

# 2530173 ONTARIO CORPORATION

## TRAFFIC IMPACT STUDY

1444-1458 Cawthra Road, City of Mississauga

Project No. 2017-0792



# COLE

**COLE ENGINEERING GROUP LTD.**

DECEMBER 2019

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December 13, 2019  
Reference No. 2017-0792

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2530173 Ontario Corporation  
80 Jutland Rd. Suite 500  
Toronto, ON M8Z 2H1

**Attention: Mr. Ryan Atkinson**

**Traffic Impact Study  
Proposed Residential Development at 1444-1458 Cawthra Road,  
City of Mississauga**

Cole Engineering Group Ltd. (COLE) is pleased to submit this Traffic Impact Study (TIS) report for the above-noted development proposal. This report documents our findings and conclusions regarding the traffic impact assessment in support of the Official Plan Amendment (OPA) and Rezoning for the proposed residential development of 12 residential townhouses and 4 detached single-family residential units. The subject site is located on the west of Cawthra Road between Arbor Road on the south and South Service Road on the north.

The comments received on the second submission are included in this revised TIS report. The results of the traffic analysis show that the study area intersections will operate at acceptable levels of service when incorporating the development with the existing study area traffic, and the existing road network can accommodate the traffic generated by the proposed development and minimal mitigation measures will be required.

Should you have any questions, please do not hesitate to contact the undersigned.

Best Regards,  
**COLE ENGINEERING GROUP LTD.**

Rao N. Marthi, B.Eng., MCIP, RPP  
Project Manager  
Urban Development (Traffic)

RM

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PREPARED BY AND CHECKED BY:

**COLE ENGINEERING GROUP LTD.**



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Rao N. Marthi, B. Eng., MCIP, RPP  
Project Manager  
Urban Development (Traffic)

**Issues and Revisions Registry**

Identification	Date	Description of Issued and/or Revision
Draft Report	April 2018	For Client Review
Draft Report	May 2018	For Submission
Final Report	September 2018	For Submission
Updated Final Report	December 2019	For Submission

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This Report / Study (the “Work”) has been prepared at the request of, and for the exclusive use of, the Owner / Client, [City of Mississauga] and its affiliates (the “Intended User”). No one other than the Intended User has the right to use and rely on the Work without first obtaining the written authorization of Cole Engineering Group Ltd. and its Owner. Cole Engineering Group Ltd. expressly excludes liability to any party except the Intended User for any use of, and/or reliance upon, the work.

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## 1 Introduction

Cole Engineering Group Ltd. (“COLE”) was retained by 2530173 Ontario Corporation (the “Owner”) to prepare a Traffic Impact Study (TIS) for a proposed residential development in support of Official Plan Amendment (OPA) and Rezoning Application in the City of Mississauga (the “City”). The subject site is located on the west of Cawthra Road between Arbor Road on the south and South Service Road on the north. The subject land is currently occupied by four single-detached houses. **Figure 1.1** illustrates the site location.

The Region had reviewed the TIS report submitted and provided the following two site access configuration options on September 20, 2019.

### Option 1

Right in / right out on the title

- **interim** full movement access with restrictions on left-out movements during the PM peak hours

### Option 2

Right in / right-out access on title

- left in movements only, to be restricted by the installation of centre median along Cawthra Road.

Option 1 was selected based on the better site access operations and the analysis has been revised accordingly. The details are discussed in **Section 5.0**.

The revised site plan provided by KFA Architects + Planners Inc. dated December 9, 2019, the proposed development is to contain four, detached single-family residential units and 12 townhouses. The vehicular access to the subject site is proposed through a private road and will be connected to Cawthra Road. The subject site also proposes a total of four visitor parking spaces. The proposed site plan is shown in **Figure 1.2**.



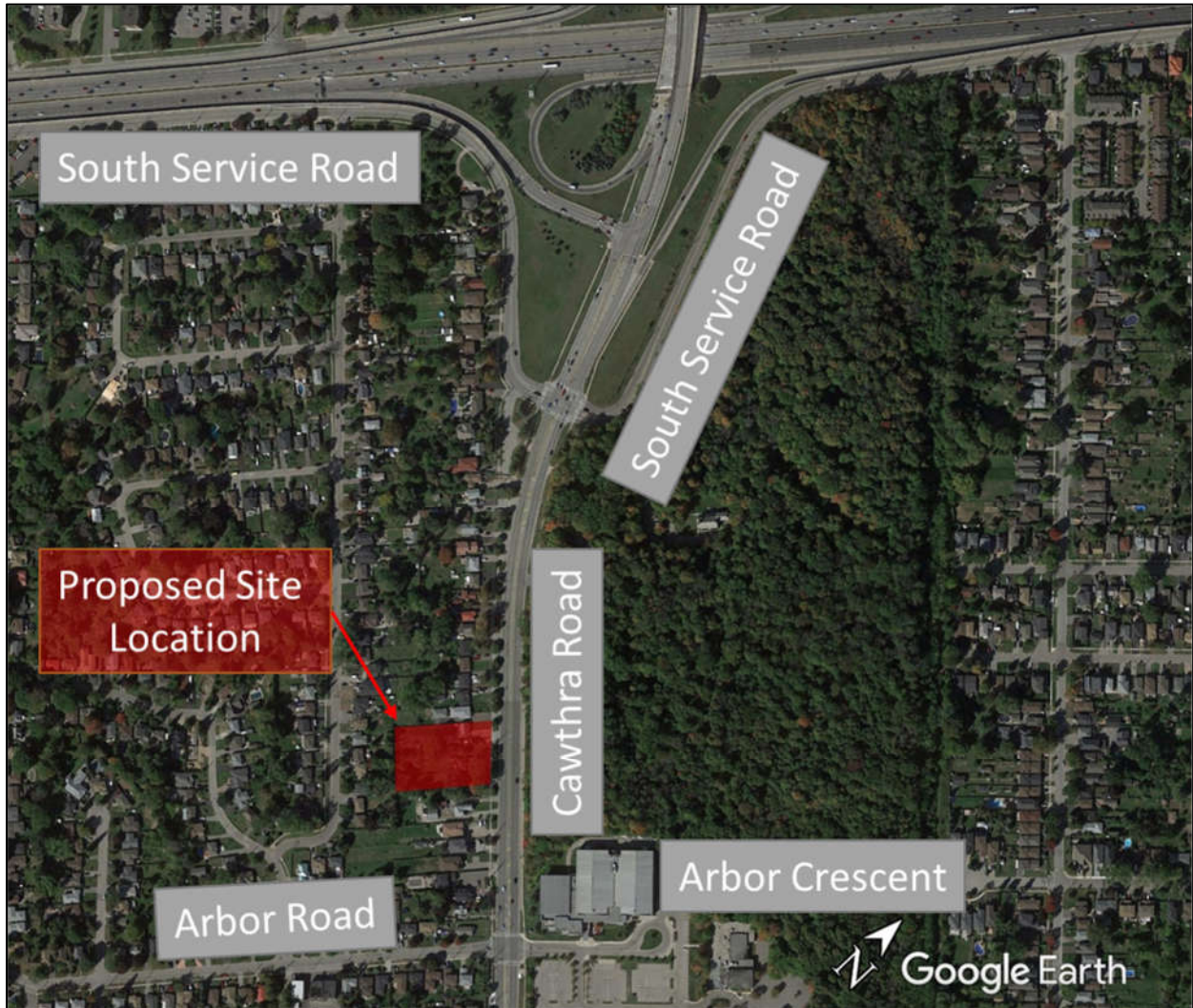


Figure 1.1 Site Location

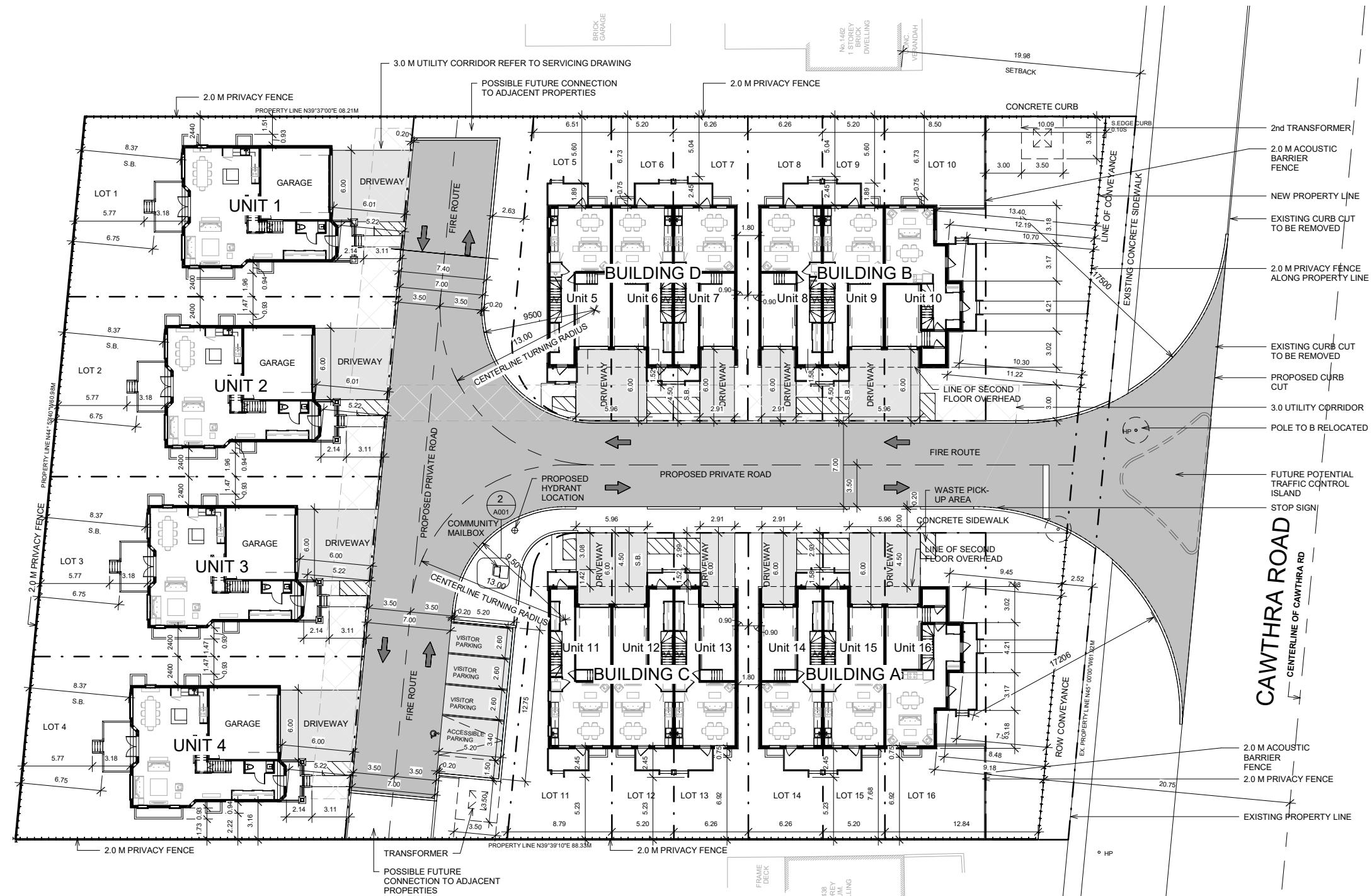


1444  
1458

1444-1458 CAWTHRA ROAD  
MISSISSAUGA, ON

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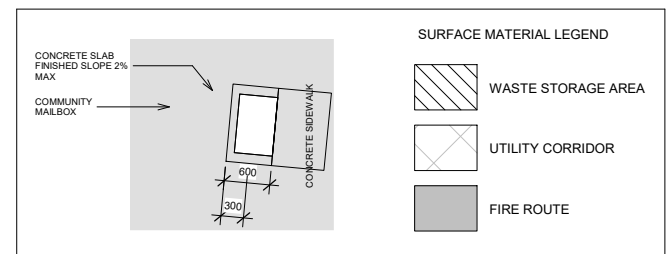
1	Issue to Consultants	2018.09.12
2	Issue for OPIRZ	2018.09.28
3	Issued for Review	2019.08.13



#### NOTES:

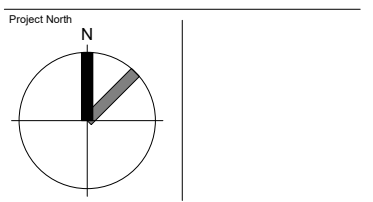
- THIS SITE HAS BEEN PREPARED IN ACCORDANCE WITH THE CITY OF MISSISSAUGA ZONING BYLAW NO. \_\_\_\_\_ FOR STORM WATER MANAGEMENT, SITE SERVING AND GRADING INFORMATION REFER TO DRAWINGS PREPARED BY LITHOS GROUP INC. 150 BERMONDSEY ROAD UNIT #220 TORONTO ON, M4A 1Y1
- FOR LANDSCAPE INFORMATION, REFER TO DRAWINGS PREPARED BY JOHN RUSSO LANDSCAPE ARCHITECT SURVEY CREDIT
- INFORMATION TAKEN FROM PLAN OF PART OF LOTS 188, 189, 190, & 191 REGISTERED PLAN B-19, CITY OF MISSISSAUGA
- PREPARED BY: TOM A. SENKUS ONTARIO LAND SURVEYOR, 40 BURROWS AVENUE TORONTO (ISLINGTON), ON M9B 4W7
- ANY GRADE ELEVATIONS ARE SHOWN FOR REFERENCE ONLY, REFER TO GRADING AND SITE SERVING PLAN FOR GRADING AND UIC SERVICES
- ALL SITE AREA LIGHTING TO BE DIRECTED DOWNWARD AND DEFLECTED AWAY FROM ADJACENT LOTS ROADS AND STREETS
- ALL CURBING AND DRIVEWAY ENTRANCES TO BE DESIGNED IN ACCORDANCE WITH THE CITY'S MATERIALS STANDARDS AND SPECIFICATIONS MANUAL
- GUARD RAILS IN ACCORDANCE TO THE OBC 2012 SHALL BE PROVIDED WHENEVER GRADE DEFERENCE EXCEEDS 600MM DETAILS TO BE SUBMITTED AND BUILDING PERMIT STAGE.
- BOULEVARD TO BE REINSTATED IN ACCORDANCE WITH CITY STANDARDS AND TO THE SATISFACTION OF THE CHIEF ENGINEER, EXECUTIVE DIRECTOR OF ENGINEERING AND CONSTRUCTION SERVICES
- EXISTING WATER SERVICE TO BE DISCONNECTED BY THE CITY OF MISSISSAUGA
- SNOW WILL BE REMOVED OFF SITE

**SITE SERVICES DISCLAIMER**  
BE ADVISED THAT SHOULD ANY PARTY INCLUDING THE APPLICANT OR ANY SUBSEQUENT OWNER, APPLY FOR MORE THAN ONE CONDOMINIUM CORPORATION ENCOMPASSING ANY OR ALL OF THIS DEVELOPMENT OR MAKE AN APPLICATION THAT RESULTS IN A LAND DIVISION, STAFF MAY REQUIRE LEGAL ASSURANCES, INCLUDING BUT NOT LIMITED TO EASEMENTS WITH RESPECT TO THE APPROVED SERVICES, SUCH ASSURANCES WILL BE DETERMINED AT THE TIME OF THE APPLICATION FOR CONDOMINIUM APPROVAL.



SURFACE MATERIAL LEGEND	
	WASTE STORAGE AREA
	UTILITY CORRIDOR
	FIRE ROUTE

2 Community Mailbox Plan  
1 : 50



Project No:	16071
Scale:	As indicated
Date:	2017/04/05
Drawn by:	R.V.W.
Drawing Title	

Site Plan

Drawing Number

A001

## 2 Study Approach

This study will:

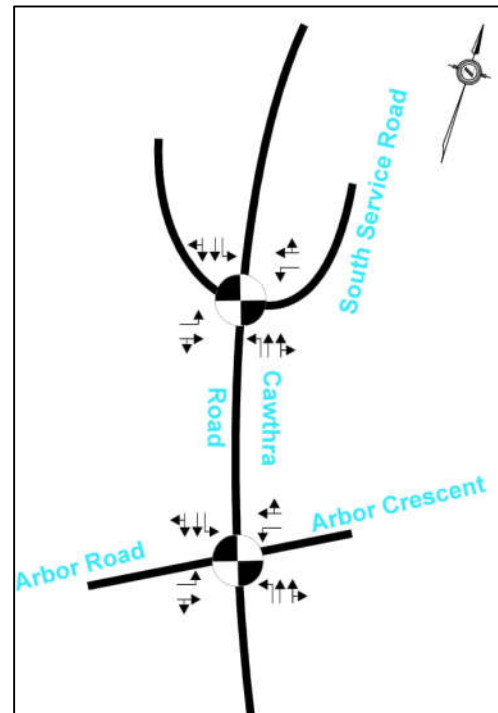
- Focus on the intersections of:
  - Cawthra Road and Arbor Road/Arbor Crescent (Signalized);
  - Cawthra Road and South Service Road(Signalized); and,
  - Cawthra Road and Future Site Access (Unsignalized).
- Assess the existing operations of the above-noted study area intersections during the weekday AM and PM peak hours;
- Assuming the opening year of 2019, estimate the future (2024) background volumes by adding background traffic growth from outside the study area and the traffic generated from other proposed developments in the vicinity of the proposed site;
- Assess the future (2024) background traffic operations of the above-noted study area intersections during the weekday AM and PM peak hours;
- Estimate site traffic based on information published in the Trip Generation Manual, 10th Edition, by the Institute of Transportation Engineers (ITE) ) and distribute based on existing traffic patterns and information extracted from 2011 Transportation Tomorrow Survey (TTS);
- Assess future total traffic operations in the horizon year 2024 during the weekday AM and PM peak hours for the subject development;
- Develop mitigation measures to address any deficiencies at each stage (existing, future background and future total traffic) for all key study area intersections;
- Review the Draft Plan regarding the functionality of the internal vehicular circulation to facilitate the fire route related to the proposed residential development using AutoTURN, as required;
- Review parking provided on the Draft Plan; and,
- Prepare a Transportation Demand Management (TDM) plan.

### 3 Existing Conditions

#### 3.1 Existing Road Network

The existing road network and lane configurations are illustrated in **Figure 3.1**. The details of the road segments are described as follows:

- **Arbor Road/Arbor Crescent** is a local minor road that runs east-west in the city of Mississauga. The roadway is called Arbor Road west of Cawthra Road and Arbor Crescent is east of it. The assigned speed limit for this roadway is 50 km/h and sidewalks are present on one side of the roadway.
- **South Service Road** is an east-west local major roadway in Mississauga. The posted speed limit is 60km/h and sidewalks are present on the south side of the roadway.
- **Cawthra Road** is a regional arterial road that runs in the north-south direction. The posted speed limit is 50km/. The left turn lane also operates a two-way-left turn lane between South Service Road and Arbor Road / Arbor Crescent. Sidewalks are present on both sides of the road in the vicinity of the proposed development.



**Figure 3.1 Existing Lane Configuration**

#### 3.2 Existing Transit Network

Mississauga MiWay transit services provide a network of local bus services through a large portion of the study. Key routes operating within the study area are as follows:

**MiWay Bus 8** - (a stop is approximately 100 m away from the site on Cawthra Road) operates Monday-Saturday from the City Centre Transit Terminal to the Lakeshore along Cawthra Road.

**MiWay Bus 312** - (a stop is approximately 200 m away from the site on Cawthra Road) operates Monday-Friday (PM only) from Gordon Graydon Centre to the City Centre Transit Terminal.

**MiWay Bus 335** – (a stop is on Atwater Avenue near Cawthra Road) operates Monday- Friday (PM only) from the Clarkson GO Station Terminal to Allan A. Martin school.

**MiWay Bus 23** - (a stop is on Lakeshore Road near Cawthra Road) operates Monday- Sunday from the Clarkson GO Station Terminal to the Long Branch GO Station Terminal.

In addition to MiWay bus services, GO Transit operates the Lakeshore West Train service and the Milton Train Station near the site. Four Go Train Stations are near the site: Port Credit and Long Branch (along the Lakeshore West route), and Dixie and Cooksville (along the Milton route).

### 3.3 Peak Periods of Analysis

Peak periods were chosen on the basis of the “worst Case” combination of site-generated trips plus background traffic/transit across the study area. Existing operations of the study area intersections during the weekday morning (7:00 AM – 9:00 AM) and weekday evening (4:00 PM – 6:00 PM) peak periods were assessed as part of this Study.

The existing traffic volumes are based on recent traffic count surveys undertaken on February 27, 2018, by Spectrum Traffic Data Inc. The weekday peak hours were observed between 7:45 AM to 8:45 AM in the morning and approximately between 4:45 PM and 5:45 PM in the evening. Existing traffic volumes at the study area intersections are illustrated in **Figure 3.2** for the weekday AM and PM peak hours. Source information for the traffic counts is provided in **Appendix A-1**.

Existing signal timings were collected from Regional staff and were used to conduct the intersection capacity analysis. Source data is provided in **Appendix A-2**.

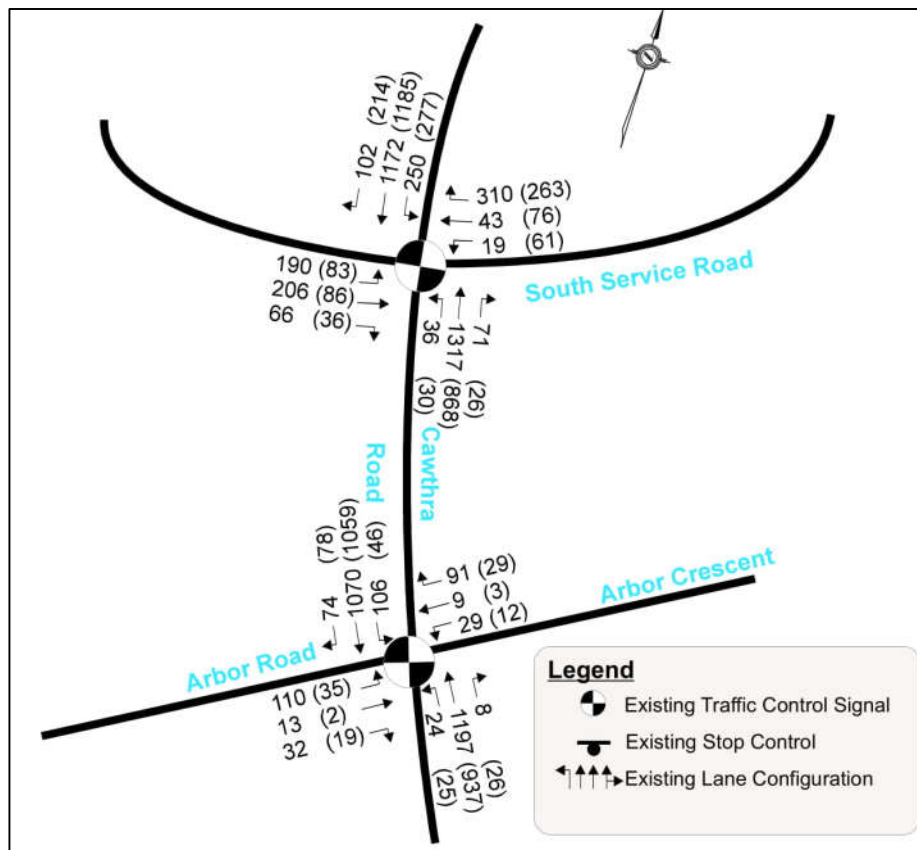


Figure 3.2 Existing (2018) Traffic Volumes

### 3.4 Existing Traffic Assessment

#### 3.4.1 Input Parameters and Assumptions

Existing Traffic Analysis Traffic operations conditions at signalized and unsignalized intersections were analyzed using *Synchro Version 9.0*, which incorporates the methodology outlined in the *Highway Capacity Manual* (HCM 2000). Analysis parameters and assumptions have been adopted in accordance with the Region's Synchro guidelines (*Regional Guidelines for Using Synchro- Version 7.73 Rev 8 dated December 2010*).

This includes the following assumptions:

- Peak hour factors of 1.00 for all movements on all approaches;
- Ideal saturation flow rate based on the Synchro default value of 1,900 vphpl for all movements;
- Existing signal timing and phasing provided by the Region (provided in **Appendix A-2**); and,
- 3.7 m lane width for all through lanes and 3.5 m for auxiliary turn lanes on all approaches.

The intersection operations are reported in two ways:

- The volume to capacity (v/c) ratio which is represented numerically for signalized and unsignalized intersections; and,
- The level of service (LOS) is indicated by a letter and is based on the average control delay per vehicle.

#### 3.4.2 Critical Movement Classifications

Per Region of Peel Traffic Impact Study Guidelines the following movements are defined as critical movements:

- Through movements; and shared through-turning movements operating with volume to capacity (v/c) ratios equal to or above 0.90;
- Overall intersection operation with volume to capacity (v/c) ratios equal to or above 0.90; and,
- Exclusive turning movements operating with volume to capacity (v/c) ratios equal to or above 1.00.

### 3.5 Intersection Capacity Analysis

The existing traffic volumes were analyzed using *Synchro 9.0* software. Results from the intersection capacity analysis, based on the existing road network configuration, existing signal timing plans, and existing traffic volumes, are summarized in **Table 3-1**. Critical movements, if any, are bolded. Detailed intersection capacity and queuing analysis reports under the existing conditions are provided in **Appendix B**.

**Table 3-1 Existing Traffic - Intersection Operations**

Intersection	Key Movement	LOS (v/c)	
		AM Peak	PM Peak
Cawthra Road and South Service Road	Overall	C (0.76)	C (0.56)
	EB Left	E (0.79)	D (0.39)
	EB Through	D (0.60)	D (0.28)
	EB Right	D (0.04)	D (0.02)
	WB Left	D (0.12)	D (0.29)
	WB Through	D (0.13)	D (0.24)
	WB Right	D (0.20)	D (0.16)
	NB Left	C (0.19)	C (0.21)
	NB Through + Right	D (0.84)	C (0.63)
	SB Left	D (0.57)	B (0.40)
	SB Through + Right	A (0.52)	A (0.54)
Cawthra Road and Arbor Road / Arbor Crescent	Overall	B (0.58)	A (0.40)
	EB Left + Through + Right	D (0.69)	D (0.38)
	WB Left	D (0.16)	D (0.17)
	WB Through + Right	D (0.09)	D (0.05)
	NB Left	A (0.10)	A (0.07)
	NB Through + Right	B (0.57)	A (0.34)
	SB Left	A (0.32)	A (0.12)
	SB Through + Right	A (0.47)	A (0.40)

Based on the analysis conducted for the existing traffic conditions during the weekday AM and PM peak hours, all intersections are performing with good levels of service and well below capacity. It is important to note that the LOS is a qualifying measure of traffic operations at an intersection, for a 15-minute analysis period, LOS 'A' is an indication of almost no delays and LOS 'F' indicates very long delays. No additional mitigation measures are recommended.

## 4 Future Background Conditions

### 4.1 Background Traffic Growth Rates

Future background traffic volumes for the 2024 horizon year consist of the following components:

- Background traffic growth from outside the study area; and,
- Traffic generated within the study area from other proposed developments.

Growth rates were received from the Region and City staff growth rates presented in **Table 4-1**.



**Table 4-1 Annual Traffic Growth Rate**

	South Service Road				Cawthra Road
	Compound Annual Growth from Existing to 2021		Compound Annual Growth from 2021-2024		Compound Annual Growth from Existing to 2024
Time	EB	WB	EB	WB	NB/SB
AM Peak Hour	0.50%	1.00%	1.50%	0.00%	1.00%
PM Peak Hour	1.00%	1.50%	1.00%	0.50%	

Growth rates on South Service Road vary due to the Light Rail Transit, which is expected to be in operation by 2021, on Hurontario Road to the east on Cawthra Road. Discussions with the Region and City are shown in **Appendix C**.

## 4.2 Background Developments

As discussed with City Staff, it was suggested to include the following three developments in the future background traffic analysis:

1. 650 Atwater Avenue Ltd.: This residential development is located in the southwest corner of Atwater Avenue and Cawthra Road in the City of Mississauga. The site is expected to have a total of 110 townhouse units. Access for the development is proposed to Atwater Avenue via a full moves driveway located west of Cawthra Road. A Traffic Impact Study for this development was conducted by GHD in April 2016.
2. Cawthra & Atwater: This residential townhouse development on the south-east corner of the Cawthra Road and Atwater Avenue intersection. The site is approximately 14,855 m<sup>2</sup> in size and the development consists of a total of 171 residential townhouse units and a new private road connection between Village Green Boulevard and Parkwest Place. Traffic Impact Study was conducted by BA Group, originally in July 2017, and revised in December 2017.
3. Queenscorp (Cawthra South) Inc.: This residential townhouse development is located on Cawthra Road opposite Village Green Boulevard in the City of Mississauga. The site is expected to include 154 dwelling units and Access for the development is proposed to Cawthra Road via a full moves driveway approximately 200 metres south of Atwater Avenue. A Traffic Impact Study for this development was conducted by GHD in March 2016.

The site generated from the above developments is included in the future background analysis. Site generated figures from the traffic impact studies for the above developments are provided in **Appendix D**.

