3387 Borrisokane Road Community Transportation Study / Transportation Impact Study Addendum 1

Prepared for:
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Project No. 163601067

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1.0 INTRODUCTION

This Community Transportation Study / Transportation Impact Study Addendum 1 serves as an update to the original *3387 Borrisokane Road Community Transportation Study / Transportation Impact Study* (Stantec, September 2016). In December 2016, and as part of the development review process, the City of Ottawa issued comments pertaining to the original study. A comment response letter was prepared in March of 2017 that addressed the City's comments which can be seen in **Appendix A**.

The major changes to the subject Addendum 1 are as follows:

- Whereas the previous draft plan only included a mix of attached and detached residential houses, the revised draft plan now includes a school block.

- As per direction from the City of Ottawa, the timing of Realigned Greenbank Road will not follow the timing outlined in the City of Ottawa's 2013 Transportation Master Plan (i.e. Phase 1: 2014 – 2019). The next TMP update will determine the revised timing of Realigned Greenbank Road. For analysis purposes, and to remain conservative, Realigned Greenbank Road was not assumed to be in place for any of the horizons of the subject study.

- The original CTS / TIS assumed that the Bus Rapid Transit along Realigned Greenbank Road would be constructed at the same time as Realigned Greenbank Road and therefore, the transit modal share was assumed to be 30%. As Realigned Greenbank Road is no longer planned to be constructed within the horizon of the subject study, the 30% transit modal share is thought to no longer be attainable. The auto modal share in the subject Addendum 1 was increased to 90%, which is consistent with assumptions of the existing auto modal share in Barrhaven South.

1.1 STUDY PURPOSE

Glenview Homes (Cedarview) Ltd. (Glenview) is preparing a development application for a proposed residential development in the Barrhaven South Community of Ottawa, Ontario. As part of the approvals process a combined Community Transportation Study (CTS) / Transportation Impact Study (TIS) is required to support the application.

This CTS / TIS has been prepared to assess the potential transportation implications of the proposed residential development and to determine whether transportation improvements are required to support it.

1.2 PROPOSED DEVELOPMENT

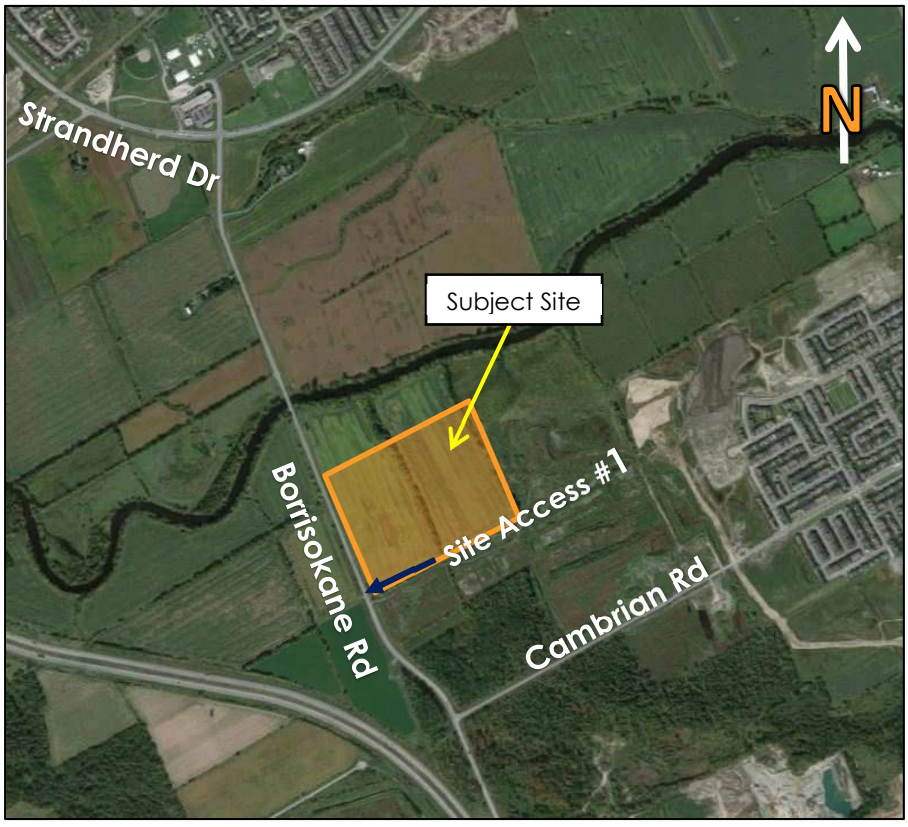
Figure 1 illustrates the location of the subject development.

The proposed development is located at 3387 Borrisokane Road in the City of Ottawa's south end. The site is bound by the Jock River to the north, Mattamy's Half Moon Bay West development to the east and south, and Borrisokane Road to the west. It should be noted that prior to June 2016, Borrisokane Road was called Cedarview Road.

The proposed development includes approximately 208 residential dwellings, consisting of 116 single family homes and 92 townhomes, as well as a 5.93-acre school block. The final number of residential units, however, is subject to change as each phase of development proceeds.

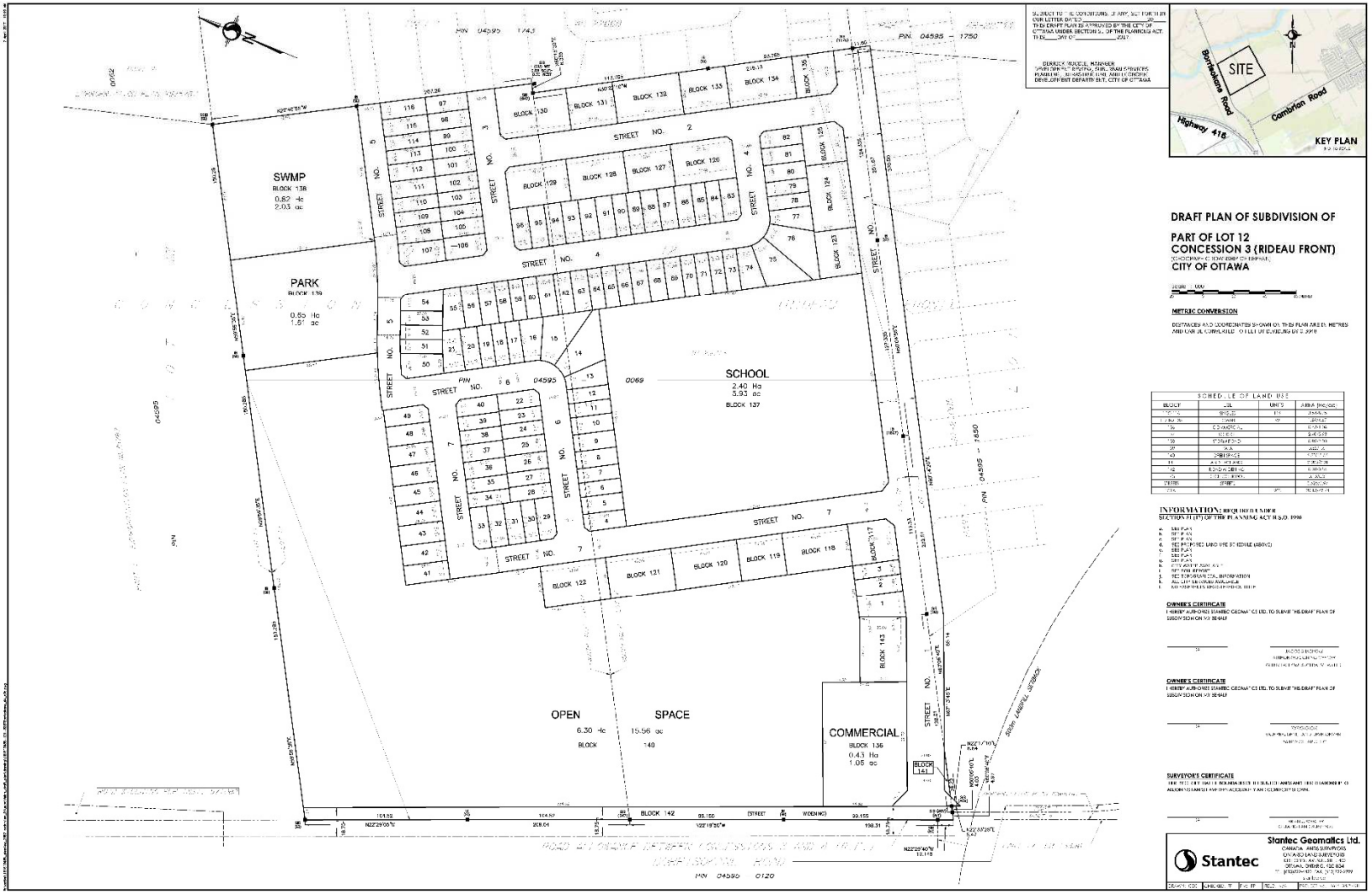
Figure 2 depicts the proposed draft plan.

Figure 1 Site Location



INTRODUCTION

Figure 2 Proposed Draft Plan



1.3 SCOPE OF THE ASSESSMENT

This CTS / TIS has been carried out in accordance with the City of Ottawa's *2006 Transportation Impact Assessment (TIA) Guidelines* and is based on a pre-consultation meeting with City of Ottawa staff. The scope of the transportation assessment, which was discussed with City staff, includes the following:

- Study area intersections include:
    - Borrisokane Road at Strandherd Drive;
    - Borrisokane Road at Site Access 1; and
    - Borrisokane Road at Cambrian Road.
- Study horizons include:
    - 2016 existing conditions;
    - 2022 future background conditions;
    - 2022 total future conditions (site build-out); and
    - 2027 total future conditions (5 years beyond build-out).
- Jock River screenline analysis from Borrisokane Road to Prince of Wales Drive
- Analysis time periods include the weekday AM and PM peak hours

The methodology used in the CTS / TIS includes:

- The net increase in site traffic from the proposed development will be estimated;
- Background traffic growth will be explicitly accounted for based on known developments in the study area;
- Future background traffic volumes will be combined with the net increase in site traffic volumes to determine total future traffic volumes;
- Intersection analyses will be performed to determine the operating characteristics of the study area intersections under each study horizon; and
- Where operational deficiencies are identified mitigation measures will be examined.

2.0 EXISTING TRANSPORTATION ENVIRONMENT

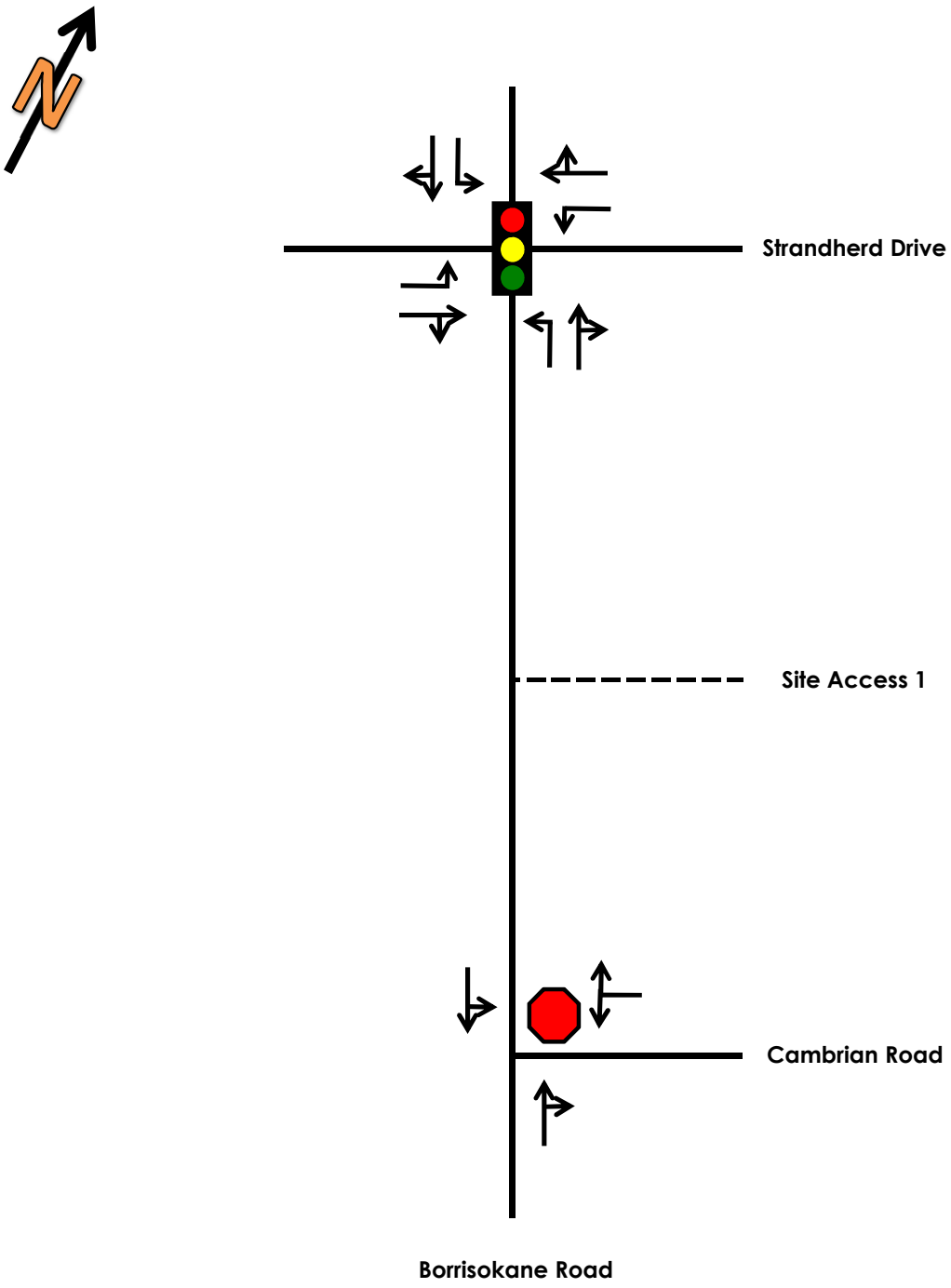
2.1 ROADS AND TRAFFIC CONTROL

The roadways under consideration in the study area are described below:

Borrisokane Road	Within the vicinity of the subject site Borrisokane Road is a two-lane urban arterial road. It has a posted speed limit of 80 km/h and gravel shoulders are provided along both sides.
Strandherd Drive	Strandherd Drive is a two-lane urban arterial road with a posted speed limit of 80 km/h. Gravel shoulders are provided along both sides of the road and the intersection with Borrisokane Road is signalized.
Cambrian Road	West of Seeley's Bay Street Cambrian Road is a two-lane urban arterial road with a posted speed limit of 70 km/h. The intersection with Borrisokane Road is currently stop controlled along the minor approach (i.e. along Cambrian Road).

The road classifications noted above are referenced from Map 6 of the City of Ottawa's *2013 Transportation Master Plan*.

Figure 3 illustrates the existing intersection control and lane configuration for the study area intersections.



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3387 Borrisokane Road

Figure 3: 2016 Existing Intersection Control and Lane Configuration

2.2 TRANSIT

Transit service is not currently provided in the immediate vicinity of the proposed development, however, it is located nearby along Cambrian Road and Strandherd Drive via routes 73, 170, 173, and 177. Route 73 is a peak direction route that runs between Mackenzie King Station and Barrhaven. Route 170 is a regular route that runs from Barrhaven Centre to Fallowfield Station. Route 173 is a regular route that runs from Bayshore Shopping Centre to Barrhaven Centre. Route 177 is a regular route that runs from Barrhaven Centre to Cambrian Road.

Figure 4 illustrates the study area transit routes.

Figure 4 Study Area Transit

(Source: OC Transpo System Map, Accessed April 11th, 2016)

2.3 WALKING AND CYCLING

As the proposed development is currently surrounded by greenfield and undeveloped land, there are currently no existing sidewalks or bicycle lanes in the immediate vicinity of the site. There are, however, sidewalks along Cambrian Road within Mattamy's Half Moon Bay North community. It should be noted that both Borrisokane Road and Cambrian Road are part of the City of Ottawa's Ultimate Cycling Network as local cycling routes.

2.4 TRAFFIC VOLUMES

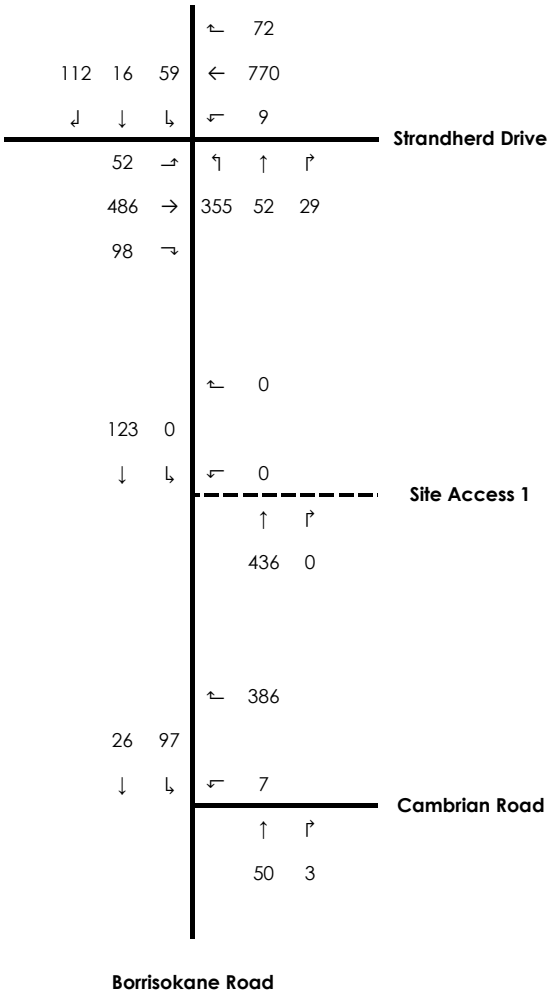
Traffic counts were provided by the City of Ottawa at the Borrisokane Road at Strandherd Drive intersection (2015). Stantec performed intersection turning movement counts at the Borrisokane Road at Cambrian Road intersection in 2015.

As the intersection counts were collected prior to 2016, the data required adjustments to reflect the current existing condition. In order to calculate the anticipated growth rate between the 2015 and 2016 horizons, volumes from the City of Ottawa's TRANS regional transportation model were used. Using the provided 2011 volumes and the 2031 projections from the TRANS model, the annual growth rate was calculated to be 4% during the AM peak hour and 5% during the PM peak hour between 2011 and 2031. Using these annual growth rates, the 2015 volumes were increased to represent 2016 conditions.

Figure 5 illustrates 2016 existing AM and PM peak hour traffic volumes at the study area intersections.

Appendix B contains the traffic data and is provided for reference.

AM Peak Hour



PM Peak Hour

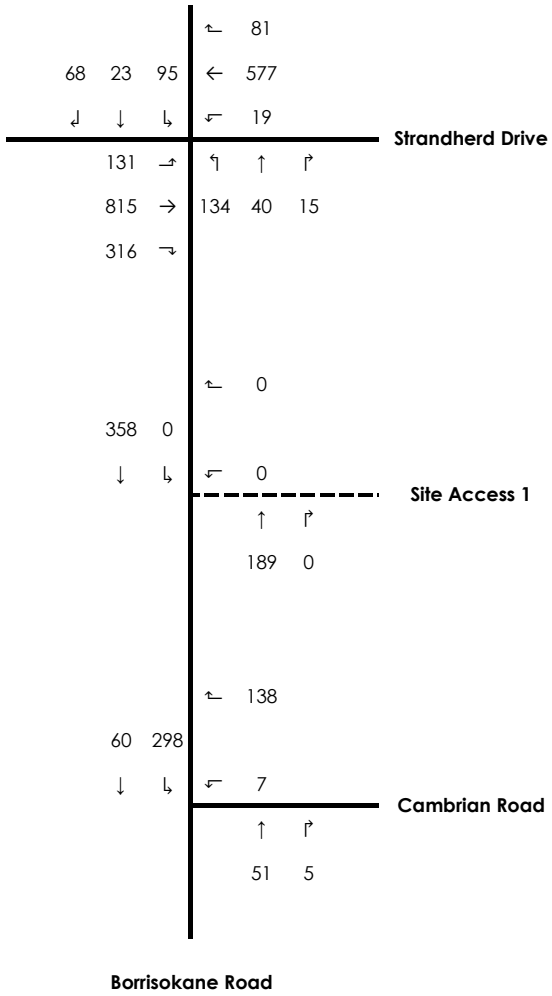


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Figure 5: 2016 Existing Traffic Volumes

3.0 FUTURE TRANSPORTATION ENVIRONMENT

3.1 FUTURE ROAD NETWORK IMPROVEMENTS

Several significant transportation improvements have been noted in the City of Ottawa's 2013 *Transportation Master Plan* (TMP) in the vicinity of the proposed site and are outlined in **Table 1** below.

Table 1 2013 Transportation Master Plan Scheduled Upgrades

PROJECT	DESCRIPTION	TMP PHASE
Realigned Greenbank Road	New four lane road from near Jockvale Road to Cambrian Road, includes Jock River Bridge	Phase 1 (2014 – 2019)
Strandherd Drive Widening	Widen from two to four lanes between Fallowfield Road and Jockvale Road	Phase 2 (2022 – 2025)
Chapman Mills Drive	New four lane arterial road from Longfields Drive to Strandherd Drive, includes Bus Rapid Transit	Phase 2 (2022 – 2025)
Cambrian Road Widening	Widen from two to four lanes from Realigned Greenbank Road to Jockvale Road	Network Concept (i.e. beyond 2031)
Southwest Transitway	From Barrhaven Centre to Cambrian Road	Network Concept (i.e. beyond 2031)

Although the TMP suggests that Realigned Greenbank Road will be constructed during Phase 1 (2014 – 2019) of the TMP, based on recent discussions with City of Ottawa staff, it has been confirmed that it will not be constructed as part of Phase 1. The next TMP update will determine the revised timing of Realigned Greenbank Road. For analysis purposes, and to remain conservative, Realigned Greenbank Road was not assumed to be in place for any of the horizons of the subject study.

The City has recently completed the Environmental Assessment Study for the westerly extension of Chapman Mills Drive and Bus Rapid Transit Corridor. The EA was available for the 30-day public review period until December 20th, 2016. The recommended plan established for the corridor includes two lanes (one in each direction) along Chapman Mills Drive for general traffic. Also, Chapman Mills Drive is identified in the TMP as a major collector roadway. Further, as per the TMP, implementation of the BRT facility along this section of Chapman Mills Drive is a post 2031 project.

3.2 FUTURE BACKGROUND DEVELOPMENTS

The Barrhaven South community has experienced substantial growth over the past few years and that growth is anticipated to continue well into the future. There are numerous developments scheduled to occur in the vicinity of the subject site, as outlined in **Table 2** and as

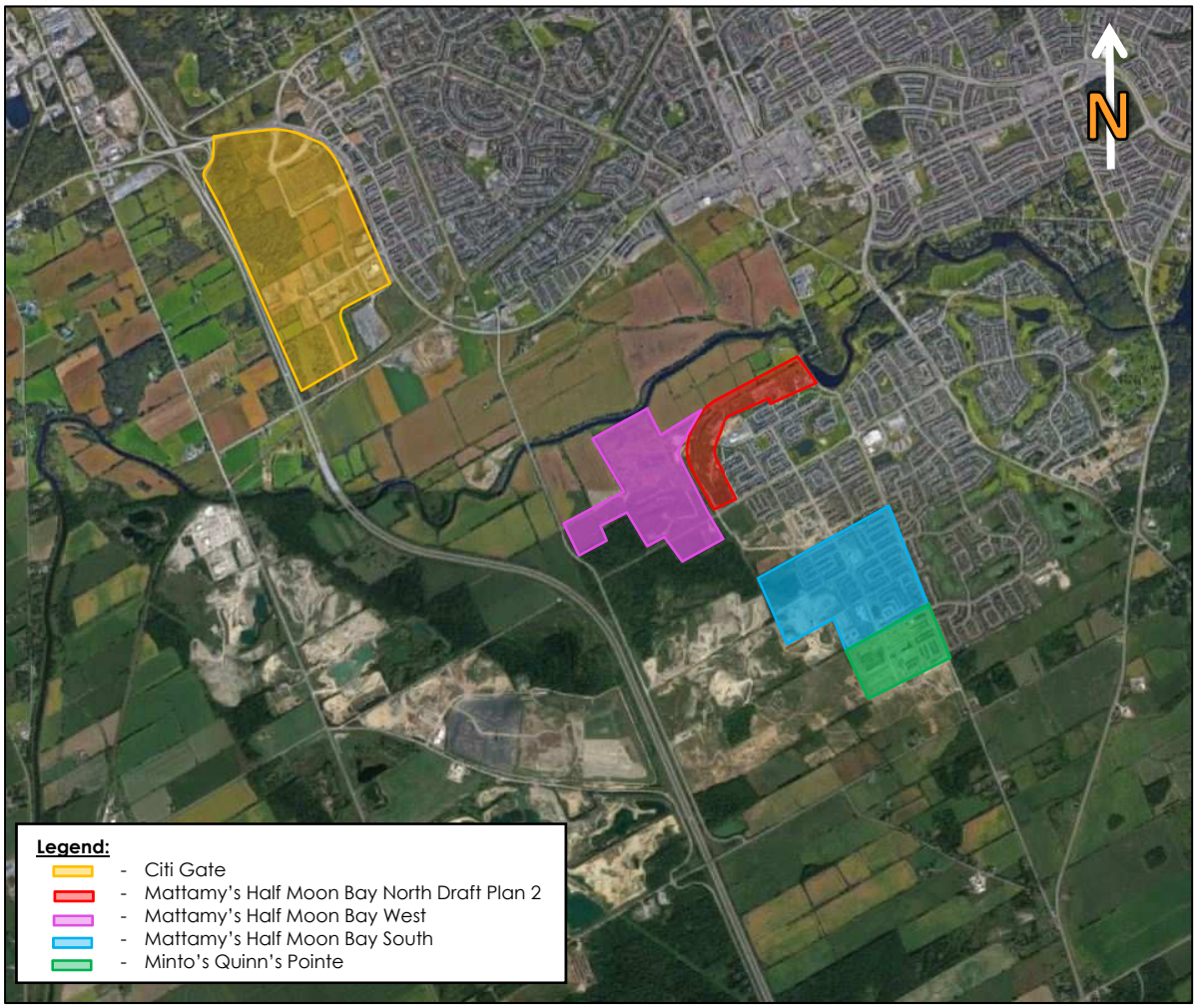
illustrated in **Figure 6** below. These background developments were explicitly accounted for and added to the roadway network as background traffic volumes.

