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Thornbury Acres

TRAFFIC IMPACT BRIEF

Thornbury Acres Holding Inc.

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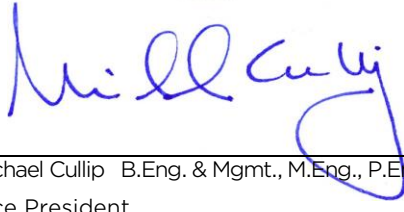
December
20, 2022

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Issue	Date	Description
1	December 20, 2022	Final Report

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1 Introduction

Tatham Engineering Limited was retained by Thornbury Acres Holding Inc. to prepare a Traffic Impact Brief in support of a proposed residential development to be located at the southeast corner of the intersection of Grey Road 2 and Grey Road 40 in the Town of The Blue Mountains. The location of the development is illustrated in Figure 1.

The purpose of this study is to review to the proposed development from a transportation perspective. Recognizing that the trip generation associated with this development will not be significant, the scope of this study has been reduced to a traffic brief with a focus on the following:

- existing conditions, including a description of the study area road network, traffic volumes, operations, and any planned/proposed improvements;
- details of the proposed development and anticipated trip generation; and
- transportation impacts associated with the proposed development.



2 Existing Conditions

This chapter will discuss the road network, traffic volumes, and operations for the existing conditions.

2.1 ROAD NETWORK

The road network to be addressed by this study consists of Grey County Road 2 (Grey Road 2), Grey County Road 40 (Grey Road 40) and their respective intersection. Aerial photographs of the road system are provided in Figure 2.

Road Sections

Grey Road 2 is oriented north-south through the study area, whereas Grey Road 40 is oriented east-west. Each road has a 2-lane rural cross-section (gravel shoulders and open ditches) providing one lane of travel per direction. A speed limit of 80 km/h is posted on each road thus a design speed of 100 km/h is assumed (posted speed limit + 20 km/h on higher-speed roads). As per the *County of Grey Official Plan*¹, both Grey Road 2 and Grey Road 40 are classified as County Arterial roads. Based on this classification, a planning capacity in the order of 800 to 1000 vehicles per hour per lane (vphpl) is considered appropriate.

Key Intersection

The intersection of Grey Road 2 and Grey Road 40 is a 4-leg, unsignalized intersection with stop control on Grey Road 40 (i.e. 2-way stop control on the west and east legs). Each approach consists of a single shared left-through-right turn lane.

2.2 TRAFFIC VOLUMES

To determine existing volumes, traffic counts were conducted at the intersection of Grey Road 2 and Grey Road 40 from 07:30 to 09:30 on Wednesday November 9, 2022, and from 15:00 to 17:00 on Tuesday November 8, 2022. The observed 2022 volumes are illustrated in Figure 3 with detailed count sheets provided in Appendix A.

Recognizing that these counts were conducted in November and that the Thornbury area is a popular summer tourism destination, the need for a seasonal volume adjustment was assessed. The volumes along Grey Road 2 at Grey Road 40 were compared to summer volumes observed approximately 1.8 km north at the intersection of Grey Road 2 and Clark Street. The traffic counts

¹ *Recolour Grey - County of Grey Official Plan*. Grey County Planning & Development Department. June 2019



at Grey Road 2 and Clark Street were conducted in August 2022 (i.e. during the peak summer season), with volumes on Grey Road 2 observed to be approximately 30% greater than the November volumes observed on Grey Road 2 at Grey Road 40. Recognizing that there is minimal development along Grey Road 2 between Grey Road 40 and Clark Street, it is reasonable to assume that the observed increase is representative of increased summer traffic volumes. Therefore, to represent peak summer conditions, the November volumes observed at the intersection of Grey Road 2 and Grey Road 40 were increased by a factor of 1.3 (i.e. increased by 30%).

The 2022 volumes, adjusted to summer conditions, are illustrated in Figure 4.

2.3 TRAFFIC OPERATIONS

The capacity, and hence operations, of a road system is effectively governed by its intersections. To provide a baseline from which the future traffic operations can be assessed, the existing intersection operations were reviewed based on the following:

- the 2022 summer traffic volumes;
- the existing intersection configuration and control; and
- procedures outlined in the *2000 Highway Capacity Manual*² (using Synchro v.11 software).

For unsignalized intersections, the analysis considers:

- the average delay (measured in seconds);
- level of service (LOS); and
- volume to capacity (v/c) for critical movements (i.e. those operating under stop control and those including left turns).

With respect to the noted metrics:

- level of service 'A' corresponds to the best operating condition with minimal delays whereas level of service 'F' corresponds to poor operations resulting from high intersection delays (additional details regarding Level of Service definitions are provided in Appendix B); and
- a v/c ratio of less than 1.0 indicates the intersection movement/approach is operating at less than capacity while v/c of 1.0 indicates capacity has been reached.

A summary of the analysis is provided in Table 1 with detailed operational worksheets provided in Appendix C.

² *Highway Capacity Manual*. Transportation Research Board, Washington DC, 2000.



Table 1: Intersection Operations – 2022

INTERSECTION, MOVEMENTS & CONTROL			WEEKDAY AM PEAK HOUR			WEEKDAY PM PEAK HOUR		
			Delay	LOS	v/c	Delay	LOS	v/c
Grey Road 2 & Grey Road 40	EB LTR	stop	13	B	0.21	14	B	0.28
	WB LTR	stop	13	B	0.19	16	C	0.33
	NB LTR	free	2	A	0.02	2	A	0.03
	SB LTR	free	2	A	0.02	1	A	0.01

As indicated, the intersection currently provides good operations (LOS C or better) with minor delays during peak times. Therefore, no improvements are required to accommodate the existing conditions.



3 Proposed Development

This chapter will provide additional details regarding the proposed development, including its location, projected site-generated traffic volumes, and the assignment of said volumes to the adjacent road network.

3.1 LOCATION

The subject site consists of approximately 151.6 ha of land located at the southeast corner of the intersection of Grey Road 2 and Grey Road 40, as illustrated in Figure 1. The site consists of 3 properties defined legally as parts of Concession 8, Lot 27, Geographic Township of Collingwood, Town of The Blue Mountains. The development is bounded by Grey Road 40 to the north, Grey Road 2 to the west, agricultural development to the south, and undeveloped property to the east.

3.2 LAND-USE

The proposed development is to consist of 37 homesteads located within an agricultural and eco-centric development, which will include community-operated greenhouses, orchards, trails, and pavilions.

A site plan is illustrated in Figure 5.

3.3 SITE ACCESS & CIRCULATION

Access to the site will be provided by two new access points as follows:

- the West Access will be located at the western limit of the site on Grey Road 2, approximately 360 metres south of Grey Road 40;
- the North Access will be located at the northern limit of the site on Grey Road 40, approximately 250 metres east of Grey Road 2; and
- each access will allow full movements and be designed to the appropriate County standards.

Internal roads serving the site will be designed to the appropriate Town standards for a 9-metre rural cross-section (6-metre paved width with 1.5-metre shoulders, employing 12-metre centreline curve radii in accordance with requirements set forth in the *Ontario Building Code* for a fire access route). As such, the internal roads will readily accommodate two-way traffic operations and the manoeuvring requirements of typical design vehicles, such as garbage trucks, single-unit trucks and emergency response vehicles.



3.4 SITE TRAFFIC

3.4.1 Trip Generation

The number of vehicle trips to be generated by the proposed development for the weekday AM and weekday PM peak hours has been determined based on the type of use, development size, and trip generation rates per the *ITE Trip Generation Manual*³. Based on the proposed development, trip rates for the *single-family detached* (ITE land-use code 210) land-use have been applied. Trip rates and trip generation for the site are summarized in Table 2.

Table 2: Trip Estimates

LAND USE	VARIABLE/ SIZE	WEEKDAY AM PEAK HOUR			WEEKDAY PM PEAK HOUR		
		In	Out	Total	In	Out	Total
single-family detached (ITE 210)	per unit	0.18	0.52	0.70	0.59	0.35	0.94
	37 units	7	19	26	22	13	35

As indicated, the proposed development is expected to generate 26 trips during the weekday AM peak hour and 35 trips during the weekday PM peak hour. It is noted that the community-operated amenities (i.e. greenhouses, orchards, trails and pavilions) are intended for internal use and thus not expected to generate any material volumes external to the subject site.

3.4.2 Trip Distribution & Assignment

The distribution of new trips generated by the site has been developed based on the proximity and location of the site in relation to major built-up areas (i.e. Thornbury and Collingwood), which are expected to be the main origin/destination of site-generated trips. The following distribution has been applied (primarily oriented to/from the north and east):

- to/from the north via Grey Road 2 - 40%;
- to/from the south via Grey Road 2 - 10%;
- to/from the east via Grey Road 40 - 40%; and
- to/from the west via Grey Road 40 - 10%.

Assignment of the site trips to the road network is based on the noted trip distribution, the site layout and expected travel routes, the results of which are illustrated in Figure 6.

³ *Trip Generation Manual, 11th Edition*. Institute of Transportation Engineers. September 2021.



4 Future Conditions

This chapter will address the future conditions with consideration for the proposed development, and the resulting impacts of such on the adjacent road system. The following areas will be addressed:

- traffic volumes;
- intersection operations;
- available sight lines at each site access; and
- potential improvements to the study area road network, if necessary.

4.1 TRAFFIC VOLUMES

Given the limited traffic to be generated by the development, a 5-year planning horizon is considered sufficient in establishing the potential impacts to the surrounding road network.

4.1.1 Background Growth

Based on census data from 2016 and 2021, the population of the Town of The Blue Mountains increased from 6,453 persons in 2011 to 7,025 persons in 2016 and to 9,390 persons in 2021. This translates to a growth rate of approximately 1.7% per annum from 2011 to 2016, 6% per annum from 2016 to 2021, and 3.8% per annum from 2011 to 2021.

