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## **Richmond Village Phase 1**

### **Transportation Impact Study**

Ottawa, Ontario

Prepared for: Richmond Village Development Corporation

Prepared by: Stantec Consulting Ltd.

May 2017

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## **1.0 INTRODUCTION**

### **1.1 STUDY PURPOSE**

Richmond Village Development Corporation is preparing a development application for the registration of Phase 1 of a proposed residential development in the Richmond Village Community of Ottawa, Ontario. As part of the approvals process a Transportation Impact Study (TIS) is required to support the application.

The subject Phase 1 development is part of a larger subdivision by Richmond Village Development Corporation that contains a total of 729 residential units. The *Village of Richmond Transportation Brief* (GENIVAR 2011) was prepared that assessed the transportation impacts of the entire development.

This TIS has been prepared to assess the potential transportation implications of Phase 1 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 along Perth Street in the City of Ottawa's Richmond Village. The site is bound by Perth Street to the north, undeveloped / vacant land to the west and south, and the Jock River Tributary to the east. Phase 1 of the development will include 214 single family homes. Given that the subject TIS was prepared in conjunction with the development of the final M-Plan, it is recognized that the final number of residential units is subject to minor change.

**Figure 2** depicts the site plan for Phase 1 of the proposed development.

**Figure 1 Site Location**





## **1.3 SCOPE OF THE ASSESSMENT**

This 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 teleconference with City of Ottawa staff held on January 12<sup>th</sup>, 2017. The scope of the transportation assessment, which was discussed with City staff, includes the following:

- Study area intersections include:
  - Perth Street at Queen Charlotte Street / Rochelle Drive; and
  - Perth Street at Site Access.
- Study horizons include:
  - 2017 existing conditions;
  - 2021 future background conditions;
  - 2021 total future conditions (site build-out); and
  - 2026 total future conditions (5 years beyond build-out).
- Analysis time periods include the weekday AM and PM peak hours

The methodology used in this 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.
- A 2% per annum growth rate will be used for the through volumes along Perth Street to account for growth outside of the immediate study area. This rate of growth is consistent with previously approved traffic studies in the area.
- Intersection analyses will be performed to determine the operating characteristics of the study area intersections under each study horizon.
- 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:

#### Perth Street

West of Queen Charlotte Street, Perth Street is a two-lane arterial road with a rural cross-section. At the eastern limits of the subject site, Perth Street is a divided road that transitions to an undivided road at the western limits of the subject site. Paved shoulders are provided along both sides of the road. East of Queen Charlotte Street, Perth Street is a four-lane undivided arterial road with an urban cross-section and sidewalks along both sides of the road. Across the frontage of the subject site, Perth Street has a posted speed limit of 80 km/h. The speed limit transitions to 50km/h approximately 300m west of Queen Charlotte Street.

#### Queen Charlotte Street

Queen Charlotte Street is a two-lane local road with a semi-urban cross-section (i.e. the west side of the road is urbanized). There are no pedestrian or cycling facilities along Queen Charlotte Street. The intersection with Perth Street is currently stop-controlled along the minor approach (i.e. along Queen Charlotte). The default speed limit is 50 km/h.

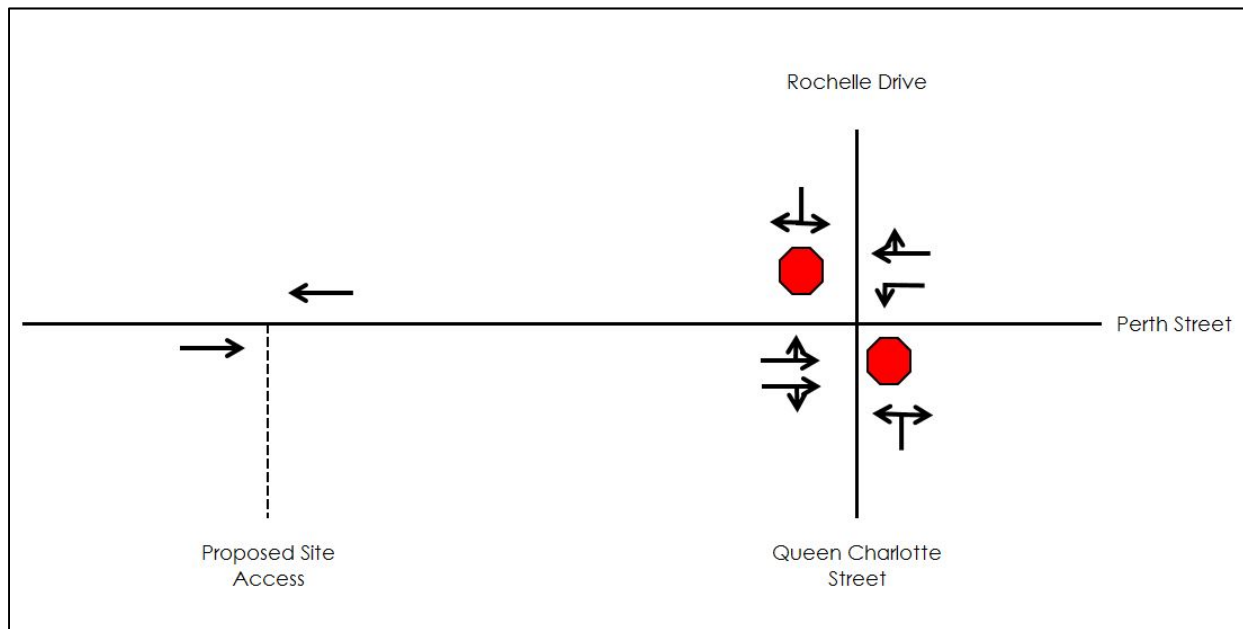
#### Rochelle Drive

Rochelle Drive is a two-lane local road with an urban cross-section. A sidewalk is provided along the eastern side of the road. The intersection with Perth Street is stop-controlled along the minor approach (i.e. along Rochelle Drive). The default speed limit is 50 km/h.

The road classifications noted above are referenced from Map 8 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.

**Figure 3 2017 Existing Intersection Control and Lane Geometry**

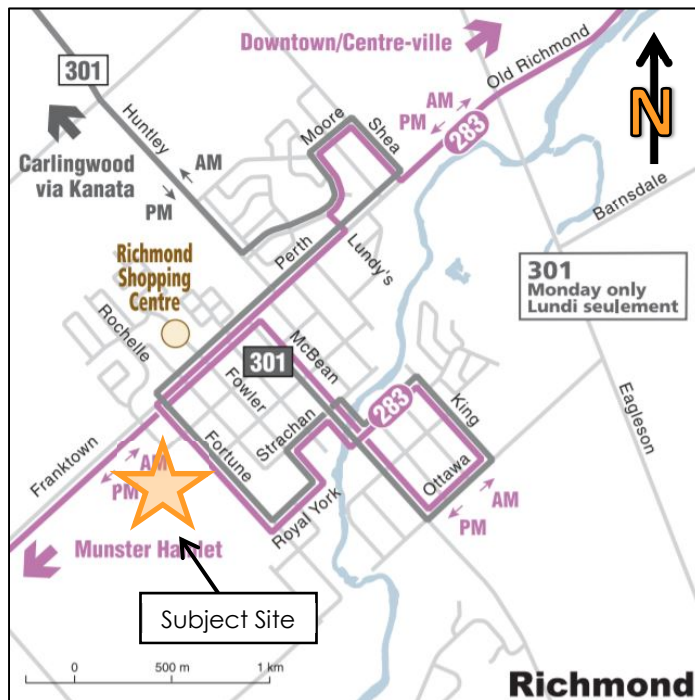


## 2.2 TRANSIT

Transit service is provided along Perth Street via two OC-Transpo bus routes; route 283 and route 301. Route 283 is a peak hour bus route that runs between Munster and Mackenzie King Station. Route 301 is a Monday only bus route that runs between the Village of Richmond and Carlingwood Shopping Centre.

**Figure 4** illustrates the study area transit routes.

**Figure 4 Transit Service**



(Source: OC Transpo System Map, accessed January 9<sup>th</sup>, 2017)

## 2.3 WALKING AND CYCLING

There are sidewalks along Perth Street, east of Queen Charlotte Street, as well as along Rochelle Street. The *Village of Richmond Community Design Plan* Schedule C indicates that Perth Street has shared use lanes, indicating that cyclists travel on the road in mixed use traffic. This is consistent with the City of Ottawa's Cycling Plan which outlines Perth Street as a suggested cycling route with the ultimate cycling network showing Perth Street as a spine route.

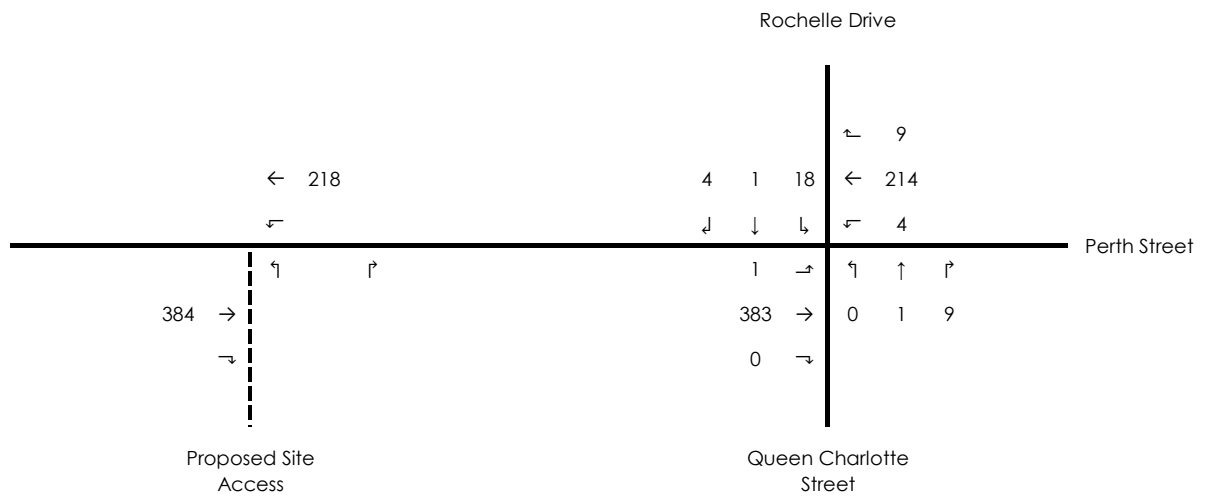
## 2.4 TRAFFIC VOLUMES

Traffic counts at the Perth Street at Queen Charlotte / Rochelle Drive intersection were obtained from the recently prepared *Richmond Oaks Health Centre Transportation Brief* (D.J. Halpenny & Associates Ltd., 2016). The intersection counts were collected prior to 2017, and therefore were adjusted to reflect the current existing condition. A 2% per annum growth rate was used to increase the through volumes along Perth Street to 2017 volumes which is consistent with previously prepared and approved traffic studies in the area.

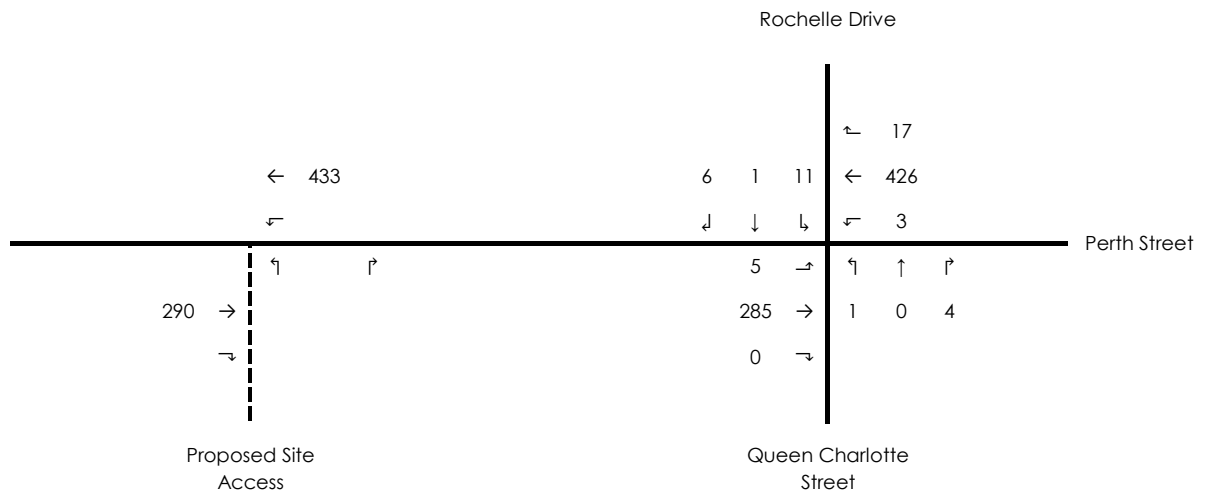
**Figure 5** illustrates 2017 existing AM and PM peak hour traffic volumes at the study area intersections.

**Appendix A** contains the traffic data and is provided for reference.

# AM Peak Hour



# PM Peak Hour



Richmond Village Development Corporation

Richmond Village - Phase 1

Figure 5

2017 Existing Traffic Volumes

## 3.0 FUTURE TRANSPORTATION ENVIRONMENT

### 3.1 FUTURE NETWORK UPGRADES

#### 3.1.1 Road Network Improvements

Several significant transportation improvements have been noted in the City of Ottawa's 2013 *Transportation Master Plan* and the Village of Richmond's 2010 *Transportation Master Plan* in the vicinity of the proposed site and are outlined in **Table 1** below.

