

## TRAFFIC IMPACT STUDY

### **218 McMURCHY AVENUE SOUTH**

Residential Development

City of Brampton

**Prepared for:**

**BHUPINDER TURNA &  
GURMEHAK TURNA  
BRAMPTON, ON**

**Prepared by:**

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## 1.0 INTRODUCTION

LMM Engineering Inc. was retained by Bhupinder Turna & Gurmehak Turna to undertake a traffic impact study to evaluate the traffic impacts of a proposed residential development located at 218 McMurchy Avenue South, close to the intersection of Elgin Drive & McMurchy Avenue S in the City of Brampton.

There is an existing single family, detached home on the subject site. The developer is proposing to conduct a lot severance, retaining the existing residential building and constructing a new single family, detached home on the severed lot. This new residential building is to be served by a driveway onto Elgin Street. The site location map is shown in **Figure 1-1** and the proposed site plan is shown in **Figure 1-2** as well as *Appendix A*.

**Figure 1-1 Site Location Map**

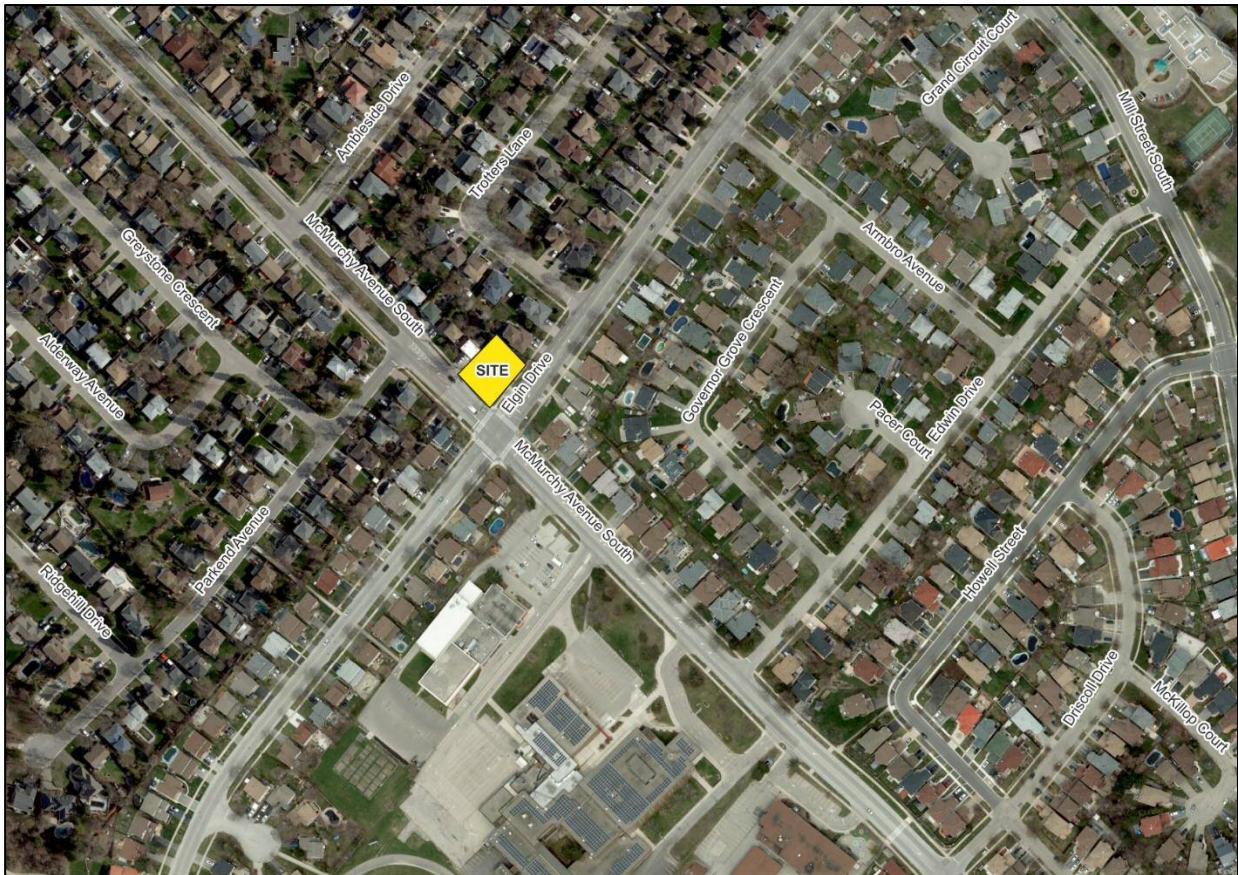
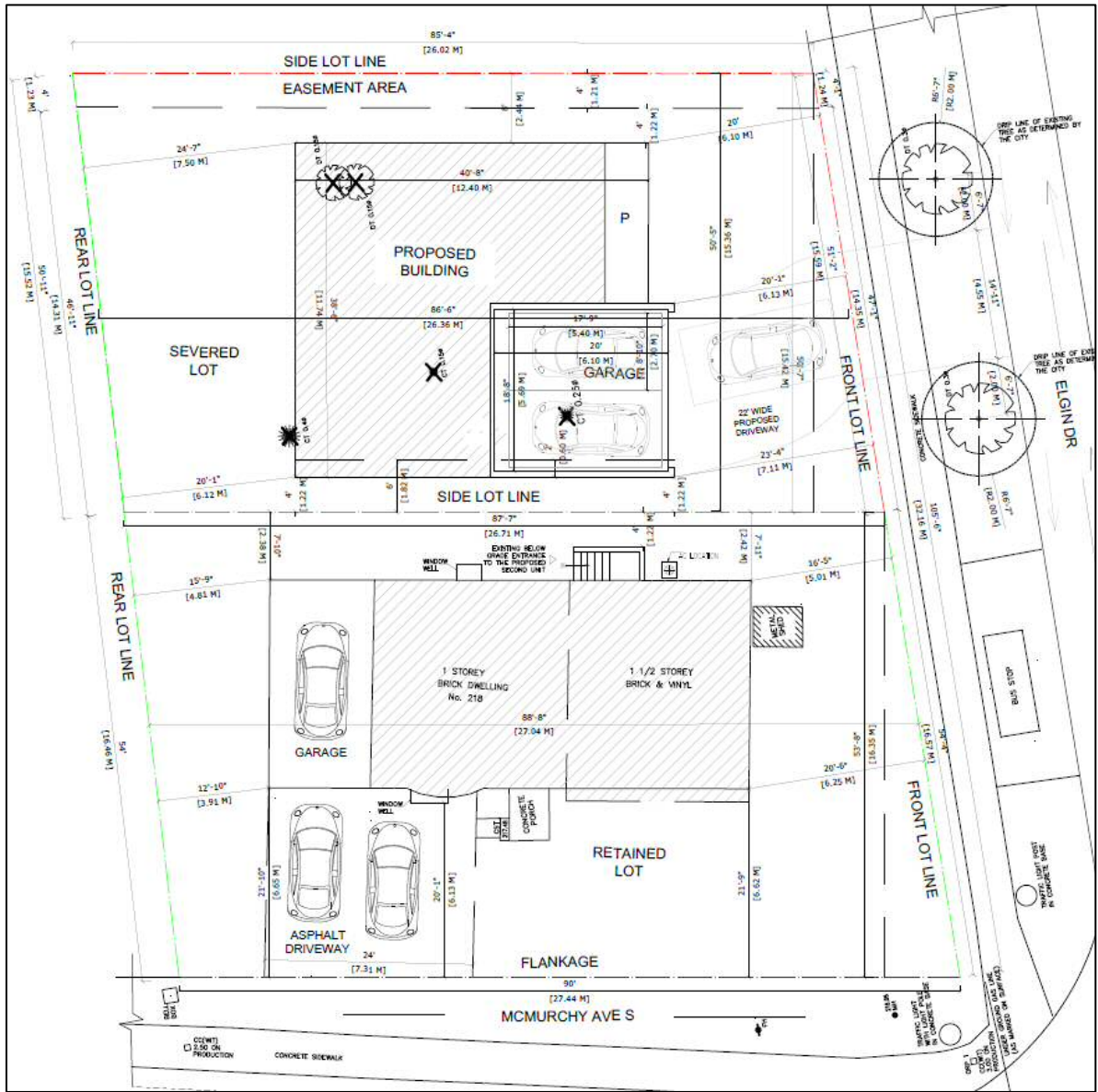


Figure 1-2 Proposed Site Plan



## 2.0 STUDY METHODOLOGY

### 2.1 STUDY AREA

In order to assess the traffic impacts of the proposed development, the following intersection was included in the Existing, Future Background, and Future Total conditions traffic operation evaluation:

- Elgin Drive at McMurchy Avenue South

### 2.2 AGENCY CORRESPONDENCE

The analysis in this report has been conducted with careful review of the City's TIS guidelines. A terms of reference letter was provided to the City prior to this analysis and feedback obtained has been incorporated herein.

## 2.3 STUDY HORIZONS

A five-year horizon, year 2029 was selected for the study horizon year for the future background and future total conditions analyses. The 2024 volumes were used for the existing condition analysis, and the 2029 future total volumes are an addition of anticipated site volumes to 2029 background volumes.

## 2.4 INTERSECTION CAPACITY EVALUATION METHODOLOGY

In this study, the methodology used for evaluating traffic operations at each of the subject intersections was based on the criteria set forth in the Transportation Research Board's Highway Capacity Manual, 2010 edition (HCM 7<sup>th</sup> Edition). Synchro 12 software, which utilizes the HCM 7<sup>th</sup> edition methodology, was used for the analysis. The following is a description of the methodology employed for the analysis of unsignalized and signalized intersections.

### 2.4.1 Signalized Intersections

For signalized intersections, it is necessary to evaluate both capacity and level of service in order to evaluate the overall operation of the intersection. The capacity analysis of an intersection is performed by comparing the volume of traffic using the various lane groups at the intersection to the capacity of those lane groups. This results in a volume/capacity ( $v/c$ ) ratio for each lane group. A  $v/c$  ratio greater than 1.0 indicates that the volume of traffic has exceeded the capacity available, resulting in a temporary excess of demand. Although the capacity of the entire intersection is not defined, a composite  $v/c$  ratio for the sum of the critical lane groups within the intersection is computed. This composite  $v/c$  ratio is an indication of the overall intersection efficiency.

Level of service for a signalized intersection is defined in terms of average controlled delay per vehicle, which is composed of initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay. The levels of service criteria for signalized intersections, based on average controlled delay, are shown in **Table 2-2**. Level of service A indicates operations with very low controlled delay, while level of service F describes operations with extremely high average controlled delay. Level of service E is typically considered to be the limit of acceptable delay, and level of service F is considered unacceptable by most drivers.

**Table 2-1 Level of Service Criteria for Signalized Intersections.**

<b>Level of Service</b>	<b>Average Control Delay (sec/veh)</b>
A	$\leq 10$
B	$> 10$ and $\leq 20$
C	$> 20$ and $\leq 35$
D	$> 35$ and $\leq 55$
E	$> 55$ and $\leq 80$
F	$> 80$

At congested arterial signalized intersections, movements with a level of service (LOS) of 'F', with average controlled delay greater than 80 seconds are considered critical. Movements operating at LOS E are also flagged since these may become critical in the future. The Ministry of Transportation of Ontario (MTO) TIS guidelines indicate that for a ramp movement, a volume to capacity (v/c) ratio greater than 0.75 would be considered critical. For any other movement, a v/c ratio greater than 0.85 would be considered critical.

### 3.0 EXISTING CONDITION

The subject site is currently an existing residential building. The site location map is shown in Figure 1-1 and the proposed site plan is shown in Figure 1-2.