Table 2 Background Developments

DEVELOPMENT	LOCATION	DEVELOPMENT SIZE	ASSUMED BUILD-OUT
Mattamy's Half Moon Bay South Phase 4	South of Half Moon Bay South Phase 3, between Realigned Greenbank and Existing Greenbank	265 Residential Units	2017
Mattamy's Half Moon Bay North Draft Plan 2	North of Cambrian Road, west of Greenbank Road	471 Residential Units	2019
Mattamy's Half Moon Bay West	North of Cambrian Road between Borrisokane Road and Realigned Greenbank Road	1,016 Residential Units	2024
Minto's Quinn's Pointe	West of Existing Greenbank Road, South of Half Moon Bay South	475 Residential Units	2019
Citi Gate Highway 416 Employment Lands	Between Highway 416 and Strandherd Drive, south of Fallowfield, north of the train tracks	350,000 ft^2 GFA 95 hectares of Business Park	Interim Phase: 2019[1] Ultimate Phase: 2029

Notes: 1. Only the interim 2019 phase for the Citi Gate development was considered as the ultimate 2029 phase occurs beyond the horizons of the subject study

Figure 6 Background Developments



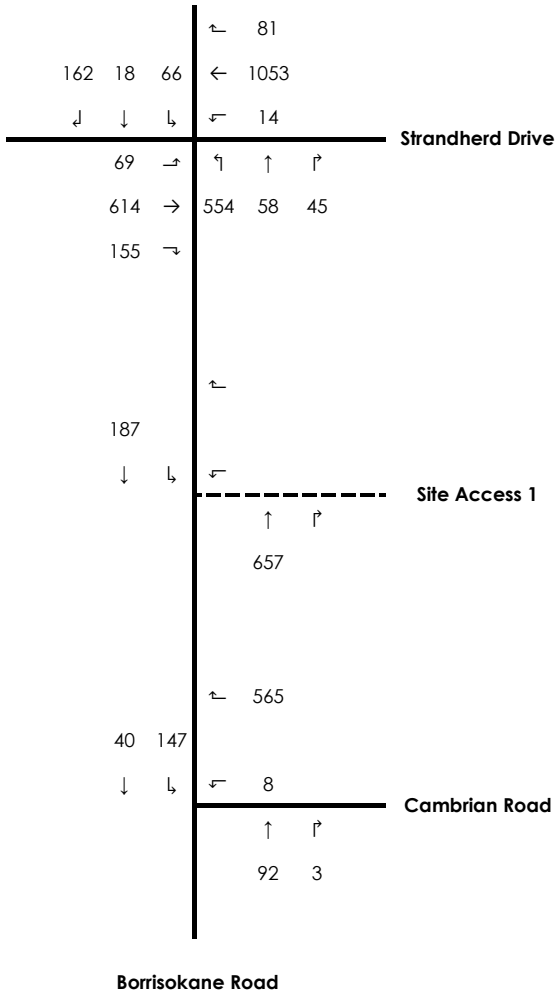
3.3 2022 FUTURE BACKGROUND CONDITIONS

Future background conditions are assessed to differentiate between the transportation improvements that may be required to address background traffic growth and those that may be required to accommodate traffic generated by the subject development. Any improvements identified to address future background conditions are not the responsibility of the developer.

In addition to the future background developments, a nominal 2% annual growth rate was applied to the Borrisokane Road and Cambrian Road traffic volumes and a 3% annual growth rate was applied to the Strandherd Drive volumes. These rates of growth are consistent with industry standards and those that were applied in previously approved studies (i.e. *Citi Gate Highway 416 Employment Lands Community Transportation Study,* Novatech 2012).

Figure 7 illustrates 2022 future background traffic volumes at the study area intersections.

AM Peak Hour



PM Peak Hour

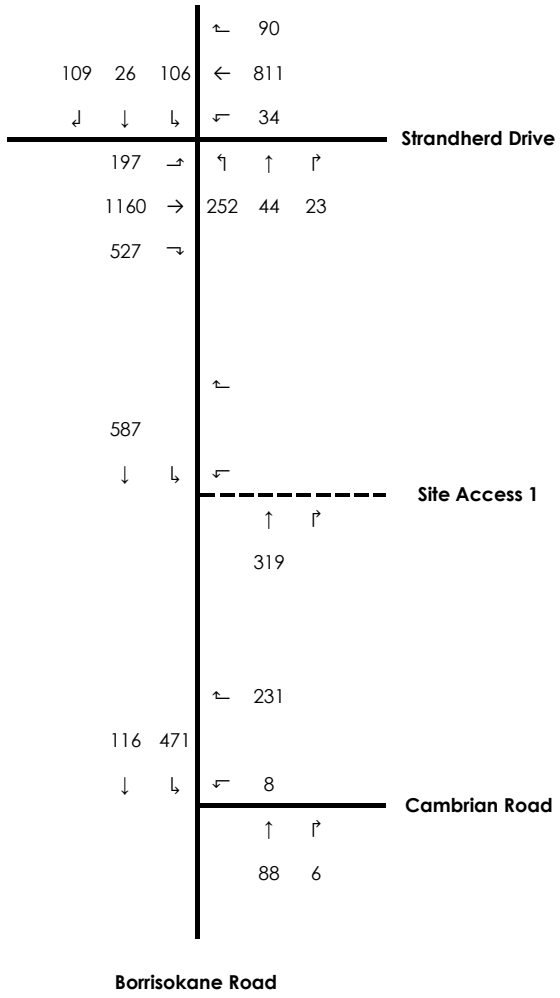


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Figure 7: 2022 Future Background Traffic Volumes

3.4 SITE TRAFFIC GENERATION

3.4.1 Land Use and Trip Generation Rates

The *Institute of Transportation Engineers (ITE) Trip Generation Manual (9th Edition)* was used to estimate traffic generated by the subject site. The ITE land use codes 210 – Single Family Homes, 230 – Condo / Townhomes, and 520 – Elementary School were thought to be most representative of the proposed land uses.

As the school board has an option on the school block for seven years, there are no concepts or drawings prepared for the school at this time. In order to assess the trip generation of the proposed school, the size of the future school was estimated using a similar sized property for an elementary school in Barrhaven South. It was assumed that the proposed school will be approximately 30,000 square feet in size.

Table 3 summarizes the trip rates obtained from the *ITE Trip Generation Manual* and the ensuing sections describe the methodology used to convert these trips to person trips across all modes of transportation.

Table 3 Trips Generated by the Proposed Residential Development

ITE LAND USE			MORNING PEAK HOUR			AFTERNOON PEAK HOUR		
			In	Out	Total	In	Out	Total
Step 1: ITE Trip Generation Rates								
210 – Single Family Homes	Units	116	0.20	0.58	0.78	0.66	0.38	1.04
230 – Condo / Townhomes	Units	92	0.09	0.43	0.52	0.41	0.20	0.61
520 – Elementary School	1000's sq. ft.	30	2.91	2.29	5.20	0.54	0.67	1.21
Step 2: Conversion from Auto Trips to Person Trips								
210 – Single Family Homes	Trip Gen		23	68	91	76	44	120
	Transit Share	10%	2	7	9	8	4	12
	Auto Occupancy	1.1	2	7	9	8	4	12
	Total Person Trips		27	82	109	92	52	144
230 – Condo / Townhomes	Trip Gen		8	40	48	38	18	56
	Transit Share	10%	1	4	5	4	2	6
	Auto Occupancy	1.1	1	4	5	4	2	6
	Total Person Trips		10	48	58	46	22	68
520 – Elementary School	Trip Gen		88	69	157	16	20	36
	Transit Share	10%	9	7	16	2	2	4
	Auto Occupancy	1.1	9	7	16	2	2	4
	Total Person Trips		106	83	189	20	24	44

ITE LAND USE			MORNING PEAK HOUR			AFTERNOON PEAK HOUR		
			In	Out	Total	In	Out	Total
Step 3: Person Trips by Modal Share								
210 – Single Family Homes	Auto	90%	24	74	98	83	47	130
	Passenger / Active Modes	10%	3	8	11	9	5	14
230 – Condo / Townhomes	Auto	90%	9	43	52	41	20	61
	Passenger / Active Modes	10%	1	5	6	5	2	7
520 – Elementary School	Auto	90%	95	75	170	18	22	40
	Passenger / Active Modes	10%	11	8	19	2	2	4
Step 4: Internal Capture Trips								
210 – Single Family Homes	Auto Trips		24	74	98	83	47	130
	Internal Capture	0%	0	0	0	0	0	0
	Net New Auto Trips		24	74	98	83	47	130
230 – Condo / Townhomes	Auto Trips		9	43	52	41	20	61
	Internal Capture	0%	0	0	0	0	0	0
	Net New Auto Trips		9	43	52	41	20	61
520 – Elementary School	Auto Trips		95	75	170	18	22	40
	Internal Capture	70%	67	53	120	13	15	28
	Net New Auto Trips		28	22	50	5	7	12
Step 5: Net New Auto Trips								
Total Development	Auto Trips		128	192	320	142	89	231
	Internal Capture		67	53	120	13	15	28
	Net New Auto Trips		61	139	200	129	74	203

3.4.2 Conversion of ITE Rates to Person Trips

The notion of quantifying the volume of "person" trips expected to be generated by a given development is becoming a commonly accepted practice. It is aimed at quantifying the expected demands across the primary modes of transportation.

In order to convert ITE rates to person trips, the rates obtained from the ITE Trip Generation Manual were adjusted to account for the transit modal share and auto occupancy thought to be inherent within the ITE rates. An assumed transit share of 10% was thought to be inherent within the ITE rates and an auto occupancy rate of 1.1 persons per vehicle was also assumed to be inherent within the ITE rates.

Step 2 of **Table 3** outlines the conversion from auto trips to person trips.

3.4.3 Net New Site Trips

To reflect Barrhaven South travel characteristics, the person trips were assigned to the four primary modal shares (i.e. auto, passenger, transit, and active moves). Based on the lack of transit service and active modes facilities in the immediate study area, it was assumed that the auto modal share will be 90%, with the remaining 10% encompassing passenger, transit, and active modes. The proposed development is anticipated to generate 356 and 256 person trips during the AM and PM peak hours, respectively. In terms of vehicle trips, the proposed development is anticipated to generate 200 and 203 net new auto trips (two-way) during the AM and PM peak hours, respectively.

Step 3 of **Table 3** summarizes the expected person trips by modal share.

3.4.4 Internal Capture

When predicting trips that are associated with different land use types the interaction between those land use types must be accounted for by applying the principals of internal capture adjustments. Internal capture trips are trips which are shared between two or more uses within a given area. A portion of the generated trips for each individual land use is therefore drawn from the adjacent land uses. Internal capture adjustments were made to account for vehicles that visit more than one land use within the subject development. Since these trips are contained within the development area, accounting for each trip separately on the roadway network would result in "double-counting". For this reason, complementary land uses ultimately had their net new trips adjusted to reflect these synergies.

As the catchment area of the elementary school will largely consist of the subject development, the majority of the trips that the elementary school will generate will originate from the immediate area. For this reason, the elementary school was assumed to have an internal capture rate of 70%.

Step 4 of **Table 3** summarizes the internal capture trips for the subject development and Step 5 summarizes the net new auto trips.

3.4.5 Traffic Distribution and Assignment

The distribution of traffic to / from the study area was determined through examination of the TRANS Committee's 2011 Origin-Destination (O-D) Survey for the South Nepean District.

Table 4 provides a summary of the estimated distribution for the traffic generated by the proposed development.

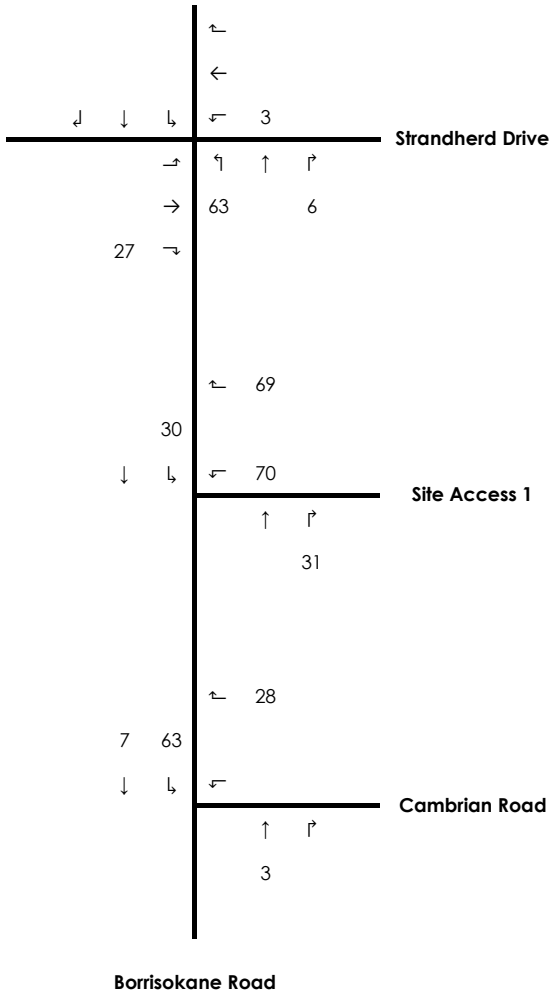
The anticipated site traffic generated by the proposed residential development was assigned to the boundary road network using a logical pattern of primary roads (i.e. along arterials and collectors) which can be seen in **Table 4** below.

Table 4 Traffic Distribution from the South Nepean District

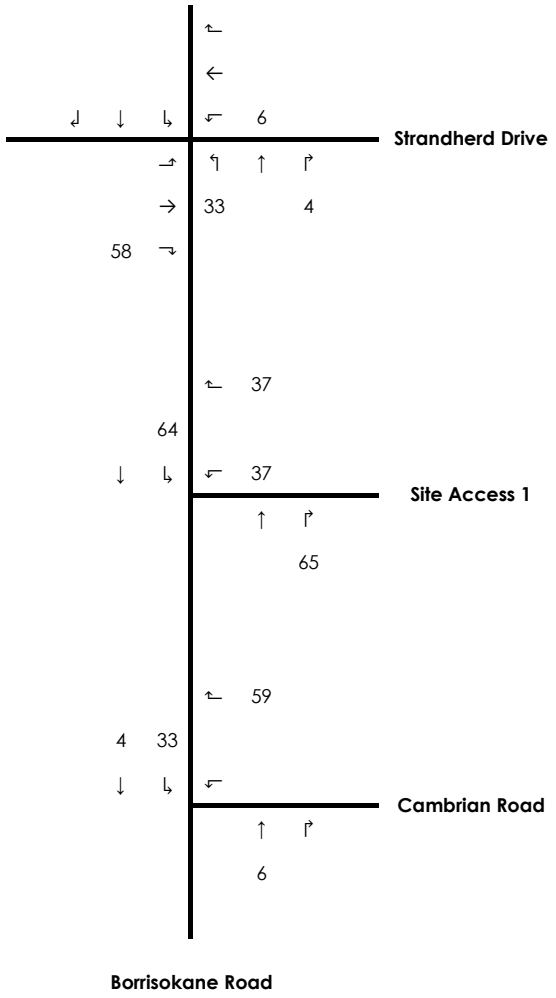
CARDINAL DIRECTION	VIA (TO / FROM)			
	% Distribution	Borrisokane North	Borrisokane South	Existing Greenbank North
North	25%	20%		5%
East	25%	12.5%		12.5%
South	5%		5%	
West	5%	5%		
Internal (South Nepean)	40%	12%		28%
Total	**100%**	**49.5%**	**5%**	**45.5%**

Figure 8 illustrates the assignment of total site traffic volumes to the boundary road network.

AM Peak Hour



PM Peak Hour



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3387 Borrisokane Road

Figure 8: 3387 Borrisokane Road Site Traffic

3.5 2022 TOTAL FUTURE CONDITIONS

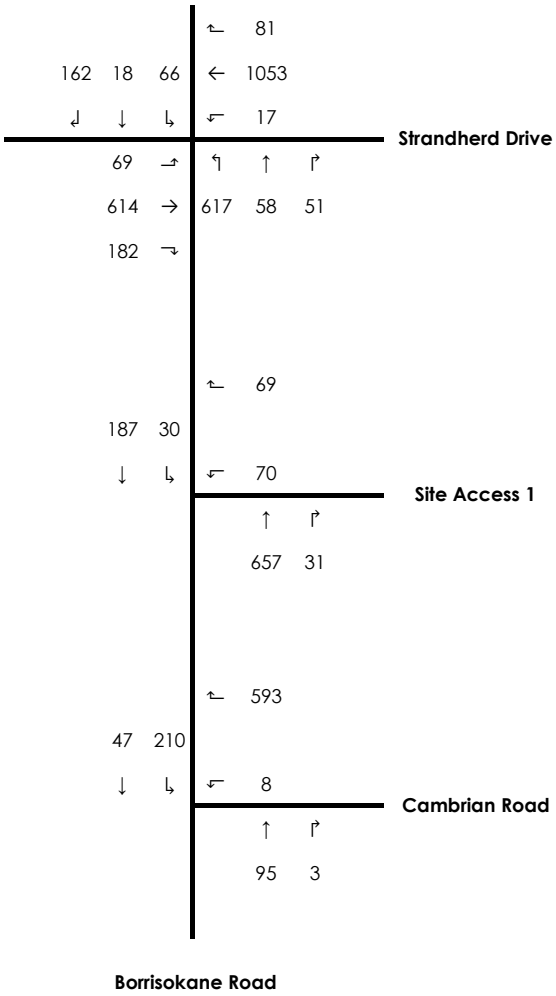
Total future conditions are examined to determine improvements that may be required as a direct result of the development of the site. It is anticipated that by 2022 the residential development will be fully built and occupied.

The 2022 total future traffic volumes were derived by adding 3387 Borrisokane Road site generated trips to future background volumes anticipated for 2022.

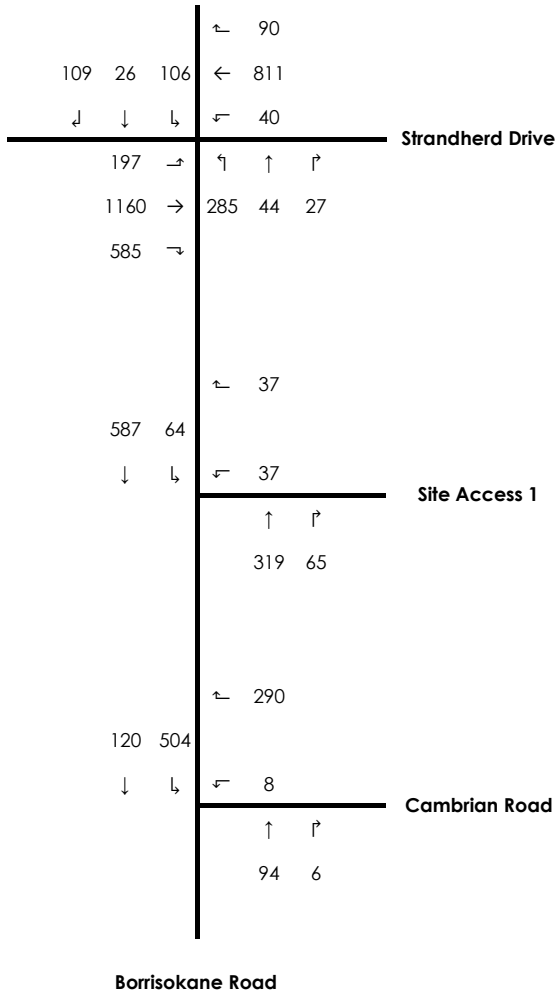
Figure 9 illustrates 2022 total future traffic volumes at the study area intersections during the AM and PM peaks.

An assessment of 2022 total future traffic conditions is outlined in **Section 4.3**.

AM Peak Hour



PM Peak Hour



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3387 Borrisokane Road

Figure 9: 2022 Total Future Traffic Volumes

3.6 2027 ULTIMATE CONDITIONS

Ultimate conditions for the 2027 horizon were examined to determine if other improvements may be required due to additional growth in background traffic volumes 5 years beyond the expected build-out of the subject site.

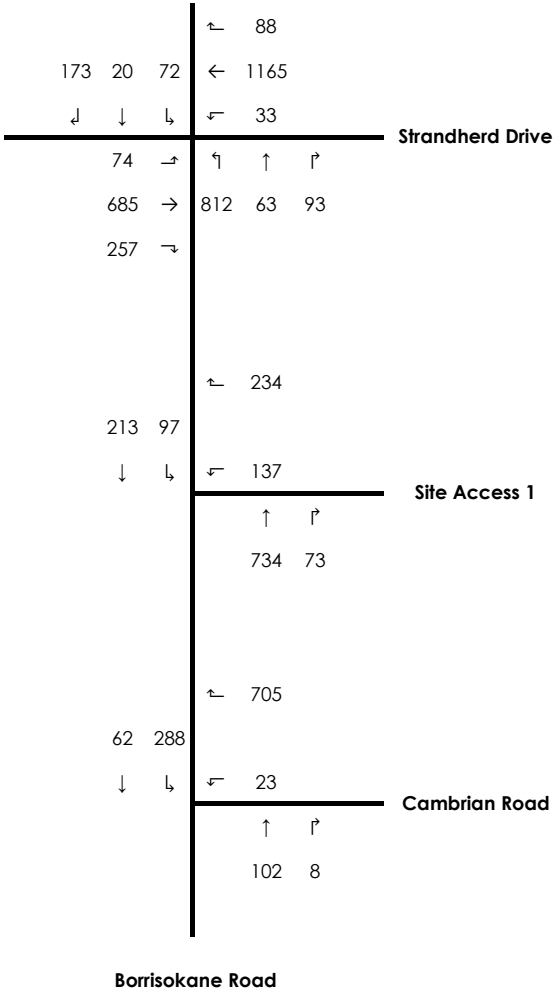
To calculate the anticipated growth rate between the 2022 and 2027 horizons, volumes from the City of Ottawa's TRANS regional transportation model was used. Using the calculated 2022 volumes and the provided 2031 projections from the TRANS model, the annual growth rate was calculated to be 3% between 2022 and 2031. Using this growth rate, the 2022 volumes were adjusted to 2027 ultimate traffic volumes.

In addition, Mattamy's adjacent Half Moon Bay West development is anticipated to be built-out prior to the ultimate 2027 horizon. With the assumption that Realigned Greenbank Road will not be in place during the horizons of the subject study, the Half Moon Bay West development will need to heavily rely on Glenview's Site Access 1 to Borrisokane Road. As such, Mattamy's site trips were added to the roadway network, and in particular, to the Borrisokane Road at Site Access 1 intersection.

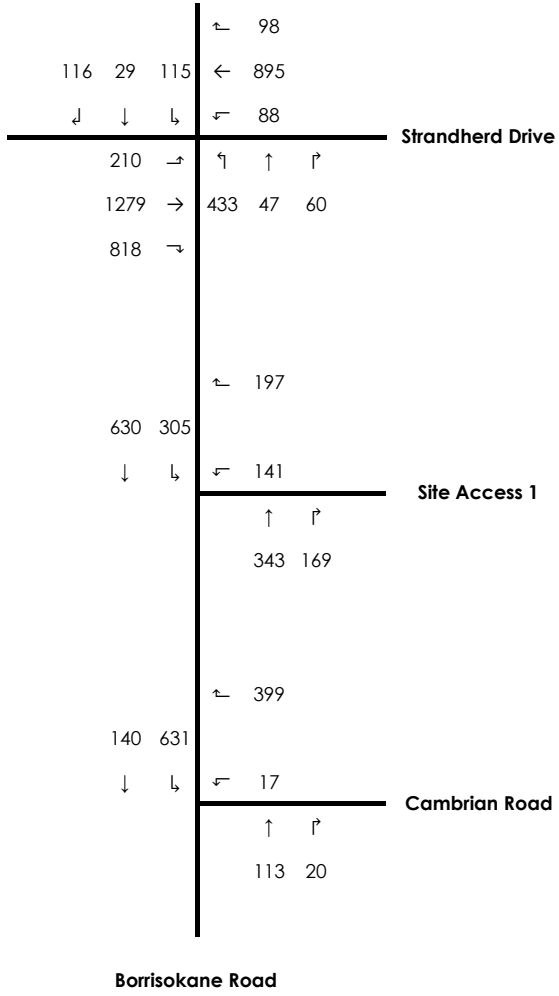
Figure 10 illustrates 2027 ultimate traffic volume at the study area intersections during the AM and PM peaks.

An assessment of 2027 ultimate traffic conditions is outlined in **Section 4.4**.

AM Peak Hour



PM Peak Hour



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3387 Borrisokane Road

Figure 10: 2027 Ultimate Traffic Volumes

4.0 TRANSPORTATION ASSESSMENT

4.1 2016 EXISTING CONDITIONS

Figure 3 (**Section 2.1**) illustrates the 2016 existing intersection controls and lane configuration at the study area intersections.

4.1.1 Jock River Screenline Analysis

A screenline is an imaginary line that is drawn along the boundary of an area of interest, in this case, the Jock River. System capacity across a screenline is determined by the number of roads and travel lanes which cross the screenline. Traffic demands are then compared to the available capacity to determine if there is a surplus or shortfall in system capacity.

Screenline data from the TRANS regional transportation model for the Jock River screenline (screenline 49) was obtained from the City of Ottawa's Transportation Modeling department for the years 2011 and 2031.

Annual growth rates were calculated for the entire screenline and at each station between Borrisokane Road and Prince of Wales Drive between 2011 and 2031 (assuming a straight-line growth assumption), which is outlined in **Table 5** below. The inbound movements represent vehicles traveling towards the urban core (i.e. leaving Barrhaven South by traveling north across the screenline) and outbound movements represent vehicles traveling away from the urban core (i.e. entering Barrhaven South by travelling south across the screenline).

As we have updated 2015 counts at the Borrisokane Road screenline station, these volumes replaced the 2011 volumes and were used in calculating the annual growth rate to 2031.

Total annual growth across the entire screenline is forecasted to be 6% during the AM peak (predominant direction being "inbound") and 6% during the PM peak (predominant direction being "outbound"). At individual stations the majority of the screenline growth is anticipated to occur at the Borrisokane Road and Greenbank Road locations.