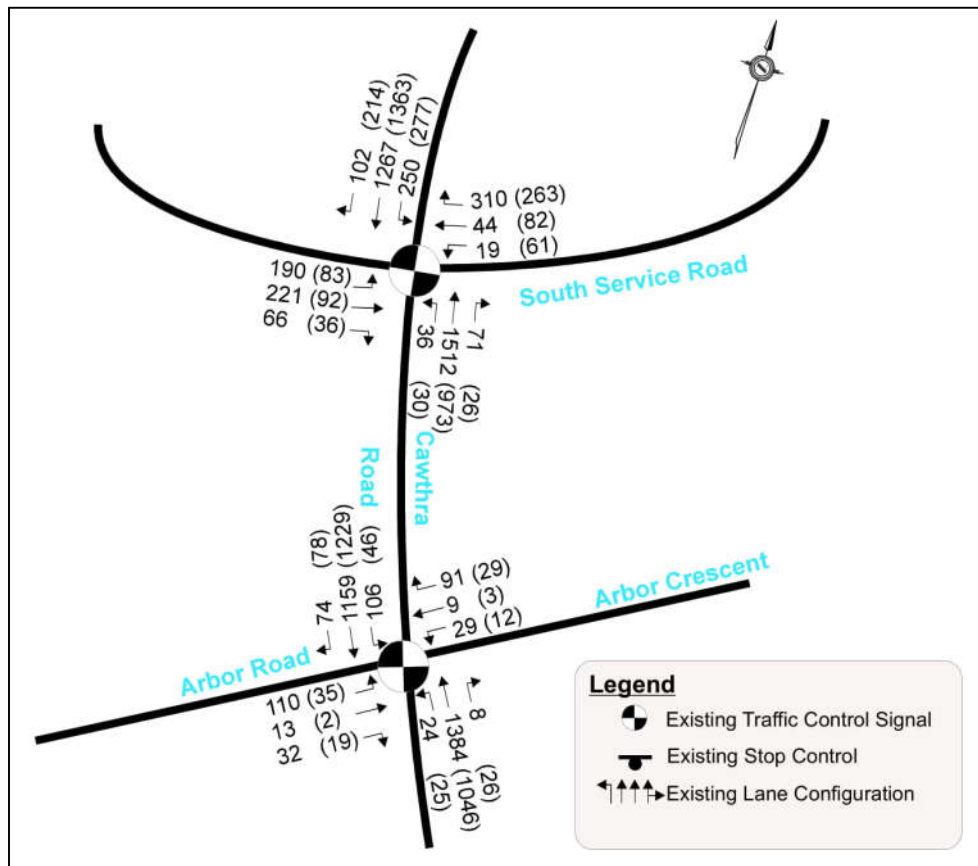


### 4.3 Future Background Analysis

The future (2024) background traffic volumes consists:

- Background traffic growth from outside the study area; and,
- Traffic generated within the study area from other proposed developments in the vicinity of the subject development.

The future (2024) background traffic volumes are illustrated in **Figure 4.1**.



**Figure 4.1 Future (2024) Background Traffic Volumes**

#### 4.3.1 Intersection Capacity Analysis

The future background traffic volumes were analyzed using Synchro 9.0 software. Results from the intersection capacity analysis are summarized in **Table 3-1**. Critical movements, if any, are bolded. Detailed intersection capacity and queuing analysis reports under the existing conditions are provided in **Appendix E**.

**Table 4-2 Future Background Traffic - Intersection Operations**

Intersection	Key Movement	LOS (v/c)	
		AM Peak	PM Peak
Cawthra Road and South Service Road	Overall	D (0.82)	C (0.62)
	EB Left	E (0.79)	E (0.60)
	EB Through	D (0.64)	D (0.46)
	EB right	D (0.06)	D (0.02)
	WB Left	D (0.13)	D (0.44)
	WB Through	D (0.13)	D (0.40)
	WB right	D (0.25)	D (0.16)
	NB Left	C (0.20)	C (0.24)
	NB Through + Right	D (0.89)	C (0.66)
	SB left	D (0.68)	B (0.39)
	SB through + right	A (0.56)	A (0.57)
Cawthra Road and Arbor Road/Arbor Crescent	Overall	B (0.65)	A (0.45)
	EB left + through + right	D (0.69)	D (0.38)
	WB Left	D (0.16)	D (0.17)
	WB through + right	D (0.09)	D (0.05)
	NB Left	A (0.11)	A (0.09)
	NB Through + Right	B (0.65)	A (0.38)
	SB left	A (0.39)	A (0.13)
	SB through + right	A (0.50)	A (0.46)

Based on the analysis conducted with the future background traffic conditions during the weekday AM and PM peak hours, all intersections are performing with good levels of service and well below capacity. No additional mitigation measures are recommended.

## 5 Site Access Configuration

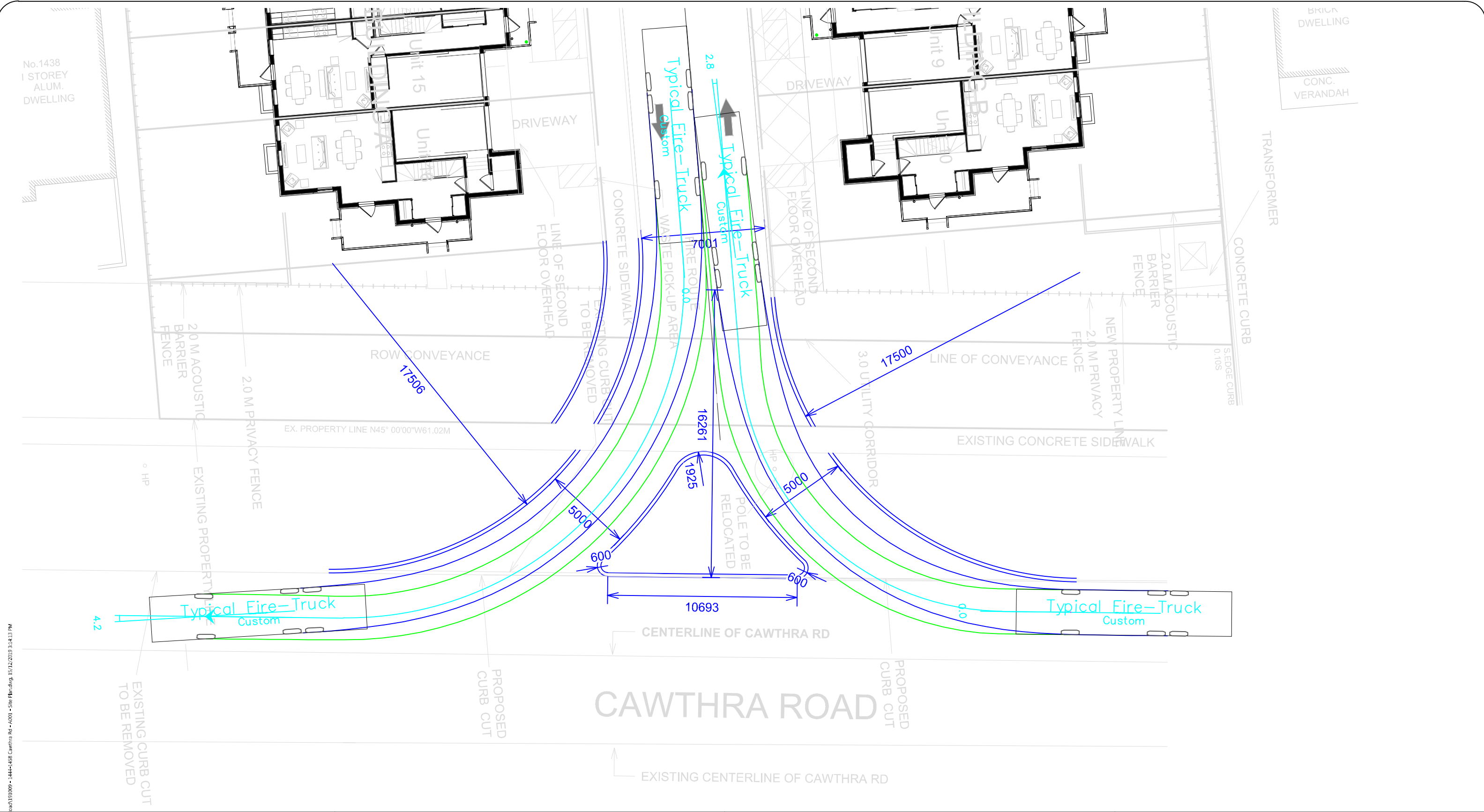
In option 1, the Region recommended for full movement access with restrictions on left-out movements during the PM peak hours in the **interim**, and Right-In/Right-Out (RIRO) on the **title**.

With regards to the RIRO access on the **title**, the Region has asked to demonstrate that a future potential directional island can be accommodated within the currently proposed access width of 7.0 metres, showing the turning templates for fire/delivery trucks.

The RIRO access with 7.0 wide access has been revised with reference to the standard drawing #5-1-4A. In order to match the base width of the pork-chop, which is approximately 9.7 m using the design parameters (9 m wide access, 15m curb radii, and 5m wide throat width), a larger curb radius of 17.5m was used.

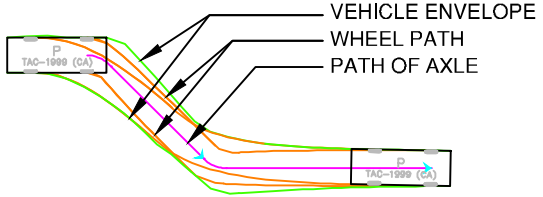
AutoTURN swept path analysis with fire and garbage trucks show no conflicts while ingress and egress the RIRO access. Fire and garbage trucks ingress and egress the RIRO access is presented in **Figure 5.1** and **Figure 5.2**, respectively.

A functional drawing showing the access configuration in the **interim** condition was prepared and presented in **Figure 5.3**.

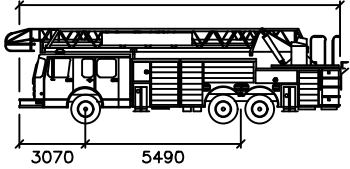


C:\Users\mhamid\Desktop\1444 Cawthra Road\151009 - 1444-1458 Cawthra Rd - A001 - Site Planning 15/12/2019 3:41:13 PM

Q:\Common Corporate\CEG LOGO\Cole\_new\_logo-blue-green.png



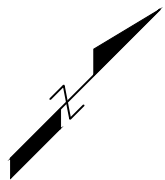
DESIGN VEHICLE  
Typical Fire-Truck  
mm  
Width : 2540  
Track : 2540  
Lock to Lock Time : 6.0  
Steering Angle : 45.0



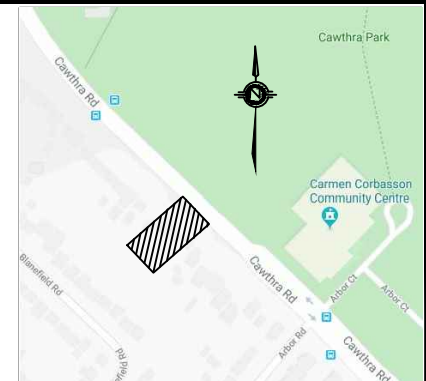
FUNCTIONAL DESIGN DRAWING - RIGHT-IN-RIGHT-OUT  
RESIDENTIAL DEVELOPMENT, 1444-1458 CAWTHRA ROAD  
CITY OF MISSISSAUGA

DATE:	DECEMBER 2019	PROJECT No.:	2017-0792
SCALE:	1 : 200	DWG No.:	5-1





CAWTHRA ROAD



- PAVEMENT MARKING LEGEND**
- ① 10 cm SOLID YELLOW LINE
  - ② 10 cm SOLID WHITE LINE
  - ③ PEDESTRIAN CROSSING (AS PER 5-2-16D)
  - ④ 45 cm WHITE STOP BAR

TACTILE WALKING SURFACE INDICATORS (TYP) 5-2-16A AND 5-2-16B

FUTURE POTENTIAL TRAFFIC CONTROL ISLAND

Rd-101  
Rd-12A  
(PM ONLY)



Drawing: P:\WORK\2017-0792\_ONTARIO\_CSPR\_MISSISSAUGA\_TRANSCON\300-DESIGN-ENGINEERING\304-CALCS\ACCESS FUNCTIONAL DESIGN\2017-0792\_TR\_AFD - RIRI\_V3.DWG  
User: 12/20/2019 11:41 AM  
Date: 12/20/2019 Time: 09:36:06 AM

No.	DATE	REVISIONS	INITIAL	SIGNED
2	12.20.2019	ISSUED FOR FUNCTIONAL DESIGN REVIEW	DL	
1	10.15.2019	ISSUED FOR FUNCTIONAL DESIGN REVIEW	DL	

ENGINEERING AND CONSTRUCTION SERVICES DIVISION

ACCEPTED TO BE IN ACCORDANCE WITH THE REGION OF PEEL STANDARDS. THIS ACCEPTANCE IS NOT TO BE CONSTRUED AS VERIFICATION OF ENGINEERING CONTENT.

MANAGER, DEVELOPMENT ENGINEERING

DATE:

1444-1458 CAWTHRA RD  
FUNCTIONAL PAVEMENT MARKINGS AND SIGNAGE PLAN

DESIGN:	DL	DRAFTING:	DL	CHECK:	RM	CONTRACT No.	2017-0792
SCALE:	HOR 1:500			DRAWING			
DATE:	OCTOBER 2019			NUMBER:		5-3	



## 6 Future Total Conditions

### 6.1 Site Generated Traffic

Site trip generation for the proposed development was undertaken using the information contained in the *Trip Generation Manual, 10<sup>th</sup> Edition* published by the ITE. The Land Use Codes 210 (Single Family Detached Housing) and 221 (Multifamily Housing-Low Rise) were used to estimate the weekday AM and PM peak hour traffic.

A 10% non-auto mode reduction was applied to the gross trips generated as calculated from the 2011 Transportation Tomorrow Survey (TTS) data results. The non-auto mode reduction was calculated using the information collected in the 2011 TTS for zones of household (3642, 3648, 3649, and 3653). Detailed analysis of the 2011 TTS data is provided in **Appendix F**. The trip generation calculations for the residential units are tabulated in **Table 6-1** below.

**Table 6-1 Trip Generation Based on ITE Manual**

Land Use	Units	Parameter	AM Peak Hour			PM Peak Hour		
			In	Out	2-Way	In	Out	2-Way
(LUC 210) Single Family Detached Houses	4	Gross Trips	2	6	8	3	2	5
		Gross Rate	0.50	1.50	2.00	0.75	0.50	1.25
		New Trips	2	5	7	2	2	4
		New Rate	0.50	0.03	0.04	0.50	0.50	1.00
(LUC 221) Multifamily Housing Low Rise	12	Gross Trips	1	5	6	6	3	9
		Gross Rate	0.11	0.35	0.46	0.47	0.28	0.75
		New Trips	1	4	5	5	3	8
		New Rate	0.08	0.33	0.42	0.42	0.25	0.67
Total New Trips			3	9	12	7	5	12

Based on the site statistics, the proposed development at full build-out is expected to generate 12 new vehicular 2-way trips during the morning peak hour (three trips in / nine trips out), and 12 new vehicular 2-way trips during the afternoon peak hour (seven trips in / five trips out).

### 6.2 Site Distribution and Assignment

The trip distribution for the proposed development is based on traffic patterns extracted from the 2011 Transportation Tomorrow Survey (TTS). The detailed trip distribution calculations based on the TTS data are summarized in **Table 6-2**, with the raw data presented in **Appendix F**.

**Table 6-2 2011 TTS Trip Distribution**

To/From	AM Peak hour	PM Peak Hour
North	40%	30%
South	20%	20%
West	10%	15%
East	30%	35%
Total	100%	100%

While assigning the site generated traffic, the eastbound left-turning movement during the PM peak hour from the site access was restricted as suggested by the Region. The Site generated traffic summarized in **Table 6-1** was assigned onto the existing road network using the distribution presented in **Table 6-2**. The assigned site generated traffic is presented in **Figure 6.1**.



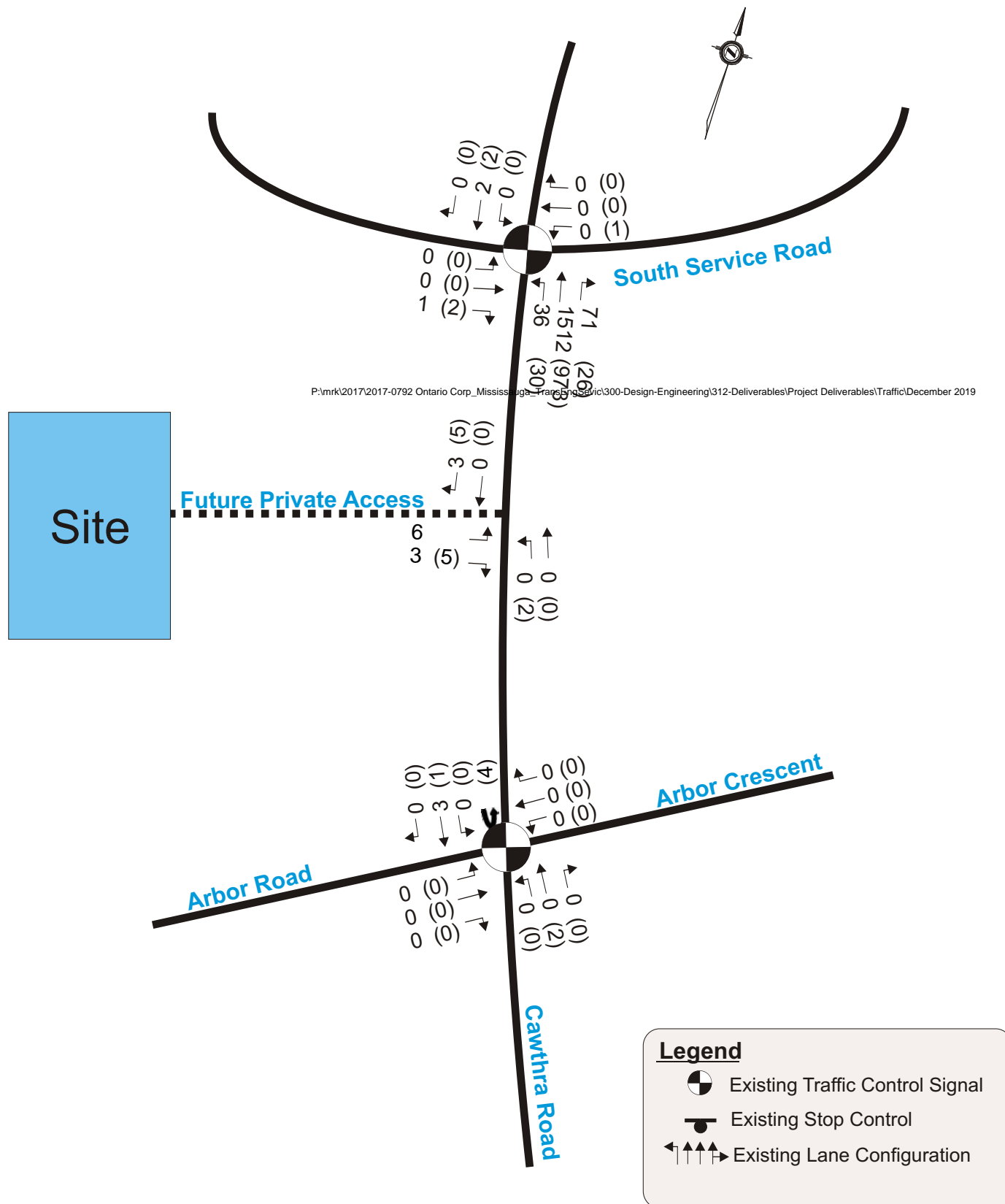


Figure 6-1  
Site Generated Traffic Volumes

### 6.3 Future Total Traffic Volumes

The Future total traffic volumes consist of the following components:

- Future background traffic volumes from corresponding horizon year; and,
- The proposed development site generated traffic volumes.

The resulting future total traffic in the horizon year 2024 is presented in **Figure 6.2**.

### 6.4 Intersection Capacity Analysis

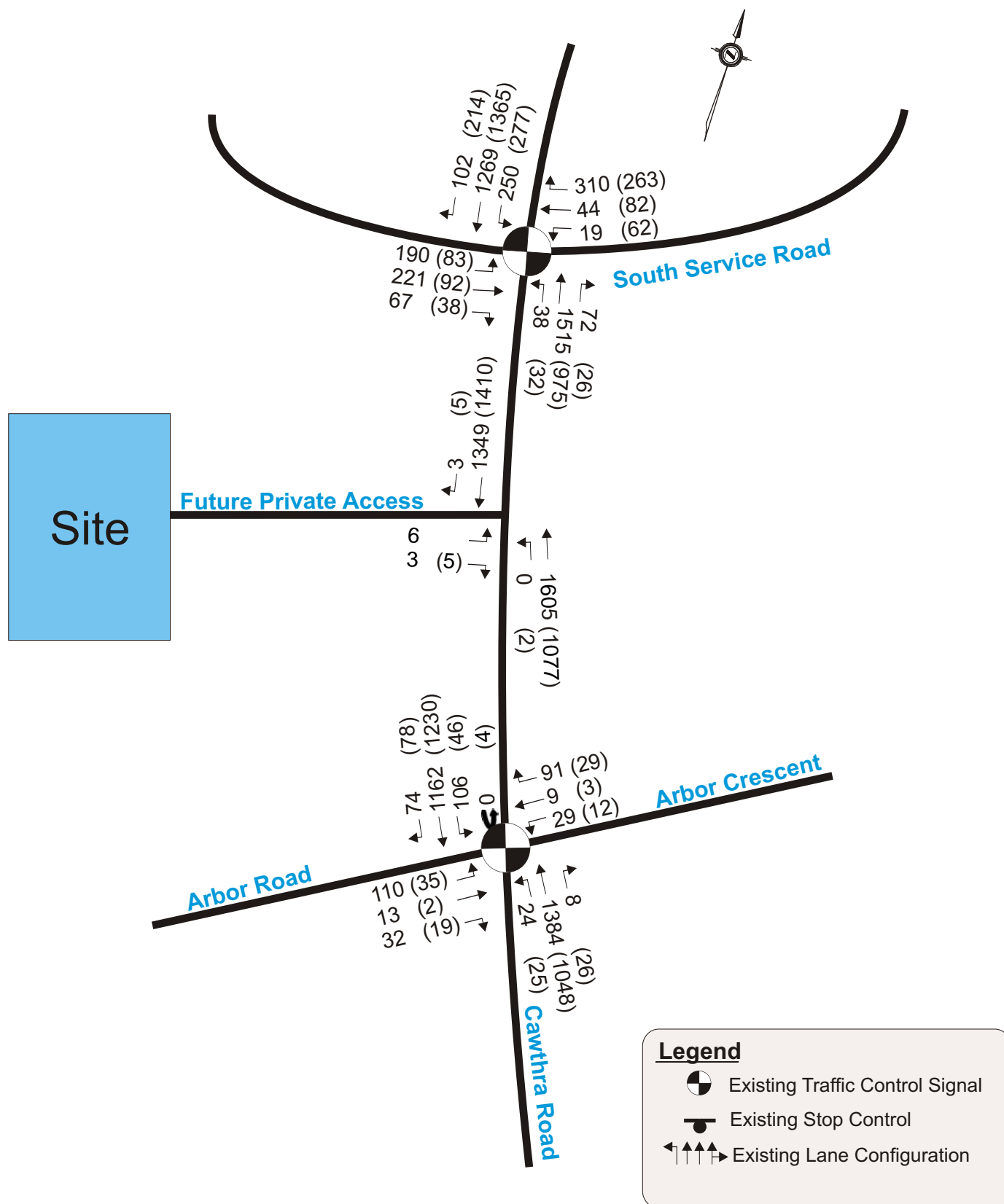
The future total traffic volumes were analyzed using *Synchro 9.0* software. Results from the intersection capacity analysis are summarized in **Table 6-3**. Critical movements, if any, are bolded. Detailed intersection capacity and queuing analysis reports under the existing conditions are provided in **Appendix G**.

**Table 6-3 Future Total Traffic - Intersection Operations**

Intersection	Key Movement	LOS (v/c)	
		AM Peak	PM Peak
Cawthra Road and South Service Road	Overall	D (0.82)	C (0.62)
	EB Left	E (0.79)	E (0.59)
	EB Through	D (0.64)	D (0.46)
	EB right	D (0.06)	D (0.02)
	WB Left	D (0.13)	D (0.45)
	WB Through	D (0.13)	D (0.40)
	WB right	D (0.25)	D (0.16)
	NB Left	C (0.21)	C (0.25)
	NB Through + Right	D (0.89)	C (0.66)
	SB left	D (0.68)	B (0.39)
	SB through + right	A (0.56)	A (0.57)
Cawthra Road and Arbor Road/Arbor Crescent	Overall	B (0.65)	A (0.45)
	EB left + through + right	D (0.69)	D (0.38)
	WB Left	D (0.16)	D (0.17)
	WB through + right	D (0.09)	D (0.05)
	NB Left	A (0.11)	A (0.09)
	NB Through + Right	B (0.65)	A (0.38)
	SB left	A (0.39)	A (0.14)
Cawthra Road and Future Site Access	SB through + right	A (0.50)	A (0.46)
	EB left <sup>1</sup> + right	B (0.02)	C (0.02)
	NB left	A (0.00)	B (0.00)
	NB through	A (0.47)	A (0.40)
	SB through + right	A (0.27)	A (0.28)

Based on the analysis conducted for the future total traffic conditions during the weekday AM and PM peak hours, all intersections including the site access intersection are performing with good levels of service and well below capacity. No additional mitigation measures are recommended.

<sup>1</sup> No EB left-turning movement during the PM peak hour



**Figure 6-2**  
**Future (2024) Total Traffic Volumes**

## 7 Parking and On-Site Circulation Review

### 7.1 Parking Analysis

The parking requirement for 'Detached Dwelling' and 'Dwelling, Townhouse or Stacked Townhouse on Public Road' land use category, as outlined in the City's Zoning By-Law 0225-2007 was used to determine the required number of parking spaces. **Table 7-1** on the following page summarizes the automobile parking requirement as per the Zoning By-law.

**Table 7-1 Parking Requirement Using the City's By-Law # 2225-2007**

Land Use	Units	Required Parking		Provided Parking
		Parking Rate	Parking Requirement	
Detached Dwelling	4	2.0 parking space / dwelling	8	8
Condominium Townhouse Dwelling	12	2 parking spaces per dwelling unit for residents	24	24
		0.25 visitor spaces per dwelling unit	3	4
<b>Total</b>	<b>193</b>		<b>35</b>	<b>36</b>

Each dwelling unit is to have two parking spaces per unit as well as four visitor parking spaces. Therefore, the parking requirement for the proposed single detached dwellings and the townhouses meet the City's By-Law requirement. The parking assessment shows that the parking provided will meet the Town's Zoning By-Law parking requirement.

### 7.2 On-Site Circulation Review

An *AutoTURN* analysis was undertaken to confirm the turning radii that garbage trucks and fire trucks can maneuver throughout the site. **Figure 7.1** and **Figure 7.2** illustrate the maneuvers of a 12.19 m fire truck and a 12.00 m garbage truck, respectively through the site.

### 7.3 Sightline Review

Sightlines and available sight distances were reviewed based on the Geometric Design Guide for Canadian Roads, published by the *Transportation Association of Canada (TAC)*, and dated *June 2017*. *Chapter 9, Section 9.9* was reviewed to identify the appropriate cases applicable to the proposed site. Case 'B', which refers to intersections with stop control on the minor road was reviewed. *Table 9.9.4* which covers stopping and turning distances for left turns, and *Table 9.9.6* which covers stopping and turning distances for right turns, were reviewed. The summary of intersection sight distance is illustrated in **Table 7-2**.

Available sight distances provide the minimum distances required for a driver, at a stop, to navigate an intersection safely. The sight distances requiring consideration for this case are for crossing and turning movements. Distances for turning movements are the minimum sight distance for a driver, at the stop, to turn in a direction without being overtaken by an approaching vehicle heading in that same direction. The posted speed limit is 50 km/h on Cawthra Road, in the vicinity of the subject site.

**Table 7-2 Intersection Sight Distance**

Design Speed (80 km/h)	Stopping Sight Distance	Intersection Sight Distance for Passenger Vehicles (m)
Right Turn from Stop	105m	130m
Left Turn from Stop		150m
Crossing Maneuver		130m

Based on a design speed of 70km/h along Cawthra Road, the minimum sight distance for crossing and turning movements are 130m and 150m, respectively.

Additionally, when vehicles approaching the intersection while opposing drivers are at the stop, also need to stop, the minimum safe stopping distance is required. Based on the TAC guidelines, Chapter 9, Section 9.10 was reviewed to identify the minimum stopping sight distance to the proposed site. The sight distance was reviewed and are summarized in **Table 7-3**.