An inventory of the surrounding roads and highway facilities in the vicinity of the site was compiled and is summarized as follows:

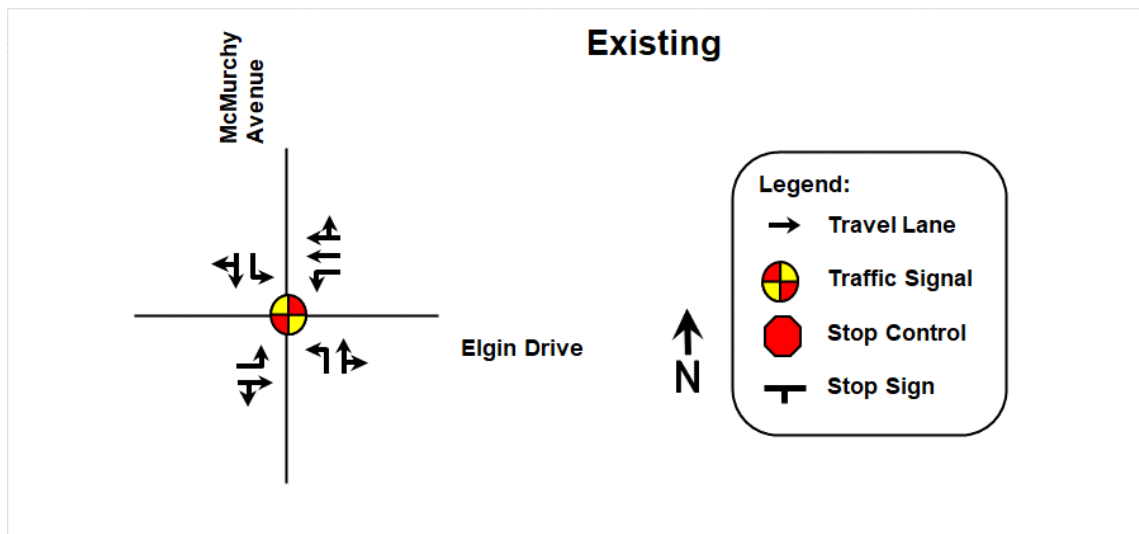
**Elgin Drive** is a 2-lane east-west collector road with a speed limit of 50 km/hr within the vicinity of the site. The road is within the jurisdiction of the City of Brampton. There is 1 lane in each direction of travel. There are sidewalks on both sides of the road. There are no dedicated bicycle facilities.

**McMurphy Avenue South** is a 2-lane north-south collector road with a speed limit of 40 km/hr within the vicinity of the site. The road is within the jurisdiction of the City of Brampton. Curbside parking is permitted on both sides of the road. There are sidewalks on both sides of the road. There are no dedicated bicycle facilities.

The intersection of Elgin Drive and McMurphy Avenue S is a signalized 4-leg intersection. There is a dedicated left-turn lane and a shared right-through lane on the west approach. There is a dedicated left-turn lane, a through lane and a shared right-through lane on the east approach. There is a dedicated left-turn lane and a shared right-through lane on the north and south approaches. There are marked crosswalks on all approaches, as well as pedestrian signal heads.

The existing lane configuration of the study area intersections is shown in **Figure 3-1**.

**Figure 3-1 Lane Configuration (N.T.S.)**

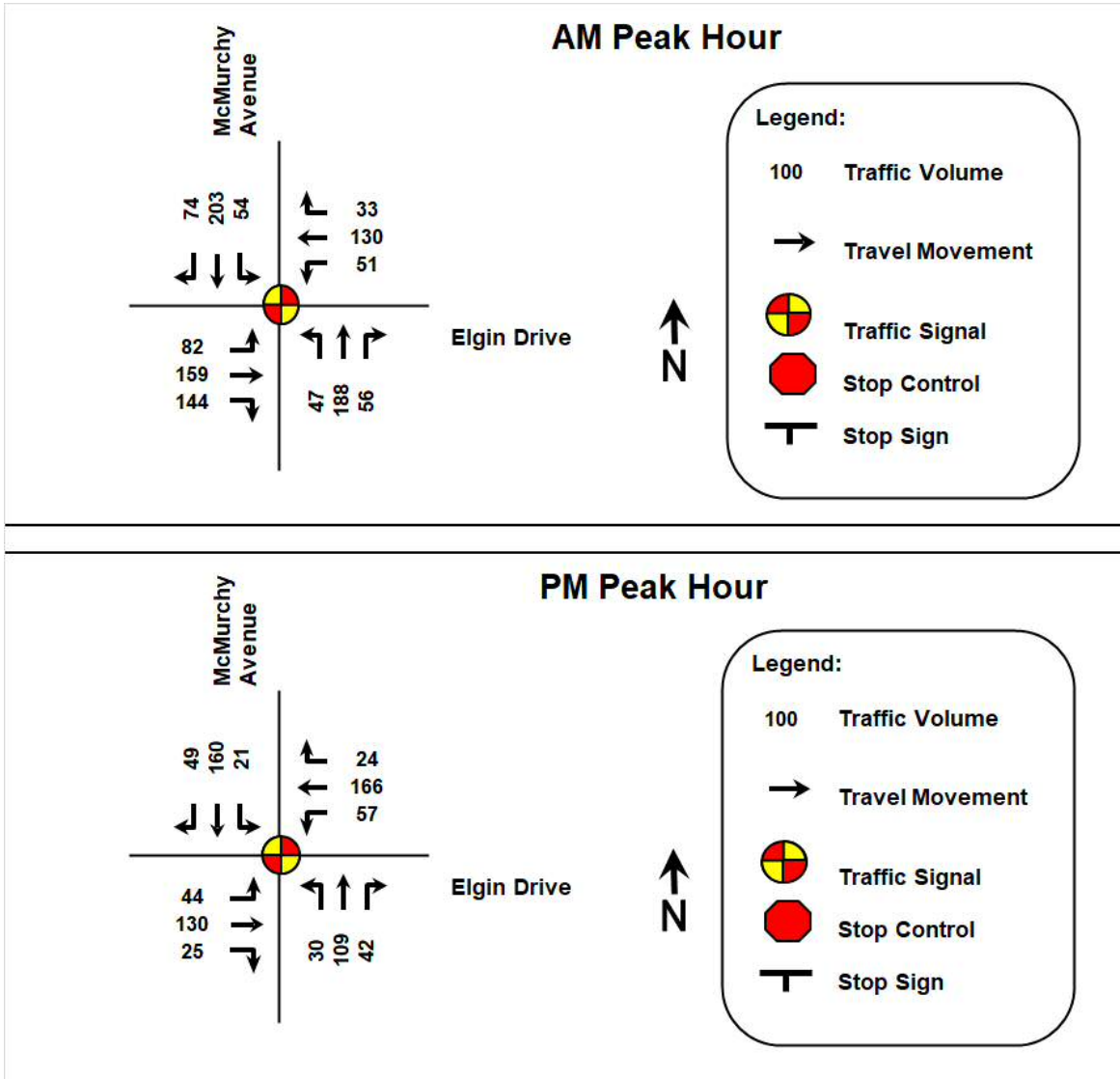


### 3.1 EXISTING TRAFFIC VOLUMES

Peak hour turning movement traffic volumes at the study intersections were obtained from counts that were scheduled on Thursday, June 20, 2024. The existing traffic volumes are shown in **Figure 3-2**.



Figure 3-2 Existing Peak Hour Traffic Volumes



**3.1.1 Existing Intersection Capacity Analysis**

The peak hour traffic volumes shown in Figure 3-2 were analyzed using Synchro 12 and HCM 7<sup>th</sup> edition methodology. The analysis results are the are summarized in Table 3-1 below. Detailed intersection capacity analysis output for this condition are included in *Appendix B*.

**Table 3-1 Existing Condition Intersection Capacity Analysis Summary**

Intersection	Overall / Critical Movement	Traffic Operations (LOS, Delay (sec's), V/C Ratio)	
		A.M. Peak Hour	P.M. Peak Hour
Elgin Drive / McMurphy Avenue	Intersection	B, 10.7s, 0.54	A, 8.4 s, 0.31
	Critical Movement	-	-

The results of the existing condition intersection capacity analysis indicate that all the existing study intersections operate at acceptable levels of service “LOS”.

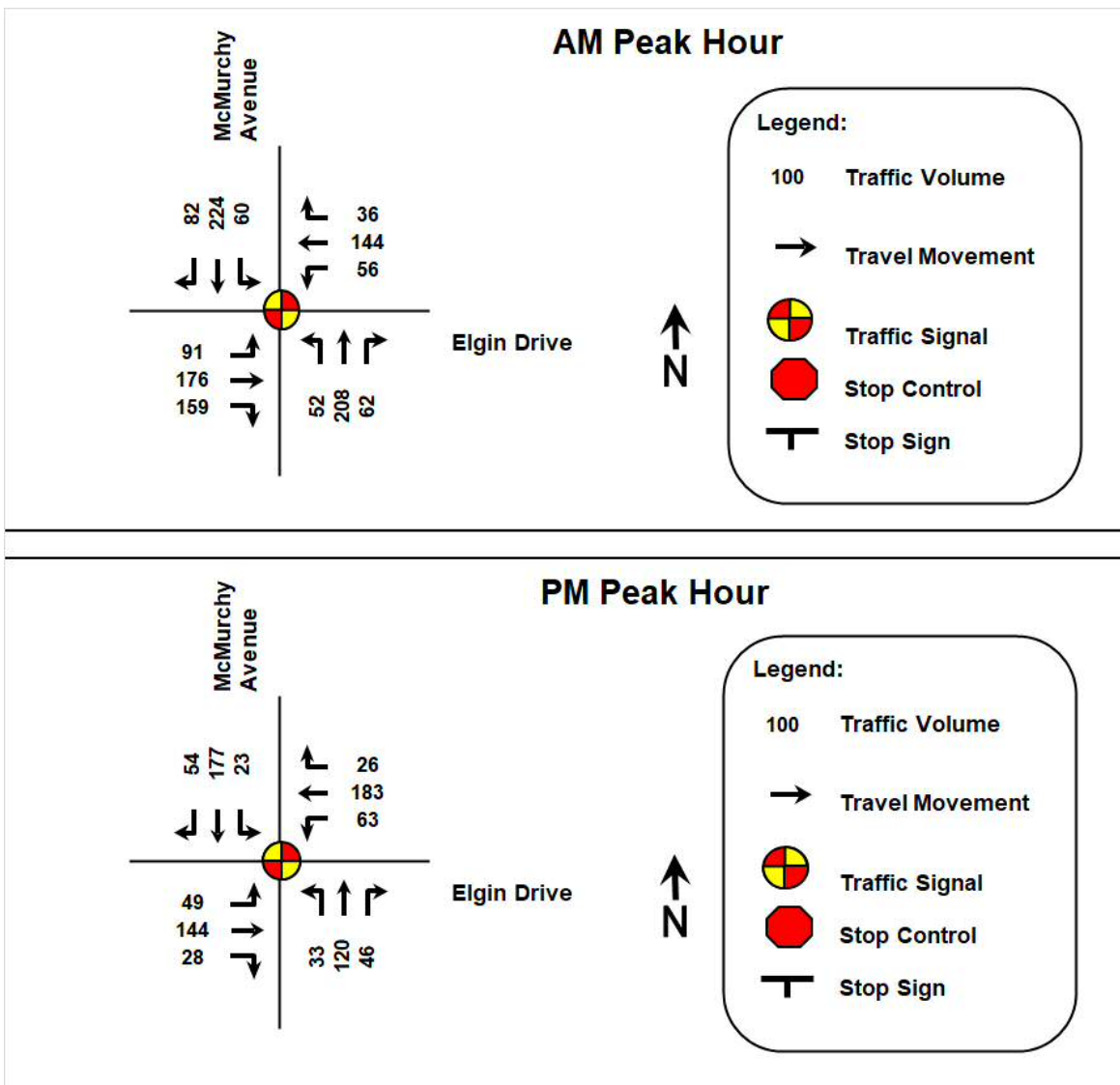
## 4.0 FUTURE BACKGROUND CONDITION

### 4.1 FUTURE BACKGROUND TRAFFIC VOLUMES

LMM reviewed Average Annual Daily Traffic (AADT) volume data for the surrounding road network using the City’s traffic data portal. It is noted that post-pandemic, AADT volumes suggest negative growth, while the period immediately prior to the pandemic had a growth rate of approximately 3% per year. As an estimate, a growth rate of 2% per year was assumed for background traffic, projected to 2029.