TRANSPORTATION ASSESSMENT

Table 5 Screenline Growth from 2011 to 2031

STATION	DIRECTION	2011		2031		ANNUAL GROWTH 2011 TO 2031	
		AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
Borrisokane	Inbound	420[1]	181[1]	694	165	4%	-1%
Borrisokane	Outbound	119[1]	342[1]	67	637	-3%	5%
Greenbank[2]	Inbound	414	137	1338	310	11%	6%
Greenbank[2]	Outbound	74	320	117	1012	3%	11%
Jockvale	Inbound	544	335	1411	381	8%	1%
Jockvale	Outbound	194	562	175	1202	0%	6%
Prince of Wales	Inbound	931	507	1751	971	4%	5%
Prince of Wales	Outbound	525	833	551	1736	0%	5%
Total	Inbound	2103	1018	5194	1827	6%	3%
Total	Outbound	811	1902	910	4587	0%	6%

Notes: 1. Taken from 2015 turning movement counts at Borrisokane / Cambrian
2. Greenbank refers to Existing Greenbank Road in 2011 and Realigned Greenbank Road in 2031

Using the annual growth rates from **Table 5**, the screenline data was interpolated to the existing 2016 condition and can be seen in **Table 6** below.

Table 6 2016 Existing Jock River Screenline Analysis

STATION	DIRECTION	2016 EXISTING CONDITIONS					
		AM Peak Hour	PM Peak Hour	Lanes	Capacity (veh/hr)	AM Peak v/c[1]	PM Peak v/c[1]
Borrisokane	Inbound	432	186	1	1000	0.43	0.19
Borrisokane	Outbound	122	352	1	1000	0.12	0.35
Greenbank	Inbound	645	180	1	1000	0.65	0.18
Greenbank	Outbound	85	493	1	1000	0.09	0.49
Jockvale	Inbound	761	347	2	2000	0.38	0.17
Jockvale	Outbound	189	722	2	2000	0.09	0.36
Prince of Wales	Inbound	1136	623	2	2000	0.57	0.31
Prince of Wales	Outbound	532	1059	2	2000	0.27	0.53
Total	Inbound	2974	1336	6	6000	0.50	0.22
Total	Outbound	928	2626	6	6000	0.15	0.44

Notes: 1. Volume to capacity ratio: compares roadway demand (vehicle volumes) with roadway supply (carrying capacity).

As shown in **Table 6**, the volumes fall well below the capacities at all four stations along the Jock River screenline under 2016 existing conditions. In addition, the total volume across the entire screenline is less than half of the existing available capacity which suggests that significant residual capacity exists to accommodate future growth. During the AM peak, where predominant direction is inbound, the screenline currently operates at v/c 0.50. During the PM peak, where the predominant direction is outbound, the screenline currently operates at v/c 0.44.

4.1.2 Intersection Operational Analysis

An assessment of the study area intersections was undertaken to determine the operational characteristics of these intersections. Intersection operations were facilitated by Synchro 9.1™ software package and analyzed using the following methodologies:

- Highway Capacity Manual 2010 edition (HCM 2010) for two-way stop controlled intersections; and
- Highway Capacity Manual 2000 edition (HCM 2000) for signalized intersections.

Table 7 provides a summary of 2016 existing intersection operations.

The Borrisokane Road at Strandherd Drive intersection currently operates at or above capacity for the peak directional movements along Strandherd Drive (i.e. westbound through during the AM peak hour and eastbound through during the PM peak hour). In addition, there is little residual capacity for the northbound left turn movement to accommodate future growth. As the Strandherd Drive widening is part of the City's TMP Affordable Network (Phase 2, 2020 – 2025), no improvements are recommended to supplement the existing condition.

The intersection of Borrisokane Road at Cambrian Road currently operates acceptably under 2016 existing conditions.

Appendix C contains detailed intersection performance worksheets.

Table 7 2016 Existing Intersection Operations

INTERSECTION	INTERSECTION CONTROL	APPROACH / MOVEMENT		AM PEAK HOUR			PM PEAK HOUR		
				LOS	v/c[1]	Delay (s)	LOS	v/c[1]	Delay (s)
Borrisokane Road at Cambrian Road	Two-Way Stop Control	WB	Left / Right	B	0.43	11.2	A	0.18	9.9
		NB	Through / Right	A	0.0	0.0	A	0.0	0.0
		SB	Left / Through	A	0.07	5.9	A	0.21	6.6
		Overall Intersection		***A***	**-**	***9.0***	***A***	**-**	***6.8***
Borrisokane Road at Strandherd Drive	Traffic Signals	**Approach/Movement**		**LOS**	**v/c[1]**	**Q[2]**	**LOS**	**v/c[1]**	**Q[2]**
		EB	Left	C	0.78	#32.8	C	0.78	#56.6
			Through / Right	B	0.70	125.5	F	1.38	#385.4
		WB	Left	A	0.04	3.6	A	0.29	9.0
			Through / Right	F	1.01	#253.4	C	0.79	153.5
		NB	Left	D	0.90	#122.2	A	0.33	35.3
			Through / Right	A	0.11	17.1	A	0.08	13.4
		SB	Left	A	0.14	17.2	A	0.22	25.7
			Through / Right	A	0.11	13.9	A	0.09	13.4
		Overall Intersection		***E***	***0.96***	**-**	***E***	***0.95***	**-**

Notes:
1. v/c – represents the anticipated volume divided by the predicted capacity
2. 95th Percentile Queue (m)
3. # - 95th percentile volume exceeds capacity, queue may be longer

4.2 2022 FUTURE BACKGROUND CONDITIONS

Future background conditions for the 2022 horizon were assessed to determine transportation improvements that may be required to address growth in traffic exclusive from improvements that may be required to accommodate traffic generated by the proposed development.

The background development assumptions and distributions outlined in **Section 3.2** and **Section 3.3** were applied to existing traffic volumes to predict 2022 future background traffic volumes.

4.2.1 Intersection Operational Analysis

Table 8 summarizes the operational characteristics of the study area intersections under 2022 future background conditions.

Consistent with the findings from the 2016 intersection capacity analysis, the Borrisokane Road at Strandherd Drive intersection is anticipated to operate at or above capacity during the 2022 future background horizon. As the widening of Strandherd Drive is part of the City of Ottawa's *2013 Transportation Master Plan* Affordable Network (Phase 2, 2020 – 2025), this intersection was reanalyzed assuming the widening is in place. The intersection configuration reflected in the analysis is consistent with the *Preliminary Design Report Strandherd Drive Widening Fallowfield*

*Road to Jockvale Road (*Delcan 2006), which includes dual northbound lefts, dual westbound lefts, and a channelized eastbound right turn lane. As depicted in **Table 8** below, with the widening of Strandherd Drive and the intersection upgrades, the intersection of Borrisokane Road at Strandherd Drive is anticipated to improve considerably, however, the northbound dual left turn movement is expected to operate close to capacity.

The intersection of Borrisokane Road at Cambrian Road is expected to operate acceptably under 2022 future background conditions.

Figure 11 illustrates the intersection control and lane requirements for the 2022 future background horizon with the Strandherd Drive widening in place.

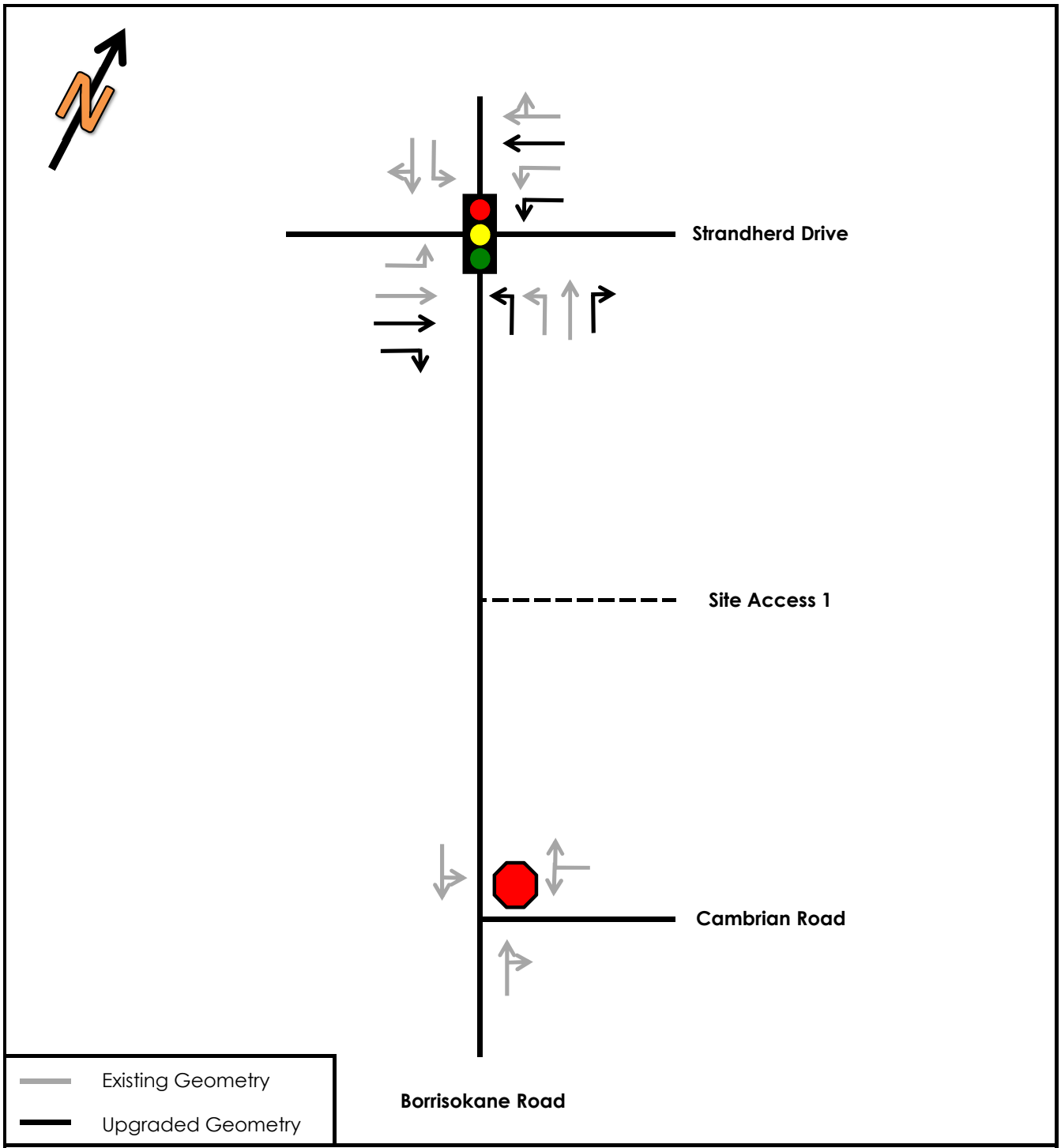
Appendix C contains detailed intersection performance worksheets.

TRANSPORTATION ASSESSMENT

Table 8 2022 Future Background Intersection Operations

INTERSECTION	INTERSECTION CONTROL	APPROACH / MOVEMENT		AM PEAK HOUR			PM PEAK HOUR		
				LOS	v/c[1]	Delay (s)	LOS	v/c[1]	Delay (s)
Borrisokane Road at Cambrian Road	Two-Way Stop Control	WB	Left / Right	B	0.60	14.5	B	0.24	11.3
		NB	Through / Right	A	0.0	0.0	A	0.0	0.0
		SB	Left / Through	A	0.10	6.0	A	0.31	6.8
		Overall Intersection		***A***	**-**	***11.0***	***A***	**-**	***7.3***
Borrisokane Road at Strandherd Drive	Traffic Signals	**Approach/Movement**		**LOS**	**v/c[1]**	**Q[2]**	**LOS**	**v/c[1]**	**Q[2]**
		EB	Left	F	1.17	#42.6	B	0.70	#89.1
			Through / Right	D	0.87	#282.6	F	1.38	#710.9
		WB	Left	A	0.22	6.7	A	0.58	#13.7
			Through / Right	F	1.27	#489.1	C	0.72	208.2
		NB	Left	F	1.29	#269.9	F	1.26	#144.5
			Through / Right	A	0.12	24.4	A	0.16	25.5
		SB	Left	A	0.14	22.1	A	0.45	45.7
			Through / Right	A	0.23	40.0	A	0.16	28.3
		Overall Intersection		***F***	***1.28***	**-**	***F***	***1.35***	**-**
		TMP Upgrades (Strandherd Drive widening from two to four lanes)							
		EB	Left	D	0.86	#50.2	C	0.79	#90.8
			Through	A	0.45	85.8	C	0.77	174.4
			Right	A	0.10	17.8	A	0.36	42.7
		WB	Dual Lefts	A	0.26	5.7	A	0.25	10.6
			Through / Right	D	0.90	#213.2	C	0.79	#161.3
		NB	Dual Lefts	E	0.98	#119.7	C	0.76	#56.4
			Through	A	0.09	20.8	A	0.10	19.8
			Right	A	0.03	0.0	A	0.02	0.0
		SB	Left	D	0.82	#42.5	B	0.70	#57.7
			Through / Right	A	0.29	43.6	A	0.14	26.4
		Overall Intersection		***C***	***0.73***	**-**	***B***	***0.61***	**-**

Notes:
1. v/c – represents the anticipated volume divided by the predicted capacity
2. 95th Percentile Queue (m)
3. # - 95th percentile volume exceeds capacity, queue may be longer



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3387 Borrisokane Road

Figure 11: 2022 Future Background Intersection Control and Lane Configuration

4.3 2022 TOTAL FUTURE CONDITIONS

Total future conditions are assessed to determine transportation improvements that may be required to accommodate traffic generated by the proposed development. The site trip generation, distribution, and assignment assumptions outlined in **Section 3.4** were applied to 2022 future background traffic volumes to predict total future traffic volumes.

4.3.1 Jock River Screenline Analysis

The Jock River screenline was assessed under 2022 total future conditions. As seen in **Table 9**, the Jock River screenline is anticipated to operate well below capacity under 2022 total future conditions. The Greenbank Road station along the Jock River screenline is projected to approach capacity during the AM peak hour in the inbound direction (i.e. vehicles traveling towards the urban core) during the 2022 total future horizon.

Table 9 2022 Total Future Jock River Screenline Analysis

STATION	DIRECTION	2022 TOTAL FUTURE CONDITIONS					
		AM Peak Hour	PM Peak Hour	Lanes	Capacity (veh/hr)	AM Peak v/c[1]	PM Peak v/c[1]
Borrisokane	Inbound	726	356	1	1000	0.73	0.36
Borrisokane	Outbound	217	651	1	1000	0.22	0.65
Greenbank	Inbound	922	232	1	1000	0.92	0.23
Greenbank	Outbound	98	701	1	1000	0.10	0.70
Jockvale	Inbound	1021	360	2	2000	0.51	0.18
Jockvale	Outbound	184	914	2	2000	0.09	0.46
Prince of Wales	Inbound	1382	762	2	2000	0.69	0.38
Prince of Wales	Outbound	539	1330	2	2000	0.27	0.67
Total	Inbound	4051	1710	6	6000	0.68	0.29
Total	Outbound	1038	3596	6	6000	0.17	0.60

Notes: 1. Volume to capacity ratio: compares roadway demand (vehicle volumes) with roadway supply (carrying capacity).

4.3.2 Auxiliary Left Turn Lane Warrants at Site Access #1

The need for a southbound left turn auxiliary lane was reviewed at the Borrisokane Road at Site Access 1 intersection using the nomographs provided in the *Geometric Design Standards for Ontario Highways*. Based on an unsignalized operation and an assumed design speed of 90 km/hr along Borrisokane Road, it was found that this intersection meets the warrant for the implementation of a southbound left turn auxiliary lane into the development with a storage length of 25m.

Appendix D contains the detailed left turn auxiliary lane warrant worksheets.

4.3.3 Intersection Operational Analysis

Table 10 summarizes the operational characteristics of the study area intersections under 2022 total future conditions.

Consistent with the findings from the 2022 future background analysis, under its current configuration the Borrisokane Road at Strandherd Drive intersection is anticipated to operate at or above capacity during the 2022 total future horizon and therefore, the intersection was also assessed assuming the Strandherd Drive widening is in place.

As depicted in **Table 10** below, with the widening of Strandherd Drive, the Borrisokane Road at Strandherd Drive intersection is projected to operate with several individual movements operating close to capacity, which is consistent with the analysis of the 2022 future background condition. The addition of site traffic generated by the subject development, however, is anticipated to have a negligible impact on this intersection.

The remaining two intersections are expected to operate acceptably under 2022 total future conditions.

Figure 12 illustrates the intersection control and lane requirements for the 2022 total future horizon.

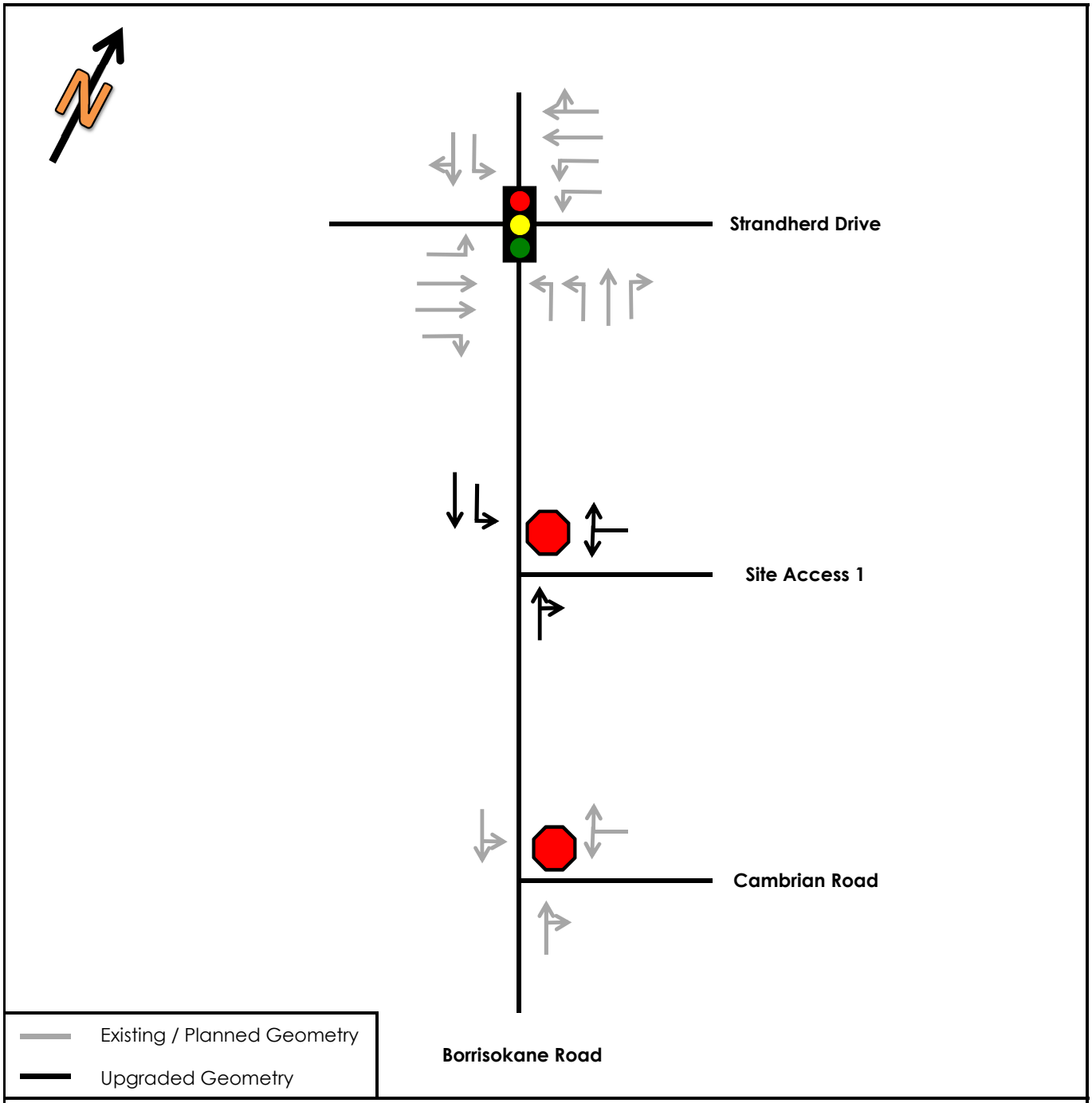
Appendix C contains detailed intersection performance worksheets.

TRANSPORTATION ASSESSMENT

Table 10 2022 Total Future Intersection Operations

INTERSECTION	INTERSECTION CONTROL	APPROACH / MOVEMENT		AM PEAK HOUR			PM PEAK HOUR		
				LOS	v/c[1]	Delay (s)	LOS	v/c[1]	Delay (s)
Borrisokane Road at Cambrian Road	Two-Way Stop Control	WB	Left / Right	C	0.64	15.5	B	0.37	12.0
		NB	Through / Right	A	0.0	0.0	A	0.0	0.0
		SB	Left / Through	A	0.14	7.8	A	0.34	8.6
		Overall Intersection		***B***	***-***	***11.5***	***A***	***-***	***7.8***
Borrisokane Road at Site Access 1	Two-Way Stop Control	WB	Left / Right	C	0.39	21.7	C	0.21	18.1
		NB	Through / Right	A	0.0	0.0	A	0.0	0.0
		SB	Left	A	0.03	9.1	A	0.06	8.2
			Through	A	0.00	0.0	A	0.0	0.0
		Overall Intersection		***A***	***-***	***3.2***	***A***	***-***	***1.7***
Borrisokane Road at Strandherd Drive	Traffic Signals	**Approach/Movement**		**LOS**	**v/c[1]**	**Q[2]**	**LOS**	**v/c[1]**	**Q[2]**
		EB	Left	F	1.17	#42.8	C	0.76	#39.1
			Through / Right	E	0.94	#305.6	F	1.63	#784.1
		WB	Left	A	0.19	9.0	A	0.35	7.1
			Through / Right	F	1.31	#496.5	D	0.87	#322.8
		NB	Left	F	1.37	#301.5	F	1.30	#160.0
			Through / Right	A	0.12	24.0	A	0.16	25.4
		SB	Left	A	0.13	21.5	A	0.42	44.8
			Through / Right	A	0.23	39.8	A	0.15	27.7
		Overall Intersection		***F***	***1.34***	***-***	***F***	***1.53***	***-***
		TMP Upgrades (Strandherd Drive widening from two to four lanes)							
		EB	Left	D	0.83	#50.2	E	0.91	#103.7
			Through	A	0.51	88.5	D	0.87	#206.8
			Right	A	0.12	20.2	A	0.45	59.7
		WB	Dual Lefts	A	0.12	6.4	A	0.33	11.9
			Through / Right	E	0.98	#221.4	D	0.89	#172.2
		NB	Dual Lefts	E	1.00	#134.5	D	0.86	#68.3
			Through	A	0.09	21.1	A	0.11	19.9
			Right	A	0.03	0.3	A	0.02	0.0
		SB	Left	A	0.52	33.1	C	0.73	#59.5
			Through / Right	A	0.28	43.5	A	0.16	27.0
		Overall Intersection		***C***	***0.77***	***-***	***B***	***0.70***	***-***

Notes:
1. v/c – represents the anticipated volume divided by the predicted capacity
2. 95th Percentile Queue (m)
3. # - 95th percentile volume exceeds capacity, queue may be longer



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3387 Borrisokane Road

Figure 12: 2022 Total Future Intersection Control and Lane Configuration

4.4 2027 ULTIMATE CONDITIONS

Ultimate future conditions for the 2027 horizon were examined to determine if other improvements may be required due to growth in background traffic 5 years beyond the anticipated build-out horizon of the site.

4.4.1 Jock River Screenline Analysis

The Jock River screenline was assessed under 2027 ultimate conditions. As seen in **Table 11**, the overall Jock River screenline is anticipated to operate below capacity under 2027 ultimate conditions. Despite this, the Greenbank Road station is projected to operate above capacity for the inbound movement (i.e. towards the urban core) during the AM peak hour.

Table 11 2027 Total Future Jock River Screenline Analysis

STATION	DIRECTION	2027 ULTIMATE CONDITIONS					
		AM Peak Hour	PM Peak Hour	Lanes	Capacity (veh/hr)	AM Peak v/c[1]	PM Peak v/c[1]
Borrisokane	Inbound	968	540	1	1000	0.97	0.54
Borrisokane	Outbound	310	935	1	1000	0.31	0.94
Greenbank	Inbound	1153	275	1	1000	1.15	0.28
Greenbank	Outbound	108	874	1	1000	0.11	0.87
Jockvale	Inbound	1238	372	2	2000	0.62	0.19
Jockvale	Outbound	179	1074	2	2000	0.09	0.54
Prince of Wales	Inbound	1587	878	2	2000	0.79	0.44
Prince of Wales	Outbound	546	1555	2	2000	0.27	0.78
Total	Inbound	4946	2065	6	6000	0.82	0.34
Total	Outbound	1143	4438	6	6000	0.19	0.74

Notes: 1. Volume to capacity ratio: compares roadway demand (vehicle volumes) with roadway supply (carrying capacity).

4.4.2 Intersection Operational Analysis

Table 12 summarizes the operational characteristics of the study area intersections under 2027 ultimate conditions.

The widening of Strandherd Drive from two to four lanes was assumed to be in place by the 2027 ultimate horizon. By 2027, the shared westbound through/right and the northbound dual left turn lanes are expected to operate above theoretical capacity.

With the addition of the background traffic, the Borrisokane Road at Site Access 1 intersection is anticipated to operate with exceptionally high delays during both peak hours under 2027 ultimate conditions. It is recommended to upgrade the intersection to include traffic signals to address the projected delays. With the implementation of the signals, it is also recommended to include exclusive westbound left and right turn lanes. A right turn lane warrant analysis was

undertaken and it was found that a northbound right turn lane will also be warranted at the proposed site access intersection. City standards require that the minimum storage length for auxiliary lanes at signalized intersection is 37.5m, therefore, it is recommended to provide 37.5m of storage for the westbound left turn and northbound right turn auxiliary lanes at this intersection.

Whereas previously the 2022 total future horizon found that the Borrisokane Road at Site Access 1 intersection warranted a southbound left turn lane with 25m of storage, the 95th percentile queue length for the southbound left turn lane is projected to reach approximately 50m during the 2027 ultimate horizon. During construction staging, it may be beneficial to construct the southbound left turn lane with the full 50m of storage to prevent having to construct it in two phases.

The Borrisokane Road at Cambrian Road intersection is expected to operate acceptably under 2027 ultimate conditions.

Figure 13 illustrates the intersection control and lane requirements for the 2027 ultimate horizon.

Appendix C contains detailed intersection operation summaries.