**Table 1 Scheduled Upgrades**

PROJECT	DESCRIPTION	OTTAWA TMP PHASE	RICHMOND TMP STAGE
Perth Street	Widen to four lanes between Shea Road and Eagleson Road and between Queen Charlotte Street and the village boundary.	Network Concept (i.e. beyond 2031)	(no timeline provided)
Richmond Village By-Pass	New two-lane road between Huntley Road and Eagleson Road.	Network Concept (i.e. beyond 2031)	Stage 2 (2021 – 2031)
New North-South Collector	Will ultimately connect Ottawa Street, Perth Street, and the Richmond Village By-Pass.	N/A	Stage 1 (2011 - 2020)
Perth Street Roundabout	Proposed at the intersection between Perth Street at the New North-South collector.	N/A	Stage 1 (2011 – 2020)

The widening of Perth Street is not scheduled to occur within the timelines of the subject study, however, adequate right-of-way width will be required to protect for the future widening.

The Richmond Village By-Pass will not directly impact the subject development and is highlighted for information purposes. The New North-South collector road will bisect the subject development and will serve as the sole access until such time that the lands to the south are developed.

The roundabout at the Perth Street at New North-South collector intersection is identified within Stage 1 of the Village of Richmond's TMP and is DC eligible. The TMP outlines that once this intersection meets traffic signal warrants, a roundabout should be implemented.

#### 3.1.2 Future Background Developments

There are a few developments scheduled to occur in the vicinity of the subject site, as outlined in **Table 2** 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
Richmond Oaks Health Centre	Northeast quadrant of the Perth Street at Rochelle Drive intersection.	24, 000 ft <sup>2</sup> GFA of retail 31 units of Senior Residence	2022
Richmond Village Development Corporation Phase 2	Bounded by Perth Street to the north, Richmond Village Development Corporation Phase 1 to the east, and vacant land to the south and west.	205 Residential Units	2024
Richmond Village Development Corporation Phase 3	Bounded by Perth Street to the south, existing development to the east, and vacant land to the west and north.	308 Residential Units	2028

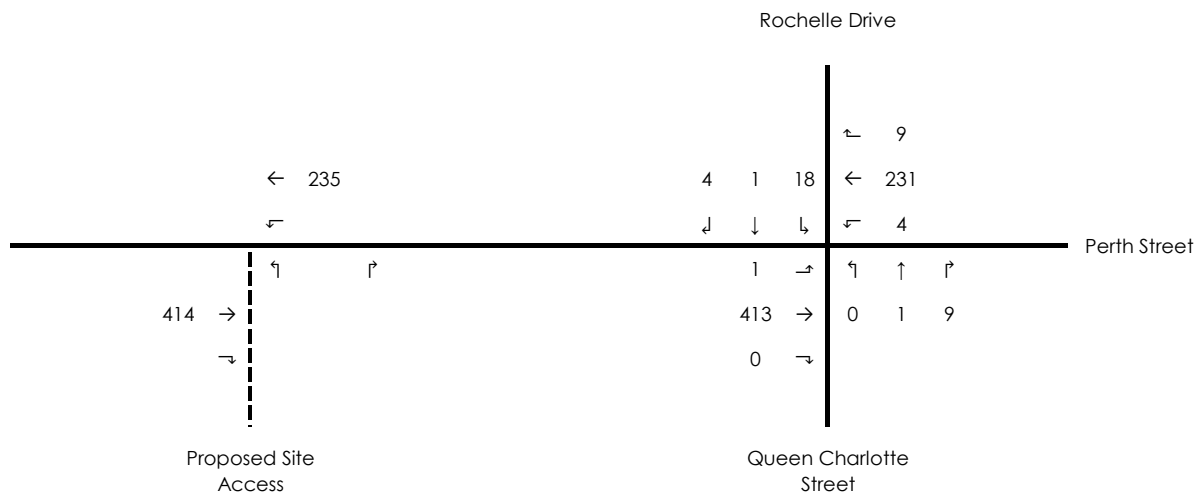
## 3.2 2021 FUTURE BACKGROUND CONDITIONS

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.

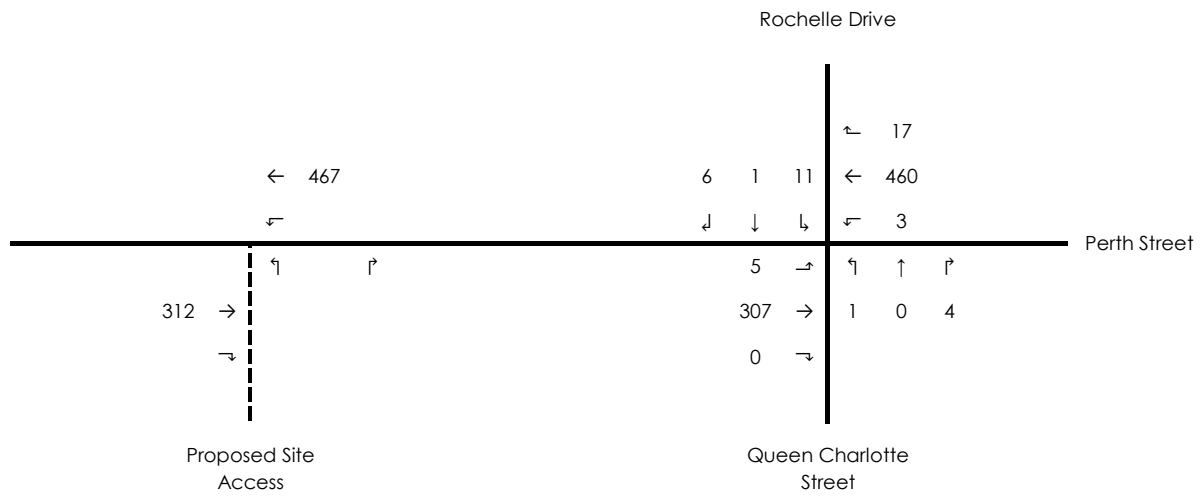
A nominal 2% annual growth rate was applied to the through volumes along Perth Street. This rate of growth is consistent with industry standards and those that were applied in previously prepared / approved studies (i.e. *Richmond Oaks Health Centre Transportation Brief* and *Western Development Lands Transportation Brief*).

**Figure 6** illustrates 2021 future background traffic volumes at the study area intersections.

**AM Peak Hour**



**PM Peak Hour**



Richmond Village Development Corporation  
Richmond Village - Phase 1  
Figure 6  
2021 Future Background Traffic Volumes

## 3.3 SITE TRAFFIC GENERATION

### 3.3.1 Land Use and Trip Generation Rates

The *Institute of Transportation Engineers (ITE) Trip Generation Manual (9<sup>th</sup> Edition)* was used to estimate traffic generated by the subject site. The ITE land use codes 210 – Single Family Homes was thought to be most representative of the proposed land uses.

**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.

**Table 3 Trips Generated by the Proposed Residential Development**

ITE LAND USE			MORNING PEAK HOUR			AFTERNOON PEAK HOUR		
			IN	OUT	TOTAL	IN	OUT	TOTAL
<b>Step 1: ITE Trip Generation Rates</b>								
210 – Single Family Homes	Units	214	25%	75%	0.75	63%	37%	0.99
<b>Step 2: Conversion from Auto Trips to Person Trips</b>								
210 – Single Family Homes	Trip Gen		40	120	160	131	77	208
	Transit Share	10%	4	12	16	13	8	21
	Auto Occupancy	1.1	4	12	16	13	8	21
	Total Person Trips		48	144	192	157	93	250
<b>Step 3: Person Trips by Modal Share</b>								
210 – Single Family Homes	Auto	80%	39	115	154	126	74	200
	Passenger	15%	7	22	29	23	14	37
	Transit	5%	2	7	9	8	5	13
	Walk / Bike	0%	0	0	0	0	0	0

### 3.3.2 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.

### **3.3.3 Net New Site Trips**

To reflect local travel characteristics, the person trips were assigned to the four primary modal shares (i.e. auto, passenger, transit, and active moves) according to the TRANS Committee's 2011 Origin-Destination (O-D) Survey for the Southwest District. The proposed residential development is anticipated to generate 192 and 250 person trips during the AM and PM peak hours, respectively. In terms of vehicle trips, the proposed residential development is anticipated to generate 154 and 200 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.

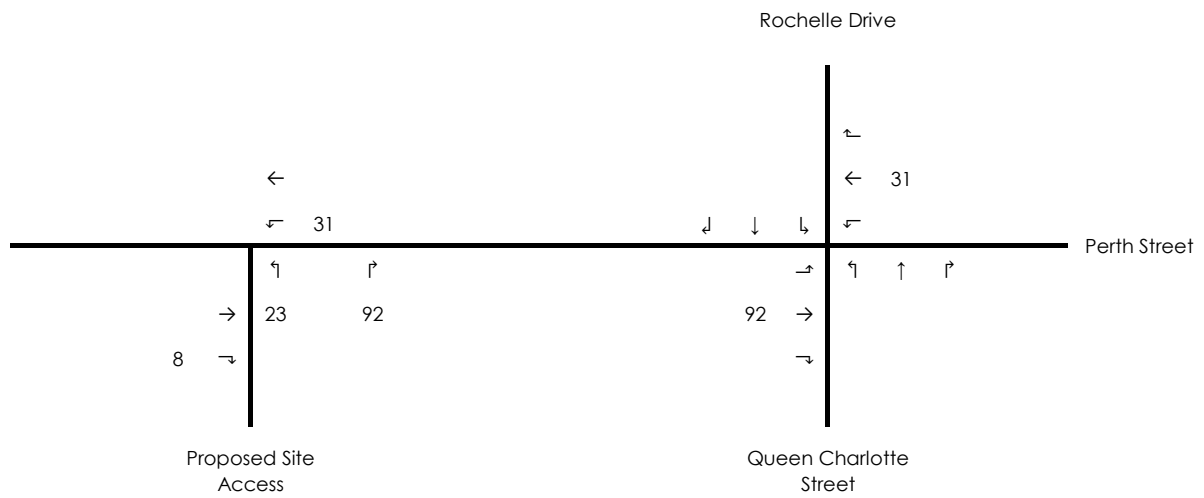
### **3.3.4 Traffic Distribution and Assignment**

The distribution of traffic to / from the study area was determined through examination of the current traffic distribution at the Perth Street at Queen Charlotte Street / Rochelle Drive intersection. The following is a summary of the estimated distribution for the traffic generated by the proposed development:

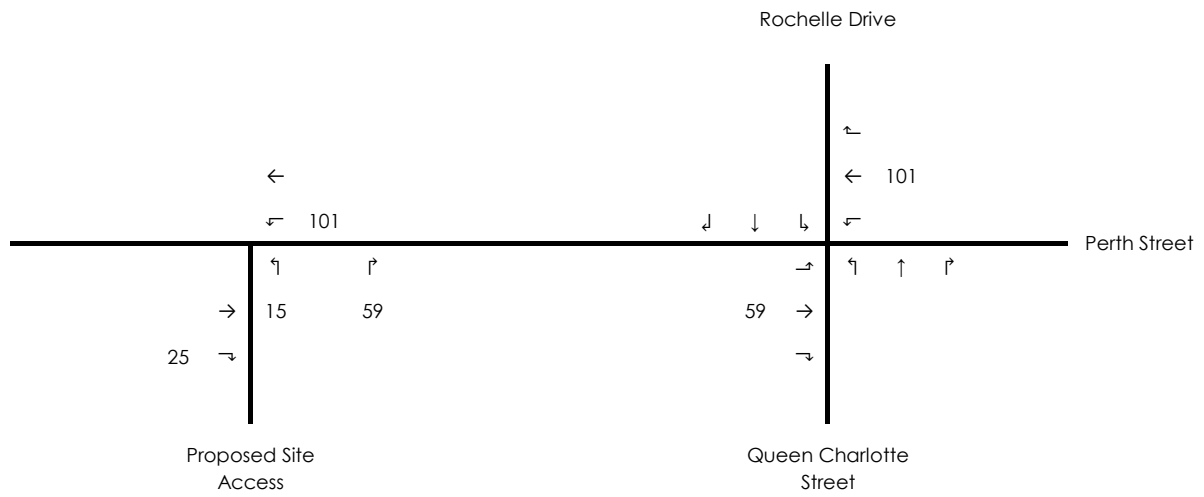
- Perth Street East – 80%
- Perth Street West – 20%

**Figure 7** illustrates the assignment of total site traffic volumes to the boundary road network.

**AM Peak Hour**



**PM Peak Hour**



Richmond Village Development Corporation  
Richmond Village - Phase 1  
Figure 7  
Site Traffic

### **3.4 2021 TOTAL FUTURE CONDITIONS**

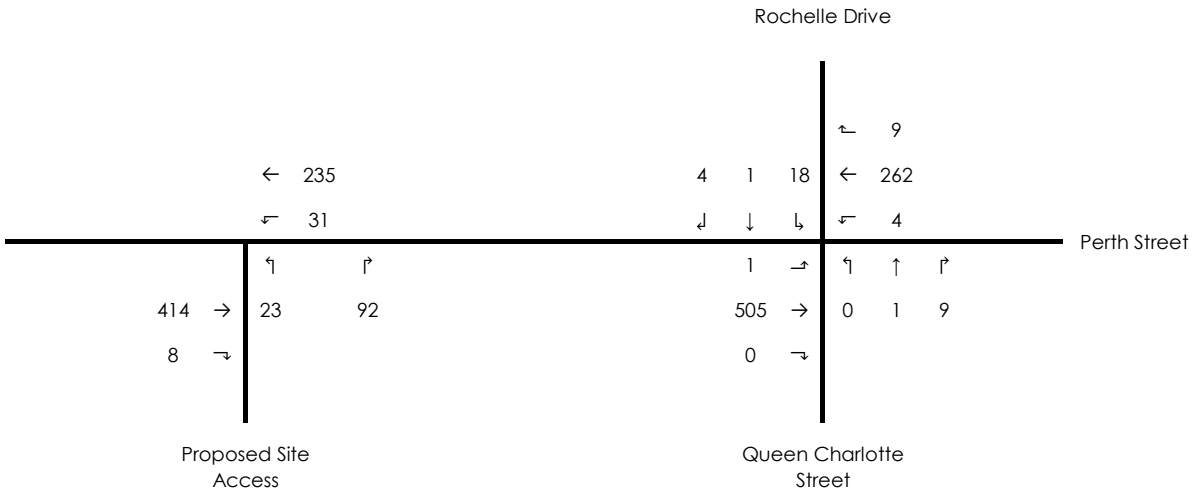
Total future conditions are examined to determine improvements that may be required as a direct result of the development of the site. It is anticipated that by 2021 Phase 1 of the residential development will be fully built and occupied.