The existing traffic volumes are shown in **Figure 4-1**.

**Figure 4-1 Background Peak Hour Traffic Volumes**



**4.1.1 Background Intersection Capacity Analysis**

The peak hour traffic volumes shown in Figure 4-1 were analyzed using Synchro 12 and HCM 7<sup>th</sup> edition methodology. The analysis results are the are summarized in Table 4-1 below. Detailed intersection capacity analysis output for this condition are included in *Appendix C*.

**Table 4-1 Background Condition Intersection Capacity Analysis Summary**

Intersection	Overall / Critical Movement	Traffic Operations (LOS, Delay (sec's), V/C Ratio)	
		A.M. Peak Hour	P.M. Peak Hour
		Elgin Drive / McMurphy Avenue	Intersection
	Critical Movement	-	-

The results of the existing condition intersection capacity analysis indicate that all the existing study intersections operate at acceptable levels of service “LOS”.

**5.0 FUTURE TOTAL CONDITION**

**5.1 PROPOSED DEVELOPMENT**

The proposed development will be a detached, single family residential building consisting of 1620.13 square feet of area, with a driveway onto Elgin Drive. The proposed site plan is shown in *Appendix A*.

**5.2 TRIP GENERATION**

In order to estimate the new vehicular trips that would be generated by the proposed facility, trip generation rates in the Institute of Transportation Engineers (ITE) Trip Generation Manual for the following uses:

- The ITE Land Use Code 210 – Single Family Detached Housing

The setting used was General Urban/Suburban, to reflect the site’s context in the City of Brampton. The resultant total trip generation for the primary traffic associated with the proposed development uses is summarized in **Table 5-1**. Trip generation excerpts are provided in *Appendix D*.

**Table 5-1 Trip Generation Summary**

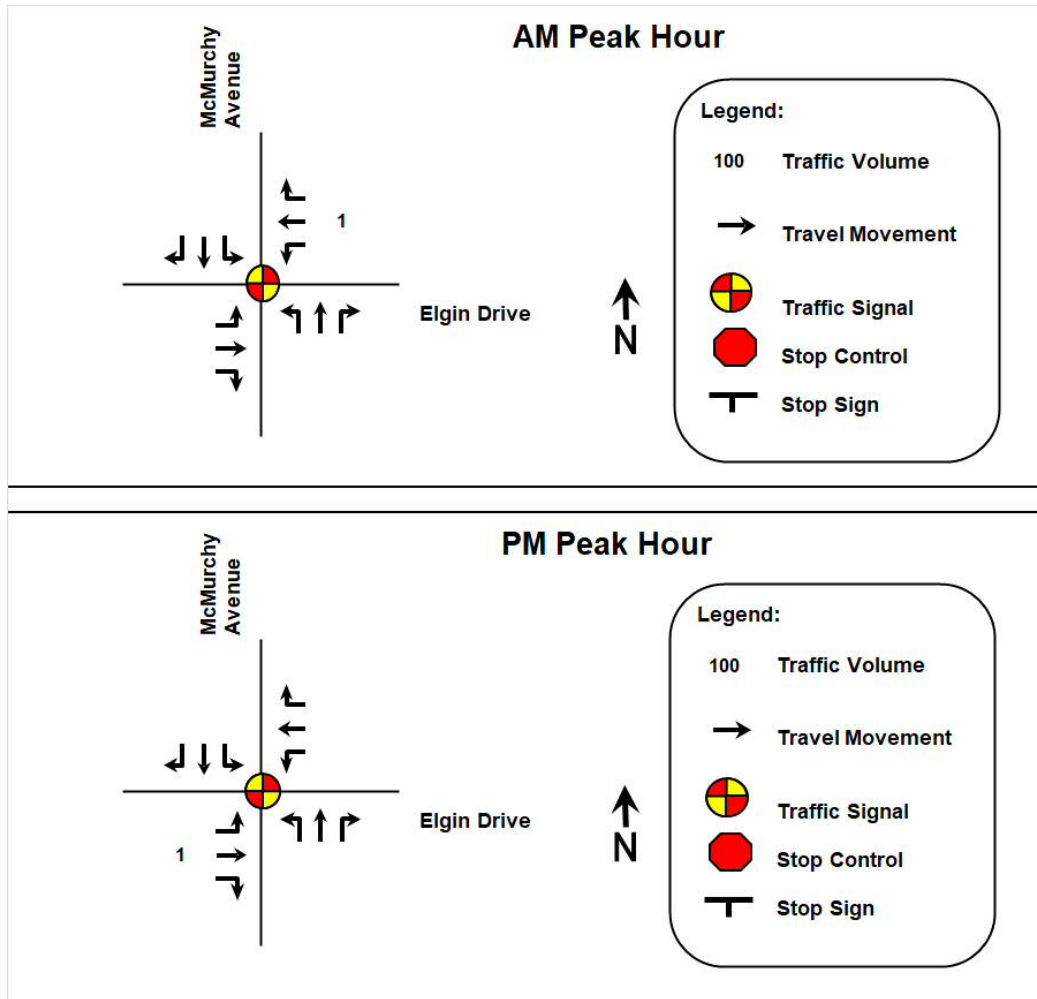
Land Use	Size of Development	Trips (vehicles per hour)					
		AM Peak Hour			PM Peak Hour		
		IN	OUT	TOTAL	IN	OUT	TOTAL
ITE Land Use Code 210 – Single Family Detached Housing	1 Unit	0	1	1	1	0	1
<b>Total</b>		0	1	1	1	0	1

The trip generation estimates shown Table 5-1 based on the ITE data indicate that the development would generate around 1 vehicle trip during the peak periods.

**5.3 TRIP DISTRIBUTION / ASSIGNMENT**

In order to analyze the future total conditions, the estimated new peak hour vehicular trips summarized in Table 5-1 were assigned to the study intersections. In order to be consistent, the directional route distribution of site generated traffic was based on the distribution at the study intersections. The total assigned peak hour site generated traffic volumes are shown in **Figure 5-1**.

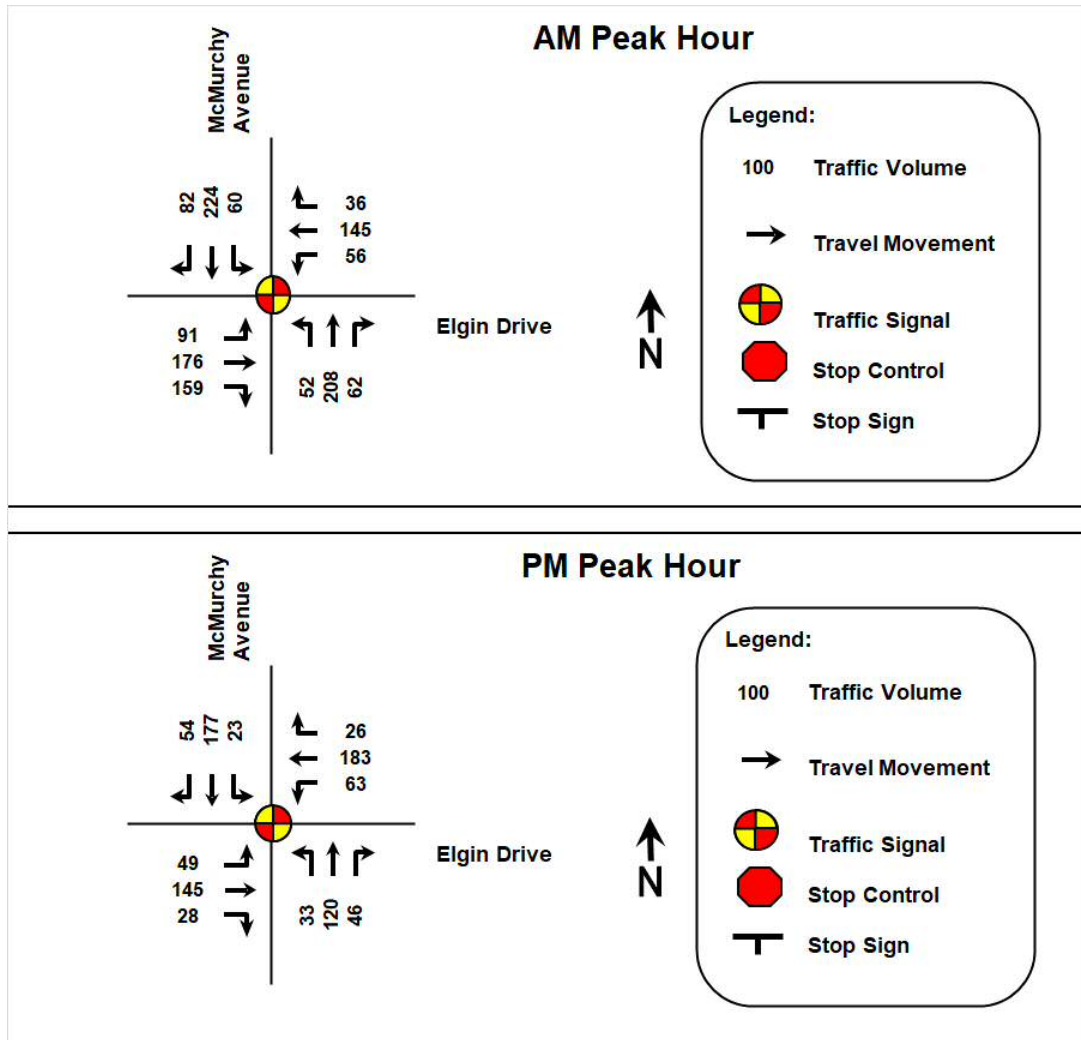
**Figure 5-1 Total Peak Hour Proposed Site Development Related Trips**



**5.4 FUTURE TOTAL INTERSECTION CAPACITY ANALYSIS**

The site generated traffic volumes in Figure 5-1 were superimposed onto the Background Traffic Peak Hour Traffic Volumes in Figure 4-1 to obtain the Future Total Peak Hour Traffic Volumes shown in **Figure 5-2**.

**Figure 5-2 Future Total Peak Hour Traffic Volumes**



**5.4.1 Future Total Intersection Capacity Analysis**

The future total peak hour traffic volumes shown in Figure 5-2 were used to analyze the study intersections according to the methodology outlined in Section 2.4 *Intersection Capacity Evaluation* for signalized intersections.

The future total intersection capacity analysis results for the study intersections are summarized in **Table 5-2** below. Detailed future total intersection capacity analysis output is included in *Appendix E*.

**Table 5-2 Future Total Condition Intersection Capacity Analysis Summary**

Intersection	Overall / Critical Movement	Traffic Operations (LOS, Delay (sec's), V/C Ratio)	
		A.M. Peak Hour	P.M. Peak Hour
Elgin Drive / McMurchy Avenue	Intersection	B, 11.2s, 0.59	A, 8.7 s, 0.34
	Critical Movement	-	-

The results of the future total condition intersection capacity analysis indicate that the study intersection will continue to operate well, similar to the future background condition with no change in levels of service “LOS”.

## **6.0 ACCESS REVIEW**

There is a proposed driveway to provide access to the new residential building on the severed lot, located on Elgin Drive, east of the existing bus stop. LMM conducted a high-level review of the proposed access location, specifically considering impacts on pedestrian, cyclist and transit movements.

### **6.1 PEDESTRIAN IMPACTS**

The proposed driveway intersects with Elgin Drive at a 90° angle, similar to other existing driveways on the road, with no permanent objects that would interfere with driver sightlines. The existing sidewalk on the north side of the road would not be impacted by curb letdowns or the driveway, since sufficient space is available for vehicle storage within the property lines.

From the attached turning movement count data, it is estimated that a total of 38 pedestrians use the east approach crosswalk during the weekday morning peak period and a total of 13 pedestrians use the east approach crosswalk during the weekday afternoon peak period. This is the crosswalk nearest to the proposed access onto Elgin Drive. The pedestrian crossing is marked and is located at a signalized intersection with dedicated pedestrian signal heads. Given that the proposed driveway intersects at Elgin Drive approximately 30m upstream of the crossing, and that vehicles are expected to obey traffic control devices at the intersection, it is not anticipated that the proposed driveway will elevate pedestrian safety concerns from existing conditions. During bus dwell time, it is possible that the bus occludes pedestrians in the crosswalk to vehicles exiting the proposed driveway. However, they would have to wait for boarding / alighting to complete, given that it occurs in the lane closest to the access. In the event of a weaving manoeuvre into the adjacent westbound lane, the vehicle would still be required to obey traffic signal heads.

