



Jackson Harvest Farms 1894 Witmer Road Transportation Impact Study

Paradigm Transportation Solutions Limited

February 2019

Project: 190038



Project Summary



Project Number

190038

February 2019

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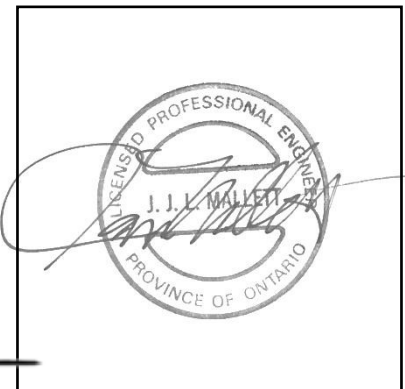
Jackson Harvest Farms, 1894 Witmer Road

Transportation Impact Study

Signatures and Seals

A handwritten signature in black ink, appearing to read 'J. Mallett', written over a horizontal line.

Signature



Engineer's Seal

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Executive Summary

Content

Jackson Harvest Farms Ltd. retained Paradigm Transportation Solutions Limited (Paradigm) to conduct this Transportation Impact Study (TIS) for a proposed aggregate extraction pit at 1894 Witmer Road, in Wilmot, Ontario. This report analyses existing traffic conditions, describes the proposed development, forecasts traffic to five years from the date of data collection (2023), and examines the need for potential road improvements to accommodate future traffic conditions.

Development Concept

The development will occupy approximately 57 hectares of land which will include the aggregate pit and related infrastructure for extraction operations. The development will have one all-moves access on Witmer Road with outbound trucks primarily travelling east on Witmer Road to Queen Street.

Conclusions

Based on the analyses undertaken in this study, it is concluded that:

- ▶ **Witmer Road and Queen Street** is forecast to operate at acceptable levels of service during the AM and PM peak hours under the Existing (2018), Background, and Total Traffic Conditions; and
- ▶ The proposed access on Witmer Road is also forecast to operate at acceptable levels service and will not require auxiliary turn lanes on Witmer Road.

Recommendations

Based on the findings and conclusions of this study, it is recommended that the aggregate pit application be approved with no requirements for off-site geometric or traffic operational improvements.



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1 Introduction

1.1 Background

Jackson Harvest Farms Ltd. retained Paradigm Transportation Solutions Limited (Paradigm) to conduct this Transportation Impact Study (TIS) for a proposed aggregate extraction pit located at 1894 Witmer Road, Wilmot, Ontario. **Figure 1.1** illustrates the location of the subject development.

The scope of the study includes a determination and assessment of the current traffic conditions in the vicinity of the existing site, the additional traffic that will be generated by the proposed development, analyses of the impact that this traffic may have on the adjacent street system, and the identification of potential remedial measures that may be required to mitigate the site generated traffic impacts in a satisfactory manner. The operational impact assessment focuses on the intersections of:

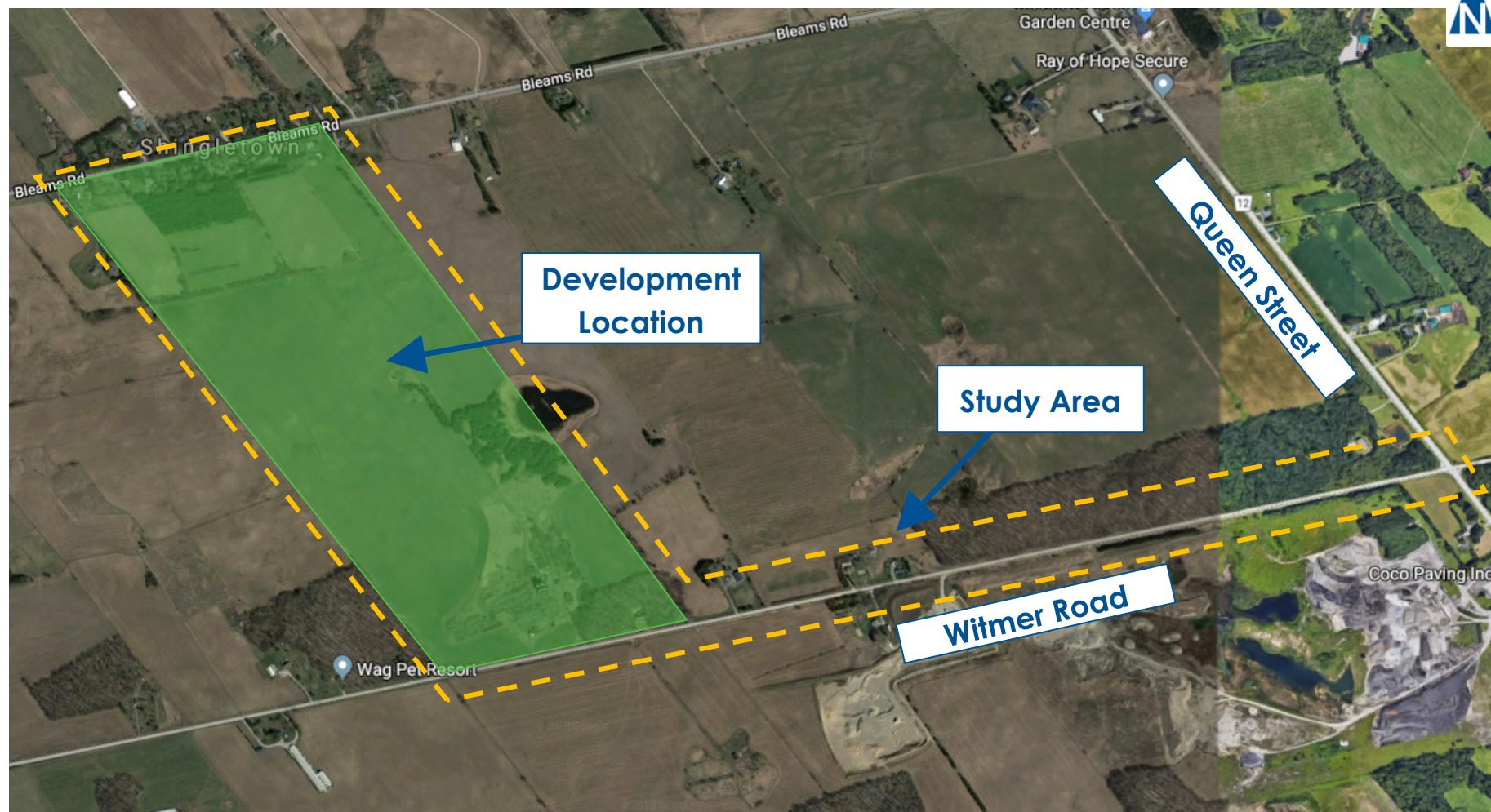
- ▶ Witmer Road and Proposed Pit Access (new); and
- ▶ Witmer Road and Queen Street.

This report analyses existing traffic conditions, describes the proposed development, forecasts traffic to five years from the date of this TIS (2023), and examines the need for potential improvements to accommodate future traffic conditions.

This study has been prepared in accordance with the requirements of the Region of Waterloo (ROW) Traffic Impact Study Guidelines¹.

¹ Traffic Impact Study Guidelines, *Region of Waterloo*, 2014.





2 Assessment of Current Conditions

This section documents current road and traffic conditions, and the results of operational analysis under existing traffic conditions.

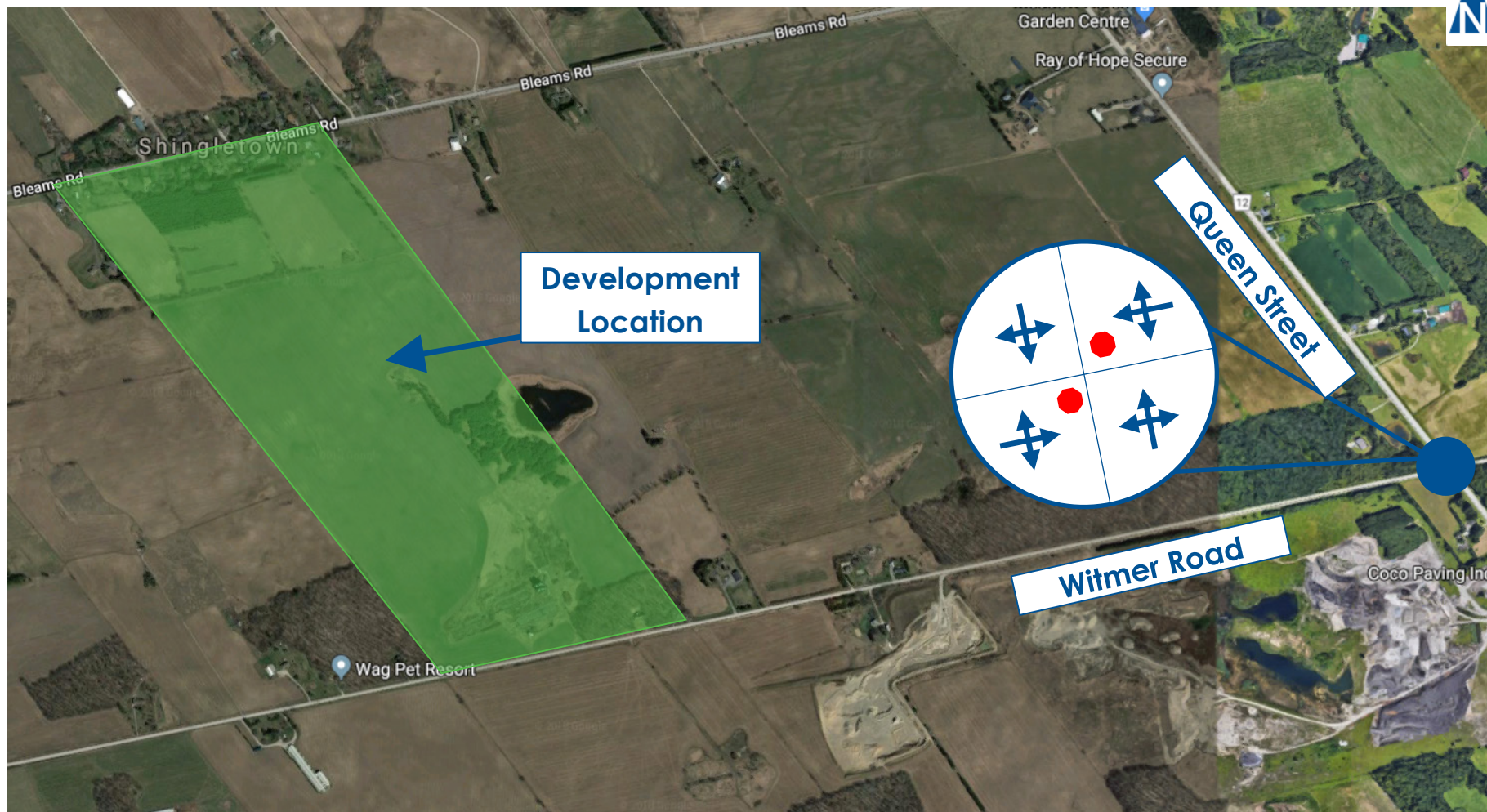
2.1 Road Network

The study-area roadways include:

- ▶ **Queen Street** is an 80 km/h, rural, 2-lane north-south roadway within the study area; and
- ▶ **Witmer Road** is an 80 km/h, rural, 2-lane east-west roadway within the study area. During March and April, there are reduced load limits from Sandhills Road to approximately 200m west of the entrance to the Steed and Evans Witmer Pit.

The Queen Street and Witmer Road intersection is an unsignalized, two-way stop controlled (TWSC) intersection. **Figure 2.1** displays existing lane configurations and traffic controls of the intersection within the study area.