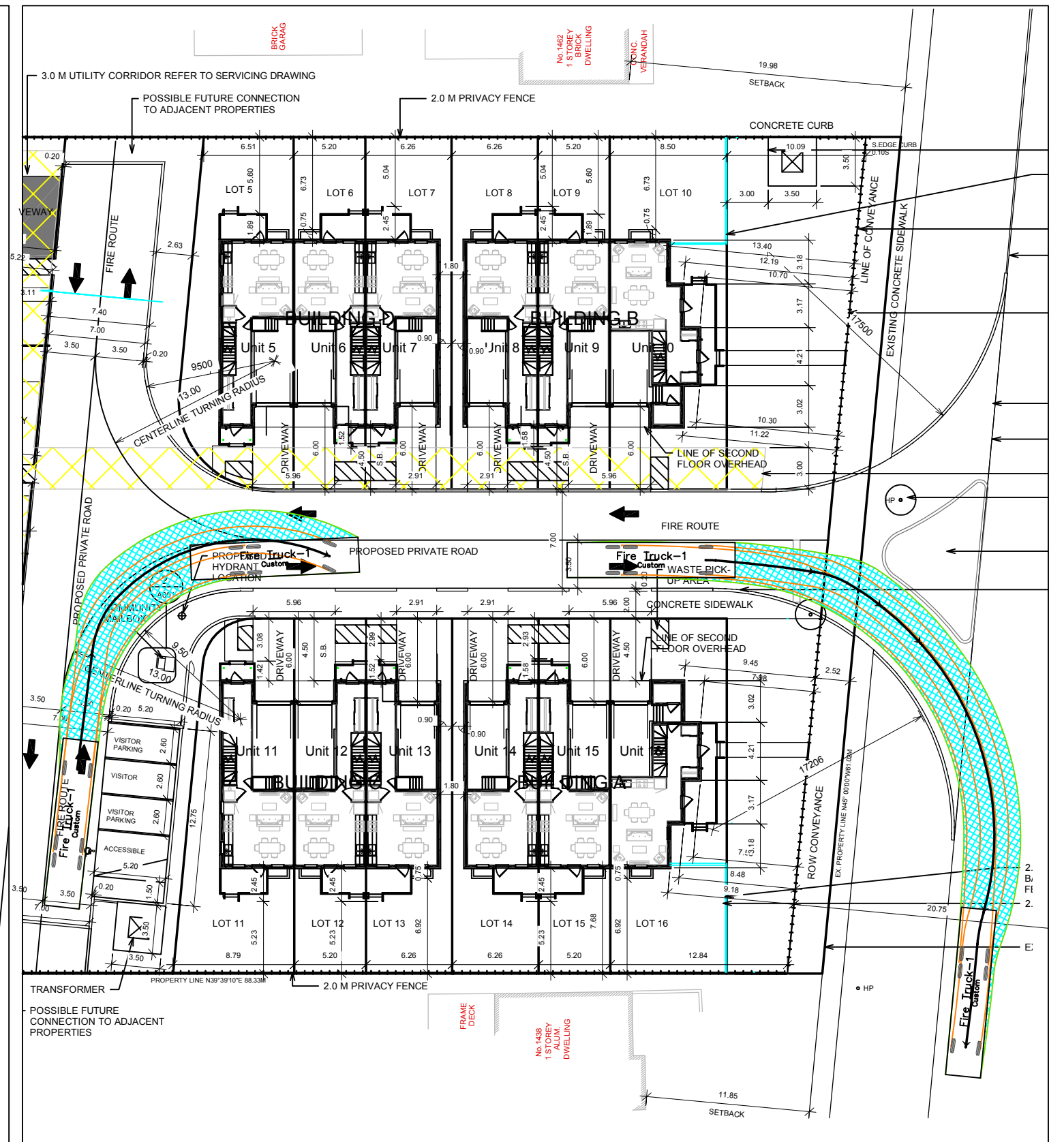
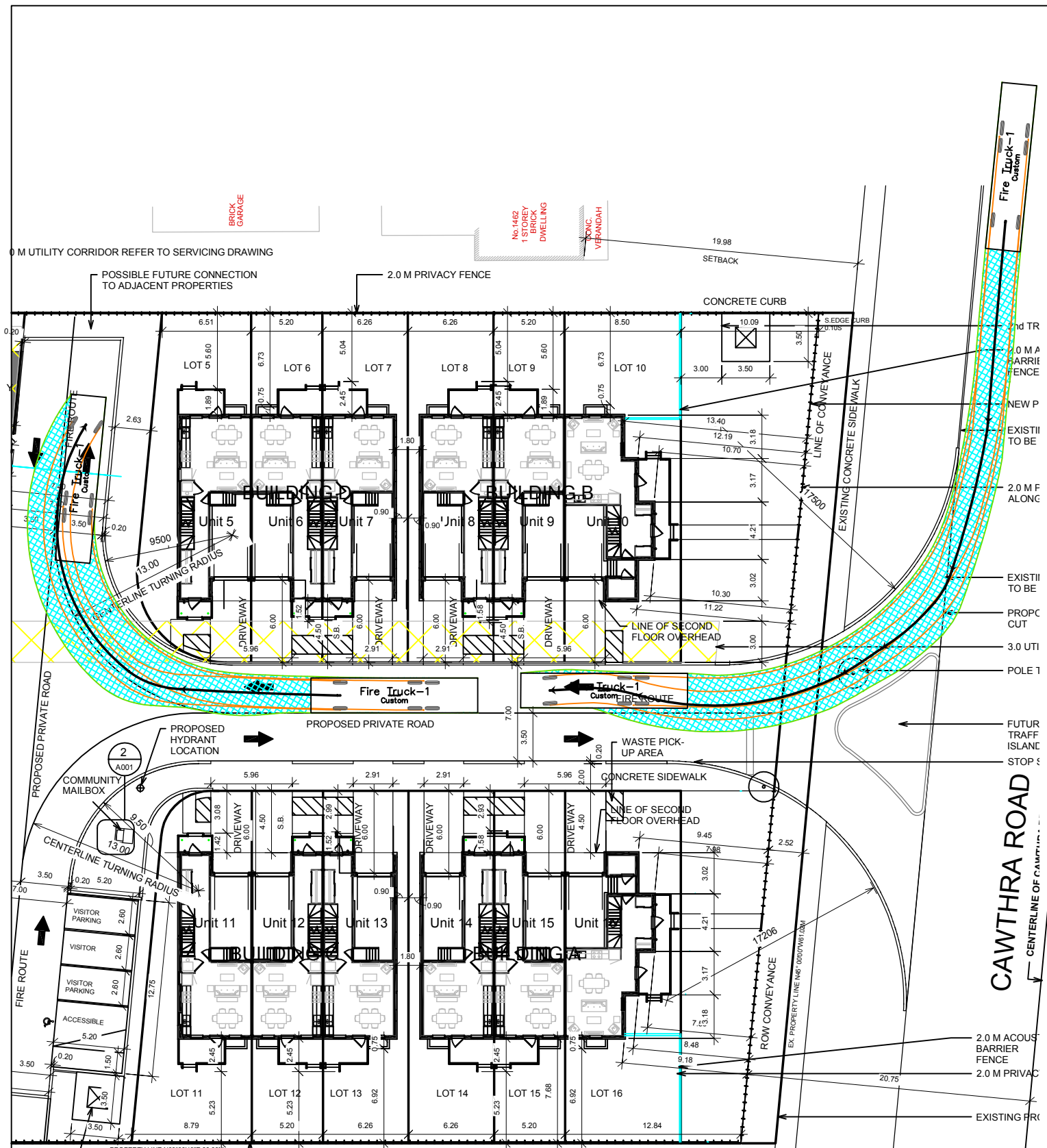
**Table 7-3 Decision Sight Distance**

Posted Speed	50km/h
Design Speed	70km/h
Decision Sight Distance	200m
Available Sight Distance	>200m

Based on a design speed of 70km/h, the decision sight distance is 200 m. The sightlines provided at the future site access with Cawthra Road are depicted in **Figure 7.3**. This figure shows that the available sight distance achieved exceeds 200 m, which therefore satisfies the minimum stopping sight distance of 105 m, intersection sight distance of 130 m and decision sight distance of 200 m.

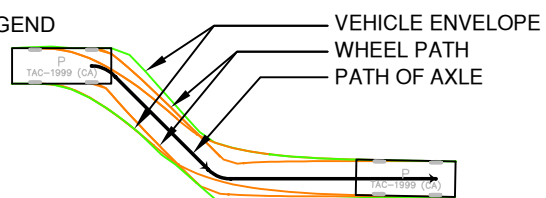






COLE

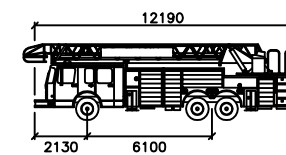
#### LEGEND



#### DESIGN VEHICLE

Fire Truck-1

Width	: 2540
Track	: 2130
Lock to Lock Time	: 6.0
Steering Angle	: 31.4



#### AUTOTURN ANALYSIS FOR FIRE TRUCK PROPOSED RESIDENTIAL DEVELOPMENT CITY OF MISSISSAUGA REGION OF PEEL

DATE:	DECEMBER 2019	PROJECT No.:	2017-0792
SCALE:	N.T.S	FIGURE No.:	7-2





COLE

LEGEND

— SIGHT LINE

— AVAILABLE SIGHT DISTANCE

SIGHT LINE ANALYSIS  
PROPOSED RESIDENTIAL DEVELOPMENT  
1444-1458 CAWTHRA ROAD  
CITY OF MISSISSAUGA  
REGION OF PEEL

DATE: DECEMBER 2019

SCALE: N.T.S.

PROJECT No.: 2017-0792

FIGURE No.: 7-3



## **8 Transportation Demand Management (TDM)**

Transportation Demand Management (TDM) refers to a variety of strategies to reduce traffic congestion, minimize the number of single-occupant vehicles, encourage non-auto modes of travel, and reduce vehicle dependency to create a sustainable transportation system. In summary, TDM works to change how, when, where and why people travel.

TDM strategies have multiple benefits including the following:

- Reduced auto-related emissions to improve air quality;
- Decreased traffic congestion to reduce travel time;
- Increased travel options for residents and commuters;
- Reduced personal transportation costs and energy consumption; and,
- Support Provincial Smart Growth Objectives.

The above-combined benefits will assist in creating a more active and liveable community.

### **8.1 TDM Strategies Identification**

#### **8.1.1 Walking / Cycling**

The Municipality is a pedestrian and cycling supportive community that embraces the “complete streets” concept by encouraging both commuter and recreational travel by walking, cycling and using public transit through a safe and desirable Municipality-wide network of on-road and off-road pedestrian and cycling facilities.

Currently, there are sidewalks available on all roads in the vicinity of the site. Near the site, there are two small trails through Cawthra Park and Dellwood Park. Additionally, Lakefront Promenade has a dedicated multi-purpose trail in both directions with many nearby waterfront trails.

### **8.2 TDM Strategies Implementation**

TDM programs nationally have experienced a wide range of implementation success. This TDM plan will be a site focused to achieve the desired outcome at the reduced dependency on single-occupant vehicles (SOV) from a holistic perspective.

#### **8.2.1 Transit Incentive**

An increase in transit use is fundamental to the overall reduction of automobile use. In general, people associate utilities with each mode of transportation (such as safety, reliability, comfort, accessibility, speed, cost and travel time), their mode choice is based on the relative costs associated with one versus another mode. The two characteristics that will most likely influence mode choice are monetary cost and travel time.

Transit productivity is a measure of return on investment in the transit system. It measures how many travelers use the transit service provided in a region. Local buses with few passengers, suggests that transit systems are not providing transportation benefits consistent with their capital and operating costs. Having more passengers on each bus generates more revenue for transit agencies and can result in better air quality and less congestion. Moreover, transit service levels (i.e. network coverage and frequency) have a strong positive correlation with transit demand (i.e. ridership).

As an incentive to encourage residents to use the MiWay transit service, the Region would provide and distribute (one time) prepaid and fee-waived complimentary PRESTO cards. This subsidized transit card will provide a financial incentive to encourage the use of public transit, especially for 'first-time' users to try local transit services as a primary mode of transportation, which is in keeping with a recent incentive (offering free preloaded PRESTO cards) initiated by the Region. Each PRESTO card is to be pre-loaded with \$50 - \$100. The total cost of the PRESTO cards is estimated to be (\$50 - \$100 PRESTO card x 16 units) \$800 - \$1,600 to be borne by the Region. Note that the amount and provision of PRESTO cards are subject to the Region's discretion.

### **8.2.2 Marketing**

It is recommended that an information package be made available by the Region to inform new/prospective residents with alternative traveling options. It is recommended that the Owner consults with the Region to provide the following materials to promote active transportation:

- Peel Region Transit Map;
- City of Mississauga Trails Map;
- Peel Region Cycling Map; and,
- Peel Region Bike-to-Work Practical Guide.

In addition to the above-noted materials, the information package will also include information on transit schedules (i.e. MiWay Transit, Go Transit) to assist residents in planning their trips (i.e. to/from work/school) utilizing the existing and growing transit network system. A location map will also be prepared to indicate the nearby facilities and points of interest (i.e. retail store, grocery store, school, community center, and library) within convenience and comfortable walking distance to further discourage vehicle dependency.

The total approximate cost for the Region to compile the above information into an information package will be approximately \$500 in total to be borne by the Region. The above information is subject to availability and to be provided at the Region's discretion.

### **8.3 TDM Monitoring**

Monitoring a TDM program can be accomplished by conducting a biennial commuter survey to determine the success of the TDM measures (individually or as a combination). It is recommended that the first survey be conducted at substantial occupancy (80%) and thereafter every two years.

A commuter survey typically gathers quantitative data (i.e. percentage use of the various modes of transportation) and qualitative data (i.e. respondents' perception of the alternative transportation programs). This survey will produce and collect essential information to understand the effectiveness of the proposed TDM strategies, which in turn will provide valuable indications (if any) in the determination of adjustments to the TDM initiatives to be required in order to achieve or exceed the targeted outcomes. Moreover, the collected data can also be used to focus on the marketing initiatives and efforts of the Region.

The questionnaire is recommended to contain no more than five questions, as the length of the survey has a negative correlation with both respondent rate as well as accuracy. Keeping the survey short and simple to understand is the first principle in achieving substantial survey data. In general, the survey should gather the following information:

- **Trip Rate** – to obtain information on how many people travel during the morning and afternoon peak hours (sample question 1);
- **Modal Split** – what is the primary transportation modes when traveling during peak hours (sample question 2);
- **Trip Purpose** – this is to test whether the majority of trips are the journey-to-work trip or other trips, as the TDM strategies should be altered accordingly between work trips and non-work trips (sample question 3);
- **Traveler's preference** – to understand aside from driving alone, which TDM measures have the greatest potential to further reduce vehicle dependency (sample question 4); and,
- **Comments** – to give respondents an opportunity to express any comments that can assist in improving the proposed/implemented TDM strategies (sample question 5).

The statistical reliability of a survey depends in part upon the response rate, which is the number of correctly completed surveys compared to the total number of distributed surveys. Therefore, it is important to maximize the survey response rate. Some of the methods that can be used to maximize the response rate are listed as follows:

- Place a notice on a bulletin board and other high pedestrian locations, and attach a cover memorandum to the questionnaire describing the purpose of the survey and requesting cooperation;
- Inform recipients of the duration it takes to respond to the questionnaire, and note that their responses are strictly confidential;
- Offer prizes to respondents, and it is preferably based on a drawing to ensure unbiased;
- Offer a contact person and phone number to respond to any questions that survey recipients may have;
- Facilitate access to the survey questionnaire by posting it on a web-page. As an alternative, deliver the questionnaire and pick-up responses of the different tenants;
- Providing the survey in different languages to assist in non-English speaking residents to understand the survey; and,
- Send one or more reminders (e-mail and flyers) requesting to complete the survey by the due date.

As noted previously, allowing the completion of the survey on-line can help reduce the time and effort spent on circulating and administrating the survey.

It is recommended to conduct a baseline survey to residents before starting the TDM program. This can assist in evaluating the program's effectiveness (before and after comparative analysis). In addition, comparing the results of the biennial survey to previous years can result in evaluating the program's progress and potential modifications. It is possible to add survey questions to assess the new

improvements. Furthermore, MiWay can be consulted for ridership statistics. The estimated cost to conduct the survey is \$500.

#### **8.4 TDM Communications Strategy**

To facilitate the implementation of TDM strategies, it is important that information and incentives be passed from the Region to the public effectively.

The owner is to contact the Region, which will, in turn, provide information packages with site-specific information on nearby pedestrian, bicycle and transit facilities. These information packages are to be provided by the Region and would be distributed by the Owner at the time of house closing.

The Owner is to prepare a TDM event which is to take place when the units are at a minimum of 50% occupancy. This event would provide an opportunity for Region, Town and MiWay staff to attend and promote sustainable transportation through presentations and question/answer sessions, to encourage engagement and participation in creating and maintaining a sustainable community. Distribution of PRESTO cards would take place at this event by Region and MiWay Staff. Region and MiWay Staff are to be provided with details and notice of the TDM event at least two months prior to the date of the event. The estimated cost of the TDM event is \$1,000 to be borne by the Owner.

#### **8.5 Projected Program Cost**

The estimated cost to implement the TDM program components are outlined in **Table 8-1**.

**Table 8-1 Estimated TDM Program Cost**

<b>TDM Measure</b>	<b>Unit Price</b>	<b>Quantity / Number of Units</b>	<b>Product Cost</b>
PRESTO Cards	\$50 - \$100	16	\$800 - \$1,600
TDM Information Package	\$500	1	\$500
Travel Survey	\$500	1	\$500
TDM Event	\$1,000	1	\$1,000
<b>Total Cost</b>			<b>\$2,800 - \$3,600</b>

The estimated cost to administer the TDM plan would be \$2,800 - \$3,600.

## 9 Conclusions and Recommendations

### 9.1 Conclusions

Based on the analysis, our conclusions are as follows:

#### Development Proposal

- The proposed site will consist of:
  - Four single detached homes; and,
  - 12 townhomes.
- The vehicular access to the subject site is proposed through a private road and will be connected to Cawthra Road. As suggested by the Region, the site access has been modified to full movement access with restrictions on left-out movements during the PM peak hours in interim, and Right-In/ Right-Out (RIRO) on the title.

#### Existing Conditions

- Turning movement counts were collected during weekday AM and PM peak hours;
- Existing signal timings for the signalized intersections in the study area was applied; and,
- All intersections operate under capacity after minimal signal optimizations in both peak hours.

#### Background Conditions

- Growth rates, as advised by the regional and city staff were applied to all through movements along boundary roads in the study area that are not directly entering or exiting the site;
- Background developments included the site traffic generated by three developments in the vicinity of the site;
- Optimized signal timings for the signalized intersections in the study area was applied; and,
- All intersections operate similar to the existing conditions in both peak hours.

#### Site Access Configuration

- In option 1, the Region recommended for full movement access with restrictions on left-out movements during the PM peak hours in the **interim**, and Right-In/Right-Out (RIRO) on the **title**.
- While applying the Region's RIRO standard drawing #5-1-4A, the curb radius was increased from 15m to 17.5m to match the base width of the prock-chop.
- AutoTURN swept path analysis with fire and garbage trucks show no conflicts while ingress and egress the RIRO access.
- A functional drawing showing the access configuration in the **interim** condition was prepared.

#### Traffic Trip Generation

- The proposed development is expected to generate 12 new vehicular 2-way trips during the morning peak hour (three trips in / nine trips out), and 12 new vehicular 2-way trips during the afternoon peak hour (seven trips in / five trips out).

- While assigning the site generated traffic, the eastbound left-turning movement during the PM peak hour from the site access was restricted as suggested by the Region.

#### **Future Conditions**

- The intersection capacity analysis under the future (2024) total traffic conditions indicate that all the intersections will operate similar to the future background conditions during both peak hours

#### **Parking Analysis**

- Each dwelling unit is to have two parking spaces per unit as well as four visitor parking spaces. Therefore, the parking requirement for the proposed single detached dwellings and the townhouses meet the City's By-Law requirement.

#### **On-Site-Circulation**

- Based on the *AutoTURN* Analysis, fire trucks and garbage trucks are able to maneuver through the site with no constraints.

#### **Sightline Analysis**

- The available sightlines for the proposed site access at Cawthra Road exceed the sight distance requirements as stipulated in the TAC Geometric Design for Canadian Roads June 2017 Chapter 9 – Intersections.

#### **Transportation Demand Management**

- A number of Transportation Demand Management opportunities and strategies are to be introduced to discourage single-occupant vehicle usage within the study area.

## **9.2 Recommendations**

Based on the traffic analysis completed for the subject site, the recommended mitigation measures are as follows:

- At the intersection of Cawthra Road and South Service Road, in the A.M. peak hour it is recommended to optimize the total split timings and to increase the time allotted to the northbound and southbound movements; and,
- At the intersection of Cawthra Road and South Service Road, in the P.M. peak hour, it is recommended to optimize the total split timings and to increase the time allotted to the eastbound and westbound movements.
- As suggested by the Region, the site access has been modified to full movement access with restrictions on left-out movements during the PM peak hours in interim, and Right-In/ Right-Out (RIRO) on the title.



**APPENDIX A-1**  
**Existing Turning Movement Counts**



Turning Movement Count (1 . CAWTHRA RD & ARBOR RD)

Start Time	Southbound CAWTHRA RD						Westbound ARBOR RD						Northbound CAWTHRA RD						Eastbound ARBOR RD						Int. Total (15 min)	Int. Total (1 hr)	
	Left N:E	Thru N:S	Right N:W	U-Turn N:N	Peds N:	Approach Total	Left E:S	Thru E:W	Right E:N	U-Turn E:E	Peds E:	Approach Total	Left S:W	Thru S:N	Right S:E	U-Turn S:S	Peds S:	Approach Total	Left W:N	Thru W:E	Right W:S	U-Turn W:W	Peds W:	Approach Total			
07:00:00	0	136	10	0	0	146	0	0	3	0	0	3	2	249	0	0	0	251	12	0	8	0	0	20	420		
07:15:00	4	139	7	1	0	151	0	1	0	0	0	1	2	289	1	0	1	292	13	0	5	0	0	18	462		
07:30:00	2	164	12	0	0	178	3	0	0	0	2	3	3	294	3	0	0	300	27	0	6	0	0	33	514		
07:45:00	11	256	19	0	0	286	4	0	5	0	2	9	4	297	2	0	5	303	22	0	6	0	2	28	626	2022	
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***BREAK***																											
16:00:00	4	263	18	0	0	285	11	0	13	0	1	24	4	260	2	0	0	266	19	0	5	0	5	24	599		
16:15:00	8	285	17	0	2	310	6	1	7	0	6	14	5	221	3	0	2	229	15	0	7	0	2	22	575		
16:30:00	5	243	13	0	1	261	1	2	10	0	0	13	6	263	2	0	1	271	8	0	5	0	1	13	558		
16:45:00	8	271	21	0	0	300	1	1	4	0	2	6	3	213	6	0	4	222	5	0	4	0	0	9	537	2269	
17:00:00	16	257	24	0	0	297	5	0	7	0	2	12	10	251	10	0	4	271	11	1	5	0	0	17	597	2267	
17:15:00	17	288	20	0	0	325	5	0	8	0	0	13	6	210	8	0	0	224	11	1	5	0	0	17	579	2271	
17:30:00	20	291	23	2	0	336	0	0	5	0	0	5	5	179	7	0	1	191	15	0	10	0	3	25	557	2270	
17:45:00	16	238	11	0	0	265	4	1	1	0	0	6	6	191	10	0	0	207	10	1	5	0	1	16	494	2227	
Grand Total	215	3807	269	3	5	4294	67	15	152	0	22	234	81	4045	67	0	34	4193	282	22	106	0	18	410	9131	-	
Approach%	5%	88.7%	6.3%	0.1%		-	28.6%	6.4%	65%	0%		-	1.9%	96.5%	1.6%	0%		-	68.8%	5.4%	25.9%	0%		-	-	-	
Totals %	2.4%	41.7%	2.9%	0%		47%	0.7%	0.2%	1.7%	0%		2.6%	0.9%	44.3%	0.7%	0%		45.9%	3.1%	0.2%	1.2%	0%		4.5%	-	-	
Heavy	7	104	4	0		-	8	1	9	0		-	6	102	9	0		-	4	0	2	0		-	-	-	
Heavy %	3.3%	2.7%	1.5%	0%		-	11.9%	6.7%	5.9%	0%		-	7.4%	2.5%	13.4%	0%		-	1.4%	0%	1.9%	0%		-	-	-	
Bicycles	-	-	-	-		-	-	-	-	-		-	-	-	-	-		-	-	-	-	-		-	-	-	
Bicycle %	-	-	-	-		-	-	-	-	-		-	-	-	-	-		-	-	-	-	-		-	-	-	



**Peak Hour: 07:45 AM - 08:45 AM Weather: Clear (0 °C)**

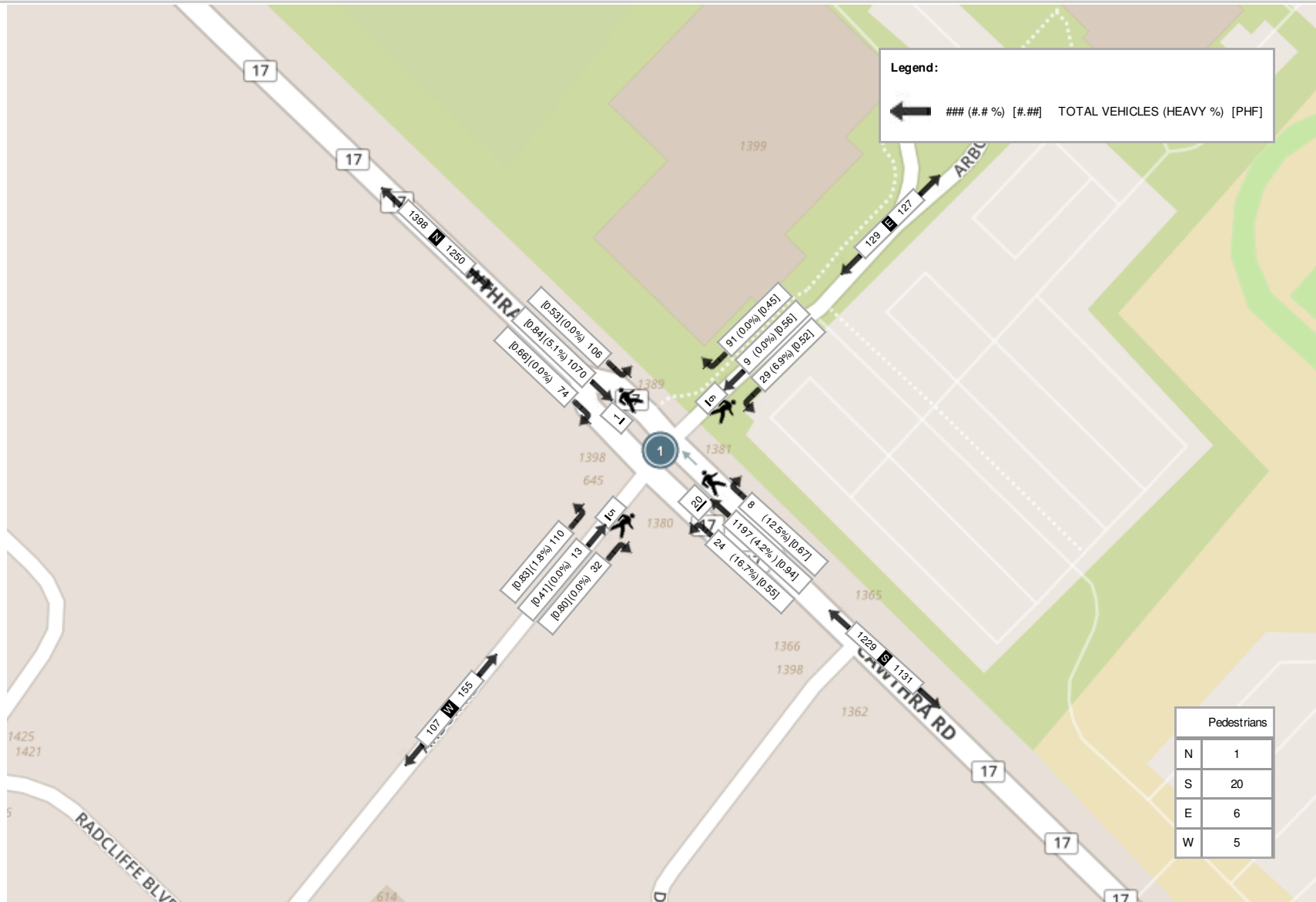
Start Time	Southbound CAWTHRA RD						Westbound ARBOR RD						Northbound CAWTHRA RD						Eastbound ARBOR RD						Int. Total (15 min)
	Left	Thru	Right	U-Turn	Peds	Approach Total	Left	Thru	Right	U-Turn	Peds	Approach Total	Left	Thru	Right	U-Turn	Peds	Approach Total	Left	Thru	Right	U-Turn	Peds	Approach Total	
07:45:00	11	256	19	0	0	286	4	0	5	0	2	9	4	297	2	0	5	303	22	0	6	0	2	28	626
08:00:00	33	285	15	0	0	333	3	4	21	0	1	28	2	315	1	0	0	318	26	3	8	0	0	37	716
08:15:00	50	319	28	0	1	397	14	4	51	0	3	69	11	317	3	0	12	331	33	8	8	0	1	49	846
08:30:00	12	210	12	0	0	234	8	1	14	0	0	23	7	268	2	0	3	277	29	2	10	0	2	41	575
<b>Grand Total</b>	106	1070	74	0	1	1250	29	9	91	0	6	129	24	1197	8	0	20	1229	110	13	32	0	5	155	<b>2763</b>
<b>Approach%</b>	8.5%	85.6%	5.9%	0%		-	22.5%	7%	70.5%	0%		-	2%	97.4%	0.7%	0%		-	71%	8.4%	20.6%	0%		-	-
<b>Totals %</b>	3.8%	38.7%	2.7%	0%		45.2%	1%	0.3%	3.3%	0%		4.7%	0.9%	43.3%	0.3%	0%		44.5%	4%	0.5%	1.2%	0%		5.6%	-
<b>PHF</b>	0.53	0.84	0.66	0		0.79	0.52	0.56	0.45	0		0.47	0.55	0.94	0.67	0		0.93	0.83	0.41	0.8	0		0.79	-
<b>Heavy</b>	0	55	0	0		55	2	0	0	0		2	4	50	1	0		55	2	0	0	0		2	-
<b>Heavy %</b>	0%	5.1%	0%	0%		4.4%	6.9%	0%	0%	0%		1.6%	16.7%	4.2%	12.5%	0%		4.5%	1.8%	0%	0%	0%		1.3%	-
<b>Lights</b>	106	1015	74	0		1195	27	9	91	0		127	20	1147	7	0		1174	108	13	32	0		153	-
<b>Lights %</b>	100%	94.9%	100%	0%		95.6%	93.1%	100%	100%	0%		98.4%	83.3%	95.8%	87.5%	0%		95.5%	98.2%	100%	100%	0%		98.7%	-
<b>Mediums</b>	0	52	0	0		52	2	0	0	0		2	4	46	1	0		51	2	0	0	0		2	-
<b>Mediums %</b>	0%	4.9%	0%	0%		4.2%	6.9%	0%	0%	0%		1.6%	16.7%	3.8%	12.5%	0%		4.1%	1.8%	0%	0%	0%		1.3%	-
<b>Articulated Trucks</b>	0	3	0	0		3	0	0	0	0		0	0	4	0	0		4	0	0	0	0		0	-
<b>Articulated Trucks %</b>	0%	0.3%	0%	0%		0.2%	0%	0%	0%	0%		0%	0%	0.3%	0%	0%		0.3%	0%	0%	0%	0%		0%	-
<b>Pedestrians</b>	-	-	-	-	1	-	-	-	-	-	6	-	-	-	-	-	20	-	-	-	-	-	5	-	-
<b>Pedestrians%</b>	-	-	-	-	3.1%	-	-	-	-	-	18.8%	-	-	-	-	-	62.5%	-	-	-	-	-	15.6%	-	-