Waste collection is to take place curbside, as is typical for residential properties in the area. During a site visit to document existing conditions, it is noted that residents of this road stage waste collection bins curbside on their driveways, between the travel lane and the sidewalk. The proposed driveway is expected to mirror this operation with adequate space in the boulevard to avoid staging waste collection bins on the sidewalk.

### **6.2 TRANSIT RIDER IMPACTS**

The proposed driveway is located approximately 9m east of the existing bus stop 1677 (Elgin Street at McMurchy Avenue South – Westbound). The bus stop is served by Brampton Transit Route 52 (McMurchy). LMM received 2023 Daily Fall Ridership data from the City. The data indicates that the stop has an average of 28 people boarding and 18 people alighting on a typical weekday. Assuming that 20% of daily boarding and alighting occurs during the peak hours, this leads to an estimate of up to 6 people waiting at the stop at any given time. According to Brampton Transit (BT) schedules, the stop is served by a total of 22 northbound buses during a typical weekday with a frequency of 50 minutes. The existing bus pad and shelter are expected to be sufficient to accommodate the number of people waiting a bus during

peak periods. The proposed driveway is not anticipated to reduce the waiting capacity of the existing bus stop facilities.

### **6.3 CYCLIST IMPACTS**

It is noted that there are no dedicated cyclist facilities along Elgin Drive, and that cyclists are expected to use the travel lanes in the same manner as automobiles. Cyclists are expected to either take the lane or share the lane at their discretion and the proposed driveway is not anticipated to impact this behaviour.

## **7.0 CONCLUSIONS AND RECOMMENDATIONS**

LMM Engineering Inc. was retained by Bhupinder Turna & Gurmehak Turna to undertake a traffic impact study to evaluate the traffic impacts of a proposed residential development located at 218 McMurphy Avenue South, close to the intersection of Elgin Drive & McMurphy Avenue S in the City of Brampton.

There is an existing single family, detached home on the subject site. The developer is proposing to conduct a lot severance, retaining the existing residential building and constructing a new single family, detached home on the severed lot. This new residential building is to be served by a driveway onto Elgin Street.

The results of the existing and future background condition intersection capacity analysis indicate that all the existing study intersections currently operate will continue to operate at acceptable levels of service by 2029.

The proposed lot severance and addition of 1 single-family residential development is expected to generate a total of 1 vehicle trip during the weekday morning and afternoon peak periods.

The results of the future total condition intersection capacity analysis indicate that the study intersection will continue to operate acceptably, similar to the future background condition with no change in levels of service "LOS".

The proposed access onto Elgin Drive is not expected to pose a pedestrian safety concern due to the geometry of the intersection of the driveway and the public road. Vehicles exiting the driveway are expected to abide by existing traffic signals located 30m downstream along Elgin Drive.

It is anticipated that transit riders can be safely accommodated by the existing bus shelter and bus pad upstream of the intersection of Elgin Drive and McMurphy Avenue S.

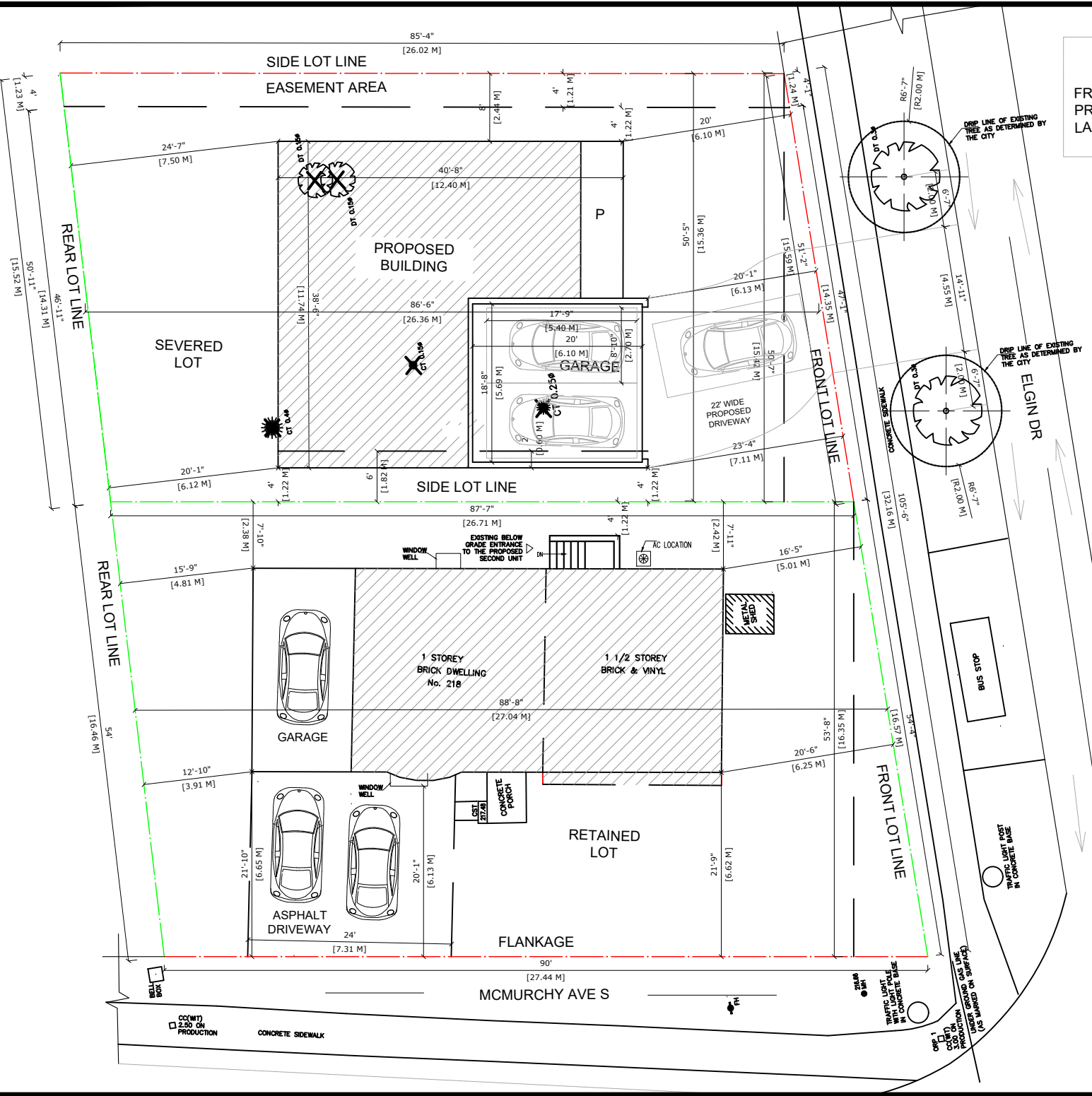
Waste collection operations are expected to take place curbside, with the staging area located outside of the sidewalk and travel lanes, with no impact to road users.

The subject proposed development will generally not have a significant impact on the road network.



# Appendix A

## Proposed Site Plan



**SEVERED LOT**

FRONT LOT AREA = 1099.91 SQ.FT  
 PROPOSED LANDSCAPING AREA = 661.28 SQ.FT  
 LANDSCAPE PROVIDED = 60.12%

**NOTE: EXISTING TREE SHALL BE PROTECTED 2M AWAY BY THE TEMPORARY FENCING AS SHOWN IN THE SITE PLAN**

	REQUIRED	RETAINED LOT	SEVERED LOT
BUILDING AREA		1329.49 SQ.FT	1624.64 SQ.FT
REAR SETBACK	7.5 M	3.91M, 4.81 M	7.50 M, 6.12 M
FRONT SETBACK	6 M	5.01 M	6.13M, 6.10M
SIDE SETBACK	1.2 M	2.38 M ,6.62 M	1.22 M,1.82M,2.44M
LOT WIDTH (INTERIOR)	15 M	-	15.42 M
LOT WIDTH (CORNER)	18 M	16.35 M	-
LOT DEPTH	30 M	27.04 M	26.36 M
LOT AREA(INTERIOR)	450 SQ.M	-	405.89 SQ.M
LOT AREA(CORNER)	540 SQ.M	442.51 SQ.M	-
LOT COVERAGE	30%	28.45 %	37.08 %

- GENERAL NOTES:
- RELEASED FOR BUILDING PERMIT
  - CONTRACTOR SHALL CHECK ALL DIMENSIONS ON THE WORK SITE AND REPORT DISCREPANCIES TO THE CONSULTANTS BEFORE PROCEEDING
  - ALL DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CONSULTANTS AND MUST BE RETURNED AT THE COMPLETION OF WORK. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNTIL SIGNED BY THE CONSULTANT.
  - DRAWINGS ARE NOT TO BE SCALED



PROJECT TYPE:  
DETACHED HOUSE

PROJECT NAME

218 McMurphy Ave  
Brampton, ON

DATE	DESCRIPTION
-	-
-	-
-	-
-	-

SCALE: 1/4" = 1'-0"  
 PROJECT NUMBER: 2022-1064  
 DRAWN BY: DONIY MARIYA  
 CHECKED BY:

SEAL

SHEET NAME

SITE PLAN

SHEET NUMBER

**A1.0**

# Appendix B

## Intersection Capacity Analysis Output Existing Condition

Timings  
1: McMurphy Ave S & Elgin Dr

2024 Weekday AM  
07/09/2024

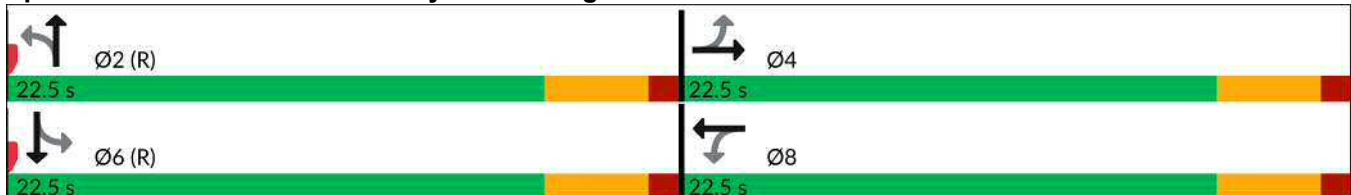


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↖	↗	↖	↗	↖	↗	↖	↗
Traffic Volume (vph)	82	159	51	130	47	188	54	203
Future Volume (vph)	82	159	51	130	47	188	54	203
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Act Effct Green (s)	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
Actuated g/C Ratio	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
v/c Ratio	0.24	0.54	0.21	0.15	0.18	0.44	0.19	0.50
Control Delay (s/veh)	10.7	10.2	11.1	7.2	10.5	10.9	10.4	11.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (s/veh)	10.7	10.2	11.1	7.2	10.5	10.9	10.4	11.5
LOS	B	B	B	A	B	B	B	B
Approach Delay (s/veh)		10.3		8.1		10.8		11.3
Approach LOS		B		A		B		B

Intersection Summary

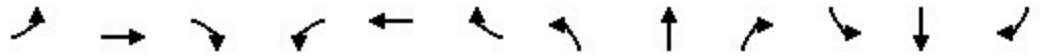
Cycle Length: 45  
 Actuated Cycle Length: 45  
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green  
 Natural Cycle: 45  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.54  
 Intersection Signal Delay (s/veh): 10.3                      Intersection LOS: B  
 Intersection Capacity Utilization 57.6%                      ICU Level of Service B  
 Analysis Period (min) 15