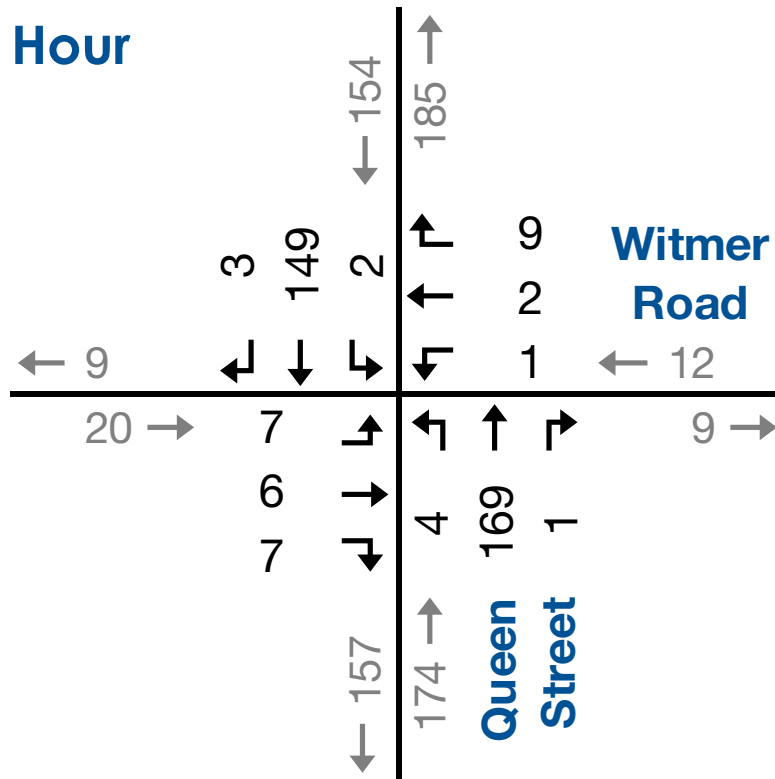
2.2 Traffic Volumes

In June 2018, Paradigm collected weekday, eight-hour turning movement data using Miovision cameras at the Queen Street and Witmer Road intersection.

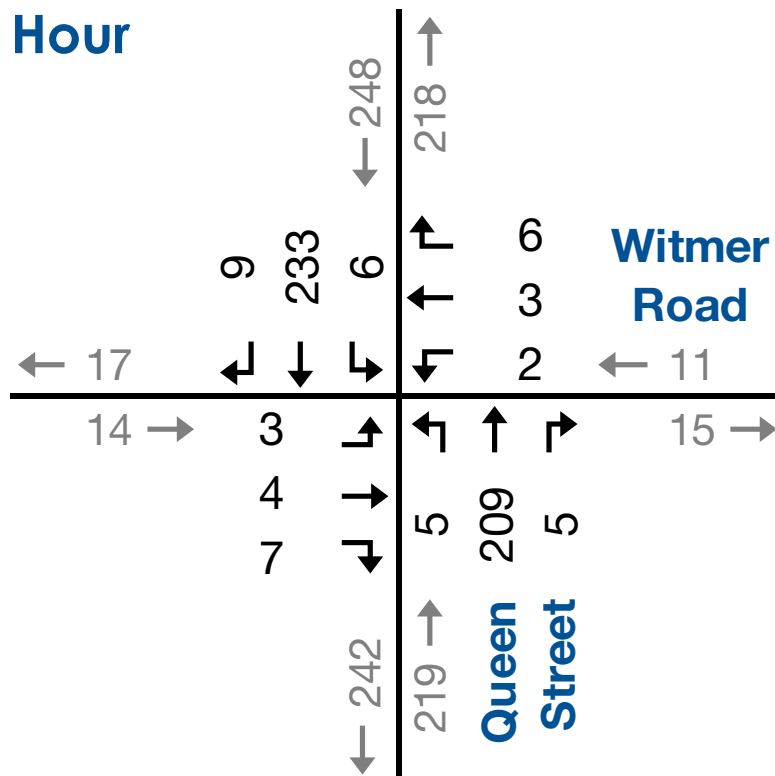
Figure 2.2 summarizes the existing AM and PM peak hour traffic volumes. **Appendix B** contains the existing count data.



AM Peak Hour



PM Peak Hour



2.3 Traffic Operations

The operations of the Queen Street and Witmer Road intersection in the study area was evaluated using the existing lane configurations, traffic controls and the observed peak hour traffic volumes.

Intersection level of service (LOS) is a recognized method of quantifying the efficiency of traffic flow at intersections. It is based on the delay experienced by individual vehicles executing the various movements. The delay is related to the number of vehicles desiring to make a particular movement, compared to the estimated capacity for that movement. The capacity is based on a number of criteria related to the opposing traffic flows. The highest possible rating is LOS A, under which the average total delay is equal or less than 10.0 seconds per vehicle. When the average delay exceeds 80 seconds at signalized intersections (50 seconds at unsignalized intersections), the movement is considered to have a LOS F and remedial measures are usually implemented, if they are feasible.

The level of service conditions on the existing road network have been assessed using Synchro 9 with HCM 2000 procedures. Movements are considered critical under the following conditions:

- ▶ Volume to capacity (v/c) ratios for overall intersection operation, through movements or shared/turning movements increased to 0.85 or above;
- ▶ Volume to capacity ratios for exclusive movements increased to 0.90 or above; or
- ▶ Queues for an individual movement are projected to exceed available turning lane storage.
- ▶ LOS based on average delay per vehicle, on individual movements exceeds LOS “E” at unsignalized intersections; or
- ▶ The estimated 95th percentile queue length for an individual movement exceeds the available storage lane length (where applicable).

Table 2.1 summarizes the level of service and other performance measures. The intersection and individual movements are currently operating with acceptable levels of service and minimum delays. **Appendix C** contains the detailed Synchro reports.



TABLE 2.1: EXISTING INTERSECTION OPERATIONAL CONDITIONS

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				Eastbound				Westbound				Northbound				Southbound				OVERALL
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	1 - Queen Street & Witmer Road	TWSC	LOS Delay V/C 95th	< < < <	B 11 0.03 1	> > > >	B 11	< < < <	A 10 0.00 0	> > > >	A 10	< < < <	A 0 0.00 0	> > > >	A 0	< < < <	A 0 0.00 0	> > > >	A 0	1
PM Peak Hour	1 - Queen Street & Witmer Road	TWSC	LOS Delay V/C 95th	< < < <	B 11 0.02 1	> > > >	B 11	< < < <	B 11 0.00 0	> > > >	B 11	< < < <	A 0 0.00 0	> > > >	A 0	< < < <	A 0 0.00 0	> > > >	A 0	1

MOE - Measure of Effectiveness

V/C - Volume to Capacity Ratio

> - Shared Right-Turn Lane

TWSC - Two-Way Stop Control

95th - 95th Percentile Queue Length

< - Shared Left-Turn Lane

LOS - Level of Service



3 Development Concept

The development will occupy approximately 57 hectares of land and will contain the aggregate pit and related infrastructure for extraction operations.

The development will have one all-moves access on Witmer Road with outbound trucks primarily directed to travel east on Witmer Road to Queen Street, and a small percentage (5 – 10% of trips) traveling west to Sandhills Drive.

The pit will consist of the following items related to the extraction of aggregate resources from the site:

- ▶ Removal of the aggregate via front-end loader;
- ▶ Crushing and / or screening of the aggregate material;
- ▶ Piling the crushed and / or screened material into stockpiles; and
- ▶ Transfer of stockpiled material into trucks via front-end loader.

3.1 Trip Generation

The highest period of traffic activity on the existing road network generally occurs during 7:30 – 8:30 in the morning and 4:30 – 5:30 in the afternoon. The trips generated by the aggregate operation were estimated for the AM and PM peak hours based on the following information related to the operations of the facility:

- ▶ **Licensed Extraction Rate:** The maximum amount of tonnage applied for in the aggregate license is 750, 000 tonnes annually. This number represents the maximum amount of material that can be removed from the site on a yearly basis. For the purpose of this report, and to assess the maximum impacts, it is assumed that the allowed maximum of 750, 000 tonnes will be extracted annually.
- ▶ **Pit Operations:** The operational plan for the pit notes that the trucks will be loaded between 6:00 AM and 7:00 PM for Monday to Friday, and between 6:00 AM and 6:00 PM on Saturday. Realities of market forces and weather have shown that this activity can be sustained for approximately 50 weeks annually, resulting in 300 operating days per year.
- ▶ **Vehicle Size:** The traffic generated by the site is directly related to the payload of the vehicles being loaded. This pit is expected to see a combination of 70% tractor trailer trucks with an average payload of 40 tonnes and 30% tri-axle trucks with an average payload of 21 tonnes. A weighted average of 34.3 tonnes per truck was used for the analysis.

Table 3.1 illustrates the estimated daily average and peak hour traffic generation at the aggregate pit. It is recognized that truck traffic in this operation is not spread uniformly through the day. Based on experience



elsewhere, a peak hour factor (PHF) of 2 is used to convert the average hourly volume to the peak hour volume. This translates into 5.6 trucks entering and leaving the site during the morning and afternoon peak hours.

The peak hour truck volume was then converted to Passenger Car Equivalents (PCE) to determine the impact on the traffic operations of the local road network. A weighted average of 3.2 PCE/Truck was used to account for the two types of truck expected at this site. The resulting PCE entering and exiting the local road network are 72 PCE per peak hour.

TABLE 3.1: TRIP GENERATION ESTIMATES

Measure	Units	Input	Calculation
Annual Rate of Extraction	tonnes/year	750,000	
Operating Days per year	day/year	300	
Average Extraction per day	tonnes/day		2500
Average Payload per truck	tonnes/truck	34.3	
Average Number of Trucks per day	trucks/day		73
Operating Hours per day	hours/day	13	
Average number of trucks per hour	trucks/hour		5.6
Peak Hour factor	dimensionless	2	
Peak Hour Truck Volume	trucks/hour		11.2
Passenger Car Equivalents per Truck	PCE/truck	3.2	
Peak Hour Entering Volume	PCE/hour		36
Peak Hour Exiting Volume	PCE/hour		36

3.2 Trip Distribution and Assignment

The likely distribution of trips from this operation was estimated by the existing trip distributions as well as information from the aggregate operator. The distribution considers the function of this pit in supplying markets in the local area. All trucks entering and exiting the pit will use Witmer Road, primarily travelling to Queen Street, with a minimal amount (estimated to be 5 -10%) travelling to Sandhills Drive for local deliveries. For non-local deliveries, trucks will use Queen Street. It is estimated by the pit operator that 90% of trips on Queen Street will come from / go to the north to Highway 7/8. The remaining 10% of trips (which represent 4 trips per direction in the peak hours) will be from / go to the south towards Highway 401. These 4 trips per direction would either use Huron Road or New Dundee Road to access Trussler Road and ultimately the Highway 401 ramps on Cedar Creek Road.

