



Village of Richmond Transportation Brief

GENIVAR Project Number – 111-18482-00
June 21st, 2011

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Village of Richmond Transportation Brief

**Prepared for
CAIVAN Communities**

**111-18482-00
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TIA GUIDELINES CHECKLIST – TRANSPORTATION BRIEF

Report Context

- ☒ Municipal Address
- ☒ Location relative to major elements of the existing transportation system (e.g. the site is located in the southwest quadrant of the intersection of Main Street/First Street, 600m from the Maple Street Rapid Transit Station)
- ☒ Existing land uses or permitted use provisions in the Official Plan, Zoning By-Law, etc
- ☒ Proposed land uses and relevant planning regulations to be used in the analysis
- ☒ Proposed development size (building size, number of residential units, etc) and location on site
- ☒ Estimated date of occupancy
- ☒ Planned phasing of development
- ☒ Proposed number of parking spaces
- ☒ Proposed Access points and type of access (full turns, right-in/right-out, turning restrictions, etc.)
- ☒ Study area
- ☒ Time periods and phasing
- ☒ Horizon years (include reference to phased development)

Existing Conditions

- ☒ Existing roads, ramps in the study area, including jurisdiction, classification, number of lanes and posted speed limit
- ☒ Existing intersections, indicating type of control, lane configurations, turning restrictions and any other relevant data (e.g. extraordinary lane widths, grades, etc)
- ☒ Existing access points to adjacent developments (both sides of all roads bordering the site)
- ☒ Existing transit system, including stations and stops
- ☒ Existing on- and off-road bicycle facilities and pedestrian sidewalks and pathway networks
- ☒ Existing system operations (V/C, LOS)
- ☒ Major trip generators/attractors within the study Area should be indicated

Demand Forecasting

- ☒ Trip generation forecasts



Impact Analysis

- ☒ Qualitative assessment of impacts on capacity; non-auto modes; on-site circulation; community

Mitigation Measures and Site Design Characteristics

- ☒ Location and timing of proposed changes to existing traffic controls at intersections (e.g. new traffic signals, Stop signs, etc)
- ☒ Mitigation measures required to offset impacts on the surface and Rapid Transit networks
- ☒ New or modified elements of the bicycle and pedestrian networks
- ☒ Community impact mitigation measures
- ☒ Proposed TDM features or programs to support the site development.



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1.0 STUDY PURPOSE

This study is to support the Draft Plan application of CAIVAN Communities for their development in the Village of Richmond. This Transportation Brief follows the City of Ottawa TIA Guidelines and is written within the context of the approved Village of Richmond Transportation Master Plan (TMP) as well as the Community Design Plan (CDP).

2.0 BACKGROUND

To understand the required scope of this Transportation Brief, GENIVAR met with City Staff on June 1, 2011. At this meeting, it was determined that it is appropriate to rely on the comprehensive nature of the Richmond Village TMP and it would be acceptable to submit a Transportation Brief to support the Draft Plan Application.

2.1 Transportation Context and Study Area

This development will be examined within the overall context of the Village of Richmond. **Figure 1** highlights the Transportation Network in Richmond, from Joys Road in the east end of Richmond to Eagleson Road in the west. The CAIVAN Communities development is located along Perth Street just west of Queen Charlotte Street, as seen in **Figure 2**.



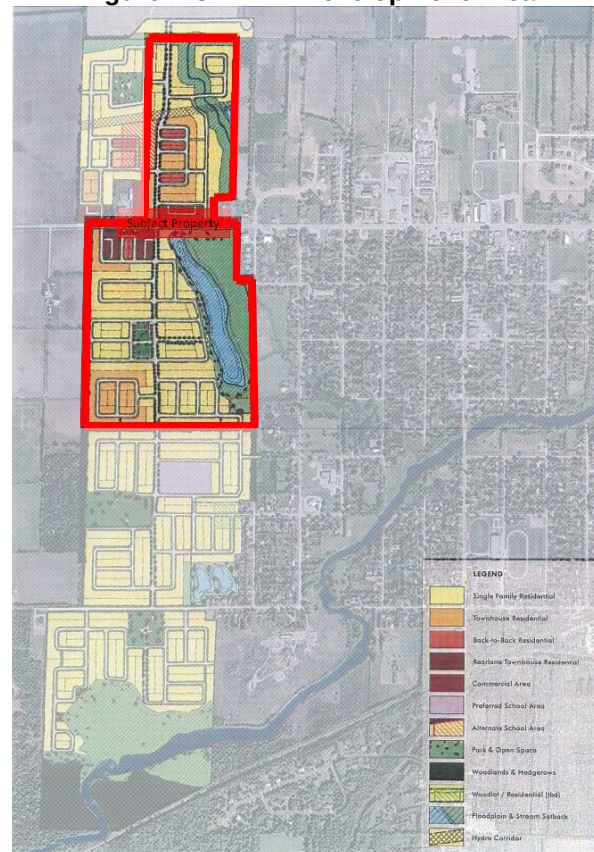
Figure 1
Richmond Village Transportation Network and Study Area



Source: Richmond Village TMP (2010)



Figure 2 CAIVAN Development Area



Source: Richmond Village TMP (2010)

2.2 Transportation Impact Assessments

Previous TIA's have examined the Village of Richmond as well as specific developments within Richmond. These TIA's include the following:

Village of Richmond a Transportation Master Plan (2010): As part of the Community Design Plan for the Village of Richmond a Transportation Master Plan was developed and approved. As previously described this TB has been drafted within the context of the overall Richmond Village TMP.

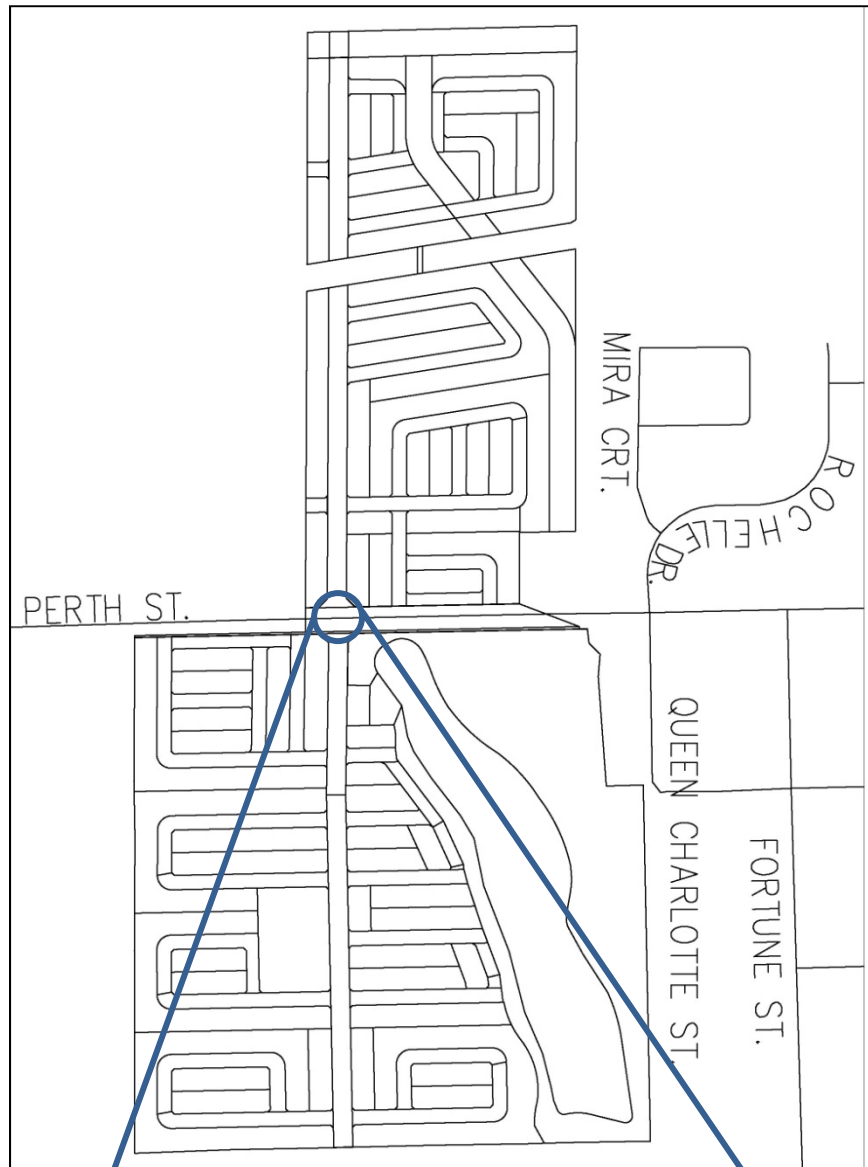
Richmond Village Square Retail CTS/TIS (2011): This TIA is in support of a retail development at the corner of Perth Street and Shea Road.

