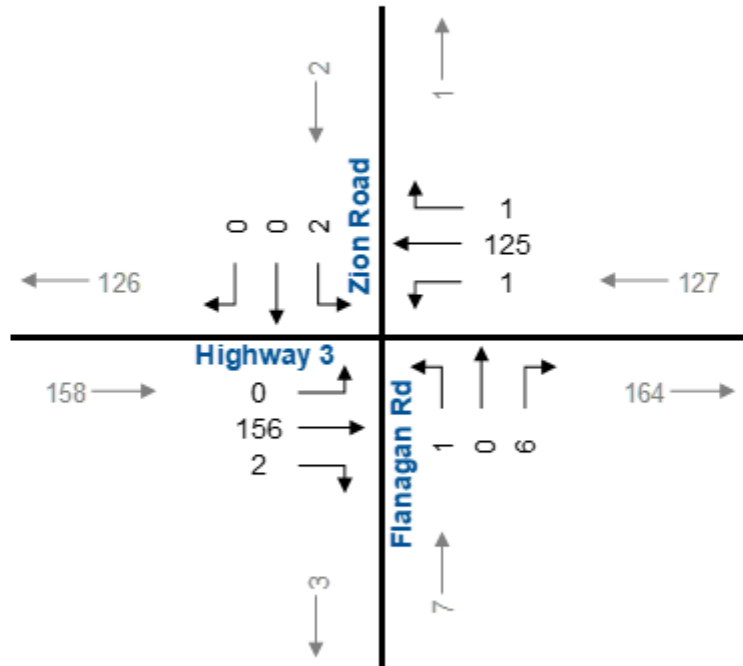
AM Peak Hour



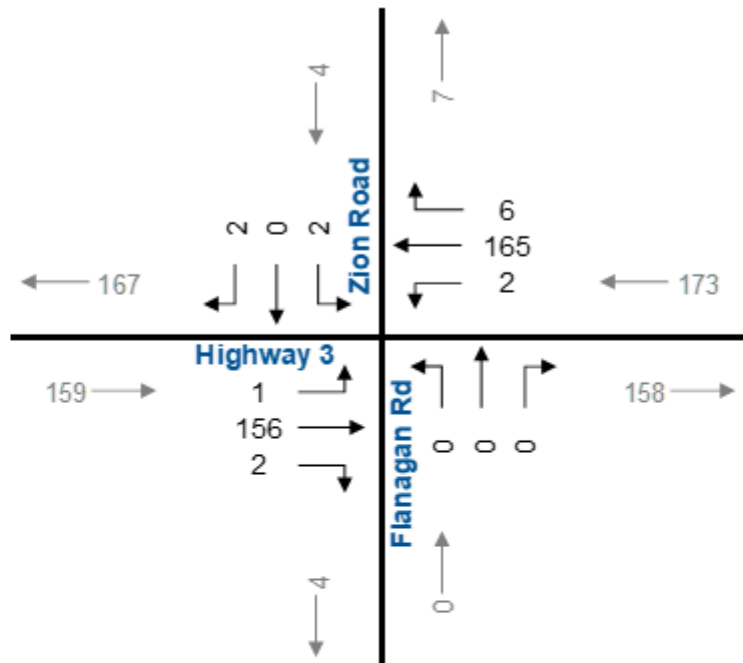
PM Peak Hour



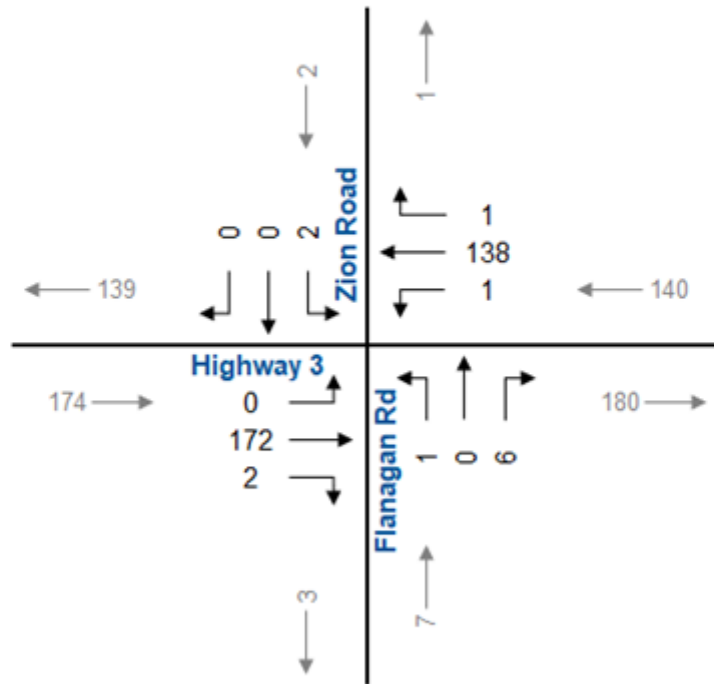
AM Peak Hour



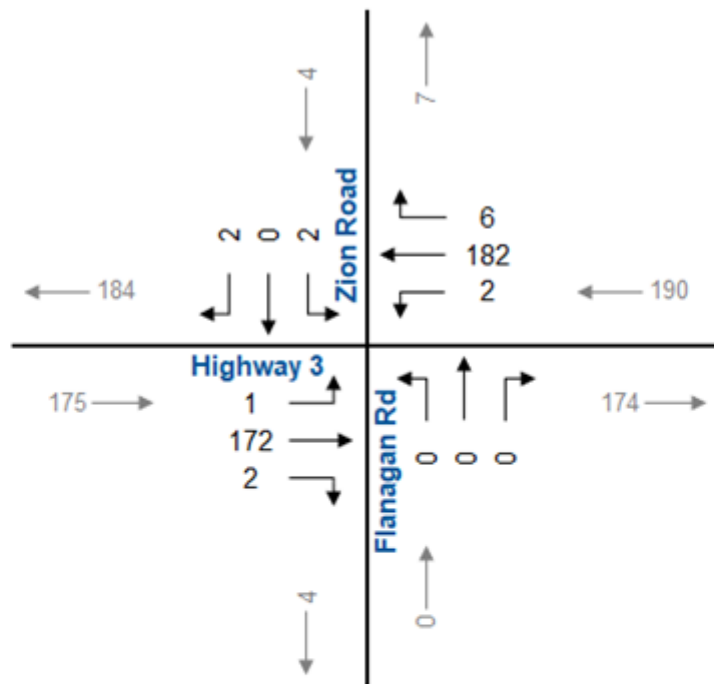
PM Peak Hour



AM Peak Hour

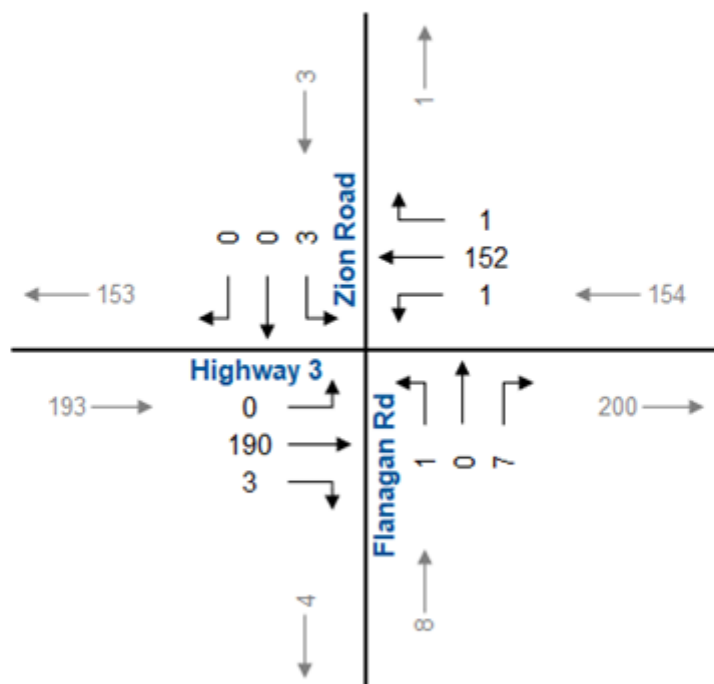


PM Peak Hour

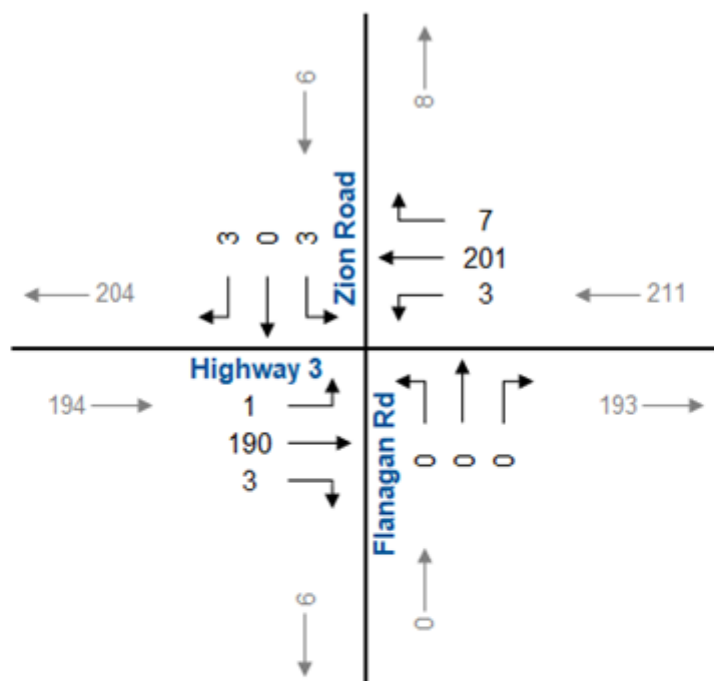


2033 Background Traffic – AM and PM Peak Hours

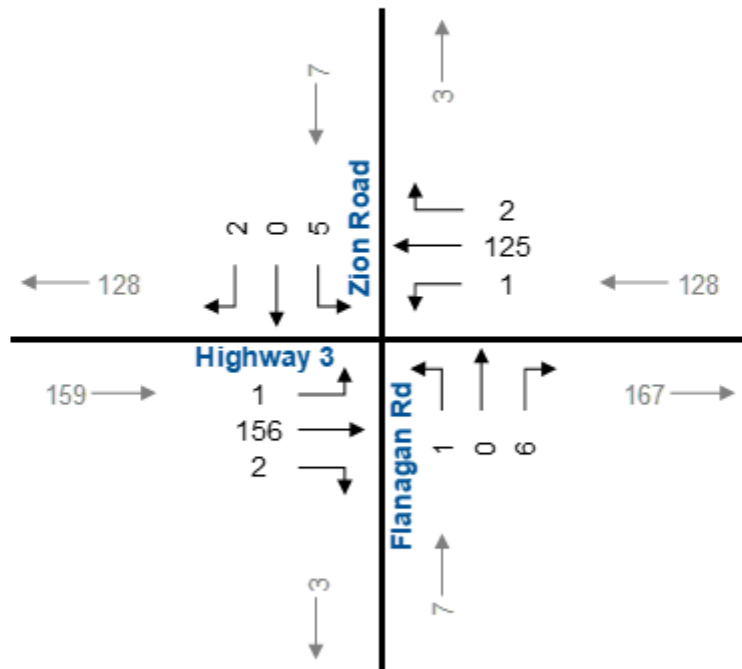
AM Peak Hour



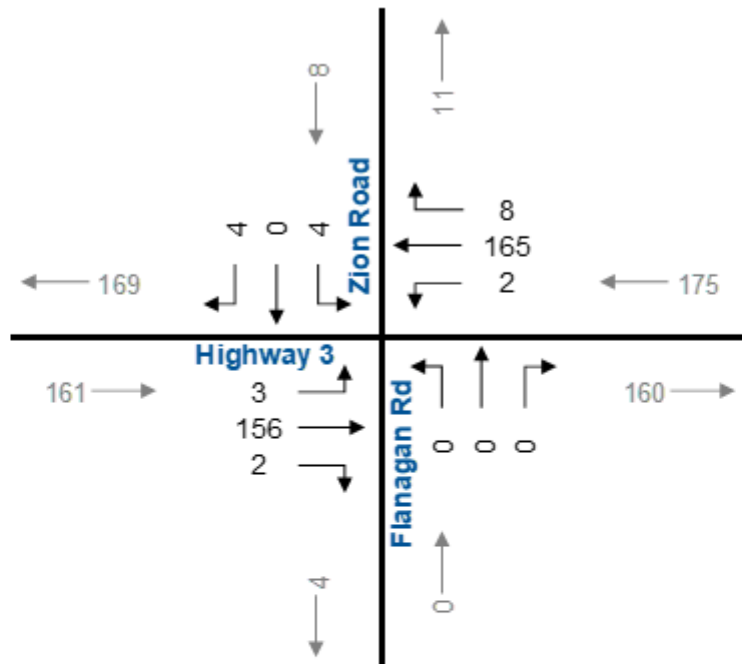
PM Peak Hour



AM Peak Hour

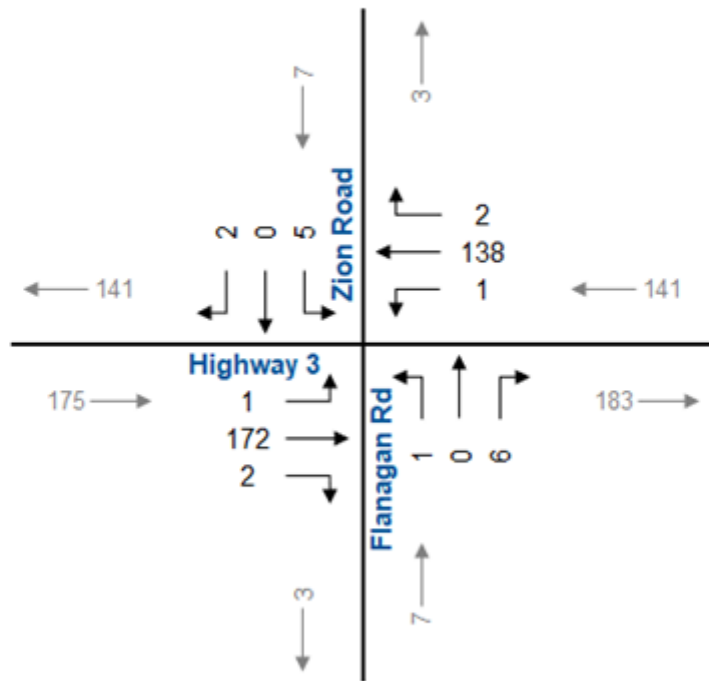


PM Peak Hour

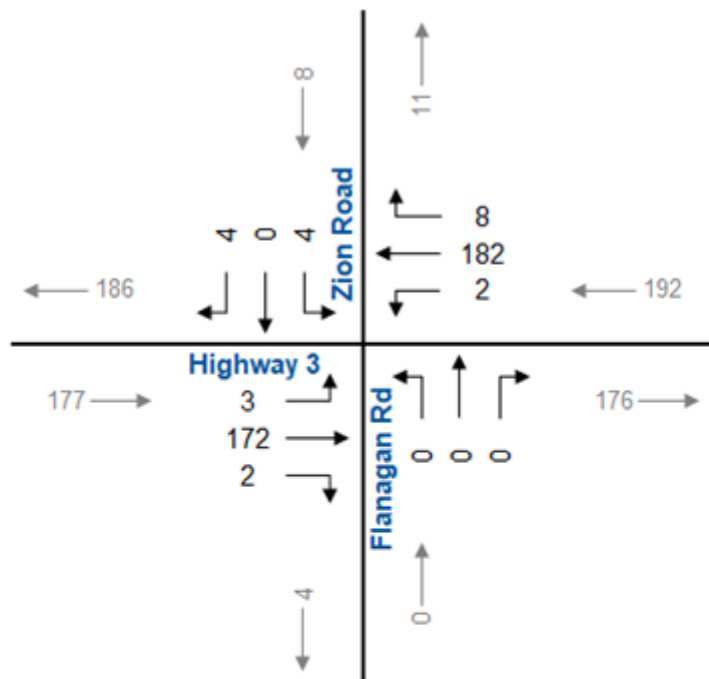


2028 Total Traffic – AM and PM Peak Hours

AM Peak Hour

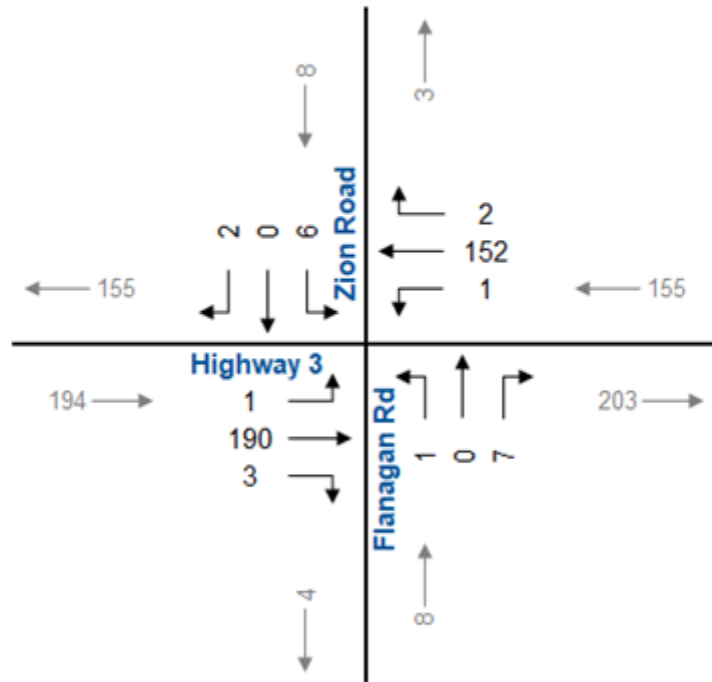


PM Peak Hour

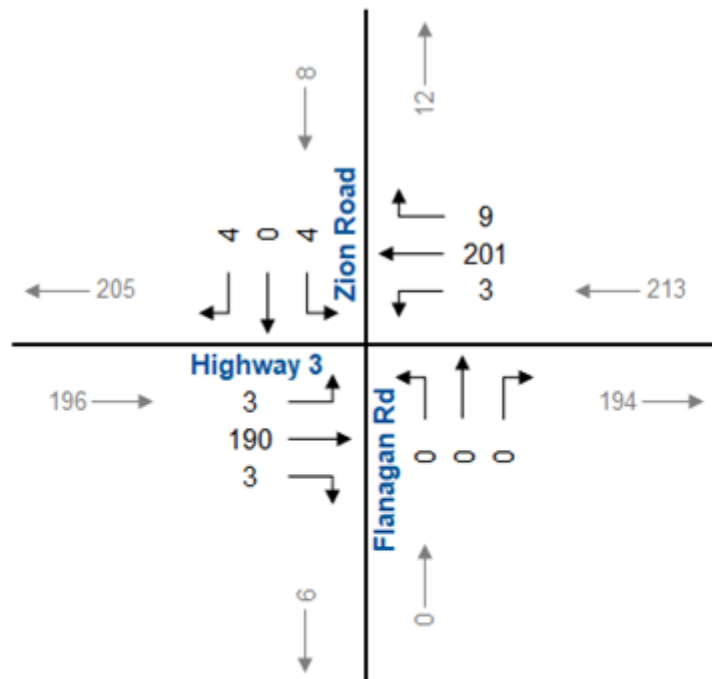


2033 Total Traffic – AM and PM Peak Hours

AM Peak Hour



PM Peak Hour



2038 Total Traffic – AM and PM Peak Hours

Appendix A

Terms of Reference



Greg Lue

From: Lagakos, Ted (MTO) <Ted.Lagakos@ontario.ca>
Sent: January 26, 2023 10:19 AM
To: Greg Lue
Cc: Dutchak, Lance (MTO); Deluca, Peter (MTO)
Subject: RE: (230055) 53814 Zion Rd, Wainfleet - Traffic Impact Study - Terms of Reference

Greg,

The ministry agrees that a traffic brief rather than a full traffic impact study is acceptable in this case.

The terms of reference is ok. Please ensure the brief includes (1) a review of the left and right turn lane warrants on Highway 3 for both Flanagan Road and Zion Road and, (2) a signal warrant for both intersections.

Please contact me if you have any questions.

Ted Lagakos
Senior Project Manager (Niagara/Hamilton)