Grey County's *Official Plan* indicates a 2038 population forecast of 9,100 persons for the Town which translates to an annual growth rate of 1.3% when considering the 2016 census population of 7,025 persons. As noted above, the 2021 census data indicates that the Town's population has already surpassed the 2038 population forecast.

As per the *Update to the Grey County Growth Management Strategy Update*⁴, the Town's population is projected to increase from 9,550 in 2021 (slightly greater than the census data) to 16,300 by 2046, reflective of an annual growth of 2.1%.

As per the Town's *Development Charges Background Study*⁵, the Town is expected to see an overall growth of 3.5% per annum between 2019 and 2028. Most of this growth is to be concentrated in the Craigeleith area – approximately 74% of all growth up to 2028. Minimal growth is expected in rural areas (less than 1% up to 2028), within which the subject site is located.

⁴ *Update to the Grey County Growth Management Strategy Memorandum*, Hemson Consulting Ltd. July 14, 2021.

⁵ *Development Charges Background Study*. Hemson Consulting. June 12, 2019.



Based on the assessment above, an annual growth rate of 2% has been applied to the traffic volumes on each of Grey Road 2 and Grey Road 40 within the study area.

4.1.2 Future Traffic Volumes

The resulting 2027 traffic volumes are illustrated in Figure 7. The volumes are based on the 2022 traffic volumes adjusted to reflect the noted background growth rate and the additional traffic volumes generated by the subject development.

4.2 TRAFFIC OPERATIONS

The intersection of Grey Road 2 and Grey Road 40 was analyzed again under future conditions. In addition, each site access was assessed to ensure that they provide acceptable operations. Results of the operational analyses are summarized in Table 3 with detailed worksheets provided in Appendix D.

Table 3: Intersection Operations – 2027

INTERSECTION, MOVEMENTS & CONTROL			WEEKDAY AM PEAK HOUR			WEEKDAY PM PEAK HOUR		
			Delay	LOS	v/c	Delay	LOS	v/c
Grey Road 2 & Grey Road 40	EB LTR	stop	14	B	0.25	16	C	0.35
	WB LTR	stop	14	B	0.22	19	C	0.41
	NB LTR	free	2	A	0.02	2	A	0.04
	SB LTR	free	2	A	0.02	1	A	0.01
Grey Road 40 & North Access	WB LT	free	1	A	0.00	1	A	0.01
	NB LR	stop	9	A	0.01	9	A	0.01
Grey Road 2 & West Access	WB LR	stop	9	A	0.01	9	A	0.01
	SB LT	free	1	A	0.00	1	A	0.01

As indicated, the key intersection is expected to continue to provide good operations (LOS C or better) with minor delays and the site access points are expected to provide excellent operations (LOS A) with minimal delays. Therefore, no improvements are required to accommodate the future conditions.



4.3 TURN LANE REQUIREMENTS

Despite the otherwise good operations anticipated at each site access, the need for exclusive left and right turn lanes at each access has been reviewed based on Transportation Association of Canada (TAC) and MTO warrants. The review is based on the following:

- TAC & MTO guidelines⁶ for auxiliary turn lanes at unsignalized intersections; and
- a design speed of 100 km/h (reflective of the 80km/h posted speed on each road).

4.3.1 Left Turn Lanes

For unsignalized intersections on two-lane undivided highways, MTO warrants are based on design speed, the volume of left turning traffic, advancing volume (i.e. traffic travelling in the same direction as the left-turning traffic) and opposing volume (i.e. traffic travelling in the opposite direction as the left-turning traffic). The completed left turn warrants are provided in Appendix E.

Given the low left turning volumes (less than 10 vehicles per hour as per Figure 7) coupled with reduced advancing and opposing volumes (in the order of 160 vehicles per hour or fewer, per direction) at each intersection, dedicated left turn lanes are not warranted at either site access.

4.3.2 Right Turn Lanes

MTO guidelines suggest that an exclusive right turn lane be considered where right turning volumes exceed 60 vehicles per hour (vph) and/or impede the operations of through traffic. As per the volume projections of Figure 7 the right turning volumes at each access are in the order of 1 to 2 right turns per hour – well below the 60 vph threshold. Therefore, right turn lanes are not necessary to serve the proposed development.

4.4 SIGHT LINE ASSESSMENT

The sight line assessment has considered minimum stopping sight distance and intersection sight distance requirements as per the TAC *Geometric Design Guide for Canadian Roads*⁷, in addition to minimum stopping sight distance requirements as per Grey County, all of which are further explained below.

- Minimum stopping sight distance provides sufficient distance for an approaching motorist to observe a hazard in the road and bring their vehicle to a complete stop prior to the hazard.

⁶ MTO Design Supplement for TAC GDG for Canadian Roads. Ontario Ministry of Transportation. April 2020.

⁷ Geometric Design Guide for Canadian Roads, Chapter 9. Transportation Association of Canada. June 2017.



- Intersection sight distance allows a vehicle to enter a main road from a side street (or site access) and attain the appropriate operating speed without significantly impacting the operating speed of an approaching vehicle.

Table 4 summarizes the sight distance requirements for a posted speed of 80 km/h (design speed of 100 km/h) as is currently posted on Grey Road 2 and Grey Road 40 whereas the available sight lines to/from each site access are summarized in Table 5 and illustrated in Figure 8.

Table 4: Sight Distance Requirements

POSTED SPEED	DESIGN SPEED	COUNTY SIGHT DISTANCE	TAC STOPPING SIGHT DISTANCE	TAC INTERSECTION SIGHT DISTANCE	
				Left Turn	Right Turn
80 km/h	100 km/h	175 m	185 m	210 m	185 m

Table 5: Available Sight Distances

ACCESS	AVAILABLE SIGHT DISTANCE TO/FROM			
	North	South	East	West
North Access	-	-	>250m	>250m
West Access	>250m	>250m	-	-

As indicated, the available sight lines at each access exceed the County and TAC requirements, thus no improvements are required.



5 Summary

Proposed Development

This study has addressed the transportation impacts associated with the proposed residential development to be located at the southeast corner of the intersection of Grey Road 2 and Grey Road 40 in the Town of The Blue Mountains. The proposed development consists of 37 homesteads located within a larger eco-centric community. Upon completion, the development is expected to generate 26 trips during the weekday AM peak hour and 35 trips during the weekday PM peak hour.

Transportation Impacts

To assess the impact of the proposed development, the operations of the intersection of Grey Road 2 and Grey Road 40 were analyzed under existing (2022) and future horizon (2027) periods. The results of the operational assessment indicate that the intersection currently provides good operations (LOS C or better) and is expected to continue to provide good operations (LOS C or better) through the 2027 horizon. No improvements are required to accommodate the existing or future traffic volumes.

In addition, the operations of the two proposed site access points were also analyzed under the future horizon period, the results of which indicate that each access is expected to provide excellent operations (LOS A) through the 2027 horizon.

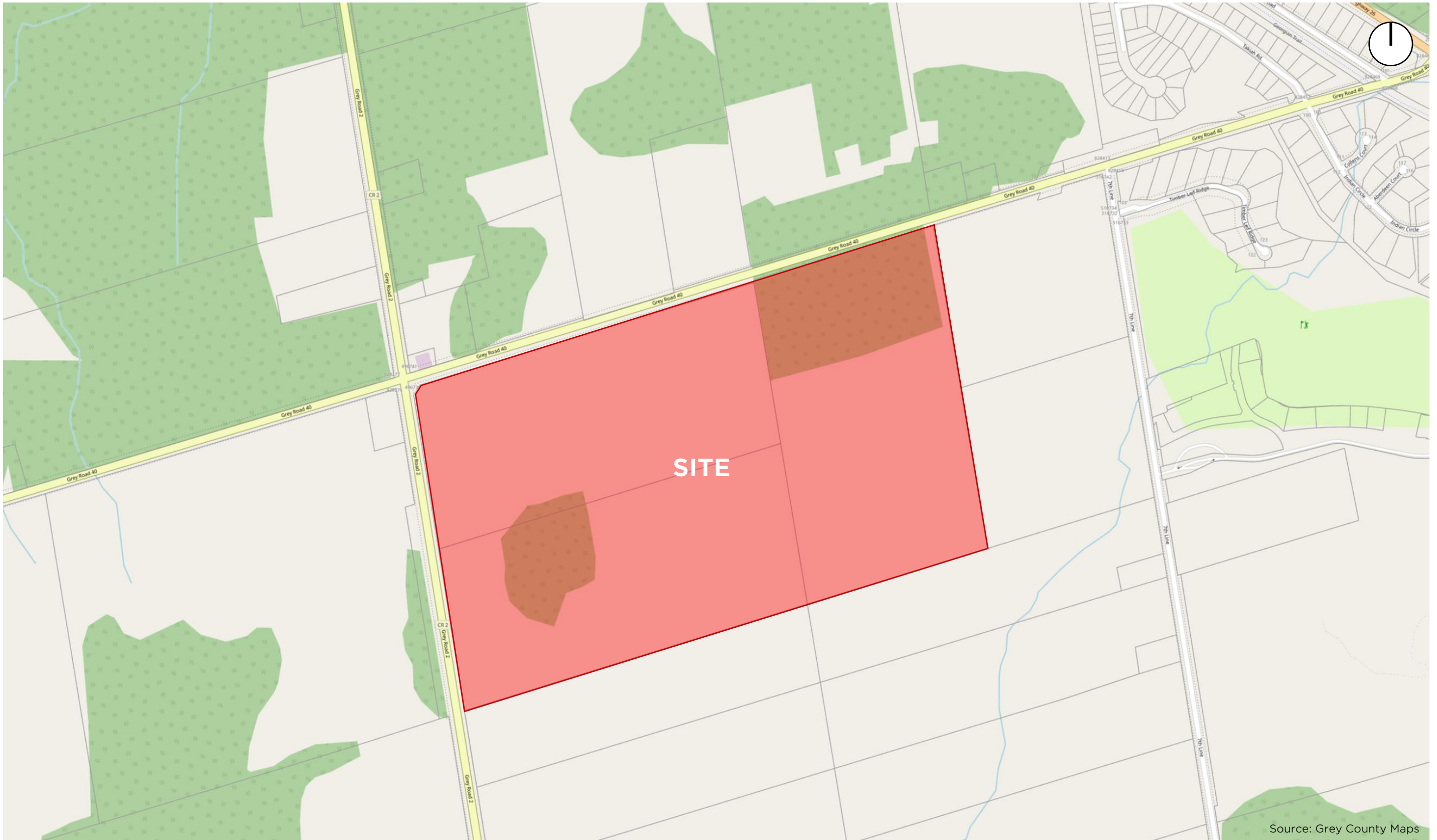
Turn Lane Requirements

The need for exclusive left and/or right turn lanes at each proposed site access was reviewed in context of TAC warrants. Based on the review, exclusive turn lanes are not required to serve the subject development.