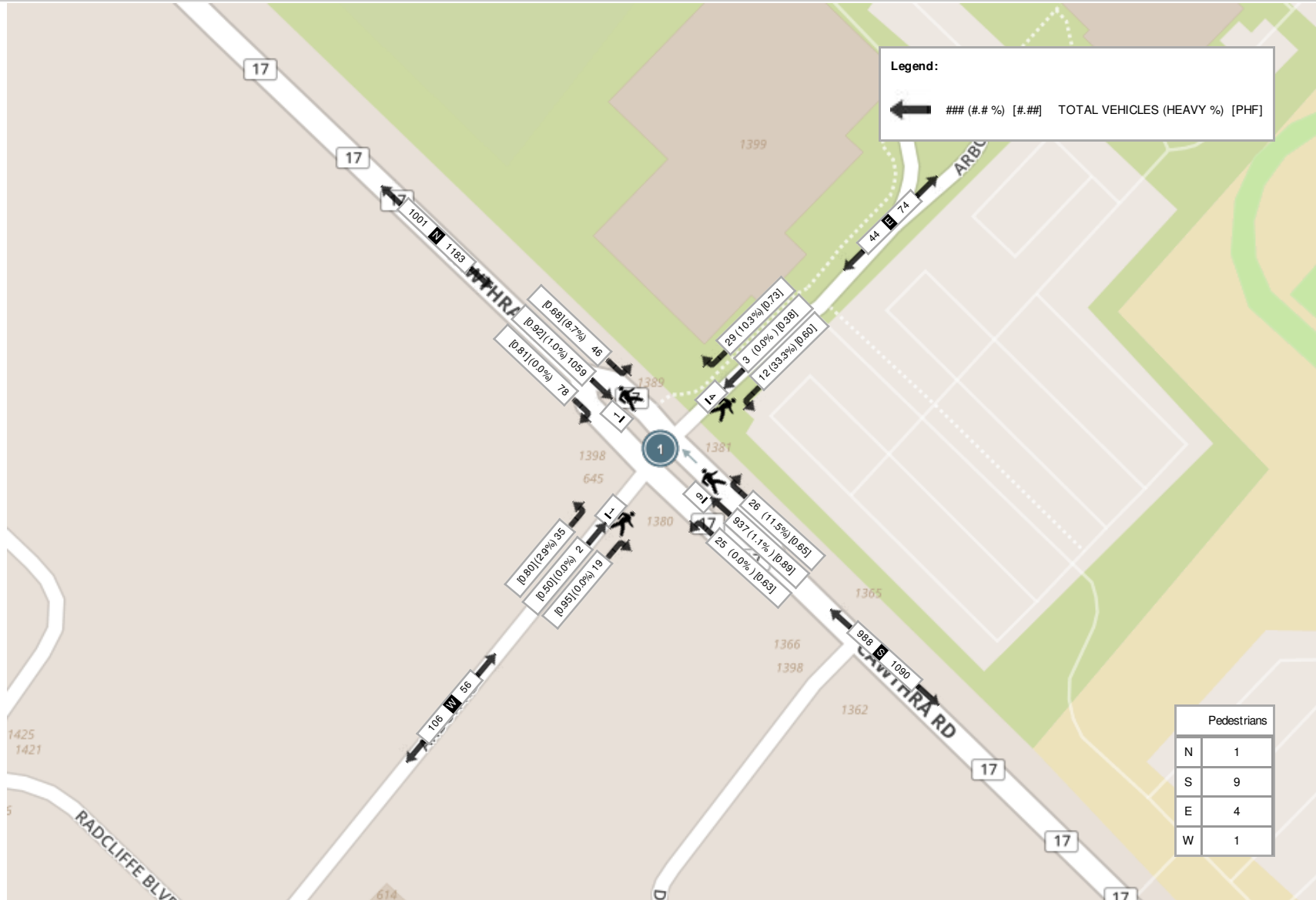
Peak Hour: 04:30 PM - 05:30 PM Weather: Partly Cloudy (13.7 °C)

Start Time	Southbound CAWTHRA RD						Westbound ARBOR RD						Northbound CAWTHRA RD						Eastbound ARBOR RD						Int. Total (15 min)
	Left	Thru	Right	U-Turn	Peds	Approach Total	Left	Thru	Right	U-Turn	Peds	Approach Total	Left	Thru	Right	U-Turn	Peds	Approach Total	Left	Thru	Right	U-Turn	Peds	Approach Total	
16:30:00	5	243	13	0	1	261	1	2	10	0	0	13	6	263	2	0	1	271	8	0	5	0	1	13	558
16:45:00	8	271	21	0	0	300	1	1	4	0	2	6	3	213	6	0	4	222	5	0	4	0	0	9	537
17:00:00	16	257	24	0	0	297	5	0	7	0	2	12	10	251	10	0	4	271	11	1	5	0	0	17	597
17:15:00	17	288	20	0	0	325	5	0	8	0	0	13	6	210	8	0	0	224	11	1	5	0	0	17	579
Grand Total	46	1059	78	0	1	1183	12	3	29	0	4	44	25	937	26	0	9	988	35	2	19	0	1	56	2271
Approach%	3.9%	89.5%	6.6%	0%		-	27.3%	6.8%	65.9%	0%		-	2.5%	94.8%	2.6%	0%		-	62.5%	3.6%	33.9%	0%		-	-
Totals %	2%	46.6%	3.4%	0%		52.1%	0.5%	0.1%	1.3%	0%		1.9%	1.1%	41.3%	1.1%	0%		43.5%	1.5%	0.1%	0.8%	0%		2.5%	-
PHF	0.68	0.92	0.81	0		0.91	0.6	0.38	0.73	0		0.85	0.63	0.89	0.65	0		0.91	0.8	0.5	0.95	0		0.82	-
Heavy	4	11	0	0		15	4	0	3	0		7	0	10	3	0		13	1	0	0	0		1	-
Heavy %	8.7%	1%	0%	0%		1.3%	33.3%	0%	10.3%	0%		15.9%	0%	1.1%	11.5%	0%		1.3%	2.9%	0%	0%	0%		1.8%	-
Lights	42	1048	78	0		1168	8	3	26	0		37	25	927	23	0		975	34	2	19	0		55	-
Lights %	91.3%	99%	100%	0%		98.7%	66.7%	100%	89.7%	0%		84.1%	100%	98.9%	88.5%	0%		98.7%	97.1%	100%	100%	0%		98.2%	-
Mediums	4	10	0	0		14	4	0	3	0		7	0	9	3	0		12	1	0	0	0		1	-
Mediums %	8.7%	0.9%	0%	0%		1.2%	33.3%	0%	10.3%	0%		15.9%	0%	1%	11.5%	0%		1.2%	2.9%	0%	0%	0%		1.8%	-
Articulated Trucks	0	1	0	0		1	0	0	0	0		0	0	1	0	0		1	0	0	0	0		0	-
Articulated Trucks %	0%	0.1%	0%	0%		0.1%	0%	0%	0%	0%		0%	0%	0.1%	0%	0%		0.1%	0%	0%	0%	0%		0%	-
Pedestrians	-	-	-	-	1	-	-	-	-	-	4	-	-	-	-	-	9	-	-	-	-	-	1	-	-
Pedestrians%	-	-	-	-	6.7%	-	-	-	-	-	26.7%	-	-	-	-	-	60%	-	-	-	-	-	6.7%	-	-

**Peak Hour: 07:45 AM - 08:45 AM Weather: Clear (0 °C)**



Peak Hour: 04:30 PM - 05:30 PM Weather: Partly Cloudy (13.7 °C)





### Turning Movement Count (2 . CAWTHRA RD & SOUTH SERVICE RD)

Start Time	Southbound CAWTHRA RD						Westbound SOUTH SERVICE RD						Northbound CAWTHRA RD						Eastbound SOUTH SERVICE RD						Int. Total (15 min)	Int. Total (1 hr)	
	Left N:E	Thru N:S	Right N:W	U-Turn N:N	Peds N:	Approach Total	Left E:S	Thru E:W	Right E:N	U-Turn E:E	Peds E:	Approach Total	Left S:W	Thru S:N	Right S:E	U-Turn S:S	Peds S:	Approach Total	Left W:N	Thru W:E	Right W:S	U-Turn W:W	Peds W:	Approach Total			
07:00:00	52	135	10	1	0	198	2	6	48	0	0	56	4	259	23	0	0	286	37	46	7	0	0	90	630		
07:15:00	80	143	6	0	0	229	2	5	48	0	0	55	1	278	23	0	1	302	44	69	8	0	1	121	707		
07:30:00	72	161	10	0	0	243	2	4	73	0	1	79	3	279	22	0	0	304	54	73	14	0	0	141	767		
07:45:00	94	267	22	0	0	383	3	14	87	0	1	104	10	283	23	0	0	316	47	91	18	0	2	156	959	3063	
08:00:00	72	316	29	1	1	418	5	15	91	0	0	111	11	317	17	0	2	345	49	56	19	0	2	124	998	3431	
08:15:00	42	361	29	0	0	432	4	9	57	0	1	70	10	403	21	0	0	434	54	30	20	0	1	104	1040	3764	
08:30:00	42	228	22	0	0	292	7	5	75	0	0	87	5	314	10	0	0	329	40	29	9	0	0	78	786	3783	
08:45:00	38	179	16	0	0	233	9	10	39	0	2	58	3	236	10	0	0	249	36	19	4	0	0	59	599	3423	
***BREAK***																											
16:00:00	54	258	34	0	0	346	14	19	62	0	0	95	10	285	1	0	0	296	35	22	9	0	0	66	803		
16:15:00	51	298	34	0	0	383	6	7	43	0	1	56	9	237	8	0	0	254	25	16	9	0	3	50	743		
16:30:00	64	241	43	0	0	348	12	18	51	0	3	81	8	252	11	1	1	272	23	28	6	0	3	57	758		
16:45:00	68	283	50	0	0	401	14	19	62	0	0	95	7	201	9	0	0	217	21	25	6	0	0	52	765	3069	
17:00:00	56	293	54	0	0	403	22	16	62	0	0	100	8	270	4	0	1	282	19	16	8	0	0	43	828	3094	
17:15:00	67	294	48	0	0	409	12	22	70	0	0	104	8	188	5	0	2	201	24	19	10	0	1	53	767	3118	
17:30:00	86	315	62	0	0	463	13	19	69	0	0	101	7	209	8	0	0	224	19	26	12	0	0	57	845	3205	
17:45:00	71	242	35	0	0	348	15	19	48	0	0	82	8	177	6	0	0	191	18	24	13	0	0	55	676	3116	
Grand Total	1009	4014	504	2	1	5529	142	207	985	0	9	1334	112	4188	201	1	7	4502	545	589	172	0	13	1306	12671	-	
Approach%	18.2%	72.6%	9.1%	0%		-	10.6%	15.5%	73.8%	0%		-	2.5%	93%	4.5%	0%		-	41.7%	45.1%	13.2%	0%		-	-	-	
Totals %	8%	31.7%	4%	0%		43.6%	1.1%	1.6%	7.8%	0%		10.5%	0.9%	33.1%	1.6%	0%		35.5%	4.3%	4.6%	1.4%	0%		10.3%	-	-	
Heavy	22	108	10	0		-	0	3	20	0		-	2	109	6	0		-	7	11	5	0		-	-	-	
Heavy %	2.2%	2.7%	2%	0%		-	0%	1.4%	2%	0%		-	1.8%	2.6%	3%	0%		-	1.3%	1.9%	2.9%	0%		-	-	-	
Bicycles	-	-	-	-		-	-	-	-	-		-	-	-	-	-		-	-	-	-	-		-	-	-	
Bicycle %	-	-	-	-		-	-	-	-	-		-	-	-	-	-		-	-	-	-	-		-	-	-	





**Peak Hour: 07:45 AM - 08:45 AM Weather: Clear (0 °C)**

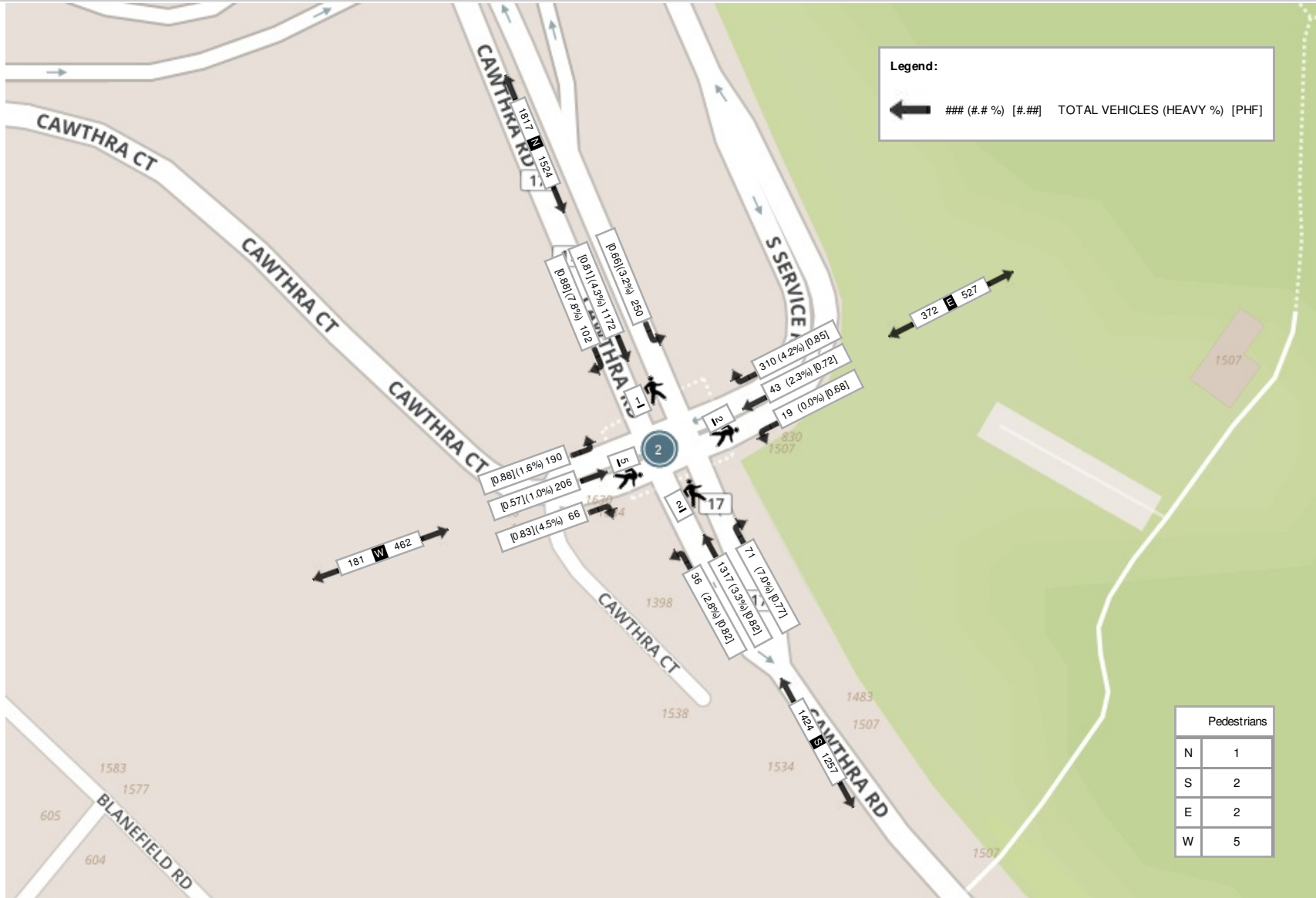
Start Time	Southbound CAWTHRA RD						Westbound SOUTH SERVICE RD						Northbound CAWTHRA RD						Eastbound SOUTH SERVICE RD						Int. Total (15 min)
	Left	Thru	Right	U-Turn	Peds	Approach Total	Left	Thru	Right	U-Turn	Peds	Approach Total	Left	Thru	Right	U-Turn	Peds	Approach Total	Left	Thru	Right	U-Turn	Peds	Approach Total	
07:45:00	94	267	22	0	0	383	3	14	87	0	1	104	10	283	23	0	0	316	47	91	18	0	2	156	959
08:00:00	72	316	29	1	1	418	5	15	91	0	0	111	11	317	17	0	2	345	49	56	19	0	2	124	998
08:15:00	42	361	29	0	0	432	4	9	57	0	1	70	10	403	21	0	0	434	54	30	20	0	1	104	1040
08:30:00	42	228	22	0	0	292	7	5	75	0	0	87	5	314	10	0	0	329	40	29	9	0	0	78	786
<b>Grand Total</b>	<b>250</b>	<b>1172</b>	<b>102</b>	<b>1</b>	<b>1</b>	<b>1525</b>	<b>19</b>	<b>43</b>	<b>310</b>	<b>0</b>	<b>2</b>	<b>372</b>	<b>36</b>	<b>1317</b>	<b>71</b>	<b>0</b>	<b>2</b>	<b>1424</b>	<b>190</b>	<b>206</b>	<b>66</b>	<b>0</b>	<b>5</b>	<b>462</b>	<b>3783</b>
<b>Approach%</b>	16.4%	76.9%	6.7%	0.1%		-	5.1%	11.6%	83.3%	0%		-	2.5%	92.5%	5%	0%		-	41.1%	44.6%	14.3%	0%		-	-
<b>Totals %</b>	6.6%	31%	2.7%	0%		40.3%	0.5%	1.1%	8.2%	0%		9.8%	1%	34.8%	1.9%	0%		37.6%	5%	5.4%	1.7%	0%		12.2%	-
<b>PHF</b>	0.66	0.81	0.88	0.25		0.88	0.68	0.72	0.85	0		0.84	0.82	0.82	0.77	0		0.82	0.88	0.57	0.83	0		0.74	-
<b>Heavy</b>	8	50	8	0		66	0	1	13	0		14	1	43	5	0		49	3	2	3	0		8	-
<b>Heavy %</b>	3.2%	4.3%	7.8%	0%		4.3%	0%	2.3%	4.2%	0%		3.8%	2.8%	3.3%	7%	0%		3.4%	1.6%	1%	4.5%	0%		1.7%	-
<b>Lights</b>	242	1122	94	1		1459	19	42	297	0		358	35	1274	66	0		1375	187	204	63	0		454	-
<b>Lights %</b>	96.8%	95.7%	92.2%	100%		95.7%	100%	97.7%	95.8%	0%		96.2%	97.2%	96.7%	93%	0%		96.6%	98.4%	99%	95.5%	0%		98.3%	-
<b>Mediums</b>	7	47	6	0		60	0	1	13	0		14	1	39	5	0		45	3	2	3	0		8	-
<b>Mediums %</b>	2.8%	4%	5.9%	0%		3.9%	0%	2.3%	4.2%	0%		3.8%	2.8%	3%	7%	0%		3.2%	1.6%	1%	4.5%	0%		1.7%	-
<b>Articulated Trucks</b>	1	3	2	0		6	0	0	0	0		0	0	4	0	0		4	0	0	0	0		0	-
<b>Articulated Trucks %</b>	0.4%	0.3%	2%	0%		0.4%	0%	0%	0%	0%		0%	0%	0.3%	0%	0%		0.3%	0%	0%	0%	0%		0%	-
<b>Pedestrians</b>	-	-	-	-	1	-	-	-	-	-	2	-	-	-	-	-	2	-	-	-	-	-	5	-	-
<b>Pedestrians%</b>	-	-	-	-	10%	-	-	-	-	-	20%	-	-	-	-	-	20%	-	-	-	-	-	50%	-	-



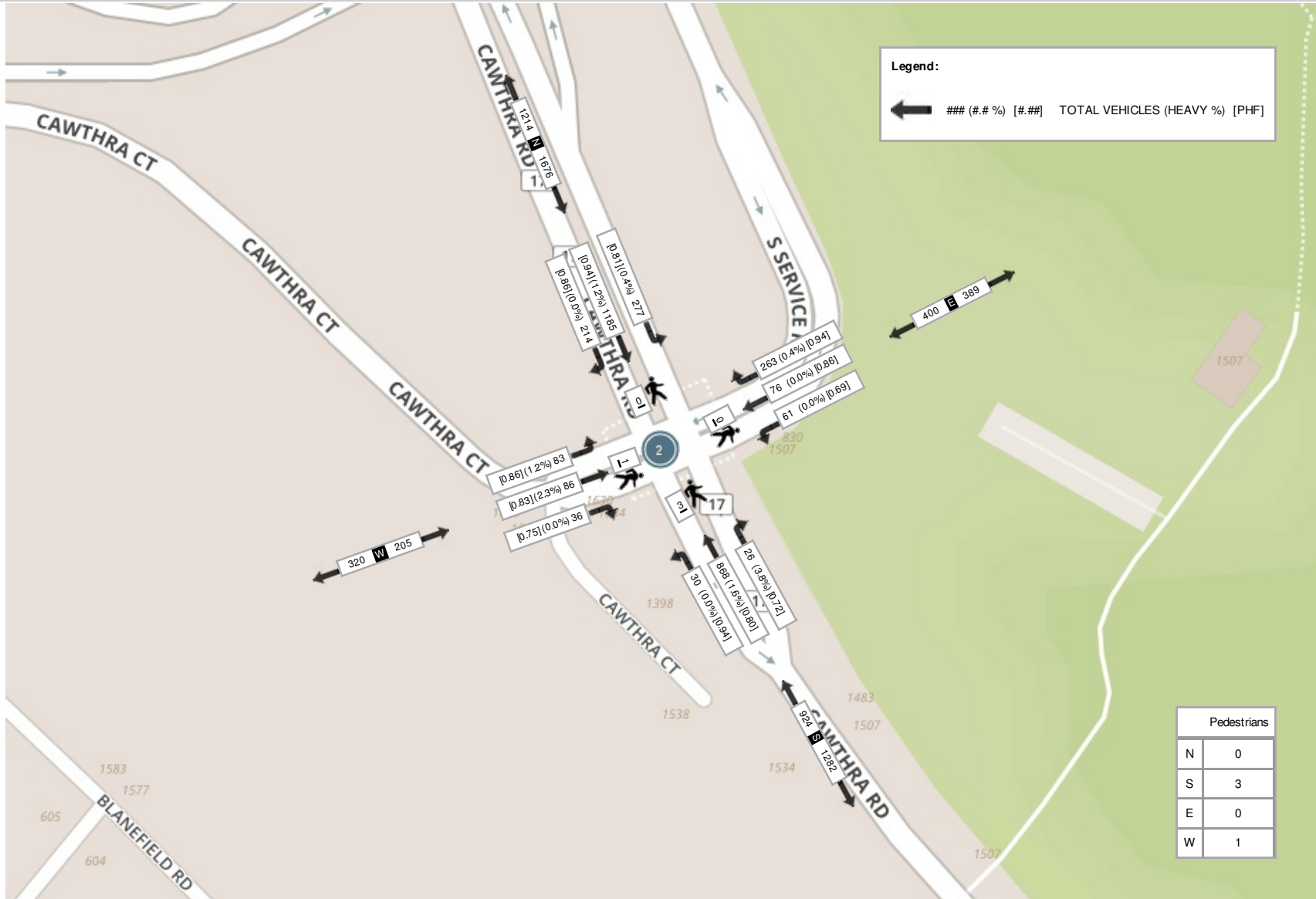
**Peak Hour: 04:45 PM - 05:45 PM Weather: Partly Cloudy (13.7 °C)**

Start Time	Southbound CAWTHRA RD						Westbound SOUTH SERVICE RD						Northbound CAWTHRA RD						Eastbound SOUTH SERVICE RD						Int. Total (15 min)
	Left	Thru	Right	U-Turn	Peds	Approach Total	Left	Thru	Right	U-Turn	Peds	Approach Total	Left	Thru	Right	U-Turn	Peds	Approach Total	Left	Thru	Right	U-Turn	Peds	Approach Total	
16:45:00	68	283	50	0	0	401	14	19	62	0	0	95	7	201	9	0	0	217	21	25	6	0	0	52	765
17:00:00	56	293	54	0	0	403	22	16	62	0	0	100	8	270	4	0	1	282	19	16	8	0	0	43	828
17:15:00	67	294	48	0	0	409	12	22	70	0	0	104	8	188	5	0	2	201	24	19	10	0	1	53	767
17:30:00	86	315	62	0	0	463	13	19	69	0	0	101	7	209	8	0	0	224	19	26	12	0	0	57	845
Grand Total	277	1185	214	0	0	1676	61	76	263	0	0	400	30	868	26	0	3	924	83	86	36	0	1	205	3205
Approach%	16.5%	70.7%	12.8%	0%		-	15.3%	19%	65.8%	0%		-	3.2%	93.9%	2.8%	0%		-	40.5%	42%	17.6%	0%		-	-
Totals %	8.6%	37%	6.7%	0%		52.3%	1.9%	2.4%	8.2%	0%		12.5%	0.9%	27.1%	0.8%	0%		28.8%	2.6%	2.7%	1.1%	0%		6.4%	-
PHF	0.81	0.94	0.86	0		0.9	0.69	0.86	0.94	0		0.96	0.94	0.8	0.72	0		0.82	0.86	0.83	0.75	0		0.9	-
Heavy	1	14	0	0		15	0	0	1	0		1	0	14	1	0		15	1	2	0	0		3	-
Heavy %	0.4%	1.2%	0%	0%		0.9%	0%	0%	0.4%	0%		0.3%	0%	1.6%	3.8%	0%		1.6%	1.2%	2.3%	0%	0%		1.5%	-
Lights	276	1171	214	0		1661	61	76	262	0		399	30	854	25	0		909	82	84	36	0		202	-
Lights %	99.6%	98.8%	100%	0%		99.1%	100%	100%	99.6%	0%		99.8%	100%	98.4%	96.2%	0%		98.4%	98.8%	97.7%	100%	0%		98.5%	-
Mediums	1	13	0	0		14	0	0	1	0		1	0	14	1	0		15	1	2	0	0		3	-
Mediums %	0.4%	1.1%	0%	0%		0.8%	0%	0%	0.4%	0%		0.3%	0%	1.6%	3.8%	0%		1.6%	1.2%	2.3%	0%	0%		1.5%	-
Articulated Trucks	0	1	0	0		1	0	0	0	0		0	0	0	0	0		0	0	0	0	0		0	-
Articulated Trucks %	0%	0.1%	0%	0%		0.1%	0%	0%	0%	0%		0%	0%	0%	0%	0%		0%	0%	0%	0%	0%		0%	-
Pedestrians	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	3	-	-	-	-	-	1	-	-
Pedestrians%	-	-	-	-	0%	-	-	-	-	-	0%	-	-	-	-	-	75%	-	-	-	-	-	25%	-	-

**Peak Hour: 07:45 AM - 08:45 AM    Weather: Clear (0 °C)**



**Peak Hour: 04:45 PM - 05:45 PM    Weather: Partly Cloudy (13.7 °C)**



**APPENDIX A-2**  
**Existing Signal Timing Plans**

# REGIONAL MUNICIPALITY OF PEEL

## Traffic Signal Timing Parameters

Database Date		February 22, 2018				Prepared Date:		February 23, 2018	
Database Rev		INET				Completed By:		JA	
Timing Card / Field rev		-				Checked By:		RS	
Location: Cawthra Road at Arbor Road									
Phase #	Direction	Vehicle Minimum (sec.)	Pedestrian Minimum (sec.)		Amber (sec.)	All Red (sec.)	TIME PERIOD (sec.) (Green+Amber+All Red)		
			WALK	FDWALK			AM MAX	OFF MAX	PM MAX
1	Not In Use								
2	SB Green - Cawthra Road	8.0	7.0	11.0	4.0	2.6	79.0	69.0	79.0
3	Not In Use								
4	WB Green - Arbor Road	8.0	9.0	15.0	4.0	3.0	31.0	31.0	31.0
5	SB P.P. LT Arrow - Cawthra Road				3.0		13.0	0.0	0.0
6	NB Green - Cawthra Road	8.0	7.0	11.0	4.0	2.6	66.0	69.0	79.0
7	Not In Use								
8	EB Green - Arbor Road	8.0	9.0	15.0	4.0	3.0	31.0	31.0	31.0
System Control		Yes							
Local Control		No							
Semi-Actuated Mode		Yes							
				TIME (M-F)		PEAK	CYCLE LENGTH (sec.)		OFFSET (sec.)
				06:00 - 09:30		AM	110		51
				9:30 - 15:00 19:30 - 00:00		OFF	100		4
				15:00 - 19:30		PM	110		105



# REGIONAL MUNICIPALITY OF PEEL

## Traffic Signal Timing Parameters

Database Date		February 22, 2018				Prepared Date:		February 23, 2018	
Database Rev		INET				Completed By:		JA	
Timing Card / Field rev		-				Checked By:		RS	
Location:		Cawthra Road at South Service Road					TIME PERIOD (sec.) (Green+Amber+All Red)		
Phase #	Direction	Vehicle Minimum (sec.)	Pedestrian Minimum (sec.)		Amber (sec.)	All Red (sec.)			
			WALK	FDWALK			AM MAX	OFF MAX	PM MAX
1	Not In Use								
2	SB Green - Cawthra Road	15.0	10.0	17.0	4.0	2.7	101.0	90.0	101.0
3	NIU								
4	WB Green - South Service Road	8.0	13.0	20.0	4.0	3.3	59.0	70.0	59.0
5	SB LT Arrow - Cawthra Road	5.0			3.0		32.0	16.0	43.0
6	NB Green - Cawthra Road	15.0	10.0	17.0	4.0	2.7	69.0	74.0	58.0
7	Not In Use								
8	EB Green - South Service Road	8.0	13.0	20.0	4.0	3.3	59.0	70.0	59.0
System Control		Yes							
Local Control		No							
Semi-Actuated Mode		Yes							
				TIME (M-F)		PEAK	CYCLE LENGTH (sec.)		OFFSET (sec.)
				06:00 - 09:30		AM	160		121
				9:30 - 15:00 19:30 - 00:00		OFF	160		40
				15:00 - 19:30		PM	160		0