Splits and Phases: 1: McMurphy Ave S & Elgin Dr



HCM Signalized Intersection Capacity Analysis  
 1: McMurphy Ave S & Elgin Dr

2024 Weekday AM  
 07/09/2024

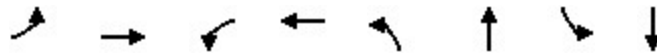


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	82	159	144	51	130	33	47	188	56	54	203	74
Future Volume (vph)	82	159	144	51	130	33	47	188	56	54	203	74
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Lane Util. Factor	1.00	1.00		1.00	0.95		1.00	1.00		1.00	1.00	
Frbp, ped/bikes	1.00	0.98		1.00	0.99		1.00	0.98		1.00	0.99	
Flpb, ped/bikes	0.99	1.00		0.98	1.00		0.99	1.00		0.97	1.00	
Frt	1.00	0.93		1.00	0.97		1.00	0.97		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1773	1707		1760	3446		1763	1789		1737	1789	
Flt Permitted	0.62	1.00		0.43	1.00		0.47	1.00		0.52	1.00	
Satd. Flow (perm)	1150	1707		793	3446		866	1789		946	1789	
Peak-hour factor, PHF	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Adj. Flow (vph)	109	212	192	68	173	44	63	251	75	72	271	99
RTOR Reduction (vph)	0	73	0	0	26	0	0	24	0	0	29	0
Lane Group Flow (vph)	109	331	0	68	191	0	63	302	0	72	341	0
Confl. Peds. (#/hr)	10		25	25		10	35		38	38		35
Confl. Bikes (#/hr)						2			5			3
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	18.0	18.0		18.0	18.0		18.0	18.0		18.0	18.0	
Effective Green, g (s)	18.0	18.0		18.0	18.0		18.0	18.0		18.0	18.0	
Actuated g/C Ratio	0.40	0.40		0.40	0.40		0.40	0.40		0.40	0.40	
Clearance Time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Lane Grp Cap (vph)	460	682		317	1378		346	715		378	715	
v/s Ratio Prot		c0.19			0.06			0.17			c0.19	
v/s Ratio Perm	0.09			0.09			0.07			0.08		
v/c Ratio	0.24	0.49		0.21	0.14		0.18	0.42		0.19	0.48	
Uniform Delay, d1	8.9	10.1		8.9	8.6		8.7	9.7		8.8	10.0	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.2	2.5		1.5	0.2		1.2	1.8		1.1	2.3	
Delay (s)	10.2	12.5		10.4	8.8		9.9	11.6		9.9	12.3	
Level of Service	B	B		B	A		A	B		A	B	
Approach Delay (s/veh)		12.0			9.2			11.3			11.9	
Approach LOS		B			A			B			B	

Intersection Summary			
HCM 2000 Control Delay (s/veh)	11.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.48		
Actuated Cycle Length (s)	45.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	57.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Timings  
1: McMurphy Ave S & Elgin Dr

2024 Existing PM  
07/09/2024

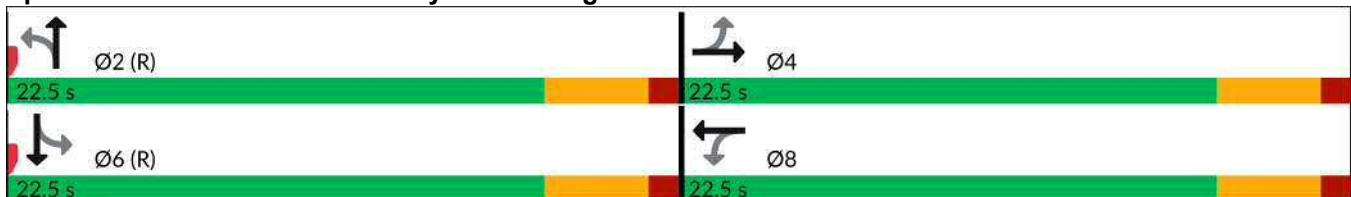


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↖	→	↖	↑	↗	→	↘	↓
Traffic Volume (vph)	44	130	57	166	30	109	21	160
Future Volume (vph)	44	130	57	166	30	109	21	160
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Act Effct Green (s)	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
Actuated g/C Ratio	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
v/c Ratio	0.10	0.23	0.13	0.15	0.07	0.22	0.05	0.31
Control Delay (s/veh)	9.3	8.6	9.5	7.8	8.9	7.6	8.7	8.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (s/veh)	9.3	8.6	9.5	7.8	8.9	7.6	8.7	8.9
LOS	A	A	A	A	A	A	A	A
Approach Delay (s/veh)		8.8		8.2		7.8		8.9
Approach LOS		A		A		A		A

Intersection Summary





















Cycle Length: 45  
 Actuated Cycle Length: 45  
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green  
 Natural Cycle: 45  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.31  
 Intersection Signal Delay (s/veh): 8.4                      Intersection LOS: A  
 Intersection Capacity Utilization 53.3%                      ICU Level of Service A  
 Analysis Period (min) 15

Splits and Phases: 1: McMurphy Ave S & Elgin Dr



HCM Signalized Intersection Capacity Analysis  
 1: McMurphy Ave S & Elgin Dr

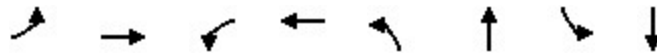
2024 Existing PM  
 07/09/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	44	130	25	57	166	24	30	109	42	21	160	49
Future Volume (vph)	44	130	25	57	166	24	30	109	42	21	160	49
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Lane Util. Factor	1.00	1.00		1.00	0.95		1.00	1.00		1.00	1.00	
Frbp, ped/bikes	1.00	0.99		1.00	1.00		1.00	0.99		1.00	1.00	
Flpb, ped/bikes	0.99	1.00		0.99	1.00		1.00	1.00		0.99	1.00	
Frt	1.00	0.98		1.00	0.98		1.00	0.96		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1779	1828		1766	3499		1785	1785		1766	1809	
Flt Permitted	0.62	1.00		0.65	1.00		0.62	1.00		0.65	1.00	
Satd. Flow (perm)	1164	1828		1208	3499		1156	1785		1212	1809	
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	48	143	27	63	182	26	33	120	46	23	176	54
RTOR Reduction (vph)	0	15	0	0	16	0	0	28	0	0	25	0
Lane Group Flow (vph)	48	155	0	63	192	0	33	138	0	23	205	0
Confl. Peds. (#/hr)	6		13	13		6	4		13	13		4
Confl. Bikes (#/hr)			2						5			7
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	18.0	18.0		18.0	18.0		18.0	18.0		18.0	18.0	
Effective Green, g (s)	18.0	18.0		18.0	18.0		18.0	18.0		18.0	18.0	
Actuated g/C Ratio	0.40	0.40		0.40	0.40		0.40	0.40		0.40	0.40	
Clearance Time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Lane Grp Cap (vph)	465	731		483	1399		462	714		484	723	
v/s Ratio Prot		c0.08			0.05			0.08			c0.11	
v/s Ratio Perm	0.04			0.05			0.03			0.02		
v/c Ratio	0.10	0.21		0.13	0.14		0.07	0.19		0.05	0.28	
Uniform Delay, d1	8.4	8.9		8.5	8.6		8.3	8.8		8.3	9.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.4	0.7		0.6	0.2		0.3	0.6		0.2	1.0	
Delay (s)	8.9	9.5		9.1	8.8		8.6	9.4		8.4	10.1	
Level of Service	A	A		A	A		A	A		A	B	
Approach Delay (s/veh)		9.4			8.9			9.3			10.0	
Approach LOS		A			A			A			A	
<b>Intersection Summary</b>												
HCM 2000 Control Delay (s/veh)	9.4			HCM 2000 Level of Service				A				
HCM 2000 Volume to Capacity ratio	0.25											
Actuated Cycle Length (s)	45.0			Sum of lost time (s)				9.0				
Intersection Capacity Utilization	53.3%			ICU Level of Service				A				
Analysis Period (min)	15											
c Critical Lane Group												

# Appendix C

## Intersection Capacity Analysis Output Background Condition



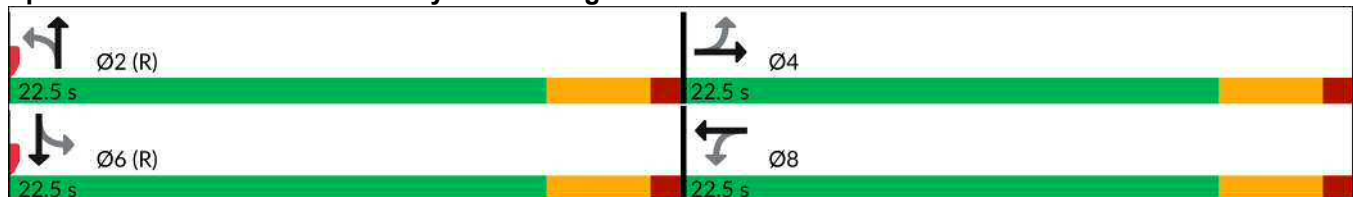


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↖	↗	↖	↗	↖	↗	↖	↗
Traffic Volume (vph)	91	176	56	144	52	208	60	224
Future Volume (vph)	91	176	56	144	52	208	60	224
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Act Effct Green (s)	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
Actuated g/C Ratio	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
v/c Ratio	0.27	0.59	0.27	0.17	0.22	0.49	0.23	0.55
Control Delay (s/veh)	11.1	11.5	12.2	7.3	11.2	11.6	11.1	12.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (s/veh)	11.1	11.5	12.2	7.3	11.2	11.6	11.1	12.4
LOS	B	B	B	A	B	B	B	B
Approach Delay (s/veh)		11.4		8.5		11.6		12.2
Approach LOS		B		A		B		B

Intersection Summary





















Cycle Length: 45  
 Actuated Cycle Length: 45  
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green  
 Natural Cycle: 45  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.59  
 Intersection Signal Delay (s/veh): 11.2                      Intersection LOS: B  
 Intersection Capacity Utilization 61.0%                      ICU Level of Service B  
 Analysis Period (min) 15

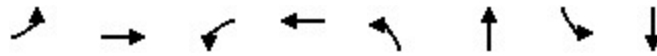
Splits and Phases: 1: McMurphy Ave S & Elgin Dr



HCM Signalized Intersection Capacity Analysis  
1: McMurphy Ave S & Elgin Dr

2029 Background AM  
07/09/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	91	176	159	56	144	36	52	208	62	60	224	82
Future Volume (vph)	91	176	159	56	144	36	52	208	62	60	224	82
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Lane Util. Factor	1.00	1.00		1.00	0.95		1.00	1.00		1.00	1.00	
Frbp, ped/bikes	1.00	0.98		1.00	0.99		1.00	0.98		1.00	0.99	
Flpb, ped/bikes	0.99	1.00		0.99	1.00		0.99	1.00		0.97	1.00	
Frt	1.00	0.93		1.00	0.97		1.00	0.97		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1773	1707		1763	3448		1765	1789		1741	1789	
Flt Permitted	0.60	1.00		0.38	1.00		0.42	1.00		0.48	1.00	
Satd. Flow (perm)	1125	1707		706	3448		787	1789		876	1789	
Peak-hour factor, PHF	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Adj. Flow (vph)	121	235	212	75	192	48	69	277	83	80	299	109
RTOR Reduction (vph)	0	72	0	0	29	0	0	24	0	0	29	0
Lane Group Flow (vph)	121	375	0	75	211	0	69	336	0	80	379	0
Confl. Peds. (#/hr)	10		25	25		10	35		38	38		35
Confl. Bikes (#/hr)						2			5			3
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	18.0	18.0		18.0	18.0		18.0	18.0		18.0	18.0	
Effective Green, g (s)	18.0	18.0		18.0	18.0		18.0	18.0		18.0	18.0	
Actuated g/C Ratio	0.40	0.40		0.40	0.40		0.40	0.40		0.40	0.40	
Clearance Time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Lane Grp Cap (vph)	450	682		282	1379		314	715		350	715	
v/s Ratio Prot		c0.22			0.06			0.19			c0.21	
v/s Ratio Perm	0.11			0.11			0.09			0.09		
v/c Ratio	0.27	0.55		0.27	0.15		0.22	0.47		0.23	0.53	
Uniform Delay, d1	9.1	10.4		9.1	8.6		8.9	10.0		8.9	10.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.5	3.2		2.3	0.2		1.6	2.2		1.5	2.8	
Delay (s)	10.5	13.6		11.4	8.9		10.5	12.2		10.4	13.1	
Level of Service	B	B		B	A		B	B		B	B	
Approach Delay (s/veh)		12.9			9.5			11.9			12.6	
Approach LOS		B			A			B			B	
<b>Intersection Summary</b>												
HCM 2000 Control Delay (s/veh)	12.0			HCM 2000 Level of Service				B				
HCM 2000 Volume to Capacity ratio	0.54											
Actuated Cycle Length (s)	45.0			Sum of lost time (s)				9.0				
Intersection Capacity Utilization	61.0%			ICU Level of Service				B				
Analysis Period (min)	15											
c Critical Lane Group												