2.3 Proposed Development Site

Figure 3 shows the planned site plan for CAIVAN's development. The site will be accessed at the intersection of Perth Street and the un-named north-south local collector. It has been proposed in the Richmond TMP that this intersection be built as a roundabout, once a traffic control is warranted at this location (**Figure 4**). Control warrants will be examined in greater detail in TIA's for the individual phases of this development. The development is expected to proceed at 100 units each year until completion of all 1000 units in approximately 2021.



Figure 3 Conceptual Site Plan



**Figure 4
Conceptual Plan of Perth Street Roundabout**



Source: Richmond Village TMP (2010)



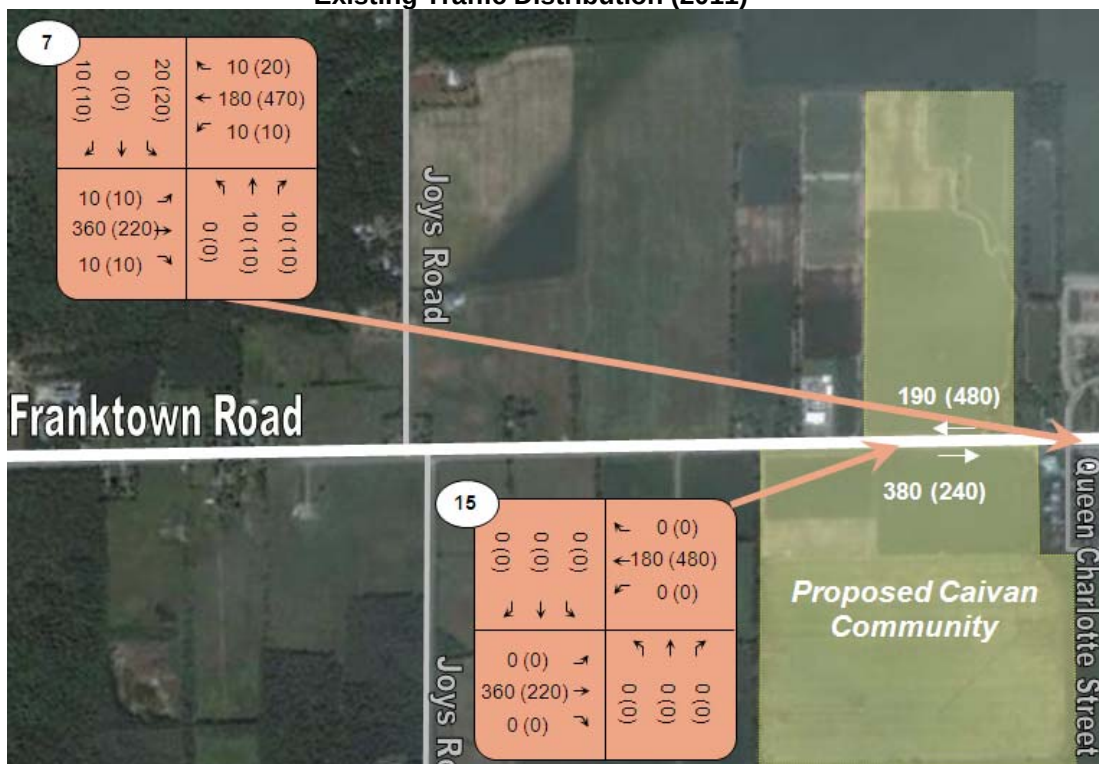
3.0 TRAFFIC CONDITIONS

The existing traffic conditions in Richmond Village have been documented in the Richmond Village TMP. The findings that apply to this property will be summarized.

3.1 Existing Traffic

The existing traffic was determined using the Richmond Village TMP traffic model and adjusting the traffic using the suggested background growth rates to 2011. Existing traffic volumes at the North South Collector are shown in .Traffic distributions have been appended (**Appendix A**).

Figure 5
Existing Traffic Distribution (2011)



3.2 Background Growth

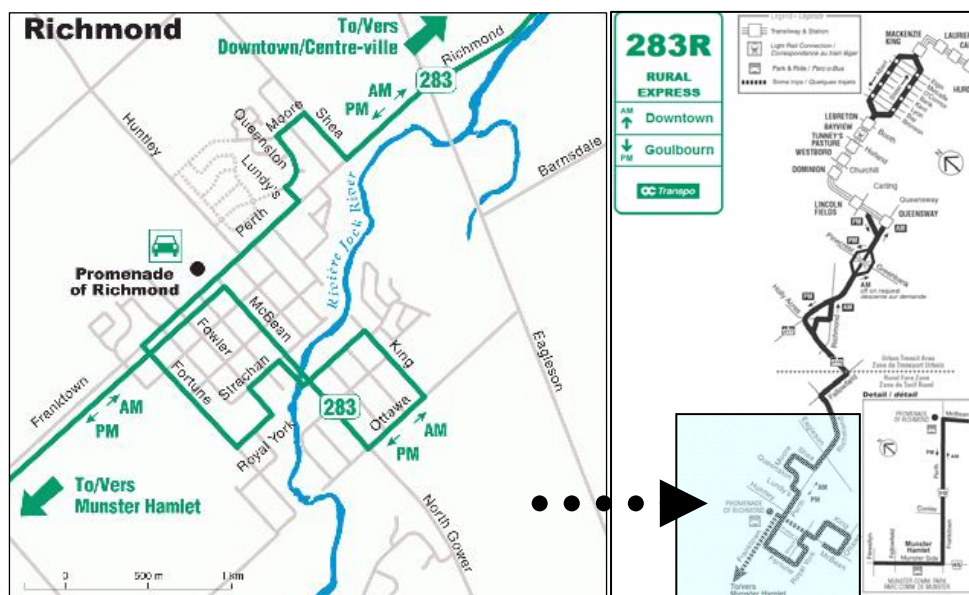
Background growth rates were based on the Richmond Village TMP, using historic growth rates the growth rate was determined. Along all arterials within Richmond a value of 2% background growth was used.

3.3 Transit Provisions and Ridership Characteristics

Figure 6 shows the path of bus route 283 which services the Village of Richmond. The bus schedule is attached in **Appendix B**.



Figure 6
Octranspo Bus Route 283R



Source: OC Transpo – www.octranspo.com

3.4 Non-Auto Modes

Sidewalks are provided along both sides of Perth Street through the Village and along the majority of McBean Street. Along local and collector streets within the residential areas of the Village, sidewalks are generally not present. The arterial and collectors do not currently provide bicycle lanes.