Corridor Management West - Central Operations

Ministry of Transportation
159 Sir William Hearst Avenue, 7th Floor
Toronto, ON M3M 0B7

Phone: 416-268-3932

E-Mail: ted.lagakos@ontario.ca

Web: www.mto.gov.on.ca/english/engineering/management/corridor

From: Greg Lue <glue@ptsl.com>
Sent: January 25, 2023 3:57 PM
To: Lagakos, Ted (MTO) <Ted.Lagakos@ontario.ca>
Subject: (230055) 53814 Zion Rd, Wainfleet - Traffic Impact Study - Terms of Reference

CAUTION -- EXTERNAL E-MAIL - Do not click links or open attachments unless you recognize the sender.

Hi Ted,

Paradigm Transportations Solutions Limited has been retained to conduct a Transportation Impact Study for a proposed development of 53814 Zion Road in the Town of Wainfleet. The property owner is proposing to develop the site to include six (6) single-family detached houses. Site concept plan is attached.

Vehicle access is proposed via individual private driveways to Zion Road. No access is proposed to Highway 3. Preliminary trip generation estimates 6 AM peak hour trips and 7 PM peak hour trips for the development. As part of the analysis we'll look at the potential need for auxiliary turn lanes on Highway 3 to Zion Road.

The MTO has identified the need for a Traffic Impact Study for the proposed development. Based on the size of the development, we want to confirm if the MTO is ok accepting a traffic brief rather than a full transportation impact study for the development.

The study will follow the MTO Guidelines for Transportation Impact Studies. Below outlines out proposed terms of reference for the study:

Proposed Terms of Reference

Study Area Intersections

- Highway 3 at Zion Road (unsignalized); and
- Highway 3 at Flanagan Road (unsignalized).

Existing Data

- We will conduct eight (8) hour turning movement and classification counts (7:00 to 10:00 AM, 11:30 AM to 1:30 PM, and 4:00 to 7:00 PM) at the study area intersections.

Horizon Years

- Opening Year
- 5 Years from Opening Year
- 10 from Opening Year

Analysis Periods

- Weekday AM peak hour
- Weekday PM peak hour

Analysis

- Synchro 11
- HCM 2000
- SimTraffic Queueing (five 60-min iterations)

Background Traffic

- Generalized growth rate 2% per annum

Site Traffic Estimates

- ITE Trip Generation Data 11th Edition
- No modal split reductions

Site Traffic Distribution

- Existing travel patterns

Report

- We will document the study methodologies, findings, and conclusions in a traffic brief with appendices containing the detailed analysis results and any data collected.

We look forward to hearing back from you.

Thanks !

Greg Lue, M.A.Sc., P.Eng.

Project Manager

(he/him)



Paradigm Transportation Solutions Limited

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w: www.ptsl.com



**** Paradigm is now operating on a 4-day workweek. Our offices are closed Fridays. ****

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Appendix B

Traffic Data





Paradigm Transportation Solutions Limited
5A-150 Pinebush Rd

Cambridge, Ontario, Canada N1R 8J8
519-896-3163 cbowness@ptsI.com

Count Name: Highway 3 & Zion Road/Flanagan Road
Site Code: 230055
Start Date: 01/31/2023
Page No: 1