**APPENDIX B**  
**Existing Synchro Analysis**  
Level Of Service Calculations

## Queues

Existing 2018 AM

04/12/2018

## 1: Cawthra Road &amp; South Service Road

											
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	
Lane Configurations											
Traffic Volume (vph)	190	206	66	19	43	310	36	1317	250	1172	
Future Volume (vph)	190	206	66	19	43	310	36	1317	250	1172	
Lane Group Flow (vph)	190	206	66	19	43	310	36	1388	250	1274	
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	pm+pt	NA	
Protected Phases	8			4			6			5	2
Permitted Phases	8	8			4	4			6	2	
Detector Phase	8	8	8	4	4	4	6	6	5	2	
Switch Phase											
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	15.0	15.0	5.0	15.0	
Minimum Split (s)	40.3	40.3	40.3	40.3	40.3	40.3	33.7	33.7	8.0	33.7	
Total Split (s)	59.0	59.0	59.0	59.0	59.0	59.0	69.0	69.0	32.0	101.0	
Total Split (%)	36.9%	36.9%	36.9%	36.9%	36.9%	36.9%	43.1%	43.1%	20.0%	63.1%	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.0	4.0	
All-Red Time (s)	3.3	3.3	3.3	3.3	3.3	3.3	2.7	2.7	0.0	2.7	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	7.3	7.3	7.3	7.3	7.3	7.3	6.7	6.7	3.0	6.7	
Lead/Lag							Lag	Lag	Lead		
Lead-Lag Optimize?											
Recall Mode	None	None	None	None	None	None	Max	Max	Max	Max	
v/c Ratio	0.79	0.60	0.20	0.13	0.13	0.58	0.19	0.84	0.57	0.52	
Control Delay	74.4	57.2	11.1	46.2	45.2	9.4	26.1	37.0	34.1	10.1	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	74.4	57.2	11.1	46.2	45.2	9.4	26.1	37.0	34.1	10.1	
Queue Length 50th (m)	50.3	52.5	0.0	4.4	10.0	0.0	5.6	170.6	42.4	74.3	
Queue Length 95th (m)	78.3	78.8	12.7	12.1	20.7	25.4	15.7	233.0	79.9	116.4	
Internal Link Dist (m)	46.2		94.2				490.7		85.8		
Turn Bay Length (m)	60.0	50.0			60.0			60.0			
Base Capacity (vph)	525	744	645	331	737	795	187	1655	440	2464	
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	
Reduced v/c Ratio	0.36	0.28	0.10	0.06	0.06	0.39	0.19	0.84	0.57	0.52	

## Intersection Summary

Cycle Length: 160

Actuated Cycle Length: 132.4

Natural Cycle: 95

Control Type: Semi Act-Uncoord

























Splits and Phases: 1: Cawthra Road &amp; South Service Road

 Ø2	 Ø4
101 s	59 s
 Ø5	 Ø6
32 s	69 s
	 Ø8
	59 s

# HCM Signalized Intersection Capacity Analysis

## 1: Cawthra Road & South Service Road
















Existing 2018 AM  
04/12/2018

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	190	206	66	19	43	310	36	1317	71	250	1172	102
Future Volume (vph)	190	206	66	19	43	310	36	1317	71	250	1172	102
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.7	3.7	3.5	3.7	3.7	3.5	3.7	3.7	3.5	3.7	3.7
Total Lost time (s)	7.3	7.3	7.3	7.3	7.3	7.3	6.7	6.7		3.0	6.7	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00	0.99	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1748	1902	1548	1782	1883	1549	1729	3505		1733	3448	
Flt Permitted	0.73	1.00	1.00	0.45	1.00	1.00	0.22	1.00		0.06	1.00	
Satd. Flow (perm)	1341	1902	1548	846	1883	1549	397	3505		116	3448	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	190	206	66	19	43	310	36	1317	71	250	1172	102
RTOR Reduction (vph)	0	0	54	0	0	254	0	2	0	0	3	0
Lane Group Flow (vph)	190	206	12	19	43	56	36	1386	0	250	1271	0
Confl. Peds. (#/hr)	1		2	2		1	5		2	2		5
Heavy Vehicles (%)	2%	1%	4%	0%	2%	4%	3%	3%	7%	3%	4%	8%
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA		pm+pt	NA	
Protected Phases		8			4			6		5	2	
Permitted Phases	8		8	4		4	6			2		
Actuated Green, G (s)	23.8	23.8	23.8	23.8	23.8	23.8	62.4	62.4		94.5	94.5	
Effective Green, g (s)	23.8	23.8	23.8	23.8	23.8	23.8	62.4	62.4		94.5	94.5	
Actuated g/C Ratio	0.18	0.18	0.18	0.18	0.18	0.18	0.47	0.47		0.71	0.71	
Clearance Time (s)	7.3	7.3	7.3	7.3	7.3	7.3	6.7	6.7		3.0	6.7	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	241	342	278	152	338	278	187	1653		438	2462	
v/s Ratio Prot		0.11			0.02			c0.40		c0.13	0.37	
v/s Ratio Perm	c0.14		0.01	0.02		0.04	0.09			0.28		
v/c Ratio	0.79	0.60	0.04	0.12	0.13	0.20	0.19	0.84		0.57	0.52	
Uniform Delay, d1	51.8	49.9	44.8	45.5	45.5	46.2	20.3	30.5		32.6	8.6	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	15.6	3.0	0.1	0.4	0.2	0.4	2.3	5.3		5.3	0.8	
Delay (s)	67.4	52.9	44.9	45.9	45.7	46.5	22.6	35.8		37.9	9.3	
Level of Service	E	D	D	D	D	D	C	D		D	A	
Approach Delay (s)		57.7			46.4			35.5			14.0	
Approach LOS		E			D			D			B	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			30.6									
HCM 2000 Volume to Capacity ratio			0.76									
Actuated Cycle Length (s)			132.3									
Intersection Capacity Utilization			86.5%									
Analysis Period (min)			15									
c Critical Lane Group												

# Queues

## 2: Cawthra Road & Arbor Road/Arbor Crescent






Existing 2018 AM  
04/12/2018

								
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	110	13	29	9	24	1197	106	1070
Future Volume (vph)	110	13	29	9	24	1197	106	1070
Lane Group Flow (vph)	0	155	29	100	24	1205	106	1144
Turn Type	Perm	NA	Perm	NA	Perm	NA	pm+pt	NA
Protected Phases		8		4		6	5	2
Permitted Phases	8		4		6		2	
Detector Phase	8	8	4	4	6	6	5	2
Switch Phase								
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	5.0	8.0
Minimum Split (s)	31.0	31.0	31.0	31.0	24.6	24.6	8.0	24.6
Total Split (s)	31.0	31.0	31.0	31.0	66.0	66.0	13.0	79.0
Total Split (%)	28.2%	28.2%	28.2%	28.2%	60.0%	60.0%	11.8%	71.8%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	3.0	4.0
All-Red Time (s)	3.0	3.0	3.0	3.0	2.6	2.6	0.0	2.6
Lost Time Adjust (s)		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)		7.0	7.0	7.0	6.6	6.6	3.0	6.6
Lead/Lag					Lag	Lag	Lead	
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Max	Max	None	Max
v/c Ratio		0.71	0.16	0.30	0.10	0.57	0.31	0.47
Control Delay		55.2	38.1	11.7	11.9	14.3	6.8	7.8
Queue Delay		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		55.2	38.1	11.7	11.9	14.3	6.8	7.8
Queue Length 50th (m)		28.8	5.3	1.6	1.9	73.0	5.1	47.2
Queue Length 95th (m)		50.8	13.7	15.8	7.3	116.7	12.7	77.8
Internal Link Dist (m)		155.8		91.3		153.1		490.7
Turn Bay Length (m)			15.0		25.0		45.0	
Base Capacity (vph)		319	276	453	241	2130	378	2443
Starvation Cap Reductn		0	0	0	0	0	0	0
Spillback Cap Reductn		0	0	0	0	0	0	0
Storage Cap Reductn		0	0	0	0	0	0	0
Reduced v/c Ratio		0.49	0.11	0.22	0.10	0.57	0.28	0.47

### Intersection Summary

Cycle Length: 110  
Actuated Cycle Length: 102.5  
Natural Cycle: 75  
Control Type: Semi Act-Uncoord




















Splits and Phases: 2: Cawthra Road & Arbor Road/Arbor Crescent

 Ø2		 Ø4
79 s		31 s
 Ø5	 Ø6	 Ø8
13 s	66 s	31 s

# HCM Signalized Intersection Capacity Analysis























## 2: Cawthra Road & Arbor Road/Arbor Crescent

Existing 2018 AM  
04/12/2018

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	110	13	32	29	9	91	24	1197	8	106	1070	74
Future Volume (vph)	110	13	32	29	9	91	24	1197	8	106	1070	74
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.7	3.7	3.7	3.5	3.7	3.7	3.5	3.7	3.7	3.5	3.7	3.7
Total Lost time (s)		7.0		7.0	7.0		6.6	6.6		3.0	6.6	
Lane Util. Factor		1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		0.99		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes		1.00		0.98	1.00		1.00	1.00		1.00	1.00	
Frt		0.97		1.00	0.86		1.00	1.00		1.00	0.99	
Flt Protected		0.97		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1763		1638	1639		1521	3504		1785	3446	
Flt Permitted		0.73		0.68	1.00		0.25	1.00		0.17	1.00	
Satd. Flow (perm)		1327		1179	1639		398	3504		316	3446	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	110	13	32	29	9	91	24	1197	8	106	1070	74
RTOR Reduction (vph)	0	9	0	0	77	0	0	0	0	0	4	0
Lane Group Flow (vph)	0	146	0	29	23	0	24	1205	0	106	1140	0
Confl. Peds. (#/hr)	1		20	20		1	5		6	6		5
Heavy Vehicles (%)	2%	0%	0%	7%	0%	0%	17%	4%	12%	0%	5%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		8			4			6		5	2	
Permitted Phases	8			4			6			2		
Actuated Green, G (s)		16.3		16.3	16.3		62.4	62.4		72.7	72.7	
Effective Green, g (s)		16.3		16.3	16.3		62.4	62.4		72.7	72.7	
Actuated g/C Ratio		0.16		0.16	0.16		0.61	0.61		0.71	0.71	
Clearance Time (s)		7.0		7.0	7.0		6.6	6.6		3.0	6.6	
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		210		187	260		242	2131		328	2441	
v/s Ratio Prot					0.01			c0.34		0.02	c0.33	
v/s Ratio Perm		c0.11		0.02			0.06			0.21		
v/c Ratio		0.69		0.16	0.09		0.10	0.57		0.32	0.47	
Uniform Delay, d1		40.8		37.2	36.8		8.4	12.0		6.8	6.5	
Progression Factor		1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		9.5		0.4	0.2		0.8	1.1		0.6	0.6	
Delay (s)		50.3		37.6	37.0		9.2	13.1		7.4	7.2	
Level of Service		D		D	D		A	B		A	A	
Approach Delay (s)		50.3			37.1			13.0			7.2	
Approach LOS		D			D			B			A	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			13.6									
HCM 2000 Volume to Capacity ratio			0.58									
Actuated Cycle Length (s)			102.6									
Intersection Capacity Utilization			73.3%									
Analysis Period (min)			15									
c Critical Lane Group												

Queues  
1: Cawthra Road & South Service Road

Existing 2018 PM  
04/12/2018

											
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	
Lane Configurations											
Traffic Volume (vph)	83	86	36	61	76	263	30	868	277	1185	
Future Volume (vph)	83	86	36	61	76	263	30	868	277	1185	
Lane Group Flow (vph)	83	86	36	61	76	263	30	894	277	1399	
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	pm+pt	NA	
Protected Phases	8				4				6	5	2
Permitted Phases	8	8		4	4		6	2			
Detector Phase	8	8	8	4	4	4	6	6	5	2	
Switch Phase											
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	15.0	15.0	5.0	15.0	
Minimum Split (s)	40.3	40.3	40.3	40.3	40.3	40.3	33.7	33.7	8.0	33.7	
Total Split (s)	59.0	59.0	59.0	59.0	59.0	59.0	58.0	58.0	43.0	101.0	
Total Split (%)	36.9%	36.9%	36.9%	36.9%	36.9%	36.9%	36.3%	36.3%	26.9%	63.1%	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.0	4.0	
All-Red Time (s)	3.3	3.3	3.3	3.3	3.3	3.3	2.7	2.7	0.0	2.7	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	7.3	7.3	7.3	7.3	7.3	7.3	6.7	6.7	3.0	6.7	
Lead/Lag							Lag	Lag	Lead		
Lead-Lag Optimize?											
Recall Mode	None	None	None	None	None	None	Max	Max	Max	Max	
v/c Ratio	0.39	0.28	0.12	0.29	0.25	0.54	0.21	0.63	0.39	0.54	
Control Delay	53.0	48.9	9.0	50.0	48.0	9.5	33.7	34.9	8.4	9.6	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	53.0	48.9	9.0	50.0	48.0	9.5	33.7	34.9	8.4	9.6	
Queue Length 50th (m)	20.1	20.5	0.0	14.5	18.0	0.0	5.2	100.1	18.4	77.1	
Queue Length 95th (m)	36.2	36.3	7.2	28.1	32.5	22.9	15.8	142.9	46.5	131.1	
Internal Link Dist (m)	46.2				94.2		490.7		85.8		
Turn Bay Length (m)	60.0			50.0			60.0	60.0			
Base Capacity (vph)	527	753	670	525	768	811	143	1415	702	2578	
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	
Reduced v/c Ratio	0.16	0.11	0.05	0.12	0.10	0.32	0.21	0.63	0.39	0.54	

Intersection Summary




Cycle Length: 160

Actuated Cycle Length: 129.7

Natural Cycle: 85

Control Type: Semi Act-Uncoord

Splits and Phases: 1: Cawthra Road & South Service Road

























 Ø2	 Ø4
101 s	59 s
 Ø5	 Ø6
43 s	58 s
	 Ø8
	59 s



# HCM Signalized Intersection Capacity Analysis
















## 1: Cawthra Road & South Service Road

Existing 2018 PM  
04/12/2018

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	83	86	36	61	76	263	30	868	26	277	1185	214
Future Volume (vph)	83	86	36	61	76	263	30	868	26	277	1185	214
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.7	3.7	3.5	3.7	3.7	3.5	3.7	3.7	3.5	3.7	3.7
Total Lost time (s)	7.3	7.3	7.3	7.3	7.3	7.3	6.7	6.7		3.0	6.7	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00		1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1767	1883	1608	1779	1921	1633	1784	3561		1785	3524	
Flt Permitted	0.71	1.00	1.00	0.70	1.00	1.00	0.19	1.00		0.18	1.00	
Satd. Flow (perm)	1316	1883	1608	1313	1921	1633	361	3561		335	3524	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	83	86	36	61	76	263	30	868	26	277	1185	214
RTOR Reduction (vph)	0	0	30	0	0	220	0	1	0	0	6	0
Lane Group Flow (vph)	83	86	6	61	76	43	30	893	0	277	1393	0
Confl. Peds. (#/hr)			3	3			1					1
Heavy Vehicles (%)	1%	2%	0%	0%	0%	0%	0%	2%	4%	0%	1%	0%
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA		pm+pt	NA	
Protected Phases		8			4			6		5	2	
Permitted Phases	8		8	4		4	6			2		
Actuated Green, G (s)	21.0	21.0	21.0	21.0	21.0	21.0	51.5	51.5		94.7	94.7	
Effective Green, g (s)	21.0	21.0	21.0	21.0	21.0	21.0	51.5	51.5		94.7	94.7	
Actuated g/C Ratio	0.16	0.16	0.16	0.16	0.16	0.16	0.40	0.40		0.73	0.73	
Clearance Time (s)	7.3	7.3	7.3	7.3	7.3	7.3	6.7	6.7		3.0	6.7	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	213	304	260	212	311	264	143	1413		694	2573	
v/s Ratio Prot		0.05			0.04			c0.25		0.12	c0.40	
v/s Ratio Perm	c0.06		0.00	0.05		0.03	0.08			0.17		
v/c Ratio	0.39	0.28	0.02	0.29	0.24	0.16	0.21	0.63		0.40	0.54	
Uniform Delay, d1	48.6	47.7	45.7	47.8	47.4	46.8	25.7	31.5		9.7	7.8	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.2	0.5	0.0	0.8	0.4	0.3	3.3	2.2		1.7	0.8	
Delay (s)	49.8	48.2	45.8	48.5	47.8	47.1	29.0	33.6		11.4	8.6	
Level of Service	D	D	D	D	D	D	C	C		B	A	
Approach Delay (s)		48.4			47.4			33.5			9.1	
Approach LOS		D			D			C			A	
<b>Intersection Summary</b>												
HCM 2000 Control Delay		23.4										
HCM 2000 Volume to Capacity ratio		0.56										
Actuated Cycle Length (s)		129.7								17.0		
Intersection Capacity Utilization		82.2%										
Analysis Period (min)		15										
c Critical Lane Group												

Queues  
2: Cawthra Road & Arbor Road/Arbor Crescent





Existing 2018 PM  
04/12/2018

								
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	35	2	12	3	25	937	46	1059
Future Volume (vph)	35	2	12	3	25	937	46	1059
Lane Group Flow (vph)	0	56	12	32	25	963	46	1137
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		8		4		6		2
Permitted Phases	8		4		6		2	
Detector Phase	8	8	4	4	6	6	2	2
Switch Phase								
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	31.0	31.0	31.0	31.0	24.6	24.6	24.6	24.6
Total Split (s)	31.0	31.0	31.0	31.0	79.0	79.0	79.0	79.0
Total Split (%)	28.2%	28.2%	28.2%	28.2%	71.8%	71.8%	71.8%	71.8%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	3.0	3.0	3.0	3.0	2.6	2.6	2.6	2.6
Lost Time Adjust (s)		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)		7.0	7.0	7.0	6.6	6.6	6.6	6.6
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Max	Max	Max	Max
v/c Ratio		0.39	0.13	0.20	0.07	0.33	0.11	0.39
Control Delay		38.7	43.9	19.1	3.5	3.5	3.8	3.8
Queue Delay		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		38.7	43.9	19.1	3.5	3.5	3.8	3.8
Queue Length 50th (m)		7.6	2.4	0.6	0.9	24.0	1.8	30.1
Queue Length 95th (m)		18.9	7.8	9.4	3.4	37.4	5.5	46.5
Internal Link Dist (m)		155.8		91.3		153.1		490.7
Turn Bay Length (m)			15.0		25.0		45.0	
Base Capacity (vph)		352	240	382	366	2942	410	2934
Starvation Cap Reductn		0	0	0	0	0	0	0
Spillback Cap Reductn		0	0	0	0	0	0	0
Storage Cap Reductn		0	0	0	0	0	0	0
Reduced v/c Ratio		0.16	0.05	0.08	0.07	0.33	0.11	0.39

Intersection Summary

Cycle Length: 110  
Actuated Cycle Length: 100.4  
Natural Cycle: 60  
Control Type: Semi Act-Uncoord




















Splits and Phases: 2: Cawthra Road & Arbor Road/Arbor Crescent

 Ø2	 Ø4
79 s	31 s
 Ø6	 Ø8
79 s	31 s

# HCM Signalized Intersection Capacity Analysis

## 2: Cawthra Road & Arbor Road/Arbor Crescent

Existing 2018 PM  
04/12/2018

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	35	2	19	12	3	29	25	937	26	46	1059	78
Future Volume (vph)	35	2	19	12	3	29	25	937	26	46	1059	78
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.7	3.7	3.7	3.5	3.7	3.7	3.5	3.7	3.7	3.5	3.7	3.7
Total Lost time (s)		7.0		7.0	7.0		6.6	6.6		6.6	6.6	
Lane Util. Factor		1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		0.99		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes		1.00		0.99	1.00		1.00	1.00		1.00	1.00	
Frt		0.95		1.00	0.86		1.00	1.00		1.00	0.99	
Flt Protected		0.97		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1730		1328	1504		1784	3586		1633	3574	
Flt Permitted		0.79		0.72	1.00		0.24	1.00		0.29	1.00	
Satd. Flow (perm)		1411		1007	1504		447	3586		501	3574	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	35	2	19	12	3	29	25	937	26	46	1059	78
RTOR Reduction (vph)	0	18	0	0	27	0	0	1	0	0	3	0
Lane Group Flow (vph)	0	38	0	12	5	0	25	962	0	46	1134	0
Confl. Peds. (#/hr)	1		9	9		1	1		4	4		1
Heavy Vehicles (%)	3%	0%	0%	33%	0%	10%	0%	1%	12%	9%	1%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		8			4			6			2	
Permitted Phases	8			4			6			2		
Actuated Green, G (s)		7.3		7.3	7.3		81.0	81.0		81.0	81.0	
Effective Green, g (s)		7.3		7.3	7.3		81.0	81.0		81.0	81.0	
Actuated g/C Ratio		0.07		0.07	0.07		0.79	0.79		0.79	0.79	
Clearance Time (s)		7.0		7.0	7.0		6.6	6.6		6.6	6.6	
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		101		72	107		355	2850		398	2840	
v/s Ratio Prot					0.00			0.27			c0.32	
v/s Ratio Perm		c0.03		0.01			0.06			0.09		
v/c Ratio		0.38		0.17	0.05		0.07	0.34		0.12	0.40	
Uniform Delay, d1		45.1		44.4	44.1		2.3	2.9		2.4	3.1	
Progression Factor		1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		2.4		1.1	0.2		0.4	0.3		0.6	0.4	
Delay (s)		47.5		45.5	44.2		2.7	3.3		3.0	3.6	
Level of Service		D		D	D		A	A		A	A	
Approach Delay (s)		47.5			44.6			3.2			3.5	
Approach LOS		D			D			A			A	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			5.3			HCM 2000 Level of Service				A		
HCM 2000 Volume to Capacity ratio			0.40									
Actuated Cycle Length (s)			101.9			Sum of lost time (s)			13.6			
Intersection Capacity Utilization			62.3%			ICU Level of Service			B			
Analysis Period (min)			15									
c Critical Lane Group												

**APPENDIX C**  
**Discussions With Region And City Staff**

**Kavleen Sachdeva**

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**From:** Giancarlo Tedesco <giancarlo.tedesco@mississauga.ca>  
**Sent:** February-27-18 10:16 AM  
**To:** Kavleen Sachdeva  
**Subject:** RE: TOR for Traffic Impact Study in Mississauga, Peel  
  
**Categories:** Blue Category

*Hi Kavleen,*

*The TIS Terms of Reference for 1458 Cawthra Road in your email dated February 21, 2018 was reviewed and Transportation Infrastructure Management is pleased to offer the following comments for incorporation. Please note that Cawthra Road is a Regional Road, therefore, the Region's comments will take precedence.*

- The signal timing plan for signalized intersections can be obtained from Traffic Signal Section ([Jim.Kartsomanis@mississauga.ca](mailto:Jim.Kartsomanis@mississauga.ca), Ext. 3964).*
- Growth Rates (Should be regarded for Municipal Roads as applicable) - Please contact Tyler Xuereb from Transportation Planning Section ([tyler.xuereb@mississauga.ca](mailto:tyler.xuereb@mississauga.ca)) for growth rates from the City's model.*
- 650 Atwater Avenue (SP-15/102), 1174-1206 Cawthra Rd. (SP-17/135) and 725 Village Green Blvd. (SP-17/131) should be consideration for background developments. Please contact the Planners for the proposal information.*

*Please ensure that the Region is circulated and comments are received prior to commencing the study.*

*Regards,*

**Giancarlo Tedesco**, E.I.T., C.E.T.  
Traffic Planning Technologist  
T 905-615-3200 ext.5798  
[giancarlo.tedesco@mississauga.ca](mailto:giancarlo.tedesco@mississauga.ca)

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**From:** Kavleen Sachdeva [<mailto:ksachdeva@coleengineering.ca>]  
**Sent:** 2018/02/21 1:11 PM  
**To:** Jay Lee  
**Cc:** Rao Marthi  
**Subject:** TOR for Traffic Impact Study in Mississauga, Peel

Good Afternoon Ms. Lee,

Cole Engineering Group Ltd. (COLE) is pleased to submit a proposed terms of reference (ToR) to prepare a Traffic Impact Study in support of Official Plan Amendment (OPA) and Rezoning Application for a proposed residential development located at 1444-1458 Cawthra Road, in the City of Mississauga.

The subject site is located west of Cawthra Road, north of Arbor Road and south of South Service Road. Currently, the subject land is occupied by four (4) single detached houses.

The proposed development would contain four (4) detached single family residential units and 12 townhouses. The vehicular access to the subject site will be provided through a private road and will be connected to Cawthra Road. The subject site proposes a total of four (4) visitor parking spaces. The site plan for the proposed development is attached here.

We are planning to use the following work plan for the subject development:

**Study Area and Intersections to Assess**

As a part of the study, we are planning to include the following intersections in the analysis



- Cawthra Road and Arbor Road (Existing Signalized Intersection);
- Cawthra Road and South Service Road (Existing Signalized Intersection); and,
- Cawthra Road and Future Private Access.

We will collect the traffic counts at existing intersections on a typical weekday during the morning (7:00 AM to 9:00 AM) and evening (4:00 PM to 6:00 PM) peak periods.

### **Analysis Periods and Scenarios**

The weekday AM and PM peak hours for 2017 existing conditions, considering a full build-out of the proposed development in 2019, a 5-year horizon (2024) year background and total traffic conditions will be analyzed.

### **Background Developments**

We will contact the planners on file for the following development applications:

- SP 17 17/ OZ/OPA 15 9 (Located south of South Service Road, west of Cawthra Road, 24 Townhouse units); and,
- SPI 15 84 (Located south of South Service Road, west of Cawthra Road, 2 storey replacement dwelling).

The above information was received from the following link:

<http://www.mississauga.ca/portal/residents/developmentinformation>

**If any further developments that should be included in our analysis, please let us know.**

### **Future Background Traffic Growth Rate**

Please provide the growth rate that can be used for Arbor Road and South Service Road.

**We will consult with the regional staff to determine a growth rate for Cawthra Road.**

Future background traffic volume will be estimated for the study area to ensure that the analysis includes background traffic growth and growth from other developments in the area.

### **Trip Generation**

Trip generation for the proposed development will be based on Trip Generation Manual, 10th Edition prepared by the Institute of Transportation Engineers (ITE) for Single-Family Detached Housing (land use code 210) and the Condominium Townhouses (land use code 230). To be more conservative the fitted curve equation will be used.

Information contained in the 2011 Transportation Tomorrow Survey (TTS) for zone 3648 (the Subject Zone) has been reviewed along with nearby zones 3642, 3649, and 3653 The summary of the non-auto modal split calculation is provided in the following table.

	Transit excluding GO rail	Cycle	Auto driver	GO rail only	Joint GO rail and local transit	Other	Auto passenger	School bus	Taxi passenger	Walk	Total
3642	303	60	8081	132	227	0	886	0	0	149	9838
3648	349	81	13338	477	230	38	1425	0	35	202	16175
3649	835	60	14344	152	80	23	2264	0	102	139	17999
3653	1815	57	14222	82	138	0	2350	22	69	375	19130
Total	3302	258	49985	843	675	61	6925	22	206	865	63142
Percent	5%	0%	79%	1%	1%	0%	11%	0%	0%	1%	100%
Non-Auto Reduction											10%

The subject zone and adjacent TTS Zones have an existing non-auto modal split of approximately 10%.

Trip distribution, assignments and the modal splits will be based on the latest 2011 Transportation Tomorrow Survey (TTS).

### **Roadway/Transit Improvements**

*Please provide details of any planned roadway/transit improvement in the study area.*

### **Analysis Procedures**

Weekday AM and PM peak hours will be analyzed using the Synchro 9.0 analysis package and Highway Capacity Manual (HCM) procedures.

### **Parking Spaces Review and Site Plan Review**

Parking review will be done based on the applicable City's Zoning By-law. We will review the site plan and comment on appropriateness of site access, along with determining the conformance of parking spaces and driving aisles with the City standards.

We will review the on-site circulation based on an AutoTURN vehicle template software, using a passenger vehicle, garbage truck, and fire truck.

### **Sight Distance Evaluation**

We review the sight distance availability for the proposed access in accordance with the 2017 Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads methodology.

Could you please provide any comments you may have on the above ToR and provide the following information for inclusion in the study:

- Please provide details of any planned roadway/transit improvement in the study area within the next ten years.
- Please provide the growth rate to be used for Arbor Road and South Service Road.

Thank you in advance for your review, comments and requested information. I would appreciate if you could respond as soon as you can.

Thanks,

**Kavleen Sachdeva, E.I.T.**

Traffic Analyst

**Cole Engineering Group Ltd.**

70 Valleywood Dr., Markham, ON L3R 4T5

Main Line: 905-364-6161, Direct Line: 905-754-8060 Ext. 393

F: 905-364-6162

Email: [ksachdeva@coleengineering.ca](mailto:ksachdeva@coleengineering.ca)

Website: [www.coleengineering.ca](http://www.coleengineering.ca)

#### **CONFIDENTIALITYNOTE**

This email may contain confidential information and any rights to privilege have not been waived. If you have received this transmission in error, please notify us by telephone or e-mail. Thank you

**Kavleen Sachdeva**

---

**From:** Kol, Rani <rani.kol@peelregion.ca>  
**Sent:** March-08-18 1:00 PM  
**To:** Kavleen Sachdeva  
**Cc:** Rao Marthi  
**Subject:** RE: Traffic Engineering Comments - TOR for Traffic Impact Study - 1458 Cawthra Road - our file - D-01701371W

**Categories:** Blue Category

Kavleen,

We agree with your approach.

Regards,

**Rani Kol**

Technical Analyst, Traffic Development & Permits  
Transportation Division, Public Works

Tel: (905) 791-7800 ext. 7858  
Fax: (905) 791-1442

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**From:** Kavleen Sachdeva [mailto:ksachdeva@coleengineering.ca]  
**Sent:** March 6, 2018 5:54 PM  
**To:** Kol, Rani  
**Cc:** Rao Marthi; Carrick, Sean  
**Subject:** RE: Traffic Engineering Comments - TOR for Traffic Impact Study - 1458 Cawthra Road - our file - D-01701371W

Good Afternoon Rani,

Thank you for your comments.