3.5 Network Performance

An assessment of the existing roadway network was undertaken to gain an understanding of existing deficiencies. The intersection capacity analysis for the volume conditions was completed using Synchro 6TM. **Table 1** below provides a summary of the existing intersection performance characteristics in the study area.

Table 1
Intersection Capacity Analysis - Existing 2011

Intersection				Performance Characteristics		
ID No.	North-South	East-West	Control	Critical V/C ³	Movement ¹	Level of Service ²
3	Huntley Road	Perth Street	Signal	0.25 (0.38)	EBT (WBT)	A (A)
4	McBean Street	Perth Street	Signal	0.45(0.40)	EBT (EBT)	A(A)
ID No.	North-South	East-West	Control	Critical Delay ³	Movement ¹	Level of Service ²
7	Queen Charlotte Street	Perth Street	Stop Control (N-S)	12.5s(16.2s)	SBT(SBT)	B(C)

1. Movement – indicates the movement associated with the associated performance characteristic (i.e.: V/C, delay).



Intersection				Performance Characteristics		
ID No.	North-South	East-West	Control	Critical V/C ³	Movement ¹	Level of Service ²

2. Level of Service (LOS) - Intersection Performance Rating (A - excellent conditions, F - congested conditions). For unsignalized intersections, the Overall LOS was taken to be the intersection's critical movement level of service.

3. Delay - Represents the delay in seconds experienced at the intersection (i.e.: critical, average)

NOTE: Format - morning peak hour (afternoon peak hour)

NOTE 2: Under optimized signal timing plans assuming the existing infrastructure to be in place.

4.0 FORECAST CONDITIONS

4.1 Site Traffic Generation

The Institute of Transportation Engineers (ITE) *Trip Generation* (8th Edition) was used to estimate site generated traffic characteristics for the CAIVAN Richmond Village Development. The following land uses (as described in *Trip Generation*) were used to approximate site traffic characteristics:

- o ITE Land Use 210 - Single Family Detached Housing;
- o ITE Land Use 230 - Residential Condominium/Townhouse.

The resulting traffic generation characteristics are detailed in **Table 2**. **Appendix C** provides full details regarding the traffic generation component of the forecasting exercise.

Table 2
Site Traffic Generation Characteristics

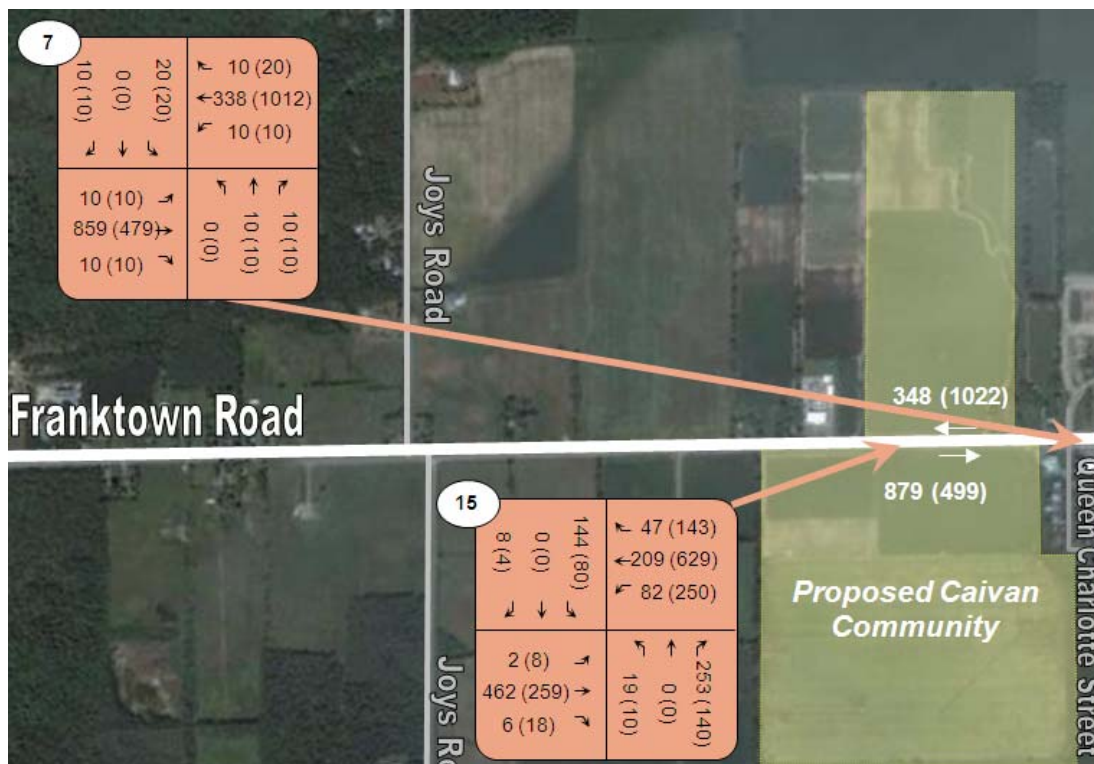
Land Use	Units	Morning Peak Hour			Afternoon Peak Hour		
		Total	Inbound	Outbound	Total	Inbound	Outbound
Totals (Site Plan)	1000	609	148	461	710	455	256
Singles	650	467	122	346	555	354	200
Condo/Townhouse	350	142	26	115	155	99	56

4.2 Trip Distribution and Assignment

Forecast traffic, based on the site traffic generation, was distributed according to the model developed in the Richmond Village TMP. The resulting volumes at the north-south collector are shown in **Figure 7**.



Figure 7 Forecast Traffic Distribution (2021)



Source: Richmond Village TMP (2010)

4.3 Future Traffic Operations

Using the background growth, the estimated trip generation and distribution in the Village of Richmond, the future traffic operations were predicted. **Table 3** summarizes the future traffic operations. It was found that most intersections in the Village of Richmond will function with excellent levels of service at both horizons (2021 and 2026).

One intersection of note is Queen Charlotte Street. At full build-out Queen Charlotte Street will function at a level of service of E in the evening peak hour. At full build-out, plus five years Queen Charlotte Street will function at a level of service of F in the evening peak hour.

4.4 Site Design Characteristics

As the Draft Plan is in its early stages, it is early to comment on specific site design characteristics (e.g.: local road geometry, daylight triangles, or turning templates). As each phase is prepared for site plan approval, the site design will be analyzed in the accompanying TIA's.

4.5 TDM

Transportation Demand Management will be discussed in the individual TIA's for each phase of the development.



Table 3
Forecast Intersection Capacity Analysis

2021							
Intersection				Performance Characteristics			
ID No.	North-South	East-West	Traffic Control	Critical V/C ⁴	Movement ¹	Overall V/C ⁴	Level of Service ²
3	Huntley Road	Perth Street	Signalized	0.51 (0.78)	EBT (EBL)	0.36 (0.59)	A (A)
4	McBean Street	Perth Street	Signalized	0.93 (0.64)	EBT (EBT)	0.50 (0.52)	A (A)
				Critical Delay ³ (s)	Movement ¹	Level of Service ²	
7	Queen Charlotte Street	Perth Street	Unsignalized	21.7 (48.5)	SBT (SBT)	C (E)	
				Critical Degree of Saturation		Control Delay (critical)	
15	N-S Spine Road	Perth Street	Roundabout	0.21 – E/W leg (0.12 – E/W leg)		1.9 – E/W leg (1.7 – E/W leg)	
2025							
Intersection				Performance Characteristics			
ID No.	North-South	East-West	Traffic Control	Critical V/C ⁴	Movement ¹	Overall V/C ⁴	Level of Service ²
3	Huntley Road	Perth Street	Signalized	0.53 (0.87)	EBT (EBL)	0.37 (0.65)	A (B)
4	McBean Street	Perth Street	Signalized	0.97 (0.66)	EBT (EBT)	0.51 (0.50)	A (A)
				Critical Delay ³ (s)	Movement ¹	Level of Service ²	
7	Queen Charlotte Street	Perth Street	Unsignalized	22.8 (56.9)	SBT (SBT)	C (F)	
				Critical Degree of Saturation		Control Delay (critical)	
15	N-S Spine Road	Perth Street	Roundabout	0.23 – E/W leg (0.14 – E/W leg)		1.9 – E/W leg (1.7 – E/W leg)	

1. Movement – indicates the movement associated with the associated performance characteristic (i.e.: V/C, delay).

2. Level of Service (LOS) - Intersection Performance Rating (A - excellent conditions, F - congested conditions). For unsignalized intersections, the Overall LOS was taken to be the intersection's critical movement level of service.