Turning Movement Data

Start Time	Highway 3 Eastbound						Highway 3 Westbound						Flanagan Road Northbound						Zion Road Southbound						Int. Total
	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	
7:00 AM	0	30	0	0	0	30	0	17	0	0	0	17	0	0	0	0	0	0	2	0	0	0	0	2	49
7:15 AM	0	34	0	0	0	34	0	32	0	0	0	32	0	0	0	0	0	0	0	0	0	0	0	0	66
7:30 AM	0	26	1	0	0	27	0	33	0	0	0	33	1	0	0	0	0	1	0	0	0	0	0	0	61
7:45 AM	0	36	0	0	0	36	0	26	0	0	0	26	1	0	0	0	0	1	0	0	0	0	0	0	63
Hourly Total	0	126	1	0	0	127	0	108	0	0	0	108	2	0	0	0	0	2	2	0	0	0	0	2	239
8:00 AM	0	23	0	0	0	23	0	29	0	0	0	29	1	0	1	0	0	2	2	0	0	0	0	2	56
8:15 AM	0	24	0	0	0	24	1	28	0	0	0	29	1	0	0	0	0	1	0	0	0	0	0	0	54
8:30 AM	0	40	0	0	0	40	0	31	1	0	0	32	1	0	0	0	0	1	0	0	0	0	0	0	73
8:45 AM	0	39	0	0	0	39	0	32	0	0	0	32	0	0	1	0	0	1	2	0	0	0	0	2	74
Hourly Total	0	126	0	0	0	126	1	120	1	0	0	122	3	0	2	0	0	5	4	0	0	0	0	4	257
9:00 AM	0	32	2	0	0	34	0	26	0	0	0	26	0	0	3	0	0	3	0	0	0	0	0	0	63
9:15 AM	0	30	0	0	0	30	1	24	0	0	0	25	0	0	1	0	0	1	0	0	0	0	0	0	56
9:30 AM	1	27	1	0	0	29	0	26	0	0	0	26	1	0	1	0	0	2	0	0	0	0	0	0	57
9:45 AM	0	38	0	0	0	38	0	29	0	0	0	29	0	0	0	0	0	0	0	0	0	0	0	0	67
Hourly Total	1	127	3	0	0	131	1	105	0	0	0	106	1	0	5	0	0	6	0	0	0	0	0	0	243
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11:30 AM	1	22	0	0	0	23	0	23	0	0	0	23	0	0	1	0	0	1	0	0	0	0	0	0	47
11:45 AM	0	38	0	0	0	38	0	31	0	0	0	31	0	0	0	0	0	0	0	0	0	0	0	0	69
Hourly Total	1	60	0	0	0	61	0	54	0	0	0	54	0	0	1	0	0	1	0	0	0	0	0	0	116
12:00 PM	0	23	0	0	0	23	0	27	1	0	0	28	2	0	0	0	0	2	1	0	1	0	0	2	55
12:15 PM	1	25	1	0	0	27	1	34	0	0	0	35	1	0	0	0	0	1	0	0	0	0	0	0	63
12:30 PM	0	34	0	0	0	34	0	28	0	0	0	28	0	0	0	0	0	0	0	0	0	0	0	0	62
12:45 PM	0	34	0	0	0	34	0	25	0	0	0	25	0	0	1	0	0	1	0	0	0	0	0	0	60
Hourly Total	1	116	1	0	0	118	1	114	1	0	0	116	3	0	1	0	0	4	1	0	1	0	0	2	240
1:00 PM	0	35	0	0	0	35	1	37	1	0	0	39	1	0	0	0	0	1	0	0	0	0	0	0	75
1:15 PM	1	25	0	0	0	26	1	32	0	0	0	33	0	0	0	0	0	0	0	0	0	0	0	0	59
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hourly Total	1	60	0	0	0	61	2	69	1	0	0	72	1	0	0	0	0	1	0	0	0	0	0	0	134
4:00 PM	0	41	0	0	0	41	0	18	0	0	0	18	1	0	0	0	0	1	1	0	0	0	0	1	61
4:15 PM	1	42	0	0	0	43	0	21	0	0	0	21	0	0	1	0	0	1	0	0	0	0	0	0	65
4:30 PM	0	37	1	0	0	38	2	36	1	0	0	39	0	0	0	0	0	0	0	0	1	0	0	1	78
4:45 PM	0	36	1	0	0	37	0	35	0	0	0	35	0	0	0	0	0	0	1	0	0	0	0	1	73
Hourly Total	1	156	2	0	0	159	2	110	1	0	0	113	1	0	1	0	0	2	2	0	1	0	0	3	277
5:00 PM	0	31	0	0	0	31	0	43	3	0	0	46	0	0	0	0	0	0	0	0	1	0	0	1	78
5:15 PM	1	37	0	0	0	38	0	35	1	0	0	36	0	0	0	0	0	0	1	0	0	0	0	1	75



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Count Name: Highway 3 & Zion Road/Flanagan Road
Site Code: 230055
Start Date: 01/31/2023
Page No: 4

Turning Movement Peak Hour Data (8:30 AM)

Start Time	Highway 3 Eastbound						Highway 3 Westbound						Flanagan Road Northbound						Zion Road Southbound						Int. Total
	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	
8:30 AM	0	40	0	0	0	40	0	31	1	0	0	32	1	0	0	0	0	1	0	0	0	0	0	0	73
8:45 AM	0	39	0	0	0	39	0	32	0	0	0	32	0	0	1	0	0	1	2	0	0	0	0	2	74
9:00 AM	0	32	2	0	0	34	0	26	0	0	0	26	0	0	3	0	0	3	0	0	0	0	0	0	63
9:15 AM	0	30	0	0	0	30	1	24	0	0	0	25	0	0	1	0	0	1	0	0	0	0	0	0	56
Total	0	141	2	0	0	143	1	113	1	0	0	115	1	0	5	0	0	6	2	0	0	0	0	2	266
Approach %	0.0	98.6	1.4	0.0	-	-	0.9	98.3	0.9	0.0	-	-	16.7	0.0	83.3	0.0	-	-	100.0	0.0	0.0	0.0	-	-	-
Total %	0.0	53.0	0.8	0.0	-	53.8	0.4	42.5	0.4	0.0	-	43.2	0.4	0.0	1.9	0.0	-	2.3	0.8	0.0	0.0	0.0	-	0.8	-
PHF	0.000	0.881	0.250	0.000	-	0.894	0.250	0.883	0.250	0.000	-	0.898	0.250	0.000	0.417	0.000	-	0.500	0.250	0.000	0.000	0.000	-	0.250	0.899
Motorcycles	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0
% Motorcycles	-	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	-	0.0	-	-	0.0	0.0	-	-	-	-	0.0	0.0
Cars & Light Goods	0	114	2	0	-	116	1	96	0	0	-	97	1	0	5	0	-	6	0	0	0	0	-	0	219
% Cars & Light Goods	-	80.9	100.0	-	-	81.1	100.0	85.0	0.0	-	-	84.3	100.0	-	100.0	-	-	100.0	0.0	-	-	-	-	0.0	82.3
Buses	0	6	0	0	-	6	0	0	1	0	-	1	0	0	0	0	-	0	1	0	0	0	-	1	8
% Buses	-	4.3	0.0	-	-	4.2	0.0	0.0	100.0	-	-	0.9	0.0	-	0.0	-	-	0.0	50.0	-	-	-	-	50.0	3.0
Single-Unit Trucks	0	3	0	0	-	3	0	4	0	0	-	4	0	0	0	0	-	0	0	0	0	0	-	0	7
% Single-Unit Trucks	-	2.1	0.0	-	-	2.1	0.0	3.5	0.0	-	-	3.5	0.0	-	0.0	-	-	0.0	0.0	-	-	-	-	0.0	2.6
Articulated Trucks	0	18	0	0	-	18	0	13	0	0	-	13	0	0	0	0	-	0	1	0	0	0	-	1	32
% Articulated Trucks	-	12.8	0.0	-	-	12.6	0.0	11.5	0.0	-	-	11.3	0.0	-	0.0	-	-	0.0	50.0	-	-	-	-	50.0	12.0
Bicycles on Road	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0
% Bicycles on Road	-	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	0.0	-	0.0	-	-	0.0	0.0	-	-	-	-	0.0	0.0
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



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Start Date: 01/31/2023
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Turning Movement Peak Hour Data (4:30 PM)