In regards to the suggested peak time periods, we have reviewed the traffic study conducted for an upcoming residential development located at 650 Atwater Avenue, at the southwest corner of Atwater Avenue and Cawthra Road (File No. SP-15/102). This development is located less than 1km south of the proposed site on Cawthra Road. The application for this development was approved this past Wednesday (February 28, 2018) as per the confirmation email attached. The peak hours observed in the traffic counts which were included in the report for the intersection of Cawthra Road and Atwater Avenue were 7:45 AM and 8:45 AM in the morning, while the afternoon peak hour was observed between 4:45 PM and 5:45 PM. These peak hours are encompassed within the proposed peak time periods in the ToR. As such, we propose using the proposed peak periods of 7:00 AM to 9:00 AM in the morning and 4:00 PM to 6:00 PM in the evening.

In regards to the 5 and 10 year horizons, the table below summarizes total traffic generated by the site. As shown below, the site generates a maximum of nine (9) two-way trips in the AM peak hour and 13 two-way trips in the PM peak hour (trip generation based on Trip Generation Manual, 10th Edition attached).

Land Use Code	AM Peak Hour	PM Peak Hour
Single-Family Detached Housing (LUC 210)	3	4

Multifamily Housing (Low-Rise) (LUC 220)	6	9
<b>Total (Two-Way) Trips</b>	<b>9</b>	<b>13</b>

Additionally, as an industry practice, generally, a five (5) year horizon period will be considered if the trip generation from the proposed development is less than 100 two-way trips during the peak hour. Given the low trip numbers and the general industry practise, we are of the opinion that a five (5) year horizon period will be sufficient for this study.

I would really appreciate it if you would review the responses and provide us your comments.

Feel free to contact me if you have any questions.

Thanks,

**Kavleen Sachdeva, E.I.T.**

Traffic Analyst

---

**From:** Kol, Rani [<mailto:rani.kol@peelregion.ca>]

**Sent:** March-06-18 8:30 AM

**To:** Kavleen Sachdeva <[ksachdeva@coleengineering.ca](mailto:ksachdeva@coleengineering.ca)>

**Cc:** Carrick, Sean <[sean.carrick@peelregion.ca](mailto:sean.carrick@peelregion.ca)>

**Subject:** Traffic Engineering Comments - TOR for Traffic Impact Study - 1458 Cawthra Road - our file - D-01701371W

Kavleen,

The Traffic Engineering section has reviewed the Terms of Reference received on March 1, 2018 and wish to offer the following;

- For consideration during the preparation of the traffic brief please refer to the Region's generic Terms of Reference, which can be found at <https://www.peelregion.ca/pw/transportation/business/impact-study.htm>
- We agree with the intersections
- **Peak time periods to be analyzed should be adjusted to 6:00–9:00 AM and 3:00–6:00 PM;**
- **5 and 10 year horizons are to be used;**
- Please contact Gordon Hui, Principal Planner, Transportation Planning at extension 4549 to obtain the Growth Rates along Cawthra Road;
- Please contact Damian Jamroz, Supervisor, Traffic Operations at extension 7856 for most recent average annual daily traffic (AADT) and TMCs required for the study; and
- Please contact Rick Laing, Supervisor, Traffic Signals and Streetlighting at extension 7859 for the most up-to-date Traffic Signal Timing Parameters.

Regards,

**Rani Kol**

Technical Analyst, Traffic Development & Permits  
Transportation Division, Public Works

Tel: (905) 791-7800 ext. 7858

Fax: (905) 791-1442

---

**From:** Carrick, Sean

**Sent:** March 1, 2018 2:55 PM

**To:** Kavleen Sachdeva

**Cc:** Rao Marthi; Kol, Rani

**Subject:** RE: TOR for Traffic Impact Study in Mississauga, Peel

Hi Kavleen,

Thank you for sending this to us, I just got back from vacation last week and have been catching up on my emails. Rani Kol (copied) will be reviewing and commenting on the ToR below, if you need to reach her she is also available at extension 7858

Thanks,

Sean

**Sean Carrick, C.E.T.**

Supervisor, Traffic Development & Permits  
Transportation Division  
Public Works, Region of Peel

Tel: (905) 791-7800 ext. 7868

Fax: (905) 791-1442

---

**From:** Kavleen Sachdeva [<mailto:ksachdeva@coleengineering.ca>]

**Sent:** February 21, 2018 1:11 PM

**To:** Carrick, Sean

**Cc:** Rao Marthi

**Subject:** TOR for Traffic Impact Study in Mississauga, Peel

Good Afternoon Mr. Carrick,

Cole Engineering Group Ltd. (COLE) is pleased to submit a proposed terms of reference (ToR) to prepare a Traffic Impact Study in support of Official Plan Amendment (OPA) and Rezoning Application for a proposed residential development located at 1444-1458 Cawthra Road, in the City of Mississauga.

The subject site is located west of Cawthra Road, north of Arbor Road and south of South Service Road. Currently, the subject land is occupied by four (4) single detached houses.

The proposed development would contain four (4) detached single family residential units and 12 townhouses. The vehicular access to the subject site will be provided through a private road and will be connected to Cawthra Road. The subject site proposes a total of four (4) visitor parking spaces. The site plan for the proposed development is attached here.

We are planning to use the following work plan for the subject development:

**Study Area and Intersections to Assess**

As a part of the study, we are planning to include the following intersections in the analysis

- Cawthra Road and Arbor Road (Existing Signalized Intersection);
- Cawthra Road and South Service Road (Existing Signalized Intersection); and,
- Cawthra Road and Future Private Access.

We will collect the traffic counts at existing intersections on a typical weekday during the morning (7:00 AM to 9:00 AM) and evening (4:00 PM to 6:00 PM) peak periods.

**Analysis Periods and Scenarios**

The weekday AM and PM peak hours for 2017 existing conditions, considering a full build-out of the proposed development in 2019, a 5-year horizon (2024) year background and total traffic conditions will be analyzed.

### **Background Developments**

We will contact the city planners on file for the following development applications:

- SP 17 17/ OZ/OPA 15 9 (Located south of South Service Road, west of Cawthra Road, 24 Townhouse units); and,
- SPI 15 84 (Located south of South Service Road, west of Cawthra Road, 2 storey replacement dwelling)

The above information was received from the following link:

<http://www.mississauga.ca/portal/residents/developmentinformation>

**If any further developments that should be included in our analysis, please let us know.**

### **Future Background Traffic Growth Rate**

Please provide the growth rate that can be used for Cawthra Road. Alternatively, please provide historical annual average daily traffic (AADT) count volumes for Cawthra Road within the study area.

We will review the historic AADT count volumes available within the study area to determine a suitable background growth rate for Cawthra Road. (Some engineering judgment will be applied to determine the growth rates).

### **Trip Generation**

Trip generation for the proposed development will be based on Trip Generation Manual, 9th Edition prepared by the Institute of Transportation Engineers (ITE) for Single-Family Detached Housing (land use code 210) and the Condominium Townhouses (land use code 230). To be more conservative the fitted curve equation will be used.

Information contained in the 2011 Transportation Tomorrow Survey (TTS) for zone 3648 (the Subject Zone) has been reviewed along with nearby zones 3642, 3649, and 3653. The summary of the non-auto modal split calculation is provided in the following table.

	Transit excluding GO rail	C
3642	303	
3648	349	
3649	835	
3653	1815	
Total	3302	2
Percent	5%	
Non-Auto Reduction		

The subject zone and adjacent TTS Zones have an existing non-auto modal split of approximately 10%.

Trip distribution, assignments and the modal splits will be based on the latest 2011 Transportation Tomorrow Survey (TTS).

### **Roadway/Transit Improvements**



***Please provide details of any planned roadway/transit improvement in the study area.***

### **Analysis Procedures**

Weekday AM and PM peak hours will be analyzed using the Synchro 9.0 analysis package and Highway Capacity Manual (HCM) procedures.

### **Parking Spaces Review and Site Plan Review**

Parking review will be done based on the applicable City's Zoning By-law. We will review the site plan and comment on appropriateness of site access, along with determining the conformance of parking spaces and driving aisles with the City standards.

We will review the on-site circulation based on an AutoTURN vehicle template software, using a passenger vehicle, garbage truck, and fire truck.

### **Sight Distance Evaluation**

We review the sight distance availability for the proposed access in accordance with the 2017 Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads methodology.

Could you please provide any comments you may have on the above ToR and provide the following information for inclusion in the study:

- Please provide the signal timing parameters for the above existing intersections along with associated cost/invoice
- Please provide details of any additional planned developments in the vicinity of the study area and any available traffic impact studies associated with the development(s).
- Please provide details of any planned roadway/transit improvement in the study area within the next ten years.
- Please provide the growth rate to be used for Cawthra Road.

Thank you in advance for your review, comments and requested information. I would appreciate if you could respond as soon as you can.

Thanks,

**Kavleen Sachdeva, E.I.T.**  
Traffic Analyst

**Cole Engineering Group Ltd.**

70 Valleywood Dr., Markham, ON L3R 4T5

Main Line: 905-364-6161, Direct Line: 905-754-8060 Ext. 393  
F: 905-364-6162

Email: [ksachdeva@coleengineering.ca](mailto:ksachdeva@coleengineering.ca)

Website: [www.coleengineering.ca](http://www.coleengineering.ca)

CONFIDENTIALITYNOTE

This email may contain confidential information and any rights to privilege have not been waived. If you have received this transmission in error, please notify us by telephone or e-mail. Thank you

## Alycia Gruchalla

---

**From:** Tyler Xuereb <Tyler.Xuereb@mississauga.ca>  
**Sent:** March-05-18 2:07 PM  
**To:** Kavleen Sachdeva  
**Subject:** RE: TOR for Traffic Impact Study in Mississauga, Peel

Hi Kavleen,

Using the City's Travel Demand Model and supporting traffic count data, the city's Transportation Planning section has determined the projected growth on South Service Road to be used as part of your study. The recommended projected growth is shown below:

### South Service Road

	Compound Annual Growth from Existing to 2021		Compound Annual Growth from 2021-2024	
	EB	WB	EB	WB
Time				
AM Peak Hour	0.5%	1.0%	1.5%	0.0%
PM Peak Hour	1.0%	1.5%	1.0%	0.5%

-The above analysis assumes lane reductions on Hurontario Street from 3 through lanes to 2 through lanes in each direction due to LRT in the 2021 scenario, therefore your analysis should also reflect these changes.

If you have any questions in regards to the information provided please let me know!

Regards,

Tyler

---

**From:** Kavleen Sachdeva [mailto:ksachdeva@coleengineering.ca]  
**Sent:** 2018/02/28 10:06 AM  
**To:** Tyler Xuereb  
**Subject:** RE: TOR for Traffic Impact Study in Mississauga, Peel

Got it, Thanks Tyler!

Regards,

**Kavleen Sachdeva, E.I.T.**  
Traffic Analyst

---

**From:** Tyler Xuereb [mailto:Tyler.Xuereb@mississauga.ca]  
**Sent:** February-28-18 10:06 AM

**To:** Kavleen Sachdeva <[ksachdeva@coleengineering.ca](mailto:ksachdeva@coleengineering.ca)>  
**Subject:** RE: TOR for Traffic Impact Study in Mississauga, Peel

Good Morning Kavleen,

We only provide growth rates for Major Collectors and Arterials, with that being said I can provide rates for South Service Road but not Arbor Road/Crescent. In regards to Cawthra Road, you can contact the Region for those rates.

Regards,

Tyler

---

**From:** Kavleen Sachdeva [<mailto:ksachdeva@coleengineering.ca>]  
**Sent:** 2018/02/28 9:47 AM  
**To:** Tyler Xuereb  
**Subject:** FW: TOR for Traffic Impact Study in Mississauga, Peel

Hi Tyler

Would you be able to tell us the expected growth rate that we can use for South Service Road (Local Road-Major), and Arbor Road/Arbor Crescent (Local Road-Minor) till 2024?

Would you also be able to tell us the growth rate for cawthra road? Or should I contact the region for that?

Feel free to contact me if you have any questions.

Thanks,

**Kavleen Sachdeva, E.I.T.**  
Traffic Analyst

---

**From:** Giancarlo Tedesco [<mailto:giancarlo.tedesco@mississauga.ca>]  
**Sent:** February-27-18 10:16 AM  
**To:** Kavleen Sachdeva <[ksachdeva@coleengineering.ca](mailto:ksachdeva@coleengineering.ca)>  
**Subject:** RE: TOR for Traffic Impact Study in Mississauga, Peel

*Hi Kavleen,*

*The TIS Terms of Reference for 1458 Cawthra Road in your email dated February 21, 2018 was reviewed and Transportation Infrastructure Management is pleased to offer the following comments for incorporation. Please note that Cawthra Road is a Regional Road, therefore, the Region's comments will take precedence.*

- *The signal timing plan for signalized intersections can be obtained from Traffic Signal Section ([Jim.Kartsomanis@mississauga.ca](mailto:Jim.Kartsomanis@mississauga.ca), Ext. 3964).*
- *Growth Rates (Should be regarded for Municipal Roads as applicable) - Please contact Tyler Xuereb from Transportation Planning Section ([tyler.xuereb@mississauga.ca](mailto:tyler.xuereb@mississauga.ca)) for growth rates from the City's model.*
- *650 Atwater Avenue (SP-15/102), 1174-1206 Cawthra Rd. (SP-17/135) and 725 Village Green Blvd. (SP-17/131) should be consideration for background developments. Please contact the Planners for the proposal information.*

*Please ensure that the Region is circulated and comments are received prior to commencing the study.*

*Regards,*

**Giancarlo Tedesco**, E.I.T., C.E.T.  
Traffic Planning Technologist  
T 905-615-3200 ext.5798  
[giancarlo.tedesco@mississauga.ca](mailto:giancarlo.tedesco@mississauga.ca)

---

**From:** Kavleen Sachdeva [<mailto:ksachdeva@coleengineering.ca>]  
**Sent:** 2018/02/21 1:11 PM  
**To:** Jay Lee  
**Cc:** Rao Marthi  
**Subject:** TOR for Traffic Impact Study in Mississauga, Peel

Good Afternoon Ms. Lee,

Cole Engineering Group Ltd. (COLE) is pleased to submit a proposed terms of reference (ToR) to prepare a Traffic Impact Study in support of Official Plan Amendment (OPA) and Rezoning Application for a proposed residential development located at 1444-1458 Cawthra Road, in the City of Mississauga.

The subject site is located west of Cawthra Road, north of Arbor Road and south of South Service Road. Currently, the subject land is occupied by four (4) single detached houses.

The proposed development would contain four (4) detached single family residential units and 12 townhouses. The vehicular access to the subject site will be provided through a private road and will be connected to Cawthra Road. The subject site proposes a total of four (4) visitor parking spaces. The site plan for the proposed development is attached here.

We are planning to use the following work plan for the subject development:

#### **Study Area and Intersections to Assess**

As a part of the study, we are planning to include the following intersections in the analysis

- Cawthra Road and Arbor Road (Existing Signalized Intersection);
- Cawthra Road and South Service Road (Existing Signalized Intersection); and,
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We will collect the traffic counts at existing intersections on a typical weekday during the morning (7:00 AM to 9:00 AM) and evening (4:00 PM to 6:00 PM) peak periods.

#### **Analysis Periods and Scenarios**

The weekday AM and PM peak hours for 2017 existing conditions, considering a full build-out of the proposed development in 2019, a 5-year horizon (2024) year background and total traffic conditions will be analyzed.

#### **Background Developments**

We will contact the planners on file for the following development applications:

- SP 17 17/ OZ/OPA 15 9 (Located south of South Service Road, west of Cawthra Road, 24 Townhouse units); and,
- SPI 15 84 (Located south of South Service Road, west of Cawthra Road, 2 storey replacement dwelling).

The above information was received from the following link:

<http://www.mississauga.ca/portal/residents/developmentinformation>

**If any further developments that should be included in our analysis, please let us know.**

**Future Background Traffic Growth Rate**

Please provide the growth rate that can be used for Arbor Road and South Service Road.

**We will consult with the regional staff to determine a growth rate for Cawthra Road.**

Future background traffic volume will be estimated for the study area to ensure that the analysis includes background traffic growth and growth from other developments in the area.

**Trip Generation**

Trip generation for the proposed development will be based on Trip Generation Manual, 10th Edition prepared by the Institute of Transportation Engineers (ITE) for Single-Family Detached Housing (land use code 210) and the Condominium Townhouses (land use code 230). To be more conservative the fitted curve equation will be used.

Information contained in the 2011 Transportation Tomorrow Survey (TTS) for zone 3648 (the Subject Zone) has been reviewed along with nearby zones 3642, 3649, and 3653. The summary of the non-auto modal split calculation is provided in the following table.

3642
3648
3649
3653
Total
Percent

The subject zone and adjacent TTS Zones have an existing non-auto modal split of approximately 10%.

Trip distribution, assignments and the modal splits will be based on the latest 2011 Transportation Tomorrow Survey (TTS).

**Roadway/Transit Improvements**

***Please provide details of any planned roadway/transit improvement in the study area.***

**Analysis Procedures**

Weekday AM and PM peak hours will be analyzed using the Synchro 9.0 analysis package and Highway Capacity Manual (HCM) procedures.

**Parking Spaces Review and Site Plan Review**

Parking review will be done based on the applicable City's Zoning By-law. We will review the site plan and comment on appropriateness of site access, along with determining the conformance of parking spaces and driving aisles with the City standards.



We will review the on-site circulation based on an AutoTURN vehicle template software, using a passenger vehicle, garbage truck, and fire truck.

### **Sight Distance Evaluation**

We review the sight distance availability for the proposed access in accordance with the 2017 Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads methodology.

Could you please provide any comments you may have on the above ToR and provide the following information for inclusion in the study:

- Please provide details of any planned roadway/transit improvement in the study area within the next ten years.
- Please provide the growth rate to be used for Arbor Road and South Service Road.

Thank you in advance for your review, comments and requested information. I would appreciate if you could respond as soon as you can.

Thanks,

**Kavleen Sachdeva, E.I.T.**

Traffic Analyst

**Cole Engineering Group Ltd.**

70 Valleywood Dr., Markham, ON L3R 4T5

Main Line: 905-364-6161, Direct Line: 905-754-8060 Ext. 393

F: 905-364-6162

Email: [ksachdeva@coleengineering.ca](mailto:ksachdeva@coleengineering.ca)

Website: [www.coleengineering.ca](http://www.coleengineering.ca)

#### **CONFIDENTIALITYNOTE**

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## Alycia Gruchalla

---

**From:** Wang, Kaili <kaili.wang@peelregion.ca>  
**Sent:** March-09-18 4:01 PM  
**To:** Kavleen Sachdeva; Hui, Gordon  
**Subject:** RE: Traffic Engineering Comments - TOR for Traffic Impact Study - 1458 Cawthra Road - our file - D-01701371W

Hi Kavleen,

I recommend using the same growth rate for both intersections because they are just 450 meters apart and there are no major links in between.

The suggested growth rates are: 1% for 2024.

Regards,

**Kaili Wang**

Transportation System Planning  
Public Works, Region of Peel  
10 Peel Centre Drive, Suite B, 4<sup>th</sup> Floor  
Brampton ON L6T 4B9  
905-791-7800, ext. 4810



---

**From:** Kavleen Sachdeva [mailto:ksachdeva@coleengineering.ca]  
**Sent:** March 9, 2018 3:50 PM  
**To:** Hui, Gordon  
**Cc:** Wang, Kaili  
**Subject:** Re: Traffic Engineering Comments - TOR for Traffic Impact Study - 1458 Cawthra Road - our file - D-01701371W

Hi Gordon,

We have received confirmation from the region that we only have to analyze the conditions for the horizon year of 2024. So we do not require a growth rate for 2029.

I would greatly appreciate it if we could receive the growth rates today. Please let me know if that is possible.

Thanks!

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---

From: Hui, Gordon <[gordon.hui@peelregion.ca](mailto:gordon.hui@peelregion.ca)>  
Sent: Thursday, March 8, 2018 10:35 AM  
Subject: RE: Traffic Engineering Comments - TOR for Traffic Impact Study - 1458 Cawthra Road - our file - D-01701371W  
To: Kavleen Sachdeva <[ksachdeva@coleengineering.ca](mailto:ksachdeva@coleengineering.ca)>

Cc: Wang, Kaili <[kaili.wang@peelregion.ca](mailto:kaili.wang@peelregion.ca)>

Received, will get to you shortly.

Regards,

**Gordon Hui**

W: 905-791-7800 x4549

C: 416-805-8040

---

**From:** Kavleen Sachdeva [<mailto:ksachdeva@coleengineering.ca>]

**Sent:** March 8, 2018 10:33 AM

**To:** Hui, Gordon

**Subject:** RE: Traffic Engineering Comments - TOR for Traffic Impact Study - 1458 Cawthra Road - our file - D-01701371W

Hi Gordon,

As discussed on the phone this morning, we are looking to get the growth rate for Cawthra Road. Our study intersections are as follows:

- Cawthra Road and Arbor Road (Existing Signalized Intersection); and,
- Cawthra Road and South Service Road (Existing Signalized Intersection).

Our horizon years are 2024 and 2029.

Feel free to contact me if you have any questions.

Thanks,

**Kavleen Sachdeva, E.I.T.**

Traffic Analyst

---

**From:** Kol, Rani [<mailto:rani.kol@peelregion.ca>]

**Sent:** March-06-18 8:30 AM

**To:** Kavleen Sachdeva <[ksachdeva@coleengineering.ca](mailto:ksachdeva@coleengineering.ca)>

**Cc:** Carrick, Sean <[sean.carrick@peelregion.ca](mailto:sean.carrick@peelregion.ca)>

**Subject:** Traffic Engineering Comments - TOR for Traffic Impact Study - 1458 Cawthra Road - our file - D-01701371W

Kavleen,

The Traffic Engineering section has reviewed the Terms of Reference received on March 1, 2018 and wish to offer the following;

- For consideration during the preparation of the traffic brief please refer to the Region's generic Terms of Reference, which can be found at <https://www.peelregion.ca/pw/transportation/business/impact-study.htm>
- We agree with the intersections
- Peak time periods to be analyzed should be adjusted to 6:00–9:00 AM and 3:00–6:00 PM;
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Regards,

**Rani Kol**

Technical Analyst, Traffic Development & Permits  
Transportation Division, Public Works

Tel: (905) 791-7800 ext. 7858

Fax: (905) 791-1442

---

**From:** Carrick, Sean  
**Sent:** March 1, 2018 2:55 PM  
**To:** Kavleen Sachdeva  
**Cc:** Rao Marthi; Kol, Rani  
**Subject:** RE: TOR for Traffic Impact Study in Mississauga, Peel

Hi Kavleen,

Thank you for sending this to us, I just got back from vacation last week and have been catching up on my emails. Rani Kol (copied) will be reviewing and commenting on the ToR below, if you need to reach her she is also available at extension 7858

Thanks,

Sean

**Sean Carrick,C.E.T.**

Supervisor, Traffic Development & Permits  
Transportation Division  
Public Works, Region of Peel

Tel: (905) 791-7800 ext. 7868

Fax: (905) 791-1442

---

**From:** Kavleen Sachdeva [<mailto:ksachdeva@coleengineering.ca>]  
**Sent:** February 21, 2018 1:11 PM  
**To:** Carrick, Sean  
**Cc:** Rao Marthi  
**Subject:** TOR for Traffic Impact Study in Mississauga, Peel

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Could you please provide any comments you may have on the above ToR and provide the following information for inclusion in the study:

- Please provide the signal timing parameters for the above existing intersections along with associated cost/invoice
- Please provide details of any additional planned developments in the vicinity of the study area and any available traffic impact studies associated with the development(s).



- Please provide details of any planned roadway/transit improvement in the study area within the next ten years.
- Please provide the growth rate to be used for Cawthra Road.

Thank you in advance for your review, comments and requested information. I would appreciate if you could respond as soon as you can.

Thanks,

**Kavleen Sachdeva, E.I.T.**

Traffic Analyst

**Cole Engineering Group Ltd.**

70 Valleywood Dr., Markham, ON L3R 4T5

Main Line: 905-364-6161, Direct Line: 905-754-8060 Ext. 393

F: 905-364-6162

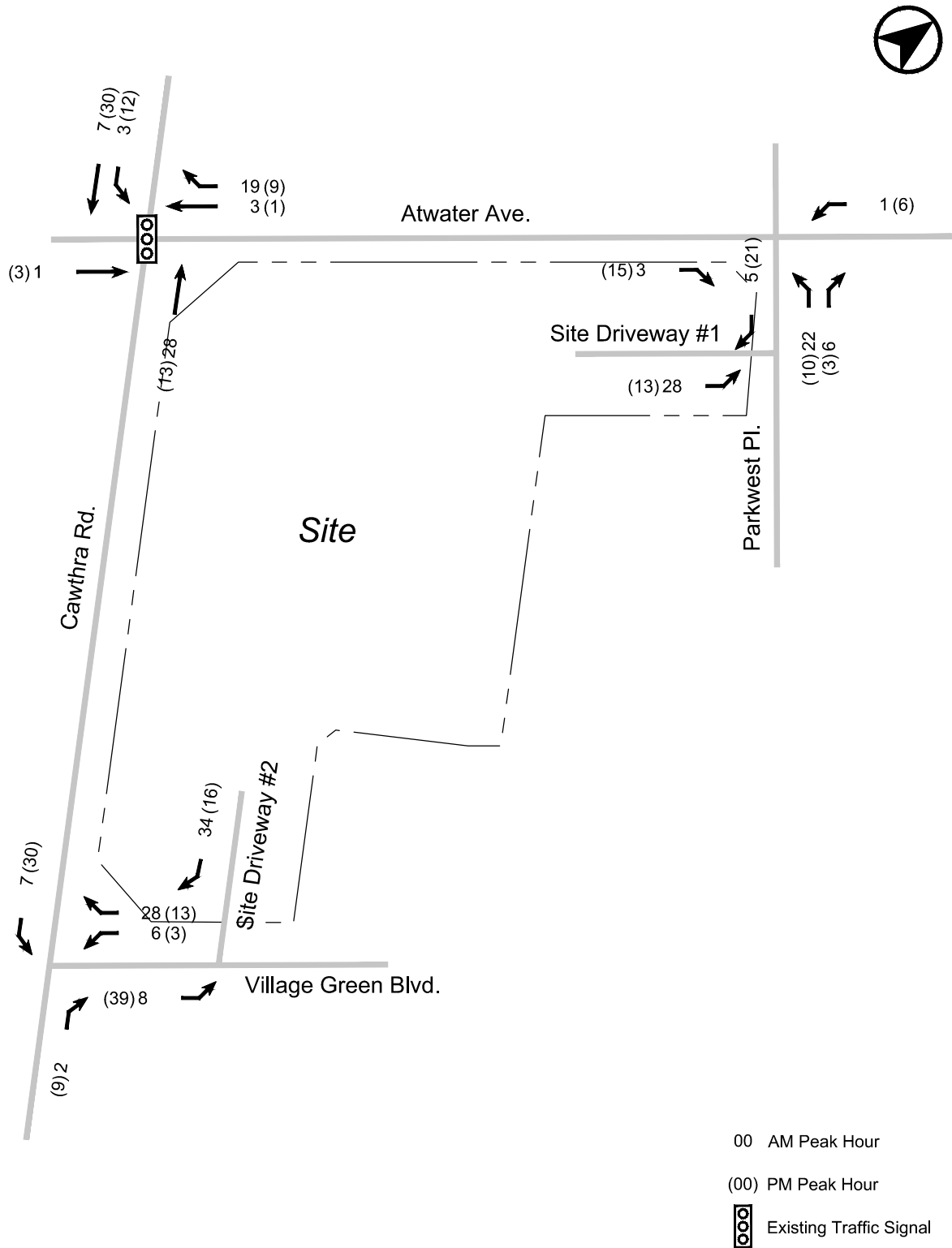
Email: [ksachdeva@coleengineering.ca](mailto:ksachdeva@coleengineering.ca)

Website: [www.coleengineering.ca](http://www.coleengineering.ca)

**CONFIDENTIALITYNOTE**

This email may contain confidential information and any rights to privilege have not been waived. If you have received this transmission in error, please notify us by telephone or e-mail. Thank you

**APPENDIX D**  
**Traffic Generated From Background**



**SITE TRAFFIC VOLUMES**



**Table 2** summarizes the proportion of residential site trips distributed to the study area under the 2021 road network by direction of approach and departure for the weekday am and pm peak hours.

Table 2 Site trip distribution

Trip Orientation	Inbound / Outbound Distribution (%)
East via Atwater Avenue	5%
West via Atwater Avenue	25%
North via Cawthra Road	55%
South via Cawthra Road	15%
Total	100%

The estimated residential site trips generated by the proposed development as assigned to the nearby road network for the weekday am and pm peak hours is shown in **Figure 5**.