3. Delay – Represents the delay in seconds experienced at the intersection (i.e.: critical, average)

4 V/C Ratio – The ratio of volume to capacity. (0 – 1.00) 1.00 being the theoretical maximum.

NOTE: Format – morning peak hour (afternoon peak hour)



5.0 CONCLUSIONS

The proposed CAIVAN Communities development will be built out steadily over the course of approximately 10 years. As each phase is brought forward for site plan approval, individual TIA's will examine the impact of the phase on the community and develop mitigation strategies. The proposed access location on Perth Street is anticipated to be a roundabout and through the TIA's for each phase, the warrants for this roundabout will be tracked. This Transportation Brief shows the same conclusions as those found in the Richmond Village TMP, there exists traffic network capacity to support development within the Village of Richmond for many years.

The current transportation network in the Village of Richmond operates with high levels of service and minimal delays to users. No deficiencies exist that would prevent development from being initiated. As the development proceeds each phase will be discussed in an individual TIA. This will allow for the monitoring of the village network and for mitigation measures to be implemented as they are required. It is recommended that the City approve CAIVAN Communities Draft Plan Application.

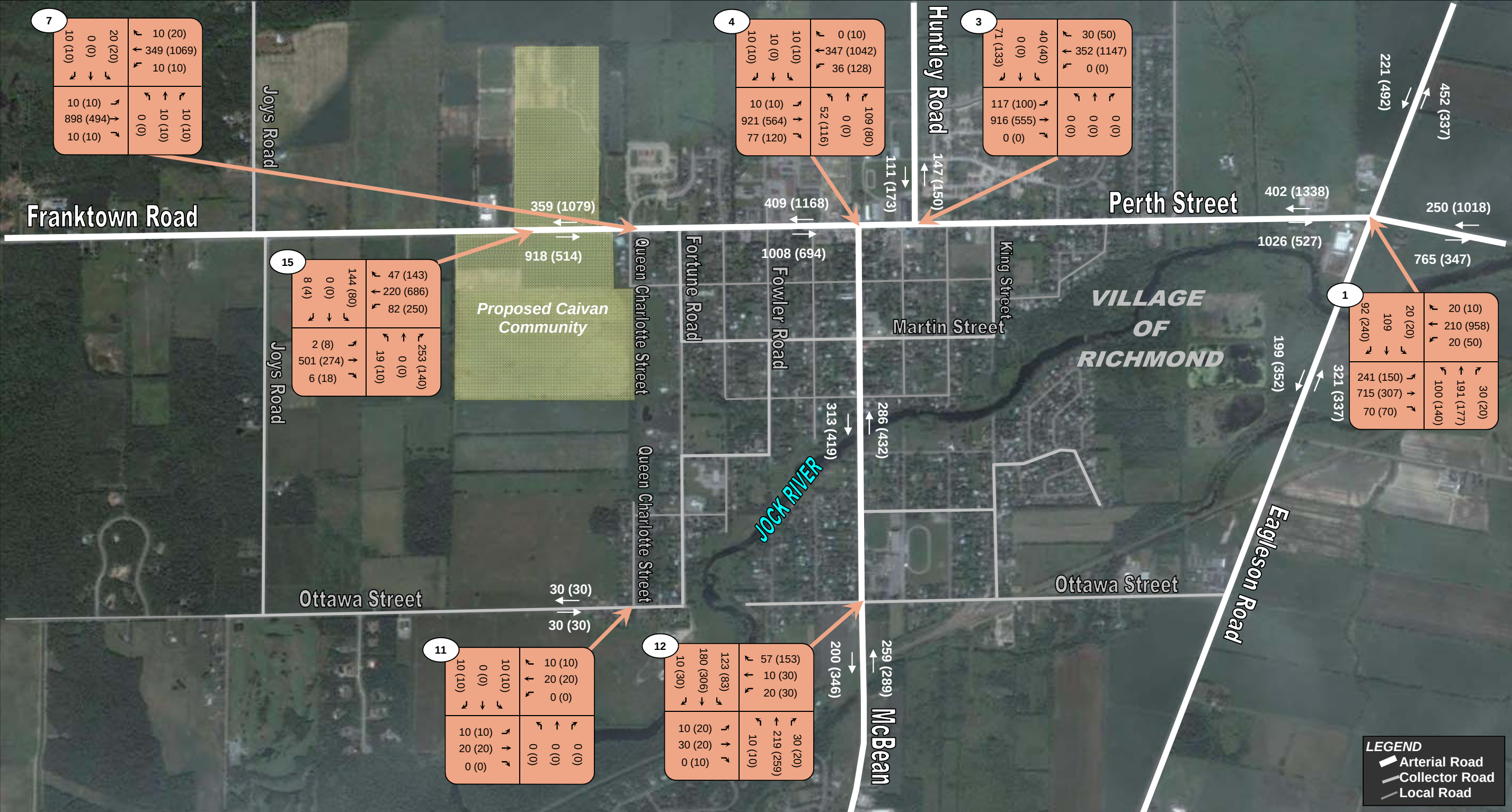


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Principal – Transportation

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Junior Transportation Engineer