The 2021 total future traffic volumes were derived by adding site generated trips to future background volumes anticipated for 2021.

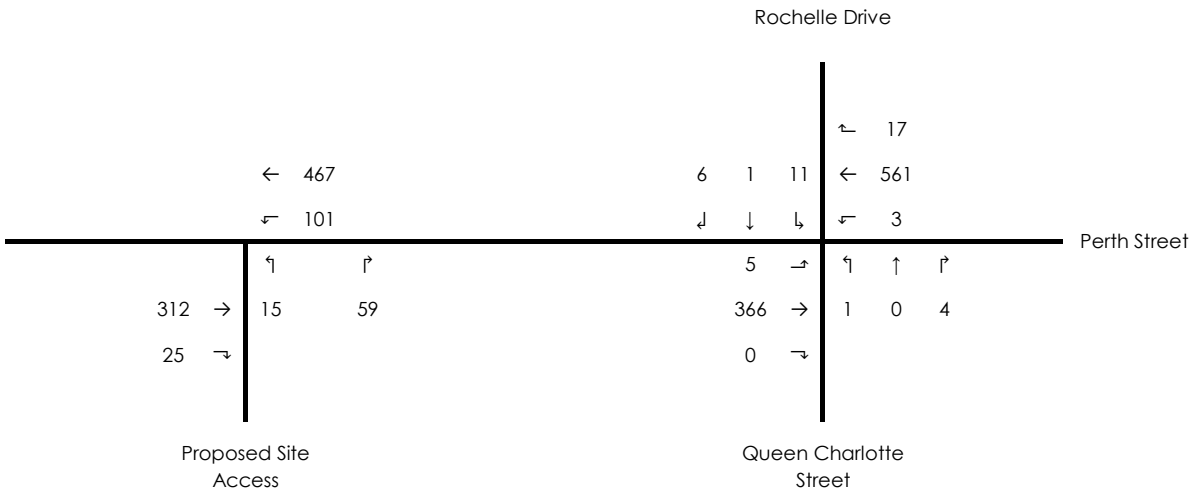
**Figure 8** illustrates 2021 total future traffic volumes at the study area intersections during the AM and PM peak hours.

An assessment of 2021 total future traffic conditions is outlined in **Section 4.3**.

# AM Peak Hour



# PM Peak Hour



Richmond Village Development Corporation  
 Richmond Village - Phase 1  
 Figure 8  
 2021 Total Future Traffic Volumes

### **3.5 2026 ULTIMATE CONDITIONS**

Ultimate conditions for the 2026 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.

The Richmond Oaks Health Centre is anticipated to be fully built by the 2026 ultimate horizon. Site traffic for this proposed development was obtained from the *Richmond Oaks Health Centre Transportation Brief* (D.J. Halpenny & Associates Ltd., 2016) and added to the roadway network as background traffic.

The Richmond Village Development Corporation's Phase 2 (205 units) and part of Phase 3 (170 units) are expected to be built by the 2026 ultimate horizon. Site traffic for these two phases were generated and added to the roadway network as background traffic.

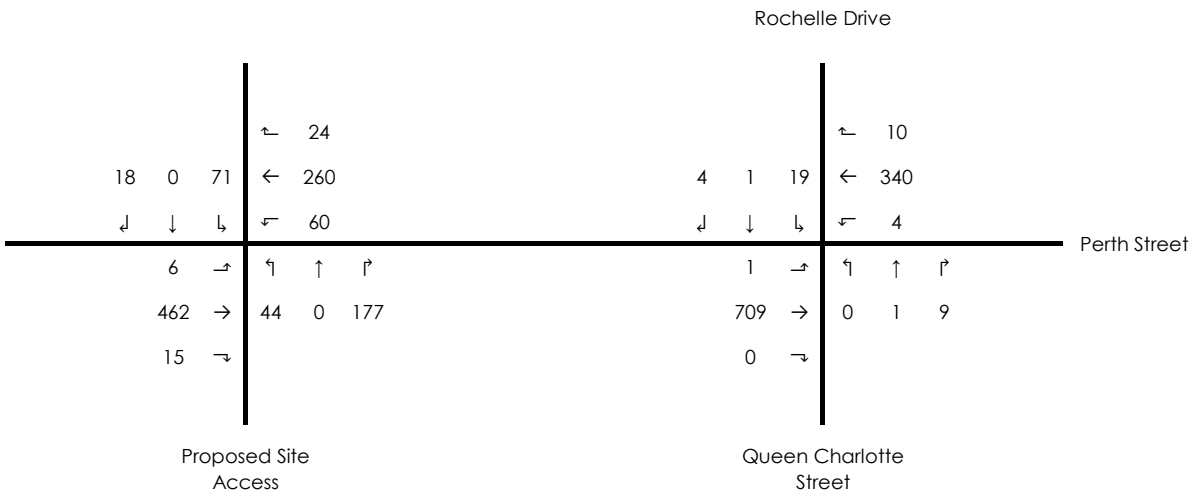
In addition to the aforementioned background developments, a nominal 2% annual growth rate was applied to the through volumes along Perth Street. This rate of growth is consistent with industry standards and those that were applied in previously prepared / approved studies (i.e. *Richmond Oaks Health Centre Transportation Brief* and *Western Development Lands Transportation Brief*).

**Figure 9** illustrates 2026 ultimate traffic volume at the study area intersections during the AM and PM peak hours.

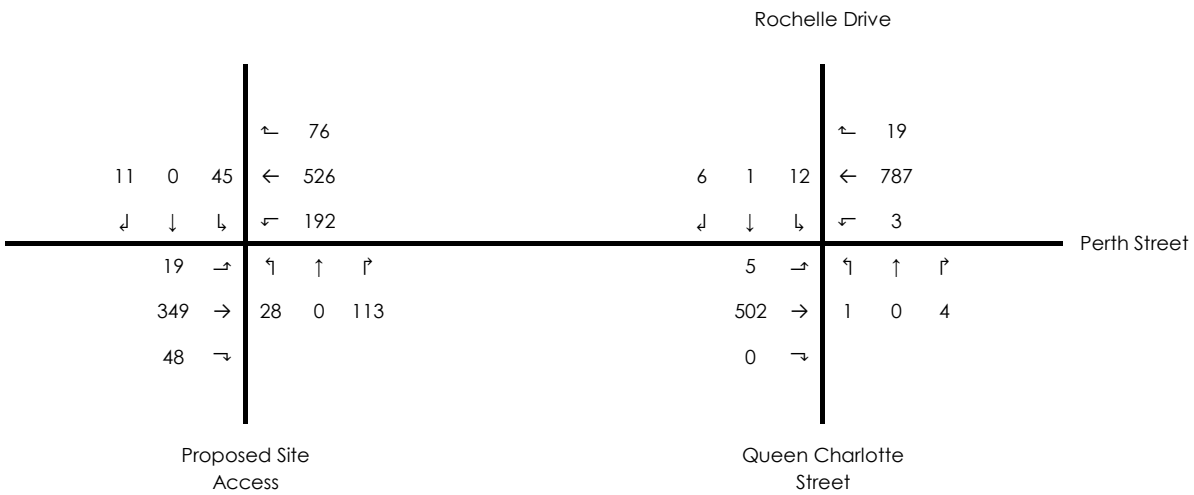
An assessment of 2026 ultimate traffic conditions is outlined in **Section 4.4**.

**Appendix B** includes the Richmond Oaks Health Centre traffic volumes as well as the Richmond Village Development Corporation's Phase 2 and part of Phase 3 traffic volumes that were used as background volumes in the subject study.

# AM Peak Hour



# PM Peak Hour



Richmond Village Development Corporation

Richmond Village - Phase 1

Figure 9

2026 Ultimate Traffic Volumes

## 4.0 TRANSPORTATION ASSESSMENT

### 4.1 2017 EXISTING CONDITIONS

**Figure 3 (Section 2.1)** illustrates the 2017 existing intersection controls and lane configuration at the study area intersections.

#### 4.1.1 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 Highway Capacity Manual 2010 edition (HCM 2010).

**Table 4** provides a summary of 2017 existing intersection operations.

The intersection of Perth Street at Queen Charlotte Drive / Rochelle Drive operates acceptably under 2017 existing conditions.

**Appendix C** contains detailed intersection performance worksheets.

**Table 4 2017 Existing Intersection Operations**

INTERSECTION	INTERSECTION CONTROL	APPROACH / MOVEMENT		AM PEAK HOUR		PM PEAK HOUR	
				LOS	Delay (s)	LOS	Delay (s)
Perth Street at Queen Charlotte Street / Rochelle Drive	Two-Way Stop Control	EB	Left / / Through / Right	A	7.7	A	8.3
		WB	Left	A	8.2	A	7.9
			Through / Right	A	0.0	A	0.0
		NB	Left / Through / Right	B	10.1	B	10.9
		SB	Left / Through / Right	B	12.3	B	14.1
		<b>Overall Intersection</b>		<b>A</b>	<b>0.6</b>	<b>A</b>	<b>0.5</b>

### 4.2 2021 FUTURE BACKGROUND CONDITIONS

Future background conditions for the 2021 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 3.1** and **Section 3.2** were applied to existing traffic volumes to predict 2021 future background traffic volumes.

## 4.2.1 Intersection Operational Analysis

**Table 5** summarizes the operational characteristics of the study area intersections under 2021 future background conditions.

The intersection of Perth Street at Queen Charlotte Drive / Rochelle Drive is projected to operate acceptably under 2021 future background conditions.

**Appendix C** contains detailed intersection performance worksheets.

**Table 5 2021 Future Background Intersection Operations**

INTERSECTION	INTERSECTION CONTROL	APPROACH / MOVEMENT		AM PEAK HOUR		PM PEAK HOUR	
				LOS	Delay (s)	LOS	Delay (s)
Perth Street at Queen Charlotte Street / Rochelle Drive	Two-Way Stop Control	EB	Left / / Through / Right	A	7.8	A	8.5
		WB	Left	A	8.3	A	8.0
			Through / Right	A	0.0	A	0.0
		NB	Left / Through / Right	B	12.4	B	14.7
		SB	Left / Through / Right	B	12.7	B	14.9
		<b>Overall Intersection</b>		<b>A</b>	<b>0.7</b>	<b>A</b>	<b>0.5</b>

## 4.3 2021 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 3.3** were applied to 2021 future background traffic volumes to predict total future traffic volumes.

The intersection of Perth Street at Queen Charlotte Street is currently the most westerly intersection along Perth Street within the Village of Richmond. The posted speed limit along Perth Street currently transitions from 80 km/h to 50 km/h approximately 300m west of Queen Charlotte Street to reflect the changing nature of the roadway environment from rural to urban. By nature of the proposed development, the urban area of the Village will shift westerly and it would be prudent to adjust the speed transition zone further west to reflect this.

It is recommended that the speed zone on Perth Street be amended to have the speed limit transition from 80 km/h to 50 km/h roughly 300m west of the New North-South Collector (i.e. Proposed Site Access).

### **4.3.1 Auxiliary Turn Lane Warrants at Site Access 1**

The need for an eastbound right turn auxiliary lane was reviewed at the Perth Street at Site Access intersection using the standards outlined in the Transportation Association of Canada's Geometric Design Guide for Canadian Roads. When the volume of right turning vehicles is above 10% of the total approach volumes, a right turn lane may be required. Based on the projected 2021 traffic volumes, an eastbound right turn lane is not warranted.

The need for a westbound left turn auxiliary lane was also reviewed at the Perth Street at Site Access intersection using the standards outlined in the Geometric Design Standards for Ontario Roads. Based on the reduced speed zone across the frontage of the subject site to 50km/h, a design speed of 60 km/h along Perth Street was assumed and it was found that this intersection meets the warrants for the implementation of a westbound left turn auxiliary lane into the development with a storage length of 25m.

**Appendix D** contains the detailed auxiliary lane warrant worksheets.

### **4.3.2 Intersection Operational Analysis**

**Table 6** summarizes the operational characteristics of the study area intersections under 2021 total future conditions.

Both study area intersections are expected to operate acceptably under 2021 total future conditions.

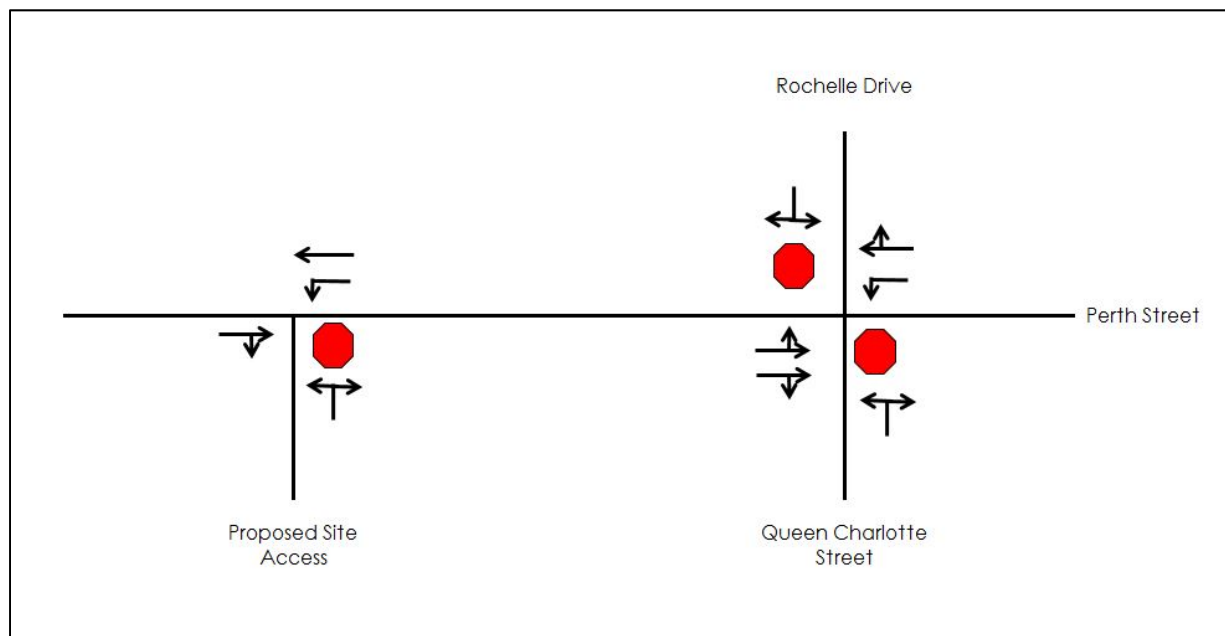
**Figure 10** illustrates the intersection control and lane requirements for the 2021 total future horizon.