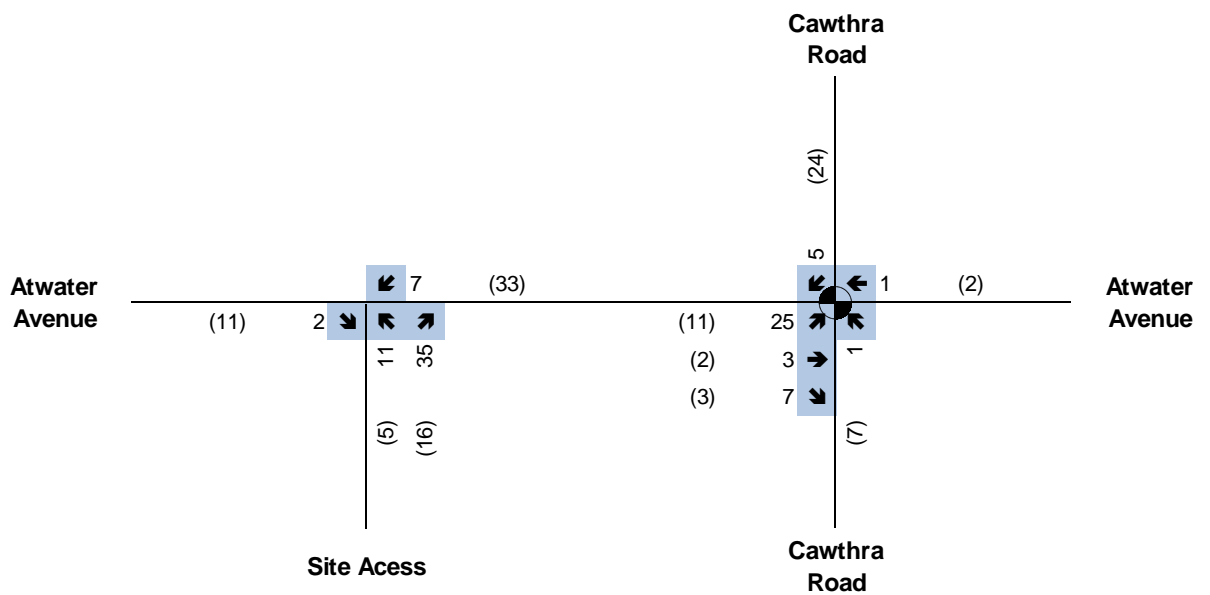
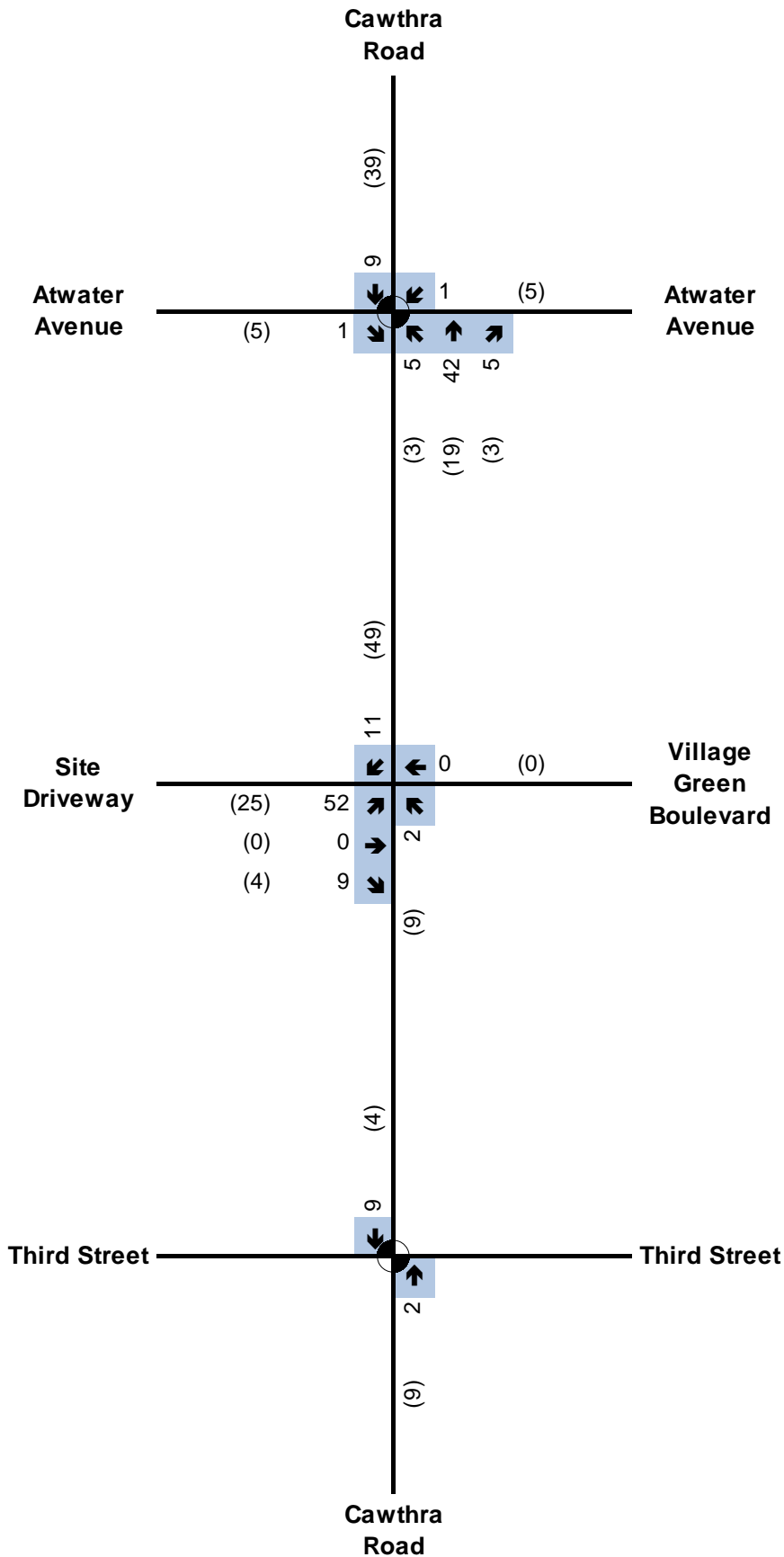


Figure 5 Estimated Residential Site Trips



#### Legend

XX AM Peak Hour Volumes  
 (XX) PM Peak Hour Volumes  
 Signalized Intersection



Queenscorp (Cawthra South) Inc.  
 Cawthra Road Residential  
 Traffic Impact Study

Job Number 11111895  
 Revision A  
 Date Mar 2016

#### Estimated Site Trips

#### Figure 05























**APPENDIX E**  
**Future Background Synchro Analysis**  
Level Of Service Calculations



# Queues

## 1: Cawthra Road & South Service Road

Future (2024) Background AM  
04/12/2018

											
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	
Lane Configurations											
Traffic Volume (vph)	190	221	66	19	44	310	36	1512	250	1267	
Future Volume (vph)	190	221	66	19	44	310	36	1512	250	1267	
Lane Group Flow (vph)	190	221	66	19	44	310	36	1583	250	1369	
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	pm+pt	NA	
Protected Phases	8			4				6	5	2	
Permitted Phases	8	8		4	4		6	2			
Detector Phase	8	8	8	4	4	4	6	6	5	2	
Switch Phase											
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	15.0	15.0	5.0	15.0	
Minimum Split (s)	40.3	40.3	40.3	40.3	40.3	40.3	33.7	33.7	8.0	33.7	
Total Split (s)	59.0	59.0	59.0	59.0	59.0	59.0	69.0	69.0	32.0	101.0	
Total Split (%)	36.9%	36.9%	36.9%	36.9%	36.9%	36.9%	43.1%	43.1%	20.0%	63.1%	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.0	4.0	
All-Red Time (s)	3.3	3.3	3.3	3.3	3.3	3.3	2.7	2.7	0.0	2.7	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	7.3	7.3	7.3	7.3	7.3	7.3	6.7	6.7	3.0	6.7	
Lead/Lag							Lag	Lag	Lead		
Lead-Lag Optimize?											
Recall Mode	None	None	None	None	None	None	Max	Max	Max	Max	
v/c Ratio	0.79	0.64	0.20	0.13	0.13	0.58	0.21	0.96	0.57	0.56	
Control Delay	73.7	58.8	13.6	46.4	45.0	9.3	27.4	48.5	35.1	10.8	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	73.7	58.8	13.6	46.4	45.0	9.3	27.4	48.5	35.1	10.8	
Queue Length 50th (m)	50.4	56.8	1.4	4.4	10.3	0.0	5.7	214.7	43.2	83.7	
Queue Length 95th (m)	78.3	84.2	14.2	12.2	21.2	25.4	16.3	#312.3	81.4	133.7	
Internal Link Dist (m)	46.2				94.2				490.7	85.8	
Turn Bay Length (m)	60.0				50.0				60.0	60.0	
Base Capacity (vph)	523	743	641	305	735	794	169	1654	437	2463	
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	
Reduced v/c Ratio	0.36	0.30	0.10	0.06	0.06	0.39	0.21	0.96	0.57	0.56	

### Intersection Summary

Cycle Length: 160

Actuated Cycle Length: 132.6

Natural Cycle: 115

Control Type: Semi Act-Uncoord

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

























Splits and Phases: 1: Cawthra Road & South Service Road

 Ø2	 Ø4
101 s	59 s
 Ø5	 Ø6
32 s	69 s
	 Ø8
	59 s

# HCM Signalized Intersection Capacity Analysis

## 1: Cawthra Road & South Service Road
















Future (2024) Background AM  
04/12/2018

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	190	221	66	19	44	310	36	1512	71	250	1267	102
Future Volume (vph)	190	221	66	19	44	310	36	1512	71	250	1267	102
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.7	3.7	3.5	3.7	3.7	3.5	3.7	3.7	3.5	3.7	3.7
Total Lost time (s)	7.3	7.3	7.3	7.3	7.3	7.3	6.7	6.7		3.0	6.7	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00	0.99	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1748	1902	1548	1782	1883	1549	1730	3510		1733	3452	
Flt Permitted	0.73	1.00	1.00	0.42	1.00	1.00	0.20	1.00		0.06	1.00	
Satd. Flow (perm)	1340	1902	1548	781	1883	1549	361	3510		111	3452	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	190	221	66	19	44	310	36	1512	71	250	1267	102
RTOR Reduction (vph)	0	0	49	0	0	254	0	2	0	0	3	0
Lane Group Flow (vph)	190	221	17	19	44	56	36	1581	0	250	1366	0
Confl. Peds. (#/hr)	1		2	2		1	5		2	2		5
Heavy Vehicles (%)	2%	1%	4%	0%	2%	4%	3%	3%	7%	3%	4%	8%
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA		pm+pt	NA	
Protected Phases		8			4			6		5	2	
Permitted Phases	8		8	4		4	6			2		
Actuated Green, G (s)	24.0	24.0	24.0	24.0	24.0	24.0	62.5	62.5		94.6	94.6	
Effective Green, g (s)	24.0	24.0	24.0	24.0	24.0	24.0	62.5	62.5		94.6	94.6	
Actuated g/C Ratio	0.18	0.18	0.18	0.18	0.18	0.18	0.47	0.47		0.71	0.71	
Clearance Time (s)	7.3	7.3	7.3	7.3	7.3	7.3	6.7	6.7		3.0	6.7	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	242	344	280	141	340	280	170	1654		435	2462	
v/s Ratio Prot		0.12			0.02			c0.45		c0.13	0.40	
v/s Ratio Perm	c0.14		0.01	0.02		0.04	0.10			0.28		
v/c Ratio	0.79	0.64	0.06	0.13	0.13	0.20	0.21	0.96		0.57	0.56	
Uniform Delay, d1	51.8	50.3	45.0	45.6	45.5	46.1	20.6	33.7		34.6	9.0	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	15.3	4.1	0.1	0.4	0.2	0.4	2.8	13.9		5.4	0.9	
Delay (s)	67.1	54.4	45.1	46.0	45.7	46.5	23.4	47.6		40.0	9.9	
Level of Service	E	D	D	D	D	D	C	D		D	A	
Approach Delay (s)		58.2			46.4			47.1			14.6	
Approach LOS		E			D			D			B	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			35.4									HCM 2000 Level of Service D
HCM 2000 Volume to Capacity ratio			0.82									
Actuated Cycle Length (s)			132.6									Sum of lost time (s) 17.0
Intersection Capacity Utilization			91.9%									ICU Level of Service F
Analysis Period (min)			15									
c Critical Lane Group												

# Queues

## 2: Cawthra Road & Arbor Road/Arbor Crescent






Future (2024) Background AM  
04/12/2018

								
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	110	13	29	9	24	1384	106	1159
Future Volume (vph)	110	13	29	9	24	1384	106	1159
Lane Group Flow (vph)	0	155	29	100	24	1392	106	1233
Turn Type	Perm	NA	Perm	NA	Perm	NA	pm+pt	NA
Protected Phases		8		4		6	5	2
Permitted Phases	8		4		6		2	
Detector Phase	8	8	4	4	6	6	5	2
Switch Phase								
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	5.0	8.0
Minimum Split (s)	31.0	31.0	31.0	31.0	24.6	24.6	8.0	24.6
Total Split (s)	31.0	31.0	31.0	31.0	66.0	66.0	13.0	79.0
Total Split (%)	28.2%	28.2%	28.2%	28.2%	60.0%	60.0%	11.8%	71.8%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	3.0	4.0
All-Red Time (s)	3.0	3.0	3.0	3.0	2.6	2.6	0.0	2.6
Lost Time Adjust (s)		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)		7.0	7.0	7.0	6.6	6.6	3.0	6.6
Lead/Lag					Lag	Lag	Lead	
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Max	Max	None	Max
v/c Ratio		0.71	0.16	0.30	0.11	0.65	0.38	0.50
Control Delay		55.2	38.1	11.7	12.2	16.0	8.3	8.2
Queue Delay		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		55.2	38.1	11.7	12.2	16.0	8.3	8.2
Queue Length 50th (m)		28.8	5.3	1.6	1.9	91.8	5.1	53.0
Queue Length 95th (m)		50.8	13.7	15.8	7.4	145.9	12.7	86.9
Internal Link Dist (m)		155.8		91.3		153.1		490.7
Turn Bay Length (m)			15.0		25.0		45.0	
Base Capacity (vph)		319	276	453	221	2130	322	2445
Starvation Cap Reductn		0	0	0	0	0	0	0
Spillback Cap Reductn		0	0	0	0	0	0	0
Storage Cap Reductn		0	0	0	0	0	0	0
Reduced v/c Ratio		0.49	0.11	0.22	0.11	0.65	0.33	0.50

### Intersection Summary

Cycle Length: 110  
Actuated Cycle Length: 102.5  
Natural Cycle: 80  
Control Type: Semi Act-Uncoord

Splits and Phases: 2: Cawthra Road & Arbor Road/Arbor Crescent




















 Ø2	 Ø4
79 s	31 s
 Ø5	 Ø6
13 s	66 s
 Ø8	
	31 s

# HCM Signalized Intersection Capacity Analysis

## 2: Cawthra Road & Arbor Road/Arbor Crescent























Future (2024) Background AM

04/12/2018

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	110	13	32	29	9	91	24	1384	8	106	1159	74
Future Volume (vph)	110	13	32	29	9	91	24	1384	8	106	1159	74
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.7	3.7	3.7	3.5	3.7	3.7	3.5	3.7	3.7	3.5	3.7	3.7
Total Lost time (s)		7.0		7.0	7.0		6.6	6.6		3.0	6.6	
Lane Util. Factor		1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		0.99		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes		1.00		0.98	1.00		1.00	1.00		1.00	1.00	
Frt		0.97		1.00	0.86		1.00	1.00		1.00	0.99	
Flt Protected		0.97		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1763		1638	1639		1522	3504		1785	3448	
Flt Permitted		0.73		0.68	1.00		0.23	1.00		0.12	1.00	
Satd. Flow (perm)		1327		1179	1639		364	3504		230	3448	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	110	13	32	29	9	91	24	1384	8	106	1159	74
RTOR Reduction (vph)	0	9	0	0	77	0	0	0	0	0	3	0
Lane Group Flow (vph)	0	146	0	29	23	0	24	1392	0	106	1230	0
Confl. Peds. (#/hr)	1		20	20		1	5		6	6		5
Heavy Vehicles (%)	2%	0%	0%	7%	0%	0%	17%	4%	12%	0%	5%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		8			4			6		5	2	
Permitted Phases	8			4			6			2		
Actuated Green, G (s)		16.3		16.3	16.3		62.4	62.4		72.7	72.7	
Effective Green, g (s)		16.3		16.3	16.3		62.4	62.4		72.7	72.7	
Actuated g/C Ratio		0.16		0.16	0.16		0.61	0.61		0.71	0.71	
Clearance Time (s)		7.0		7.0	7.0		6.6	6.6		3.0	6.6	
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		210		187	260		221	2131		273	2443	
v/s Ratio Prot					0.01			c0.40		0.03	c0.36	
v/s Ratio Perm		c0.11		0.02			0.07			0.25		
v/c Ratio		0.69		0.16	0.09		0.11	0.65		0.39	0.50	
Uniform Delay, d1		40.8		37.2	36.8		8.4	13.1		8.6	6.8	
Progression Factor		1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		9.5		0.4	0.2		1.0	1.6		0.9	0.7	
Delay (s)		50.3		37.6	37.0		9.4	14.6		9.5	7.5	
Level of Service		D		D	D		A	B		A	A	
Approach Delay (s)		50.3			37.1			14.5			7.7	
Approach LOS		D			D			B			A	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			14.3									B
HCM 2000 Volume to Capacity ratio			0.65									
Actuated Cycle Length (s)			102.6							16.6		
Intersection Capacity Utilization			76.9%								D	
ICU Level of Service												
Analysis Period (min)			15									
c Critical Lane Group												

Queues  
1: Cawthra Road & South Service Road

Future (2024) Background PM  
04/12/2018

											
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	
Lane Configurations											
Traffic Volume (vph)	83	92	36	61	82	263	30	973	277	1363	
Future Volume (vph)	83	92	36	61	82	263	30	973	277	1363	
Lane Group Flow (vph)	83	92	36	61	82	263	30	999	277	1577	
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	pm+pt	NA	
Protected Phases	8				4				6	5	2
Permitted Phases	8	8		4	4		6	2			
Detector Phase	8	8	8	4	4	4	6	6	5	2	
Switch Phase											
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	15.0	15.0	5.0	15.0	
Minimum Split (s)	40.3	40.3	40.3	40.3	40.3	40.3	33.7	33.7	8.0	33.7	
Total Split (s)	59.0	59.0	59.0	59.0	59.0	59.0	58.0	58.0	43.0	101.0	
Total Split (%)	36.9%	36.9%	36.9%	36.9%	36.9%	36.9%	36.3%	36.3%	26.9%	63.1%	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.0	4.0	
All-Red Time (s)	3.3	3.3	3.3	3.3	3.3	3.3	2.7	2.7	0.0	2.7	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	7.3	7.3	7.3	7.3	7.3	7.3	6.7	6.7	3.0	6.7	
Lead/Lag							Lag	Lag	Lead		
Lead-Lag Optimize?											
Recall Mode	None	None	None	None	None	None	Max	Max	Max	Max	
v/c Ratio	0.60	0.46	0.17	0.44	0.40	0.64	0.24	0.66	0.38	0.57	
Control Delay	69.2	58.2	11.4	60.6	56.1	13.6	30.1	31.1	7.5	6.6	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	69.2	58.2	11.4	60.6	56.1	13.6	30.1	31.1	7.5	6.6	
Queue Length 50th (m)	20.2	22.0	0.0	14.6	19.5	0.0	4.8	103.5	12.5	68.6	
Queue Length 95th (m)	37.7	39.3	7.9	29.0	35.7	25.4	14.1	137.2	39.5	103.7	
Internal Link Dist (m)	46.2				94.2				490.7	85.8	
Turn Bay Length (m)	60.0			50.0				60.0	60.0		
Base Capacity (vph)	558	803	711	556	819	847	126	1508	727	2754	
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	
Reduced v/c Ratio	0.15	0.11	0.05	0.11	0.10	0.31	0.24	0.66	0.38	0.57	

Intersection Summary

Cycle Length: 160

Actuated Cycle Length: 121.3

Natural Cycle: 85

Control Type: Semi Act-Uncoord

Splits and Phases: 1: Cawthra Road & South Service Road

























 Ø2	 Ø4
101 s	59 s
 Ø5	 Ø6
43 s	58 s
	 Ø8
	59 s

# HCM Signalized Intersection Capacity Analysis

## 1: Cawthra Road & South Service Road

Future (2024) Background PM

04/12/2018
















												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	83	92	36	61	82	263	30	973	26	277	1363	214
Future Volume (vph)	83	92	36	61	82	263	30	973	26	277	1363	214
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.7	3.7	3.5	3.7	3.7	3.5	3.7	3.7	3.5	3.7	3.7
Total Lost time (s)	7.3	7.3	7.3	7.3	7.3	7.3	6.7	6.7		3.0	6.7	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00		1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1767	1883	1608	1780	1921	1633	1784	3563		1785	3534	
Flt Permitted	0.70	1.00	1.00	0.70	1.00	1.00	0.16	1.00		0.15	1.00	
Satd. Flow (perm)	1309	1883	1608	1306	1921	1633	301	3563		290	3534	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	83	92	36	61	82	263	30	973	26	277	1363	214
RTOR Reduction (vph)	0	0	32	0	0	235	0	1	0	0	4	0
Lane Group Flow (vph)	83	92	4	61	82	28	30	998	0	277	1573	0
Confl. Peds. (#/hr)			3	3			1					1
Heavy Vehicles (%)	1%	2%	0%	0%	0%	0%	0%	2%	4%	0%	1%	0%
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA		pm+pt	NA	
Protected Phases		8			4			6		5	2	
Permitted Phases	8		8	4		4	6			2		
Actuated Green, G (s)	12.9	12.9	12.9	12.9	12.9	12.9	51.4	51.4		94.4	94.4	
Effective Green, g (s)	12.9	12.9	12.9	12.9	12.9	12.9	51.4	51.4		94.4	94.4	
Actuated g/C Ratio	0.11	0.11	0.11	0.11	0.11	0.11	0.42	0.42		0.78	0.78	
Clearance Time (s)	7.3	7.3	7.3	7.3	7.3	7.3	6.7	6.7		3.0	6.7	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	139	200	171	138	204	173	127	1509		718	2750	
v/s Ratio Prot		0.05			0.04			c0.28		0.13	c0.44	
v/s Ratio Perm	c0.06		0.00	0.05		0.02	0.10			0.17		
v/c Ratio	0.60	0.46	0.02	0.44	0.40	0.16	0.24	0.66		0.39	0.57	
Uniform Delay, d1	51.7	50.9	48.6	50.8	50.6	49.3	22.4	28.0		8.9	5.4	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	6.7	1.7	0.1	2.3	1.3	0.4	4.3	2.3		1.6	0.9	
Delay (s)	58.5	52.6	48.6	53.1	51.9	49.7	26.7	30.3		10.5	6.2	
Level of Service	E	D	D	D	D	D	C	C		B	A	
Approach Delay (s)		54.2			50.7			30.2			6.9	
Approach LOS		D			D			C			A	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			21.7									
HCM 2000 Volume to Capacity ratio			0.62									
Actuated Cycle Length (s)			121.3									
Intersection Capacity Utilization			87.1%									
Analysis Period (min)			15									
c Critical Lane Group												

# Queues

## 2: Cawthra Road & Arbor Road/Arbor Crescent

Future (2024) Background PM

04/12/2018

								
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	35	2	12	3	25	1046	46	1229
Future Volume (vph)	35	2	12	3	25	1046	46	1229
Lane Group Flow (vph)	0	56	12	32	25	1072	46	1307
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		8		4		6		2
Permitted Phases	8		4		6		2	
Detector Phase	8	8	4	4	6	6	2	2
Switch Phase								
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	31.0	31.0	31.0	31.0	24.6	24.6	24.6	24.6
Total Split (s)	31.0	31.0	31.0	31.0	79.0	79.0	79.0	79.0
Total Split (%)	28.2%	28.2%	28.2%	28.2%	71.8%	71.8%	71.8%	71.8%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	3.0	3.0	3.0	3.0	2.6	2.6	2.6	2.6
Lost Time Adjust (s)		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)		7.0	7.0	7.0	6.6	6.6	6.6	6.6
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Max	Max	Max	Max
v/c Ratio		0.39	0.13	0.20	0.08	0.36	0.13	0.45
Control Delay		38.7	43.9	19.1	3.8	3.7	4.1	4.1
Queue Delay		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		38.7	43.9	19.1	3.8	3.7	4.1	4.1
Queue Length 50th (m)		7.6	2.4	0.6	1.0	28.0	1.8	37.3
Queue Length 95th (m)		18.9	7.8	9.4	3.6	43.2	5.7	57.3
Internal Link Dist (m)		155.8		91.3		153.1		490.7
Turn Bay Length (m)			15.0		25.0		45.0	
Base Capacity (vph)		352	240	382	298	2942	362	2937
Starvation Cap Reductn		0	0	0	0	0	0	0
Spillback Cap Reductn		0	0	0	0	0	0	0
Storage Cap Reductn		0	0	0	0	0	0	0
Reduced v/c Ratio		0.16	0.05	0.08	0.08	0.36	0.13	0.45

### Intersection Summary





Cycle Length: 110

Actuated Cycle Length: 100.4

Natural Cycle: 60

Control Type: Semi Act-Uncoord

Splits and Phases: 2: Cawthra Road & Arbor Road/Arbor Crescent

 Ø2	 Ø4
79 s	31 s
 Ø6	 Ø8
79 s	31 s






















# HCM Signalized Intersection Capacity Analysis

## 2: Cawthra Road & Arbor Road/Arbor Crescent

Future (2024) Background PM

04/12/2018

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	35	2	19	12	3	29	25	1046	26	46	1229	78
Future Volume (vph)	35	2	19	12	3	29	25	1046	26	46	1229	78
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.7	3.7	3.7	3.5	3.7	3.7	3.5	3.7	3.7	3.5	3.7	3.7
Total Lost time (s)		7.0		7.0	7.0		6.6	6.6		6.6	6.6	
Lane Util. Factor		1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		0.99		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes		1.00		0.99	1.00		1.00	1.00		1.00	1.00	
Frt		0.95		1.00	0.86		1.00	1.00		1.00	0.99	
Flt Protected		0.97		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1730		1328	1504		1784	3589		1634	3579	
Flt Permitted		0.79		0.72	1.00		0.19	1.00		0.26	1.00	
Satd. Flow (perm)		1411		1007	1504		365	3589		442	3579	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	35	2	19	12	3	29	25	1046	26	46	1229	78
RTOR Reduction (vph)	0	18	0	0	27	0	0	1	0	0	2	0
Lane Group Flow (vph)	0	38	0	12	5	0	25	1071	0	46	1305	0
Confl. Peds. (#/hr)	1		9	9		1	1		4	4		1
Heavy Vehicles (%)	3%	0%	0%	33%	0%	10%	0%	1%	12%	9%	1%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		8			4			6			2	
Permitted Phases	8			4			6			2		
Actuated Green, G (s)		7.3		7.3	7.3		81.0	81.0		81.0	81.0	
Effective Green, g (s)		7.3		7.3	7.3		81.0	81.0		81.0	81.0	
Actuated g/C Ratio		0.07		0.07	0.07		0.79	0.79		0.79	0.79	
Clearance Time (s)		7.0		7.0	7.0		6.6	6.6		6.6	6.6	
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		101		72	107		290	2852		351	2844	
v/s Ratio Prot					0.00			0.30			c0.36	
v/s Ratio Perm		c0.03		0.01			0.07			0.10		
v/c Ratio		0.38		0.17	0.05		0.09	0.38		0.13	0.46	
Uniform Delay, d1		45.1		44.4	44.1		2.3	3.1		2.4	3.4	
Progression Factor		1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		2.4		1.1	0.2		0.6	0.4		0.8	0.5	
Delay (s)		47.5		45.5	44.2		2.9	3.4		3.2	3.9	
Level of Service		D		D	D		A	A		A	A	
Approach Delay (s)		47.5			44.6			3.4			3.9	
Approach LOS		D			D			A			A	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			5.3									
HCM 2000 Volume to Capacity ratio			0.45									
Actuated Cycle Length (s)			101.9									
Intersection Capacity Utilization			62.3%									
Analysis Period (min)			15									
c Critical Lane Group												

## **APPENDIX F**

### **TTS Analysis**

[illegible]

Wed Feb 28 2018 15:05:35 GMT-0500 (Eastern Standard Time)

Cross Tabulation Query Form - Trip - 2006

Row: Planning district of destination - pd\_dest

Column: 2006 GTA zone of origin - gta06\_orig

Filters:

Age of person - age In 18-99

and

Start time of trip - start\_time In 700-859

and

2006 GTA zone of origin - gta06\_orig In 3648,3649,364

Trip 2006

Table:

,3642,3648,3649,3653

PD 1 of Toronto,288,326,418,261

PD 2 of Toronto,0,57,38,0

PD 3 of Toronto,42,19,21,24

PD 4 of Toronto,0,19,19,24

PD 5 of Toronto,0,0,0,48

PD 6 of Toronto,0,38,19,0

PD 7 of Toronto,63,138,191,46

PD 8 of Toronto,43,112,347,121

PD 9 of Toronto,63,19,38,48

PD 10 of Toronto,21,24,38,0

PD 11 of Toronto,21,0,0,0

PD 12 of Toronto,0,0,19,0

PD 13 of Toronto,21,19,0,19

PD 14 of Toronto,0,0,17,0

PD 15 of Toronto,0,0,0,24

PD 16 of Toronto,0,21,0,0

Vaughan,20,34,0,0

Brampton,21,19,75,48

Mississauga,1215,1596,1796,1923

Milton,0,38,0,0

Oakville,21,95,115,73

Burlington,0,19,0,0

Flamborough,0,0,0,24

Hamilton,0,0,0,24

City of Guelph,0,19,0,0

Barrie,0,0,38,0

Weekday AM Peak Period	TOTAL		To/From North		To/From South		To From West		To/From East			TOTAL	CHECK
		PERCENT	%	#	%	#	%	#	%	#			
PD 1 of Toronto	1293	12%	20%	259		0		0	80%	1035	100%	1294	FALSE
PD 2 of Toronto	95	1%	20%	19		0		0	80%	76	100%	95	TRUE
PD 3 of Toronto	106	1%	20%	22		0		0	80%	85	100%	107	FALSE
PD 4 of Toronto	62	1%	20%	13		0		0	80%	50	100%	63	FALSE
PD 5 of Toronto	48	0%	20%	10		0		0	80%	39	100%	49	FALSE
PD 6 of Toronto	57	1%	20%	12		0		0	80%	46	100%	58	FALSE
PD 7 of Toronto	438	4%	20%	88		0		0	80%	351	100%	439	FALSE
PD 8 of Toronto	623	6%	20%	125		0		0	80%	499	100%	624	FALSE
PD 9 of Toronto	168	2%	20%	34		0		0	80%	135	100%	169	FALSE
PD 10 of Toronto	83	1%	20%	17		0		0	80%	67	100%	84	FALSE
PD 11 of Toronto	21	0%	20%	5		0		0	80%	17	100%	22	FALSE
PD 12 of Toronto	19	0%	20%	4		0		0	80%	16	100%	20	FALSE
PD 13 of Toronto	59	1%	20%	12		0		0	80%	48	100%	60	FALSE
PD 14 of Toronto	17	0%	20%	4		0		0	80%	14	100%	18	FALSE
PD 15 of Toronto	24	0%	20%	5		0		0	80%	20	100%	25	FALSE
PD 16 of Toronto	21	0%	20%	5		0		0	80%	17	100%	22	FALSE
Vaughan	54	1%	50%	27		0		0	50%	27	100%	54	TRUE
Brampton	163	2%	100%	163		0		0		0	100%	163	TRUE
Mississauga	6530	63%	39%	2546	33%	2155	15%	980	14%	915	101%	6596	FALSE
Milton	38	0%	50%	19		0	50%	19		0	100%	38	TRUE
Oakville	304	3%		0		0	100%	304		0	100%	304	TRUE
Burlington	19	0%	20%	4		0	80%	15		0	100%	19	TRUE
Flamborough	24	0%	20%	5		0	80%	19		0	100%	24	TRUE
Hamilton	24	0%	20%	5		0	80%	19		0	100%	24	TRUE
City of Guelph	19	0%	50%	10		0	50%	9		0	100%	19	TRUE
Barrie	38	0%		0		0	100%	38		0	100%	38	TRUE
Total	10347	100%	33%	3413	21%	2155	14%	1403	33%	3457	101%	10428	FALSE