Appendix A – Intersection Capacity Analysis

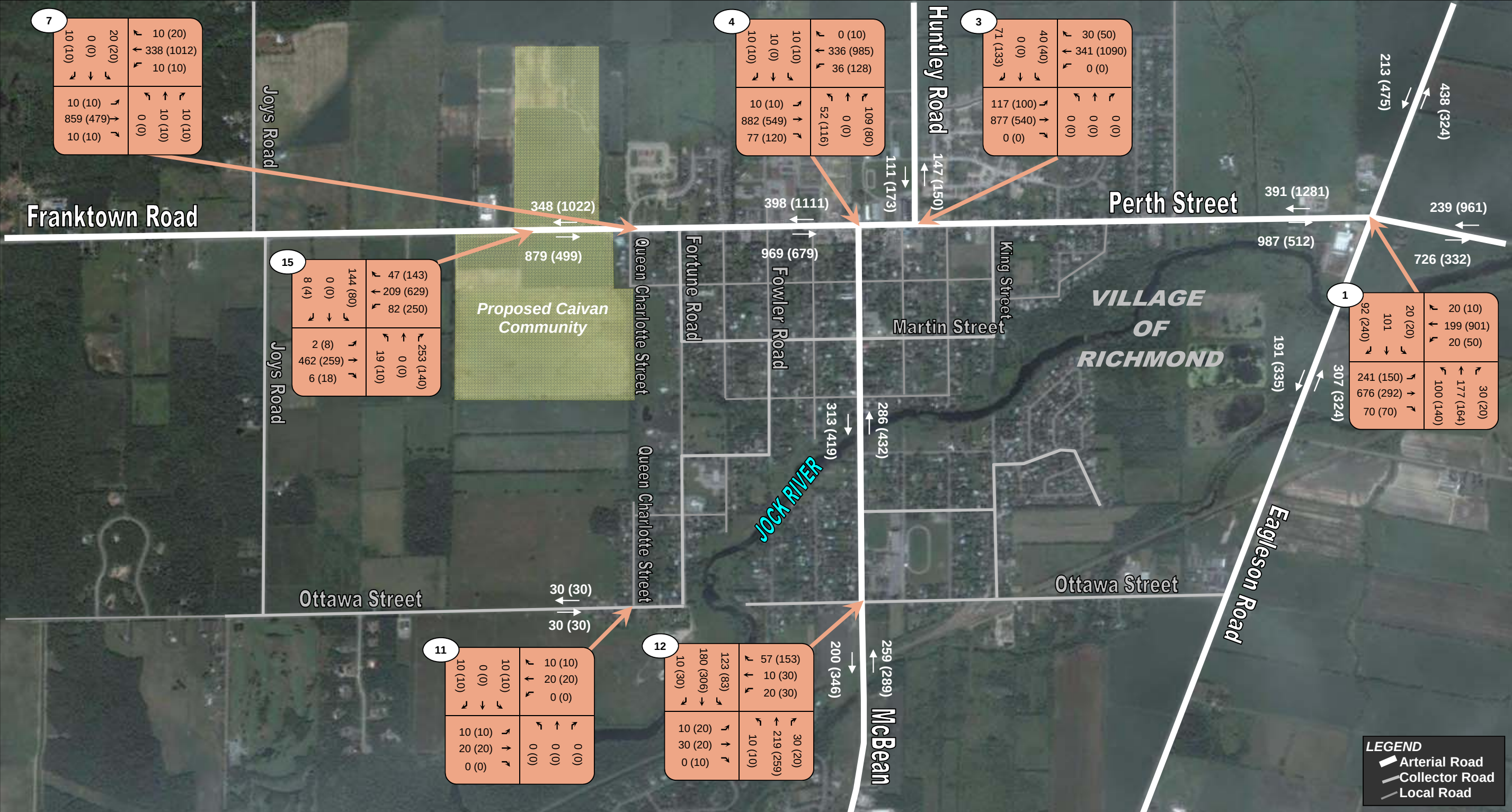


Total Traffic Forecast (Existing Infrastructure)

Horizon Year	Annual Background Growth
2026	Village of Richmond Arterials 2%
	Kanata/Stittsville - Barrhaven 5%
	Fallowfield Road west of Eagleson 6%

Assumptions:
Fitted Curve Traffic Generation Rates

Traffic Volume Format:
AM (PM)

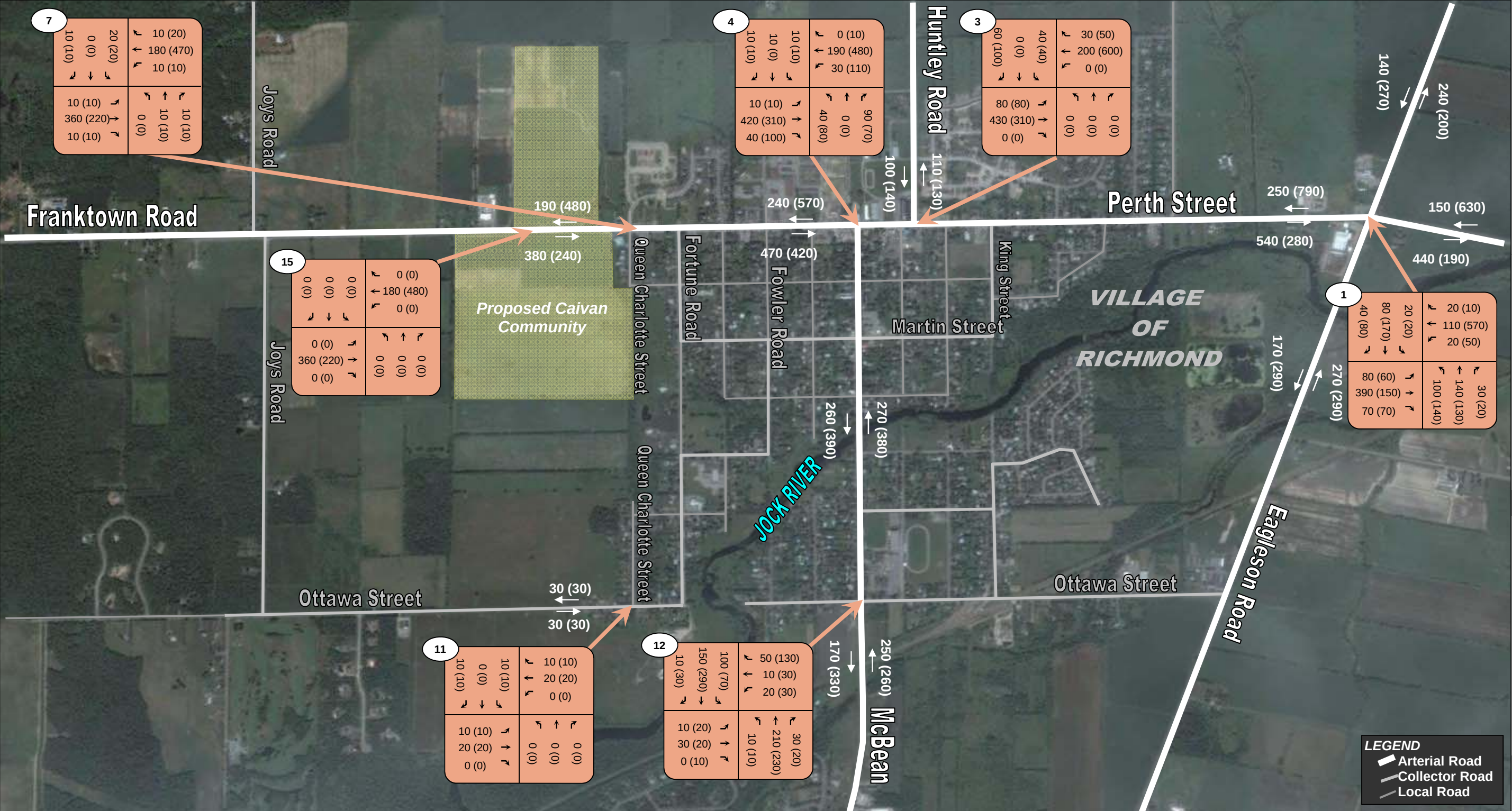


Total Traffic Forecast (Existing Infrastructure)

Horizon Year	Annual Background Growth	
2021	Village of Richmond Arterials	2%
	Kanata/Stittsville - Barrhaven	5%
	Fallowfield Road west of Eagleson	6%

Assumptions:
Fitted Curve Traffic Generation Rates

Traffic Volume Format:
AM (PM)



2011 Existing Traffic (Historical + Background Growth to 2011)

Horizon Year
2011

Annual Background Growth	
Village of Richmond Arterials	2%
Kanata/Stittsville - Barrhaven	5%
Fallowfield Road west of Eagleson	6%

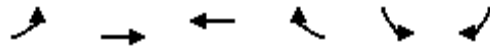
Assumptions:
Fitted Curve Traffic Generation Rates

Traffic Volume Format:
AM (PM)