**Appendix C** contains detailed intersection performance worksheets.

**Table 6 2021 Total Future Intersection Operations**

INTERSECTION	INTERSECTION CONTROL	APPROACH / MOVEMENT		AM PEAK HOUR		PM PEAK HOUR	
				LOS	Delay (s)	LOS	Delay (s)
Perth Street at Queen Charlotte Street / Rochelle Drive	Two-Way Stop Control	EB	Left / / Through / Right	A	7.8	A	8.8
		WB	Left	A	8.6	A	8.1
			Through / Right	A	0.0	A	0.0
		NB	Left / Through / Right	B	13.7	C	17.1
		SB	Left / Through / Right	B	13.8	C	17.5
		<b>Overall Intersection</b>		<b>A</b>	<b>0.7</b>	<b>A</b>	<b>0.5</b>
Perth Street at Site Access	Two-Way Stop Control	EB	Through / Right	A	0	A	0
		WB	Left	A	8.3	A	8.2
			Through	A	0	A	0
		NB	Left / Right	B	13.1	B	13.1
		<b>Overall Intersection</b>		<b>A</b>	<b>2.2</b>	<b>A</b>	<b>1.9</b>

**Figure 10 2021 Total Future Intersection Control and Lane Geometry**



## **4.4 2026 ULTIMATE CONDITIONS**

Ultimate future conditions for the 2026 horizon were examined to determine if other improvements may be required due to growth in background traffic volumes 5 years beyond the anticipated build-out horizon of the site.

### **4.4.1 Intersection Operational Analysis**

**Table 7** summarizes the operational characteristics of the study area intersections under 2026 ultimate conditions.

Consistent with the 2021 total horizon, the Perth Street at Queen Charlotte Street / Rochelle Drive intersection is expected to operate acceptably under 2026 ultimate conditions.

At the Perth Street and Site Access intersection, however, the southbound movement is anticipated to operate with significant delays. Due to the expected volume of through traffic on Perth Street, motorists attempting to make the southbound left turn maneuver will be significantly delayed as they attempt to find an adequate gap in east-west through traffic. Motorists may become frustrated by the long delays and, in doing so, increase their risk tolerance and attempt to turn within smaller gaps in traffic which could have safety implications.

As outlined in the Village of Richmond's Transportation Master Plan, the site access intersection to Perth Street – which will act as a gateway to the Village - was ultimately envisioned to be built as a roundabout in the future. As this intersection is forecasted to operate with significant delays when examined under a two-way stop configuration, upgrading the intersection to a single lane roundabout by the 2026 ultimate horizon should be considered. With a roundabout in place, the intersection of Perth Street at Site Access is anticipated to operate acceptably.

As previously outlined, a westbound left turn lane at the proposed site access is projected to be warranted by 2021 (i.e. at full-build out of Phase 1), and by 2026 a roundabout may be triggered. There are two potential staging options associated with these upgrades:

1. Construct a westbound left turn lane – as required to accommodate Phase 1 of the development (i.e. by 2021) – and continue to monitor the need and timing for the roundabout through the preparation of traffic studies submitted for subsequent phases of development; or
2. Implement the single lane roundabout during Phase 1 (i.e. by 2021) to reduce or avoid the potential throw-away costs associated with constructing a westbound left turn lane prior to constructing the roundabout.

**Figure 11** illustrates the intersection control and lane requirements for the 2026 total future horizon.

**Appendix C** contains detailed intersection operation summaries.

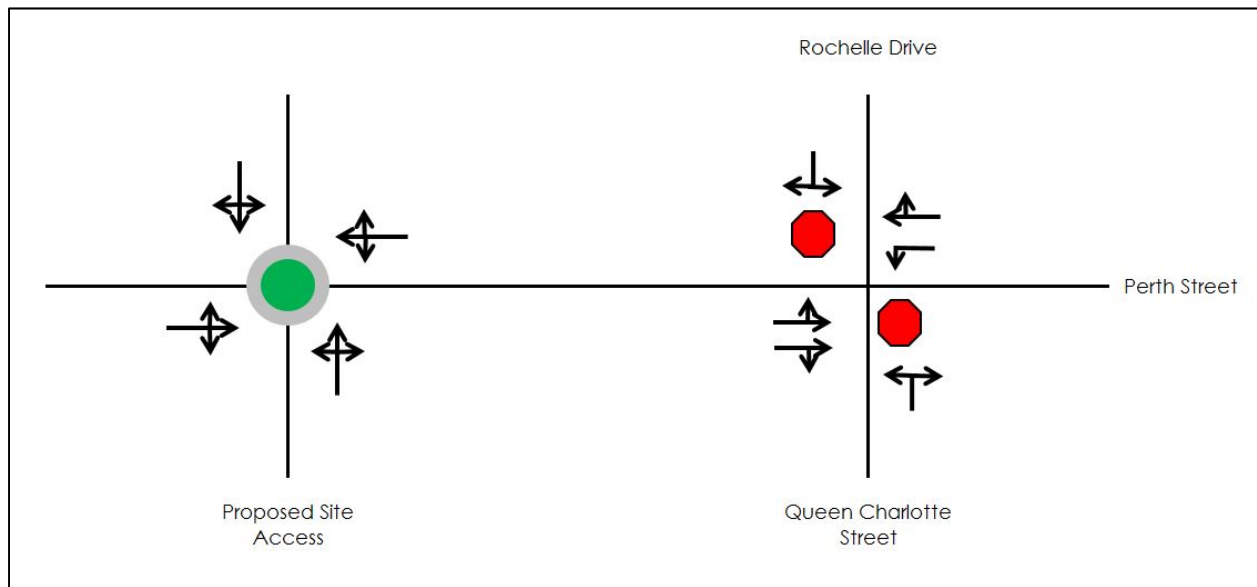
**RICHMOND VILLAGE PHASE 1**  
**TRANSPORTATION IMPACT STUDY**  
MAY 2017

TRANSPORTATION ASSESSMENT

**Table 7 2026 Ultimate Intersection Operations**

Intersection	Intersection Control	Approach / Movement		AM Peak Hour		PM Peak Hour	
				LOS	Delay (s)	LOS	Delay (s)
Perth Street at Queen Charlotte Street / Rochelle Drive	Two-Way Stop Control	EB	Left / / Through / Right	A	8.1	A	9.7
		WB	Left	A	9.3	A	8.6
			Through / Right	A	0.0	A	0.0
		NB	Left / Through / Right	C	18.1	D	25.7
		SB	Left / Through / Right	C	17.3	D	26.9
		Overall Intersection		A	0.7	A	0.6
Perth Street at Site Access	Two-Way Stop Control	EB	Left / Through / Right	A	7.8	A	8.8
		WB	Left	A	8.5	A	8.7
			Through / Right	A	0.0	A	0.0
		NB	Left / Through / Right	C	20.7	D	28.4
		SB	Left / Through / Right	E	43.3	F	102.4
		Overall Intersection		A	8.1	A	8.6
	Recommended Improvements: Single Lane Roundabout						
	Single-Lane Roundabout	EB	Left / Through / Right	A	9.9	B	10.4
		WB	Left / Through / Right	A	6.7	C	17.6
		NB	Left / Through / Right	B	10.5	A	7.2
		SB	Left / Through / Right	A	5.9	A	8.5
		Overall Intersection		A	8.8	B	14.0

**Figure 11 2026 Intersection Control and Lane Geometry**



## 5.0 SUMMARY AND CONCLUSIONS

### Proposed Development

- Phase 1 of the proposed development is located along Perth Street in the Village of Richmond in the City of Ottawa. The site is bound by Perth Street to the north, undeveloped / vacant land to the west and south, and the Jock River Tributary to the east. Phase 1 of the development will include 214 single family homes. Given that the subject TIS was prepared in conjunction with the development of the final M-Plan, it is recognized that the final number of residential units is subject to minor change.
- The proposed residential development is anticipated to generate 192 and 250 person trips during the AM and PM peak hours respectively. In terms of vehicle trips, the proposed residential development is anticipated to generate 154 and 200 net new auto trips (two-way) during the AM and PM peak hours respectively.

### 2017 Existing Conditions

- The intersection of Perth Street at Queen Charlotte Drive / Rochelle Drive currently operates acceptably under 2017 existing conditions.

### 2021 Future Background Conditions

- Consistent with the findings from the 2017 existing intersection capacity analysis, the intersection of Perth Street at Queen Charlotte Drive / Rochelle Drive is projected to operate acceptably under 2021 future background conditions.

### 2021 Total Future Conditions

- It is recommended that the speed zone on Perth Street be amended to have the speed limit transition from 80 km/h to 50 km/h roughly 300m west of the New North-South Collector (i.e. Proposed Site Access). Currently the speed zone transitions roughly 300m west of Queen Charlotte Street.
- The need for an eastbound right turn auxiliary lane was reviewed at the Perth Street at Site Access intersection. It was found that this intersection does not meet the warrant for the implementation of an eastbound right turn lane.
- The need for a westbound left turn auxiliary lane was reviewed at the Perth Street at Site Access intersection. Based on the reduction in speed limit across the frontage of the subject site to 50km/h, a design speed of 60 km/h along Perth Street was assumed and it was found that this intersection meets the warrants for the implementation of a westbound left turn auxiliary lane into the development with a storage length of 25m.
- Both study area intersections are expected to operate acceptably under 2021 total future conditions.

### 2026 Ultimate Conditions

**SUMMARY AND CONCLUSIONS**

- The Perth Street at Queen Charlotte Street / Rochelle Drive intersection is anticipated to operate acceptably under 2026 ultimate conditions, and therefore, no improvements are required.
- With the addition of the background developments, the southbound movement at the Perth Street at Site Access intersection is anticipated to experience significant delays. Due to the high volume of through traffic on Perth Street, motorists attempting to make the southbound left turn maneuver will find it challenging to find a gap in traffic to complete their turn.
- As outlined in the Village of Richmond's Transportation Master Plan, the site access intersection to Perth Street – which will act as a gateway to the Village - was ultimately envisioned to be built as a roundabout in the future. As this intersection is forecasted to operate with significant delays when examined under a two-way stop configuration, upgrading the intersection to a single lane roundabout by the 2026 ultimate horizon should be considered. With a roundabout in place, the intersection of Perth Street at Site Access is anticipated to operate acceptably.

Staging Consideration

There are two potential staging options associated with the above upgrades:

1. Construct a westbound left turn lane – as required to accommodate Phase 1 of the development (i.e. by 2021) – and continue to monitor the need and timing for the roundabout through the preparation of traffic studies submitted for subsequent phases of development; or
2. Implement the single lane roundabout during Phase 1 (i.e. by 2021) to reduce or avoid the potential throw-away costs associated with constructing a westbound left turn lane prior to constructing the roundabout.

Based on the transportation evaluation and improvements recommended in this study, Phase 1 of Richmond Village Develop Corporation's proposed residential development should be permitted to proceed.