Further, as per the guidelines the Agricultural Impact Assessment (AIA) Guidance Document², to reduce the impacts of non-agricultural vehicles in agricultural prevalent areas, aggregate trucks should take the shortest possible route to major roads. The direct route to Queen Street for the proposed pit is consistent with the AIA guidelines. While the preferred route will be to the east, there may be some trips (estimated to be 5 – 10%) that will head west for local delivery purposes. These vehicles will abide by all load

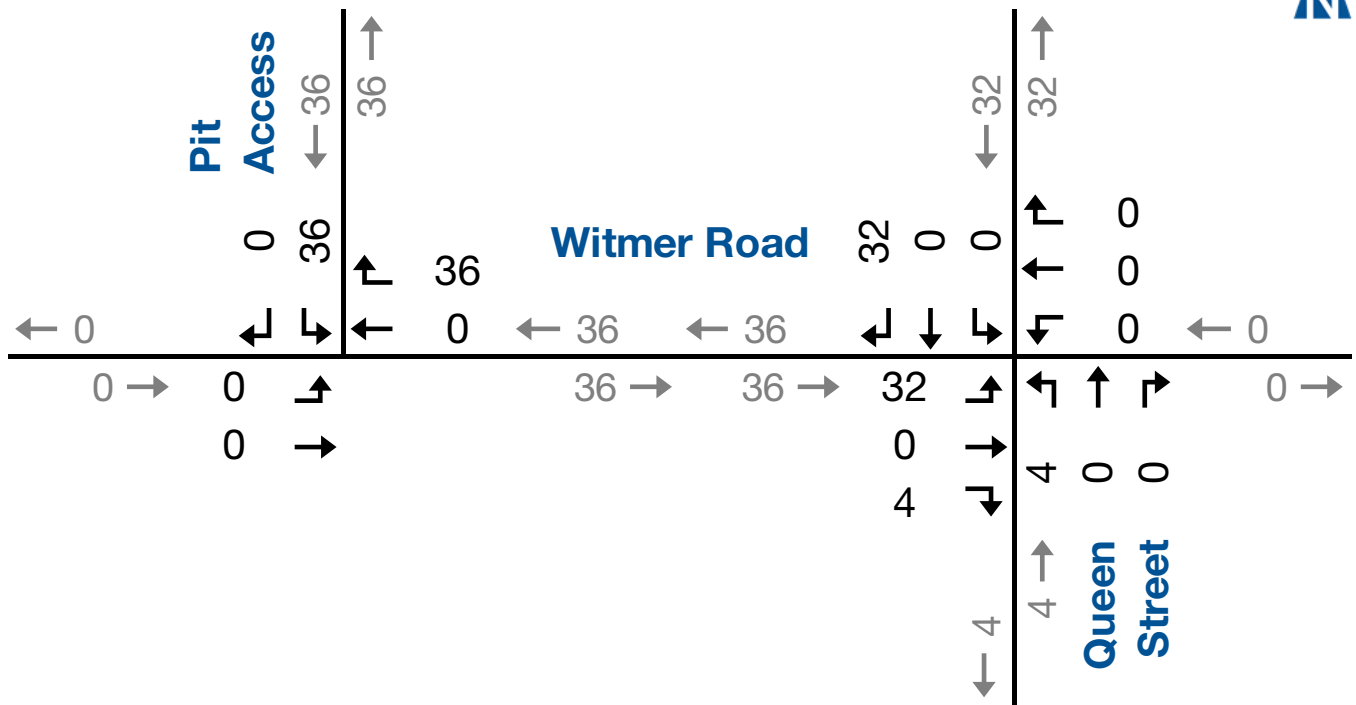
² Draft Agricultural Impact Assessment (AIA) Guidance Document, *Ontario Ministry of Agriculture, Food and Rural Affairs*, March 2018



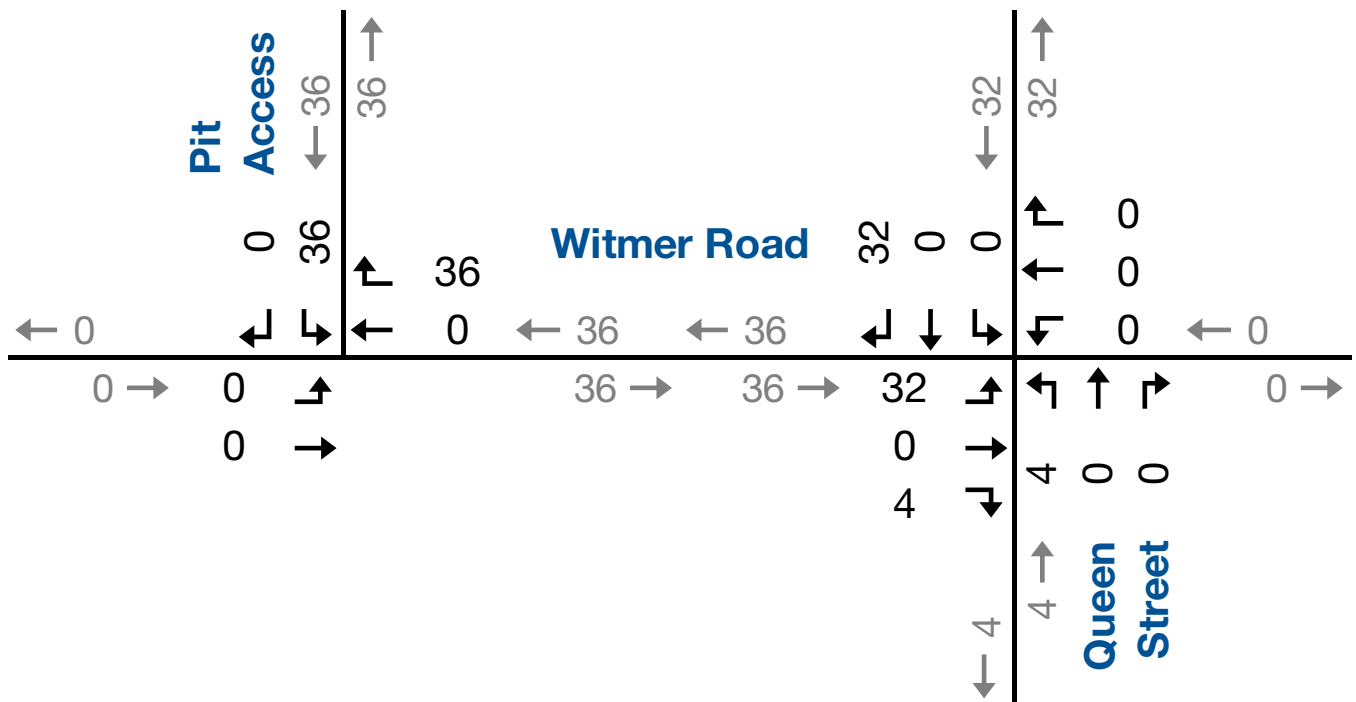
restrictions on Witmer and Sandhills Road. **Figure 3.1** illustrates the projected peak hour PCE's resulting from aggregate pit operations.



AM Peak Hour



PM Peak Hour



4 Evaluation of Future Traffic Conditions

Future traffic conditions assessed include estimates of future background and total traffic volumes for the 2023 horizon. The future traffic volumes near the pit will consist of increased non-site traffic volumes (i.e. background traffic comprising an increase in roadway traffic volumes and traffic generated by other approved or in-stream developments in the area), and the traffic forecast to be generated by the subject development.

4.1 Background Traffic Forecasts

4.1.1 General Background Growth

The future general background traffic volumes within the study area result from applying a growth rate of 1.5 % compounded per annum to the base year (2018) traffic volumes. This growth rate was confirmed with Region staff during pre-consultation.

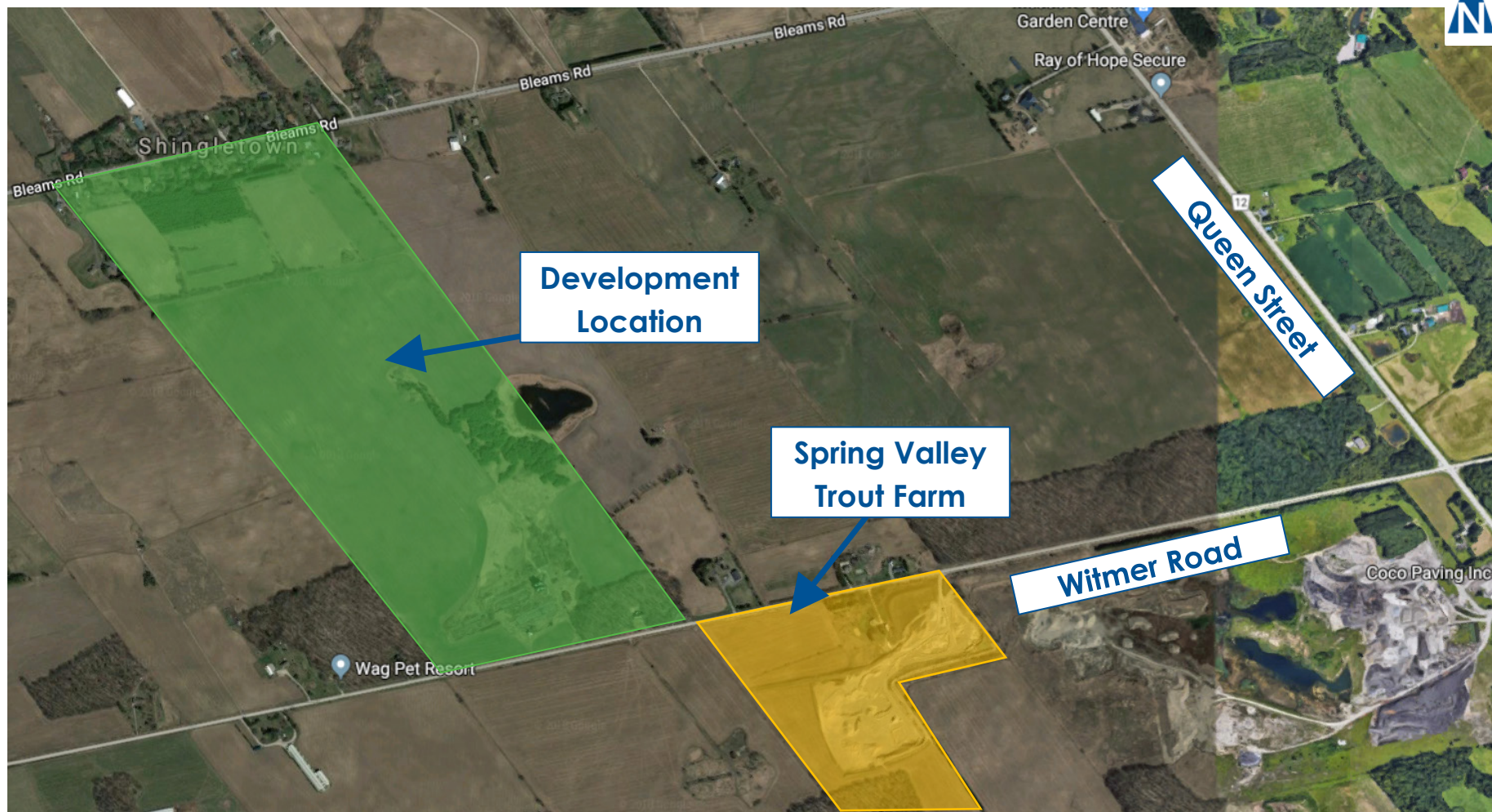
4.1.2 Background Developments

During pre-consultation, IBI staff identified an approved development, Spring Valley Trout Farm Inc., that will potentially increase traffic volumes within the study area at the future traffic horizons. **Table 4.1** summarizes the planned development activities within the study area with their respective trip generation, as specified by IBI staff. Trip generation values were determined using the same methods as discussed in **Section 3.1**. **Figure 4.1** illustrates the locations of the other area developments with respect to the subject site.