Sight Line Assessment

Sight lines at each of the proposed site access points were reviewed in context of County and TAC requirements for minimum stopping and intersection sight distances. Based on the review, the sight lines at each access were found to be adequate in that they exceed the minimum requirements (and thus approaching and departing vehicles can readily see one another and manoeuvre safely to/from the site).





Source: Grey County Maps

THORNBURY ACRES
Figure 1: Site Location





THORNBURY ACRES

Figure 2A: Road Network





Intersection of Grey Road 2 and Grey Road 40 – north and east legs



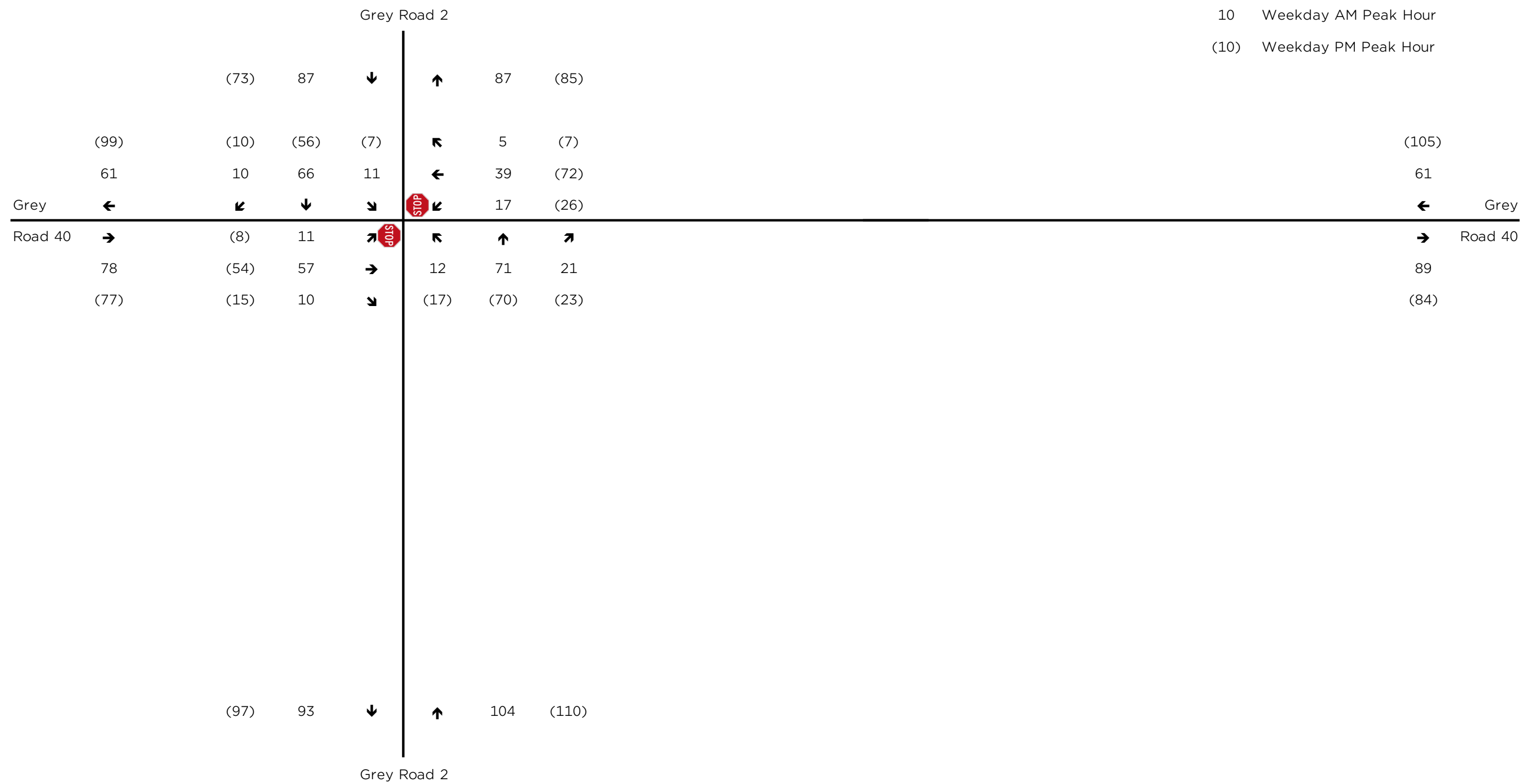
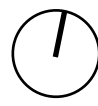
Source: Google Streetview