\*\*\*\*\*

**STANTEC CONSULTING LTD.**

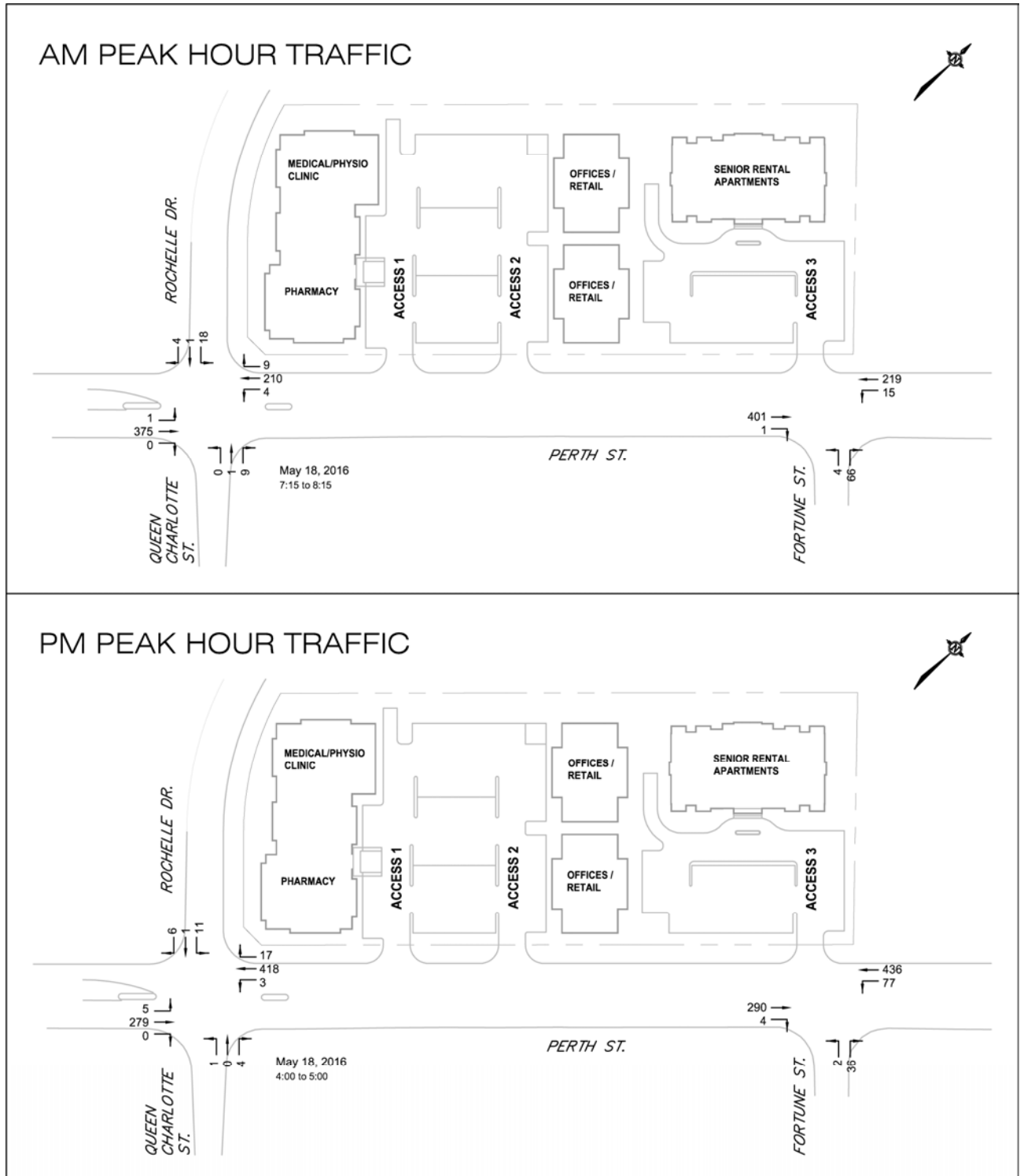
*(Original signed and stamped)*

Robert Vastag, RPP  
Project Manager, Senior Transportation Planner

Lauren O'Grady, P.Eng.  
Transportation Engineer

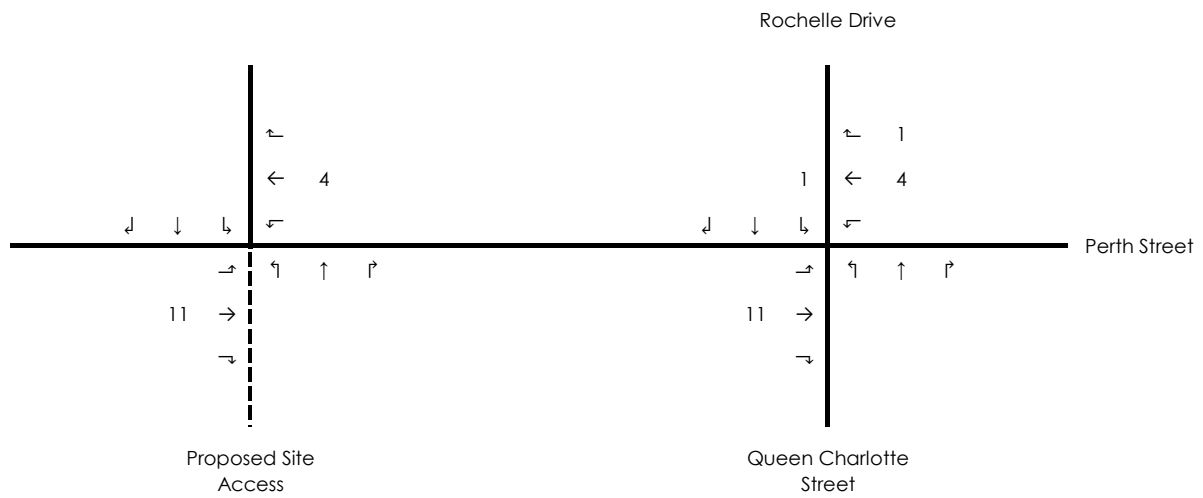
## **Appendix A TRAFFIC DATA**

**FIGURE 2.1**  
**EXISTING 2016 WEEKDAY PEAK AM AND PM HOUR TRAFFIC COUNTS**

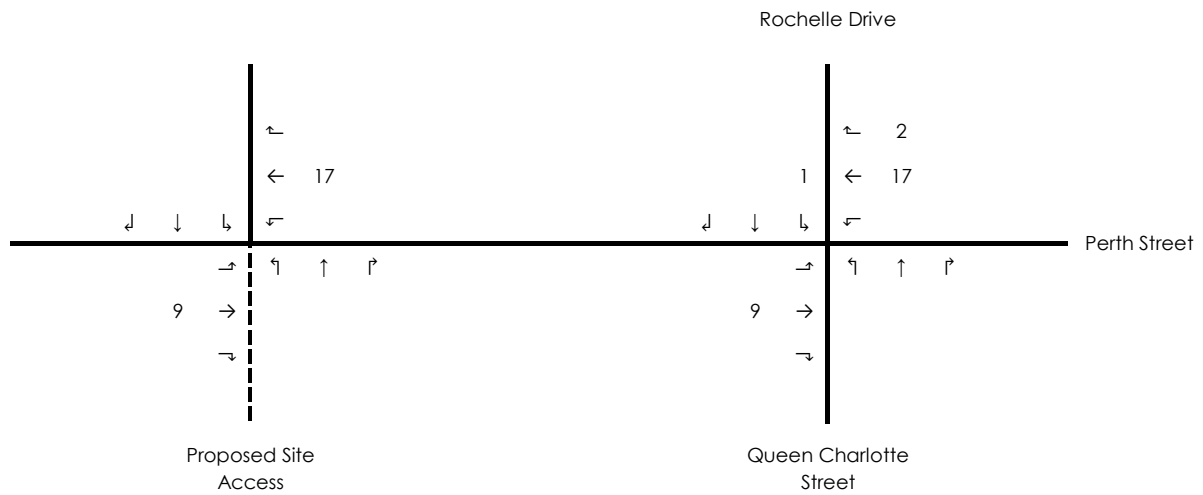


## **Appendix B BACKGROUND DEVELOPMENTS**

**AM Peak Hour**



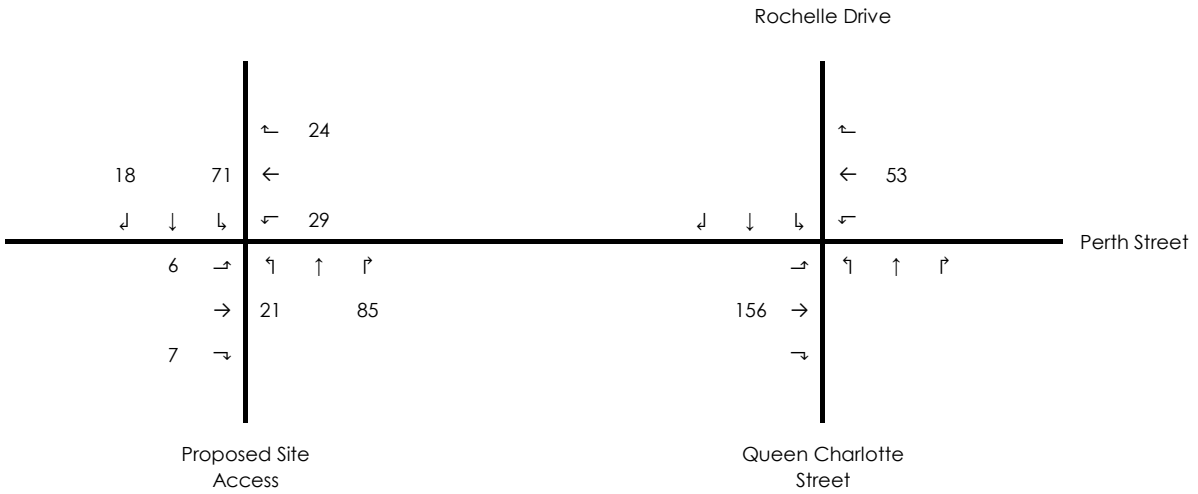
**PM Peak Hour**



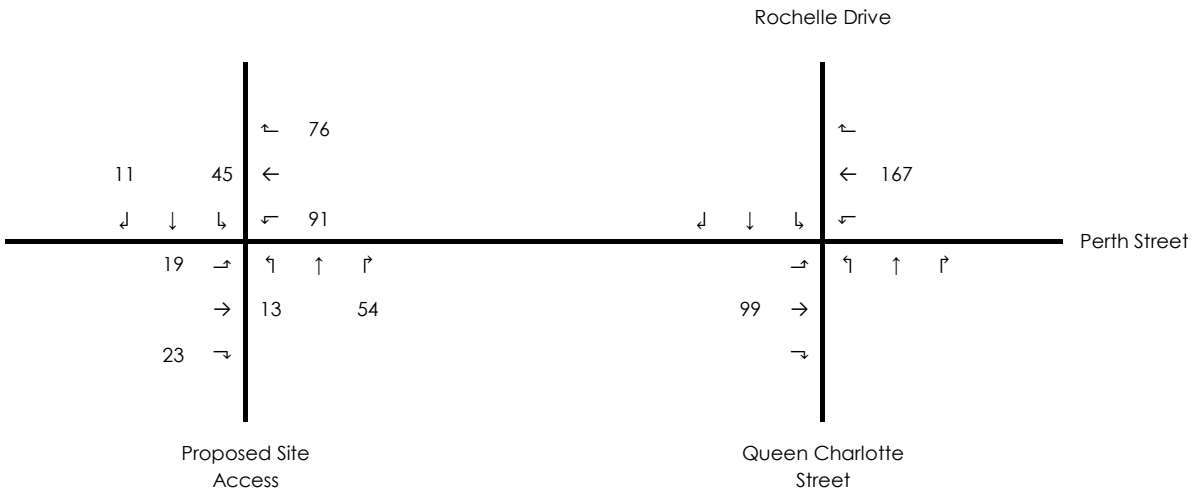
Richmond Village Development Corporation  
Richmond Village - Phase 1

Richmond Oaks Health Centre Trips

**AM Peak Hour**



**PM Peak Hour**



Richmond Village Development Corporation  
Richmond Village - Phase 1

Richmond Village Development Corporation  
Phase 2 (205 units) and Part of Phase 3 (170 units)

## **Appendix C INTERSECTION PERFORMANCE WORKSHEETS**

## **C.1 2017 EXISTING CONDITIONS**

Intersection		0.6													
Int Delay, s/veh															
Movement		EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR		
Traffic Vol, veh/h		1	383	0	4	214	9	0	1	9	18	1	4		
Future Vol, veh/h		1	383	0	4	214	9	0	1	9	18	1	4		
Conflicting Peds, #/hr		0	0	0	0	0	0	0	0	0	0	0	0		
Sign Control		Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop		
RT Channelized		-	-	None	-	-	None	-	-	None	-	-	None		
Storage Length		-	-	-	0	-	-	-	-	-	-	-	-		
Veh in Median Storage, #		-	0	-	-	0	-	-	0	-	-	0	-		
Grade, %		-	0	-	-	0	-	-	0	-	-	0	-		
Peak Hour Factor		92	92	92	92	92	92	92	92	92	92	92	92		
Heavy Vehicles, %		2	2	2	2	2	2	2	2	2	2	2	2		
Mvmt Flow		1	416	0	4	233	10	0	1	10	20	1	4		
Major/Minor		Major1			Major2			Minor1			Minor2				
Conflicting Flow All		242	0	0	416	0	0	667	669	208	457	664	238		
Stage 1		-	-	-	-	-	-	418	418	-	246	246	-		
Stage 2		-	-	-	-	-	-	249	251	-	211	418	-		
Critical Hdwy		4.12	-	-	4.14	-	-	7.33	6.53	6.93	7.33	6.53	6.23		
Critical Hdwy Stg 1		-	-	-	-	-	-	6.53	5.53	-	6.13	5.53	-		
Critical Hdwy Stg 2		-	-	-	-	-	-	6.13	5.53	-	6.53	5.53	-		
Follow-up Hdwy		2.218	-	-	2.22	-	-	3.519	4.019	3.319	3.519	4.019	3.319		
Pot Cap-1 Maneuver		1324	-	-	1139	-	-	358	378	799	500	380	800		
Stage 1		-	-	-	-	-	-	584	590	-	757	702	-		
Stage 2		-	-	-	-	-	-	754	698	-	772	590	-		
Platoon blocked, %		-	-	-	-	-	-	-	-	-	-	-	-		
Mov Cap-1 Maneuver		1324	-	-	1139	-	-	354	376	799	491	378	800		
Mov Cap-2 Maneuver		-	-	-	-	-	-	354	376	-	491	378	-		
Stage 1		-	-	-	-	-	-	583	589	-	756	700	-		
Stage 2		-	-	-	-	-	-	746	696	-	760	589	-		
Approach		EB		WB		NB		SB							
HCM Control Delay, s		0		0.1		10.1		12.3							
HCM LOS				B		B		B							
Minor Lane/Major Mvmt		NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1						
Capacity (veh/h)		718	1324	-	-	1139	-	-	519						
HCM Lane V/C Ratio		0.015	0.001	-	-	0.004	-	-	0.048						
HCM Control Delay (s)		10.1	7.7	0	-	8.2	-	-	12.3						
HCM Lane LOS		B	A	A	-	A	-	-	B						
HCM 95th %ile Q(veh)		0	0	-	-	0	-	-	0.2						