TABLE 4.1: OTHER AREA DEVELOPMENT (SPRING VALLEY) – TRIP GENERATION ESTIMATES

Measure	Units	Input	Calculation
Annual Rate of Extraction	tonnes/year	200,000	
Operating Days per year	day/year	250	
Average Extraction per day	tonnes/day		800
Average Payload per truck	tonnes/truck	34.3	
Average Number of Trucks per day	trucks/day		23
Operating Hours per day	hours/day	12	
Average number of trucks per hour	trucks/hour		1.9
Peak Hour factor	dimensionless	2	
Peak Hour Truck Volume	trucks/hour		3.9
Passenger Car Equivalents per Truck	PCE/truck	3.2	
Peak Hour Entering Volume	PCE/hour		12
Peak Hour Exiting Volume	PCE/hour		12





4.2 2023 Horizon

4.2.1 Background Traffic Operations

Figure 4.2 displays the 2023 background traffic volumes for the weekday AM and PM peak hours.

Based on these volumes and Level of Service analyses using Synchro 9 with HCM 2000 procedures, the Witmer Road and Queen Street intersection is forecast to operate at acceptable levels of service.

The results of the analysis are summarized in **Table 4.2** indicating acceptable levels of service (LOS), volume to capacity ratios (V/C) and 95th percentile queues experienced at the intersection.

Appendix D includes the detailed Synchro 9 reports.

4.2.2 Total Traffic Operations

The 2023 total traffic volumes expected in 2023, including both background traffic and development traffic, are shown in **Figure 4.3** for the AM and PM peak hours.

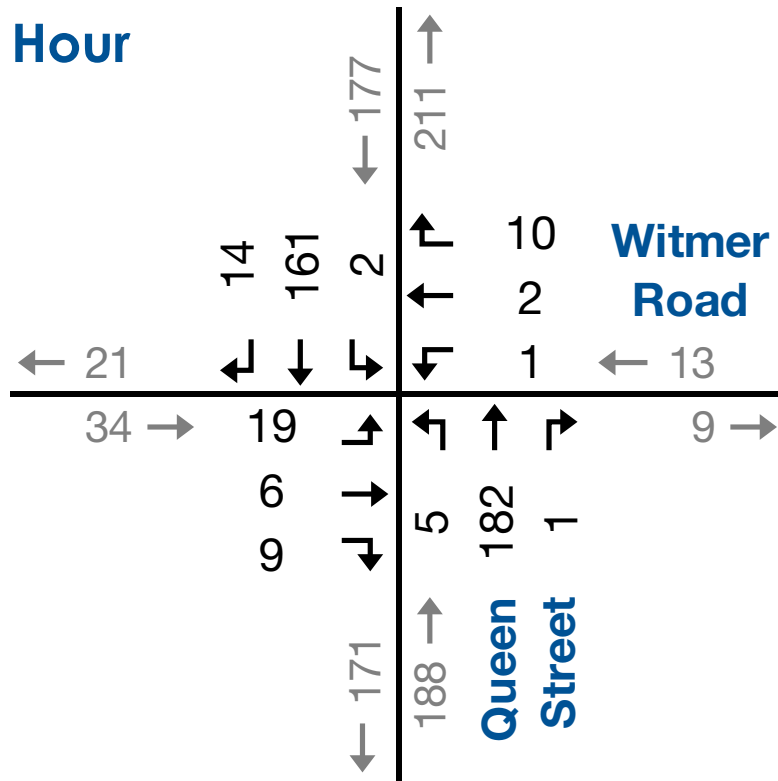
Similar to background traffic conditions, Level of Service analysis was undertaken, and the results are summarized in **Table 4.3**.

As under background traffic conditions, the Witmer Road and Queen Street intersection is forecast to have acceptable operational performance.

Appendix E includes the detailed Synchro 9 reports.



AM Peak Hour



PM Peak Hour

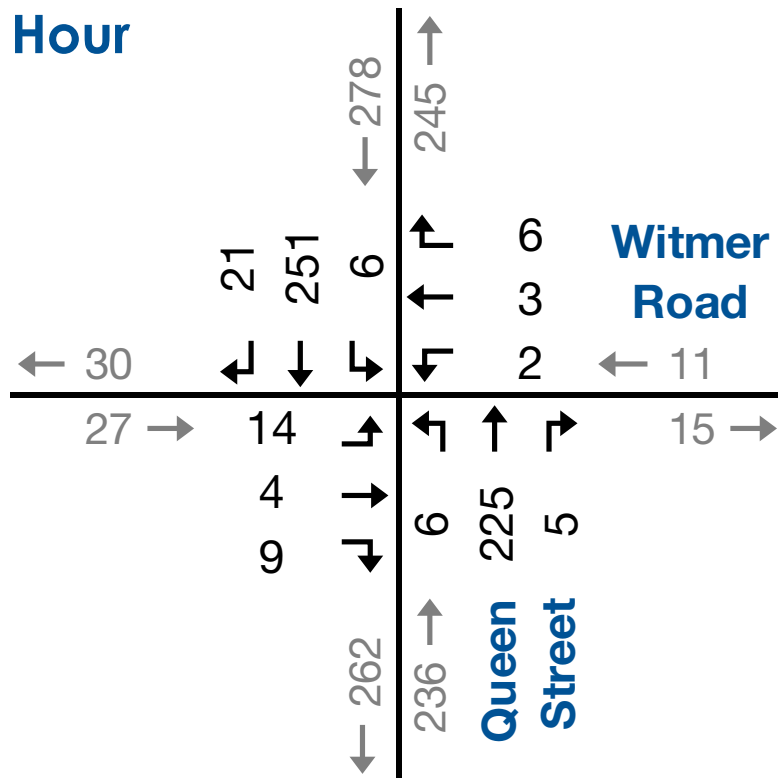


TABLE 4.2: 2023 BACKGROUND TRAFFIC OPERATIONS

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				Eastbound				Westbound				Northbound				Southbound				OVERALL
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	1 - Queen Street & Witmer Road	TWSC	LOS Delay V/C 95th	< < < <	B 11 0.06 1	> > > >	B 11	< < < <	B 10 0.00 0	> > > >	A 10	< < < <	A 0 0.00 0	> > > >	A 0	< < < <	A 0 0.00 0	> > > >	A 0	1
PM Peak Hour	1 - Queen Street & Witmer Road	TWSC	LOS Delay V/C 95th	< < < <	B 12 0.05 1	> > > >	B 12	< < < <	B 11 0.00 0	> > > >	B 11	< < < <	A 0 0.00 0	> > > >	A 0	< < < <	A 0 0.00 0	> > > >	A 0	1

MOE - Measure of Effectiveness

V/C - Volume to Capacity Ratio

> - Shared Right-Turn Lane

TWSC - Two-Way Stop Control

95th - 95th Percentile Queue Length

< - Shared Left-Turn Lane

LOS - Level of Service



TABLE 4.3: 2023 TOTAL TRAFFIC OPERATIONS

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																
				Eastbound				Westbound				Northbound				Southbound				OVERALL
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	1 - Queen Street & Witmer Road	TWSC	LOS Delay V/C 95th	<	B	>	B	<	A	>	A	<	A	>	A	<	A	>	A	2
				<	12	>	12	<	10	>	10	<	0	>	0	<	0	>	0	
				<	0.12	>		<	0.00	>		<	0.01	>		<	0.00	>		
				<	3	>		<	0	>		<	0	>		<	0	>		
AM Peak Hour	2 - Pit Access & Witmer Road	TWSC	LOS Delay V/C 95th	<	A		A		A	>	A					A		>	A	2
				<	0		0	>	0					9		>	9			
				<	0.00		0.05	>					0.04		>					
				<	0		0	>				1		>						
PM Peak Hour	1 - Queen Street & Witmer Road	TWSC	LOS Delay V/C 95th	<	B	>	B	<	B	>	B	<	A	>	A	<	A	>	A	2
				<	14	>	14	<	11	>	11	<	0	>	0	<	0	>	0	
				<	0.13	>		<	0.00	>		<	0.01	>		<	0.00	>		
				<	4	>		<	0	>		<	0	>		<	0	>		
PM Peak Hour	2 - Pit Access & Witmer Road	TWSC	LOS Delay V/C 95th	<	A		A		A	>	A					A		>	A	2
				<	0		0	>	0					9		>	9			
				<	0.00		0.06	>					0.04		>					
				<	0		0	>				1		>						

MOE - Measure of Effectiveness

TWSC - Two-Way Stop Control

LOS - Level of Service

V/C - Volume to Capacity Ratio

95th - 95th Percentile Queue Length

> - Shared Right-Turn Lane

< - Shared Left-Turn Lane



5 Remedial Measures

Given the operational analyses above, no improvements are required to the surrounding roadway network in order to accommodate the forecast traffic volumes in a safe and efficient manner, from a traffic operational perspective. However, from a safety perspective, the need for auxiliary turn lanes, sight distances, and other concerns relating to the use of the aggregate pit for the study area intersection and access were investigated.

5.1 Auxiliary Turning Lanes

The need for auxiliary turn lanes was reviewed at the intersection of Witmer Road and the proposed pit access based on the 2023 future total traffic forecasts.

Since the traffic volumes are forecast to be less than 100 vph for both approaches in the AM and PM peaks, there is no requirement of an auxiliary turn lane on this road.

5.2 Agricultural Equipment

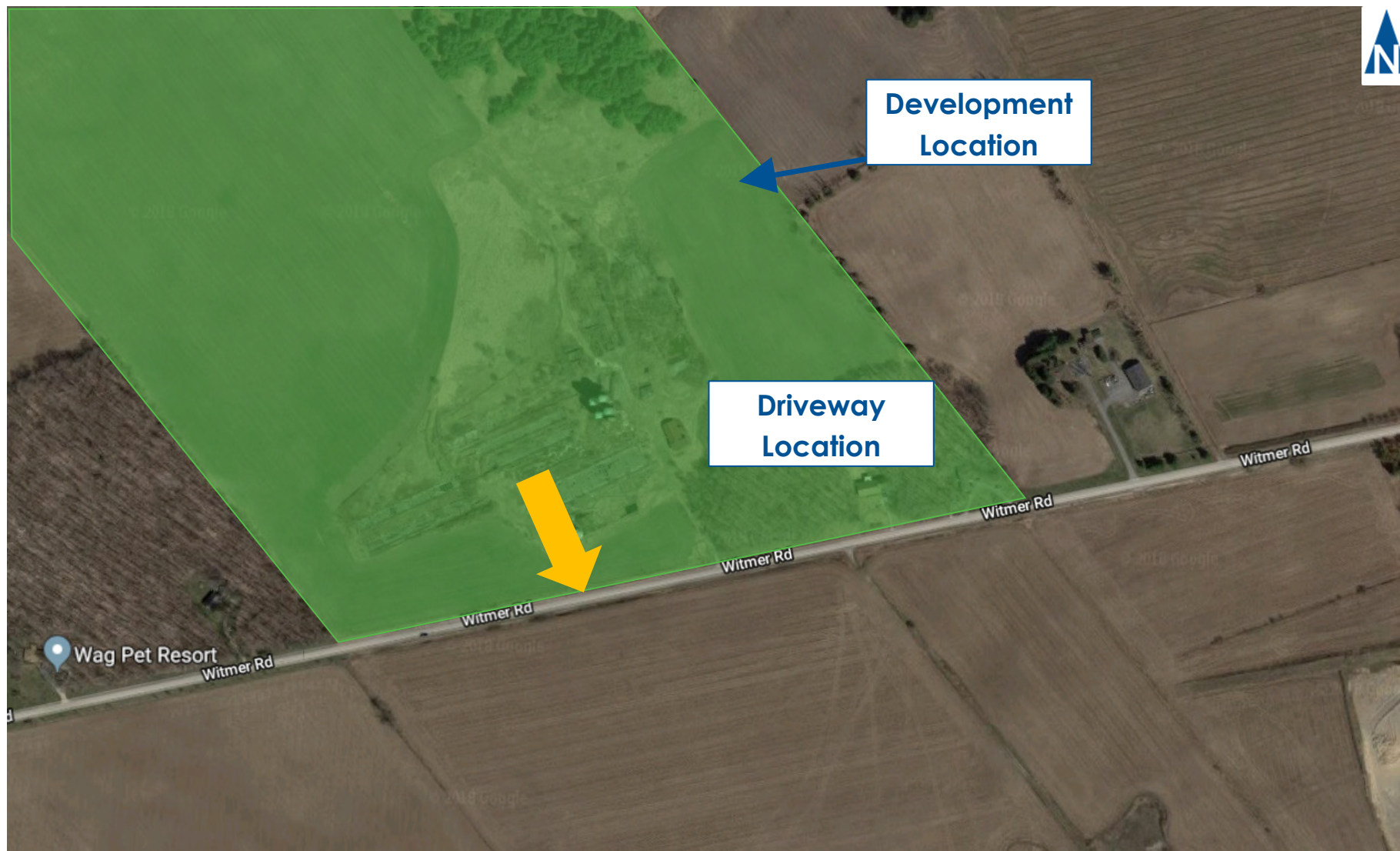
The use of agricultural equipment is prevalent in this area. The Agricultural Impact Assessment (AIA) Guidance Document³, requires aggregate trucks to take the shortest possible route to major roads to reduce the impacts on agricultural vehicles. The direct route to Queen Street for the proposed pit is consistent with the AIA guidelines and will minimize impact on agricultural vehicles.