HCM Signalized Intersection Capacity Analysis

3: Perth Street & Huntley Road

Caivan - Village of Richmond
2011 Existing Conditions - Morning Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Total Lost time (s)	5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.98		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1567	3320	3235		1644	1342
Flt Permitted	0.60	1.00	1.00		0.95	1.00
Satd. Flow (perm)	984	3320	3235		1644	1342
Volume (vph)	80	430	200	30	40	60
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	87	467	217	33	43	65
RTOR Reduction (vph)	0	0	14	0	0	45
Lane Group Flow (vph)	87	467	236	0	43	20
Confl. Peds. (#/hr)	1			1		
Heavy Vehicles (%)	9%	3%	2%	12%	4%	14%
Turn Type	Perm				Perm	
Protected Phases		4	8		6	
Permitted Phases	4					6
Actuated Green, G (s)	43.6	43.6	43.6		24.0	24.0
Effective Green, g (s)	45.0	45.0	45.0		25.0	25.0
Actuated g/C Ratio	0.56	0.56	0.56		0.31	0.31
Clearance Time (s)	6.4	6.4	6.4		6.0	6.0
Lane Grp Cap (vph)	554	1868	1820		514	419
v/s Ratio Prot		c0.14	0.07		c0.03	
v/s Ratio Perm	0.09					0.02
v/c Ratio	0.16	0.25	0.13		0.08	0.05
Uniform Delay, d1	8.4	8.9	8.3		19.4	19.2
Progression Factor	0.74	0.72	1.00		1.00	1.00
Incremental Delay, d2	0.6	0.3	0.1		0.3	0.2
Delay (s)	6.8	6.7	8.4		19.7	19.4
Level of Service	A	A	A		B	B
Approach Delay (s)		6.7	8.4		19.5	
Approach LOS		A	A		B	
Intersection Summary						
HCM Average Control Delay			8.7		HCM Level of Service	A
HCM Volume to Capacity ratio			0.19			
Actuated Cycle Length (s)			80.0		Sum of lost time (s)	10.0
Intersection Capacity Utilization			40.5%		ICU Level of Service	A
Analysis Period (min)			15			

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

4: Perth Street & Commercial Access

Caivan - Village of Richmond

2011 Existing Conditions - Morning Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	5.0	5.0		5.0	5.0		5.0	5.0			5.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00			1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00			1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00			1.00	
Frt	1.00	0.99		1.00	1.00		1.00	0.85			1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00			0.98	
Satd. Flow (prot)	1708	3184		1644	3353		1706	1430			1756	
Flt Permitted	0.62	1.00		0.34	1.00		0.74	1.00			0.89	
Satd. Flow (perm)	1118	3184		592	3353		1334	1430			1604	
Volume (vph)	10	420	40	30	190	0	40	0	90	10	10	0
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)	11	457	43	33	207	0	43	0	98	11	11	0
RTOR Reduction (vph)	0	9	0	0	0	0	0	67	0	0	0	0
Lane Group Flow (vph)	11	491	0	33	207	0	43	31	0	0	22	0
Confl. Peds. (#/hr)	1		2			1	2					3
Heavy Vehicles (%)	0%	6%	4%	4%	2%	0%	0%	0%	7%	0%	0%	0%
Turn Type	Perm		pm+pt		Perm		Perm		Perm		Perm	
Protected Phases	4		3		8		2		6		6	
Permitted Phases	4		8		2		6		6		6	
Actuated Green, G (s)	26.6	26.6		43.6	43.6		24.1	24.1			24.1	
Effective Green, g (s)	28.0	28.0		45.0	45.0		25.0	25.0			25.0	
Actuated g/C Ratio	0.35	0.35		0.56	0.56		0.31	0.31			0.31	
Clearance Time (s)	6.4	6.4		6.4	6.4		5.9	5.9			5.9	
Lane Grp Cap (vph)	391	1114		491	1886		417	447			501	
v/s Ratio Prot	c0.15		0.01		c0.06		0.02					
v/s Ratio Perm	0.01		0.03		c0.03						0.01	
v/c Ratio	0.03	0.44		0.07	0.11		0.10	0.07			0.04	
Uniform Delay, d1	17.1	20.0		8.3	8.2		19.5	19.3			19.2	
Progression Factor	1.00	1.00		0.79	0.78		1.00	1.00			1.00	
Incremental Delay, d2	0.1	1.3		0.3	0.1		0.5	0.3			0.2	
Delay (s)	17.2	21.2		6.9	6.5		20.0	19.6			19.3	
Level of Service	B	C		A	A		C	B			B	
Approach Delay (s)	21.2		6.5		19.7		19.3					
Approach LOS	C		A		B		B					
Intersection Summary												
HCM Average Control Delay			17.1		HCM Level of Service			B				
HCM Volume to Capacity ratio			0.25									
Actuated Cycle Length (s)			80.0		Sum of lost time (s)			15.0				
Intersection Capacity Utilization			49.6%		ICU Level of Service			A				
Analysis Period (min)			15									

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

7: Perth Street & Queen Charlotte Street

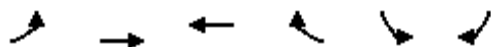
Caivan - Village of Richmond
2011 Existing Conditions - Morning Peak Hour

																						
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR										
Lane Configurations																						
Sign Control	Free			Free			Stop			Stop												
Grade	0%			0%			0%			0%												
Volume (veh/h)	0	360	0	10	180	10	10	0	10	20	0	0										
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92										
Hourly flow rate (vph)	0	391	0	11	196	11	11	0	11	22	0	0										
Pedestrians																						
Lane Width (m)																						
Walking Speed (m/s)																						
Percent Blockage																						
Right turn flare (veh)																						
Median type	None						None															
Median storage veh																						
Upstream signal (m)																						
pX, platoon unblocked																						
vC, conflicting volume	207			391			609	620	391	620	609	196										
vC1, stage 1 conf vol																						
vC2, stage 2 conf vol																						
vCu, unblocked vol	207			391			609	620	391	620	609	196										
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2										
tC, 2 stage (s)																						
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3										
p0 queue free %	100			99			97	100	98	94	100	100										
cM capacity (veh/h)	1365			1167			404	400	657	391	406	846										
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1																
Volume Total	0	391	207	11	22	22																
Volume Left	0	0	11	0	11	22																
Volume Right	0	0	0	11	11	0																
cSH	1700	1700	1167	1700	501	391																
Volume to Capacity	0.00	0.23	0.01	0.01	0.04	0.06																
Queue Length 95th (m)	0.0	0.0	0.2	0.0	1.1	1.4																
Control Delay (s)	0.0	0.0	0.5	0.0	12.5	14.7																
Lane LOS			A			B	B															
Approach Delay (s)	0.0			0.5			12.5	14.7														
Approach LOS					B	B																
Intersection Summary																						
Average Delay			1.1																			
Intersection Capacity Utilization			31.7%	ICU Level of Service				A														
Analysis Period (min)			15																			

HCM Signalized Intersection Capacity Analysis

3: Perth Street & Huntley Road

Caivan - Village of Richmond
2011 Existing Conditions - Afternoon Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Total Lost time (s)	5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.98		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1567	3320	3235		1644	1342
Flt Permitted	0.60	1.00	1.00		0.95	1.00
Satd. Flow (perm)	984	3320	3235		1644	1342
Volume (vph)	80	430	200	30	40	60
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	87	467	217	33	43	65
RTOR Reduction (vph)	0	0	14	0	0	45
Lane Group Flow (vph)	87	467	236	0	43	20
Confl. Peds. (#/hr)	1			1		
Heavy Vehicles (%)	9%	3%	2%	12%	4%	14%
Turn Type	Perm				Perm	
Protected Phases		4	8		6	
Permitted Phases	4					6
Actuated Green, G (s)	43.6	43.6	43.6		24.0	24.0
Effective Green, g (s)	45.0	45.0	45.0		25.0	25.0
Actuated g/C Ratio	0.56	0.56	0.56		0.31	0.31
Clearance Time (s)	6.4	6.4	6.4		6.0	6.0
Lane Grp Cap (vph)	554	1868	1820		514	419
v/s Ratio Prot		c0.14	0.07		c0.03	
v/s Ratio Perm	0.09					0.02
v/c Ratio	0.16	0.25	0.13		0.08	0.05
Uniform Delay, d1	8.4	8.9	8.3		19.4	19.2
Progression Factor	0.74	0.72	1.00		1.00	1.00
Incremental Delay, d2	0.6	0.3	0.1		0.3	0.2
Delay (s)	6.8	6.7	8.4		19.7	19.4
Level of Service	A	A	A		B	B
Approach Delay (s)		6.7	8.4		19.5	
Approach LOS		A	A		B	
Intersection Summary						
HCM Average Control Delay			8.7		HCM Level of Service	A
HCM Volume to Capacity ratio			0.19			
Actuated Cycle Length (s)			80.0		Sum of lost time (s)	10.0
Intersection Capacity Utilization			40.5%		ICU Level of Service	A
Analysis Period (min)			15			