Intersection		0.5													
Int Delay, s/veh		0.5													
Movement		EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR		
Traffic Vol, veh/h		5	285	0	3	426	17	1	0	4	11	1	6		
Future Vol, veh/h		5	285	0	3	426	17	1	0	4	11	1	6		
Conflicting Peds, #/hr		0	0	0	0	0	0	0	0	0	0	0	0		
Sign Control		Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop		
RT Channelized		-	-	None	-	-	None	-	-	None	-	-	None		
Storage Length		-	-	-	0	-	-	-	-	-	-	-	-		
Veh in Median Storage, #		-	0	-	-	0	-	-	0	-	-	-	0		
Grade, %		-	0	-	-	0	-	-	0	-	-	-	0		
Peak Hour Factor		92	92	92	92	92	92	92	92	92	92	92	92		
Heavy Vehicles, %		2	2	2	2	2	2	2	2	2	2	2	2		
Mvmt Flow		5	310	0	3	463	18	1	0	4	12	1	7		
Major/Minor		Major1			Major2			Minor1			Minor2				
Conflicting Flow All		482	0	0	310	0	0	804	809	155	645	800	472		
Stage 1		-	-	-	-	-	-	321	321	-	479	479	-		
Stage 2		-	-	-	-	-	-	483	488	-	166	321	-		
Critical Hdwy		4.12	-	-	4.14	-	-	7.33	6.53	6.93	7.33	6.53	6.23		
Critical Hdwy Stg 1		-	-	-	-	-	-	6.13	5.53	-	6.13	5.53	-		
Critical Hdwy Stg 2		-	-	-	-	-	-	6.13	5.53	-	6.53	5.53	-		
Follow-up Hdwy		2.218	-	-	2.22	-	-	3.519	4.019	3.319	3.519	4.019	3.319		
Pot Cap-1 Maneuver		1081	-	-	1247	-	-	287	314	864	371	317	591		
Stage 1		-	-	-	-	-	-	666	651	-	567	554	-		
Stage 2		-	-	-	-	-	-	564	549	-	820	651	-		
Platoon blocked, %		-	-	-	-	-	-	-	-	-	-	-	-		
Mov Cap-1 Maneuver		1081	-	-	1247	-	-	281	311	864	367	314	591		
Mov Cap-2 Maneuver		-	-	-	-	-	-	281	311	-	367	314	-		
Stage 1		-	-	-	-	-	-	662	647	-	564	553	-		
Stage 2		-	-	-	-	-	-	555	548	-	811	647	-		
Approach		EB		WB		NB		SB							
HCM Control Delay, s		0.1		0.1		10.9		14.1							
HCM LOS				B		B		B							
Minor Lane/Major Mvmt		NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1						
Capacity (veh/h)		611	1081	-	-	1247	-	-	416						
HCM Lane V/C Ratio		0.009	0.005	-	-	0.003	-	-	0.047						
HCM Control Delay (s)		10.9	8.3	0	-	7.9	-	-	14.1						
HCM Lane LOS		B	A	A	-	A	-	B	B						
HCM 95th %ile Q(veh)		0	0	-	-	0	-	-	0.1						

## **C.2 2021 FUTURE BACKGROUND CONDITIONS**

Intersection		0.7											
Int Delay, s/veh		0.7											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations	1	413	5	4	231	9	5	1	9	18	1	4	
Traffic Vol, veh/h	1	413	5	4	231	9	5	1	9	18	1	4	
Future Vol, veh/h	1	413	5	4	231	9	5	1	9	18	1	4	
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0	
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop	
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None	
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-	
Veh in Median Storage, #	-	0	-	-	0	-	-	-	0	-	-	0	
Grade, %	-	0	-	-	0	-	-	-	0	-	-	0	
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92	
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2	
Mvmt Flow	1	413	5	4	231	9	5	1	9	18	1	4	
Major/Minor	Major1			Major2			Minor1			Minor2			
Conflicting Flow All	261	0	0	454	0	0	721	724	227	492	722	256	
Stage 1	-	-	-	-	-	-	454	454	-	265	265	-	
Stage 2	-	-	-	-	-	-	267	270	-	227	457	-	
Critical Hwy	413	-	-	413	-	-	733	653	693	733	653	623	
Critical Hwy Stg 1	-	-	-	-	-	-	653	553	-	613	553	-	
Critical Hwy Stg 2	-	-	-	-	-	-	613	553	-	653	553	-	
Follow-up Hwy	2219	-	-	2219	-	-	3519	4019	3319	3519	4019	3319	
Pot Cap-1 Maneuver	1302	-	-	1105	-	-	328	351	777	473	352	782	
Stage 1	-	-	-	-	-	-	556	568	-	740	689	-	
Stage 2	-	-	-	-	-	-	738	685	-	756	567	-	
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-	
Mov Cap-1 Maneuver	1302	-	-	1105	-	-	324	349	777	464	350	782	
Mov Cap-2 Maneuver	-	-	-	-	-	-	324	349	-	464	350	-	
Stage 1	-	-	-	-	-	-	555	567	-	739	687	-	
Stage 2	-	-	-	-	-	-	730	683	-	744	566	-	
Approach	EB		WB		NB		SB						
HCM Control Delay, s	0		0.1		12.4		12.7						
HCM LOS			B		B								
Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1					
Capacity (veh/h)	502	1302	-	-	1105	-	-	492					
HCM Lane V/C Ratio	0.032	0.001	-	-	0.004	-	-	0.051					
HCM Control Delay (s)	12.4	7.8	0	-	8.3	-	-	12.7					
HCM Lane LOS	B	A	A	-	A	-	-	B					
HCM 95th %ile Q(veh)	0.1	0	-	-	0	-	-	0.2					

Intersection		0.5											
Int Delay, s/veh		0.5											
Movement		EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		5	307	5	3	460	17	1	5	4	11	1	6
Traffic Vol, veh/h		5	307	5	3	460	17	1	5	4	11	1	6
Future Vol, veh/h		0	0	0	0	0	0	0	0	0	0	0	0
Conflicting Peds, #/hr		Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
Sign Control		-	-	None	-	-	None	-	-	None	-	-	None
RT Channelized		-	-	None	-	-	None	-	-	None	-	-	None
Storage Length		-	-	-	0	-	-	-	-	-	-	-	-
Veh in Median Storage, #		-	0	-	-	0	-	-	0	-	-	0	-
Grade, %		-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor		92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %		2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow		5	307	5	3	460	17	1	5	4	11	1	6
Major/Minor		Major1			Major2			Minor1			Minor2		
Conflicting Flow All		518	0	0	339	0	0	867	872	170	696	866	509
Stage 1		-	-	-	-	-	-	347	347	-	516	516	-
Stage 2		-	-	-	-	-	-	520	525	-	180	350	-
Critical Hdwy		4.13	-	-	4.13	-	-	7.33	6.53	6.93	7.33	6.53	6.23
Critical Hdwy Stg 1		-	-	-	-	-	-	6.53	5.53	-	6.13	5.53	-
Critical Hdwy Stg 2		-	-	-	-	-	-	6.13	5.53	-	6.53	5.53	-
Follow-up Hdwy		2,219	-	-	2,219	-	-	3,519	4,019	3,319	3,519	4,019	3,319
Pot Cap-1 Maneuver		1046	-	-	1219	-	-	260	288	845	342	290	563
Stage 1		-	-	-	-	-	-	643	634	-	541	533	-
Stage 2		-	-	-	-	-	-	538	528	-	805	632	-
Platoon blocked, %		-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver		1046	-	-	1219	-	-	255	286	845	333	288	563
Mov Cap-2 Maneuver		-	-	-	-	-	-	255	286	-	333	288	-
Stage 1		-	-	-	-	-	-	639	630	-	538	532	-
Stage 2		-	-	-	-	-	-	529	527	-	789	628	-
Approach		EB		WB		NB		SB					
HCM Control Delay, s		0.1		0		14.7		14.9					
HCM LOS				B		B		B					
Minor Lane/Major Mvmt		NBLn1		EBL		EBR		WBL		WBR		SBLn1	
Capacity (veh/h)		383		1046		-		-		-		382	
HCM Lane V/C Ratio		0.028		0.005		-		-		0.003		-	
HCM Control Delay (s)		14.7		8.5		0		-		8		-	
HCM Lane LOS		B		A		A		A		A		B	
HCM 95th %ile Q(veh)		0.1		0		-		-		0		-	

### **C.3 2021 TOTAL FUTURE CONDITIONS**

Intersection													
Int Delay, s/veh													
0.7													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations	1	505	5	4	262	9	5	1	9	18	1	4	
Traffic Vol. veh/h	1	505	5	4	262	9	5	1	9	18	1	4	
Future Vol. veh/h	1	505	5	4	262	9	5	1	9	18	1	4	
Conflicting Peds. #/hr	0	0	0	0	0	0	0	0	0	0	0	0	
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop	
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None	
Storage Length	-	-	-	0	-	-	-	-	-	-	-	-	
Veh in Median Storage, #	-	0	-	-	0	-	-	-	-	-	-	-	
Grade, %	-	0	-	-	0	-	-	-	-	-	-	-	
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92	
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2	
Mmt Flow	1	505	5	4	262	9	5	1	9	18	1	4	
Major/Minor													
Major1													
Minor1													
Conflicting Flow All	295	0	0	554	0	0	855	857	277	575	855	290	
Stage 1	-	-	-	-	-	-	554	554	-	298	298	-	
Stage 2	-	-	-	-	-	-	301	303	-	277	557	-	
Critical Hwy	4.13	-	-	4.13	-	-	7.33	6.53	6.93	7.33	6.53	6.23	
Critical Hwy Stg 1	-	-	-	-	-	-	6.53	5.53	-	6.13	5.53	-	
Critical Hwy Stg 2	-	-	-	-	-	-	6.13	5.53	-	6.53	5.53	-	
Follow-up Hwy	2.219	-	-	2.219	-	-	3.519	4.019	3.319	3.519	4.019	3.319	
Pot Cap-1 Maneuver	1265	-	-	1014	-	-	265	294	721	415	295	748	
Stage 1	-	-	-	-	-	-	485	513	-	710	666	-	
Stage 2	-	-	-	-	-	-	707	663	-	707	511	-	
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-	
Mov Cap-1 Maneuver	1265	-	-	1014	-	-	262	293	721	407	294	748	
Mov Cap-2 Maneuver	-	-	-	-	-	-	262	293	-	407	294	-	
Stage 1	-	-	-	-	-	-	485	512	-	709	663	-	
Stage 2	-	-	-	-	-	-	699	660	-	695	510	-	
Approach													
EB													
WB													
NB													
Approach	EB	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
HCM Control Delay, s	0	-	-	0.1	-	-	13.7	-	-	13.8	-	-	
HCM LOS	-	-	-	B	-	-	B	-	-	B	-	-	
Minor Lane/Major Mmt													
NBLn1													
WBL													
SBLn1													
Capacity (veh/h)	429	1265	-	-	1014	-	-	-	-	434	-	-	
HCM Lane V/C Ratio	0.038	0.001	-	-	0.004	-	-	-	-	0.058	-	-	
HCM Control Delay (s)	13.7	7.8	0	-	8.6	-	-	-	-	13.8	-	-	
HCM Lane LOS	B	A	A	-	A	-	-	-	-	B	-	-	
HCM 95th %ile Q(veh)	0.1	0	-	-	0	-	-	-	-	0.2	-	-	

Intersection													
Int Delay, s/veh													
2.2													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations	1	505	5	4	262	9	5	1	9	18	1	4	
Traffic Vol. veh/h	1	505	5	4	262	9	5	1	9	18	1	4	
Future Vol. veh/h	1	505	5	4	262	9	5	1	9	18	1	4	
Conflicting Peds. #/hr	0	0	0	0	0	0	0	0	0	0	0	0	
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop	
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None	
Storage Length	-	-	-	300	-	-	-	-	-	-	-	-	
Veh in Median Storage, #	-	0	-	-	0	-	-	-	-	-	-	-	
Grade, %	-	0	-	-	0	-	-	-	-	-	-	-	
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92	
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2	
Mmt Flow	1	505	5	4	262	9	5	1	9	18	1	4	
Major/Minor													
Major1													
Major2													
Minor1													
Conflicting Flow All	295	0	0	554	0	0	855	857	277	575	855	290	
Stage 1	-	-	-	-	-	-	554	554	-	298	298	-	
Stage 2	-	-	-	-	-	-	301	303	-	277	557	-	
Critical Hwy	4.13	-	-	4.13	-	-	7.33	6.53	6.93	7.33	6.53	6.23	
Critical Hwy Stg 1	-	-	-	-	-	-	6.53	5.53	-	6.13	5.53	-	
Critical Hwy Stg 2	-	-	-	-	-	-	6.13	5.53	-	6.53	5.53	-	
Follow-up Hwy	2.219	-	-	2.219	-	-	3.519	4.019	3.319	3.519	4.019	3.319	
Pot Cap-1 Maneuver	1265	-	-	1014	-	-	265	294	721	415	295	748	
Stage 1	-	-	-	-	-	-	485	513	-	710	666	-	
Stage 2	-	-	-	-	-	-	707	663	-	707	511	-	
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-	
Mov Cap-1 Maneuver	1265	-	-	1014	-	-	262	293	721	407	294	748	
Mov Cap-2 Maneuver	-	-	-	-	-	-	262	293	-	407	294	-	
Stage 1	-	-	-	-	-	-	485	512	-	709	663	-	
Stage 2	-	-	-	-	-	-	699	660	-	695	510	-	
Approach													
EB													
WB													
NB													
Approach	EB	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
HCM Control Delay, s	0	-	-	0.1	-	-	13.7	-	-	13.8	-	-	
HCM LOS	-	-	-	B	-	-	B	-	-	B	-	-	
Minor Lane/Major Mmt													
NBLn1													
WBL													
SBLn1													
Capacity (veh/h)	429	1265	-	-	1014	-	-	-	-	434	-	-	
HCM Lane V/C Ratio	0.038	0.001	-	-	0.004	-	-	-	-	0.058	-	-	
HCM Control Delay (s)	13.7	7.8	0	-	8.6	-	-	-	-	13.8	-	-	
HCM Lane LOS	B	A	A	-	A	-	-	-	-	B	-	-	
HCM 95th %ile Q(veh)	0.1	0	-	-	0	-	-	-	-	0.2	-	-	