5.3 Site Access Placement

To optimize sight lines for the development, the site access should be placed approximately 220 meters east of the western border of the property, shown in **Figure 5.1**. This will place the site access on the crest of a hill, giving the furthest possible site in both directions.

³ Draft Agricultural Impact Assessment (AIA) Guidance Document, *Ontario Ministry of Agriculture, Food and Rural Affairs*, March 2018





6. Conclusions and Recommendations

6.1 Conclusions

Based on the analyses undertaken in this study, it is concluded that:

- ▶ **Witmer Road and Queen Street** is forecast to operate at acceptable levels of service during the AM and PM peak hours under the Existing (2018), Background, and Total Traffic Conditions; and
- ▶ The proposed access on Witmer Road is also forecast to operate at acceptable levels service and will not require auxiliary turn lanes on Witmer Road.

6.2 Recommendations

Based on the findings and conclusions of this study, it is recommended that the aggregate pit application be approved with no requirements for off-site geometric or traffic operational improvements.



Appendix A

Township of Wilmot PSC Comments





TOWNSHIP OF WILMOT

PUBLIC WORKS ENGINEERING

60 Snyder's Road West, Baden, ON N3A 1A1

Public Works-Engineering Department

T: 519-634-8444

F: 519-634-5044

Email: engineering@wilmot.ca

MEMORANDUM

TO: Adam Morrison
CC: Jeff Molenhuis
Andrew Martin

PREPARED BY: Mark Jeffery

DATE: July 5, 2018

RE: 1894 Witmer Road – Aggregate Pit
Pre-study Comments for TIS

We have reviewed the preliminary TIS scope for the above noted site location and request the following items are included and reviewed as part of the traffic impact study. It is understood that access to and the use of Sandhills Road for the purpose of the pit operation and its haul route is not being proposed.

- 1) Based on current and future projected traffic volumes please comment on the requirement for:
 - i. Intersection improvements at Witmer Road and Regional Road 12
 - ii. Improvements on Witmer Road opposite the entrance/exit location to the proposed aggregate pit, not limited to acceleration, deceleration and turning lanes.
- 2) Review the preferred location of an entrance/exit on Witmer Road taking into consideration the geometry of the existing roadway.

For information only, we offer the following comments:

- 1) The Township has no capital transportation improvements planned in the area within the next 5 years.
- 2) For the purpose of this study the Region will confirm the annual growth rate requirement.
- 3) Witmer Road currently has reduced load limits during March and April from Sandhills Road to approximately 200m west of the entrance to the Steed and Evans Witmer Pit. Structural improvements to this road section, west of the Steed and Evans pit to the proposed pit entrance would be required at the expense of the developer.

Appendix B

Existing Count Data





Paradigm Transportation Solutions Limited
22 King Street South, Suite 300

Waterloo, Ontario, Canada N2J 1N8
519-896-3163 cbowness@ptsl.com

Count Name: Witmer Road & Regional Road 12
Site Code:
Start Date: 06/21/2018
Page No: 1

Turning Movement Data

Start Time	Witmer Road Eastbound						Witmer Road Westbound						Regional Road 12 Northbound						Regional Road 12 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	0	1	0	0	1	1	1	1	0	0	3	2	19	0	0	0	21	0	18	0	0	0	18	43
7:15 AM	1	0	1	0	0	2	0	2	1	0	0	3	2	38	0	0	0	40	0	20	1	0	0	21	66
7:30 AM	3	2	4	0	0	9	0	2	0	0	0	2	1	49	0	0	0	50	0	39	0	0	0	39	100
7:45 AM	1	0	1	0	0	2	0	0	5	0	0	5	1	35	0	0	0	36	0	40	1	0	0	41	84
Hourly Total	5	2	7	0	0	14	1	5	7	0	0	13	6	141	0	0	0	147	0	117	2	0	0	119	293
8:00 AM	1	2	2	0	0	5	0	0	1	0	0	1	0	47	1	0	0	48	2	41	1	0	0	44	98
8:15 AM	2	2	0	0	0	4	1	0	3	1	0	5	2	38	0	0	0	40	0	29	1	0	0	30	79
8:30 AM	2	0	3	0	0	5	2	1	3	1	0	7	2	39	1	0	0	42	0	28	0	0	0	28	82
8:45 AM	0	1	1	0	0	2	3	1	0	0	0	4	1	35	0	0	0	36	3	42	0	0	0	45	87
Hourly Total	5	5	6	0	0	16	6	2	7	2	0	17	5	159	2	0	0	166	5	140	2	0	0	147	346
9:00 AM	0	0	3	0	0	3	2	1	1	0	0	4	1	27	0	0	0	28	1	35	0	0	0	36	71
9:15 AM	0	1	2	0	0	3	0	2	0	0	0	2	2	31	1	0	0	34	0	24	1	0	0	25	64
9:30 AM	0	0	3	0	0	3	0	1	1	0	0	2	0	38	0	0	0	38	1	29	1	0	0	31	74
9:45 AM	1	1	1	0	0	3	1	0	5	0	0	6	0	35	2	0	0	37	0	24	1	0	0	25	71
Hourly Total	1	2	9	0	0	12	3	4	7	0	0	14	3	131	3	0	0	137	2	112	3	0	0	117	280
10:00 AM	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
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hourly Total	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
11:30 AM	0	1	1	0	0	2	0	0	0	0	0	0	0	25	1	0	0	26	3	24	1	0	0	28	56
11:45 AM	2	0	2	0	0	4	0	1	2	0	0	3	0	30	0	0	0	30	2	27	2	0	0	31	68
Hourly Total	2	1	3	0	0	6	0	1	2	0	0	3	0	55	1	0	0	56	5	51	3	0	0	59	124
12:00 PM	0	0	1	0	0	1	0	0	0	0	0	0	2	23	1	0	0	26	1	30	0	0	0	31	58
12:15 PM	1	0	1	0	0	2	2	1	0	0	0	3	1	33	0	0	0	34	2	25	0	0	0	27	66
12:30 PM	0	0	2	0	0	2	2	1	1	0	0	4	0	29	2	0	0	31	1	27	1	0	0	29	66
12:45 PM	1	0	1	0	0	2	0	0	1	0	0	1	3	30	1	0	0	34	3	26	0	0	0	29	66
Hourly Total	2	0	5	0	0	7	4	2	2	0	0	8	6	115	4	0	0	125	7	108	1	0	0	116	256
1:00 PM	0	1	1	0	0	2	1	1	0	0	0	2	0	31	0	0	0	31	1	32	2	0	0	35	70
1:15 PM	0	0	0	0	0	0	1	0	1	0	0	2	0	28	0	0	0	28	1	39	1	0	0	41	71
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hourly Total	0	1	1	0	0	2	2	1	1	0	0	4	0	59	0	0	0	59	2	71	3	0	0	76	141
4:00 PM	0	0	1	0	0	1	1	1	1	0	0	3	1	36	2	0	0	39	6	57	4	0	0	67	110
4:15 PM	1	1	5	0	0	7	0	0	3	1	0	4	2	35	0	0	0	37	2	53	1	0	0	56	104
4:30 PM	1	2	0	0	0	3	0	1	2	0	0	3	1	52	1	0	0	54	3	48	2	0	0	53	113
4:45 PM	2	0	3	0	0	5	1	0	1	0	0	2	2	52	2	0	0	56	1	62	2	0	0	65	128
Hourly Total	4	3	9	0	0	16	2	2	7	1	0	12	6	175	5	0	0	186	12	220	9	0	0	241	455
5:00 PM	0	1	3	0	0	4	0	2	3	0	0	5	2	46	1	0	0	49	2	68	2	1	0	73	131
5:15 PM	0	1	1	0	0	2	1	0	0	0	0	1	0	59	1	0	0	60	0	55	3	0	0	58	121

[illegible]

Turning Movement Data Plot

Start Time	Witmer Road Eastbound						Witmer Road Westbound						Regional Road 12 Northbound						Regional Road 12 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	
7:30 AM	3	2	4	0	0	9	0	2	0	0	0	2	1	49	0	0	0	50	0	39	0	0	0	39	100
7:45 AM	1	0	1	0	0	2	0	0	5	0	0	5	1	35	0	0	0	36	0	40	1	0	0	41	84
8:00 AM	1	2	2	0	0	5	0	0	1	0	0	1	0	47	1	0	0	48	2	41	1	0	0	44	98
8:15 AM	2	2	0	0	0	4	1	0	3	1	0	5	2	38	0	0	0	40	0	29	1	0	0	30	79
Total	7	6	7	0	0	20	1	2	9	1	0	13	4	169	1	0	0	174	2	149	3	0	0	154	361
Approach %	35.0	30.0	35.0	0.0	-	-	7.7	15.4	69.2	7.7	-	-	2.3	97.1	0.6	0.0	-	-	1.3	96.8	1.9	0.0	-	-	-
Total %	1.9	1.7	1.9	0.0	-	5.5	0.3	0.6	2.5	0.3	-	3.6	1.1	46.8	0.3	0.0	-	48.2	0.6	41.3	0.8	0.0	-	42.7	-
PHF	0.583	0.750	0.438	0.000	-	0.556	0.250	0.250	0.450	0.250	-	0.650	0.500	0.862	0.250	0.000	-	0.870	0.250	0.909	0.750	0.000	-	0.875	0.903
Lights	6	6	5	0	-	17	0	2	9	1	-	12	3	156	1	0	-	160	1	129	0	0	-	130	319
% Lights	85.7	100.0	71.4	-	-	85.0	0.0	100.0	100.0	100.0	-	92.3	75.0	92.3	100.0	-	-	92.0	50.0	86.6	0.0	-	-	84.4	88.4
Mediums	1	0	0	0	-	1	1	0	0	0	-	1	0	8	0	0	-	8	1	19	2	0	-	22	32
% Mediums	14.3	0.0	0.0	-	-	5.0	100.0	0.0	0.0	0.0	-	7.7	0.0	4.7	0.0	-	-	4.6	50.0	12.8	66.7	-	-	14.3	8.9
Articulated Trucks	0	0	2	0	-	2	0	0	0	0	-	0	1	5	0	0	-	6	0	1	1	0	-	2	10
% Articulated Trucks	0.0	0.0	28.6	-	-	10.0	0.0	0.0	0.0	0.0	-	0.0	25.0	3.0	0.0	-	-	3.4	0.0	0.7	33.3	-	-	1.3	2.8
Pedestrians	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Turning Movement Peak Hour Data Plot (7:30 AM)