Intersection of Grey Road 2 and Grey Road 40 – south and west legs

THORNBURY ACRES

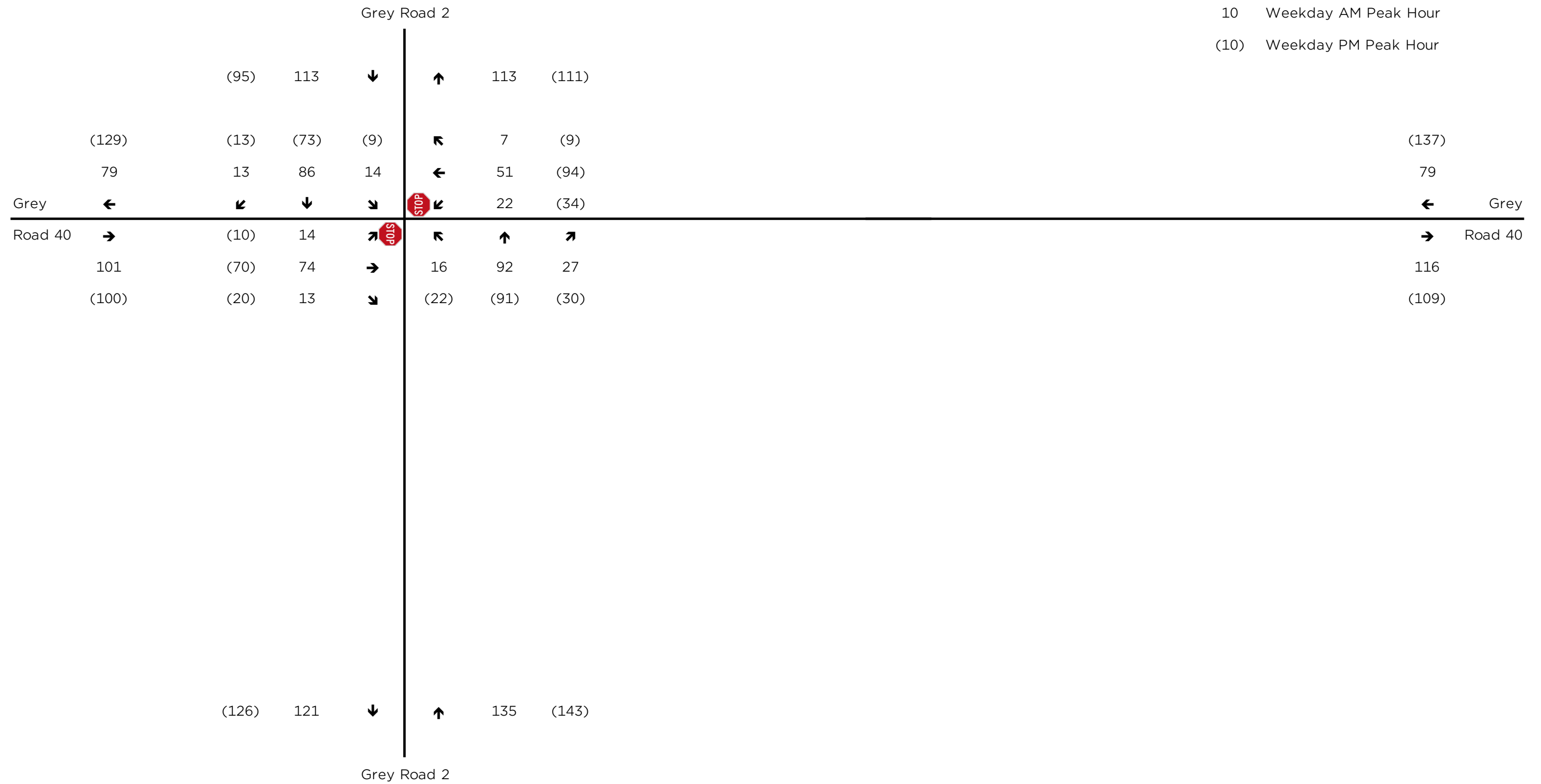
Figure 2B: Road Network

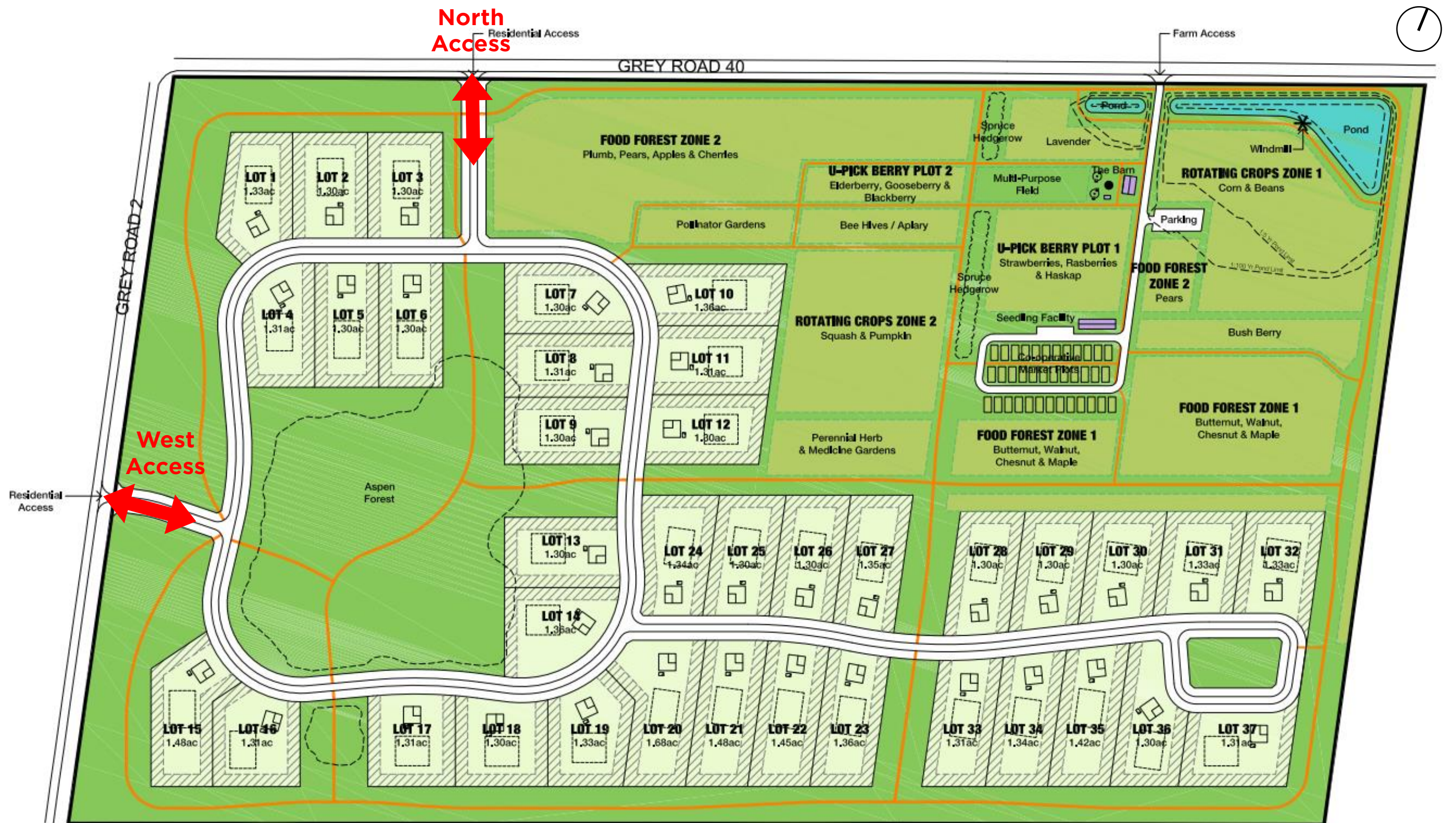




THORNBURY ACRES
Figure 3: Traffic Volumes – 2022 Observed



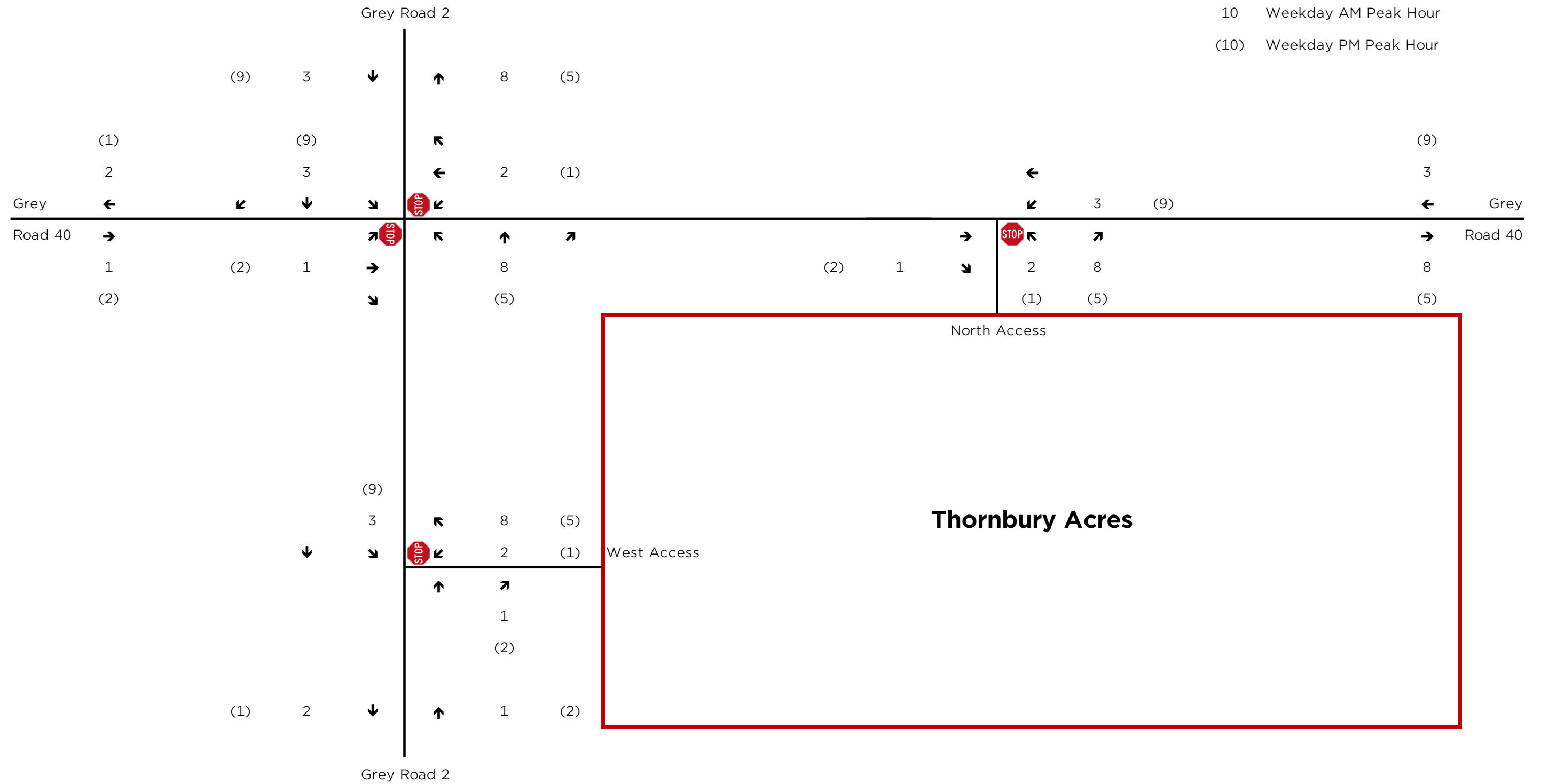


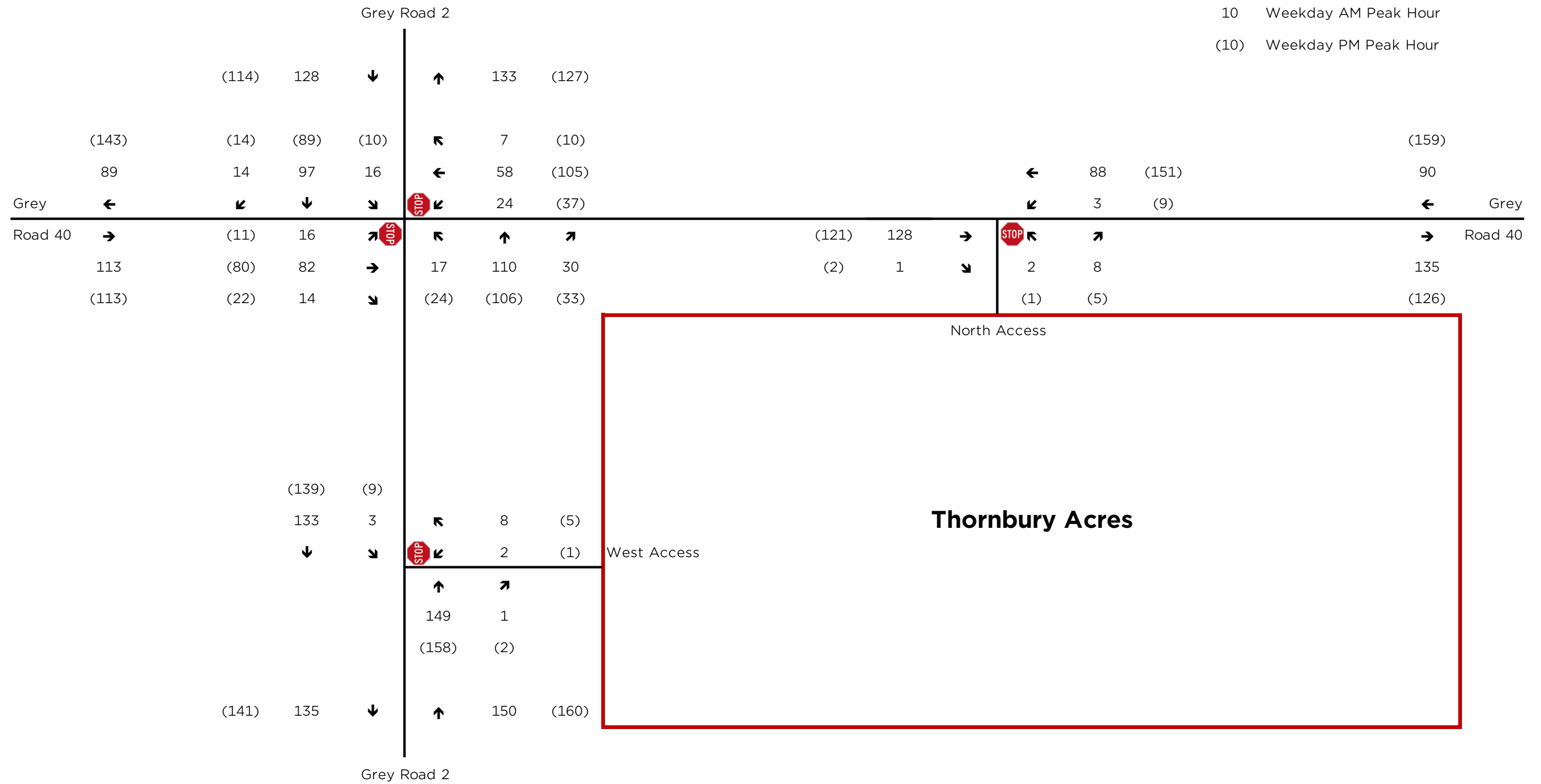


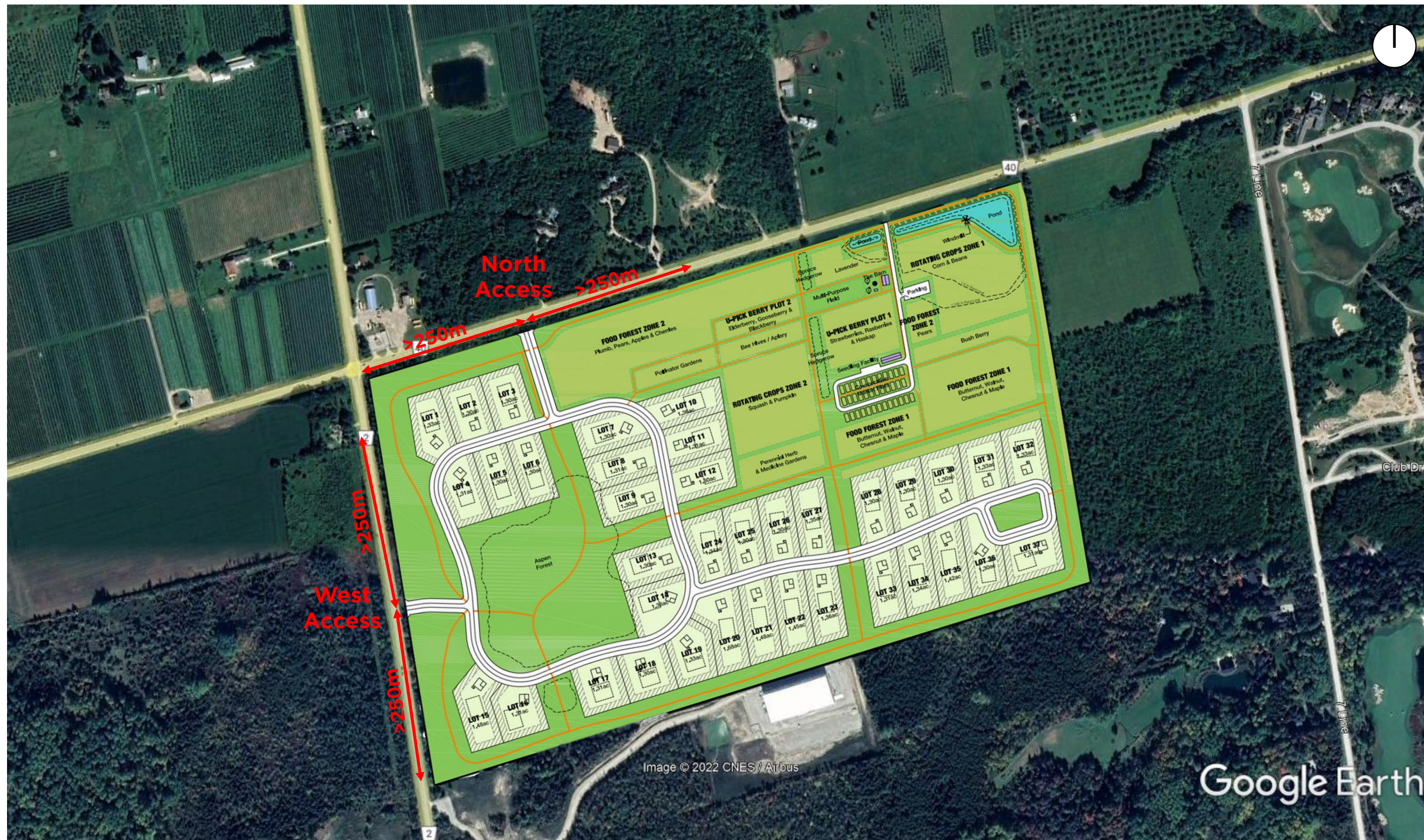
THORBURY ACRES

Figure 5: Site Plan









THORNBURY ACRES
Figure 8: Sight Lines



Appendix A: Traffic Counts

GENERAL INFORMATION			
Surveyor Name	Hunter Yovanovich	Jurisdiction/Date	Grey CountyNovember 08/09, 2022
Weather Conditions	Sunny, 5-10°C	Major Street	Grey Road 2N-S
Project Name	Thornbury Acres	Minor Street	Grey Road 40E-W
Project Number	120251	Intersection Control	stop control on minor street
Additional Comments			

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PM COUNT		Grey Road 40						Grey Road 2						TOTAL	HOUR TOTAL