Intersection													
Init Delay, s/veh													
0.5													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Traffic Vol. veh/h	5	366	5	3	561	17	1	5	4	11	1	6	
Future Vol. veh/h	5	366	5	3	561	17	1	5	4	11	1	6	
Conflicting Peds. #/hr	0	0	0	0	0	0	0	0	0	0	0	0	
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop	
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None	
Storage Length	-	-	-	0	-	-	-	-	-	-	-	-	
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	-	0	
Grade, %	-	0	-	-	0	-	-	0	-	-	-	0	
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92	
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2	
Mmt Flow	5	366	5	3	561	17	1	5	4	11	1	6	
Major/Minor													
Major1													
Minor1													
Conflicting Flow All	628	0	0	403	0	0	1040	1046	202	839	1040	619	
Stage 1	-	-	-	-	-	-	411	411	-	626	626	-	
Stage 2	-	-	-	-	-	-	629	635	-	213	414	-	
Critical Hwy	413	-	-	413	-	-	733	653	693	733	653	623	
Critical Hwy Stg 1	-	-	-	-	-	-	653	553	-	613	553	-	
Critical Hwy Stg 2	-	-	-	-	-	-	613	553	-	653	553	-	
Follow-up Hwy	2219	-	-	2219	-	-	3519	4019	3319	3519	4019	3319	
Pot Cap-1 Maneuver	952	-	-	1154	-	-	196	228	806	272	230	488	
Stage 1	-	-	-	-	-	-	589	594	-	471	476	-	
Stage 2	-	-	-	-	-	-	469	471	-	770	592	-	
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-	
Mov Cap-1 Maneuver	952	-	-	1154	-	-	191	226	806	264	228	488	
Mov Cap-2 Maneuver	-	-	-	-	-	-	191	226	-	264	228	-	
Stage 1	-	-	-	-	-	-	585	590	-	468	475	-	
Stage 2	-	-	-	-	-	-	460	470	-	753	588	-	
Approach													
EB													
WB													
NB													
SB													
Approach	EB	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
HCM Control Delay, s	0.1	-	-	0	-	-	17.1	-	-	17.5	-	-	
HCM LOS	C	-	-	C	-	-	C	-	-	C	-	-	
Minor Lane/Major Mmt													
NBLn1													
EBL													
EBT													
EBR													
WBL													
WBT													
WBR													
SBLn1													
Capacity (veh/h)	309	952	-	-	1154	-	-	-	-	308	-	-	
HCM Lane V/C Ratio	0.035	0.006	-	-	0.003	-	-	-	-	0.064	-	-	
HCM Control Delay (s)	17.1	8.8	0	-	8.1	-	-	-	-	17.5	-	-	
HCM Lane LOS	C	A	A	-	A	-	-	-	-	C	-	-	
HCM 95th %ile Q(veh)	0.1	0	-	-	0	-	-	-	-	0.2	-	-	

Intersection													
Init Delay, s/veh													
1.9													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Traffic Vol. veh/h	312	25	312	25	101	467	15	15	59	15	59	59	
Future Vol. veh/h	312	25	312	25	101	467	15	15	59	15	59	59	
Conflicting Peds. #/hr	0	0	0	0	0	0	0	0	0	0	0	0	
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop	
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None	
Storage Length	-	-	-	300	-	-	0	-	0	-	-	0	
Veh in Median Storage, #	0	-	-	-	0	-	0	-	0	-	-	0	
Grade, %	0	-	-	-	0	-	0	-	0	-	-	0	
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100	
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2	
Mmt Flow	312	25	312	25	101	467	15	15	59	15	59	59	
Major/Minor													
Major1													
Major2													
Minor1													
Minor2													
Conflicting Flow All	0	0	0	337	0	0	994	325	325	994	325	325	
Stage 1	-	-	-	-	-	-	-	-	-	-	-	-	
Stage 2	-	-	-	-	-	-	669	669	-	-	-	-	
Critical Hwy	-	-	-	412	-	-	642	642	622	-	-	-	
Critical Hwy Stg 1	-	-	-	-	-	-	542	542	-	-	-	-	
Critical Hwy Stg 2	-	-	-	-	-	-	542	542	-	-	-	-	
Follow-up Hwy	-	-	-	2218	-	-	3518	3518	3318	-	-	-	
Pot Cap-1 Maneuver	-	-	-	1222	-	-	272	272	716	-	-	-	
Stage 1	-	-	-	-	-	-	732	732	-	-	-	-	
Stage 2	-	-	-	-	-	-	509	509	-	-	-	-	
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-	
Mov Cap-1 Maneuver	-	-	-	1222	-	-	250	250	716	-	-	-	
Mov Cap-2 Maneuver	-	-	-	-	-	-	250	250	-	-	-	-	
Stage 1	-	-	-	-	-	-	732	732	-	-	-	-	
Stage 2	-	-	-	-	-	-	467	467	-	-	-	-	
Approach													
EB													
WB													
NB													
B													
Approach	EB	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
HCM Control Delay, s	0	-	-	1.5	-	-	13.1	-	-	13.1	-	-	
HCM LOS	B	-	-	B	-	-	B	-	-	B	-	-	
Minor Lane/Major Mmt													
NBLn1													
EBL													
EBT													
EBR													
WBL													
WBT													
WBR													
SBLn1													
Capacity (veh/h)	520	-	-	1222	-	-	-	-	-	1222	-	-	
HCM Lane V/C Ratio	0.142	-	-	0.083	-	-	-	-	-	0.083	-	-	
HCM Control Delay (s)	13.1	-	-	8.2	-	-	-	-	-	8.2	-	-	
HCM Lane LOS	B	-	-	A	-	-	-	-	-	A	-	-	
HCM 95th %ile Q(veh)	0.5	-	-	0.3	-	-	-	-	-	0.3	-	-	

## **C.4 2026 ULTIMATE CONDITIONS**

# HCM 2010 TWSC

1.: Queen Charlotte St/Rochelle Dr & Perth St

HCM 2010 TWSC

2: Site Access & Perth Street

Richmond Village Phase 1  
2026 Ultimate AM

Intersection													
Int Delay, s/veh													
0.7													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	SBT
Lane Configurations	1	709	5	4	340	10	5	1	9	19	1	4	4
Traffic Vol, veh/h	1	709	5	4	340	10	5	1	9	19	1	4	4
Future Vol, veh/h	1	709	5	4	340	10	5	1	9	19	1	4	4
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None	-
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	0	-	-	-	-	-	-	-	-	-
Grade, %	-	0	-	-	0	-	-	0	-	-	-	-	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2	2
Mmt Flow	1	709	5	4	340	10	5	1	9	19	1	4	4
Major/Minor													
Major1													
Minor1													
Minor2													
Conflicting Flow All	380	0	0	776	0	0	1162	1165	388	772	1162	375	772
Stage 1	-	-	-	-	-	-	776	776	-	384	384	-	384
Stage 2	-	-	-	-	-	-	386	389	-	388	778	-	388
Critical Hwy	4.13	-	-	4.13	-	-	7.33	6.53	6.93	7.33	6.53	6.23	7.33
Critical Hwy Stg 1	-	-	-	-	-	-	6.53	5.53	-	6.13	5.53	-	6.13
Critical Hwy Stg 2	-	-	-	-	-	-	6.13	5.53	-	6.53	5.53	-	6.53
Follow-up Hwy	2.219	-	-	2.219	-	-	3.519	4.019	3.319	3.519	4.019	3.319	3.519
Pot Cap-1 Maneuver	1177	-	-	838	-	-	161	193	611	303	194	670	670
Stage 1	-	-	-	-	-	-	357	407	-	638	611	-	638
Stage 2	-	-	-	-	-	-	636	608	-	608	406	-	608
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1177	-	-	838	-	-	159	192	611	296	193	670	670
Mov Cap-2 Maneuver	-	-	-	-	-	-	159	192	-	296	193	-	296
Stage 1	-	-	-	-	-	-	357	407	-	637	608	-	637
Stage 2	-	-	-	-	-	-	628	605	-	596	406	-	596
Approach													
EB													
WB													
NB													
SB													
HCM Control Delay, s													
0													
HCM LOS													
C													
Minor Lane/Major Mmt													
NBLn1													
EBL													
WBL													
WBR													
Capacity (veh/h)													
292													
HCM Lane V/C Ratio													
0.056													
HCM Control Delay (s)													
18.1													
HCM Lane LOS													
C													
HCM 95th %ile Q(veh)													
0.2													

02/07/2017

Synchro 9 Report  
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Intersection													
Int Delay, s/veh													8.1
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations	↔		↔	↖	↗	↘		↔			↔	↔	
Traffic Vol, veh/h	6	462	15	60	260	24	44	5	177	71	5	18	
Future Vol, veh/h	6	462	15	60	260	24	44	5	177	71	5	18	
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0	
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop	
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None	
Storage Length	-	-	-	300	-	-	-	-	-	-	-	-	
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-	
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-	
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100	
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2	
Mvmt Flow	6	462	15	60	260	24	44	5	177	71	5	18	
Major/Minor													
Major1													
Minor1													
Minor2													
Conflicting Flow All	284	0	0	477	0	0	886	886	470	965	881	272	
Stage 1	-	-	-	-	-	-	482	482	-	392	392	-	
Stage 2	-	-	-	-	-	-	404	404	-	573	489	-	
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22	
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-	
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-	
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318	
Pot Cap-1 Maneuver	1278	-	-	1085	-	-	265	284	594	234	285	767	
Stage 1	-	-	-	-	-	-	565	553	-	633	606	-	
Stage 2	-	-	-	-	-	-	623	599	-	505	549	-	
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-	
Mov Cap-1 Maneuver	1278	-	-	1085	-	-	243	267	594	154	268	767	
Mov Cap-2 Maneuver	-	-	-	-	-	-	243	267	-	154	268	-	
Stage 1	-	-	-	-	-	-	562	550	-	629	572	-	
Stage 2	-	-	-	-	-	-	570	566	-	349	546	-	
Approach													
EB													
WB													
NB													
SB													
HCM Control Delay, s													
0.1													
HCM LOS													
C													
E													
Minor Lane/Major Mvmt													
NBLn1													
EBL													
WBL													
WBR													
SBLn1													
Capacity (veh/h)	454	1278	-	-	1085	-	-	187					
HCM Lane V/C Ratio	0.498	0.005	-	-	0.065	-	-	0.503					
HCM Control Delay (s)	20.7	7.8	0	-	8.5	-	-	43.3					
HCM Lane LOS	C	A	A	-	A	-	-	E					
HCM 95th %tile Q(veh)	2.9	0	-	-	0.2	-	-	2.9					

# HCM 2010 TWSC

1.: Queen Charlotte St/Rochelle Dr & Perth St

Richmond Village Phase 1  
2026 Ultimate PM

Intersection		0.6													
Int Delay, s/veh															
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR			
Lane Configurations															
Traffic Vol. veh/h	5	502	5	3	787	19	1	5	4	12	1	6			
Future Vol. veh/h	5	502	5	3	787	19	1	5	4	12	1	6			
Conflicting Peds. #/hr	0	0	0	0	0	0	0	0	0	0	0	0			
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop			
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None			
Storage Length	-	-	-	0	-	-	-	-	-	-	-	-			
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-			
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-			
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92			
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2			
Mvmt Flow	5	502	5	3	787	19	1	5	4	12	1	6			
Major/Minor	Major1			Major2			Minor1			Minor2					
Conflicting Flow All	876	0	0	551	0	0	1435	1442	276	1158	1434	866			
Stage 1	-	-	-	-	-	-	559	559	-	872	872	-			
Stage 2	-	-	-	-	-	-	876	883	-	286	562	-			
Critical Hwy	4.13	-	-	4.13	-	-	7.33	6.53	6.93	7.33	6.53	6.23			
Critical Hwy Stg 1	-	-	-	-	-	-	6.53	5.53	-	6.13	5.53	-			
Critical Hwy Stg 2	-	-	-	-	-	-	6.13	5.53	-	6.53	5.53	-			
Follow-up Hwy	2.219	-	-	2.219	-	-	3.519	4.019	3.319	3.519	4.019	3.319			
Pot Cap-1 Maneuver	769	-	-	1017	-	-	102	132	722	162	133	352			
Stage 1	-	-	-	-	-	-	482	510	-	344	367	-			
Stage 2	-	-	-	-	-	-	343	363	-	698	509	-			
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-			
Mov Cap-1 Maneuver	769	-	-	1017	-	-	99	130	722	154	131	352			
Mov Cap-2 Maneuver	-	-	-	-	-	-	99	130	-	154	131	-			
Stage 1	-	-	-	-	-	-	478	505	-	341	366	-			
Stage 2	-	-	-	-	-	-	335	362	-	680	504	-			
Approach	EB			WB			NB			SB					
HCM Control Delay, s	0.1			0			25.7			26.9					
HCM LOS							D			D					
Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1							
Capacity (veh/h)	185	769	-	-	1017	-	-	185							
HCM Lane V/C Ratio	0.059	0.007	-	-	0.003	-	-	0.112							
HCM Control Delay (s)	25.7	9.7	0	-	8.6	-	-	26.9							
HCM Lane LOS	D	A	A	-	A	-	-	D							
HCM 95th %ile Q(veh)	0.2	0	-	-	0	-	-	0.4							