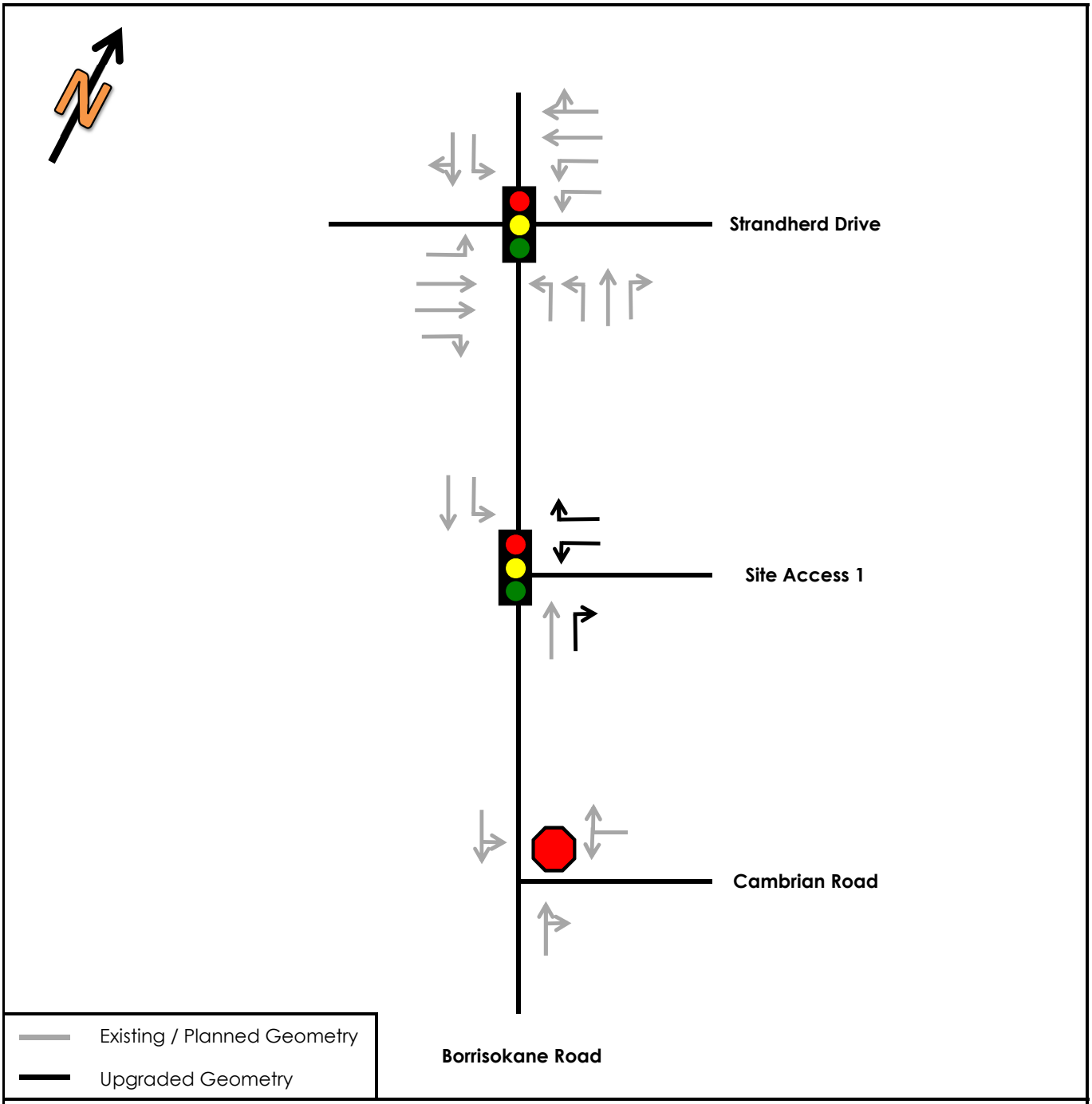
Appendix D contains the right turn lane warrant analysis.

TRANSPORTATION ASSESSMENT

Table 12 2027 Ultimate Intersection Operations

INTERSECTION	INTERSECTION CONTROL	APPROACH / MOVEMENT		AM PEAK HOUR			PM PEAK HOUR		
				LOS	v/c[1]	Delay (s)	LOS	v/c[1]	Delay (s)
Borrisokane Road at Cambrian Road	Two-Way Stop Control	WB	Left / Right	D	0.82	26.4	C	0.68	22.8
		NB	Through / Right	A	0.0	0.0	A	0.0	0.0
		SB	Left / Through	A	0.20	8.0	A	0.44	9.4
		Overall Intersection		**C**	**-**	***18.1***	**B**	**-**	***11.7***
Borrisokane Road at Site Access 1	Two-Way Stop Control	WB	Left / Right	F	1.32	643.0	F	2.20	2221.1
		NB	Through / Right	A	0.0	0.0	A	0.0	0.0
		SB	Left	A	0.11	10.0	A	0.29	9.8
			Through	A	0.0	0.0	A	0.0	0.0
		Overall Intersection		***F***	**-**	***161.0***	***F***	**-**	***422.3***
	Traffic Signals	***Improvement – Signalization and Turning Lanes***							
		Approach/Movement		**LOS**	**v/c[1]**	**Q[2]**	**LOS**	**v/c[1]**	**Q[2]**
		WB	Left	A	0.44	26.8	A	0.45	27.5
			Right	A	0.37	26.7	A	0.13	16.1
		NB	Through	C	0.71	#136.3	A	0.33	36.2
			Right	A	0.05	5.3	A	0.11	8.0
		SB	Left	A	0.34	18.2	A	0.53	#48.5
			Through	A	0.21	22.6	B	0.61	86.5
		Overall Intersection		***B***	***0.64***	**-**	***A***	***0.57***	**-**
Borrisokane Road at Strandherd Drive	Traffic Signals	**Approach/Movement**		**LOS**	**v/c[1]**	**Q[2]**	**LOS**	**v/c[1]**	**Q[2]**
		EB	Left	D	0.84	#53.5	D	0.83	#99.6
			Through	A	0.56	98.8	D	0.81	#202.2
			Right	A	0.17	24.7	A	0.59	105.4
		WB	Dual Lefts	A	0.20	10.2	A	0.58	#24.6
			Through / Right	F	1.04	#250.5	D	0.81	#177.9
		NB	Dual Lefts	F	1.52	#202.5	D	0.84	#89.1
			Through	A	0.10	22.0	A	0.13	22.7
			Right	A	0.06	10.6	A	0.04	0.0
		SB	Left	C	0.79	#50.0	B	0.63	50.2
			Through / Right	A	0.29	44.6	A	0.20	31.4
		Overall Intersection		***D***	***0.89***	**-**	***C***	***0.72***	**-**

Notes:
1. v/c – represents the anticipated volume divided by the predicted capacity
2. 95th Percentile Queue (m)
3. # - 95th percentile volume exceeds capacity, queue may be longer



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3387 Borrisokane Road

Figure 13: 2027 Ultimate Intersection Control and Lane Configuration

5.0 SUMMARY AND CONCLUSIONS

This Community Transportation Study / Transportation Impact Study Addendum 1 serves as an update to the original *3387 Borrisokane Road Community Transportation Study / Transportation Impact Study* (Stantec, September 2016). The major changes between the subject addendum and the original report include a revised draft plan, new assumptions related to the construction of Realigned Greenbank Road which is now expected to occur beyond the horizon of the subject study, and new assumptions related to the expected future auto modal share on account of delays to the Bus Rapid Transit component of Realigned Greenbank Road.

The implications of the City's decision to postpone Realigned Greenbank Road is demonstrated through a comparison of the original study to the subject Addendum 1. Whereas previously all study area intersections were projected to operate acceptably, with the removal of Realigned Greenbank Road, the study area intersections are expected to operate with a reduced level of service. For example, the Strandherd Drive at Borrisokane Road intersection is projected to operate at or above capacity as early as the 2022 future background horizon. The Borrisokane Road at Site Access 1 intersection will now require traffic signals, whereas previously it was projected to operate acceptably under a side-street stop-controlled configuration.

<u>Proposed Development</u>

- The proposed Glenview development is located at 3387 Borrisokane Road in the City of Ottawa's south end. The site is bound by the Jock River to the north, Mattamy's Half Moon Bay West development to the east and south, and Borrisokane Road to the west. It should be noted that prior to June 2016, Borrisokane Road was called Cedarview Road.

- Transportation access to the site will be facilitated through a proposed Site Access to Borrisokane Road, approximately 400m north of Cambrian Road.

- The proposed residential development is anticipated to generate 356 and 256 person trips during the AM and PM peak hours, respectively. In terms of vehicle trips, the proposed residential development is anticipated to generate 200 and 203 net new auto trips (two-way) during the AM and PM peak hours, respectively.

<u>2016 Existing Conditions</u>

- The Jock River screenline, between Borrisokane Road and Prince of Wales Drive, was examined under 2016 existing conditions. It was found that every station (Borrisokane, Greenbank, Jockvale, and Prince of Wales) is operating below the available capacity.

- The Borrisokane Road at Strandherd Drive intersection currently operates at or above capacity for the peak directional movements along Strandherd Drive (i.e. westbound through during the AM peak hour and eastbound through during the PM peak hour). As

the Strandherd Drive widening is part of the City's TMP Affordable Network (Phase 2, 2020 – 2025), no improvements are recommended to supplement existing conditions.

- The Borrisokane Road at Cambrian Road intersection currently operates satisfactorily under 2016 existing conditions.

2022 Future Background Conditions

- Consistent with the findings from the 2016 intersection capacity analysis, the Borrisokane Road at Strandherd Drive intersection is anticipated to operate at or above capacity during the 2022 future background horizon. As the widening of Strandherd Drive is part of the City of Ottawa's *2013 Transportation Master Plan* Affordable Network (Phase 2, 2020 – 2025), this intersection was reanalyzed assuming the widening is in place. The intersection configuration reflected in the analysis is consistent with the *Preliminary Design Report Strandherd Drive Widening Fallowfield Road to Jockvale Road (*Delcan 2006), which includes dual northbound lefts, dual westbound lefts, and a channelized eastbound right turn lane. With the widening of Strandherd Drive and the intersection upgrades, the intersection of Borrisokane Road at Strandherd Drive is anticipated to improve considerably, however, the northbound dual left turn movement is expected to operate close to capacity.

- The intersection of Borrisokane Road at Cambrian Road is expected to operate acceptably under 2022 future background conditions.

2022 Total Future Conditions

- The Jock River screenline is anticipated to operate well below capacity under 2022 total future conditions, however, the Greenbank Road station is projected to approach capacity during the AM peak hour in the inbound direction (i.e. vehicles traveling towards the urban core).

- The need for a southbound left turn auxiliary lane was reviewed at the Borrisokane Road at Site Access #1 intersection. Using an assumed design speed of 90 km/hr along Borrisokane Road, it was found that this intersection meets the warrants to implement a southbound left turn lane with a storage length of 25m.

- Consistent with the findings from the 2022 future background intersection capacity analysis, the intersection of Borrisokane Road at Strandherd Drive is projected to operate with several individual movements operating close to capacity, which is consistent with the analysis of the 2022 future background condition. The addition of site traffic from the subject development, however, is anticipated to have a negligible impact on this intersection.

- Overall, the addition of site traffic from the subject development is anticipated to have a negligible impact on the study area intersections that exist today.

2027 Ultimate Conditions

- While the overall Jock River screenline is anticipated to operate below capacity under 2027 ultimate conditions, the Greenbank Road station is projected to operate above capacity for the inbound movement (i.e. towards the urban core) during the AM peak hour.

- The widening of Strandherd Drive from two to four lanes was assumed to be in place by the 2027 ultimate horizon. By 2027, the shared westbound through/right and the northbound dual left turn lanes are expected to operate above theoretical capacity.

- With the addition of the background traffic, the Borrisokane Road at Site Access 1 intersection is anticipated to operate with exceptionally high delays during both peak hours under 2027 ultimate conditions. It is recommended to upgrade the intersection to include traffic signals to address the projected delays. With the implementation of the signals, it is also recommended to include exclusive westbound left and right turn lanes. A right turn lane warrant analysis was undertaken and it was found that a northbound right turn lane will also be warranted at the proposed site access intersection. City standards require that the minimum storage length for auxiliary lanes at signalized intersection is 37.5m, therefore, it is recommended to provide 37.5m of storage for the westbound left turn and northbound right turn auxiliary lanes at this intersection.

- Whereas previously the 2022 total future horizon found that the Borrisokane Road at Site Access 1 intersection warranted a southbound left turn lane with 25m of storage, the 95th percentile queue length for the southbound left turn lane is projected to reach approximately 50m during the 2027 ultimate horizon. During construction staging, it may be beneficial to construct the southbound left turn lane with the full 50m of storage to prevent having to construct it in two phases.

- The Borrisokane Road at Cambrian Road intersection is expected to operate acceptably under 2027 ultimate conditions.

As the subject development proceeds through the development approvals process to Registration, subsequent Transportation Impact Assessments (TIA) will need to be completed. These TIAs will serve as an update to the subject CTS / TIS and will rely on the most up to date traffic information including information pertaining to the timing of planned transportation network improvements and background developments. Should the timing of any of these differ from the subject CTS / TIS (i.e. the timing of Realigned Greenbank Road), the subsequent TIAs will take these into consideration and update the traffic model accordingly, which may have implications on the overall findings of this study.

Based on the transportation evaluation and improvements recommended in this study, Glenview's proposed residential development located at 3387 Borrisokane Road should be permitted to proceed.

*****

STANTEC CONSULTING LTD.

(Original signed and stamped)

Robert Vastag, RPP
Project Manager, Senior Transportation Planner

Lauren O'Grady, P.Eng.
Transportation Engineer

Appendix A COMMENT RESPONSE LETTER (MARCH 2017)

Stantec Consulting Ltd.
400 - 1331 Clyde Avenue, Ottawa ON K2C 3G4

March 1, 2017
File: 163601067

Attention: Sean Moore
110 Laurier Avenue West
Ottawa, Ontario
K1P 1J1

Dear Sean,

Reference: 163601067 – 3387 Borrisokane Road Community Transportation Study / Transportation Impact Study

In September 2016 Stantec Consulting Ltd. (Stantec) prepared the 3387 Borrisokane Road Community Transportation Study (CTS) / Transportation Impact Study (TIS) for Glenview Homes (Cedarview) Ltd. (Glenview) for a proposed development located in the Barrhaven South community of Ottawa. On December 21st 2016 Stantec received comments from the City of Ottawa pertaining to the CTS / TIS.

In early January 2017 Stantec prepared a draft comment response letter to address the comments received from the City. The intent of the draft comment response letter was to obtain concurrence from the City regarding Stantec's approach in addressing the comments.

On February 17th, 2017 Stantec spoke with Mr. Asad Yousfani at the City to discuss the draft comment response letter. During this phone call, Mr. Yousfani was able to provide concurrence to most of the responses, with the exception of the comments pertaining to the timing of Realigned Greenbank Road. Stantec is currently involved with the Barrhaven South Urban Expansion Area Transportation Master Study. Through this project and ensuing discussions with the Technical Advisory Committee, we were informed in June 2016 that Phase 1 of Realigned Greenbank Road would likely be constructed with a four-lane cross-section with two of the lanes operating as Transitway. Mr. Yousfani indicated that this is no longer the current thinking regarding the timing of Realigned Greenbank Road.

Stantec spoke with Mr. Frank McKinney at the City to discuss the planned timelines for Realigned Greenbank Road and the corresponding Bus Rapid Transit. Mr. McKinney indicated that the exact timing of Realigned Greenbank Road is unknown at this time and will be determined through the next update to the Transportation Master Plan. Given that the timing is currently unknown, Stantec recommended that the subject CTS / TIS assumes Realigned Greenbank Road, including the Bus Rapid Transit, is not in place for both the build-out year (2022) and the plus 5-year horizon (2027). Mr. McKinney agreed with Stantec's approach and thus the traffic study will be updated accordingly.

Reference: 163601067 – 3387 Borrisokane Road Community Transportation Study / Transportation Impact Study

Table 1 below includes the December 21st 2016 comments from the City of Ottawa along with the original responses by Stantec (provided on January 10th) as well as the updated responses based on the conversation with City of Ottawa staff on February 17th, 2017.

City of Ottawa Comment	Stantec Response
12. Please note that City's OP identifies 37.5m ROW protection along Borrisokane Road between Strandherd Drive and Cambrian Road which translates into 18.75m (37.5/2 = 18.75) on either side from the roadway centreline. Block 20 accomplishes this - thank you.	Noted.
13. Section 1.2.1- Site Plan Concepts (p-2): The first and second concepts include a school block. The third concept has 77 and 66 more residential units comparing it with the first and second concepts respectively. Without knowing the size and type of school considered for the first and second concepts, how an assumption can be established that more residential units would necessarily generate more vehicular trips in a development? The catchment area for school sites generally go beyond the adjacent community. Please provide clarification along with the concept plan drawings showing the size / type of school facility envisaged for first and second concept plans and the associated vehicular trip generations.	Since the submission of the original CTS / TIS, the school board has expressed interest in a parcel of land within Glenview's development. As the school board has an option on the parcel for seven years, there are no concepts or drawings prepared for the school at this time. In order to assess the trip generation of the proposed development with a school, the size of the future school was estimated using a similar sized property for an elementary school in Barrhaven South. It was assumed that the proposed school will be approximately 30,000 square feet. With this assumption, the trip generation was completed. It was found that the trips generated by the draft plan that includes the school is lower than the draft plan that replaces the school block with residential houses. It can therefore be concluded that the way in which the CTS / TIS was assessed (i.e. without the school block) represents a conservative approach. **Attachment 1** contains the trip generation tables for the draft plan both with and without the school block for comparison purposes. *Updated February 2017: the CTS / TIS will be updated with the latest site concept.*
14. Section 2.1 - Roads and Traffic Control (p-5): • Borrisokane Road between Strandherd Drive and Cambrian Road is an Urban Arterial as identified in the City's 2013 TMP (Map 6). Please correct the report text where it states Borrisokane Road as a rural arterial road. • Same is true for Strandherd Drive and Cambrian	• The text will be corrected to state that Borrisokane Road is an urban arterial. • The text will be corrected to state that Strandherd Drive and Cambrian Road, within the vicinity of the subject sites, are both urban arterials.

Reference: 163601067 – 3387 Borrisokane Road Community Transportation Study / Transportation Impact Study

Road which are identified in the City's TMP as Urban Arterials. Please correct the report text accordingly. • Also Map 5 of the City's 2013 TMP reflect the Rapid Transit and Transit Priority Network 0 2031 Affordable Network. However, the report notes it otherwise.	• This was a typo. The text will be revised to state that the road classifications are referenced from Map 6 of the City of Ottawa's *2013 Transportation Master Plan*.
15. Section 2.3 Walking and Cycling (p-7): As shown on the geoOttawa, Borrisokane Road and Cambrian Road both are identified as part of the Ultimate Bicycle Network. It seems appropriate to make note of it in the report.	Text will be added to Section 2.3 to indicate that Borrisokane Road and Cambrian Road are both identified as part of the Ultimate Bicycle Network.
16. Section 3.1.1 Road Network Improvements (Table 1, p-10): Regarding Chapman Mills Drive, please note that the City has recently completed the EA Study for westerly extension of Chapman Mills Drive and BRT corridor. The EA Study is out for 30-day public review period until 20 December, 2016. The recommended plan established for the corridor includes two lanes (one in each direction) along Chapman Mills Drive for general traffic as opposed to four lanes as noted in the report. Also, Chapman Mills Drive is identified in the TMP as a major collector roadway. Further, as per the TMP, implementation of BRT facility along this section of Chapman Mills Drive is a post 2031 project. Please correct the text in the report accordingly.	This text will be added to Section 3.1.1.

Reference: 163601067 – 3387 Borrisokane Road Community Transportation Study / Transportation Impact Study

17. Section 3.2 – 2022 Future Background Conditions (p-11): The report states that by 2022 the BRT part of Realigned Greenbank Road will be built and operational. What is the source of this information? It will affect the ensuing assumptions and analysis related to future background and total traffic volumes. 2nd last paragraph (p-12): The 2011 OD Survey results may be a good indicator to understand travel pattern for a larger area, its application to individual sites require careful consideration. The future rapid transit facility as mentioned in the report, is fairly away from the proposed site and is unlikely to be accessible by walking. Its implementation is also post 2031. Therefore, for an area similar to the subject site, where the transit service is not very frequent, 30% transit modal share appears fairly high. Please provide a rationale for how a 30% transit modal share is justified for the subject development. It has the potential to affect the ensuing assumptions regarding background and future traffic volumes, traffic analysis undertaken and the Findings and Conclusion section of the report.	Stantec is currently involved with the Barrhaven South Urban Expansion Area Transportation Master Study. Through this project and ensuing discussions with the Technical Advisory Committee, we were informed in June 2016 by Frank McKinney that Phase 1 of Realigned Greenbank Road would likely be constructed with a four-lane cross-section with two lanes operating as Transitway. The 2011 TRANS Origin-Destination Survey shows a 27% transit modal share for commuters leaving the South Nepean zone during the AM peak. Based on the lack of transit service / infrastructure within Barrhaven South (part of the South Nepean zone), we adjusted the existing modal share from 27% to 10% to reflect this. We established a target of 30% for the future modal share (i.e. by 2022 when the Realigned Greenbank Road BRT was assumed to be in place) for the following reasons: • It is close to the existing 27% transit modal share as seen in the O-D survey • It is consistent with the City's investment in transit and overall goal of 26% across the City • It represents a conservative indication of potential transit riders *Updated February 2017: Based on the recent discussions regarding the timing of Realigned Greenbank Road, Stantec will update the CTS / TIS to reflect a future road network that does not include Realigned Greenbank Road. As a result, the future auto modal share will be assumed to be 90% which is consistent with the assumptions of the existing traffic mode share in Barrhaven South.*
18. Section 3.3 - Site Traffic Generation (p-14): • What is the source of factors (0.75, 0.99 for Land Use Type 210 and 0:51 and 0.59 Land Use Type 230) used for AM and PM peak hours as reflected in Table 3 (Step 1)? • The Trip Generation volumes as reflected in Table 3 (Step 2) seem higher when comparing to the volumes using ITE equations. Please provide	• Consistent with industry standards, the factors that were used were derived from the fitted curve equations from the ITE Trip Generation Manual (9th Edition). • Step 2 of Table 3 outlines the trip generation for the total development (i.e. the combination of the trips generated for 179 single family homes and 109 condo / townhomes). The table will be

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clarification. • Step 3: As commented earlier, the 30% transit modal share appears fairly high in the vicinity where the subject development is proposed to occur.	updated in the report to avoid confusion. **Attachment 2** contains the detailed trip generation tables. • Please refer to the response to comment 17 above.
19. Table 3 - Step 3: The table shows 137 and 174 two-way vehicular trips during the AM and PM peak hours. However, 50% of the trips are assigned to enter/exit the site from Borrisokane Road. The remaining 50% would use the three proposed internal connections to Mattamy's Half Moon Bay West development as stated in the report. What would be the impact of 50% traffic from the subject site on the adjacent neighbourhood?	A Community Design Plan for the areas north of Cambrian Road, west of Realigned Greenbank Road, and east of Borrisokane Road was prepared in 2005. At the time the area was referred to as Area 2. This area is now owned by Mattamy and Glenview, who have each submitted recent development applications. If a single CTS would have been submitted for both, would the City have expressed the same concern regarding impact to the adjacent neighbourhood? We feel that this is one community being developed by two developers and the question as to what impact site traffic has on the neighbouring development is not particularly relevant. *Updated February 2017: Based on the recent discussions regarding the timing of Realigned Greenbank Road, the traffic assignment for the subject development will be revisited and updated accordingly.*
20. GeoOttawa shows a future cycling link between Jock River and Cambrian Road as part of the Ultimate Network. It runs north-south just east of the subject site. What measures are proposed to provide connection to this future cycle facility?	The location of the future cycling link is within the Mattamy portion of the overall development area. Residents from Glenview can use local streets to access the cycling link.
21. The modal split proposed (30% transit) once subdivision is occupied seems optimistic. The report states that existing Barrhaven South auto modal share is 90%. A 20-30% reduction in 5-10 years seems doubtful - please comment.	Please refer to the response to comment 17 above.
22. Section 3.3, Table 3. Conversion of Auto Trips to person trips - transit modal share = 10%. How does this then go to 30% for Person Trips to Modal Share?	The *Institute for Transportation Engineers (ITE) Trip Generation Manual* is a compilation of survey data gathered from various land uses across the United States and Canada. The surveys counted auto trips only for each land use. In order to account for all modes of transportation (i.e. transit, auto), the trips generated first need to be converted to person trips

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	and then the person trips are assigned to the various modal shares. To convert the ITE rates to person trips, a transit modal share must be determined as well as an auto-occupancy rate. As the data provided is an average of all the surveys conducted, the transit modal share cannot be explicitly determined. For this reason, the transit modal share is assumed to be 10% across all the surveyed locations. This 10% assumption is consistent with industry standards and has been used in numerous approved Transportation Impact Assessments within the City of Ottawa and surrounding municipalities. The 10% transit modal share in Step 2 of Table 3 represents the assumed transit modal share within the ITE survey data. It does not represent the local transit share.
23. If traffic from the Half Moon Bay Road development is taken into account in this report, then what are the impacts of the Glenview Homes traffic travelling through Half Moon Bay Road and north on Greenbank Road?	In responding to the City's comment we assume reference to "Half Moon Bay Road development" was intended to reference "Half Moon Bay West development". The implications are detailed within Stantec's recently prepared Half Moon Bay West Community Transportation Study whereby Glenview's trips were explicitly included. The Half Moon Bay West traffic study found that the two intersections with Realigned Greenbank Road are projected to operate acceptably under the 2029 future horizon. *Updated February 2017: Based on the recent discussions regarding the timing of Realigned Greenbank Road, the traffic assignment for the subject development will be revisited and updated accordingly.*
24. The intersection of Strandherd Drive and Borrisokane Road is currently failing as mentioned in report. Volumes have likely increased since the traffic counts were provided to Stantec, especially with recent opening of Costco on Strandherd Drive. A new count was to be conducted around the end of November 2016.	As part of this subject study, we accounted for all known surrounding developments that are scheduled to occur as background growth. The Costco traffic was included as part of this background growth. The Costco / Citi Gate traffic studies would have presumably assessed these impacts.