		EASTBOUND			WESTBOUND			NORTHBOUND			SOUTHBOUND				
15:00 lane configuration	to 17:00	left	thru LTR	right	left	thru LTR	right	left	thru LTR	right	left	thru LTR	right		
15:00 -	15:15	1	9	1	6	14	1	1	16	4	3	9	7	72	316 344 331 336 365
15:15 -	15:30	4	13	2	7	18	3	1	17	4	3	17	4	93	
15:30 -	15:45	6	10	4	6	20	2	6	10	2	4	19	5	94	
15:45 -	16:00	2	8	2	2	6	2	0	10	5	0	15	5	57	
16:00 -	16:15	2	14	3	6	15	3	3	26	5	2	17	4	100	
16:15 -	16:30	3	10	1	4	19	2	3	19	5	3	9	2	80	
16:30 -	16:45	2	20	8	9	19	1	2	10	7	0	19	2	99	
16:45 -	17:00	1	10	3	7	19	1	9	15	6	2	11	2	86	
-	-														
-	-														
-	-														
-	-														
-	-														
-	-														
PM PEAK HOUR															
16:00 to	17:00 total	8	54	15	26	72	7	17	70	23	7	56	10	365	365
			77			105			110			73			
light trucks		0	2	1	0	2	1	2	2	3	1	2	2	18	
heavy trucks		1	0	0	1	0	0	0	0	0	1	1	0	4	
% trucks		13%	4%	7%	4%	3%	14%	12%	3%	13%	29%	5%	20%	6%	
	total		5%			4%			6%			10%			