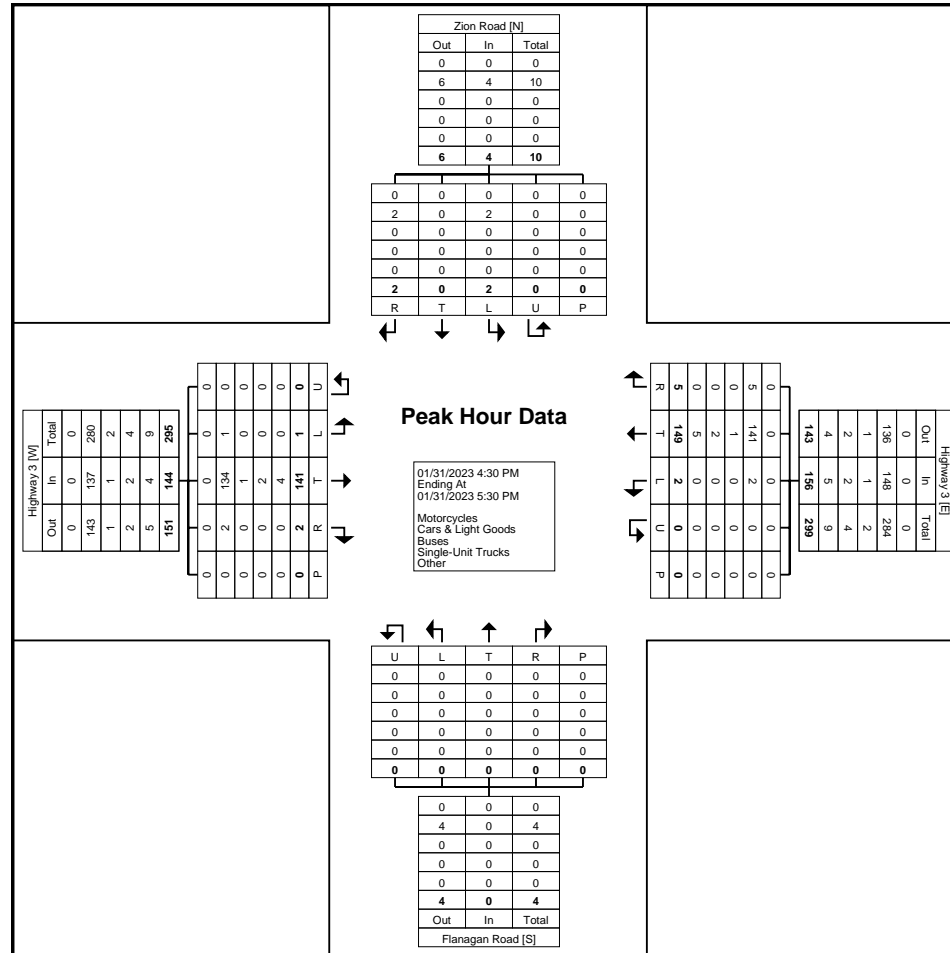
Start Time	Highway 3 Eastbound						Highway 3 Westbound						Flanagan Road Northbound						Zion Road Southbound						Int. Total
	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	
4:30 PM	0	37	1	0	0	38	2	36	1	0	0	39	0	0	0	0	0	0	0	0	1	0	0	1	78
4:45 PM	0	36	1	0	0	37	0	35	0	0	0	35	0	0	0	0	0	0	1	0	0	0	0	1	73
5:00 PM	0	31	0	0	0	31	0	43	3	0	0	46	0	0	0	0	0	0	0	0	1	0	0	1	78
5:15 PM	1	37	0	0	0	38	0	35	1	0	0	36	0	0	0	0	0	0	1	0	0	0	0	1	75
Total	1	141	2	0	0	144	2	149	5	0	0	156	0	0	0	0	0	0	2	0	2	0	0	4	304
Approach %	0.7	97.9	1.4	0.0	-	-	1.3	95.5	3.2	0.0	-	-	0.0	0.0	0.0	0.0	-	-	50.0	0.0	50.0	0.0	-	-	-
Total %	0.3	46.4	0.7	0.0	-	47.4	0.7	49.0	1.6	0.0	-	51.3	0.0	0.0	0.0	0.0	-	0.0	0.7	0.0	0.7	0.0	-	1.3	-
PHF	0.250	0.953	0.500	0.000	-	0.947	0.250	0.866	0.417	0.000	-	0.848	0.000	0.000	0.000	0.000	-	0.000	0.500	0.000	0.500	0.000	-	1.000	0.974
Motorcycles	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0
% Motorcycles	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	-	-	-	-	-	-	0.0	-	0.0	-	-	0.0	0.0
Cars & Light Goods	1	134	2	0	-	137	2	141	5	0	-	148	0	0	0	0	-	0	2	0	2	0	-	4	289
% Cars & Light Goods	100.0	95.0	100.0	-	-	95.1	100.0	94.6	100.0	-	-	94.9	-	-	-	-	-	-	100.0	-	100.0	-	-	100.0	95.1
Buses	0	1	0	0	-	1	0	1	0	0	-	1	0	0	0	0	-	0	0	0	0	0	-	0	2
% Buses	0.0	0.7	0.0	-	-	0.7	0.0	0.7	0.0	-	-	0.6	-	-	-	-	-	-	0.0	-	0.0	-	-	0.0	0.7
Single-Unit Trucks	0	2	0	0	-	2	0	2	0	0	-	2	0	0	0	0	-	0	0	0	0	0	-	0	4
% Single-Unit Trucks	0.0	1.4	0.0	-	-	1.4	0.0	1.3	0.0	-	-	1.3	-	-	-	-	-	-	0.0	-	0.0	-	-	0.0	1.3
Articulated Trucks	0	4	0	0	-	4	0	5	0	0	-	5	0	0	0	0	-	0	0	0	0	0	-	0	9
% Articulated Trucks	0.0	2.8	0.0	-	-	2.8	0.0	3.4	0.0	-	-	3.2	-	-	-	-	-	-	0.0	-	0.0	-	-	0.0	3.0
Bicycles on Road	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0
% Bicycles on Road	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	-	-	-	-	-	-	0.0	-	0.0	-	-	0.0	0.0
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



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Turning Movement Peak Hour Data Plot (4:30 PM)

Appendix C

Synchro Results



HCM Unsignalized Intersection Capacity Analysis
1: Flanagan Rd/Zion Rd & Highway 3

AM - Base Year
53814 Zion Road

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR		
Lane Configurations		↔			↔			↔			↔			
Traffic Volume (veh/h)	0	141	2	1	113	1	1	0	5	2	0	0		
Future Volume (Veh/h)	0	141	2	1	113	1	1	0	5	2	0	0		
Sign Control	Free			Free			Stop			Stop				
Grade	0%			0%			0%			0%				
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92		
Hourly flow rate (vph)	0	153	2	1	123	1	1	0	5	2	0	0		
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	124				155				280	280	154	284	280	124
vC1, stage 1 conf vol														
vC2, stage 2 conf vol														
vCu, unblocked vol	124				155				280	280	154	284	280	124
tC, single (s)	4.1				4.1				7.1	6.5	6.2	8.1	6.5	6.2
tC, 2 stage (s)														
tF (s)	2.2				2.2				3.5	4.0	3.3	4.4	4.0	3.3
p0 queue free %	100				100				100	100	99	100	100	100
cM capacity (veh/h)	1475				1438				677	631	897	508	631	933
Direction, Lane #	EB 1	WB 1	NB 1	SB 1										
Volume Total	155	125	6	2										
Volume Left	0	1	1	2										
Volume Right	2	1	5	0										
eSH	1475	1438	851	508										
Volume to Capacity	0.00	0.00	0.01	0.00										
Queue Length 95th (m)	0.0	0.0	0.2	0.1										
Control Delay (s)	0.0	0.1	9.3	12.1										
Lane LOS	A	A	A	B										
Approach Delay (s)	0.0	0.1	9.3	12.1										
Approach LOS			A	B										
Intersection Summary														
Average Delay				0.3										
Intersection Capacity Utilization				17.5%	ICU Level of Service			A						
Analysis Period (min)				15										

HCM Unsignalized Intersection Capacity Analysis
1: Flanagan Rd/Zion Rd & Highway 3