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	As the traffic counts were not available until recently, we will not be updating the analysis with the new November 2016 traffic counts. *Updated February 2017: The City indicated concurrence with Stantec's response.*
25. Traffic Services has concerns about queuing on Strandherd Drive, especially in the PM peak period backing up past Maravista Drive. This site, as well as neighbouring sites is shown to add significant traffic demand on Strandherd Drive.	Noted. This is primarily attributed to background developments and not the subject development.
26. <u>Synchro Modelling Notes:</u> • Timing plans have been changed at Strandherd Drive and Borrisokane Road as a result of Costco opening. Updated plans can be provided to Stantec upon request. • Models show max recalls for north-south, and no recalls for east-west, with no detection provided for PM. This results in no east-west movement. Models should be revised to show max recalls for east-west. This affects the v/c calculations of the program. • Side-street through movements should have a minimum of 10s in accordance with TIA guidelines. • For future Strandherd Drive conditions, if one left-turn direction is fully protected, the opposite must be as well. • Double westbound left turn lanes provided, but only one southbound receiving lane. • Future intersection width will require a much higher flashing-don't-walk value for both directions, calculated at 1.0 m/s (new standard). FDW numbers should be increased.	• Stantec requested the most recent timing plans in April 2016. Our intention is not to update the analysis. Please keep in mind that future intersection operations and timing plans are optimized and not directly comparably to existing conditions. o *Updated February 2017: The City indicated concurrence with Stantec's response.* • Traffic analyses will be updated with the appropriate recalls in place. The intersection operations tables will be updated accordingly. • Traffic analyses will be updated with the appropriate minimum through signal time in place. The intersection operations tables will be updated accordingly. • Traffic analyses will be updated with the appropriate left turn phases in place. The intersection operations tables will be updated accordingly. • Traffic analyses will be updated with the appropriate receiving lanes in place. This change does not affect the intersection operations. • Traffic analyses will be updated with the appropriate FDW numbers in place. The intersection operations tables will be updated accordingly.

Reference: 163601067 – 3387 Borrisokane Road Community Transportation Study / Transportation Impact Study

27. The report should map the locations of the background developments indicated in Table 2. An RMA is required for the proposed southbound left-turn lane.	A map of the surrounding background developments will be added to Section 3.1.2. Noted. This will be provided at the time of registration along with an updated Transportation Impact Assessment.

An updated CTS / TIS will be resubmitted to the City which will reflect the aforementioned changes.

Should you have any further questions or concerns related to the above please feel free to contact the undersigned at your earliest convenience.

Regards,

Stantec Consulting Ltd.

Robert Vastag, RPP
Senior Transportation Planner
Phone: 613-724-4354
Robert.Vastag@stantec.com

Attachments: Attachment 1 – Trip Generation Comparison
Attachment 2 – Detailed Trip Generation Tables

Attachment 1 - Scenario Comparison

Scenario 1 - With School Block

Table 1: Trip Generation Rates

Land Use	Units / 1000s sq ft	AM Peak Hour			PM Peak Hour		
		Inbound	Outbound	Rate	Inbound	Outbound	Rate
210 - Single Detached Houses	117	25%	75%	0.78	63%	37%	1.03
230 - Residential Condo / Townhouse	94	17%	83%	0.52	67%	33%	0.61
520 - Elementary School	30	56%	44%	5.20	45%	55%	1.21
Land Use	**Units / 1000s sq ft**	**AM Peak Hour**			**PM Peak Hour**		
		Inbound	**Outbound**	**Total**	**Inbound**	**Outbound**	**Total**
210 - Single Detached Houses	117	23	69	92	76	45	121
230 - Residential Condo / Townhouse	94	8	41	49	38	19	57
520 - Elementary School	30	88	69	157	16	20	36
TOTAL		119	179	298	130	84	214

Table 2: Internal Capture

Land Use	Internal Capture	AM Peak Hour			PM Peak Hour		
		Inbound	Outbound	Total	Inbound	Outbound	Total
210 - Single Detached Houses	0%	0	0	0	0	0	0
230 - Residential Condo / Townhouse	0%	0	0	0	0	0	0
520 - Elementary School	70%	62	48	110	11	14	25
TOTAL		62	48	110	11	14	25

Table 3: Total Site Trips

Land Use	Units / 1000s sq ft	AM Peak Hour			PM Peak Hour		
		Inbound	Outbound	Total	Inbound	Outbound	Total
210 - Single Detached Houses	117	23	69	92	76	45	121
230 - Residential Condo / Townhouse	94	8	41	49	38	19	57
520 - Elementary School	30	26	21	47	5	6	11
TOTAL		57	131	188	119	70	189

Scenario 2 - Without School Block

Table 1: Trip Generation Rates

Land Use	Units / 1000s sq ft	AM Peak Hour			PM Peak Hour		
		Inbound	Outbound	Rate	Inbound	Outbound	Rate
210 - Single Detached Houses	179	25%	75%	0.75	63%	37%	0.99
230 - Residential Condo / Townhouse	109	17%	83%	0.51	67%	33%	0.59
520 - Elementary School	0	56%	44%	5.20	45%	55%	1.21
Land Use	**Units / 1000s sq ft**	**AM Peak Hour**			**PM Peak Hour**		
		Inbound	**Outbound**	**Total**	**Inbound**	**Outbound**	**Total**
210 - Single Detached Houses	179	34	101	135	112	65	177
230 - Residential Condo / Townhouse	109	9	46	55	44	21	65
520 - Elementary School	0	0	0	0	0	0	0
TOTAL		43	147	190	156	86	242

Table 2: Total Site Trips

Land Use	Units / 1000s sq ft	AM Peak Hour			PM Peak Hour		
		Inbound	Outbound	Total	Inbound	Outbound	Total
210 - Single Detached Houses	179	34	101	135	112	65	177
230 - Residential Condo / Townhouse	109	9	46	55	44	21	65
520 - Elementary School	0	0	0	0	0	0	0
TOTAL		43	147	190	156	86	242

Attachment 2 - Detailed Trip Generation Tables

Table 1: Trip Generation Rates

Land Use	Units	AM Peak Hour			PM Peak Hour		
		Rate	Inbound	Outbound	Rate	Inbound	Outbound
210 - Single Detached Houses	179	0.75	25%	75%	0.99	63%	37%
230 - Residential Condo / Townhouse	109	0.51	17%	83%	0.59	67%	33%

Land Use	Units	AM Peak Hour			PM Peak Hour		
		Inbound	Outbound	Total	Inbound	Outbound	Total
210 - Single Detached Houses	179	34	101	135	112	65	177
230 - Residential Condo / Townhouse	109	9	46	55	44	21	65
TOTAL		43	147	190	156	86	242

Table 2: Conversion to Person Trips

Land Use	Units	Modal Share	AM Peak Hour			PM Peak Hour		
			Inbound	Outbound	Total	Inbound	Outbound	Total
210 - Single Detached Houses	179	Auto	34	101	135	112	65	177
		Auto Occupants	3	10	14	12	6	18
		Transit	3	10	14	12	6	18
		Person	40	121	163	136	77	213
230 - Residential Condo / Townhouse	109	Auto	9	46	55	44	21	65
		Auto Occupants	1	5	6	4	2	6
		Transit	1	5	6	4	2	6
		Person	11	56	67	52	25	77
Total	288	Auto	43	147	190	156	86	242
		Auto Occupants	4	15	19	16	8	24
		Transit	4	15	19	16	8	24
		Person	51	177	228	188	102	290

Table 3: Net Generated Trips By Modes

Land Use	Units	Modal Share	%	AM Peak Hour			PM Peak Hour		
				Inbound	Outbound	Total	Inbound	Outbound	Total
210 - Single Detached Houses	179	Auto	60%	**24**	**72**	96	**82**	**46**	128
		Passenger	10%	4	12	16	14	8	22
		Transit	30%	12	36	48	41	23	64
		Walk / Bike	0%	0	0	0	0	0	0
		Other	0%	0	0	0	0	0	0
230 - Residential Condo / Townhouse	109	Auto	60%	**7**	**34**	41	**31**	**15**	46
		Passenger	10%	1	6	7	5	3	8
		Transit	30%	3	17	20	16	8	24
		Walk / Bike	0%	0	0	0	0	0	0
		Other	0%	0	0	0	0	0	0
Total Development		Auto	60%	**31**	**106**	**137**	**113**	**61**	**174**
		Passenger	10%	5	18	23	19	10	29
		Transit	30%	15	53	68	56	31	87
		Walk / Bike	0%	0	0	0	0	0	0
		Other	0%	0	0	0	0	0	0

Appendix B TRAFFIC DATA

Intersection: Cambrian at Borrisokane
Date: 21-Jul-15

	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR	Total	Hour
7:15 - 7:30	0	5	0	19	4	0	0	0	0	1	0	83	112	
7:30 -7:45	0	7	1	21	3	0	0	0	0	1	0	83	116	
7:45 - 8:00	0	7	0	18	10	0	0	0	0	0	0	82	117	
8:00 - 8:15	0	5	2	24	5	0	0	0	0	2	0	74	112	457
8:15 - 8:30	0	14	1	20	5	0	0	0	0	1	0	69	110	455
8:30 - 8:45	0	9	0	20	8	0	0	0	0	1	0	71	109	448
Peak Hour	**0**	**24**	**3**	**82**	**22**	**0**	**0**	**0**	**0**	**4**	**0**	**322**		

	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR	Total	Hour
3:30 - 3:45	0	10	1	48	9	0	0	0	0	1	0	31	100	
3:45 - 4:00	0	12	1	53	11	0	0	0	0	2	0	33	112	
4:00 - 4:15	0	9	2	56	14	0	0	0	0	2	0	34	117	
4:15 - 4:30	0	19	1	67	11	0	0	0	0	1	0	22	121	450
4:30 - 4:45	0	4	1	60	11	0	0	0	0	2	0	31	109	459
4:45 - 5:00	0	3	1	57	5	0	0	0	0	3	0	28	97	444
Peak Hour	**0**	**44**	**5**	**236**	**47**	**0**	**0**	**0**	**0**	**7**	**0**	**120**		

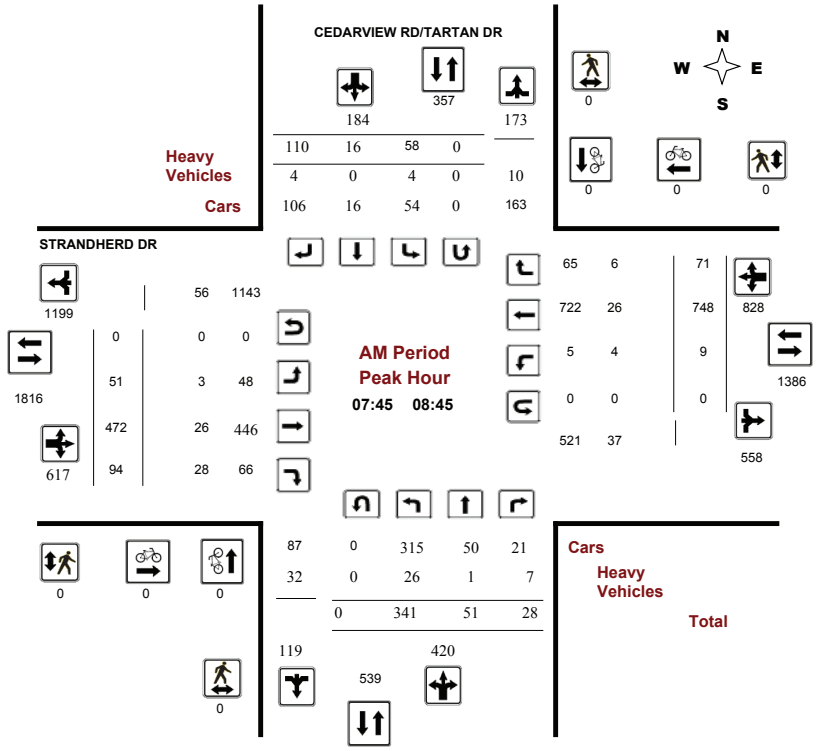
Public Works - Traffic Services

Turning Movement Count - Peak Hour Diagram

STRANDHERD DR @ CEDARVIEW RD/TARTAN DR

Survey Date: Thursday, December 17, 2015 **WO No:** 35623

Start Time: 07:00 **Device:** Miovision



Comments

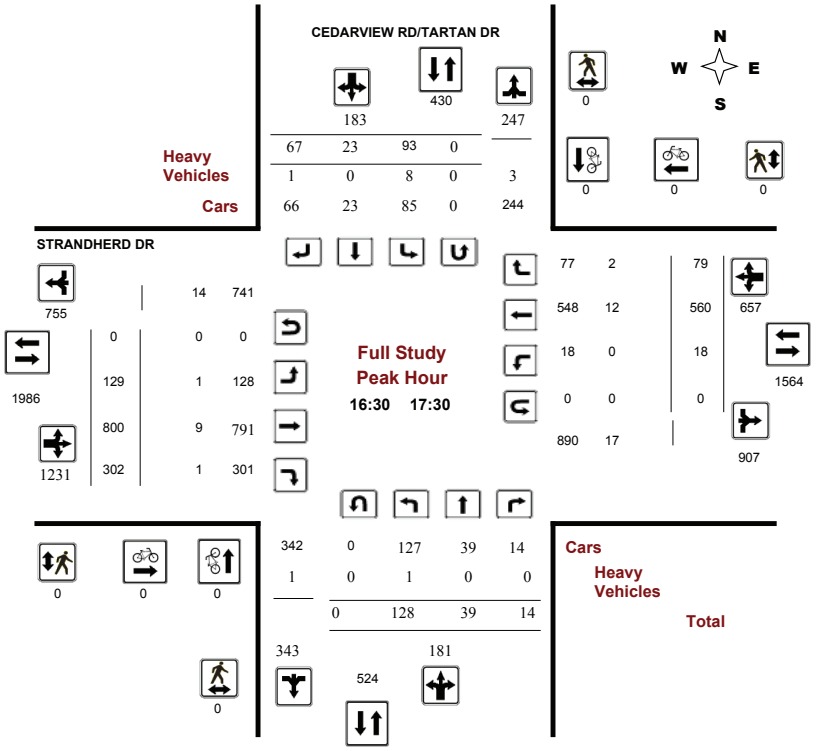
Public Works - Traffic Services

Turning Movement Count - Peak Hour Diagram

STRANDHERD DR @ CEDARVIEW RD/TARTAN DR

Survey Date: Thursday, December 17, 2015 **WO No:** 35623

Start Time: 07:00 **Device:** Miovision



Comments

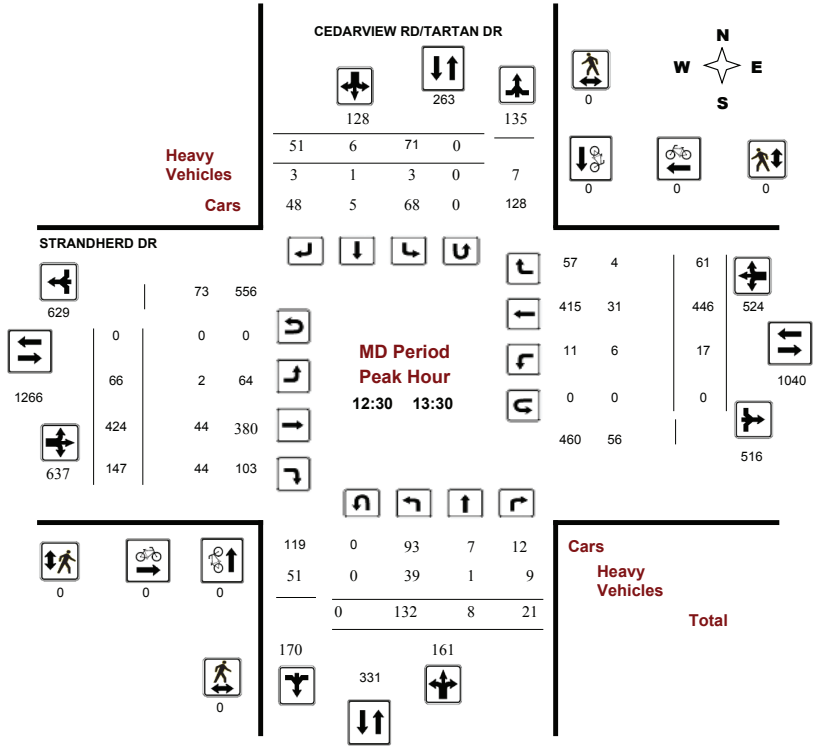
Public Works - Traffic Services

Turning Movement Count - Peak Hour Diagram

STRANDHERD DR @ CEDARVIEW RD/TARTAN DR

Survey Date: Thursday, December 17, 2015 **WO No:** 35623

Start Time: 07:00 **Device:** Miovision



Comments

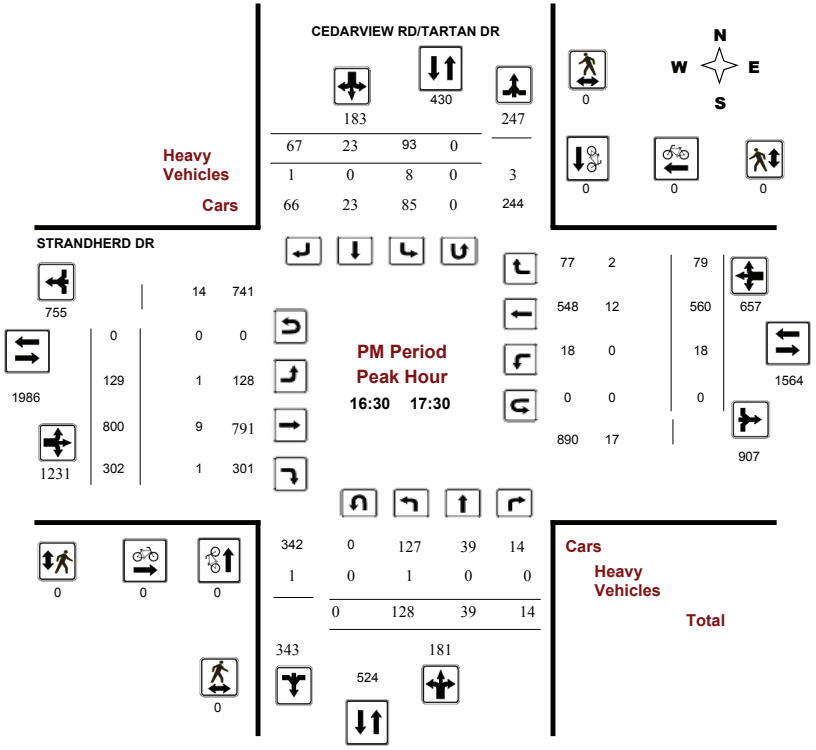
Public Works - Traffic Services

Turning Movement Count - Peak Hour Diagram

STRANDHERD DR @ CEDARVIEW RD/TARTAN DR

Survey Date: Thursday, December 17, 2015 **WO No:** 35623

Start Time: 07:00 **Device:** Miovision



Comments

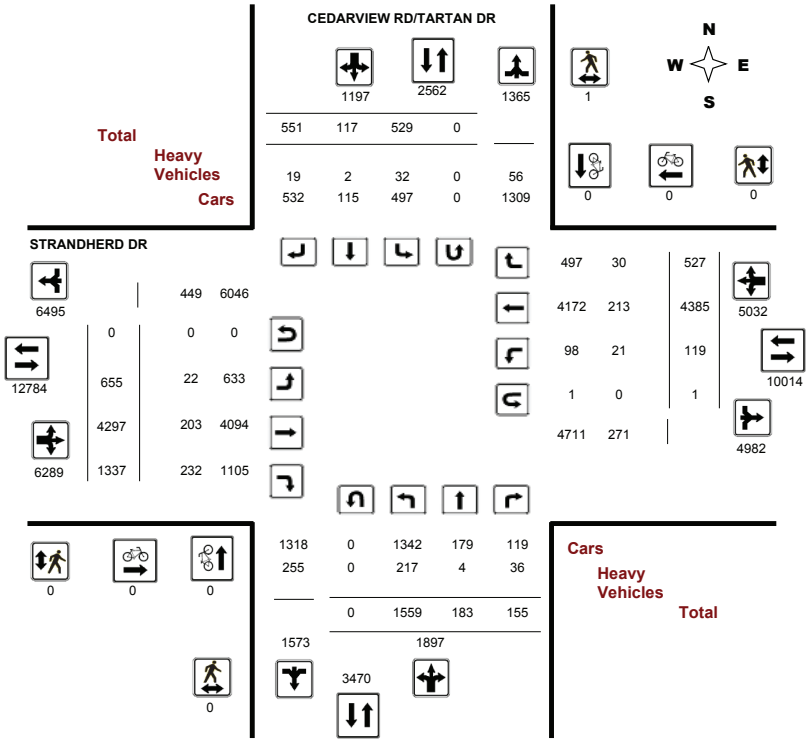
Public Works - Traffic Services

Turning Movement Count - Full Study Diagram

STRANDHERD DR @ CEDARVIEW RD/TARTAN DR

Survey Date: Thursday, December 17, 2015 **WO#:** 35623

Device: Miovision



Comments

Public Works - Traffic Services

Work Order 35623

Turning Movement Count - Full Study Summary Report

STRANDHERD DR @ CEDARVIEW RD/TARTAN DR

Survey Date: Thursday, December 17, 2015

Total Observed U-Turns

Northbound: 0 Southbound: 0

Eastbound: 0 Westbound: 1

AADT Factor 1.00

Full Study

	CEDARVIEW RD/TARTAN DR								STRANDHERD DR									
	Northbound				Southbound				Eastbound				Westbound					
Period	LT	ST	RT	NB TOT	LT	ST	RT	SB TOT	STR TOT	LT	ST	RT	EB TOT	LT	ST	RT	WB TOT	STR TOT	Grand Total
07:00 08:00	319	20	19	**358**	32	1	108	**141**	**499**	50	446	88	**584**	14	592	25	**631**	**1215**	**1714**
08:00 09:00	300	48	29	**377**	58	21	100	**179**	**556**	63	456	110	**629**	9	745	72	**826**	**1455**	**2011**
09:00 10:00	234	13	17	**264**	33	4	51	**88**	**352**	61	346	110	**517**	8	496	57	**561**	**1078**	**1430**
11:30 12:30	149	7	20	**176**	69	6	51	**126**	**302**	50	426	113	**589**	17	407	77	**501**	**1090**	**1392**
12:30 13:30	132	8	21	**161**	71	6	51	**128**	**289**	66	424	147	**637**	17	446	61	**524**	**1161**	**1450**
15:00 16:00	145	26	17	**188**	90	28	80	**198**	**386**	109	630	214	**953**	20	579	79	**678**	**1631**	**2017**
16:00 17:00	139	31	14	**184**	84	33	63	**180**	**364**	126	797	279	**1202**	19	591	75	**685**	**1887**	**2251**
17:00 18:00	141	30	18	**189**	92	18	47	**157**	**346**	130	772	276	**1178**	15	529	81	**625**	**1803**	**2149**
Sub Total	1559	183	155	**1897**	529	117	551	**1197**	**3094**	655	4297	1337	**6289**	119	4385	527	**5031**	**11320**	**14414**
U Turns				**0**				**0**	**0**				**0**				**1**	**1**	**1**
Total	1559	183	155	**1897**	529	117	551	**1197**	**3094**	655	4297	1337	**6289**	119	4385	527	**5032**	**11321**	**14415**
EQ 12Hr	2167	254	215	**2637**	735	163	766	**1664**	**4301**	910	5973	1858	**8742**	165	6095	733	**6994**	**15736**	**20037**
Note: These values are calculated by multiplying the totals by the appropriate expansion factor. **1.39**																			
AVG 12Hr	2167	254	215	**2637**	735	163	766	**1664**	**4301**	910	5973	1858	**8742**	165	6095	733	**6994**	**15736**	**20037**
Note: These volumes are calculated by multiplying the Equivalent 12 hr. totals by the AADT factor. **1.00**																			
AVG 24Hr	2839	333	282	**3454**	963	213	1003	**2180**	**5634**	1193	7824	2435	**11452**	217	7985	960	**9163**	**20615**	**26249**
Note: These volumes are calculated by multiplying the Average Daily 12 hr. totals by 12 to 24 expansion factor. **1.31**																			

Comments:

Note: U-Turns provided for approach totals. Refer to 'U-Turn' Report for specific breakdown.