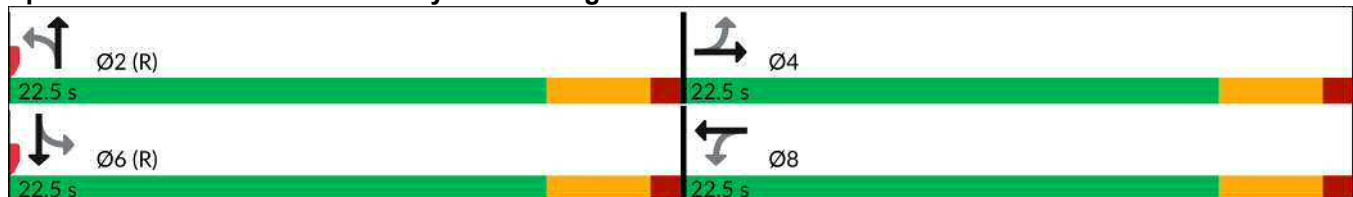


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↖	↗	↖	↗	↖	↗	↖	↗
Traffic Volume (vph)	49	144	63	183	33	120	23	177
Future Volume (vph)	49	144	63	183	33	120	23	177
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Act Effct Green (s)	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
Actuated g/C Ratio	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
v/c Ratio	0.12	0.25	0.15	0.16	0.08	0.25	0.05	0.34
Control Delay (s/veh)	9.4	8.9	9.7	7.9	9.0	7.7	8.7	9.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (s/veh)	9.4	8.9	9.7	7.9	9.0	7.7	8.7	9.4
LOS	A	A	A	A	A	A	A	A
Approach Delay (s/veh)		9.0		8.3		7.9		9.4
Approach LOS		A		A		A		A

Intersection Summary





















Cycle Length: 45  
 Actuated Cycle Length: 45  
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green  
 Natural Cycle: 45  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.34  
 Intersection Signal Delay (s/veh): 8.7                      Intersection LOS: A  
 Intersection Capacity Utilization 53.3%                      ICU Level of Service A  
 Analysis Period (min) 15

Splits and Phases: 1: McMurphy Ave S & Elgin Dr



HCM Signalized Intersection Capacity Analysis  
1: McMurphy Ave S & Elgin Dr

2029 Background PM  
07/09/2024

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Traffic Volume (vph)	49	144	28	63	183	26	33	120	46	23	177	54	
Future Volume (vph)	49	144	28	63	183	26	33	120	46	23	177	54	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5		
Lane Util. Factor	1.00	1.00		1.00	0.95		1.00	1.00		1.00	1.00		
Frbp, ped/bikes	1.00	0.99		1.00	1.00		1.00	0.99		1.00	1.00		
Flpb, ped/bikes	0.99	1.00		0.99	1.00		1.00	1.00		0.99	1.00		
Frt	1.00	0.98		1.00	0.98		1.00	0.96		1.00	0.97		
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00		
Satd. Flow (prot)	1780	1826		1767	3499		1785	1784		1767	1810		
Flt Permitted	0.61	1.00		0.64	1.00		0.60	1.00		0.64	1.00		
Satd. Flow (perm)	1140	1826		1188	3499		1131	1784		1194	1810		
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	
Adj. Flow (vph)	54	158	31	69	201	29	36	132	51	25	195	59	
RTOR Reduction (vph)	0	16	0	0	17	0	0	31	0	0	24	0	
Lane Group Flow (vph)	54	173	0	69	213	0	36	152	0	25	230	0	
Confl. Peds. (#/hr)	6		13	13		6	4		13	13		4	
Confl. Bikes (#/hr)			2						5			7	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA		
Protected Phases		4			8			2			6		
Permitted Phases	4			8			2			6			
Actuated Green, G (s)	18.0	18.0		18.0	18.0		18.0	18.0		18.0	18.0		
Effective Green, g (s)	18.0	18.0		18.0	18.0		18.0	18.0		18.0	18.0		
Actuated g/C Ratio	0.40	0.40		0.40	0.40		0.40	0.40		0.40	0.40		
Clearance Time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5		
Lane Grp Cap (vph)	456	730		475	1399		452	713		477	724		
v/s Ratio Prot		c0.09			0.06			0.09			c0.13		
v/s Ratio Perm	0.05			0.06			0.03			0.02			
v/c Ratio	0.12	0.24		0.15	0.15		0.08	0.21		0.05	0.32		
Uniform Delay, d1	8.5	9.0		8.6	8.6		8.4	8.9		8.3	9.3		
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		
Incremental Delay, d2	0.5	0.8		0.6	0.2		0.3	0.7		0.2	1.2		
Delay (s)	9.0	9.7		9.2	8.9		8.7	9.5		8.5	10.4		
Level of Service	A	A		A	A		A	A		A	B		
Approach Delay (s/veh)		9.6			8.9			9.4			10.3		
Approach LOS		A			A			A			B		
<b>Intersection Summary</b>													
HCM 2000 Control Delay (s/veh)			9.5									HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio			0.28										
Actuated Cycle Length (s)			45.0									Sum of lost time (s)	9.0
Intersection Capacity Utilization			53.3%									ICU Level of Service	A
Analysis Period (min)			15										
c Critical Lane Group													

# Appendix D

## Trip Generation Excerpts

# Single-Family Detached Housing (210)

Vehicle Trip Ends vs: Dwelling Units

On a: Weekday,

Peak Hour of Adjacent Street Traffic,  
One Hour Between 7 and 9 a.m.

Setting/Location: General Urban/Suburban

Number of Studies: 192

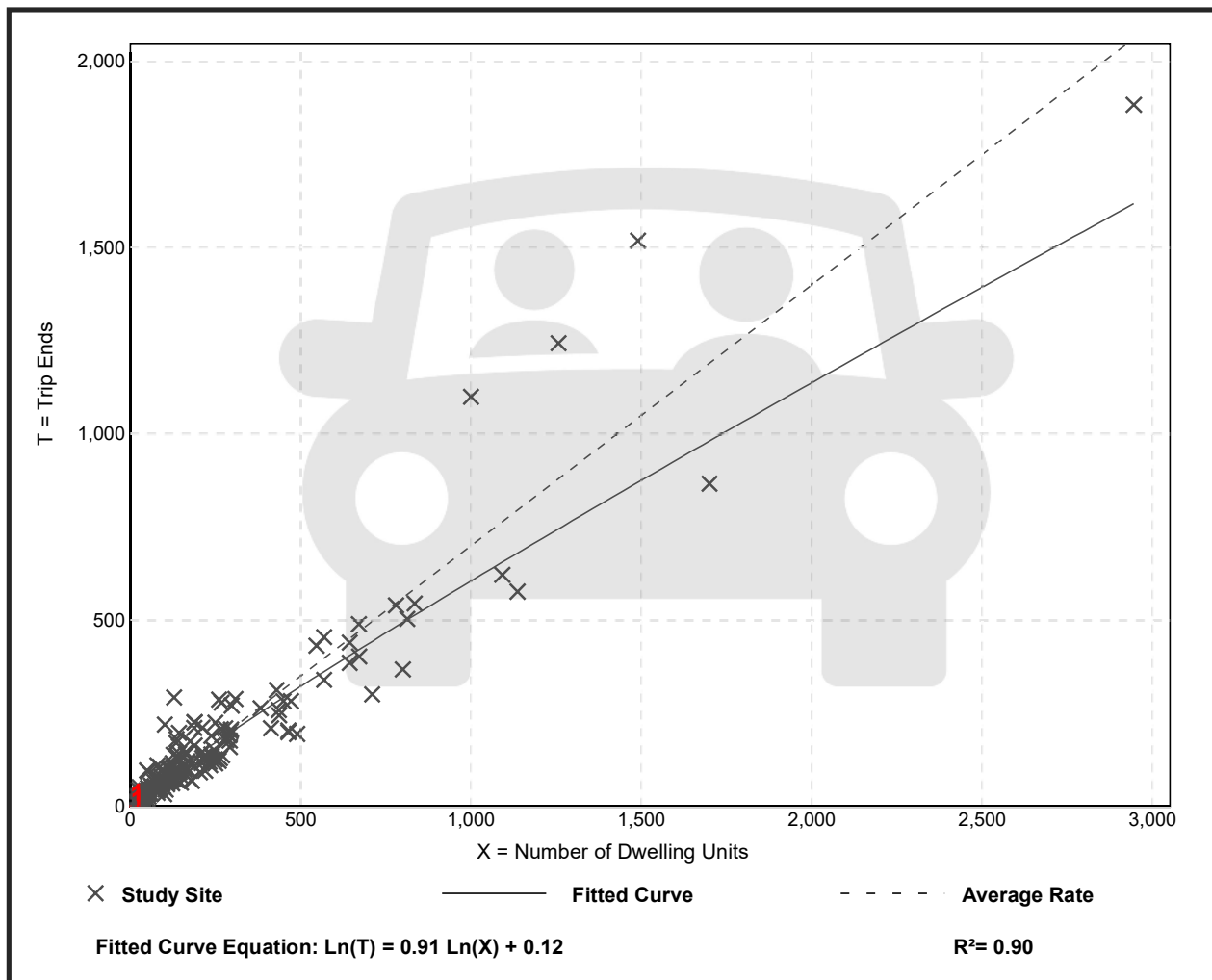
Avg. Num. of Dwelling Units: 226

Directional Distribution: 25% entering, 75% exiting

## Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.70	0.27 - 2.27	0.24

## Data Plot and Equation



# Single-Family Detached Housing (210)

Vehicle Trip Ends vs: Dwelling Units

On a: Weekday,

Peak Hour of Adjacent Street Traffic,  
One Hour Between 4 and 6 p.m.