PM - Base Year
53814 Zion Road

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR		
Lane Configurations		↔			↔			↔			↔			
Traffic Volume (veh/h)	1	141	2	2	149	5	0	0	0	2	0	2		
Future Volume (Veh/h)	1	141	2	2	149	5	0	0	0	2	0	2		
Sign Control	Free			Free			Stop			Stop				
Grade	0%			0%			0%			0%				
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92		
Hourly flow rate (vph)	1	153	2	2	162	5	0	0	0	2	0	2		
Pedestrians														
Lane Width (m)														
Walking Speed (m/s)														
Percent Blockage														
Right turn flare (veh)														
Median type	None				None									
Median storage (veh)														
Upstream signal (m)														
pX, platoon unblocked														
vC, conflicting volume	167				155				326	327	154	324	326	164
vC1, stage 1 conf vol														
vC2, stage 2 conf vol														
vCu, unblocked vol	167				155				326	327	154	324	326	164
tC, single (s)	4.1				4.1				7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)														
tF (s)	2.2				2.2				3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100				100				100	100	100	100	100	100
cM capacity (veh/h)	1423				1438				628	594	897	631	595	885
Direction, Lane #	EB 1	WB 1	NB 1	SB 1										
Volume Total	156	169	0	4										
Volume Left	1	2	0	2										
Volume Right	2	5	0	2										
eSH	1423	1438	1700	737										
Volume to Capacity	0.00	0.00	0.01	0.01										
Queue Length 95th (m)	0.0	0.0	0.0	0.1										
Control Delay (s)	0.1	0.1	0.0	9.9										
Lane LOS	A	A	A	A										
Approach Delay (s)	0.1	0.1	0.0	9.9										
Approach LOS			A	A										
Intersection Summary														
Average Delay				0.2										
Intersection Capacity Utilization				19.5%	ICU Level of Service			A						
Analysis Period (min)				15										

HCM Unsignalized Intersection Capacity Analysis
1: Flanagan Rd/Zion Rd & Highway 3

AM - Background 2028
53814 Zion Road

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (veh/h)	0	156	2	1	125	1	1	0	6	2	0	0
Future Volume (Veh/h)	0	156	2	1	125	1	1	0	6	2	0	0
Sign Control	Free			Free			Stop			Stop		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	170	2	1	136	1	1	0	7	2	0	0
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	137			172			310	310	171	316	310	136
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	137			172			310	310	171	316	310	136
tC, single (s)	4.1			4.1			7.1	6.5	6.2	8.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	4.4	4.0	3.3
p0 queue free %	100			100			100	100	99	100	100	100
cM capacity (veh/h)	1447			1405			643	604	873	480	604	912
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	172	138	8	2								
Volume Left	0	1	1	2								
Volume Right	2	1	7	0								
cSH	1447	1405	835	480								
Volume to Capacity	0.00	0.00	0.01	0.00								
Queue Length 95th (m)	0.0	0.0	0.2	0.1								
Control Delay (s)	0.0	0.1	9.4	12.5								
Lane LOS	A	A	A	B								
Approach Delay (s)	0.0	0.1	9.4	12.5								
Approach LOS		A	B									
Intersection Summary												
Average Delay	0.3											
Intersection Capacity Utilization	18.3%			ICU Level of Service			A					
Analysis Period (min)	15											

HCM Unsignalized Intersection Capacity Analysis
1: Flanagan Rd/Zion Rd & Highway 3

PM - Background 2028
53814 Zion Road

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (veh/h)	1	156	2	2	165	6	0	0	0	2	0	2
Future Volume (Veh/h)	1	156	2	2	165	6	0	0	0	2	0	2
Sign Control	Free			Free			Stop			Stop		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1	170	2	2	179	7	0	0	0	2	0	2
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type	None				None							
Median storage (veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	186			172			362	363	171	360	360	182
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	186			172			362	363	171	360	360	182
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	100	100	100	100
cM capacity (veh/h)	1388			1405			592	563	873	595	565	860
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	173	188	0	4								
Volume Left	1	2	0	2								
Volume Right	2	7	0	2								
cSH	1388	1405	1700	703								
Volume to Capacity	0.00	0.00	0.01	0.01								
Queue Length 95th (m)	0.0	0.0	0.0	0.1								
Control Delay (s)	0.0	0.1	0.0	10.1								
Lane LOS	A	A	A	B								
Approach Delay (s)	0.0	0.1	0.0	10.1								
Approach LOS		A	B									
Intersection Summary												
Average Delay	0.2											
Intersection Capacity Utilization	20.4%			ICU Level of Service			A					
Analysis Period (min)	15											

HCM Unsignalized Intersection Capacity Analysis
1: Flanagan Rd/Zion Rd & Highway 3

AM - Background 2033
53814 Zion Road

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (veh/h)	0	172	2	1	138	1	1	0	6	2	0	0
Future Volume (Veh/h)	0	172	2	1	138	1	1	0	6	2	0	0
Sign Control	Free			Free			Stop			Stop		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	187	2	1	150	1	1	0	7	2	0	0
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	151			189			340	341	188	348	342	150
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	151			189			340	341	188	348	342	150
tC, single (s)	4.1			4.1			7.1	6.5	6.2	8.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	4.4	4.0	3.3
p0 queue free %	100			100			100	100	99	100	100	100
cM capacity (veh/h)	1430			1385			613	580	854	455	580	896
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	189	152	8	2								
Volume Left	0	1	1	2								
Volume Right	2	1	7	0								
cSH	1430	1385	814	455								
Volume to Capacity	0.00	0.00	0.01	0.00								
Queue Length 95th (m)	0.0	0.0	0.2	0.1								
Control Delay (s)	0.0	0.1	9.5	12.9								
Lane LOS		A	A	B								
Approach Delay (s)	0.0	0.1	9.5	12.9								
Approach LOS		A	B									
Intersection Summary												
Average Delay		0.3										
Intersection Capacity Utilization		19.2%		ICU Level of Service			A					
Analysis Period (min)		15										

HCM Unsignalized Intersection Capacity Analysis
1: Flanagan Rd/Zion Rd & Highway 3

PM - Background 2033
53814 Zion Road

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (veh/h)	1	172	2	2	182	6	0	0	0	2	0	2
Future Volume (Veh/h)	1	172	2	2	182	6	0	0	0	2	0	2
Sign Control	Free			Free			Stop			Stop		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1	187	2	2	198	7	0	0	0	2	0	2
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type	None			None								
Median storage (veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	205			189			398	399	188	396	396	202
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	205			189			398	399	188	396	396	202
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	100	100	100	100
cM capacity (veh/h)	1366			1385			560	538	854	563	540	839
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	190	207	0	4								
Volume Left	1	2	0	2								
Volume Right	2	7	0	2								
cSH	1366	1385	1700	674								
Volume to Capacity	0.00	0.00	0.01	0.01								
Queue Length 95th (m)	0.0	0.0	0.0	0.1								
Control Delay (s)	0.0	0.1	0.0	10.4								
Lane LOS	A	A	A	B								
Approach Delay (s)	0.0	0.1	0.0	10.4								
Approach LOS		A	B									
Intersection Summary												
Average Delay		0.2										
Intersection Capacity Utilization		21.3%		ICU Level of Service			A					
Analysis Period (min)		15										

HCM Unsignalized Intersection Capacity Analysis
1: Flanagan Rd/Zion Rd & Highway 3

AM - Background 2038
53814 Zion Road

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (veh/h)	0	190	3	1	152	1	1	0	7	3	0	0
Future Volume (Veh/h)	0	190	3	1	152	1	1	0	7	3	0	0
Sign Control	Free			Free			Stop			Stop		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	207	3	1	165	1	1	0	8	3	0	0
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	166			210			376	376	208	384	378	166
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	166			210			376	376	208	384	378	166
tC, single (s)	4.1			4.1			7.1	6.5	6.2	8.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	4.4	4.0	3.3
p0 queue free %	100			100			100	100	99	99	100	100
cM capacity (veh/h)	1412			1361			581	554	832	428	554	879
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	210	167	9	3								
Volume Left	0	1	1	3								
Volume Right	3	1	8	0								
eSH	1412	1361	794	428								
Volume to Capacity	0.00	0.00	0.01	0.01								
Queue Length 95th (m)	0.0	0.0	0.3	0.2								
Control Delay (s)	0.0	0.1	9.6	13.5								
Lane LOS		A	A	B								
Approach Delay (s)	0.0	0.1	9.6	13.5								
Approach LOS		A	B									
Intersection Summary												
Average Delay				0.3								
Intersection Capacity Utilization				20.2%	ICU Level of Service	A						
Analysis Period (min)				15								

HCM Unsignalized Intersection Capacity Analysis
1: Flanagan Rd/Zion Rd & Highway 3