Public Works - Traffic Services

W.O. 35623

Turning Movement Count - 15 Minute Summary Report

STRANDHERD DR @ CEDARVIEW RD/TARTAN DR

Survey Date: Thursday, December 17, 2015

Total Observed U-Turns

Northbound: 0 Southbound: 0

Eastbound: 0 Westbound: 1

		CEDARVIEW RD/TARTAN DR								STRANDHERD DR									
		Northbound				Southbound				Eastbound				Westbound					
Time Period		LT	ST	RT	N TOT	LT	ST	RT	S TOT	STR TOT	LT	ST	RT	E TOT	LT	ST	RT	W TOT	STR TOT	Grand Total
07:00	07:15	80	1	2	**83**	5	0	25	**30**	**113**	16	85	25	**126**	4	106	1	**111**	**237**	**350**
07:15	07:30	62	6	4	**72**	6	0	24	**30**	**102**	14	112	21	**147**	2	139	6	**147**	**294**	**396**
07:30	07:45	81	6	8	**95**	13	0	32	**45**	**140**	13	117	27	**157**	6	171	6	**183**	**340**	**480**
07:45	08:00	96	7	5	**108**	8	1	27	**36**	**144**	7	132	15	**154**	2	176	12	**190**	**344**	**488**
08:00	08:15	85	13	7	**105**	12	3	22	**37**	**142**	12	122	21	**155**	1	187	15	**203**	**358**	**500**
08:15	08:30	76	24	8	**108**	24	9	37	**70**	**178**	15	100	33	**148**	2	189	28	**219**	**367**	**545**
08:30	08:45	84	7	8	**99**	14	3	24	**41**	**140**	17	118	25	**160**	4	196	16	**216**	**376**	**516**
08:45	09:00	55	4	6	**65**	8	6	17	**31**	**96**	19	116	31	**166**	2	173	13	**189**	**355**	**451**
09:00	09:15	94	6	4	**104**	14	1	16	**31**	**135**	14	79	27	**120**	0	151	14	**165**	**285**	**420**
09:15	09:30	56	3	4	**63**	5	0	16	**21**	**84**	15	101	26	**142**	1	119	14	**134**	**276**	**360**
09:30	09:45	43	1	5	**49**	9	2	10	**21**	**70**	13	106	35	**154**	3	120	7	**130**	**284**	**354**
09:45	10:00	41	3	4	**48**	5	1	9	**15**	**63**	19	60	22	**101**	4	106	22	**132**	**233**	**296**
11:30	11:45	49	1	5	**55**	25	4	15	**44**	**99**	9	112	26	**147**	9	108	19	**136**	**283**	**382**
11:45	12:00	27	2	4	**33**	24	2	6	**32**	**65**	18	103	32	**153**	1	92	25	**118**	**271**	**336**
12:00	12:15	38	2	4	**44**	11	0	11	**22**	**66**	11	98	25	**134**	5	104	12	**121**	**255**	**321**
12:15	12:30	35	2	7	**44**	9	0	19	**28**	**72**	12	113	30	**155**	2	103	21	**126**	**281**	**353**
12:30	12:45	27	3	8	**38**	23	0	10	**33**	**71**	16	112	37	**165**	1	121	13	**135**	**300**	**371**
12:45	13:00	30	3	2	**35**	16	0	9	**25**	**60**	19	96	38	**153**	2	100	18	**120**	**273**	**333**
13:00	13:15	40	2	6	**48**	14	2	19	**35**	**83**	11	98	32	**141**	11	112	15	**138**	**279**	**362**
13:15	13:30	35	0	5	**40**	18	4	13	**35**	**75**	20	118	40	**178**	3	113	15	**131**	**309**	**384**
15:00	15:15	37	13	1	**51**	16	6	15	**37**	**88**	29	144	36	**209**	7	129	22	**158**	**367**	**455**
15:15	15:30	38	8	4	**50**	20	8	22	**50**	**100**	24	152	48	**224**	5	111	28	**144**	**368**	**468**
15:30	15:45	25	0	5	**30**	29	10	21	**60**	**90**	27	176	62	**265**	4	196	14	**214**	**479**	**569**
15:45	16:00	45	5	7	**57**	25	4	22	**51**	**108**	29	158	68	**255**	4	143	15	**162**	**417**	**525**
16:00	16:15	38	5	4	**47**	18	10	9	**37**	**84**	31	189	62	**282**	3	157	21	**181**	**463**	**547**
16:15	16:30	35	6	4	**45**	19	10	11	**40**	**85**	33	201	74	**308**	4	145	13	**162**	**470**	**555**
16:30	16:45	30	10	5	**45**	19	5	23	**47**	**92**	31	207	68	**306**	7	149	20	**176**	**482**	**574**
16:45	17:00	36	10	1	**47**	28	8	20	**56**	**103**	31	200	75	**306**	5	140	21	**166**	**472**	**575**
17:00	17:15	24	12	4	**40**	24	3	9	**36**	**76**	31	203	67	**301**	1	142	24	**167**	**468**	**544**
17:15	17:30	38	7	4	**49**	22	7	15	**44**	**93**	36	190	92	**318**	5	129	14	**148**	**466**	**559**
17:30	17:45	49	5	7	**61**	26	5	9	**40**	**101**	31	205	72	**308**	5	131	18	**154**	**462**	**563**
17:45	18:00	30	6	3	**39**	20	3	14	**37**	**76**	32	174	45	**251**	4	127	25	**156**	**407**	**483**
TOTAL:		1559	183	155	**1897**	529	117	551	**1197**	**3094**	655	4297	1337	**6289**	119	4385	527	**5032**	**11321**	**14415**

Note: U-Turns are included in Totals.

Comment:

Public Works - Traffic Services

Turning Movement Count - Cyclist Volume Report

Work Order 35623

STRANDHERD DR @ CEDARVIEW RD/TARTAN DR

Count Date: Thursday, December 17, 2015 **Start Time:** 07:00

	CEDARVIEW RD/TARTAN DR			STRANDHERD DR			
Time Period	Northbound	Southbound	Street Total	Eastbound	Westbound	Street Total	Grand Total
07:00 08:00	0	0	**0**	0	0	**0**	**0**
08:00 09:00	0	0	**0**	0	0	**0**	**0**
09:00 10:00	0	0	**0**	0	0	**0**	**0**
11:30 12:30	0	0	**0**	0	0	**0**	**0**
12:30 13:30	0	0	**0**	0	0	**0**	**0**
15:00 16:00	0	0	**0**	0	0	**0**	**0**
16:00 17:00	0	0	**0**	0	0	**0**	**0**
17:00 18:00	0	0	**0**	0	0	**0**	**0**
Total	0	0	**0**	0	0	**0**	**0**

Comment:

Note: These volumes consists of bicycles only (no mopeds or motorcycles) and ARE NOT included in the Turning Movement Count Summary.

Public Works - Traffic Services

W.O. 35623

Turning Movement Count - Heavy Vehicle Report

STRANDHERD DR @ CEDARVIEW RD/TARTAN DR

Survey Date: Thursday, December 17, 2015

		CEDARVIEW RD/TARTAN DR									STRANDHERD DR									
		Northbound				Southbound					Eastbound				Westbound					
Time Period		LT	ST	RT	N TOT	LT	ST	RT	S TOT	STR TOT	LT	ST	RT	E TOT	LT	ST	RT	W TOT	STR TOT	Grand Total
07:00	08:00	24	1	4	**29**	3	0	1	**4**	**33**	6	34	30	**70**	3	20	6	**29**	**99**	**132**
08:00	09:00	29	1	7	**37**	3	0	6	**9**	**46**	2	33	35	**70**	4	26	5	**35**	**105**	**151**
09:00	10:00	29	0	7	**36**	2	0	2	**4**	**40**	3	33	35	**71**	2	42	4	**48**	**119**	**159**
11:30	12:30	42	0	3	**45**	3	0	1	**4**	**49**	3	27	40	**70**	5	37	3	**45**	**115**	**164**
12:30	13:30	39	1	9	**49**	3	1	3	**7**	**56**	2	44	44	**90**	6	31	4	**41**	**131**	**187**
15:00	16:00	35	0	4	**39**	4	1	2	**7**	**46**	3	18	36	**57**	1	33	3	**37**	**94**	**140**
16:00	17:00	15	1	2	**18**	8	0	4	**12**	**30**	3	6	11	**20**	0	20	2	**22**	**42**	**72**
17:00	18:00	4	0	0	**4**	6	0	0	**6**	**10**	0	8	1	**9**	0	4	3	**7**	**16**	**26**
Sub Total		217	4	36	**257**	32	2	19	**53**	**310**	22	203	232	**457**	21	213	30	**264**	**721**	**1031**
U-Turns (Heavy Vehicles)					**0**				**0**	**0**				**0**				**0**	**0**	**0**
Total		217	4	36	**0**	32	2	19	**53**	**310**	22	203	232	**457**	21	213	30	**264**	**721**	**1031**

Heavy Vehicles are vehicles having one rear axle with four or more wheels, or having two or more rear axles. These vehicles include most O.C. Transpo, school and inter-city buses. Further, they ARE included in the Turning Movement Count Summary.

Public Works - Traffic Services

Work Order 35623

Turning Movement Count - Pedestrian Volume Report

STRANDHERD DR @ CEDARVIEW RD/TARTAN DR

Count Date: Thursday, December 17, 2015 **Start Time:** 07:00

Time Period		NB Approach (E or W Crossing)	SB Approach (E or W Crossing)	Total	EB Approach (N or S Crossing)	WB Approach (N or S Crossing)	Total	Grand Total
07:00	07:15	0	0	**0**	0	0	**0**	**0**
07:15	07:30	0	0	**0**	0	0	**0**	**0**
07:30	07:45	0	0	**0**	0	0	**0**	**0**
07:45	08:00	0	0	**0**	0	0	**0**	**0**
07:00	08:00	0	0	**0**	0	0	**0**	**0**
08:00	08:15	0	0	**0**	0	0	**0**	**0**
08:15	08:30	0	0	**0**	0	0	**0**	**0**
08:30	08:45	0	0	**0**	0	0	**0**	**0**
08:45	09:00	0	0	**0**	0	0	**0**	**0**
08:00	09:00	0	0	**0**	0	0	**0**	**0**
09:00	09:15	0	0	**0**	0	0	**0**	**0**
09:15	09:30	0	0	**0**	0	0	**0**	**0**
09:30	09:45	0	0	**0**	0	0	**0**	**0**
09:45	10:00	0	0	**0**	0	0	**0**	**0**
09:00	10:00	0	0	**0**	0	0	**0**	**0**
11:30	11:45	0	0	**0**	0	0	**0**	**0**
11:45	12:00	0	0	**0**	0	0	**0**	**0**
12:00	12:15	0	1	**1**	0	0	**0**	**1**
12:15	12:30	0	0	**0**	0	0	**0**	**0**
11:30	12:30	0	1	**1**	0	0	**0**	**1**
12:30	12:45	0	0	**0**	0	0	**0**	**0**
12:45	13:00	0	0	**0**	0	0	**0**	**0**
13:00	13:15	0	0	**0**	0	0	**0**	**0**
13:15	13:30	0	0	**0**	0	0	**0**	**0**
12:30	13:30	0	0	**0**	0	0	**0**	**0**
15:00	15:15	0	0	**0**	0	0	**0**	**0**
15:15	15:30	0	0	**0**	0	0	**0**	**0**
15:30	15:45	0	0	**0**	0	0	**0**	**0**
15:45	16:00	0	0	**0**	0	0	**0**	**0**
15:00	16:00	0	0	**0**	0	0	**0**	**0**
16:00	16:15	0	0	**0**	0	0	**0**	**0**
16:15	16:30	0	0	**0**	0	0	**0**	**0**
16:30	16:45	0	0	**0**	0	0	**0**	**0**
16:45	17:00	0	0	**0**	0	0	**0**	**0**
16:00	17:00	0	0	**0**	0	0	**0**	**0**
17:00	17:15	0	0	**0**	0	0	**0**	**0**
17:15	17:30	0	0	**0**	0	0	**0**	**0**
17:30	17:45	0	0	**0**	0	0	**0**	**0**
17:45	18:00	0	0	**0**	0	0	**0**	**0**
17:00	18:00	0	0	**0**	0	0	**0**	**0**
Total	.....	0	1	**1**	0	0	**0**	**1**

Comment:

Public Works - Traffic Services

Work Order
35623

Turning Movement Count - 15 Min U-Turn Total Report

STRANDHERD DR @ CEDARVIEW RD/TARTAN DR

Survey Date: Thursday, December 17, 2015

Time Period		Northbound U-Turn Total	Southbound U-Turn Total	Eastbound U-Turn Total	Westbound U-Turn Total	Total
07:00	07:15	0	0	0	0	0
07:15	07:30	0	0	0	0	0
07:30	07:45	0	0	0	0	0
07:45	08:00	0	0	0	0	0
08:00	08:15	0	0	0	0	0
08:15	08:30	0	0	0	0	0
08:30	08:45	0	0	0	0	0
08:45	09:00	0	0	0	1	1
09:00	09:15	0	0	0	0	0
09:15	09:30	0	0	0	0	0
09:30	09:45	0	0	0	0	0
09:45	10:00	0	0	0	0	0
11:30	11:45	0	0	0	0	0
11:45	12:00	0	0	0	0	0
12:00	12:15	0	0	0	0	0
12:15	12:30	0	0	0	0	0
12:30	12:45	0	0	0	0	0
12:45	13:00	0	0	0	0	0
13:00	13:15	0	0	0	0	0
13:15	13:30	0	0	0	0	0
15:00	15:15	0	0	0	0	0
15:15	15:30	0	0	0	0	0
15:30	15:45	0	0	0	0	0
15:45	16:00	0	0	0	0	0
16:00	16:15	0	0	0	0	0
16:15	16:30	0	0	0	0	0
16:30	16:45	0	0	0	0	0
16:45	17:00	0	0	0	0	0
17:00	17:15	0	0	0	0	0
17:15	17:30	0	0	0	0	0
17:30	17:45	0	0	0	0	0
17:45	18:00	0	0	0	0	0
Total		0	0	0	1	1

Appendix C INTERSECTION PERFORMANCE WORKSHEETS

Appendix C Intersection performance worksheets
MAY 2017

C.1 2016 EXISTING CONDITIONS

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	57	635	10	915	386	89	64	139
v/c Ratio	0.78	0.70	0.04	1.01	0.90	0.14	0.14	0.22
Control Delay	84.1	22.8	12.4	56.4	55.7	14.8	22.2	6.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	84.1	22.8	12.4	56.4	55.7	14.8	22.2	6.3
Queue Length 50th (m)	8.3	84.7	0.9	~166.7	67.8	7.0	8.0	2.1
Queue Length 95th (m)	#32.8	125.5	3.6	#253.4	#122.2	17.1	17.2	13.9
Internal Link Dist (m)		124.7		145.0		270.9		84.5
Turn Bay Length (m)	120.0		130.0		80.0		37.5	
Base Capacity (vph)	73	902	238	909	429	628	449	635
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.78	0.70	0.04	1.01	0.90	0.14	0.14	0.22

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	52	486	98	9	770	72	355	52	29	59	16	112
Future Volume (vph)	52	486	98	9	770	72	355	52	29	59	16	112
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	6.4	6.4		6.4	6.4		5.8	5.8		5.8	5.8	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.97		1.00	0.99		1.00	0.95		1.00	0.87	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1695	1739		1695	1761		1695	1688		1695	1549	
Flt Permitted	0.08	1.00		0.26	1.00		0.67	1.00		0.70	1.00	
Satd. Flow (perm)	143	1739		464	1761		1192	1688		1248	1549	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	57	528	107	10	837	78	386	57	32	64	17	122
RTOR Reduction (vph)	0	7	0	0	3	0	0	20	0	0	78	0
Lane Group Flow (vph)	57	628	0	10	912	0	386	69	0	64	61	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	50.0	50.0		50.0	50.0		35.0	35.0		35.0	35.0	
Effective Green, g (s)	50.0	50.0		50.0	50.0		35.0	35.0		35.0	35.0	
Actuated g/C Ratio	0.51	0.51		0.51	0.51		0.36	0.36		0.36	0.36	
Clearance Time (s)	6.4	6.4		6.4	6.4		5.8	5.8		5.8	5.8	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	73	894		238	905		429	607		449	557	
v/s Ratio Prot		0.36			c0.52			0.04			0.04	
v/s Ratio Perm	0.40			0.02			c0.32			0.05		
v/c Ratio	0.78	0.70		0.04	1.01		0.90	0.11		0.14	0.11	
Uniform Delay, d1	19.2	17.9		11.7	23.6		29.4	20.7		21.0	20.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	56.0	4.6		0.3	31.7		24.4	0.4		0.7	0.4	
Delay (s)	75.2	22.5		12.0	55.3		53.9	21.1		21.6	21.1	
Level of Service	E	C		B	E		D	C		C	C	
Approach Delay (s)		26.9			54.8			47.7			21.3	
Approach LOS		C			D			D			C	

Intersection Summary				
HCM 2000 Control Delay	42.0	HCM 2000 Level of Service	D	
HCM 2000 Volume to Capacity ratio	0.96			
Actuated Cycle Length (s)	97.2	Sum of lost time (s)	12.2	
Intersection Capacity Utilization	91.3%	ICU Level of Service	F	
Analysis Period (min)	15			

c Critical Lane Group

Intersection	
Int Delay, s/veh	9

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	7	386	50	3	97	26
Future Vol, veh/h	7	386	50	3	97	26
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	8	420	54	3	105	28

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	295	56	0	0	58	0
Stage 1	56	-	-	-	-	-
Stage 2	239	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	696	1011	-	-	1546	-
Stage 1	967	-	-	-	-	-
Stage 2	801	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	648	1011	-	-	1546	-
Mov Cap-2 Maneuver	648	-	-	-	-	-
Stage 1	967	-	-	-	-	-
Stage 2	746	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	11.2	0	5.9
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	1001	1546	-
HCM Lane V/C Ratio	-	-	0.427	0.068	-
HCM Control Delay (s)	-	-	11.2	7.5	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	2.2	0.2	-

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	142	1229	21	715	146	59	103	99
v/c Ratio	0.78	1.38	0.29	0.79	0.33	0.09	0.22	0.16
Control Delay	51.0	200.3	26.3	26.8	25.2	16.6	23.3	8.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.0	200.3	26.3	26.8	25.2	16.6	23.3	8.4
Queue Length 50th (m)	20.6	~307.8	2.2	103.3	19.7	5.3	13.3	3.0
Queue Length 95th (m)	#56.6	#385.4	9.0	153.5	35.3	13.4	25.7	13.4
Internal Link Dist (m)		124.6		144.9		270.9		84.5
Turn Bay Length (m)	120.1		130.1		79.9		37.5	
Base Capacity (vph)	182	893	73	906	445	626	461	617
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.78	1.38	0.29	0.79	0.33	0.09	0.22	0.16

Intersection Summary	
~	Volume exceeds capacity, queue is theoretically infinite.
	Queue shown is maximum after two cycles.
#	95th percentile volume exceeds capacity, queue may be longer.
	Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	131	815	316	19	577	81	134	40	15	95	23	68
Future Volume (vph)	131	815	316	19	577	81	134	40	15	95	23	68
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	6.4	6.4		6.4	6.4		5.8	5.8		5.8	5.8	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.96		1.00	0.98		1.00	0.96		1.00	0.89	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1695	1710		1695	1751		1695	1712		1695	1584	
Flt Permitted	0.20	1.00		0.08	1.00		0.69	1.00		0.72	1.00	
Satd. Flow (perm)	355	1710		143	1751		1236	1712		1282	1584	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	142	886	343	21	627	88	146	43	16	103	25	74
RTOR Reduction (vph)	0	15	0	0	5	0	0	10	0	0	47	0
Lane Group Flow (vph)	142	1214	0	21	710	0	146	49	0	103	52	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	50.0	50.0		50.0	50.0		35.0	35.0		35.0	35.0	
Effective Green, g (s)	50.0	50.0		50.0	50.0		35.0	35.0		35.0	35.0	
Actuated g/C Ratio	0.51	0.51		0.51	0.51		0.36	0.36		0.36	0.36	
Clearance Time (s)	6.4	6.4		6.4	6.4		5.8	5.8		5.8	5.8	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	182	879		73	900		445	616		461	570	
v/s Ratio Prot		c0.71			0.41			0.03			0.03	
v/s Ratio Perm	0.40			0.15			c0.12			0.08		
v/c Ratio	0.78	1.38		0.29	0.79		0.33	0.08		0.22	0.09	
Uniform Delay, d1	19.1	23.6		13.5	19.3		22.6	20.5		21.6	20.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	27.5	178.8		9.7	6.9		2.0	0.3		1.1	0.3	
Delay (s)	46.6	202.4		23.1	26.2		24.5	20.7		22.8	20.9	
Level of Service	D	F		C	C		C	C		C	C	
Approach Delay (s)		186.3			26.1			23.4			21.8	
Approach LOS		F			C			C			C	

Intersection Summary				
HCM 2000 Control Delay	112.9	HCM 2000 Level of Service	F	
HCM 2000 Volume to Capacity ratio	0.95			
Actuated Cycle Length (s)	97.2	Sum of lost time (s)	12.2	
Intersection Capacity Utilization	99.8%	ICU Level of Service	F	
Analysis Period (min)	15			

c Critical Lane Group

Intersection	
Int Delay, s/veh	6.8

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	7	138	51	5	298	60
Future Vol, veh/h	7	138	51	5	298	60
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	8	150	55	5	324	65

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	771	58	0	0	61	0
Stage 1	58	-	-	-	-	-
Stage 2	713	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	368	1008	-	-	1542	-
Stage 1	965	-	-	-	-	-
Stage 2	486	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	288	1008	-	-	1542	-
Mov Cap-2 Maneuver	288	-	-	-	-	-
Stage 1	965	-	-	-	-	-
Stage 2	380	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	9.9	0	6.6
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	899	1542	-
HCM Lane V/C Ratio	-	-	0.175	0.21	-
HCM Control Delay (s)	-	-	9.9	8	0
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0.6	0.8	-

Appendix C Intersection performance worksheets
MAY 2017

C.2 2022 FUTURE BACKGROUND CONDITIONS

Queues
1: Borrisokane Road & Strandherd Drive

3387 Cedarview Road
2022 FBG AM

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	69	769	14	1134	554	103	66	180
v/c Ratio	1.17	0.87	0.11	1.27	1.29	0.15	0.14	0.28
Control Delay	481.0	40.0	18.5	523.4	569.5	15.6	24.4	16.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	481.0	40.0	18.5	523.4	569.5	15.6	24.4	16.5
Queue Length 50th (m)	~19.2	152.8	1.7	~338.1	~166.0	9.5	9.8	17.2
Queue Length 95th (m)	#42.6	#282.6	6.7	#489.1	#269.9	24.4	22.1	40.0
Internal Link Dist (m)		124.7		145.0		270.9		84.5
Turn Bay Length (m)	120.0		130.0		80.0		37.5	
Base Capacity (vph)	59	881	126	893	430	678	484	647
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.17	0.87	0.11	1.27	1.29	0.15	0.14	0.28

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
1: Borrisokane Road & Strandherd Drive

3387 Cedarview Road
2022 FBG AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	69	614	155	14	1053	81	554	58	45	66	18	162
Future Volume (vph)	69	614	155	14	1053	81	554	58	45	66	18	162
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	6.4	6.4		6.4	6.4		5.8	5.8		5.8	5.8	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.97		1.00	0.99		1.00	0.93		1.00	0.86	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1695	1730		1695	1765		1695	1667		1695	1543	
Flt Permitted	0.07	1.00		0.14	1.00		0.61	1.00		0.69	1.00	
Satd. Flow (perm)	118	1730		250	1765		1093	1667		1232	1543	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	69	614	155	14	1053	81	554	58	45	66	18	162
RTOR Reduction (vph)	0	7	0	0	2	0	0	23	0	0	41	0
Lane Group Flow (vph)	69	762	0	14	1132	0	554	80	0	66	139	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	60.6	60.6		60.6	60.6		47.2	47.2		47.2	47.2	
Effective Green, g (s)	60.6	60.6		60.6	60.6		47.2	47.2		47.2	47.2	
Actuated g/C Ratio	0.51	0.51		0.51	0.51		0.39	0.39		0.39	0.39	
Clearance Time (s)	6.4	6.4		6.4	6.4		5.8	5.8		5.8	5.8	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	59	873		126	891		429	655		484	606	
v/s Ratio Prot		0.44			c0.64			0.05			0.09	
v/s Ratio Perm	0.59			0.06			c0.51			0.05		
v/c Ratio	1.17	0.87		0.11	1.27		1.29	0.12		0.14	0.23	
Uniform Delay, d1	29.7	26.3		15.6	29.7		36.4	23.2		23.3	24.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	448.3	13.3		1.8	495.2		542.5	0.4		0.6	0.9	
Delay (s)	478.0	39.6		17.4	524.9		578.9	23.6		23.9	25.2	
Level of Service	F	D		B	F		F	C		C	C	
Approach Delay (s)		75.7			518.7			491.8			24.8	
Approach LOS		E			F			F			C	

Intersection Summary				
HCM 2000 Control Delay	342.0	HCM 2000 Level of Service	F	
HCM 2000 Volume to Capacity ratio	1.28			
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.2	
Intersection Capacity Utilization	122.6%	ICU Level of Service	H	
Analysis Period (min)	60			

c Critical Lane Group

Intersection	
Int Delay, s/veh	11

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	8	565	92	3	147	40
Future Vol, veh/h	8	565	92	3	147	40
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	8	565	92	3	147	40

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	428	94	0	0	95	0
Stage 1	94	-	-	-	-	-
Stage 2	334	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	584	963	-	-	1499	-
Stage 1	930	-	-	-	-	-
Stage 2	725	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	526	963	-	-	1499	-
Mov Cap-2 Maneuver	526	-	-	-	-	-
Stage 1	930	-	-	-	-	-
Stage 2	653	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	14.5	0	6
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	952	1499	-
HCM Lane V/C Ratio	-	-	0.602	0.098	-
HCM Control Delay (s)	-	-	14.5	7.7	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	4.4	0.3	-

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	197	1687	34	901	252	67	106	135
v/c Ratio	0.70	1.38	0.58	0.72	1.27	0.20	0.45	0.36
Control Delay	27.0	702.8	56.2	14.1	559.7	32.4	50.7	14.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	27.0	702.8	56.2	14.1	559.7	32.4	50.7	14.7
Queue Length 50th (m)	23.5	~526.5	3.4	109.2	~74.5	9.6	22.4	5.1
Queue Length 95th (m)	#89.1	#710.9	#13.7	208.2	#144.5	25.5	45.7	28.3
Internal Link Dist (m)		124.6		144.9		270.9		84.5
Turn Bay Length (m)	120.1		130.1		79.9		37.5	
Base Capacity (vph)	282	1226	59	1257	199	328	235	378
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.70	1.38	0.58	0.72	1.27	0.20	0.45	0.36

Intersection Summary	
~	Volume exceeds capacity, queue is theoretically infinite.
	Queue shown is maximum after two cycles.
#	95th percentile volume exceeds capacity, queue may be longer.
	Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	197	1160	527	34	811	90	252	44	23	106	26	109
Future Volume (vph)	197	1160	527	34	811	90	252	44	23	106	26	109
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	6.4	6.4		6.4	6.4		5.8	5.8		5.8	5.8	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.95		1.00	0.99		1.00	0.95		1.00	0.88	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1695	1701		1695	1758		1695	1692		1695	1568	
Flt Permitted	0.22	1.00		0.05	1.00		0.61	1.00		0.71	1.00	
Satd. Flow (perm)	396	1701		83	1758		1082	1692		1273	1568	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	197	1160	527	34	811	90	252	44	23	106	26	109
RTOR Reduction (vph)	0	14	0	0	3	0	0	15	0	0	89	0
Lane Group Flow (vph)	197	1673	0	34	898	0	252	52	0	106	46	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	85.6	85.6		85.6	85.6		22.2	22.2		22.2	22.2	
Effective Green, g (s)	85.6	85.6		85.6	85.6		22.2	22.2		22.2	22.2	
Actuated g/C Ratio	0.71	0.71		0.71	0.71		0.18	0.18		0.18	0.18	
Clearance Time (s)	6.4	6.4		6.4	6.4		5.8	5.8		5.8	5.8	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	282	1213		59	1254		200	313		235	290	
v/s Ratio Prot		c0.98			0.51			0.03			0.03	
v/s Ratio Perm	0.50			0.41			c0.23			0.08		
v/c Ratio	0.70	1.38		0.58	0.72		1.26	0.16		0.45	0.16	
Uniform Delay, d1	9.8	17.2		8.4	10.1		48.9	41.1		43.5	41.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	14.4	688.3		39.5	3.6		508.2	1.1		6.3	1.2	
Delay (s)	24.2	705.5		47.8	13.7		557.1	42.2		49.7	42.2	
Level of Service	C	F		D	B		F	D		D	D	
Approach Delay (s)		634.3			14.9			448.9			45.5	
Approach LOS		F			B			F			D	