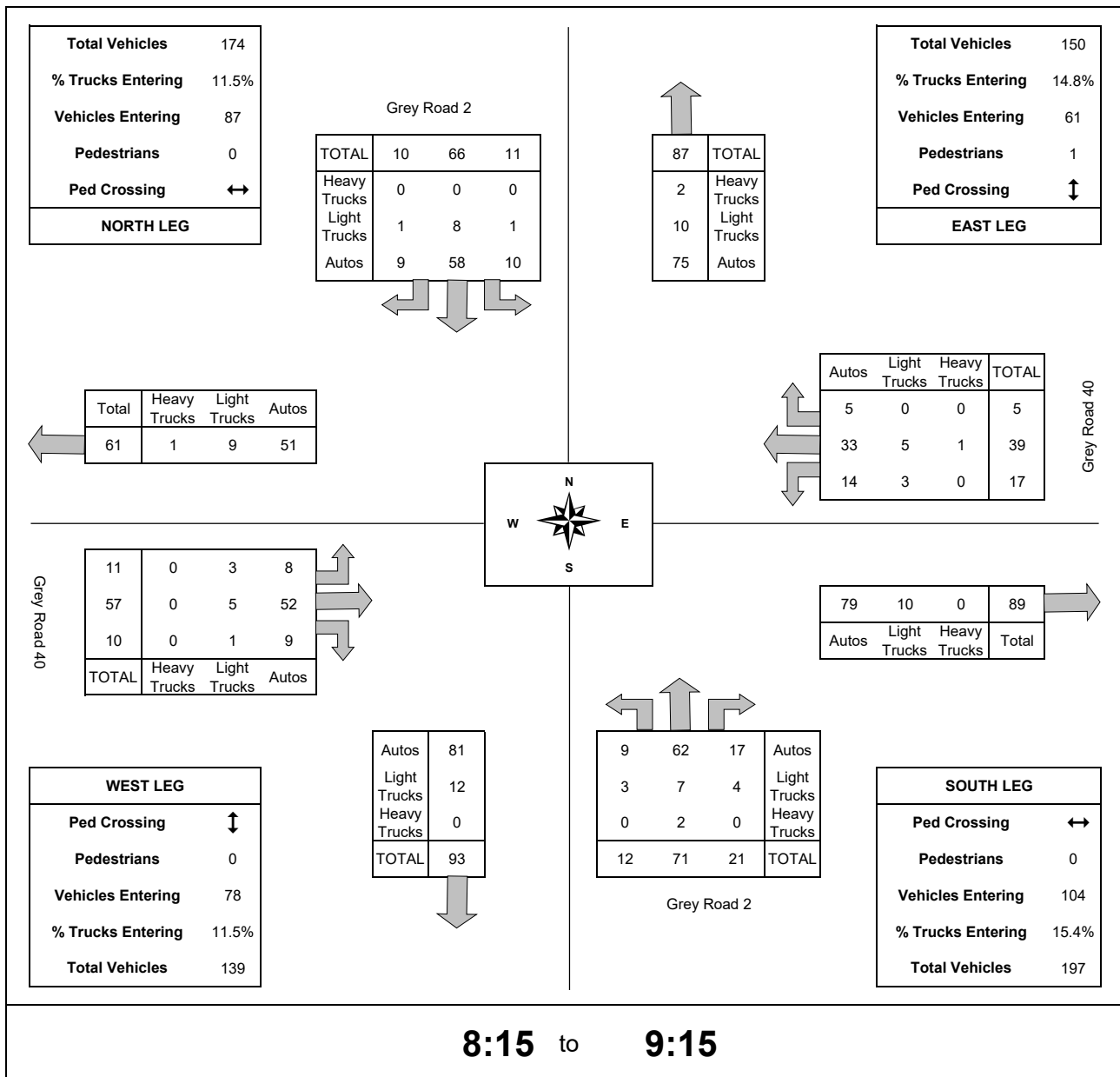
MID-DAY COUNT		Grey Road 40						Grey Road 2						TOTAL	HOUR TOTAL
		EASTBOUND			WESTBOUND			NORTHBOUND			SOUTHBOUND				
11:00 to 13:00 lane configuration		left	thru	right	left	thru	right	left	thru	right	left	thru	right		
		LTR			LTR			LTR			LTR				
11:00	- 11:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0 0 0 0 0 0 0
11:15	- 11:30	0	0	0	0	0	0	0	0	0	0	0	0	0	
11:30	- 11:45	0	0	0	0	0	0	0	0	0	0	0	0	0	
11:45	- 12:00	0	0	0	0	0	0	0	0	0	0	0	0	0	
12:00	- 12:15	0	0	0	0	0	0	0	0	0	0	0	0	0	
12:15	- 12:30	0	0	0	0	0	0	0	0	0	0	0	0	0	
12:30	- 12:45	0	0	0	0	0	0	0	0	0	0	0	0	0	
12:45	- 13:00	0	0	0	0	0	0	0	0	0	0	0	0	0	
-	- -														
-	- -														
-	- -														
-	- -														
-	- -														
MID-DAY PEAK HOUR															
11:00 to 12:00		0	0	0	0	0	0	0	0	0	0	0	0	0	0
total			0			0			0			0			
light trucks		0	0	0	0	0	0	0	0	0	0	0	0	0	
heavy trucks		0	0	0	0	0	0	0	0	0	0	0	0	0	
% trucks															
total															

INTERSECTION COUNT AM PEAK HOUR

GENERAL INFORMATION

Surveyor Name	Hunter Yovanovich	Jurisdiction/Date	Grey County	November 08/09, 2022
Weather Conditions	Sunny, 5-10°C	Major Street	Grey Road 2	N-S
Project Name	Thornbury Acres	Minor Street	Grey Road 40	E-W
Project Number	120251	Intersection Control	stop control on minor street	

Additional Comments

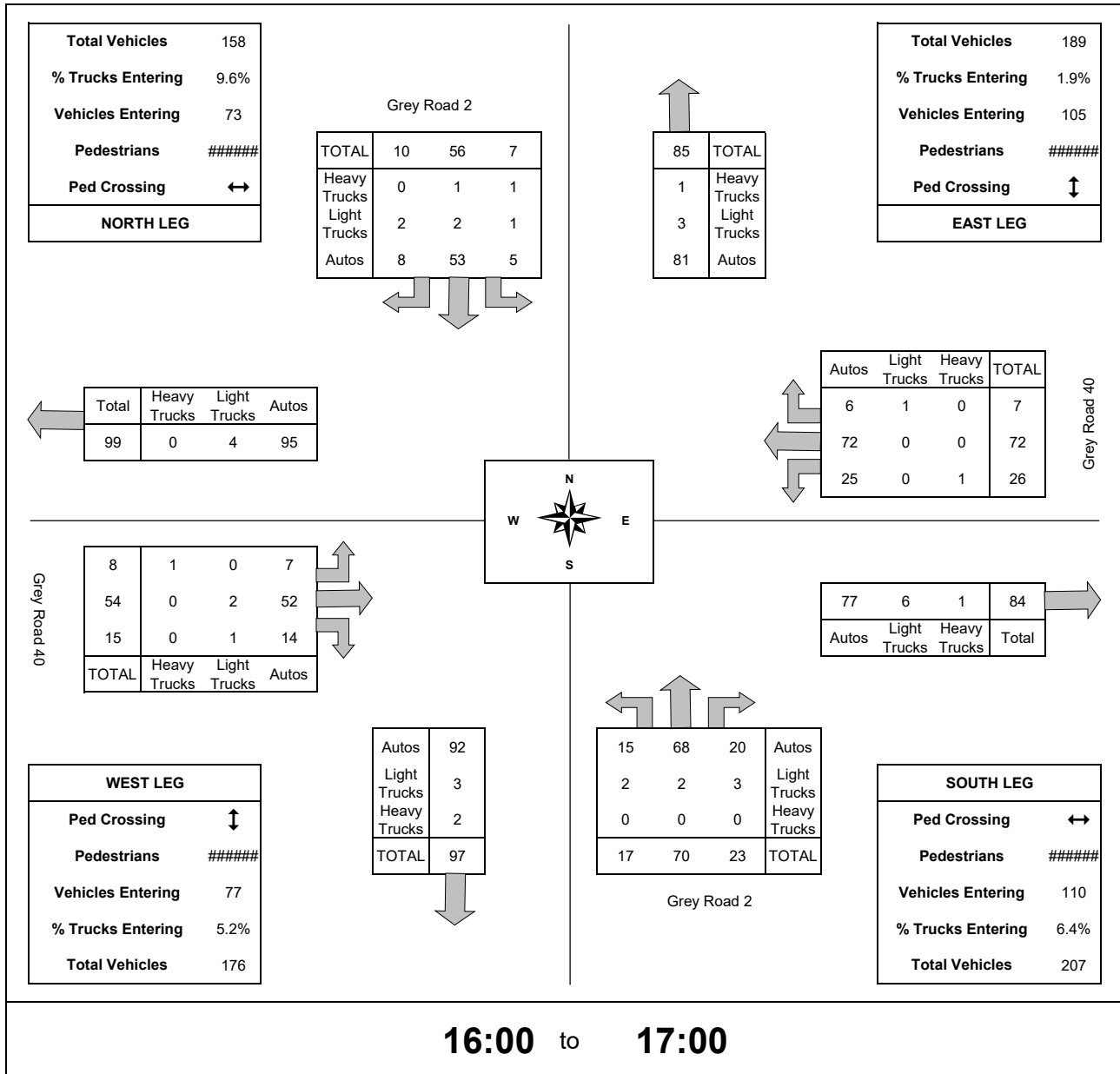


INTERSECTION COUNT PM PEAK HOUR

GENERAL INFORMATION

Surveyor Name	Hunter Yovanovich	Jurisdiction/Date	Grey County	November 08/09, 2022
Weather Conditions	Sunny, 5-10°C	Major Street	Grey Road 2	N-S
Project Name	Thornbury Acres	Minor Street	Grey Road 40	E-W
Project Number	120251	Intersection Control	stop control on minor street	

Additional Comments



Appendix B: Level of Service Definitions

CAPACITY ANALYSIS AT UNSIGNALIZED INTERSECTIONS

Highway Capacity Manual Methodology

The level of service at an unsignalized intersection is determined on the basis of control delay for each critical lane. This method of analysis is taken from the Highway Capacity Manual, Special Report 209, by the Transportation Research Board, 1997.

The average control delay for any particular critical movement (control delay includes initial deceleration, queue move-up time, stopped delay, and final acceleration delay) is a function of the service rate or capacity of the approach and degree of saturation. The level of service criteria for unsignalized intersections is outlined below and is related to ranges in vehicle delay.

Level of Service	Expected Delay to Minor Street Traffic	Average Control Delay 'd' (sec/veh)
A	Little or no delays	$0 < d \leq 10$
B	Short traffic delays	$10 \leq d \leq 15$
C	Average traffic delays	$15 \leq d \leq 25$
D	Long traffic delays	$25 \leq d \leq 35$
E	Very long traffic delays	$35 \leq d \leq 50$
F	Extreme delays with queuing which may cause congestion affecting other traffic movements in the intersection	$d > 50$

















Appendix C: Existing Operations

HCM Unsignalized Intersection Capacity Analysis

1: Grey Road 2 & Grey Road 40

2022 Existing Conditions

Weekday AM Peak Hour

















												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	14	74	13	22	51	7	16	92	27	14	86	13
Future Volume (Veh/h)	14	74	13	22	51	7	16	92	27	14	86	13
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.55	0.89	0.83	0.71	0.81	0.63	0.60	0.93	0.75	0.55	0.92	0.83
Hourly flow rate (vph)	25	83	16	31	63	11	27	99	36	25	93	16
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	364	340	101	380	330	117	109			135		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	364	340	101	380	330	117	109			135		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	95	85	98	94	89	99	98			98		
cM capacity (veh/h)	521	561	954	491	568	935	1481			1449		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	124	105	162	134								
Volume Left	25	31	27	25								
Volume Right	16	11	36	16								
cSH	583	565	1481	1449								
Volume to Capacity	0.21	0.19	0.02	0.02								
Queue Length 95th (m)	6.1	5.1	0.4	0.4								
Control Delay (s)	12.8	12.8	1.4	1.5								
Lane LOS	B	B	A	A								
Approach Delay (s)	12.8	12.8	1.4	1.5								
Approach LOS	B	B										
Intersection Summary												
Average Delay			6.4									
Intersection Capacity Utilization			24.1%		ICU Level of Service				A			
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis

1: Grey Road 2 & Grey Road 40

2022 Existing Conditions

Weekday PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	70	20	34	94	9	22	91	30	9	73	13
Future Volume (Veh/h)	10	70	20	34	94	9	22	91	30	9	73	13
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.67	0.68	0.47	0.72	0.95	0.58	0.47	0.67	0.82	0.58	0.74	0.63
Hourly flow rate (vph)	15	103	43	47	99	16	47	136	37	16	99	21
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type	None								None			
Median storage veh												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	456	408	110	484	400	154	120			173		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	456	408	110	484	400	154	120			173		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	96	80	95	88	81	98	97			99		
cM capacity (veh/h)	417	509	944	385	515	891	1468			1404		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	161	162	220	136								
Volume Left	15	47	47	16								
Volume Right	43	16	37	21								
cSH	568	487	1468	1404								
Volume to Capacity	0.28	0.33	0.03	0.01								
Queue Length 95th (m)	8.8	11.0	0.8	0.3								
Control Delay (s)	13.8	16.0	1.8	1.0								
Lane LOS	B	C	A	A								
Approach Delay (s)	13.8	16.0	1.8	1.0								
Approach LOS	B	C										
Intersection Summary												
Average Delay			7.9									
Intersection Capacity Utilization			32.9%	ICU Level of Service					A			
Analysis Period (min)			15									

















Appendix D: Future Operations

HCM Unsignalized Intersection Capacity Analysis

1: Grey Road 2 & Grey Road 40

2027 Future Conditions










Weekday AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	14	79	13	22	55	7	16	107	27	14	94	13
Future Volume (Veh/h)	14	79	13	22	55	7	16	107	27	14	94	13
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.55	0.89	0.83	0.71	0.81	0.63	0.60	0.93	0.75	0.55	0.92	0.83
Hourly flow rate (vph)	25	89	16	31	68	11	27	115	36	25	102	16
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	392	365	110	408	355	133	118			151		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	392	365	110	408	355	133	118			151		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	95	84	98	93	88	99	98			98		
cM capacity (veh/h)	494	543	943	464	550	916	1470			1430		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	130	110	178	143								
Volume Left	25	31	27	25								
Volume Right	16	11	36	16								
cSH	562	543	1470	1430								
Volume to Capacity	0.23	0.20	0.02	0.02								
Queue Length 95th (m)	6.8	5.7	0.4	0.4								
Control Delay (s)	13.3	13.3	1.3	1.4								
Lane LOS	B	B	A	A								
Approach Delay (s)	13.3	13.3	1.3	1.4								
Approach LOS	B	B										
Intersection Summary												
Average Delay			6.5									
Intersection Capacity Utilization			25.3%		ICU Level of Service				A			
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis

2: North Access & Grey Road 40










2027 Future Conditions
Weekday AM Peak Hour

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	122	1	3	83	2	8
Future Volume (Veh/h)	122	1	3	83	2	8
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	133	1	3	90	2	9
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None		None			
Median storage veh						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			134		230	134
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			134		230	134
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	99
cM capacity (veh/h)			1451		757	916
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	134	93	11			
Volume Left	0	3	2			
Volume Right	1	0	9			
cSH	1700	1451	882			
Volume to Capacity	0.08	0.00	0.01			
Queue Length 95th (m)	0.0	0.0	0.3			
Control Delay (s)	0.0	0.3	9.1			
Lane LOS		A	A			
Approach Delay (s)	0.0	0.3	9.1			
Approach LOS			A			
Intersection Summary						
Average Delay			0.5			
Intersection Capacity Utilization			16.8%	ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

3: Grey Road 2 & West Access

2027 Future Conditions
Weekday AM Peak Hour

















						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	0	10	142	0	3	127
Future Volume (Veh/h)	0	10	142	0	3	127
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	11	154	0	3	138
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	298	154			154	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	298	154			154	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	99			100	
cM capacity (veh/h)	692	892			1426	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	11	154	141			
Volume Left	0	0	3			
Volume Right	11	0	0			
cSH	892	1700	1426			
Volume to Capacity	0.01	0.09	0.00			
Queue Length 95th (m)	0.3	0.0	0.0			
Control Delay (s)	9.1	0.0	0.2			
Lane LOS	A		A			
Approach Delay (s)	9.1	0.0	0.2			
Approach LOS	A					
Intersection Summary						
Average Delay		0.4				
Intersection Capacity Utilization		19.1%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis

1: Grey Road 2 & Grey Road 40










2027 Future Conditions

Weekday PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	76	20	34	100	9	22	102	30	9	87	13
Future Volume (Veh/h)	10	76	20	34	100	9	22	102	30	9	87	13
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.67	0.68	0.47	0.72	0.95	0.58	0.47	0.67	0.82	0.58	0.74	0.63
Hourly flow rate (vph)	15	112	43	47	105	16	47	152	37	16	118	21
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	494	444	128	524	436	170	139			189		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	494	444	128	524	436	170	139			189		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	96	77	95	87	79	98	97			99		
cM capacity (veh/h)	386	487	921	352	492	873	1445			1385		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	170	168	236	155								
Volume Left	15	47	47	16								
Volume Right	43	16	37	21								
cSH	538	460	1445	1385								
Volume to Capacity	0.32	0.37	0.03	0.01								
Queue Length 95th (m)	10.2	12.6	0.8	0.3								
Control Delay (s)	14.7	17.3	1.7	0.9								
Lane LOS	B	C	A	A								
Approach Delay (s)	14.7	17.3	1.7	0.9								
Approach LOS	B	C										
Intersection Summary												
Average Delay			8.2									
Intersection Capacity Utilization			34.3%		ICU Level of Service				A			
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis2: North Access & Grey Road 40










2027 Future Conditions
Weekday PM Peak Hour

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	115	2	9	143	1	5
Future Volume (Veh/h)	115	2	9	143	1	5
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	125	2	10	155	1	5
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			127		301	126
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			127		301	126
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		100	99
cM capacity (veh/h)			1459		686	924
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	127	165	6			
Volume Left	0	10	1			
Volume Right	2	0	5			
cSH	1700	1459	874			
Volume to Capacity	0.07	0.01	0.01			
Queue Length 95th (m)	0.0	0.2	0.2			
Control Delay (s)	0.0	0.5	9.1			
Lane LOS		A	A			
Approach Delay (s)	0.0	0.5	9.1			
Approach LOS			A			
Intersection Summary						
Average Delay			0.5			
Intersection Capacity Utilization			24.7%	ICU Level of Service		A
Analysis Period (min)			15			

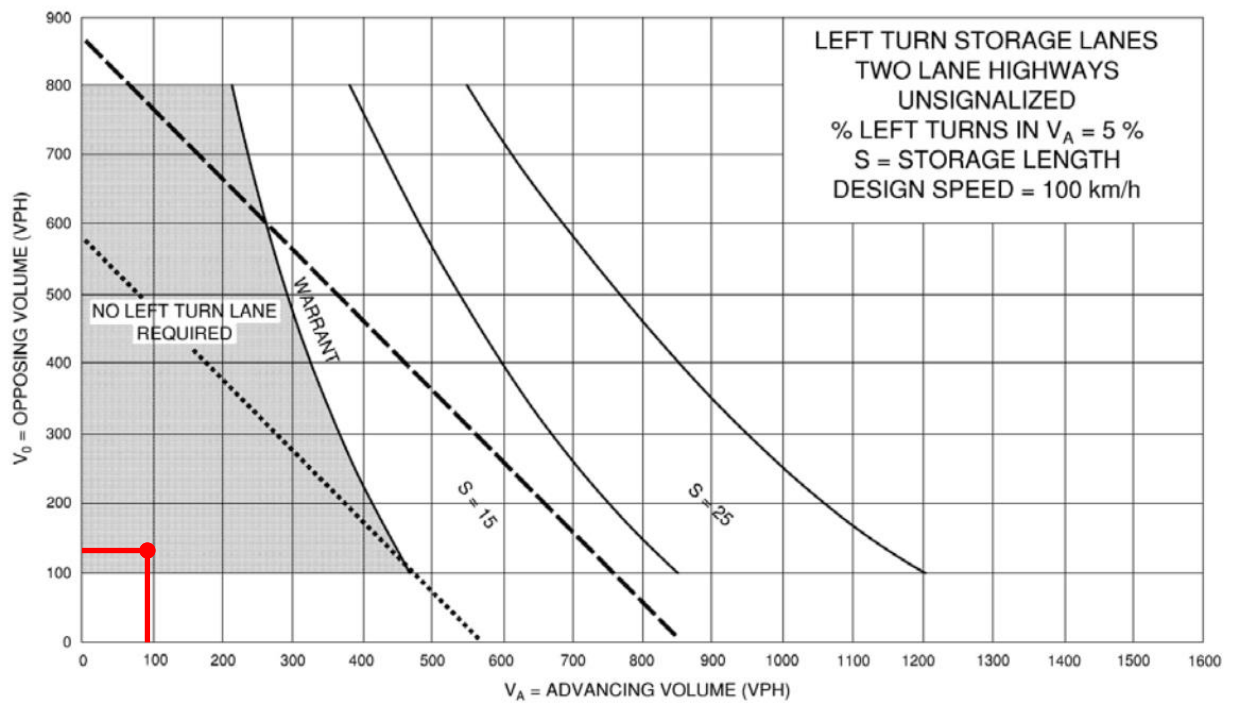
HCM Unsignalized Intersection Capacity Analysis