PM - Background 2038
53814 Zion Road

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (veh/h)	1	190	3	3	201	7	0	0	0	3	0	3
Future Volume (Veh/h)	1	190	3	3	201	7	0	0	0	3	0	3
Sign Control	Free			Free			Stop			Stop		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1	207	3	3	218	8	0	0	0	3	0	3
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type	None			None								
Median storage (veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	226			210			442	442	208	438	440	222
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	226			210			442	442	208	438	440	222
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	100	99	100	100
cM capacity (veh/h)	1342			1361			523	508	832	527	510	818
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	211	229	0	6								
Volume Left	1	3	0	3								
Volume Right	3	8	0	3								
eSH	1342	1361	1700	641								
Volume to Capacity	0.00	0.00	0.01	0.01								
Queue Length 95th (m)	0.0	0.1	0.0	0.2								
Control Delay (s)	0.0	0.1	0.0	10.7								
Lane LOS	A	A	A	B								
Approach Delay (s)	0.0	0.1	0.0	10.7								
Approach LOS		A	B									
Intersection Summary												
Average Delay				0.2								
Intersection Capacity Utilization				23.1%	ICU Level of Service	A						
Analysis Period (min)				15								

HCM Unsignalized Intersection Capacity Analysis
1: Flanagan Rd/Zion Rd & Highway 3

AM - Total Build-Out 2028
53814 Zion Road

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔				↔
Traffic Volume (veh/h)	1	156	2	1	125	2	1	0	6	5	0	2
Future Volume (Veh/h)	1	156	2	1	125	2	1	0	6	5	0	2
Sign Control	Free			Free			Stop			Stop		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1	170	2	1	136	2	1	0	7	5	0	2
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type	None			None								
Median storage (veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	138			172			314	313	171	319	313	137
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	138			172			314	313	171	319	313	137
tC, single (s)	4.1			4.1			7.1	6.5	6.2	8.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	4.4	4.0	3.3
p0 queue free %	100			100			100	100	99	99	100	100
cM capacity (veh/h)	1446			1405			637	601	873	478	601	911
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	173	139	8	7								
Volume Left	1	1	1	5								
Volume Right	2	2	7	2								
cSH	1446	1405	834	553								
Volume to Capacity	0.00	0.00	0.01	0.01								
Queue Length 95th (m)	0.0	0.0	0.2	0.3								
Control Delay (s)	0.0	0.1	9.4	11.6								
Lane LOS	A	A	A	B								
Approach Delay (s)	0.0	0.1	9.4	11.6								
Approach LOS			A	B								
Intersection Summary												
Average Delay			0.5									
Intersection Capacity Utilization			19.0%	ICU Level of Service	A							
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis
1: Flanagan Rd/Zion Rd & Highway 3

PM - Total Build-Out 2028
53814 Zion Road

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔				↔
Traffic Volume (veh/h)	3	156	2	2	165	8	0	0	0	4	0	4
Future Volume (Veh/h)	3	156	2	2	165	8	0	0	0	4	0	4
Sign Control	Free			Free			Stop			Stop		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	3	170	2	2	179	9	0	0	0	4	0	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	188			172			368	369	171	364	366	184
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	188			172			368	369	171	364	366	184
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	100	99	100	100
cM capacity (veh/h)	1386			1405			584	558	873	590	561	859
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	175	190	0	8								
Volume Left	3	2	0	4								
Volume Right	2	9	0	4								
cSH	1386	1405	1700	699								
Volume to Capacity	0.00	0.00	0.01	0.01								
Queue Length 95th (m)	0.1	0.0	0.0	0.3								
Control Delay (s)	0.1	0.1	0.0	10.2								
Lane LOS	A	A	A	B								
Approach Delay (s)	0.1	0.1	0.0	10.2								
Approach LOS			A	B								
Intersection Summary												
Average Delay			0.3									
Intersection Capacity Utilization			20.2%	ICU Level of Service	A							
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis
1: Flanagan Rd/Zion Rd & Highway 3

AM - Future Total 2033
53814 Zion Road

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR		
Lane Configurations		↔			↔			↔				↔		
Traffic Volume (veh/h)	1	172	2	1	138	2	1	0	6	5	0	2		
Future Volume (Veh/h)	1	172	2	1	138	2	1	0	6	5	0	2		
Sign Control	Free			Free			Stop			Stop				
Grade	0%			0%			0%			0%				
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92		
Hourly flow rate (vph)	1	187	2	1	150	2	1	0	7	5	0	2		
Pedestrians														
Lane Width (m)														
Walking Speed (m/s)														
Percent Blockage														
Right turn flare (veh)														
Median type	None				None									
Median storage (veh)														
Upstream signal (m)														
pX, platoon unblocked														
vC, conflicting volume	152				189				345	344	188	350	344	151
vC1, stage 1 conf vol														
vC2, stage 2 conf vol														
vCu, unblocked vol	152				189				345	344	188	350	344	151
tC, single (s)	4.1				4.1				7.1	6.5	6.2	8.1	6.5	6.2
tC, 2 stage (s)														
tF (s)	2.2				2.2				3.5	4.0	3.3	4.4	4.0	3.3
p0 queue free %	100				100				100	100	99	99	100	100
cM capacity (veh/h)	1429				1385				607	578	854	453	578	895
Direction, Lane #	EB 1	WB 1	NB 1	SB 1										
Volume Total	190	153	8	7										
Volume Left	1	1	1	5										
Volume Right	2	2	7	2										
cSH	1429	1385	813	528										
Volume to Capacity	0.00	0.00	0.01	0.01										
Queue Length 95th (m)	0.0	0.0	0.2	0.3										
Control Delay (s)	0.0	0.1	9.5	11.9										
Lane LOS	A	A	A	B										
Approach Delay (s)	0.0	0.1	9.5	11.9										
Approach LOS			A	B										
Intersection Summary														
Average Delay				0.5										
Intersection Capacity Utilization				19.8%	ICU Level of Service	A								
Analysis Period (min)				15										

HCM Unsignalized Intersection Capacity Analysis
1: Flanagan Rd/Zion Rd & Highway 3

PM - Future Total 2033
53814 Zion Road

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR		
Lane Configurations		↔			↔			↔				↔		
Traffic Volume (veh/h)	3	172	2	2	182	8	0	0	0	4	0	4		
Future Volume (Veh/h)	3	172	2	2	182	8	0	0	0	4	0	4		
Sign Control	Free			Free			Stop			Stop				
Grade	0%			0%			0%			0%				
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92		
Hourly flow rate (vph)	3	187	2	2	198	9	0	0	0	4	0	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	207				189				404	405	188	400	402	202
vC1, stage 1 conf vol														
vC2, stage 2 conf vol														
vCu, unblocked vol	207				189				404	405	188	400	402	202
tC, single (s)	4.1				4.1				7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)														
tF (s)	2.2				2.2				3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100				100				100	100	100	99	100	100
cM capacity (veh/h)	1364				1385				552	533	854	558	535	838
Direction, Lane #	EB 1	WB 1	NB 1	SB 1										
Volume Total	192	209	0	8										
Volume Left	3	2	0	4										
Volume Right	2	9	0	4										
cSH	1364	1385	1700	670										
Volume to Capacity	0.00	0.00	0.01	0.01										
Queue Length 95th (m)	0.1	0.0	0.0	0.3										
Control Delay (s)	0.1	0.1	0.0	10.4										
Lane LOS	A	A	A	B										
Approach Delay (s)	0.1	0.1	0.0	10.4										
Approach LOS			A	B										
Intersection Summary														
Average Delay				0.3										
Intersection Capacity Utilization				21.1%	ICU Level of Service	A								
Analysis Period (min)				15										

HCM Unsignalized Intersection Capacity Analysis
1: Flanagan Rd/Zion Rd & Highway 3