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# HCM 2010 TWSC

2: Site Access & Perth Street

Richmond Village Phase 1  
2026 Ultimate PM

Intersection		8.6													
Int Delay, s/veh															
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR			
Lane Configurations															
Traffic Vol. veh/h	19	349	48	192	526	76	28	5	113	45	5	11			
Future Vol. veh/h	19	349	48	192	526	76	28	5	113	45	5	11			
Conflicting Peds. #/hr	0	0	0	0	0	0	0	0	0	0	0	0			
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop			
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None			
Storage Length	-	-	-	300	-	-	-	-	-	-	-	-			
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-			
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-			
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100			
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2			
Mvmt Flow	19	349	48	192	526	76	28	5	113	45	5	11			
Major/Minor	Major1			Major2			Minor1			Minor2					
Conflicting Flow All	602	0	0	397	0	0	1367	1397	373	1418	1383	564			
Stage 1	-	-	-	-	-	-	411	411	-	948	948	-			
Stage 2	-	-	-	-	-	-	956	986	-	470	435	-			
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22			
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-			
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-			
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318			
Pot Cap-1 Maneuver	975	-	-	1162	-	-	124	141	673	114	144	525			
Stage 1	-	-	-	-	-	-	618	595	-	313	339	-			
Stage 2	-	-	-	-	-	-	310	326	-	574	580	-			
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-			
Mov Cap-1 Maneuver	975	-	-	1162	-	-	101	115	673	79	117	525			
Mov Cap-2 Maneuver	-	-	-	-	-	-	101	115	-	79	117	-			
Stage 1	-	-	-	-	-	-	603	580	-	305	283	-			
Stage 2	-	-	-	-	-	-	249	272	-	462	566	-			
Approach	EB			WB			NB			SB					
HCM Control Delay, s	0.4			2.1			28.4			102.4					
HCM LOS							D			F					
Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1							
Capacity (veh/h)	299	975	-	-	1162	-	-	96							
HCM Lane V/C Ratio	0.488	0.019	-	-	0.165	-	-	0.635							
HCM Control Delay (s)	28.4	8.8	0	-	8.7	-	-	102.4							
HCM Lane LOS	D	A	A	-	A	-	-	F							
HCM 95th %ile Q(veh)	2.8	0.1	-	-	0.6	-	-	4.2							

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## **C.5 2026 ULTIMATE CONDITIONS WITH IMPROVEMENTS**

# HCM 2010 TWSC

1.: Queen Charlotte St/Rochelle Dr & Perth St

Richmond Village Phase 1  
2026 Ultimate AM with improvements

Intersection	0.7													
Int Delay, s/veh														
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR		
Lane Configurations														
Traffic Vol, veh/h	1	709	5	4	340	10	5	1	9	19	1	4		
Future Vol, veh/h	1	709	5	4	340	10	5	1	9	19	1	4		
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0		
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop		
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None		
Storage Length	-	-	-	0	-	-	-	-	-	-	-	-		
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	-	0		
Grade, %	-	0	-	-	0	-	-	0	-	-	-	0		
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92		
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2		
Mmt Flow	1	709	5	4	340	10	5	1	9	19	1	4		
Major/Minor	Major1			Major2			Minor1			Minor2				
Conflicting Flow All	380	0	0	776	0	0	1162	1165	388	772	1162	375		
Stage 1	-	-	-	-	-	-	776	776	-	384	384	-		
Stage 2	-	-	-	-	-	-	386	389	-	388	778	-		
Critical Hwy	4.13	-	-	4.13	-	-	7.33	6.53	6.93	7.33	6.53	6.23		
Critical Hwy Stg 1	-	-	-	-	-	-	6.53	5.53	-	6.13	5.53	-		
Critical Hwy Stg 2	-	-	-	-	-	-	6.13	5.53	-	6.53	5.53	-		
Follow-up Hwy	2.219	-	-	2.219	-	-	3.519	4.019	3.319	3.519	4.019	3.319		
Pot Cap-1 Maneuver	1177	-	-	838	-	-	161	193	611	303	194	670		
Stage 1	-	-	-	-	-	-	357	407	-	638	611	-		
Stage 2	-	-	-	-	-	-	636	608	-	608	406	-		
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-		
Mov Cap-1 Maneuver	1177	-	-	838	-	-	159	192	611	296	193	670		
Mov Cap-2 Maneuver	-	-	-	-	-	-	159	192	-	296	193	-		
Stage 1	-	-	-	-	-	-	357	407	-	637	608	-		
Stage 2	-	-	-	-	-	-	628	605	-	596	406	-		
Approach	EB			WB			NB			SB				
HCM Control Delay, s	0			0.1			18.1			17.3				
HCM LOS							C			C				
Minor Lane/Major Mmt	NBLn1			EBL			EBR			WBL			WBR SBLn1	
Capacity (veh/h)	292			1177			-			-			-	
HCM Lane V/C Ratio	0.056			0.001			-			-			-	
HCM Control Delay (s)	18.1			8.1			0			-			-	
HCM Lane LOS	C			A			A			A			C	
HCM 95th %ile Q(veh)	0.2			0			-			0			-	

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HCM 2010 Roundabout  
2: Site Access & Perth Street

Richmond Village Phase 1  
2026 Ultimate AM with improvements

Intersection	8.8													
Intersection Delay, s/veh														
Intersection LOS	A													
Approach	EB			WB			NB			SB				
Entry Lanes	1			1			1			1				
Conflicting Circle Lanes	1			1			1			1				
Adj Approach Flow, veh/h	483			344			226			94				
Demand Flow Rate, veh/h	492			350			231			95				
Vehicles Circulating, veh/h	138			56			549			371				
Vehicles Exiting, veh/h	328			724			81			35				
Follow-Up Headway, s	3.186			3.186			3.186			3.186				
Ped Vol Crossing Leg, #/h	0			0			0			0				
Ped Cap Adj	1.000			1.000			1.000			1.000				
Approach Delay, s/veh	9.9			6.7			10.5			5.9				
Approach LOS	A			A			B			A				
Lane	Left			Left			Left			Left				
Designated Moves	LTR			LTR			LTR			LTR				
Assumed Moves	LTR			LTR			LTR			LTR				
RT Channelized														
Lane Util	1.000			1.000			1.000			1.000				
Critical Headway, s	5.193			5.193			5.193			5.193				
Entry Flow, veh/h	492			350			231			95				
Cap Entry Lane, veh/h	984			1068			653			780				
Entry HV Adj Factor	0.981			0.982			0.978			0.988				
Flow Entry, veh/h	483			344			226			94				
Cap Entry, veh/h	966			1049			638			771				
V/C Ratio	0.500			0.328			0.354			0.122				
Control Delay, s/veh	9.9			6.7			10.5			5.9				
LOS	A			A			B			A				
95th %ile Queue, veh	3			1			2			0				

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# HCM 2010 TWSC

1.: Queen Charlotte St/Rochelle Dr & Perth St

Richmond Village Phase 1  
2026 Ultimate PM with improvements

Intersection	0.6											
Int Delay, s/veh												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	5	502	5	3	787	19	1	5	4	12	1	6
Future Vol, veh/h	5	502	5	3	787	19	1	5	4	12	1	6
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	0	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	-	0
Grade, %	-	0	-	-	0	-	-	0	-	-	-	0
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	5	502	5	3	787	19	1	5	4	12	1	6
Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	876	0	0	551	0	0	1435	1442	276	1158	1434	866
Stage 1	-	-	-	-	-	-	559	559	-	872	872	-
Stage 2	-	-	-	-	-	-	876	883	-	286	562	-
Critical Hwy	4.13	-	-	4.13	-	-	7.33	6.53	6.93	7.33	6.53	6.23
Critical Hwy Stg 1	-	-	-	-	-	-	6.53	5.53	-	6.13	5.53	-
Critical Hwy Stg 2	-	-	-	-	-	-	6.13	5.53	-	6.53	5.53	-
Follow-up Hwy	2.219	-	-	2.219	-	-	3.519	4.019	3.319	3.519	4.019	3.319
Pot Cap-1 Maneuver	769	-	-	1017	-	-	102	132	722	162	133	352
Stage 1	-	-	-	-	-	-	482	510	-	344	367	-
Stage 2	-	-	-	-	-	-	343	363	-	698	509	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	769	-	-	1017	-	-	99	130	722	154	131	352
Mov Cap-2 Maneuver	-	-	-	-	-	-	99	130	-	154	131	-
Stage 1	-	-	-	-	-	-	478	505	-	341	366	-
Stage 2	-	-	-	-	-	-	335	362	-	680	504	-
Approach	EB			WB			NB			SB		
HCM Control Delay, s	0.1			0			25.7			26.9		
HCM LOS							D			D		
Minor Lane/Major Mvmt	NBLn1			EBL			EBR			WBR		
Capacity (veh/h)	185			769			-			-		
HCM Lane V/C Ratio	0.059			0.007			-			-		
HCM Control Delay (s)	25.7			9.7			0			-		
HCM Lane LOS	D			A			A			-		
HCM 95th %ile Q(veh)	0.2			0			-			-		

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HCM 2010 Roundabout  
2: Site Access & Perth Street

Richmond Village Phase 1  
2026 Ultimate PM with improvements

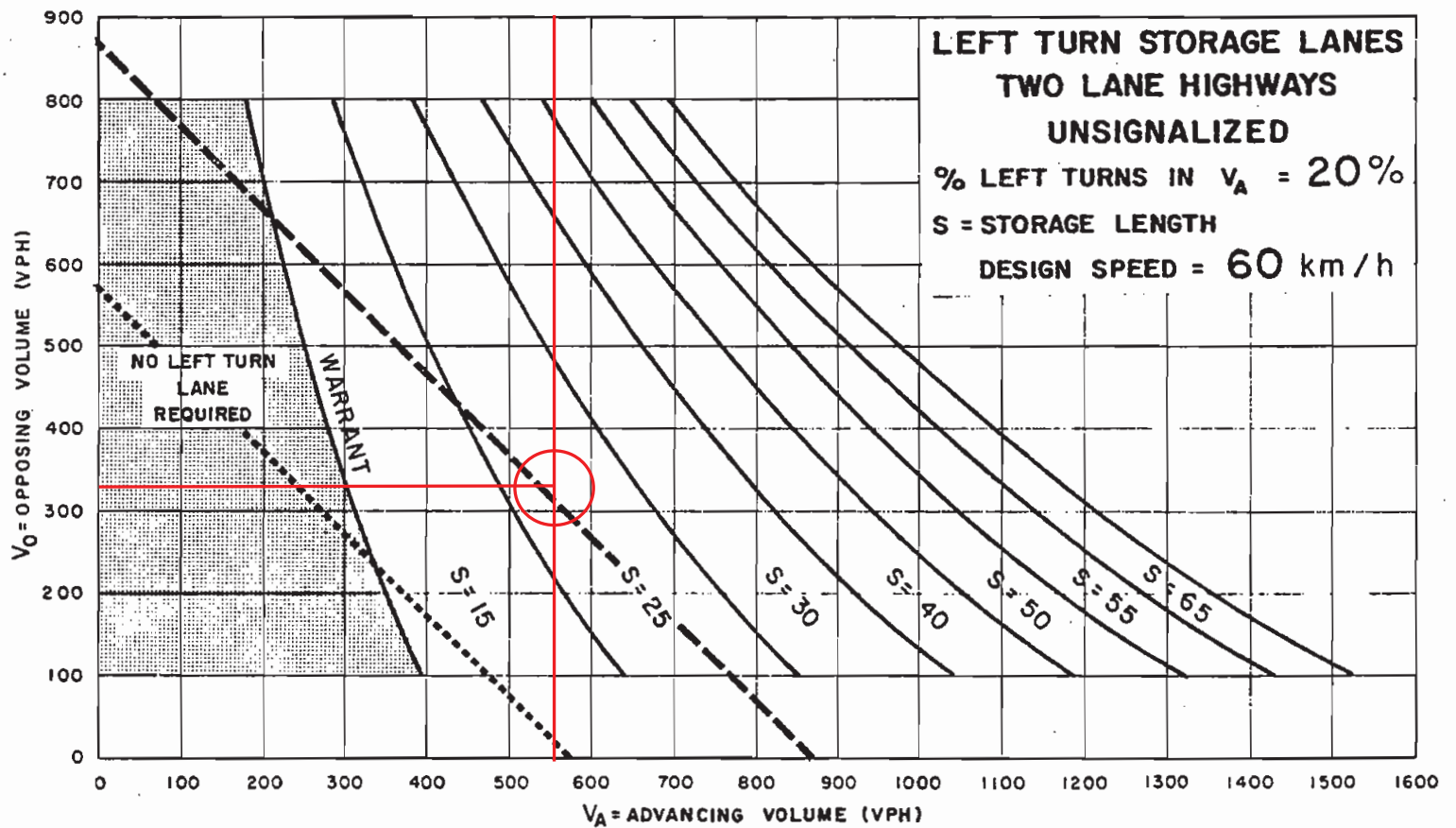
Intersection	14.0			
Intersection Delay, s/veh				
Intersection LOS	B			
Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	416	794	146	61
Demand Flow Rate, veh/h	424	811	149	62
Vehicles Circulating, veh/h	247	53	421	762
Vehicles Exiting, veh/h	577	517	250	102
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	10.4	17.6	7.2	8.5
Approach LOS	B	C	A	A
Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	424	811	149	62
Cap Entry Lane, veh/h	883	1072	742	527
Entry HV Adj Factor	0.981	0.980	0.979	0.982
Flow Entry, veh/h	416	794	146	61
Cap Entry, veh/h	866	1050	726	518
V/C Ratio	0.480	0.757	0.201	0.118
Control Delay, s/veh	10.4	17.6	7.2	8.5
LOS	B	C	A	A
95th %ile Queue, veh	3	9	1	0

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## **Appendix D   AUXILIARY LANE WARRANTS**

Perth Street at Site Access - Westbound Left - 2021 Total



## **Right Turn Warrants**

**Project: Richmond Village Development Corporation - Phase 1 TIS**

Intersection: Perth Street at Site Access

Warrant: 10-20% of total approach volume (TAC)

Peak Period: AM 2021 Total Future

Approach: Eastbound

Left	0	Volume (approaching)	422
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Through	414	Volume (right turn)	8
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Right	8		
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Right Turn %	2%
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**No right turn lane required**

Intersection: Perth Street at Site Access

Warrant: 10-20% of total approach volume (TAC)

Peak Period: PM 2021 Total Future

Approach: Eastbound

Left	0	Volume (approaching)	337
------	---	----------------------	-----

Through	312	Volume (right turn)	25
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Right	25		
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Right Turn %	7%
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**No right turn lane required**