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

4: Perth Street & Commercial Access

Caivan - Village of Richmond

2011 Existing Conditions - Afternoon Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	5.0	5.0		5.0	5.0		5.0	5.0			5.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00			1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00			1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00			1.00	
Frt	1.00	0.99		1.00	1.00		1.00	0.85			1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00			0.98	
Satd. Flow (prot)	1708	3184		1644	3353		1706	1430			1756	
Flt Permitted	0.62	1.00		0.34	1.00		0.74	1.00			0.89	
Satd. Flow (perm)	1118	3184		592	3353		1334	1430			1604	
Volume (vph)	10	420	40	30	190	0	40	0	90	10	10	0
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)	11	457	43	33	207	0	43	0	98	11	11	0
RTOR Reduction (vph)	0	9	0	0	0	0	0	67	0	0	0	0
Lane Group Flow (vph)	11	491	0	33	207	0	43	31	0	0	22	0
Confl. Peds. (#/hr)	1		2			1	2					3
Heavy Vehicles (%)	0%	6%	4%	4%	2%	0%	0%	0%	7%	0%	0%	0%
Turn Type	Perm		pm+pt		Perm		Perm		Perm		Perm	
Protected Phases	4		3		8		2		6		6	
Permitted Phases	4		8		2		6		6		6	
Actuated Green, G (s)	26.6	26.6		43.6	43.6		24.1	24.1			24.1	
Effective Green, g (s)	28.0	28.0		45.0	45.0		25.0	25.0			25.0	
Actuated g/C Ratio	0.35	0.35		0.56	0.56		0.31	0.31			0.31	
Clearance Time (s)	6.4	6.4		6.4	6.4		5.9	5.9			5.9	
Lane Grp Cap (vph)	391	1114		491	1886		417	447			501	
v/s Ratio Prot		c0.15		0.01	c0.06			0.02				
v/s Ratio Perm	0.01			0.03			c0.03				0.01	
v/c Ratio	0.03	0.44		0.07	0.11		0.10	0.07			0.04	
Uniform Delay, d1	17.1	20.0		8.3	8.2		19.5	19.3			19.2	
Progression Factor	1.00	1.00		0.79	0.78		1.00	1.00			1.00	
Incremental Delay, d2	0.1	1.3		0.3	0.1		0.5	0.3			0.2	
Delay (s)	17.2	21.2		6.9	6.5		20.0	19.6			19.3	
Level of Service	B	C		A	A		C	B			B	
Approach Delay (s)		21.2			6.5			19.7			19.3	
Approach LOS		C			A			B			B	
Intersection Summary												
HCM Average Control Delay	17.1			HCM Level of Service			B					
HCM Volume to Capacity ratio	0.25											
Actuated Cycle Length (s)	80.0			Sum of lost time (s)			15.0					
Intersection Capacity Utilization	49.6%			ICU Level of Service			A					
Analysis Period (min)	15											

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

7: Perth Street & Queen Charlotte Street

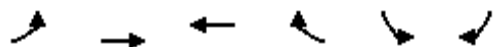
Caivan - Village of Richmond
2011 Existing Conditions - Afternoon Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	0	360	0	10	180	10	10	0	10	20	0	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	391	0	11	196	11	11	0	11	22	0	0
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	207			391			609	620	391	620	609	196
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	207			391			609	620	391	620	609	196
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			99			97	100	98	94	100	100
cM capacity (veh/h)	1365			1167			404	400	657	391	406	846
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total	0	391	207	11	22	22						
Volume Left	0	0	11	0	11	22						
Volume Right	0	0	0	11	11	0						
cSH	1700	1700	1167	1700	501	391						
Volume to Capacity	0.00	0.23	0.01	0.01	0.04	0.06						
Queue Length 95th (m)	0.0	0.0	0.2	0.0	1.1	1.4						
Control Delay (s)	0.0	0.0	0.5	0.0	12.5	14.7						
Lane LOS			A		B	B						
Approach Delay (s)	0.0		0.5		12.5	14.7						
Approach LOS					B	B						
Intersection Summary												
Average Delay			1.1									
Intersection Capacity Utilization			31.7%		ICU Level of Service				A			
Analysis Period (min)			15									

HCM Signalized Intersection Capacity Analysis

3: Perth Street & Huntley Road

Caivan - Village of Richmond
2021 Future Conditions - Morning Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Total Lost time (s)	5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1567	3320	3280		1644	1342
Flt Permitted	0.51	1.00	1.00		0.95	1.00
Satd. Flow (perm)	849	3320	3280		1644	1342
Volume (vph)	117	877	341	30	40	71
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	127	953	371	33	43	77
RTOR Reduction (vph)	0	0	8	0	0	53
Lane Group Flow (vph)	127	953	396	0	43	24
Confl. Peds. (#/hr)	1			1		
Heavy Vehicles (%)	9%	3%	2%	12%	4%	14%
Turn Type	Perm				Perm	
Protected Phases		4	8		6	
Permitted Phases	4					6
Actuated Green, G (s)	43.6	43.6	43.6		24.0	24.0
Effective Green, g (s)	45.0	45.0	45.0		25.0	25.0
Actuated g/C Ratio	0.56	0.56	0.56		0.31	0.31
Clearance Time (s)	6.4	6.4	6.4		6.0	6.0
Lane Grp Cap (vph)	478	1868	1845		514	419
v/s Ratio Prot		c0.29	0.12		c0.03	
v/s Ratio Perm	0.15					0.02
v/c Ratio	0.27	0.51	0.21		0.08	0.06
Uniform Delay, d1	9.0	10.7	8.7		19.4	19.3
Progression Factor	1.60	1.42	1.00		1.00	1.00
Incremental Delay, d2	0.7	0.5	0.3		0.3	0.3
Delay (s)	15.1	15.8	9.0		19.7	19.5
Level of Service	B	B	A		B	B
Approach Delay (s)		15.7	9.0		19.6	
Approach LOS		B	A		B	
Intersection Summary						
HCM Average Control Delay			14.3		HCM Level of Service	B
HCM Volume to Capacity ratio			0.36			
Actuated Cycle Length (s)			80.0		Sum of lost time (s)	10.0
Intersection Capacity Utilization			42.7%		ICU Level of Service	A
Analysis Period (min)			15			