AM - Future Total 2038
53814 Zion Road

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR		
Lane Configurations		↔			↔			↔				↔		
Traffic Volume (veh/h)	1	190	3	1	152	2	1	0	7	6	0	2		
Future Volume (Veh/h)	1	190	3	1	152	2	1	0	7	6	0	2		
Sign Control	Free			Free			Stop			Stop				
Grade	0%			0%			0%			0%				
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92		
Hourly flow rate (vph)	1	207	3	1	165	2	1	0	8	7	0	2		
Pedestrians														
Lane Width (m)														
Walking Speed (m/s)														
Percent Blockage														
Right turn flare (veh)														
Median type	None			None										
Median storage (veh)														
Upstream signal (m)														
pX, platoon unblocked														
vC, conflicting volume	167				210				380	380	208	386	380	166
vC1, stage 1 conf vol														
vC2, stage 2 conf vol														
vCu, unblocked vol	167				210				380	380	208	386	380	166
tC, single (s)	4.1				4.1				7.1	6.5	6.2	8.1	6.5	6.2
tC, 2 stage (s)														
tF (s)	2.2				2.2				3.5	4.0	3.3	4.4	4.0	3.3
p0 queue free %	100				100				100	100	99	98	100	100
cM capacity (veh/h)	1411				1361				575	552	832	426	552	878
Direction, Lane #	EB 1	WB 1	NB 1	SB 1										
Volume Total	211	168	9	9										
Volume Left	1	1	1	7										
Volume Right	3	2	8	2										
eSH	1411	1361	793	481										
Volume to Capacity	0.00	0.00	0.01	0.02										
Queue Length 95th (m)	0.0	0.0	0.3	0.5										
Control Delay (s)	0.0	0.1	9.6	12.6										
Lane LOS	A	A	A	B										
Approach Delay (s)	0.0	0.1	9.6	12.6										
Approach LOS				A	B									
Intersection Summary														
Average Delay				0.5										
Intersection Capacity Utilization				20.8%	ICU Level of Service	A								
Analysis Period (min)				15										

HCM Unsignalized Intersection Capacity Analysis
1: Flanagan Rd/Zion Rd & Highway 3

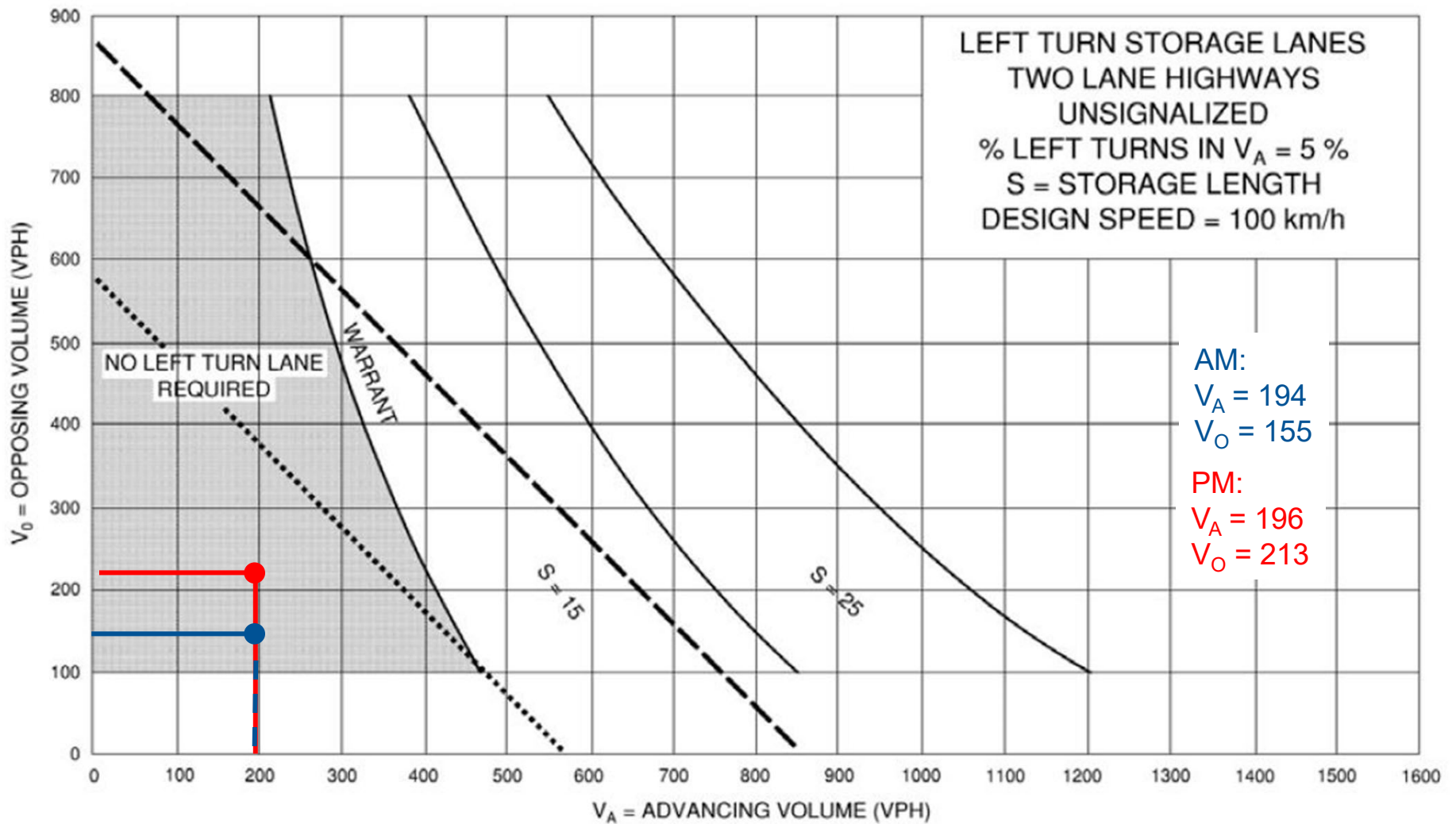
PM - Future Total 2038
53814 Zion Road

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR		
Lane Configurations		↔			↔			↔				↔		
Traffic Volume (veh/h)	3	190	3	3	201	9	0	0	0	4	0	4		
Future Volume (Veh/h)	3	190	3	3	201	9	0	0	0	4	0	4		
Sign Control	Free			Free			Stop			Stop				
Grade	0%			0%			0%			0%				
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92		
Hourly flow rate (vph)	3	207	3	3	218	10	0	0	0	4	0	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	228				210				448	448	208	444	445	223
vC1, stage 1 conf vol														
vC2, stage 2 conf vol														
vCu, unblocked vol	228				210				448	448	208	444	445	223
tC, single (s)	4.1				4.1				7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)														
tF (s)	2.2				2.2				3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100				100				100	100	100	99	100	100
cM capacity (veh/h)	1340				1361				517	503	832	523	506	817
Direction, Lane #	EB 1	WB 1	NB 1	SB 1										
Volume Total	213	231	0	8										
Volume Left	3	3	0	4										
Volume Right	3	10	0	4										
eSH	1340	1361	1700	637										
Volume to Capacity	0.00	0.00	0.01	0.01										
Queue Length 95th (m)	0.1	0.1	0.0	0.3										
Control Delay (s)	0.1	0.1	0.0	10.7										
Lane LOS	A	A	A	B										
Approach Delay (s)	0.1	0.1	0.0	10.7										
Approach LOS				A	B									
Intersection Summary														
Average Delay				0.3										
Intersection Capacity Utilization				22.8%	ICU Level of Service	A								
Analysis Period (min)				15										

Appendix D

Turn Lane and Signal Warrants





2038 Total Scenario – Zion Road at Highway 3 Eastbound Left-Turn Lane Warrant

Signal Justification Calculation for Existing Volumes (OTM Book 12 - Justification 7)



Horizon Year: 2038
Region/City/Township: Wainfleet

Major Street: Highway 3 North/South: N
Minor Street: Zion Road

Number of Approach Lanes: 2 or more
Tee Intersection? N
Flow Conditions: Free

PM Forecast Only? N

Warrant Results		
150% Satisfied	No	Justification for new intersections with forecast traffic
120% Satisfied	No	Justification for existing intersections with forecast traffic

Time Period	Major Street Highway 3						Minor Street Zion Road						Peds Crossing Main Road
	Eastbound			Westbound			Northbound			Southbound			
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
	AM Peak Hour	1	190	3	1	152	2	1	0	7	6	0	
PM Peak Hour	3	190	3	3	201	9	0	0	0	4	0	4	
Average Hourly Volume	1	95	2	1	88	3	0	0	2	3	0	2	0

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
	All Approaches	480	720	600	900	
% Fulfilled						32.6%

1B	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
	Minor Street Approaches	120	170	120	170	
% Fulfilled						3.5%

Warrant	AHV
1A - All	196
1B - Minor	6
2A - Major	190
2B - Cross	3

Warrant 2 - Delay To Cross Traffic

2A	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
	Major Street Approaches	480	720	600	900	
% Fulfilled						31.6%

2B	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
	Traffic Crossing Major Street	50	75	120	170	
% Fulfilled						3.7%