Intersection Summary				
HCM 2000 Control Delay	403.4	HCM 2000 Level of Service	F	
HCM 2000 Volume to Capacity ratio	1.35			
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.2	
Intersection Capacity Utilization	146.1%	ICU Level of Service	H	
Analysis Period (min)	60			

c Critical Lane Group

Intersection						
Int Delay, s/veh	7.3					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	8	231	88	6	471	116
Future Vol, veh/h	8	231	88	6	471	116
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	8	231	88	6	471	116

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1149	91	0	0	94	0
Stage 1	91	-	-	-	-	-
Stage 2	1058	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	219	967	-	-	1500	-
Stage 1	933	-	-	-	-	-
Stage 2	334	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	145	967	-	-	1500	-
Mov Cap-2 Maneuver	145	-	-	-	-	-
Stage 1	933	-	-	-	-	-
Stage 2	222	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	11.3	0	6.8
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	813	1500	-
HCM Lane V/C Ratio	-	-	0.294	0.314	-
HCM Control Delay (s)	-	-	11.3	8.5	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	1.2	1.4	-

C.3 2022 FUTURE BACKGROUND CONDITIONS WITH IMPROVEMENTS

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	69	614	155	14	1134	554	58	45	66	180
v/c Ratio	0.83	0.43	0.21	0.10	0.93	0.95	0.09	0.07	0.65	0.41
Control Delay	140.9	26.8	4.7	57.1	53.7	89.7	26.7	0.2	87.5	20.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	140.9	26.8	4.7	57.1	53.7	89.7	26.7	0.2	87.5	20.5
Queue Length 50th (m)	16.4	50.0	0.0	1.6	133.3	67.1	9.1	0.0	15.5	15.1
Queue Length 95th (m)	#50.2	85.8	17.8	5.7	#213.2	#119.7	20.8	0.0	#42.5	43.6
Internal Link Dist (m)		124.7			145.0		270.9			84.5
Turn Bay Length (m)	120.0			130.0		80.0		37.5	37.5	
Base Capacity (vph)	83	1418	724	137	1222	583	657	631	104	437
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.83	0.43	0.21	0.10	0.93	0.95	0.09	0.07	0.63	0.41

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	69	614	155	14	1053	81	554	58	45	66	18	162
Future Volume (vph)	69	614	155	14	1053	81	554	58	45	66	18	162
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	4.5	6.4	6.4	4.5	6.4		4.5	5.8	5.8	4.5	5.8	
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95		0.97	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	0.86	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1695	3390	1517	3288	3354		3288	1784	1517	1695	1543	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1695	3390	1517	3288	3354		3288	1784	1517	1695	1543	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	69	614	155	14	1053	81	554	58	45	66	18	162
RTOR Reduction (vph)	0	0	92	0	4	0	0	0	29	0	77	0
Lane Group Flow (vph)	69	614	63	14	1130	0	554	58	16	66	103	0
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	Perm	Prot	NA	
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases			2						4			
Actuated Green, G (s)	5.9	50.2	50.2	2.0	46.3		21.3	44.3	44.3	5.9	28.9	
Effective Green, g (s)	5.9	50.2	50.2	2.0	46.3		21.3	44.3	44.3	5.9	28.9	
Actuated g/C Ratio	0.05	0.41	0.41	0.02	0.37		0.17	0.36	0.36	0.05	0.23	
Clearance Time (s)	4.5	6.4	6.4	4.5	6.4		4.5	5.8	5.8	4.5	5.8	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	80	1376	616	53	1256		566	639	543	80	360	
v/s Ratio Prot	c0.04	c0.18		0.00	c0.34		c0.17	0.03		0.04	c0.07	
v/s Ratio Perm			0.04						0.01			
v/c Ratio	0.86	0.45	0.10	0.26	0.90		0.98	0.09	0.03	0.82	0.29	
Uniform Delay, d1	58.4	26.6	22.7	60.1	36.5		50.9	26.3	25.7	58.3	38.9	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	82.2	1.1	0.3	2.7	12.0		56.4	0.3	0.1	62.9	2.0	
Delay (s)	140.7	27.7	23.1	62.7	48.5		107.3	26.6	25.8	121.3	40.9	
Level of Service	F	C	C	E	D		F	C	C	F	D	
Approach Delay (s)		36.1			48.6			94.6			62.4	
Approach LOS		D			D			F			E	

Intersection Summary				
HCM 2000 Control Delay	56.6	HCM 2000 Level of Service	E	
HCM 2000 Volume to Capacity ratio	0.73			
Actuated Cycle Length (s)	123.6	Sum of lost time (s)	21.2	
Intersection Capacity Utilization	83.5%	ICU Level of Service	E	
Analysis Period (min)	60			

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	197	1160	527	34	901	252	44	23	106	135
v/c Ratio	0.79	0.77	0.55	0.25	0.79	0.76	0.10	0.05	0.70	0.30
Control Delay	75.8	32.4	4.5	60.3	41.8	68.9	36.2	0.2	80.0	12.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	75.8	32.4	4.5	60.3	41.8	68.9	36.2	0.2	80.0	12.4
Queue Length 50th (m)	44.5	118.8	2.0	4.0	101.7	30.1	8.1	0.0	24.5	4.8
Queue Length 95th (m)	#90.8	174.4	42.7	10.6	#161.3	#56.4	19.8	0.0	#57.7	26.4
Internal Link Dist (m)		124.6			144.9		270.9			84.5
Turn Bay Length (m)	120.1			130.1		80.0		37.5	37.5	
Base Capacity (vph)	276	1510	959	137	1145	343	439	489	163	450
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.71	0.77	0.55	0.25	0.79	0.73	0.10	0.05	0.65	0.30

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	197	1160	527	34	811	90	252	44	23	106	26	109
Future Volume (vph)	197	1160	527	34	811	90	252	44	23	106	26	109
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	4.5	6.4	6.4	4.5	6.4		4.5	5.8	5.8	4.5	5.8	
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95		0.97	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	0.88	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1695	3390	1517	3288	3339		3288	1784	1517	1695	1568	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1695	3390	1517	3288	3339		3288	1784	1517	1695	1568	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	197	1160	527	34	811	90	252	44	23	106	26	109
RTOR Reduction (vph)	0	0	284	0	7	0	0	0	17	0	83	0
Lane Group Flow (vph)	197	1160	243	34	894	0	252	44	6	106	52	0
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	Perm	Prot	NA	
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases			2						4			
Actuated Green, G (s)	17.5	53.3	53.3	5.0	40.8		12.1	29.4	29.4	10.7	28.0	
Effective Green, g (s)	17.5	53.3	53.3	5.0	40.8		12.1	29.4	29.4	10.7	28.0	
Actuated g/C Ratio	0.15	0.45	0.45	0.04	0.34		0.10	0.25	0.25	0.09	0.23	
Clearance Time (s)	4.5	6.4	6.4	4.5	6.4		4.5	5.8	5.8	4.5	5.8	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	248	1510	676	137	1139		332	438	372	151	367	
v/s Ratio Prot	c0.12	c0.34		0.01	0.27		c0.08	0.02		0.06	c0.03	
v/s Ratio Perm			0.16						0.00			
v/c Ratio	0.79	0.77	0.36	0.25	0.79		0.76	0.10	0.02	0.70	0.14	
Uniform Delay, d1	49.3	27.9	21.9	55.5	35.5		52.3	34.9	34.1	52.9	36.3	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	17.8	3.9	1.5	1.0	5.7		10.2	0.5	0.1	14.8	0.8	
Delay (s)	67.1	31.9	23.4	56.4	41.2		62.5	35.3	34.2	67.7	37.1	
Level of Service	E	C	C	E	D		E	D	C	E	D	
Approach Delay (s)		33.2			41.7			56.7			50.5	
Approach LOS		C			D			E			D	

Intersection Summary				
HCM 2000 Control Delay	39.0	HCM 2000 Level of Service	D	
HCM 2000 Volume to Capacity ratio	0.61			
Actuated Cycle Length (s)	119.6	Sum of lost time (s)	21.2	
Intersection Capacity Utilization	72.0%	ICU Level of Service	C	
Analysis Period (min)	60			

c Critical Lane Group

C.4 2022 TOTAL FUTURE CONDITIONS

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	69	796	17	1134	617	109	66	180
v/c Ratio	1.17	0.94	0.19	1.31	1.37	0.15	0.13	0.27
Control Delay	481.7	54.7	24.3	599.7	707.7	13.9	23.1	16.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	481.7	54.7	24.3	599.7	707.7	13.9	23.1	16.4
Queue Length 50th (m)	~19.3	169.0	2.2	~345.5	~191.7	9.1	9.6	17.7
Queue Length 95th (m)	#42.8	#305.6	9.0	#496.5	#301.5	24.0	21.5	39.8
Internal Link Dist (m)		124.7		145.0		270.9		84.5
Turn Bay Length (m)	120.0		130.0		80.0		37.5	
Base Capacity (vph)	59	850	88	864	451	706	502	668
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.17	0.94	0.19	1.31	1.37	0.15	0.13	0.27

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	69	614	182	17	1053	81	617	58	51	66	18	162
Future Volume (vph)	69	614	182	17	1053	81	617	58	51	66	18	162
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	6.4	6.4		6.4	6.4		5.8	5.8		5.8	5.8	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.97		1.00	0.99		1.00	0.93		1.00	0.86	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1695	1723		1695	1765		1695	1659		1695	1543	
Flt Permitted	0.07	1.00		0.10	1.00		0.62	1.00		0.69	1.00	
Satd. Flow (perm)	122	1723		181	1765		1100	1659		1225	1543	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	69	614	182	17	1053	81	617	58	51	66	18	162
RTOR Reduction (vph)	0	9	0	0	3	0	0	27	0	0	36	0
Lane Group Flow (vph)	69	787	0	17	1131	0	617	82	0	66	144	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	58.6	58.6		58.6	58.6		49.2	49.2		49.2	49.2	
Effective Green, g (s)	58.6	58.6		58.6	58.6		49.2	49.2		49.2	49.2	
Actuated g/C Ratio	0.49	0.49		0.49	0.49		0.41	0.41		0.41	0.41	
Clearance Time (s)	6.4	6.4		6.4	6.4		5.8	5.8		5.8	5.8	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	59	841		88	861		451	680		502	632	
v/s Ratio Prot		0.46			c0.64			0.05			0.09	
v/s Ratio Perm	0.57			0.09			c0.56			0.05		
v/c Ratio	1.17	0.94		0.19	1.31		1.37	0.12		0.13	0.23	
Uniform Delay, d1	30.7	28.9		17.3	30.7		35.4	22.0		22.1	23.0	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	448.3	25.7		4.9	574.0		677.0	0.4		0.5	0.8	
Delay (s)	479.0	54.6		22.2	604.7		712.4	22.3		22.6	23.9	
Level of Service	F	D		C	F		F	C		C	C	
Approach Delay (s)		88.4			596.1			608.8			23.5	
Approach LOS		F			F			F			C	

Intersection Summary					
HCM 2000 Control Delay	405.1	HCM 2000 Level of Service	F		
HCM 2000 Volume to Capacity ratio	1.34				
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.2		
Intersection Capacity Utilization	126.3%	ICU Level of Service	H		
Analysis Period (min)	60				

c Critical Lane Group

Intersection	
Int Delay, s/veh	3.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	70	69	657	31	30	187
Future Vol, veh/h	70	69	657	31	30	187
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	250	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	70	69	657	31	30	187

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	920	673	0	0	688	0
Stage 1	673	-	-	-	-	-
Stage 2	247	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	301	455	-	-	906	-
Stage 1	507	-	-	-	-	-
Stage 2	794	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	291	455	-	-	906	-
Mov Cap-2 Maneuver	291	-	-	-	-	-
Stage 1	507	-	-	-	-	-
Stage 2	768	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	21.7	0	1.3
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	- 354	906	-
HCM Lane V/C Ratio	-	- 0.393	0.033	-
HCM Control Delay (s)	-	- 21.7	9.1	-
HCM Lane LOS	-	- C	A	-
HCM 95th %tile Q(veh)	-	- 1.9	0.1	-

Intersection	
Int Delay, s/veh	11.5

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	8	593	95	3	210	47
Future Vol, veh/h	8	593	95	3	210	47
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	8	593	95	3	210	47

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	564	97	0	0	98	0
Stage 1	97	-	-	-	-	-
Stage 2	467	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	487	959	-	-	1495	-
Stage 1	927	-	-	-	-	-
Stage 2	631	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	417	959	-	-	1495	-
Mov Cap-2 Maneuver	417	-	-	-	-	-
Stage 1	927	-	-	-	-	-
Stage 2	540	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	15.5	0	6.4
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	- 943	1495	-
HCM Lane V/C Ratio	-	- 0.637	0.14	-
HCM Control Delay (s)	-	- 15.5	7.8	0
HCM Lane LOS	-	- C	A	A
HCM 95th %tile Q(veh)	-	- 5.1	0.5	-

Queues
1: Borrisokane Road & Strandherd Drive

3387 Cedarview Road
2022 Total PM

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	197	1745	40	901	285	71	106	135
v/c Ratio	0.75	1.61	0.31	0.88	1.29	0.20	0.42	0.33
Control Delay	31.2	1116.8	12.2	34.3	592.6	29.6	47.6	13.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	31.2	1116.8	12.2	34.3	592.6	29.6	47.6	13.8
Queue Length 50th (m)	13.4	~596.7	2.5	170.8	~85.5	9.4	21.9	5.0
Queue Length 95th (m)	#39.1	#784.1	7.1	#322.8	#160.0	25.4	44.8	27.7
Internal Link Dist (m)		124.6		144.9		270.9		84.5
Turn Bay Length (m)	120.1		130.1		79.9		37.5	
Base Capacity (vph)	264	1087	131	1026	221	357	255	403
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.75	1.61	0.31	0.88	1.29	0.20	0.42	0.33

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
1: Borrisokane Road & Strandherd Drive

3387 Cedarview Road
2022 Total PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	197	1160	585	40	811	90	285	44	27	106	26	109
Future Volume (vph)	197	1160	585	40	811	90	285	44	27	106	26	109
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	4.5	6.4		4.5	6.4		5.8	5.8		5.8	5.8	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.95		1.00	0.99		1.00	0.94		1.00	0.88	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1695	1695		1695	1758		1695	1683		1695	1568	
Flt Permitted	0.12	1.00		0.06	1.00		0.61	1.00		0.71	1.00	
Satd. Flow (perm)	211	1695		101	1758		1096	1683		1268	1568	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	197	1160	585	40	811	90	285	44	27	106	26	109
RTOR Reduction (vph)	0	15	0	0	3	0	0	18	0	0	87	0
Lane Group Flow (vph)	197	1730	0	40	898	0	285	53	0	106	48	0
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases	5	2		1	6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	84.4	75.9		74.7	70.7		24.2	24.2		24.2	24.2	
Effective Green, g (s)	84.4	75.9		74.7	70.7		24.2	24.2		24.2	24.2	
Actuated g/C Ratio	0.70	0.63		0.62	0.59		0.20	0.20		0.20	0.20	
Clearance Time (s)	4.5	6.4		4.5	6.4		5.8	5.8		5.8	5.8	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	260	1064		115	1028		219	337		254	314	
v/s Ratio Prot	c0.06	c1.02		0.01	0.51			0.03			0.03	
v/s Ratio Perm	0.47			0.20			c0.26			0.08		
v/c Ratio	0.76	1.63		0.35	0.87		1.30	0.16		0.42	0.15	
Uniform Delay, d1	20.7	22.4		27.8	21.2		48.3	39.9		42.1	39.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	12.8	1131.3		1.8	11.5		575.9	1.0		5.1	1.0	
Delay (s)	33.5	1153.7		29.7	32.7		624.2	40.9		47.2	40.9	
Level of Service	C	F		C	C		F	D		D	D	
Approach Delay (s)		1040.1			32.6			507.9			43.7	
Approach LOS		F			C			F			D	

Intersection Summary				
HCM 2000 Control Delay	644.2	HCM 2000 Level of Service	F	
HCM 2000 Volume to Capacity ratio	1.53			
Actuated Cycle Length (s)	120.8	Sum of lost time (s)	16.7	
Intersection Capacity Utilization	150.2%	ICU Level of Service	H	
Analysis Period (min)	60			

c Critical Lane Group

Intersection	
Int Delay, s/veh	1.7

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	37	37	319	65	64	587
Future Vol, veh/h	37	37	319	65	64	587
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	250	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	37	37	319	65	64	587

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1067	352	0	0	384	0
Stage 1	352	-	-	-	-	-
Stage 2	715	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	246	692	-	-	1174	-
Stage 1	712	-	-	-	-	-
Stage 2	485	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	233	692	-	-	1174	-
Mov Cap-2 Maneuver	233	-	-	-	-	-
Stage 1	712	-	-	-	-	-
Stage 2	459	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	18.1	0	0.8
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	- 349	1174	-
HCM Lane V/C Ratio	-	- 0.212	0.055	-
HCM Control Delay (s)	-	- 18.1	8.2	-
HCM Lane LOS	-	- C	A	-
HCM 95th %tile Q(veh)	-	- 0.8	0.2	-

Intersection	
Int Delay, s/veh	7.8

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	8	290	94	6	504	120
Future Vol, veh/h	8	290	94	6	504	120
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	8	290	94	6	504	120

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1225	97	0	0	100	0
Stage 1	97	-	-	-	-	-
Stage 2	1128	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	198	959	-	-	1493	-
Stage 1	927	-	-	-	-	-
Stage 2	309	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	126	959	-	-	1493	-
Mov Cap-2 Maneuver	126	-	-	-	-	-
Stage 1	927	-	-	-	-	-
Stage 2	197	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	12	0	7
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	- 814	1493	-
HCM Lane V/C Ratio	-	- 0.366	0.338	-
HCM Control Delay (s)	-	- 12	8.6	0
HCM Lane LOS	-	- B	A	A
HCM 95th %tile Q(veh)	-	- 1.7	1.5	-

C.5 2022 TOTAL FUTURE CONDITIONS WITH IMPROVEMENTS

Queues
1: Borrisokane Road & Strandherd Drive

3387 Cedarview Road
2022 Total AM with TMP Modifications

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	69	614	182	17	1134	617	58	51	66	180
v/c Ratio	0.83	0.51	0.28	0.12	0.98	1.00	0.09	0.08	0.52	0.40
Control Delay	140.9	32.6	5.0	57.5	74.2	123.0	27.2	0.3	68.2	20.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	140.9	32.6	5.0	57.5	74.2	123.0	27.2	0.3	68.2	20.3
Queue Length 50th (m)	16.4	59.7	0.0	2.0	137.4	~75.7	9.2	0.0	15.1	15.4
Queue Length 95th (m)	#50.2	88.5	20.2	6.4	#221.4	#134.5	21.1	0.3	33.1	43.5
Internal Link Dist (m)		124.7			145.0		270.9			84.5
Turn Bay Length (m)	120.0			130.0		80.0		37.5	37.5	
Base Capacity (vph)	83	1194	652	137	1161	616	630	609	146	447
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.83	0.51	0.28	0.12	0.98	1.00	0.09	0.08	0.45	0.40

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
1: Borrisokane Road & Strandherd Drive

3387 Cedarview Road
2022 Total AM with TMP Modifications

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	69	614	182	17	1053	81	617	58	51	66	18	162
Future Volume (vph)	69	614	182	17	1053	81	617	58	51	66	18	162
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	4.5	6.4	6.4	4.5	6.4		4.5	5.8	5.8	4.5	5.8	
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95		0.97	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	0.86	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1695	3390	1517	3288	3354		3288	1784	1517	1695	1543	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1695	3390	1517	3288	3354		3288	1784	1517	1695	1543	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	69	614	182	17	1053	81	617	58	51	66	18	162
RTOR Reduction (vph)	0	0	118	0	5	0	0	0	33	0	75	0
Lane Group Flow (vph)	69	614	64	17	1129	0	617	58	18	66	105	0
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	Perm	Prot	NA	
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases			2						4			
Actuated Green, G (s)	5.9	42.3	42.3	5.0	41.4		22.5	42.4	42.4	9.1	29.0	
Effective Green, g (s)	5.9	42.3	42.3	5.0	41.4		22.5	42.4	42.4	9.1	29.0	
Actuated g/C Ratio	0.05	0.35	0.35	0.04	0.34		0.19	0.35	0.35	0.08	0.24	
Clearance Time (s)	4.5	6.4	6.4	4.5	6.4		4.5	5.8	5.8	4.5	5.8	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	83	1194	534	137	1157		616	630	536	128	372	
v/s Ratio Prot	c0.04	0.18		0.01	c0.34		c0.19	0.03		0.04	c0.07	
v/s Ratio Perm			0.04						0.01			
v/c Ratio	0.83	0.51	0.12	0.12	0.98		1.00	0.09	0.03	0.52	0.28	
Uniform Delay, d1	56.6	30.7	26.3	55.4	38.8		48.8	25.9	25.4	53.3	37.0	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	64.2	1.6	0.5	0.4	35.1		74.1	0.3	0.1	3.5	1.9	
Delay (s)	120.8	32.3	26.7	55.8	73.9		122.8	26.2	25.5	56.8	38.9	
Level of Service	F	C	C	E	E		F	C	C	E	D	
Approach Delay (s)		38.2			73.6			108.3			43.7	
Approach LOS		D			E			F			D	

Intersection Summary				
HCM 2000 Control Delay	69.3	HCM 2000 Level of Service	E	
HCM 2000 Volume to Capacity ratio	0.77			
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	21.2	
Intersection Capacity Utilization	85.4%	ICU Level of Service	E	
Analysis Period (min)	60			

c Critical Lane Group

Queues
1: Borrisokane Road & Strandherd Drive

3387 Cedarview Road
2022 Total PM with TMP Modifications

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	197	1160	585	40	901	285	44	27	106	135
v/c Ratio	0.91	0.87	0.64	0.33	0.89	0.86	0.11	0.06	0.74	0.33
Control Delay	111.1	40.2	6.1	63.2	51.0	82.9	36.3	0.3	85.6	12.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	111.1	40.2	6.1	63.2	51.0	82.9	36.3	0.3	85.6	12.9
Queue Length 50th (m)	46.1	128.4	3.3	4.7	104.7	34.4	8.1	0.0	24.5	4.8
Queue Length 95th (m)	#103.7	#206.8	59.7	11.9	#172.2	#68.3	19.9	0.0	#59.5	27.0
Internal Link Dist (m)		124.6			144.9		270.9			84.5
Turn Bay Length (m)	120.1			130.1		79.9		37.5	37.5	
Base Capacity (vph)	222	1330	910	123	1015	333	402	457	155	413
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.89	0.87	0.64	0.33	0.89	0.86	0.11	0.06	0.68	0.33

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
1: Borrisokane Road & Strandherd Drive

3387 Cedarview Road
2022 Total PM with TMP Modifications

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	197	1160	585	40	811	90	285	44	27	106	26	109
Future Volume (vph)	197	1160	585	40	811	90	285	44	27	106	26	109
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	4.5	6.4	6.4	4.5	6.4		4.5	5.8	5.8	4.5	5.8	
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95		0.97	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	0.88	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1526	3051	1365	2960	3005		2960	1606	1365	1526	1411	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1526	3051	1365	2960	3005		2960	1606	1365	1526	1411	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	197	1160	585	40	811	90	285	44	27	106	26	109
RTOR Reduction (vph)	0	0	316	0	7	0	0	0	20	0	84	0
Lane Group Flow (vph)	197	1160	269	40	894	0	285	44	7	106	51	0
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	Perm	Prot	NA	
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases			2						4			
Actuated Green, G (s)	17.1	52.3	52.3	5.0	40.2		13.4	30.0	30.0	11.4	28.0	
Effective Green, g (s)	17.1	52.3	52.3	5.0	40.2		13.4	30.0	30.0	11.4	28.0	
Actuated g/C Ratio	0.14	0.44	0.44	0.04	0.34		0.11	0.25	0.25	0.10	0.23	
Clearance Time (s)	4.5	6.4	6.4	4.5	6.4		4.5	5.8	5.8	4.5	5.8	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	217	1330	595	123	1007		330	401	341	145	329	
v/s Ratio Prot	c0.13	c0.38		0.01	0.30		c0.10	0.03		0.07	c0.04	
v/s Ratio Perm			0.20						0.00			
v/c Ratio	0.91	0.87	0.45	0.33	0.89		0.86	0.11	0.02	0.73	0.16	
Uniform Delay, d1	50.6	30.8	23.7	55.8	37.7		52.4	34.7	33.9	52.8	36.6	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	52.2	8.9	2.5	1.5	13.2		24.4	0.6	0.1	18.9	1.0	
Delay (s)	102.8	39.6	26.2	57.4	50.9		76.7	35.2	34.0	71.7	37.6	
Level of Service	F	D	C	E	D		E	D	C	E	D	
Approach Delay (s)		42.0			51.2			68.4			52.6	
Approach LOS		D			D			E			D	

Intersection Summary				
HCM 2000 Control Delay	47.9	HCM 2000 Level of Service	D	
HCM 2000 Volume to Capacity ratio	0.70			
Actuated Cycle Length (s)	119.9	Sum of lost time (s)	21.2	
Intersection Capacity Utilization	79.1%	ICU Level of Service	D	
Analysis Period (min)	60			

c Critical Lane Group

C.6 2027 ULTIMATE CONDITIONS

Queues
3387 Cedarview Road
1: Borrisokane Road & Strandherd Drive
2027 Ultimate AM

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	76	685	257	33	1253	812	63	93	72	193
v/c Ratio	0.84	0.56	0.36	0.20	1.04	1.52	0.10	0.15	0.79	0.42
Control Delay	135.9	32.6	4.7	57.9	133.8	982.0	26.5	3.6	120.8	19.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	135.9	32.6	4.7	57.9	133.8	982.0	26.5	3.6	120.8	19.3
Queue Length 50th (m)	18.1	67.1	0.0	3.9	~166.8	~137.6	9.8	0.0	17.1	15.4
Queue Length 95th (m)	#53.5	98.8	24.7	10.2	#250.5	#202.5	22.0	10.6	#50.0	44.6
Internal Link Dist (m)		124.7			145.0		270.9			84.5
Turn Bay Length (m)	120.0			130.0		80.0		37.5	37.5	
Base Capacity (vph)	91	1234	715	164	1208	534	634	612	91	465
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.84	0.56	0.36	0.20	1.04	1.52	0.10	0.15	0.79	0.42