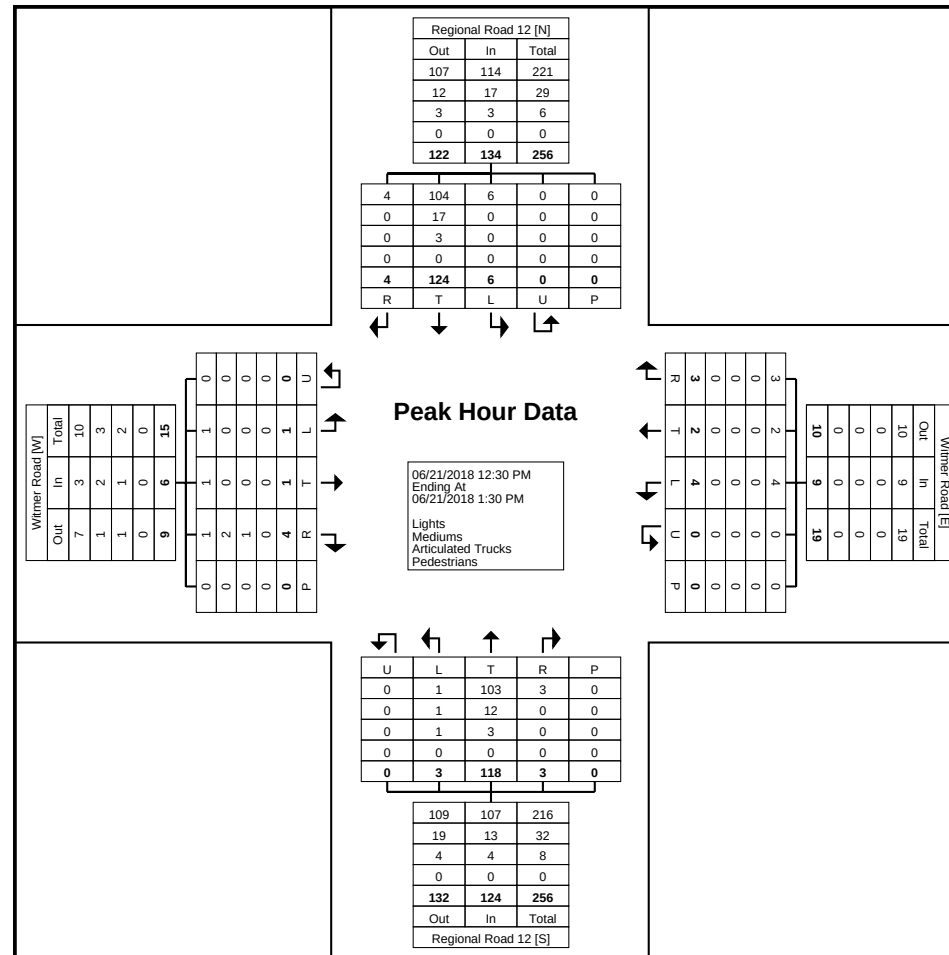
Start Time	Witmer Road Eastbound						Witmer Road Westbound						Regional Road 12 Northbound						Regional Road 12 Southbound						Int. Total
	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	Left	Thru	Right	U-Turn	Peds	App. Total	
12:30 PM	0	0	2	0	0	2	2	1	1	0	0	4	0	29	2	0	0	31	1	27	1	0	0	29	66
12:45 PM	1	0	1	0	0	2	0	0	1	0	0	1	3	30	1	0	0	34	3	26	0	0	0	29	66
1:00 PM	0	1	1	0	0	2	1	1	0	0	0	2	0	31	0	0	0	31	1	32	2	0	0	35	70
1:15 PM	0	0	0	0	0	0	1	0	1	0	0	2	0	28	0	0	0	28	1	39	1	0	0	41	71
Total	1	1	4	0	0	6	4	2	3	0	0	9	3	118	3	0	0	124	6	124	4	0	0	134	273
Approach %	16.7	16.7	66.7	0.0	-	-	44.4	22.2	33.3	0.0	-	-	2.4	95.2	2.4	0.0	-	-	4.5	92.5	3.0	0.0	-	-	-
Total %	0.4	0.4	1.5	0.0	-	2.2	1.5	0.7	1.1	0.0	-	3.3	1.1	43.2	1.1	0.0	-	45.4	2.2	45.4	1.5	0.0	-	49.1	-
PHF	0.250	0.250	0.500	0.000	-	0.750	0.500	0.500	0.750	0.000	-	0.563	0.250	0.952	0.375	0.000	-	0.912	0.500	0.795	0.500	0.000	-	0.817	0.961
Lights	1	1	1	0	-	3	4	2	3	0	-	9	1	103	3	0	-	107	6	104	4	0	-	114	233
% Lights	100.0	100.0	25.0	-	-	50.0	100.0	100.0	100.0	-	-	100.0	33.3	87.3	100.0	-	-	86.3	100.0	83.9	100.0	-	-	85.1	85.3
Mediums	0	0	2	0	-	2	0	0	0	0	-	0	1	12	0	0	-	13	0	17	0	0	-	17	32
% Mediums	0.0	0.0	50.0	-	-	33.3	0.0	0.0	0.0	-	-	0.0	33.3	10.2	0.0	-	-	10.5	0.0	13.7	0.0	-	-	12.7	11.7
Articulated Trucks	0	0	1	0	-	1	0	0	0	0	-	0	1	3	0	0	-	4	0	3	0	0	-	3	8
% Articulated Trucks	0.0	0.0	25.0	-	-	16.7	0.0	0.0	0.0	-	-	0.0	33.3	2.5	0.0	-	-	3.2	0.0	2.4	0.0	-	-	2.2	2.9
Pedestrians	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Paradigm Transportation Solutions Limited
22 King Street South, Suite 300

Waterloo, Ontario, Canada N2J 1N8
519-896-3163 cbowness@pts1.com

Count Name: Witmer Road & Regional Road 12
Site Code:
Start Date: 06/21/2018
Page No: 7



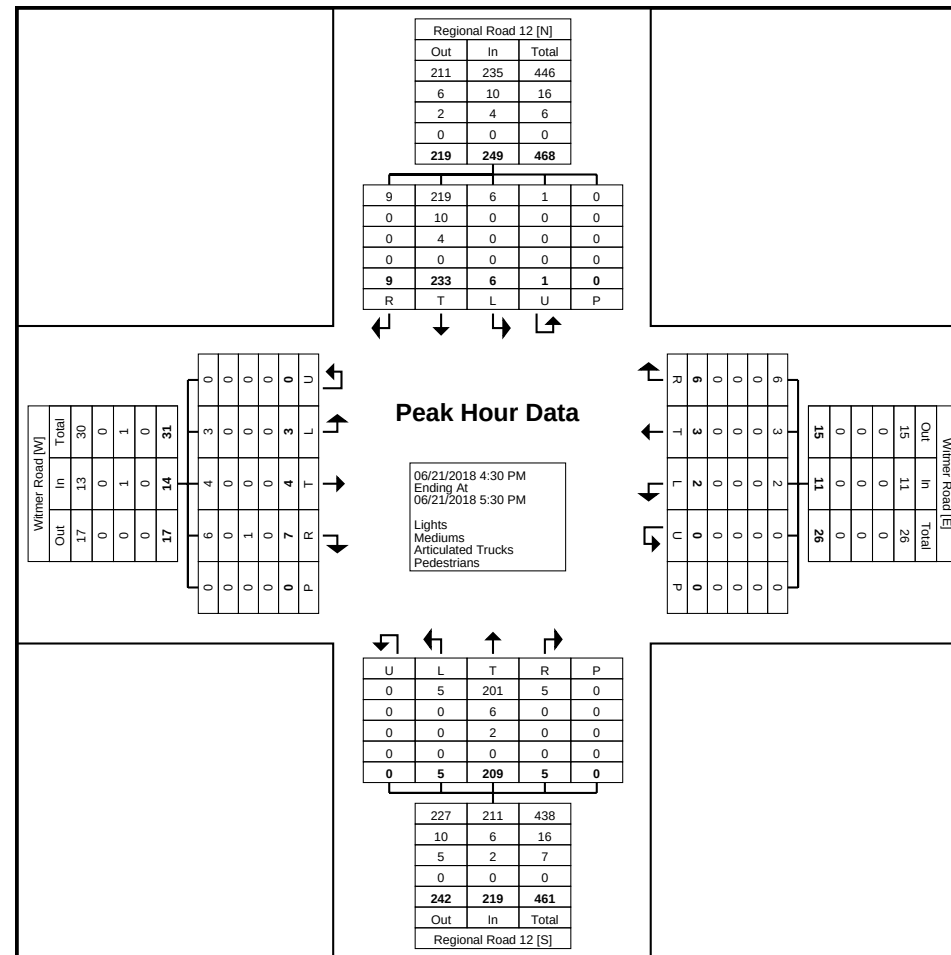
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Count Name: Witmer Road & Regional Road 12
Site Code:
Start Date: 06/21/2018
Page No: 10

Appendix C

Existing Traffic Operations Reports



Lanes, Volumes, Timings
1: Witmer Road & Queen Street

180124 - 1894 Witmer Road
Existing AM

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (vph)	7	6	7	1	2	9	4	169	1	2	149	3
Future Volume (vph)	7	6	7	1	2	9	4	169	1	2	149	3
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.953			0.899			0.999			0.997	
Flt Protected		0.983			0.996			0.999			0.999	
Satd. Flow (prot)	0	1262	0	0	1281	0	0	1428	0	0	1329	0
Flt Permitted		0.983			0.996			0.999			0.999	
Satd. Flow (perm)	0	1262	0	0	1281	0	0	1428	0	0	1329	0
Link Speed (k/h)		80			80			80			80	
Link Distance (m)		2128.4			444.6			391.5			246.4	
Travel Time (s)		95.8			20.0			17.6			11.1	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	14%	0%	29%	100%	0%	0%	25%	8%	0%	50%	14%	100%
Adj. Flow (vph)	7	6	7	1	2	9	4	169	1	2	149	3
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	20	0	0	12	0	0	174	0	0	154	0
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 24.2%
Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis
1: Witmer Road & Queen Street

180124 - 1894 Witmer Road
Existing AM

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (veh/h)	7	6	7	1	2	9	4	169	1	2	149	3
Future Volume (Veh/h)	7	6	7	1	2	9	4	169	1	2	149	3
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	7	6	7	1	2	9	4	169	1	2	149	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	342	332	150	342	334	170	152			170		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	342	332	150	342	334	170	152			170		
tC, single (s)	7.2	6.5	6.5	8.1	6.5	6.2	4.3			4.6		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.6	4.4	4.0	3.3	2.4			2.7		
p0 queue free %	99	99	99	100	100	99	100			100		
cM capacity (veh/h)	580	588	830	455	587	880	1300			1163		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	20	12	174	154
Volume Left	7	1	4	2
Volume Right	7	9	1	3
cSH	651	758	1300	1163
Volume to Capacity	0.03	0.02	0.00	0.00
Queue Length 95th (m)	0.8	0.4	0.1	0.0
Control Delay (s)	10.7	9.8	0.2	0.1
Lane LOS	B	A	A	A
Approach Delay (s)	10.7	9.8	0.2	0.1
Approach LOS	B	A		

Intersection Summary

Average Delay 1.1
Intersection Capacity Utilization 24.2%
Analysis Period (min) 15
ICU Level of Service A