Setting/Location: General Urban/Suburban

Number of Studies: 208

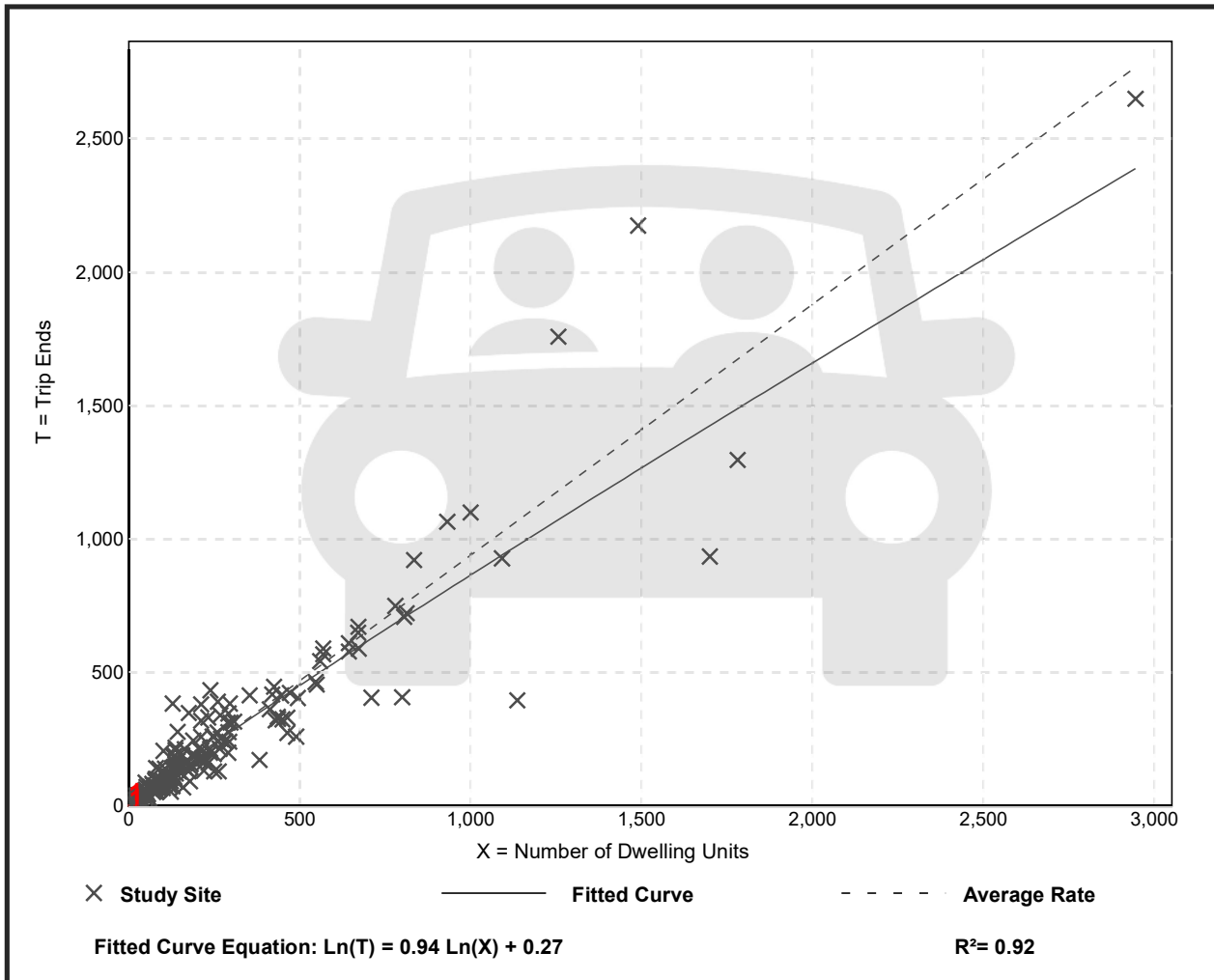
Avg. Num. of Dwelling Units: 248

Directional Distribution: 63% entering, 37% exiting

## Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.94	0.35 - 2.98	0.31

## Data Plot and Equation



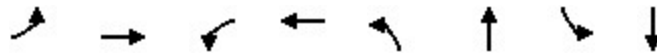
# Appendix E

## Intersection Capacity Analysis Output Future Total Condition



Timings  
1: McMurchy Ave S & Elgin Dr

2029 Total AM  
07/09/2024

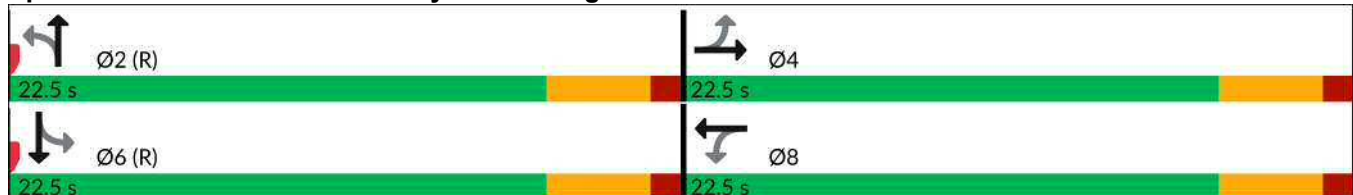


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↖	↗	↖	↕	↖	↗	↖	↗
Traffic Volume (vph)	91	176	56	145	52	208	60	224
Future Volume (vph)	91	176	56	145	52	208	60	224
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Act Effct Green (s)	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
Actuated g/C Ratio	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
v/c Ratio	0.27	0.59	0.27	0.17	0.22	0.49	0.23	0.55
Control Delay (s/veh)	11.2	11.5	12.2	7.3	11.2	11.6	11.1	12.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (s/veh)	11.2	11.5	12.2	7.3	11.2	11.6	11.1	12.4
LOS	B	B	B	A	B	B	B	B
Approach Delay (s/veh)		11.4		8.5		11.6		12.2
Approach LOS		B		A		B		B

Intersection Summary





















Cycle Length: 45  
 Actuated Cycle Length: 45  
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green  
 Natural Cycle: 45  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.59  
 Intersection Signal Delay (s/veh): 11.2                      Intersection LOS: B  
 Intersection Capacity Utilization 61.0%                      ICU Level of Service B  
 Analysis Period (min) 15

Splits and Phases: 1: McMurchy Ave S & Elgin Dr



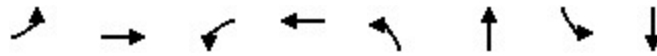
HCM Signalized Intersection Capacity Analysis  
 1: McMurphy Ave S & Elgin Dr

2029 Total AM  
 07/09/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	91	176	159	56	145	36	52	208	62	60	224	82
Future Volume (vph)	91	176	159	56	145	36	52	208	62	60	224	82
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Lane Util. Factor	1.00	1.00		1.00	0.95		1.00	1.00		1.00	1.00	
Frbp, ped/bikes	1.00	0.98		1.00	0.99		1.00	0.98		1.00	0.99	
Flpb, ped/bikes	0.99	1.00		0.99	1.00		0.99	1.00		0.97	1.00	
Frt	1.00	0.93		1.00	0.97		1.00	0.97		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1773	1707		1763	3448		1765	1789		1741	1789	
Flt Permitted	0.60	1.00		0.38	1.00		0.42	1.00		0.48	1.00	
Satd. Flow (perm)	1124	1707		706	3448		787	1789		876	1789	
Peak-hour factor, PHF	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Adj. Flow (vph)	121	235	212	75	193	48	69	277	83	80	299	109
RTOR Reduction (vph)	0	72	0	0	29	0	0	24	0	0	29	0
Lane Group Flow (vph)	121	375	0	75	212	0	69	336	0	80	379	0
Confl. Peds. (#/hr)	10		25	25		10	35		38	38		35
Confl. Bikes (#/hr)						2			5			3
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	18.0	18.0		18.0	18.0		18.0	18.0		18.0	18.0	
Effective Green, g (s)	18.0	18.0		18.0	18.0		18.0	18.0		18.0	18.0	
Actuated g/C Ratio	0.40	0.40		0.40	0.40		0.40	0.40		0.40	0.40	
Clearance Time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Lane Grp Cap (vph)	449	682		282	1379		314	715		350	715	
v/s Ratio Prot		c0.22			0.06			0.19			c0.21	
v/s Ratio Perm	0.11			0.11			0.09			0.09		
v/c Ratio	0.27	0.55		0.27	0.15		0.22	0.47		0.23	0.53	
Uniform Delay, d1	9.1	10.4		9.1	8.6		8.9	10.0		8.9	10.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.5	3.2		2.3	0.2		1.6	2.2		1.5	2.8	
Delay (s)	10.6	13.6		11.4	8.9		10.5	12.2		10.4	13.1	
Level of Service	B	B		B	A		B	B		B	B	
Approach Delay (s/veh)		12.9			9.5			11.9			12.6	
Approach LOS		B			A			B			B	
<b>Intersection Summary</b>												
HCM 2000 Control Delay (s/veh)	12.0			HCM 2000 Level of Service				B				
HCM 2000 Volume to Capacity ratio	0.54											
Actuated Cycle Length (s)	45.0			Sum of lost time (s)				9.0				
Intersection Capacity Utilization	61.0%			ICU Level of Service				B				
Analysis Period (min)	15											
c Critical Lane Group												

Timings  
1: McMurchy Ave S & Elgin Dr

2029 Total PM  
07/09/2024

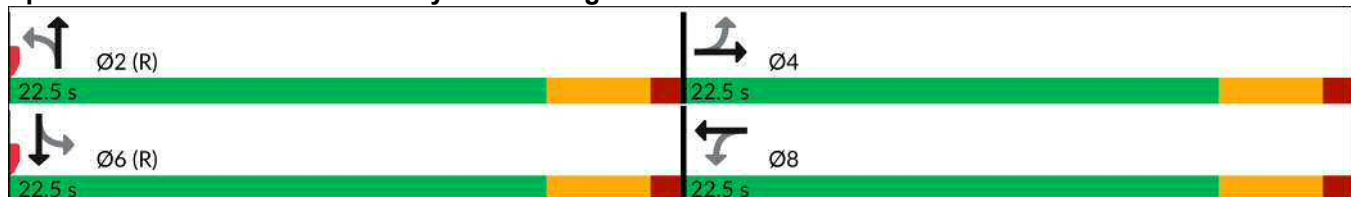


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↖	↗	↖	↗	↖	↗	↖	↗
Traffic Volume (vph)	49	145	63	183	33	120	23	177
Future Volume (vph)	49	145	63	183	33	120	23	177
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max
Act Effct Green (s)	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
Actuated g/C Ratio	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
v/c Ratio	0.12	0.25	0.15	0.16	0.08	0.25	0.05	0.34
Control Delay (s/veh)	9.4	8.9	9.7	7.9	9.0	7.7	8.7	9.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (s/veh)	9.4	8.9	9.7	7.9	9.0	7.7	8.7	9.4
LOS	A	A	A	A	A	A	A	A
Approach Delay (s/veh)		9.0		8.3		7.9		9.4
Approach LOS		A		A		A		A

Intersection Summary





















Cycle Length: 45  
 Actuated Cycle Length: 45  
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green  
 Natural Cycle: 45  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.34  
 Intersection Signal Delay (s/veh): 8.7                      Intersection LOS: A  
 Intersection Capacity Utilization 53.3%                      ICU Level of Service A  
 Analysis Period (min) 15

Splits and Phases: 1: McMurchy Ave S & Elgin Dr



HCM Signalized Intersection Capacity Analysis  
 1: McMurphy Ave S & Elgin Dr

2029 Total PM  
 07/09/2024

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	49	145	28	63	183	26	33	120	46	23	177	54
Future Volume (vph)	49	145	28	63	183	26	33	120	46	23	177	54
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Lane Util. Factor	1.00	1.00		1.00	0.95		1.00	1.00		1.00	1.00	
Frbp, ped/bikes	1.00	0.99		1.00	1.00		1.00	0.99		1.00	1.00	
Flpb, ped/bikes	0.99	1.00		0.99	1.00		1.00	1.00		0.99	1.00	
Frt	1.00	0.98		1.00	0.98		1.00	0.96		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1780	1826		1767	3499		1785	1784		1767	1810	
Flt Permitted	0.61	1.00		0.64	1.00		0.60	1.00		0.64	1.00	
Satd. Flow (perm)	1140	1826		1187	3499		1131	1784		1194	1810	
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	54	159	31	69	201	29	36	132	51	25	195	59
RTOR Reduction (vph)	0	16	0	0	17	0	0	31	0	0	24	0
Lane Group Flow (vph)	54	174	0	69	213	0	36	152	0	25	230	0
Confl. Peds. (#/hr)	6		13	13		6	4		13	13		4
Confl. Bikes (#/hr)			2						5			7
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	18.0	18.0		18.0	18.0		18.0	18.0		18.0	18.0	
Effective Green, g (s)	18.0	18.0		18.0	18.0		18.0	18.0		18.0	18.0	
Actuated g/C Ratio	0.40	0.40		0.40	0.40		0.40	0.40		0.40	0.40	
Clearance Time (s)	4.5	4.5		4.5	4.5		4.5	4.5		4.5	4.5	
Lane Grp Cap (vph)	456	730		474	1399		452	713		477	724	
v/s Ratio Prot		c0.10			0.06			0.09			c0.13	
v/s Ratio Perm	0.05			0.06			0.03			0.02		
v/c Ratio	0.12	0.24		0.15	0.15		0.08	0.21		0.05	0.32	
Uniform Delay, d1	8.5	9.0		8.6	8.6		8.4	8.9		8.3	9.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.5	0.8		0.6	0.2		0.3	0.7		0.2	1.2	
Delay (s)	9.0	9.7		9.2	8.9		8.7	9.5		8.5	10.4	
Level of Service	A	A		A	A		A	A		A	B	
Approach Delay (s/veh)		9.6			8.9			9.4			10.3	
Approach LOS		A			A			A			B	
<b>Intersection Summary</b>												
HCM 2000 Control Delay (s/veh)	9.5			HCM 2000 Level of Service				A				
HCM 2000 Volume to Capacity ratio	0.28											
Actuated Cycle Length (s)	45.0			Sum of lost time (s)				9.0				
Intersection Capacity Utilization	53.3%			ICU Level of Service				A				
Analysis Period (min)	15											
c Critical Lane Group												