To/From		Via	
North	33%	Cawthra Road	33%
South	21%	Cawthra Road	21%
West	14%	QEW	9%
		Lakeshore Road East	4%
East	33%	QWE	23%
		Lakeshore Road East	10%
Total	101%		101%

Cross Tabulation Query Form - Trip - 2006

Row: Planning district of origin - pd\_orig  
Column: 2006 GTA zone of destination - gta06\_dest

Filters:  
Age of person - age In 18-99  
and  
Start time of trip - start\_time In 1600-1759  
and  
2006 GTA zone of destination - gta06\_dest In 3648,3649,3642,3653

Trip 2006  
Table:

,3642,3648,3649,3653  
PD 1 of Toronto,295,289,299,210  
PD 2 of Toronto,26,38,94,18  
PD 3 of Toronto,0,19,40,0  
PD 4 of Toronto,0,19,38,73  
PD 5 of Toronto,0,0,16,24  
PD 6 of Toronto,21,21,0,0  
PD 7 of Toronto,84,58,131,48  
PD 8 of Toronto,60,284,208,142  
PD 9 of Toronto,42,0,59,48  
PD 10 of Toronto,0,0,38,48  
PD 12 of Toronto,0,0,41,24  
Markham,21,0,38,0

Vaughan,21,33,19,24

Caledon,0,0,0,19  
Brampton,42,19,38,71  
Mississauga,1366,1274,1625,1822  
Milton,0,19,0,0  
Oakville,21,127,57,97  
Burlington,17,19,17,43

Weekday AM Peak Period	3642	3648	3649	3653	TOTAL				To/From North		To/From South		To From West		To/From East			TOTAL	CHECK
						PERCENT	%	#	%	#	%	#	%	#	%	#			
PD 1 of Toronto	295	289	299	210	1093	11%	20%	219		0		0		0	80%	874	100%	1093	TRUE
PD 2 of Toronto	26	38	94	18	176	2%	20%	36		0		0		0	80%	140	100%	176	TRUE
PD 3 of Toronto	0	19	40	0	59	1%	20%	12		0		0		0	80%	47	100%	59	TRUE
PD 4 of Toronto	0	19	38	73	130	1%	20%	26		0		0		0	80%	104	100%	130	TRUE
PD 5 of Toronto	0	0	16	24	40	0%	20%	8		0		0		0	80%	32	100%	40	TRUE
PD 6 of Toronto	21	21	0	0	42	0%	20%	9		0		0		0	80%	33	100%	42	TRUE
PD 7 of Toronto	84	58	131	48	321	3%	20%	65		0		0		0	80%	256	100%	321	TRUE
PD 8 of Toronto	60	284	208	142	694	7%	20%	139		0		0		0	80%	555	100%	694	TRUE
PD 9 of Toronto	42	0	59	48	149	2%	20%	30		0		0		0	80%	119	100%	149	TRUE
PD 10 of Toronto	0	0	38	48	86	1%	20%	18		0		0		0	80%	68	100%	86	TRUE
PD 11 of Toronto	21	0	75	0	96	1%	20%	20		0		0		0	80%	76	100%	96	TRUE
PD 12 of Toronto	0	0	41	24	65	1%	20%	13		0		0		0	80%	52	100%	65	TRUE
PD 16 of Toronto	0	0	19	0	19	0%	20%	4		0		0		0	80%	15	100%	19	TRUE
Markham	21	0	38	0	59	1%	20%	12		0		0		0	80%	47	100%	59	TRUE
Vaughan	21	33	19	24	97	1%	50%	49		0		0		0	50%	48	100%	97	TRUE
Caledon	0	0	0	19	19	0%	20%	4		0		0		0	80%	15	100%	19	TRUE
Brampton	42	19	38	71	170	2%	100%	170		0		0		0		0	100%	170	TRUE
Mississauga	1366	1274	1625	1822	6087	62%	48%	2920	29%	1766	8%	487	15%	914	100%	6087	100%	6087	TRUE
Milton	0	19	0	0	19	0%	50%	10		0	50%	9		0	100%	19	100%	19	TRUE
Oakville	21	127	57	97	302	3%		0		0	100%	302		0	100%	302	100%	302	TRUE
Burlington	17	19	17	43	96	1%	20%	20		0	80%	76		0	100%	96	100%	96	TRUE
Total	2037	2219	2852	2711	9819	100%	39%	3784	18%	1766	9%	874	35%	3395	100%	9819	100%	9819	TRUE

To/From		Via	
North	39%	Cawthra Road	39%
South	18%	Cawthra Road	18%
West	9%	QEW	6%
		Lakeshore Road East	3%
East	35%	QWE	24%
		Lakeshore Road East	10%
Total	100%		100%























**APPENDIX G**  
**Future Total Synchro Analysis**  
Level Of Service Calculations

## Queues

## Future (2024) Total Conditions

## 1: Cawthra Road &amp; South Service Road

04/12/2018

											
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL	SBT	
Lane Configurations											
Traffic Volume (vph)	190	221	67	19	44	310	38	1515	250	1269	
Future Volume (vph)	190	221	67	19	44	310	38	1515	250	1269	
Lane Group Flow (vph)	190	221	67	19	44	310	38	1587	250	1371	
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA	pm+pt	NA	
Protected Phases	8				4				6	5	2
Permitted Phases	8	8		4	4		6	2			
Detector Phase	8	8	8	4	4	4	6	6	5	2	
Switch Phase											
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	15.0	15.0	5.0	15.0	
Minimum Split (s)	40.3	40.3	40.3	40.3	40.3	40.3	33.7	33.7	8.0	33.7	
Total Split (s)	59.0	59.0	59.0	59.0	59.0	59.0	74.0	74.0	27.0	101.0	
Total Split (%)	36.9%	36.9%	36.9%	36.9%	36.9%	36.9%	46.3%	46.3%	16.9%	63.1%	
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.0	4.0	
All-Red Time (s)	3.3	3.3	3.3	3.3	3.3	3.3	2.7	2.7	0.0	2.7	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	7.3	7.3	7.3	7.3	7.3	7.3	6.7	6.7	3.0	6.7	
Lead/Lag							Lag	Lag	Lead		
Lead-Lag Optimize?											
Recall Mode	None	None	None	None	None	None	Max	Max	Max	Max	
v/c Ratio	0.79	0.64	0.20	0.13	0.13	0.60	0.21	0.89	0.67	0.56	
Control Delay	73.7	58.8	14.0	46.4	45.0	11.4	24.1	37.3	42.9	10.9	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	73.7	58.8	14.0	46.4	45.0	11.4	24.1	37.3	42.9	10.9	
Queue Length 50th (m)	50.4	56.8	1.6	4.4	10.3	4.1	5.6	198.7	46.3	84.0	
Queue Length 95th (m)	78.3	84.2	14.4	12.2	21.2	31.3	16.0	#293.0	86.0	133.7	
Internal Link Dist (m)	46.2				94.2		211.0		85.8		
Turn Bay Length (m)	60.0			50.0			60.0	60.0			
Base Capacity (vph)	523	743	641	305	735	783	183	1787	372	2463	
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	
Reduced v/c Ratio	0.36	0.30	0.10	0.06	0.06	0.40	0.21	0.89	0.67	0.56	

## Intersection Summary

Cycle Length: 160

Actuated Cycle Length: 132.6

Natural Cycle: 115

Control Type: Semi Act-Uncoord

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 1: Cawthra Road &amp; South Service Road

 Ø2	 Ø4
101 s	59 s
 Ø5	 Ø8
27 s	59 s
 Ø6	
74 s	



























# HCM Signalized Intersection Capacity Analysis

Future (2024) Total Conditions

## 1: Cawthra Road & South Service Road

04/12/2018
















												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	190	221	67	19	44	310	38	1515	72	250	1269	102
Future Volume (vph)	190	221	67	19	44	310	38	1515	72	250	1269	102
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.7	3.7	3.5	3.7	3.7	3.5	3.7	3.7	3.5	3.7	3.7
Total Lost time (s)	7.3	7.3	7.3	7.3	7.3	7.3	6.7	6.7		3.0	6.7	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00	0.99	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1748	1902	1548	1782	1883	1549	1730	3510		1733	3452	
Flt Permitted	0.73	1.00	1.00	0.42	1.00	1.00	0.20	1.00		0.06	1.00	
Satd. Flow (perm)	1340	1902	1548	781	1883	1549	360	3510		103	3452	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	190	221	67	19	44	310	38	1515	72	250	1269	102
RTOR Reduction (vph)	0	0	49	0	0	239	0	2	0	0	3	0
Lane Group Flow (vph)	190	221	18	19	44	71	38	1585	0	250	1368	0
Confl. Peds. (#/hr)	1		2	2		1	5		2	2		5
Heavy Vehicles (%)	2%	1%	4%	0%	2%	4%	3%	3%	7%	3%	4%	8%
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA		pm+pt	NA	
Protected Phases		8			4			6		5	2	
Permitted Phases	8		8	4		4	6			2		
Actuated Green, G (s)	24.0	24.0	24.0	24.0	24.0	24.0	67.5	67.5		94.6	94.6	
Effective Green, g (s)	24.0	24.0	24.0	24.0	24.0	24.0	67.5	67.5		94.6	94.6	
Actuated g/C Ratio	0.18	0.18	0.18	0.18	0.18	0.18	0.51	0.51		0.71	0.71	
Clearance Time (s)	7.3	7.3	7.3	7.3	7.3	7.3	6.7	6.7		3.0	6.7	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	242	344	280	141	340	280	183	1786		369	2462	
v/s Ratio Prot		0.12			0.02			c0.45		c0.12	0.40	
v/s Ratio Perm	c0.14		0.01	0.02		0.05	0.11			0.36		
v/c Ratio	0.79	0.64	0.06	0.13	0.13	0.25	0.21	0.89		0.68	0.56	
Uniform Delay, d1	51.8	50.3	45.0	45.6	45.5	46.6	17.9	29.1		38.1	9.0	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	15.3	4.1	0.1	0.4	0.2	0.5	2.6	7.0		9.6	0.9	
Delay (s)	67.1	54.4	45.1	46.0	45.7	47.1	20.4	36.1		47.7	9.9	
Level of Service	E	D	D	D	D	D	C	D		D	A	
Approach Delay (s)		58.2			46.9			35.8			15.8	
Approach LOS		E			D			D			B	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			31.5									
HCM 2000 Volume to Capacity ratio			0.82									
Actuated Cycle Length (s)			132.6									
Intersection Capacity Utilization			92.0%									
Analysis Period (min)			15									
c Critical Lane Group												

## Queues

## Future (2024) Total Conditions

## 2: Cawthra Road &amp; Arbor Road/Arbor Crescent

04/12/2018

								
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	110	13	29	9	24	1384	106	1162
Future Volume (vph)	110	13	29	9	24	1384	106	1162
Lane Group Flow (vph)	0	155	29	100	24	1392	106	1236
Turn Type	Perm	NA	Perm	NA	Perm	NA	pm+pt	NA
Protected Phases		8		4		6	5	2
Permitted Phases	8		4		6		2	
Detector Phase	8	8	4	4	6	6	5	2
Switch Phase								
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	5.0	8.0
Minimum Split (s)	31.0	31.0	31.0	31.0	24.6	24.6	8.0	24.6
Total Split (s)	31.0	31.0	31.0	31.0	66.0	66.0	13.0	79.0
Total Split (%)	28.2%	28.2%	28.2%	28.2%	60.0%	60.0%	11.8%	71.8%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	3.0	4.0
All-Red Time (s)	3.0	3.0	3.0	3.0	2.6	2.6	0.0	2.6
Lost Time Adjust (s)		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)		7.0	7.0	7.0	6.6	6.6	3.0	6.6
Lead/Lag					Lag	Lag	Lead	
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Max	Max	None	Max
v/c Ratio		0.71	0.16	0.30	0.11	0.65	0.38	0.51
Control Delay		55.2	38.1	11.7	12.2	16.0	8.3	8.2
Queue Delay		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		55.2	38.1	11.7	12.2	16.0	8.3	8.2
Queue Length 50th (m)		28.8	5.3	1.6	1.9	91.8	5.1	53.2
Queue Length 95th (m)		50.8	13.7	15.8	7.5	145.9	12.7	87.2
Internal Link Dist (m)		155.8		91.3		153.1		254.7
Turn Bay Length (m)			15.0		25.0		45.0	
Base Capacity (vph)		319	276	453	220	2130	322	2445
Starvation Cap Reductn		0	0	0	0	0	0	0
Spillback Cap Reductn		0	0	0	0	0	0	0
Storage Cap Reductn		0	0	0	0	0	0	0
Reduced v/c Ratio		0.49	0.11	0.22	0.11	0.65	0.33	0.51

## Intersection Summary






Cycle Length: 110

Actuated Cycle Length: 102.5

Natural Cycle: 80

Control Type: Semi Act-Uncoord

Splits and Phases: 2: Cawthra Road &amp; Arbor Road/Arbor Crescent




















 Ø2		 Ø4
79 s		31 s
 Ø5	 Ø6	 Ø8
13 s	66 s	31 s

# HCM Signalized Intersection Capacity Analysis

## 2: Cawthra Road & Arbor Road/Arbor Crescent

Future (2024) Total Conditions

04/12/2018











												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	110	13	32	29	9	91	24	1384	8	106	1162	74
Future Volume (vph)	110	13	32	29	9	91	24	1384	8	106	1162	74
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.7	3.7	3.7	3.5	3.7	3.7	3.5	3.7	3.7	3.5	3.7	3.7
Total Lost time (s)		7.0		7.0	7.0		6.6	6.6		3.0	6.6	
Lane Util. Factor		1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		0.99		1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes		1.00		0.98	1.00		1.00	1.00		1.00	1.00	
Frt		0.97		1.00	0.86		1.00	1.00		1.00	0.99	
Flt Protected		0.97		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1763		1638	1639		1522	3504		1785	3448	
Flt Permitted		0.73		0.68	1.00		0.23	1.00		0.12	1.00	
Satd. Flow (perm)		1327		1179	1639		362	3504		230	3448	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	110	13	32	29	9	91	24	1384	8	106	1162	74
RTOR Reduction (vph)	0	9	0	0	77	0	0	0	0	0	3	0
Lane Group Flow (vph)	0	146	0	29	23	0	24	1392	0	106	1233	0
Confl. Peds. (#/hr)	1		20	20		1	5		6	6		5
Heavy Vehicles (%)	2%	0%	0%	7%	0%	0%	17%	4%	12%	0%	5%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		8			4			6		5	2	
Permitted Phases	8			4			6			2		
Actuated Green, G (s)		16.3		16.3	16.3		62.4	62.4		72.7	72.7	
Effective Green, g (s)		16.3		16.3	16.3		62.4	62.4		72.7	72.7	
Actuated g/C Ratio		0.16		0.16	0.16		0.61	0.61		0.71	0.71	
Clearance Time (s)		7.0		7.0	7.0		6.6	6.6		3.0	6.6	
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		210		187	260		220	2131		273	2443	
v/s Ratio Prot					0.01			c0.40		0.03	c0.36	
v/s Ratio Perm		c0.11		0.02			0.07			0.25		
v/c Ratio		0.69		0.16	0.09		0.11	0.65		0.39	0.50	
Uniform Delay, d1		40.8		37.2	36.8		8.4	13.1		8.6	6.8	
Progression Factor		1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		9.5		0.4	0.2		1.0	1.6		0.9	0.7	
Delay (s)		50.3		37.6	37.0		9.4	14.6		9.5	7.5	
Level of Service		D		D	D		A	B		A	A	
Approach Delay (s)		50.3			37.1			14.5			7.7	
Approach LOS		D			D			B			A	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			14.3									
HCM 2000 Volume to Capacity ratio			0.65									
Actuated Cycle Length (s)			102.6									
Intersection Capacity Utilization			76.9%									
Analysis Period (min)			15									
c Critical Lane Group												

# HCM Unsignalized Intersection Capacity Analysis

## 3: Cawthra Road & Future Site Access

Future (2024) Total Conditions

04/12/2018

























						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	6	3	0	1605	1349	3
Future Volume (Veh/h)	6	3	0	1605	1349	3
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	6	3	0	1605	1349	3
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				TWLTL	TWLTL	
Median storage veh				2	2	
Upstream signal (m)				279	235	
pX, platoon unblocked	0.82	0.81	0.81			
vC, conflicting volume	2153	676	1352			
vC1, stage 1 conf vol	1350					
vC2, stage 2 conf vol	802					
vCu, unblocked vol	927	140	972			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	100	100			
cM capacity (veh/h)	260	717	573			
Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	9	0	802	802	899	453
Volume Left	6	0	0	0	0	0
Volume Right	3	0	0	0	0	3
cSH	330	1700	1700	1700	1700	1700
Volume to Capacity	0.03	0.00	0.47	0.47	0.53	0.27
Queue Length 95th (m)	0.7	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	16.2	0.0	0.0	0.0	0.0	0.0
Lane LOS	C					
Approach Delay (s)	16.2	0.0			0.0	
Approach LOS	C					
Intersection Summary						
Average Delay			0.0			
Intersection Capacity Utilization			54.4%		ICU Level of Service	A
Analysis Period (min)			15			

# HCM Signalized Intersection Capacity Analysis

## 1: Cawthra Road & South Service Road

Future (2024) Total PM Peak Conditions

12/14/2019

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	83	92	38	62	82	263	32	975	26	277	1365	214
Future Volume (vph)	83	92	38	62	82	263	32	975	26	277	1365	214
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.5	3.7	3.7	3.5	3.7	3.7	3.5	3.7	3.7	3.5	3.7	3.7
Total Lost time (s)	7.3	7.3	7.3	7.3	7.3	7.3	6.7	6.7		3.0	6.7	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00		1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1767	1883	1608	1780	1921	1633	1784	3563		1785	3535	
Flt Permitted	0.70	1.00	1.00	0.70	1.00	1.00	0.16	1.00		0.15	1.00	
Satd. Flow (perm)	1309	1883	1608	1306	1921	1633	301	3563		288	3535	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	83	92	38	62	82	263	32	975	26	277	1365	214
RTOR Reduction (vph)	0	0	34	0	0	235	0	1	0	0	4	0
Lane Group Flow (vph)	83	92	4	62	82	28	32	1000	0	277	1575	0
Confl. Peds. (#/hr)			3	3			1					1
Heavy Vehicles (%)	1%	2%	0%	0%	0%	0%	0%	2%	4%	0%	1%	0%
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Perm	NA		pm+pt	NA	
Protected Phases		8			4			6		5	2	
Permitted Phases	8		8	4		4	6			2		
Actuated Green, G (s)	13.0	13.0	13.0	13.0	13.0	13.0	51.4	51.4		94.4	94.4	
Effective Green, g (s)	13.0	13.0	13.0	13.0	13.0	13.0	51.4	51.4		94.4	94.4	
Actuated g/C Ratio	0.11	0.11	0.11	0.11	0.11	0.11	0.42	0.42		0.78	0.78	
Clearance Time (s)	7.3	7.3	7.3	7.3	7.3	7.3	6.7	6.7		3.0	6.7	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	140	201	172	139	205	174	127	1508		717	2748	
v/s Ratio Prot		0.05			0.04			c0.28		0.13	c0.45	
v/s Ratio Perm	c0.06		0.00	0.05		0.02	0.11			0.17		
v/c Ratio	0.59	0.46	0.02	0.45	0.40	0.16	0.25	0.66		0.39	0.57	
Uniform Delay, d1	51.7	50.9	48.5	50.8	50.6	49.2	22.6	28.1		9.0	5.4	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	6.6	1.7	0.1	2.3	1.3	0.4	4.7	2.3		1.6	0.9	
Delay (s)	58.3	52.5	48.6	53.1	51.8	49.7	27.3	30.4		10.5	6.3	
Level of Service	E	D	D	D	D	D	C	C		B	A	
Approach Delay (s)		54.1			50.6			30.3			6.9	
Approach LOS		D			D			C			A	
<b>Intersection Summary</b>												
HCM 2000 Control Delay			21.7									
HCM 2000 Volume to Capacity ratio			0.62									
Actuated Cycle Length (s)			121.4									
Intersection Capacity Utilization			87.1%									
Analysis Period (min)			15									
c Critical Lane Group												

## Queues

## Future (2024) Total PM Peak Conditions

## 2: Cawthra Road &amp; Arbor Road/Arbor Crescent

12/14/2019



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBU	SBL	SBT
Lane Configurations		↔	↔	↔	↔	↔		↔	↔
Traffic Volume (vph)	35	2	12	3	25	1048	4	46	1230
Future Volume (vph)	35	2	12	3	25	1048	4	46	1230
Lane Group Flow (vph)	0	56	12	32	25	1074	0	50	1308
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	Perm	NA
Protected Phases		8		4		6			2
Permitted Phases	8		4		6		2	2	
Detector Phase	8	8	4	4	6	6	2	2	2
Switch Phase									
Minimum Initial (s)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Minimum Split (s)	31.0	31.0	31.0	31.0	24.6	24.6	24.6	24.6	24.6
Total Split (s)	31.0	31.0	31.0	31.0	79.0	79.0	79.0	79.0	79.0
Total Split (%)	28.2%	28.2%	28.2%	28.2%	71.8%	71.8%	71.8%	71.8%	71.8%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	3.0	3.0	3.0	3.0	2.6	2.6	2.6	2.6	2.6
Lost Time Adjust (s)		0.0	0.0	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)		7.0	7.0	7.0	6.6	6.6		6.6	6.6
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	None	None	None	None	Max	Max	Max	Max	Max
v/c Ratio		0.39	0.13	0.20	0.08	0.37		0.14	0.45
Control Delay		38.7	43.9	19.1	3.8	3.7		4.2	4.1
Queue Delay		0.0	0.0	0.0	0.0	0.0		0.0	0.0
Total Delay		38.7	43.9	19.1	3.8	3.7		4.2	4.1
Queue Length 50th (m)		7.6	2.4	0.6	1.0	28.0		2.0	37.4
Queue Length 95th (m)		18.9	7.8	9.4	3.6	43.3		6.1	57.4
Internal Link Dist (m)		155.8		91.3		153.1			254.7
Turn Bay Length (m)			15.0		25.0			45.0	
Base Capacity (vph)		352	240	382	298	2942		363	2937
Starvation Cap Reductn		0	0	0	0	0		0	0
Spillback Cap Reductn		0	0	0	0	0		0	0
Storage Cap Reductn		0	0	0	0	0		0	0
Reduced v/c Ratio		0.16	0.05	0.08	0.08	0.37		0.14	0.45

## Intersection Summary

Cycle Length: 110

Actuated Cycle Length: 100.4

Natural Cycle: 65

Control Type: Semi Act-Uncoord

Splits and Phases: 2: Cawthra Road &amp; Arbor Road/Arbor Crescent



# HCM Signalized Intersection Capacity Analysis

## 2: Cawthra Road & Arbor Road/Arbor Crescent

Future (2024) Total PM Peak Conditions

12/14/2019



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBU	SBL	SBT
Lane Configurations		↔		↔	↔		↔	↔			↔	↔
Traffic Volume (vph)	35	2	19	12	3	29	25	1048	26	4	46	1230
Future Volume (vph)	35	2	19	12	3	29	25	1048	26	4	46	1230
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	3.7	3.7	3.7	3.5	3.7	3.7	3.5	3.7	3.7	3.7	3.5	3.7
Total Lost time (s)		7.0		7.0	7.0		6.6	6.6			6.6	6.6
Lane Util. Factor		1.00		1.00	1.00		1.00	0.95			1.00	0.95
Frpb, ped/bikes		0.99		1.00	0.99		1.00	1.00			1.00	1.00
Flpb, ped/bikes		1.00		0.99	1.00		1.00	1.00			1.00	1.00
Frt		0.95		1.00	0.86		1.00	1.00			1.00	0.99
Flt Protected		0.97		0.95	1.00		0.95	1.00			0.95	1.00
Satd. Flow (prot)		1730		1328	1504		1784	3589			1642	3579
Flt Permitted		0.79		0.72	1.00		0.19	1.00			0.26	1.00
Satd. Flow (perm)		1411		1007	1504		364	3589			443	3579
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	35	2	19	12	3	29	25	1048	26	4	46	1230
RTOR Reduction (vph)	0	18	0	0	27	0	0	1	0	0	0	2
Lane Group Flow (vph)	0	38	0	12	5	0	25	1073	0	0	50	1306
Confl. Peds. (#/hr)	1		9	9		1	1		4		4	
Heavy Vehicles (%)	3%	0%	0%	33%	0%	10%	0%	1%	12%	2%	9%	1%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	Perm	NA
Protected Phases		8			4			6				2
Permitted Phases	8			4			6		2		2	
Actuated Green, G (s)		7.3		7.3	7.3		81.0	81.0			81.0	81.0
Effective Green, g (s)		7.3		7.3	7.3		81.0	81.0			81.0	81.0
Actuated g/C Ratio		0.07		0.07	0.07		0.79	0.79			0.79	0.79
Clearance Time (s)		7.0		7.0	7.0		6.6	6.6			6.6	6.6
Vehicle Extension (s)		3.0		3.0	3.0		3.0	3.0			3.0	3.0
Lane Grp Cap (vph)		101		72	107		289	2852			352	2844
v/s Ratio Prot					0.00			0.30				c0.36
v/s Ratio Perm		c0.03		0.01			0.07				0.11	
v/c Ratio		0.38		0.17	0.05		0.09	0.38			0.14	0.46
Uniform Delay, d1		45.1		44.4	44.1		2.3	3.1			2.4	3.4
Progression Factor		1.00		1.00	1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2		2.4		1.1	0.2		0.6	0.4			0.8	0.5
Delay (s)		47.5		45.5	44.2		2.9	3.4			3.3	3.9
Level of Service		D		D	D		A	A			A	A
Approach Delay (s)		47.5			44.6			3.4				3.9
Approach LOS		D			D			A				A

### Intersection Summary

HCM 2000 Control Delay	5.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	101.9	Sum of lost time (s)	13.6
Intersection Capacity Utilization	65.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			



# HCM Signalized Intersection Capacity Analysis

## 2: Cawthra Road & Arbor Road/Arbor Crescent

Future (2024) Total PM Peak Conditions  
12/14/2019











Movement	SBR
Lane Configurations	
Traffic Volume (vph)	78
Future Volume (vph)	78
Ideal Flow (vphpl)	1900
Lane Width	3.7
Total Lost time (s)	
Lane Util. Factor	
Frpb, ped/bikes	
Flpb, ped/bikes	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Peak-hour factor, PHF	1.00
Adj. Flow (vph)	78
RTOR Reduction (vph)	0
Lane Group Flow (vph)	0
Confl. Peds. (#/hr)	1
Heavy Vehicles (%)	0%
Turn Type	
Protected Phases	
Permitted Phases	
Actuated Green, G (s)	
Effective Green, g (s)	
Actuated g/C Ratio	
Clearance Time (s)	
Vehicle Extension (s)	
Lane Grp Cap (vph)	
v/s Ratio Prot	
v/s Ratio Perm	
v/c Ratio	
Uniform Delay, d1	
Progression Factor	
Incremental Delay, d2	
Delay (s)	
Level of Service	
Approach Delay (s)	
Approach LOS	
Intersection Summary	

# HCM Unsignalized Intersection Capacity Analysis

## 3: Cawthra Road & Future Site Access

Future (2024) Total PM Peak Conditions

12/14/2019

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	1	2	1077	1410	5
Future Volume (Veh/h)	0	1	2	1077	1410	5
Sign Control	Stop			Free		Free
Grade	0%			0%		0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	1	2	1077	1410	5
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type						
				TWLT	TWLT	
Median storage veh				2	2	
Upstream signal (m)				279	235	
pX, platoon unblocked	0.86	0.83	0.83			
vC, conflicting volume	1955	708	1415			
vC1, stage 1 conf vol	1412					
vC2, stage 2 conf vol	542					
vCu, unblocked vol	1445	243	1094			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	100	100			
cM capacity (veh/h)	224	630	527			
Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	1	2	538	538	940	475
Volume Left	0	2	0	0	0	0
Volume Right	1	0	0	0	0	5
cSH	630	527	1700	1700	1700	1700
Volume to Capacity	0.00	0.00	0.32	0.32	0.55	0.28
Queue Length 95th (m)	0.0	0.1	0.0	0.0	0.0	0.0
Control Delay (s)	10.7	11.9	0.0	0.0	0.0	0.0
Lane LOS	B	B				
Approach Delay (s)	10.7	0.0			0.0	
Approach LOS	B					
Intersection Summary						
Average Delay			0.0			
Intersection Capacity Utilization			49.1%		ICU Level of Service	A
Analysis Period (min)			15			