Lanes, Volumes, Timings
1: Witmer Road & Queen Street

180124 - 1894 Witmer Road
Existing PM

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (vph)	3	4	7	2	3	6	5	209	5	6	233	9
Future Volume (vph)	3	4	7	2	3	6	5	209	5	6	233	9
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.932				0.926			0.997			0.995	
Flt Protected	0.989				0.991			0.999			0.999	
Satd. Flow (prot)	0	1335	0	0	1422	0	0	1487	0	0	1458	0
Flt Permitted	0.989				0.991			0.999			0.999	
Satd. Flow (perm)	0	1335	0	0	1422	0	0	1487	0	0	1458	0
Link Speed (k/h)	80				80			80			80	
Link Distance (m)	2128.4				444.6			391.5			246.4	
Travel Time (s)	95.8				20.0			17.6			11.1	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	14%	0%	0%	0%	0%	4%	0%	0%	6%	0%
Adj. Flow (vph)	3	4	7	2	3	6	5	209	5	6	233	9
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	14	0	0	11	0	0	219	0	0	248	0
Sign Control	Stop				Stop			Free			Free	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 29.3%
Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis
1: Witmer Road & Queen Street

180124 - 1894 Witmer Road
Existing PM

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (veh/h)	3	4	7	2	3	6	5	209	5	6	233	9
Future Volume (Veh/h)	3	4	7	2	3	6	5	209	5	6	233	9
Sign Control	Stop			Stop			Free			Free		
Grade	0%			0%			0%			0%		
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	3	4	7	2	3	6	5	209	5	6	233	9
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	478	474	238	480	476	212	242			214		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	478	474	238	480	476	212	242			214		
tC, single (s)	7.1	6.5	6.3	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.4	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	99	99	100	99	99	100			100		
cM capacity (veh/h)	492	488	773	489	487	834	1336			1368		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	14	11	219	248
Volume Left	3	2	5	6
Volume Right	7	6	5	9
cSH	599	630	1336	1368
Volume to Capacity	0.02	0.02	0.00	0.00
Queue Length 95th (m)	0.6	0.4	0.1	0.1
Control Delay (s)	11.1	10.8	0.2	0.2
Lane LOS	B	B	A	A
Approach Delay (s)	11.1	10.8	0.2	0.2
Approach LOS	B	B		

Intersection Summary

Average Delay 0.8
Intersection Capacity Utilization 29.3%
Analysis Period (min) 15
ICU Level of Service A

Appendix D

2023 Background Traffic Operations Reports



Lanes, Volumes, Timings
1: Witmer Road & Queen Street

180124-1 - 1894 Witmer Road
Background 2023 AM

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (vph)	19	6	9	1	2	10	5	182	1	2	161	14
Future Volume (vph)	19	6	9	1	2	10	5	182	1	2	161	14
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.964			0.896			0.999			0.989	
Flt Protected		0.973			0.996			0.999			0.999	
Satd. Flow (prot)	0	1259	0	0	1284	0	0	1427	0	0	1263	0
Flt Permitted		0.973			0.996			0.999			0.999	
Satd. Flow (perm)	0	1259	0	0	1284	0	0	1427	0	0	1263	0
Link Speed (k/h)		80			80			80			80	
Link Distance (m)		2128.4			444.6			391.5			246.4	
Travel Time (s)		95.8			20.0			17.6			11.1	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	14%	0%	29%	100%	0%	0%	25%	8%	0%	50%	14%	100%
Adj. Flow (vph)	19	6	9	1	2	10	5	182	1	2	161	14
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	34	0	0	13	0	0	188	0	0	177	0
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 31.2% ICU Level of Service A
Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis
1: Witmer Road & Queen Street

180124-1 - 1894 Witmer Road
Background 2023 AM

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (veh/h)	19	6	9	1	2	10	5	182	1	2	161	14
Future Volume (Veh/h)	19	6	9	1	2	10	5	182	1	2	161	14
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	19	6	9	1	2	10	5	182	1	2	161	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	376	365	168	376	372	182	175			183		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	376	365	168	376	372	182	175			183		
tC, single (s)	7.2	6.5	6.5	8.1	6.5	6.2	4.3			4.6		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.6	4.4	4.0	3.3	2.4			2.7		
p0 queue free %	97	99	99	100	100	99	100			100		
cM capacity (veh/h)	550	563	811	427	559	865	1274			1149		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	34	13	188	177
Volume Left	19	1	5	2
Volume Right	9	10	1	14
cSH	604	744	1274	1149
Volume to Capacity	0.06	0.02	0.00	0.00
Queue Length 95th (m)	1.4	0.4	0.1	0.0
Control Delay (s)	11.3	9.9	0.2	0.1
Lane LOS	B	A	A	A
Approach Delay (s)	11.3	9.9	0.2	0.1
Approach LOS	B	A		

Intersection Summary

Average Delay 1.4
Intersection Capacity Utilization 31.2% ICU Level of Service A
Analysis Period (min) 15

Lanes, Volumes, Timings
2: Witmer Road

180124-1 - 1894 Witmer Road
Background 2023 AM

	EBL	EBT	WBT	WBR	SBL	SBR
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔	↔		↔	↔
Traffic Volume (vph)	0	34	21	0	0	0
Future Volume (vph)	0	34	21	0	0	0
Ideal Flow (vphpl)	1650	1650	1650	1650	1765	1765
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt						
Flt Protected						
Satd. Flow (prot)	0	1650	1650	0	1730	0
Flt Permitted						
Satd. Flow (perm)	0	1650	1650	0	1730	0
Link Speed (k/h)		80	80		80	
Link Distance (m)		158.6	2128.4		229.2	
Travel Time (s)		7.1	95.8		10.3	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	0%	0%	2%	2%
Adj. Flow (vph)	0	34	21	0	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	34	21	0	0	0
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization 6.7%	ICU Level of Service A					
Analysis Period (min) 15						

HCM Unsignalized Intersection Capacity Analysis
2: Witmer Road

180124-1 - 1894 Witmer Road
Background 2023 AM

	EBL	EBT	WBT	WBR	SBL	SBR
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔	↔		↔	↔
Traffic Volume (veh/h)	0	34	21	0	0	0
Future Volume (Veh/h)	0	34	21	0	0	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	34	21	0	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	21				55	21
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	21				55	21
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				100	100
cM capacity (veh/h)	1608				953	1056
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	34	21	0			
Volume Left	0	0	0			
Volume Right	0	0	0			
cSH	1608	1700	1700			
Volume to Capacity	0.00	0.01	0.00			
Queue Length 95th (m)	0.0	0.0	0.0			
Control Delay (s)	0.0	0.0	0.0			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	0.0			
Approach LOS			A			
Intersection Summary						
Average Delay			0.0			
Intersection Capacity Utilization			6.7%		ICU Level of Service	A
Analysis Period (min)			15			

Lanes, Volumes, Timings
1: Witmer Road & Queen Street

180124-1 - 1894 Witmer Road
Background 2023 PM

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (vph)	14	4	9	2	3	6	6	225	5	6	251	21
Future Volume (vph)	14	4	9	2	3	6	6	225	5	6	251	21
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.955			0.926			0.997			0.990	
Flt Protected		0.975			0.991			0.999			0.999	
Satd. Flow (prot)	0	1379	0	0	1422	0	0	1487	0	0	1454	0
Flt Permitted		0.975			0.991			0.999			0.999	
Satd. Flow (perm)	0	1379	0	0	1422	0	0	1487	0	0	1454	0
Link Speed (k/h)		80			80			80			80	
Link Distance (m)		2128.4			444.6			391.5			246.4	
Travel Time (s)		95.8			20.0			17.6			11.1	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	14%	0%	0%	0%	0%	4%	0%	0%	6%	0%
Adj. Flow (vph)	14	4	9	2	3	6	6	225	5	6	251	21
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	27	0	0	11	0	0	236	0	0	278	0
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 32.3% ICU Level of Service A

Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis
1: Witmer Road & Queen Street

180124-1 - 1894 Witmer Road
Background 2023 PM

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Movement		↔			↔			↔			↔	
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (veh/h)	14	4	9	2	3	6	6	225	5	6	251	21
Future Volume (Veh/h)	14	4	9	2	3	6	6	225	5	6	251	21
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	14	4	9	2	3	6	6	225	5	6	251	21
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type							None				None	
Median storage (veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	520	516	262	524	524	228	272			230		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	520	516	262	524	524	228	272			230		
tC, single (s)	7.1	6.5	6.3	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.4	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	97	99	99	100	99	99	100			100		
cM capacity (veh/h)	461	462	749	455	457	817	1303			1350		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	27	11	236	278
Volume Left	14	2	6	6
Volume Right	9	6	5	21
cSH	529	601	1303	1350
Volume to Capacity	0.05	0.02	0.00	0.00
Queue Length 95th (m)	1.3	0.4	0.1	0.1
Control Delay (s)	12.2	11.1	0.2	0.2
Lane LOS	B	B	A	A
Approach Delay (s)	12.2	11.1	0.2	0.2
Approach LOS	B	B		

Intersection Summary

Average Delay	1.0
Intersection Capacity Utilization	32.3% ICU Level of Service A
Analysis Period (min)	15

Lanes, Volumes, Timings
2: Witmer Road

180124-1 - 1894 Witmer Road
Background 2023 PM

	EBL	EBT	WBT	WBR	SBL	SBR
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (vph)	0	27	30	0	0	0
Future Volume (vph)	0	27	30	0	0	0
Ideal Flow (vphpl)	1650	1650	1650	1650	1765	1765
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Flt						
Flt Protected						
Satd. Flow (prot)	0	1618	1618	0	1730	0
Flt Permitted						
Satd. Flow (perm)	0	1618	1618	0	1730	0
Link Speed (k/h)		80	80		80	
Link Distance (m)		158.6	2128.4		229.2	
Travel Time (s)		7.1	95.8		10.3	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	27	30	0	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	27	30	0	0	0
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization 6.7%	ICU Level of Service A					
Analysis Period (min) 15						

HCM Unsignalized Intersection Capacity Analysis
2: Witmer Road

180124-1 - 1894 Witmer Road
Background 2023 PM

	EBL	EBT	WBT	WBR	SBL	SBR
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (veh/h)	0	27	30	0	0	0
Future Volume (Veh/h)	0	27	30	0	0	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	27	30	0	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	30				57	30
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	30				57	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 %	100				100	100
cM capacity (veh/h)	1583				950	1044
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	27	30	0			
Volume Left	0	0	0			
Volume Right	0	0	0			
cSH	1583	1700	1700			
Volume to Capacity	0.00	0.02	0.00			
Queue Length 95th (m)	0.0	0.0	0.0			
Control Delay (s)	0.0	0.0	0.0			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	0.0			
Approach LOS			A			
Intersection Summary						
Average Delay			0.0			
Intersection Capacity Utilization 6.7%			ICU Level of Service		A	
Analysis Period (min)			15			

Appendix E

2023 Total Traffic Operations Reports



Lanes, Volumes, Timings
1: Witmer Road & Queen Street

180124-1 - 1894 Witmer Road
Total 2023 AM

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (vph)	51	6	13	1	2	10	9	182	1	2	161	46
Future Volume (vph)	51	6	13	1	2	10	9	182	1	2	161	46
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.975			0.896			0.999			0.970	
Flt Protected		0.965			0.996			0.998				
Satd. Flow (prot)	0	1262	0	0	1284	0	0	1421	0	0	1128	0
Flt Permitted		0.965			0.996			0.998				
Satd. Flow (perm)	0	1262	0	0	1284	0	0	1421	0	0	1128	0
Link Speed (k/h)		80			80			80			80	
Link Distance (m)		2128.4			444.6			391.5			246.4	
Travel Time (s)		95.8			20.0			17.6			11.1	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	14%	0%	29%	100%	0%	0%	25%	8%	0%	50%	14%	100%
Adj. Flow (vph)	51	6	13	1	2	10	9	182	1	2	161	46
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	70	0	0	13	0	0	192	0	0	209	0
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 37.0% ICU Level of Service A

Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis
1: Witmer Road & Queen Street

180124-1 - 1894 Witmer Road
Total 2023 AM

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (veh/h)	51	6	13	1	2	10	9	182	1	2	161	46
Future Volume (Veh/h)	51	6	13	1	2	10	9	182	1	2	161	46
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	51	6	13	1	2	10	9	182	1	2	161	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	400	389	184	404	412	182	207			183		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	400	389	184	404	412	182	207			183		
tC, single (s)	7.2	6.5	6.5	8.1	6.5	6.2	4.3			4.6		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.6	4.4	4.0	3.3	2.4			2.7		
p0 queue free %	90	99	98	100	100	99	99			100		
cM capacity (veh/h)	529	544	794	404	529	865	1238			1149		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	70	13	192	209
Volume Left	51	1	9	2
Volume Right	13	10	1	46
cSH	565	730	1238	1149
Volume to Capacity	0.12	0.02	0.01	0.00
Queue Length 95th (m)	3.4	0.4	0.2	0.0
Control Delay (s)	12.3	10.0	0.4	0.1
Lane LOS	B	B	A	A
Approach Delay (s)	12.3	10.0	0.4	0.1
Approach LOS	B	B		

Intersection Summary

Average Delay 2.3
Intersection Capacity Utilization 37.0% ICU Level of Service A
Analysis Period (min) 15

Lanes, Volumes, Timings
2: Witmer Road

180124-1 - 1894 Witmer Road
Total 2023 AM

	EBL	EBT	WBT	WBR	SBL	SBR
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (vph)	0	70	57	36	36	0
Future Volume (vph)	0	70	57	36	36	0
Ideal Flow (vphpl)	1650	1650	1650	1650	1765	1765
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.948				
Frt Protected					0.950	
Satd. Flow (prot)	0	1650	1564	0	1644	0
Frt Permitted					0.950	
Satd. Flow (perm)	0	1650	1564	0	1644	0
Link Speed (k/h)		80	80		80	
Link Distance (m)		158.6	2128.4		229.2	
Travel Time (s)		7.1	95.8		10.3	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	0%	0%	2%	2%
Adj. Flow (vph)	0	70	57	36	36	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	70	93	0	36	0
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization 16.0%	ICU Level of Service A					
Analysis Period (min) 15						

HCM Unsignalized Intersection Capacity Analysis
2: Witmer Road

180124-1 - 1894 Witmer Road
Total 2023 AM

	EBL	EBT	WBT	WBR	SBL	SBR
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (veh/h)	0	70	57	36	36	0
Future Volume (Veh/h)	0	70	57	36	36	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	70	57	36	36	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	93				145	75
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	93				145	75
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				96	100
cM capacity (veh/h)	1514				847	986
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	70	93	36			
Volume Left	0	0	36			
Volume Right	0	36	0			
cSH	1514	1700	847			
Volume to Capacity	0.00	0.05	0.04			
Queue Length 95th (m)	0.0	0.0	1.1			
Control Delay (s)	0.0	0.0	9.4			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	9.4			
Approach LOS			A			
Intersection Summary						
Average Delay			1.7			
Intersection Capacity Utilization			16.0%		ICU Level of Service	A
Analysis Period (min)			15			

Lanes, Volumes, Timings
1: Witmer Road & Queen Street

180124-1 - 1894 Witmer Road
Total 2023 PM

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (vph)	46	4	13	2	3	6	10	225	5	6	251	53
Future Volume (vph)	46	4	13	2	3	6	10	225	5	6	251	53
Ideal Flow (vphpl)	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550	1550
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.972			0.926			0.997			0.977	
Flt Protected		0.965			0.991			0.998			0.999	
Satd. Flow (prot)	0	1413	0	0	1422	0	0	1487	0	0	1443	0
Flt Permitted		0.965			0.991			0.998			0.999	
Satd. Flow (perm)	0	1413	0	0	1422	0	0	1487	0	0	1443	0
Link Speed (k/h)		80			80			80			80	
Link Distance (m)		2128.4			444.6			391.5			246.4	
Travel Time (s)		95.8			20.0			17.6			11.1	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles (%)	0%	0%	14%	0%	0%	0%	0%	4%	0%	0%	6%	0%
Adj. Flow (vph)	46	4	13	2	3	6	10	225	5	6	251	53
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	63	0	0	11	0	0	240	0	0	310	0
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 40.5% ICU Level of Service A

Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis
1: Witmer Road & Queen Street

180124-1 - 1894 Witmer Road
Total 2023 PM

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (veh/h)	46	4	13	2	3	6	10	225	5	6	251	53
Future Volume (Veh/h)	46	4	13	2	3	6	10	225	5	6	251	53
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	46	4	13	2	3	6	10	225	5	6	251	53
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	544	540	278	552	564	228	304			230		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	544	540	278	552	564	228	304			230		
tC, single (s)	7.1	6.5	6.3	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.4	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	90	99	98	100	99	99	99			100		
cM capacity (veh/h)	443	446	733	432	432	817	1268			1350		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	63	11	240	310
Volume Left	46	2	10	6
Volume Right	13	6	5	53
cSH	482	582	1268	1350
Volume to Capacity	0.13	0.02	0.01	0.00
Queue Length 95th (m)	3.6	0.5	0.2	0.1
Control Delay (s)	13.6	11.3	0.4	0.2
Lane LOS	B	B	A	A
Approach Delay (s)	13.6	11.3	0.4	0.2
Approach LOS	B	B		

Intersection Summary

Average Delay	1.8
Intersection Capacity Utilization	40.5%
ICU Level of Service	A
Analysis Period (min)	15

Lanes, Volumes, Timings
2: Witmer Road

180124-1 - 1894 Witmer Road
Total 2023 PM

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	0	63	66	36	36	0
Future Volume (vph)	0	63	66	36	36	0
Ideal Flow (vphpl)	1650	1650	1650	1650	1765	1765
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.952				
Frt Protected					0.950	
Satd. Flow (prot)	0	1618	1540	0	1644	0
Frt Permitted					0.950	
Satd. Flow (perm)	0	1618	1540	0	1644	0
Link Speed (k/h)		80	80		80	
Link Distance (m)		158.6	2128.4		229.2	
Travel Time (s)		7.1	95.8		10.3	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	63	66	36	36	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	63	102	0	36	0
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	16.5%			ICU Level of Service A		
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
2: Witmer Road

180124-1 - 1894 Witmer Road
Total 2023 PM

	EBL	EBT	WBT	WBR	SBL	SBR
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (veh/h)	0	63	66	36	36	0
Future Volume (Veh/h)	0	63	66	36	36	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	63	66	36	36	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	102				147	84
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	102				147	84
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				96	100
cM capacity (veh/h)	1490				845	975
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	63	102	36			
Volume Left	0	0	36			
Volume Right	0	36	0			
cSH	1490	1700	845			
Volume to Capacity	0.00	0.06	0.04			
Queue Length 95th (m)	0.0	0.0	1.1			
Control Delay (s)	0.0	0.0	9.4			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	9.4			
Approach LOS			A			
Intersection Summary						
Average Delay			1.7			
Intersection Capacity Utilization			16.5%		ICU Level of Service	A
Analysis Period (min)			15			

Education

- ▶ Bachelor of Applied Science (Civil Engineering) University of Waterloo, 2003.

Specialized Training

- ▶ Project Management Fundamentals, 2018.
- ▶ Roundabout Design and Construction Institute of Transportation Engineers, 2012.
- ▶ Travel Demand Modeling with TransCAD Caliper Corporation, 2008.
- ▶ Vissim Intro PTV Vision, 2007.
- ▶ Transportation Impact Analysis for Site Development Institute of Transportation Engineers, 2006.
- ▶ Analytical Transportation Planning and EMME2 Modelling Alican Consulting, 2005.

Professional Affiliations

- ▶ Professional Engineers of Ontario, P. Eng.
- ▶ Institute of Transportation Engineers (Member)

Representative Projects

Transportation Master Plans

Role: Engineer, Modeller

Services Provided: TransCad/EMME Model Development, Travel Demand Forecasting, Demand Analysis Simcoe Commercial Vehicle O-D Survey, Simcoe County (2011)

- ▶ Halton Growth Management Study (Halton) (Emme 4) (2018)
- ▶ Caledon Transportation Master Plan (Caledon) (Emme 4) (2016)
- ▶ Niagara Escarpment Crossing Study (Niagara Region) (TransCAD) (2014)
- ▶ Stratford Master Plan (Stratford) (TransCAD) (2010)
- ▶ Bolton Residential Expansion (Caledon) (Emme 2) (2013)
- ▶ Caledon Transportation Needs Assessment Update (Caledon) (Emme 2) (2008)

Travel and Market Surveys

Role: Survey Manager

Services Provided: Management of Survey Crew, Data Analysis, Design of Passenger Surveys, Conducting Surveys

- ▶ Gordon Street Pedestrian Crossing (Guelph) (2018)
- ▶ Simcoe Commercial Vehicle O-D Survey (Simcoe County) (2011)
- ▶ Pelee Island Transportation Needs Study (Essex County) (2010)
- ▶ Mitchell River Crossing Study (Mitchell) (2009)
- ▶ Grand River Transit On-Board Passenger Survey (Waterloo Region) (2008)
- ▶ Intercity Transit Passenger Survey (Waterloo Region) (2008)
- ▶ Ontario-New York Border Crossings Survey (Niagara Region) (2007)

Active Transportation

Role: Engineer

Services Provided: Development and Analysis of Pedestrian and Cycling Plans

- ▶ Separated Cycle Lane Network Pilot (Waterloo) (2018)
- ▶ Guelph Active Transportation Network and Sidewalk Inventory (2015)
- ▶ Woodstock Master Cycling Plan (Woodstock) (2013)

Traffic Operations and Safety

Role: Engineer, Modeller

Services Provided: Vissim and Synchro Model Development, Analysis of Traffic Operations and Development of Remedial Plans

- ▶ Ontario Street Improvement Opportunities and Priorities (Grand Bend) (2017)

- ▶ Highway 7 & Wellington Street – Christie Digital (Kitchener) (2014)
- ▶ Blair Business Park (Cambridge) (2014)
- ▶ Ottawa and Mill LRT Intersection Design (Kitchener) (2013)
- ▶ Tavistock Operational Review (Tavistock) (2013)
- ▶ Northwest Listowel Transportation Study (Listowel) (2012)
- ▶ Grand River Hospital LRT Impacts (Kitchener) (2012)
- ▶ Bathurst Street (Toronto) (2010)

Neighbourhood Traffic Calming

Role: Engineer

Services Provided: Data Collection Management, Traffic Forecasting, Traffic Operations Analysis, Collision Analysis, Public Consultation, Presentation Production

- ▶ Woolwich Street Reconstruction (Breslau) (2014)
- ▶ Auburn / University Neighbourhood Study (Waterloo) (2008, 2013)
- ▶ Davenport Road Reconstruction (Waterloo) (2010)

Transportation Impact Studies

Role: Engineer

Services Provided: Traffic Forecasting, Collision Analysis, Traffic Operations Analysis, Site Plan Review, Stakeholder Consultation, Report Writing on

- ▶ Over 100 Transportation Impact Studies across Ontario.