# Appendix F

## Turning Movement Counts

## Peak Hour Diagram

### Specified Period

From: 07:00:00  
To: 09:00:00

### One Hour Peak

From: 08:00:00  
To: 09:00:00

**Intersection:** Elgin Dr & McMurchy Ave S  
**Site Code:** 2428100001  
**Count Date:** Jun 20, 2024

**Weather conditions:** Clear

**\*\* Signalized Intersection \*\***

**Major Road:** McMurchy Ave S runs N/S

### North Approach

	Out	In	Total
	324	282	606
	7	29	36
	3	5	8
<b>Totals</b>	<b>334</b>	<b>316</b>	<b>650</b>

### McMurchy Ave S

	0	3	0	0
	2	2	3	0
	72	201	51	0
<b>Totals</b>	<b>74</b>	<b>206</b>	<b>54</b>	<b>0</b>

### East Approach

	Out	In	Total
	206	260	466
	12	9	21
	2	1	3
<b>Totals</b>	<b>220</b>	<b>270</b>	<b>490</b>

### Elgin Dr

				Totals	
0	0	0	0	<b>0</b>	
0	8	82	<b>90</b>		
1	3	156	<b>160</b>		
0	0	144	<b>144</b>		

Peds: 10

Peds: 35



Peds: 38

Peds: 25

### Elgin Dr

Totals			
<b>0</b>	0	0	0
<b>33</b>	28	5	0
<b>136</b>	132	2	2
<b>51</b>	46	5	0

### West Approach

	Out	In	Total
	382	251	633
	11	4	15
	1	2	3
<b>Totals</b>	<b>394</b>	<b>257</b>	<b>651</b>

Totals				
<b>47</b>	<b>193</b>	<b>56</b>	<b>0</b>	
	47	172	53	0
	0	16	3	0
	0	5	0	0

### McMurchy Ave S

### South Approach

	Out	In	Total
	272	391	663
	19	7	26
	5	3	8
<b>Totals</b>	<b>296</b>	<b>401</b>	<b>697</b>

- Cars

- Trucks

- Bicycles

### Comments



## Peak Hour Summary

Intersection: Elgin Dr & McMurchy Ave S  
 Site Code: 2428100001  
 Count Date: Jun 20, 2024  
 Period: 07:00 - 09:00

### Peak Hour Data (08:00 - 09:00)

Start Time	North Approach McMurchy Ave S						South Approach McMurchy Ave S						East Approach Elgin Dr						West Approach Elgin Dr						Total Vehicles
	←	↑	→	↻	Peds	Total	←	↑	→	↻	Peds	Total	←	↑	→	↻	Peds	Total	←	↑	→	↻	Peds	Total	
08:00	13	39	17	0	7	69	11	55	21	0	21	87	17	32	9	0	28	58	37	41	68	0	13	146	360
08:15	28	65	30	0	2	123	27	72	13	0	4	112	8	44	10	0	7	62	37	28	54	0	10	119	416
08:30	8	58	13	0	0	79	2	28	6	0	0	36	8	41	7	0	1	56	9	55	8	0	5	72	243
08:45	5	44	14	0	1	63	7	38	16	0	0	61	18	19	7	0	2	44	7	36	14	0	7	57	225
<b>Grand Total</b>	<b>54</b>	<b>206</b>	<b>74</b>	<b>0</b>	<b>10</b>	<b>334</b>	<b>47</b>	<b>193</b>	<b>56</b>	<b>0</b>	<b>25</b>	<b>296</b>	<b>51</b>	<b>136</b>	<b>33</b>	<b>0</b>	<b>38</b>	<b>220</b>	<b>90</b>	<b>160</b>	<b>144</b>	<b>0</b>	<b>35</b>	<b>394</b>	<b>1244</b>
Approach %	16.2	61.7	22.2	0	-	-	15.9	65.2	18.9	0	-	-	23.2	61.8	15	0	-	-	22.8	40.6	36.5	0	-	-	
Totals %	4.3	16.6	5.9	0	26.8	23.8	3.8	15.5	4.5	0	23.8	17.7	4.1	10.9	2.7	0	17.7	17.7	7.2	12.9	11.6	0	31.7	31.7	
<b>PHF</b>	<b>0.48</b>	<b>0.79</b>	<b>0.62</b>	<b>0</b>	<b>0.68</b>	<b>0.66</b>	<b>0.44</b>	<b>0.67</b>	<b>0.67</b>	<b>0</b>	<b>0.66</b>	<b>0.66</b>	<b>0.71</b>	<b>0.77</b>	<b>0.83</b>	<b>0</b>	<b>0.89</b>	<b>0.89</b>	<b>0.61</b>	<b>0.73</b>	<b>0.53</b>	<b>0</b>	<b>0.67</b>	<b>0.75</b>	
Cars	51	201	72	0	324	272	47	172	53	0	272	206	46	132	28	0	206	206	82	156	144	0	382	1184	
% Cars	94.4	97.6	97.3	0	97	91.9	100	89.1	94.6	0	91.9	93.6	90.2	97.1	84.8	0	93.6	93.6	91.1	97.5	100	0	97	95.2	
Trucks	3	2	2	0	7	19	0	16	3	0	19	12	5	2	5	0	12	12	8	3	0	0	11	49	
% Trucks	5.6	1	2.7	0	2.1	6.4	0	8.3	5.4	0	6.4	5.5	9.8	1.5	15.2	0	5.5	5.5	8.9	1.9	0	0	2.8	3.9	
Bicycles	0	3	0	0	3	5	0	5	0	0	5	2	0	2	0	0	2	2	0	1	0	0	1	11	
% Bicycles	0	1.5	0	0	0.9	1.7	0	2.6	0	0	1.7	0.9	0	1.5	0	0	0.9	0.9	0	0.6	0	0	0.3	0.9	
Peds					10	-					25	-					38	-					35	-	108
% Peds					9.3	-					23.1	-					35.2	-					32.4	-	

## Peak Hour Diagram

### Specified Period

From: 16:00:00  
To: 18:00:00

### One Hour Peak

From: 16:00:00  
To: 17:00:00

**Intersection:** Elgin Dr & McMurchy Ave S  
**Site Code:** 2428100001  
**Count Date:** Jun 20, 2024

**Weather conditions:** Clear

**\*\* Signalized Intersection \*\***

**Major Road:** McMurchy Ave S runs N/S

### North Approach

	Out	In	Total
	225	270	495
	5	7	12
	8	1	9
<b>Totals</b>	<b>238</b>	<b>278</b>	<b>516</b>

### McMurchy Ave S

	0	7	1	0
	1	3	1	0
	48	157	20	0
<b>Totals</b>	<b>49</b>	<b>167</b>	<b>22</b>	<b>0</b>

### East Approach

	Out	In	Total
	241	192	433
	6	1	7
	0	6	6
<b>Totals</b>	<b>247</b>	<b>199</b>	<b>446</b>

### Elgin Dr

				Totals	
0	0	0	0	<b>0</b>	
0	2	42	<b>44</b>		
1	0	130	<b>131</b>		
1	1	24	<b>26</b>		

Peds: 6



### Elgin Dr

Totals			
<b>0</b>	0	0	0
<b>24</b>	24	0	0
<b>166</b>	165	1	0
<b>57</b>	52	5	0

### West Approach

	Out	In	Total
	196	243	439
	3	2	5
	2	0	2
<b>Totals</b>	<b>201</b>	<b>245</b>	<b>446</b>

Totals				
<b>30</b>	<b>210</b>	<b>46</b>	<b>0</b>	
	30	204	42	0
	0	5	0	0
	0	1	4	0

### McMurchy Ave S

### South Approach

	Out	In	Total
	276	233	509
	5	9	14
	5	8	13
<b>Totals</b>	<b>286</b>	<b>250</b>	<b>536</b>

- Cars

- Trucks

- Bicycles

### Comments





## Peak Hour Summary

Intersection: Elgin Dr & McMurchy Ave S  
 Site Code: 2428100001  
 Count Date: Jun 20, 2024  
 Period: 16:00 - 18:00

### Peak Hour Data (16:00 - 17:00)

Start Time	North Approach McMurchy Ave S						South Approach McMurchy Ave S						East Approach Elgin Dr						West Approach Elgin Dr						Total Vehicles
	←	↑	→	↻	Peds	Total	←	↑	→	↻	Peds	Total	←	↑	→	↻	Peds	Total	←	↑	→	↻	Peds	Total	
16:00	3	43	9	0	3	55	0	48	10	0	5	58	17	56	6	0	4	79	12	39	0	0	0	51	243
16:15	7	40	16	0	3	63	10	55	10	0	4	75	16	43	7	0	3	66	14	36	12	0	3	62	266
16:30	8	38	13	0	0	59	14	53	17	0	2	84	12	35	5	0	3	52	10	28	9	0	1	47	242
16:45	4	46	11	0	0	61	6	54	9	0	2	69	12	32	6	0	3	50	8	28	5	0	0	41	221
<b>Grand Total</b>	<b>22</b>	<b>167</b>	<b>49</b>	<b>0</b>	<b>6</b>	<b>238</b>	<b>30</b>	<b>210</b>	<b>46</b>	<b>0</b>	<b>13</b>	<b>286</b>	<b>57</b>	<b>166</b>	<b>24</b>	<b>0</b>	<b>13</b>	<b>247</b>	<b>44</b>	<b>131</b>	<b>26</b>	<b>0</b>	<b>4</b>	<b>201</b>	<b>972</b>
Approach %	9.2	70.2	20.6	0	-	-	10.5	73.4	16.1	0	-	-	23.1	67.2	9.7	0	-	-	21.9	65.2	12.9	0	-	-	
Totals %	2.3	17.2	5	0	24.5	29.4	3.1	21.6	4.7	0	29.4	25.4	5.9	17.1	2.5	0	25.4	25.4	4.5	13.5	2.7	0	20.7	20.7	
<b>PHF</b>	<b>0.69</b>	<b>0.91</b>	<b>0.77</b>	<b>0</b>	<b>0.94</b>	<b>0.85</b>	<b>0.54</b>	<b>0.95</b>	<b>0.68</b>	<b>0</b>	<b>0.85</b>	<b>0.78</b>	<b>0.84</b>	<b>0.74</b>	<b>0.86</b>	<b>0</b>	<b>0.78</b>	<b>0.78</b>	<b>0.79</b>	<b>0.84</b>	<b>0.54</b>	<b>0</b>	<b>0.81</b>	<b>0.91</b>	
Cars	20	157	48	0	225	276	30	204	42	0	276	241	52	165	24	0	241	241	42	130	24	0	196	938	
% Cars	90.9	94	98	0	94.5	96.5	100	97.1	91.3	0	96.5	97.6	91.2	99.4	100	0	97.6	97.6	95.5	99.2	92.3	0	97.5	96.5	
Trucks	1	3	1	0	5	5	0	5	0	0	5	6	5	1	0	0	6	6	2	0	1	0	3	19	
% Trucks	4.5	1.8	2	0	2.1	1.7	0	2.4	0	0	1.7	2.4	8.8	0.6	0	0	2.4	2.4	4.5	0	3.8	0	1.5	2	
Bicycles	1	7	0	0	8	5	0	1	4	0	5	0	0	0	0	0	0	0	0	1	1	0	2	15	
% Bicycles	4.5	4.2	0	0	3.4	1.7	0	0.5	8.7	0	1.7	0	0	0	0	0	0	0	0	0.8	3.8	0	1	1.5	
Peds					6	-					13	-					13	-					4	-	36
% Peds					16.7	-					36.1	-					36.1	-					11.1	-	