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
3387 Cedarview Road
1: Borrisokane Road & Strandherd Drive
2027 Ultimate AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	76	685	257	33	1165	88	812	63	93	72	20	173
Future Volume (vph)	76	685	257	33	1165	88	812	63	93	72	20	173
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	4.5	6.4	6.4	4.5	6.4		4.5	5.8	5.8	4.5	5.8	
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95		0.97	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	0.87	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1695	3390	1517	3288	3354		3288	1784	1517	1695	1544	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1695	3390	1517	3288	3354		3288	1784	1517	1695	1544	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	76	685	257	33	1165	88	812	63	93	72	20	173
RTOR Reduction (vph)	0	0	163	0	4	0	0	0	60	0	84	0
Lane Group Flow (vph)	76	685	94	33	1249	0	812	63	33	72	109	0
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	Perm	Prot	NA	
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases			2						4			
Actuated Green, G (s)	6.5	43.7	43.7	5.9	43.1		19.5	42.7	42.7	6.5	29.7	
Effective Green, g (s)	6.5	43.7	43.7	5.9	43.1		19.5	42.7	42.7	6.5	29.7	
Actuated g/C Ratio	0.05	0.36	0.36	0.05	0.36		0.16	0.36	0.36	0.05	0.25	
Clearance Time (s)	4.5	6.4	6.4	4.5	6.4		4.5	5.8	5.8	4.5	5.8	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	91	1234	552	161	1204		534	634	539	91	382	
v/s Ratio Prot	c0.04	0.20		0.01	c0.37		c0.25	0.04		0.04	c0.07	
v/s Ratio Perm			0.06						0.02			
v/c Ratio	0.84	0.56	0.17	0.20	1.04		1.52	0.10	0.06	0.79	0.29	
Uniform Delay, d1	56.2	30.4	25.9	54.8	38.5		50.2	25.8	25.5	56.1	36.6	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	60.6	1.8	0.7	0.6	95.7		946.8	0.3	0.2	44.6	1.9	
Delay (s)	116.8	32.2	26.5	55.4	134.2		997.1	26.1	25.7	100.7	38.5	
Level of Service	F	C	C	E	F		F	C	C	F	D	
Approach Delay (s)		37.1			132.1			840.6			55.4	
Approach LOS		D			F			F			E	

Intersection Summary				
HCM 2000 Control Delay	292.9	HCM 2000 Level of Service	F	
HCM 2000 Volume to Capacity ratio	0.89			
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	21.2	
Intersection Capacity Utilization	95.9%	ICU Level of Service	F	
Analysis Period (min)	60			

c Critical Lane Group

Intersection	
Int Delay, s/veh	161

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	137	234	734	73	97	213
Future Vol, veh/h	137	234	734	73	97	213
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	250	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	137	234	734	73	97	213

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1178	771	0	0	807	0
Stage 1	771	-	-	-	-	-
Stage 2	407	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	211	400	-	-	818	-
Stage 1	456	-	-	-	-	-
Stage 2	672	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	186	400	-	-	818	-
Mov Cap-2 Maneuver	186	-	-	-	-	-
Stage 1	456	-	-	-	-	-
Stage 2	592	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	$ 643	0	3.1
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	- 281	818	-
HCM Lane V/C Ratio	-	- 1.32	0.119	-
HCM Control Delay (s)	-	- $ 643	10	-
HCM Lane LOS	-	- F	A	-
HCM 95th %tile Q(veh)	-	- 55.1	0.4	-

Notes
~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection	
Int Delay, s/veh	18.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	23	705	102	8	288	62
Future Vol, veh/h	23	705	102	8	288	62
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	23	705	102	8	288	62

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	744	106	0	0	110	0
Stage 1	106	-	-	-	-	-
Stage 2	638	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	382	948	-	-	1480	-
Stage 1	918	-	-	-	-	-
Stage 2	526	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	305	948	-	-	1480	-
Mov Cap-2 Maneuver	305	-	-	-	-	-
Stage 1	918	-	-	-	-	-
Stage 2	420	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	26.4	0	6.6
HCM LOS	D		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	- 889	1480	-
HCM Lane V/C Ratio	-	- 0.819	0.195	-
HCM Control Delay (s)	-	- 26.4	8	0
HCM Lane LOS	-	- D	A	A
HCM 95th %tile Q(veh)	-	- 11.8	0.7	-

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	210	1279	818	88	993	433	47	60	115	145
v/c Ratio	0.83	0.81	0.74	0.58	0.81	0.84	0.13	0.14	0.64	0.43
Control Delay	80.5	32.3	7.4	72.6	41.0	66.6	41.8	0.7	67.5	17.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	80.5	32.3	7.4	72.6	41.0	66.6	41.8	0.7	67.5	17.2
Queue Length 50th (m)	47.9	132.7	8.8	10.6	112.1	51.2	9.2	0.0	26.2	6.0
Queue Length 95th (m)	#99.6	#202.2	105.4	#24.6	#177.9	#89.1	22.7	0.0	50.2	31.4
Internal Link Dist (m)		124.6			144.9		270.9			84.5
Turn Bay Length (m)	120.1			130.1		79.9		25.0	37.5	
Base Capacity (vph)	277	1587	1109	151	1224	538	357	427	226	335
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.76	0.81	0.74	0.58	0.81	0.80	0.13	0.14	0.51	0.43

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	210	1279	818	88	895	98	433	47	60	115	29	116
Future Volume (vph)	210	1279	818	88	895	98	433	47	60	115	29	116
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	4.5	6.4	6.4	4.5	6.4		4.5	5.8	5.8	4.5	5.8	
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95		0.97	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	0.88	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1695	3390	1517	3288	3340		3288	1784	1517	1695	1570	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1695	3390	1517	3288	3340		3288	1784	1517	1695	1570	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	210	1279	818	88	895	98	433	47	60	115	29	116
RTOR Reduction (vph)	0	0	399	0	7	0	0	0	48	0	98	0
Lane Group Flow (vph)	210	1279	419	88	986	0	433	47	12	115	47	0
Turn Type	Prot	NA	Perm	Prot	NA		Prot	NA	Perm	Prot	NA	
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases			2						4			
Actuated Green, G (s)	17.9	55.8	55.8	5.5	43.4		18.7	23.9	23.9	12.8	18.0	
Effective Green, g (s)	17.9	55.8	55.8	5.5	43.4		18.7	23.9	23.9	12.8	18.0	
Actuated g/C Ratio	0.15	0.47	0.47	0.05	0.36		0.16	0.20	0.20	0.11	0.15	
Clearance Time (s)	4.5	6.4	6.4	4.5	6.4		4.5	5.8	5.8	4.5	5.8	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	254	1586	710	151	1216		515	357	304	182	237	
v/s Ratio Prot	c0.12	c0.38		0.03	0.30		c0.13	0.03		0.07	c0.03	
v/s Ratio Perm			0.28						0.01			
v/c Ratio	0.83	0.81	0.59	0.58	0.81		0.84	0.13	0.04	0.63	0.20	
Uniform Delay, d1	49.1	27.1	23.3	55.7	34.2		48.8	39.1	38.4	50.9	44.3	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	22.5	4.7	3.6	5.8	6.2		13.1	0.8	0.2	7.2	1.9	
Delay (s)	71.6	31.8	26.9	61.5	40.4		61.9	39.9	38.6	58.1	46.1	
Level of Service	E	C	C	E	D		E	D	D	E	D	
Approach Delay (s)		33.7			42.1			57.4			51.4	
Approach LOS		C			D			E			D	

Intersection Summary				
HCM 2000 Control Delay	40.0	HCM 2000 Level of Service	D	
HCM 2000 Volume to Capacity ratio	0.72			
Actuated Cycle Length (s)	119.2	Sum of lost time (s)	21.2	
Intersection Capacity Utilization	81.5%	ICU Level of Service	D	
Analysis Period (min)	60			

c Critical Lane Group

Intersection	
Int Delay, s/veh	422.3

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	141	197	343	169	305	630
Future Vol, veh/h	141	197	343	169	305	630
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	250	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	141	197	343	169	305	630

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1668	428	0	0	512	0
Stage 1	428	-	-	-	-	-
Stage 2	1240	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	~ 106	627	-	-	1053	-
Stage 1	657	-	-	-	-	-
Stage 2	273	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	~ 75	627	-	-	1053	-
Mov Cap-2 Maneuver	~ 75	-	-	-	-	-
Stage 1	657	-	-	-	-	-
Stage 2	194	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	$ 2221.1	0	3.2
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	- 154	1053	-
HCM Lane V/C Ratio	-	- 2.195	0.29	-
HCM Control Delay (s)	-	$ 2221.1	9.8	-
HCM Lane LOS	-	- F	A	-
HCM 95th %tile Q(veh)	-	- 97.2	1.2	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	11.7

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	17	399	113	20	631	140
Future Vol, veh/h	17	399	113	20	631	140
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	17	399	113	20	631	140

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1525	123	0	0	133	0
Stage 1	123	-	-	-	-	-
Stage 2	1402	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	130	928	-	-	1452	-
Stage 1	902	-	-	-	-	-
Stage 2	228	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	69	928	-	-	1452	-
Mov Cap-2 Maneuver	69	-	-	-	-	-
Stage 1	902	-	-	-	-	-
Stage 2	121	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	22.8	0	7.7
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	- 615	1452	-
HCM Lane V/C Ratio	-	- 0.676	0.435	-
HCM Control Delay (s)	-	- 22.8	9.4	0
HCM Lane LOS	-	- C	A	A
HCM 95th %tile Q(veh)	-	- 5.9	2.3	-

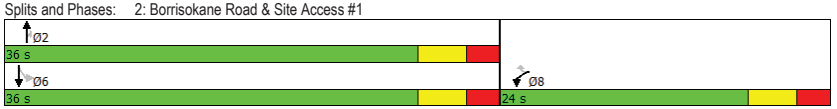
C.7 2027 ULTIMATE CONDITIONS WITH IMPROVEMENTS

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	137	234	734	73	97	213
Future Volume (vph)	137	234	734	73	97	213
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Storage Length (m)	37.5	0.0		37.5	37.5	
Storage Lanes	1	1		1	1	
Taper Length (m)	25.0				25.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850		0.850		
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1695	1517	1784	1517	1695	1784
Flt Permitted	0.950				0.273	
Satd. Flow (perm)	1695	1517	1784	1517	487	1784
Right Turn on Red		Yes		Yes		
Satd. Flow (RTOR)		158		71		
Link Speed (k/h)	50		80			80
Link Distance (m)	263.5		187.1			1201.4
Travel Time (s)	19.0		8.4			54.1
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	137	234	734	73	97	213
Shared Lane Traffic (%)						
Lane Group Flow (vph)	137	234	734	73	97	213
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(m)	3.7		3.7			3.7
Link Offset(m)	0.0		0.0			0.0
Crosswalk Width(m)	1.6		1.6			1.6
Two way Left Turn Lane						
Headway Factor	1.06	1.06	1.06	1.06	1.06	1.06
Turning Speed (k/h)	24	14		14	24	
Number of Detectors	1	0	0	0	1	0
Detector Template	Left				Left	
Leading Detector (m)	6.1	0.0	0.0	0.0	6.1	0.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	6.1	6.1	1.8	6.1	6.1	1.8
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Turn Type	Prot	Perm	NA	Perm	Perm	NA
Protected Phases	8		2			6
Permitted Phases		8		2	6	
Detector Phase	8	8	2	2	6	6
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	24.0	24.0	24.0	24.0	24.0	24.0
Total Split (s)	24.0	24.0	36.0	36.0	36.0	36.0

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Total Split (%)	40.0%	40.0%	60.0%	60.0%	60.0%	60.0%
Maximum Green (s)	18.0	18.0	30.0	30.0	30.0	30.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	2.5	2.5	2.5	2.5	2.5	2.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	Min	Min	Max	Max	Max	Max
Act Effct Green (s)	9.6	9.6	30.1	30.1	30.1	30.1
Actuated g/C Ratio	0.19	0.19	0.58	0.58	0.58	0.58
v/c Ratio	0.44	0.57	0.71	0.08	0.34	0.21
Control Delay	23.0	13.2	13.9	2.3	11.1	6.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.0	13.2	13.9	2.3	11.1	6.5
LOS	C	B	B	A	B	A
Approach Delay	16.8		12.9			7.9
Approach LOS	B		B			A

Intersection Summary			
Area Type:	Other		
Cycle Length: 60			
Actuated Cycle Length: 51.7			
Natural Cycle: 60			
Control Type: Semi Act-Uncoord			
Maximum v/c Ratio: 0.71			
Intersection Signal Delay: 12.8		Intersection LOS: B	
Intersection Capacity Utilization 69.5%		ICU Level of Service C	
Analysis Period (min) 60			

Splits and Phases: 2: Borrisokane Road & Site Access #1



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	137	234	734	73	97	213
v/c Ratio	0.44	0.57	0.71	0.08	0.34	0.21
Control Delay	23.0	13.2	13.9	2.3	11.1	6.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.0	13.2	13.9	2.3	11.1	6.5
Queue Length 50th (m)	11.3	6.1	40.7	0.1	3.9	7.9
Queue Length 95th (m)	26.8	26.7	#136.3	5.3	18.2	22.6
Internal Link Dist (m)	239.5		163.1			1177.4
Turn Bay Length (m)	37.5			37.5	37.5	
Base Capacity (vph)	591	632	1037	912	283	1037
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.23	0.37	0.71	0.08	0.34	0.21

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	137	234	734	73	97	213
Future Volume (vph)	137	234	734	73	97	213
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1695	1517	1784	1517	1695	1784
Flt Permitted	0.95	1.00	1.00	1.00	0.27	1.00
Satd. Flow (perm)	1695	1517	1784	1517	486	1784
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	137	234	734	73	97	213
RTOR Reduction (vph)	0	129	0	30	0	0
Lane Group Flow (vph)	137	105	734	43	97	213
Turn Type	Prot	Perm	NA	Perm	Perm	NA
Protected Phases	8		2			6
Permitted Phases		8		2	6	
Actuated Green, G (s)	9.6	9.6	30.1	30.1	30.1	30.1
Effective Green, g (s)	9.6	9.6	30.1	30.1	30.1	30.1
Actuated g/C Ratio	0.19	0.19	0.58	0.58	0.58	0.58
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	314	281	1038	883	282	1038
v/s Ratio Prot	c0.08		c0.41			0.12
v/s Ratio Perm		0.07		0.03	0.20	
v/c Ratio	0.44	0.37	0.71	0.05	0.34	0.21
Uniform Delay, d1	18.7	18.4	7.7	4.6	5.6	5.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.0	0.8	4.2	0.1	3.3	0.4
Delay (s)	19.6	19.3	11.8	4.8	9.0	5.6
Level of Service	B	B	B	A	A	A
Approach Delay (s)	19.4		11.2			6.6
Approach LOS	B		B			A

Intersection Summary				
HCM 2000 Control Delay	12.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	51.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	69.5%	ICU Level of Service	C
Analysis Period (min)	60		

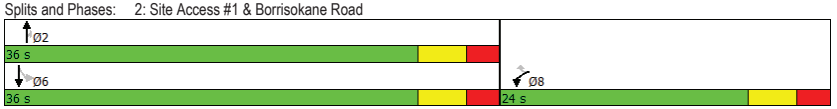
c Critical Lane Group

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	141	197	343	169	305	630
Future Volume (vph)	141	197	343	169	305	630
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Storage Length (m)	37.5	0.0		37.5	37.5	
Storage Lanes	1	1		1	1	
Taper Length (m)	25.0				25.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850		0.850		
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1695	1517	1784	1517	1695	1784
Flt Permitted	0.950				0.555	
Satd. Flow (perm)	1695	1517	1784	1517	990	1784
Right Turn on Red		Yes		Yes		
Satd. Flow (RTOR)		197		169		
Link Speed (k/h)	50		80			80
Link Distance (m)	311.3		138.9			1205.9
Travel Time (s)	22.4		6.3			54.3
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	141	197	343	169	305	630
Shared Lane Traffic (%)						
Lane Group Flow (vph)	141	197	343	169	305	630
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(m)	3.7		3.7			3.7
Link Offset(m)	0.0		0.0			0.0
Crosswalk Width(m)	1.6		1.6			1.6
Two way Left Turn Lane						
Headway Factor	1.06	1.06	1.06	1.06	1.06	1.06
Turning Speed (k/h)	24	14		14	24	
Number of Detectors	1	0	0	1	1	0
Detector Template	Left			Right	Left	
Leading Detector (m)	6.1	0.0	0.0	6.1	6.1	0.0
Trailing Detector (m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Position(m)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Size(m)	6.1	6.1	1.8	6.1	6.1	1.8
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Turn Type	Prot	Perm	NA	Perm	Perm	NA
Protected Phases	8		2			6
Permitted Phases		8		2	6	
Detector Phase	8	8	2	2	6	6
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	24.0	24.0	24.0	24.0	24.0	24.0
Total Split (s)	24.0	24.0	36.0	36.0	36.0	36.0

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Total Split (%)	40.0%	40.0%	60.0%	60.0%	60.0%	60.0%
Maximum Green (s)	18.0	18.0	30.0	30.0	30.0	30.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	2.5	2.5	2.5	2.5	2.5	2.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	Min	Min	Max	Max	Max	Max
Walk Time (s)	7.0	7.0	7.0	7.0	7.0	7.0
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0	0	0	0	0
Act Effct Green (s)	9.5	9.5	30.1	30.1	30.1	30.1
Actuated g/C Ratio	0.18	0.18	0.58	0.58	0.58	0.58
v/c Ratio	0.45	0.45	0.33	0.18	0.53	0.61
Control Delay	23.5	7.1	7.2	1.8	11.6	10.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.5	7.1	7.2	1.8	11.6	10.8
LOS	C	A	A	A	B	B
Approach Delay	13.9		5.4			11.1
Approach LOS	B		A			B

Intersection Summary			
Area Type:	Other		
Cycle Length: 60			
Actuated Cycle Length: 51.6			
Natural Cycle: 60			
Control Type: Semi Act-Uncoord			
Maximum v/c Ratio: 0.61			
Intersection Signal Delay: 10.0		Intersection LOS: A	
Intersection Capacity Utilization 60.1%		ICU Level of Service B	
Analysis Period (min) 60			

Splits and Phases: 2: Site Access #1 & Borrisokane Road



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	141	197	343	169	305	630
v/c Ratio	0.45	0.45	0.33	0.18	0.53	0.61
Control Delay	23.5	7.1	7.2	1.8	11.6	10.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.5	7.1	7.2	1.8	11.6	10.8
Queue Length 50th (m)	11.7	0.0	13.9	0.0	14.5	32.0
Queue Length 95th (m)	27.5	16.1	36.2	8.0	#48.5	86.5
Internal Link Dist (m)	287.3		114.9			1181.9
Turn Bay Length (m)	37.5			37.5	37.5	
Base Capacity (vph)	592	658	1039	954	576	1039
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.24	0.30	0.33	0.18	0.53	0.61

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

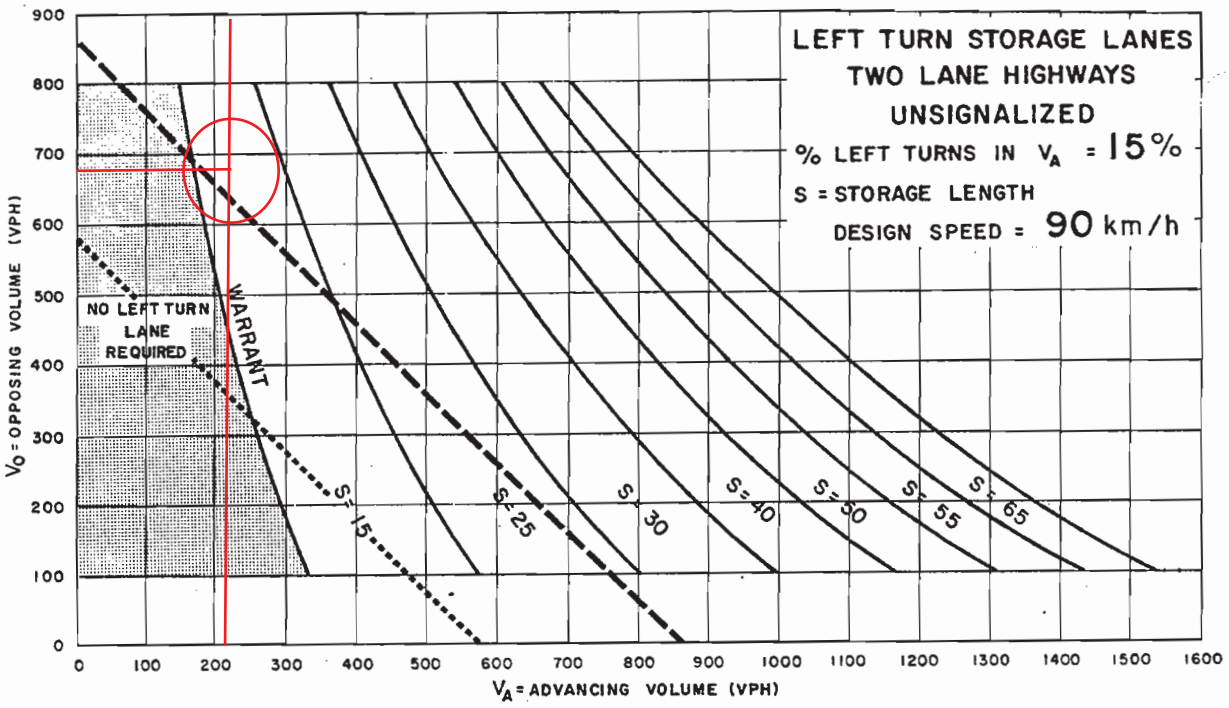
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	141	197	343	169	305	630
Future Volume (vph)	141	197	343	169	305	630
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1695	1517	1784	1517	1695	1784
Flt Permitted	0.95	1.00	1.00	1.00	0.55	1.00
Satd. Flow (perm)	1695	1517	1784	1517	990	1784
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	141	197	343	169	305	630
RTOR Reduction (vph)	0	161	0	70	0	0
Lane Group Flow (vph)	141	36	343	99	305	630
Turn Type	Prot	Perm	NA	Perm	Perm	NA
Protected Phases	8		2			6
Permitted Phases		8		2	6	
Actuated Green, G (s)	9.5	9.5	30.1	30.1	30.1	30.1
Effective Green, g (s)	9.5	9.5	30.1	30.1	30.1	30.1
Actuated g/C Ratio	0.18	0.18	0.58	0.58	0.58	0.58
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	312	279	1040	884	577	1040
v/s Ratio Prot	c0.08		0.19			c0.35
v/s Ratio Perm		0.02		0.07	0.31	
v/c Ratio	0.45	0.13	0.33	0.11	0.53	0.61
Uniform Delay, d1	18.7	17.6	5.5	4.8	6.5	6.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.0	0.2	0.9	0.3	3.5	2.6
Delay (s)	19.8	17.8	6.4	5.0	10.0	9.6
Level of Service	B	B	A	A	A	A
Approach Delay (s)	18.6		6.0			9.7
Approach LOS	B		A			A

Intersection Summary				
HCM 2000 Control Delay	10.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	51.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	60.1%	ICU Level of Service	B
Analysis Period (min)	60		

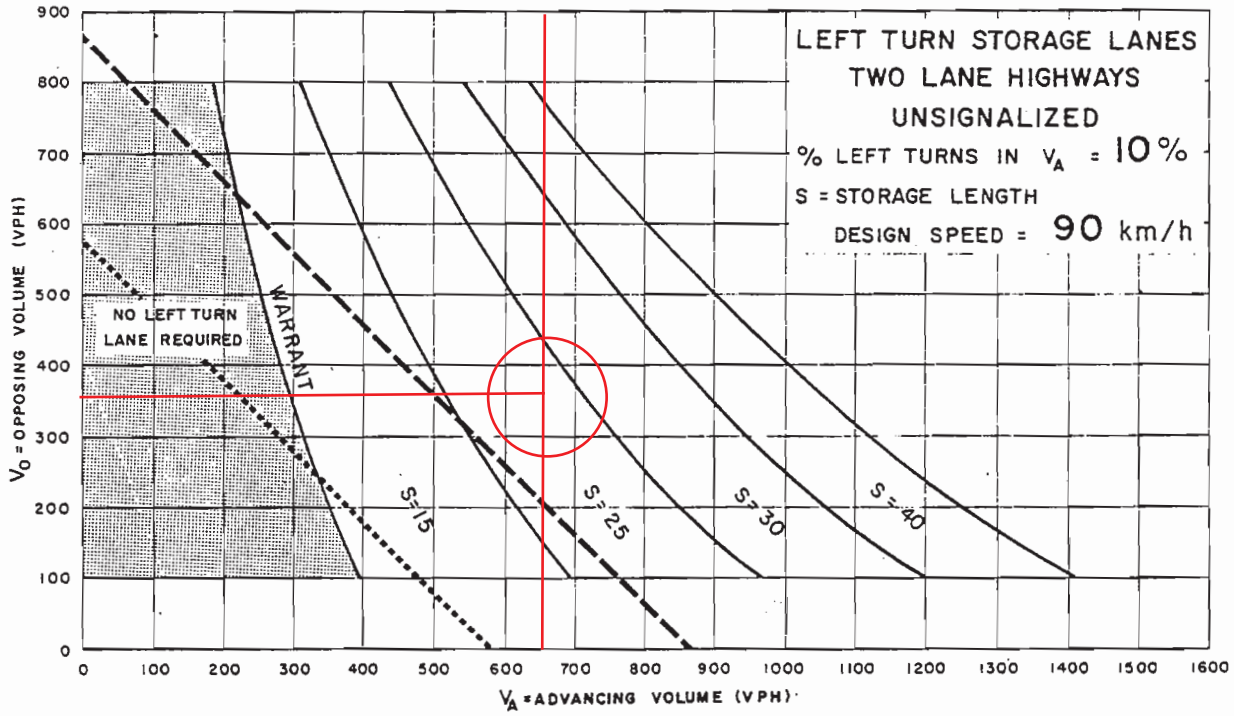
c Critical Lane Group

Appendix D AUXILIARY LANE WARRANTS

Borrisokane Road at Site Access 1 - 2022 Total Future AM Peak Hour



Borrisokane Road at Site Access 1 - 2022 Total Future PM Peak Hour



Right Turn Warrants

Project: 3387 Borrisokane Road

Intersection:	Borrisokane Road at Site Access 1
Warrant:	> 10% of total approach volume (TAC)
Horizon:	2027 Ultimate
Peak Period:	AM

Approach:			
Left	0	Volume (approaching)	807
Through	734	Volume (right turn)	73
Right	73		
		Right Turn %	9%

No right turn lane required

Intersection:	Borrisokane Road at Site Access 1
Warrant:	> 10% of total approach volume (TAC)
Horizon:	2027 Ultimate
Peak Period:	PM

Approach:			
Left	0	Volume (approaching)	512
Through	343	Volume (right turn)	169
Right	169		
		Right Turn %	33%

Right turn lane required