3: Grey Road 2 & West Access

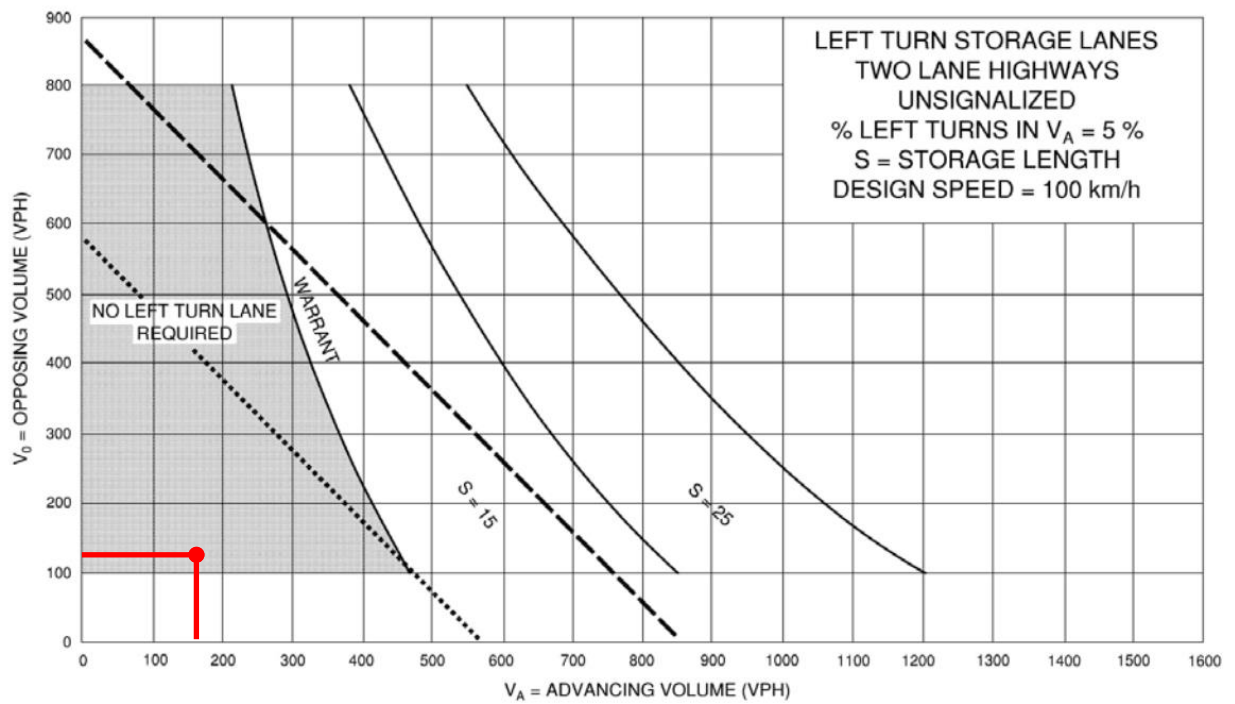
2027 Future Conditions
Weekday PM Peak Hour

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	6	0	150	0	11	133
Future Volume (Veh/h)	6	0	150	0	11	133
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	7	0	163	0	12	145
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	332	163			163	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	332	163			163	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	99	100			99	
cM capacity (veh/h)	657	882			1416	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	7	163	157			
Volume Left	7	0	12			
Volume Right	0	0	0			
cSH	657	1700	1416			
Volume to Capacity	0.01	0.10	0.01			
Queue Length 95th (m)	0.2	0.0	0.2			
Control Delay (s)	10.5	0.0	0.6			
Lane LOS	B		A			
Approach Delay (s)	10.5	0.0	0.6			
Approach LOS	B					
Intersection Summary						
Average Delay			0.5			
Intersection Capacity Utilization			26.1%	ICU Level of Service		A
Analysis Period (min)			15			

Appendix E: Left Turn Warrants



2027 Traffic Volumes – AM Peak Hour

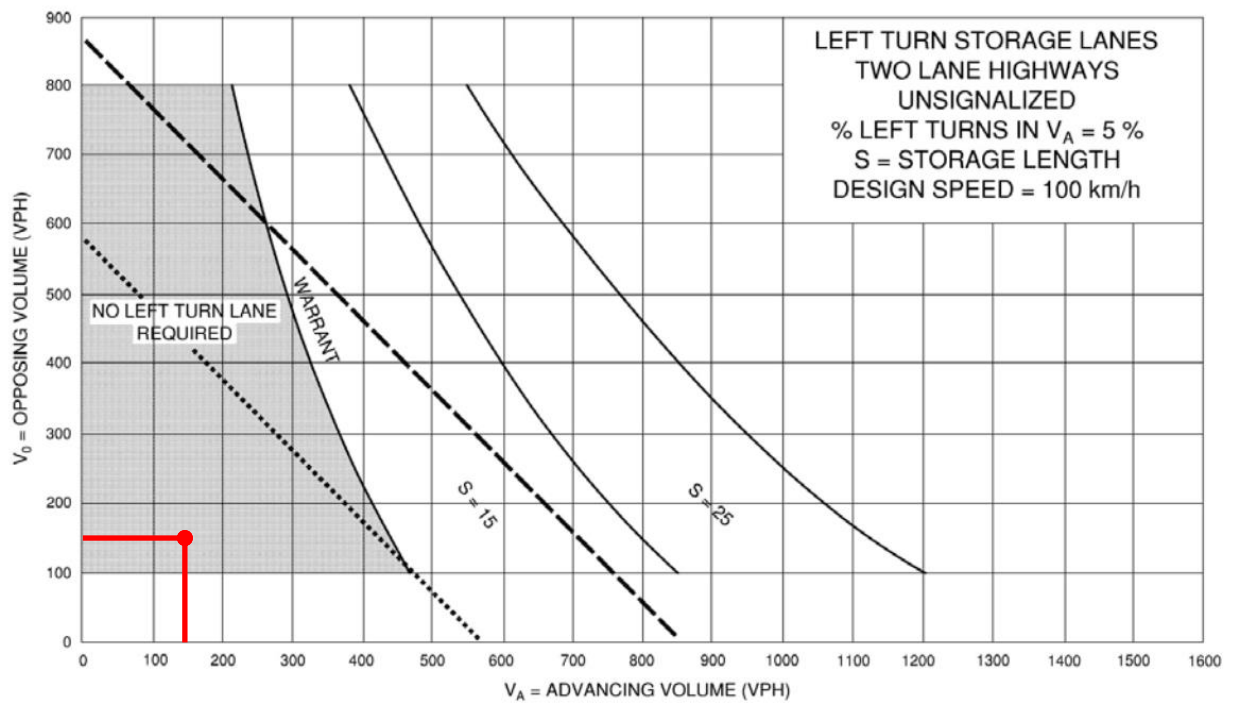


2027 Traffic Volumes – PM Peak Hour

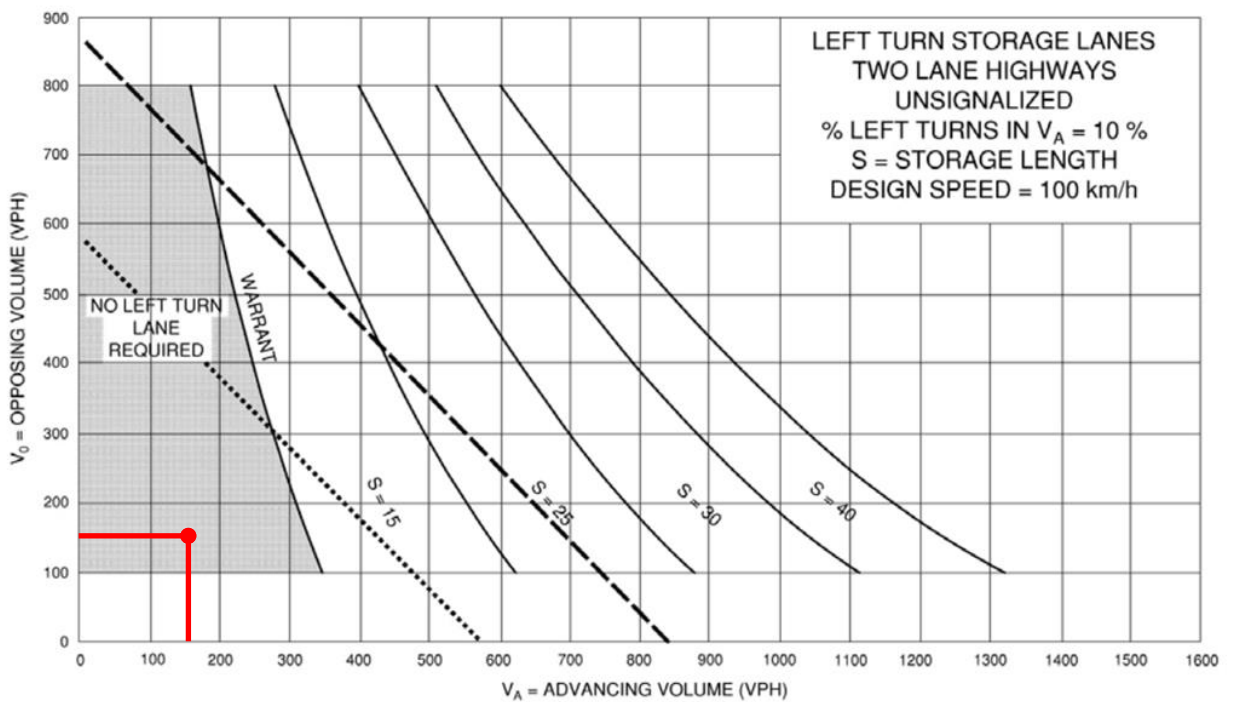
THORNBURY ACRES

Figure E1: North Access





2027 Traffic Volumes – AM Peak Hour



2027 Traffic Volumes – PM Peak Hour

THORNBURY ACRES

Figure E2: West Access