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

4: Perth Street & Commercial Access

Caivan - Village of Richmond

2021 Future Conditions - Morning Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	5.0	5.0		5.0	5.0		5.0	5.0			5.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00			1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00			1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00			1.00	
Frt	1.00	0.99		1.00	1.00		1.00	0.85			1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00			0.98	
Satd. Flow (prot)	1708	3186		1644	3353		1706	1430			1756	
Flt Permitted	0.53	1.00		0.12	1.00		0.74	1.00			0.89	
Satd. Flow (perm)	961	3186		210	3353		1334	1430			1594	
Volume (vph)	10	882	77	36	336	0	52	0	109	10	10	0
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)	11	959	84	39	365	0	57	0	118	11	11	0
RTOR Reduction (vph)	0	8	0	0	0	0	0	81	0	0	0	0
Lane Group Flow (vph)	11	1035	0	39	365	0	57	37	0	0	22	0
Confl. Peds. (#/hr)	1		2			1	2					3
Heavy Vehicles (%)	0%	6%	4%	4%	2%	0%	0%	0%	7%	0%	0%	0%
Turn Type	Perm		pm+pt		Perm		Perm		Perm		Perm	
Protected Phases	4		3		8		2		6		6	
Permitted Phases	4		8		2		6		6		6	
Actuated Green, G (s)	26.6	26.6		43.6	43.6		24.1	24.1			24.1	
Effective Green, g (s)	28.0	28.0		45.0	45.0		25.0	25.0			25.0	
Actuated g/C Ratio	0.35	0.35		0.56	0.56		0.31	0.31			0.31	
Clearance Time (s)	6.4	6.4		6.4	6.4		5.9	5.9			5.9	
Lane Grp Cap (vph)	336	1115		333	1886		417	447			498	
v/s Ratio Prot	c0.32		0.02		c0.11		0.03					
v/s Ratio Perm	0.01		0.05		c0.04						0.01	
v/c Ratio	0.03	0.93		0.12	0.19		0.14	0.08			0.04	
Uniform Delay, d1	17.1	25.0		11.3	8.6		19.7	19.4			19.2	
Progression Factor	1.00	1.00		0.92	0.70		1.00	1.00			1.00	
Incremental Delay, d2	0.2	14.4		0.7	0.2		0.7	0.4			0.2	
Delay (s)	17.3	39.4		11.1	6.3		20.4	19.8			19.3	
Level of Service	B	D		B	A		C	B			B	
Approach Delay (s)	39.2		6.7		20.0		19.3					
Approach LOS	D		A		B		B					
Intersection Summary												
HCM Average Control Delay			29.0		HCM Level of Service			C				
HCM Volume to Capacity ratio			0.50									
Actuated Cycle Length (s)			80.0		Sum of lost time (s)			15.0				
Intersection Capacity Utilization			54.9%		ICU Level of Service			A				
Analysis Period (min)			15									

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

7: Perth Street & Queen Charlotte Street

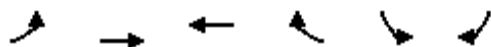
Caivan - Village of Richmond
2021 Future Conditions - Morning Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	0	859	0	10	338	10	0	0	10	20	0	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	934	0	11	367	11	0	0	11	22	0	0
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type	None								None			
Median storage veh												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	378			934			1139	1334	467	872	1328	189
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	378			934			1139	1334	467	872	1328	189
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			99			100	100	98	91	100	100
cM capacity (veh/h)	1177			729			154	150	543	237	152	821
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total	467	467	195	195	11	22						
Volume Left	0	0	11	0	0	22						
Volume Right	0	0	0	11	11	0						
cSH	1177	1700	729	1700	543	237						
Volume to Capacity	0.00	0.27	0.01	0.11	0.02	0.09						
Queue Length 95th (m)	0.0	0.0	0.4	0.0	0.5	2.4						
Control Delay (s)	0.0	0.0	0.7	0.0	11.8	21.7						
Lane LOS			A		B	C						
Approach Delay (s)	0.0		0.4		11.8	21.7						
Approach LOS					B	C						
Intersection Summary												
Average Delay			0.5									
Intersection Capacity Utilization			41.2%	ICU Level of Service					A			
Analysis Period (min)			15									

HCM Signalized Intersection Capacity Analysis

3: Perth Street & Huntley Road

Caivan - Village of Richmond
2021 Future Conditions - Afternoon Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Total Lost time (s)	5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1568	3320	3314		1644	1342
Flt Permitted	0.15	1.00	1.00		0.95	1.00
Satd. Flow (perm)	249	3320	3314		1644	1342
Volume (vph)	100	540	1090	50	40	133
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	109	587	1185	54	43	145
RTOR Reduction (vph)	0	0	4	0	0	45
Lane Group Flow (vph)	109	587	1235	0	43	100
Confl. Peds. (#/hr)	1			1		
Heavy Vehicles (%)	9%	3%	2%	12%	4%	14%
Turn Type	Perm				Perm	
Protected Phases		4	8		6	
Permitted Phases	4					6
Actuated Green, G (s)	43.6	43.6	43.6		24.0	24.0
Effective Green, g (s)	45.0	45.0	45.0		25.0	25.0
Actuated g/C Ratio	0.56	0.56	0.56		0.31	0.31
Clearance Time (s)	6.4	6.4	6.4		6.0	6.0
Lane Grp Cap (vph)	140	1868	1864		514	419
v/s Ratio Prot		0.18	0.37		0.03	
v/s Ratio Perm	c0.44					c0.07
v/c Ratio	0.78	0.31	0.66		0.08	0.24
Uniform Delay, d1	13.6	9.3	12.2		19.4	20.4
Progression Factor	1.69	1.04	1.00		1.00	1.00
Incremental Delay, d2	28.9	0.4	1.9		0.3	1.3
Delay (s)	51.9	10.0	14.1		19.7	21.8
Level of Service	D	B	B		B	C
Approach Delay (s)		16.6	14.1		21.3	
Approach LOS		B	B		C	
Intersection Summary						
HCM Average Control Delay			15.5		HCM Level of Service	B
HCM Volume to Capacity ratio			0.59			
Actuated Cycle Length (s)			80.0		Sum of lost time (s)	10.0
Intersection Capacity Utilization			56.0%		ICU Level of Service	B
Analysis Period (min)			15			

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

4: Perth Street & Commercial Access

Caivan - Village of Richmond

2021 Future Conditions - Afternoon Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	5.0	5.0		5.0	5.0		5.0	5.0			5.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00			1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00			0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00			1.00	
Frt	1.00	0.97		1.00	1.00		1.00	0.85			0.93	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00			0.98	
Satd. Flow (prot)	1709	3137		1644	3348		1706	1430			1625	
Flt Permitted	0.26	1.00		0.22	1.00		0.74	1.00			0.89	
Satd. Flow (perm)	475	3137		373	3348		1334	1430			1488	
Volume (vph)	10	549	120	128	985	10	116	0	80	10	0	10
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)	11	597	130	139	1071	11	126	0	87	11	0	11
RTOR Reduction (vph)	0	23	0	0	1	0	0	60	0	0	8	0
Lane Group Flow (vph)	11	704	0	139	1081	0	126	27	0	0	14	0
Confl. Peds. (#/hr)	1		2			1	2					3
Heavy Vehicles (%)	0%	6%	4%	4%	2%	0%	0%	0%	7%	0%	0%	0%
Turn Type	Perm		pm+pt		Perm		Perm		Perm		Perm	
Protected Phases	4		3		8		2		6		6	
Permitted Phases	4		8		2		6		6		6	
Actuated Green, G (s)	26.6	26.6		43.6	43.6		24.1	24.1			24.1	
Effective Green, g (s)	28.0	28.0		45.0	45.0		25.0	25.0			25.0	
Actuated g/C Ratio	0.35	0.35		0.56	0.56		0.31	0.31			0.31	
Clearance Time (s)	6.4	6.4		6.4	6.4		5.9	5.9			5.9	
Lane Grp Cap (vph)	166	1098		400	1883		417	447			465	
v/s Ratio Prot		c0.22		0.05	c0.32			0.02				
v/s Ratio Perm	0.02			0.14			c0.09				0.01	
v/c Ratio	0.07	0.64		0.35	0.57		0.30	0.06			0.03	
Uniform Delay, d1	17.3	21.8		9.9	11.3		20.9	19.3			19.1	
Progression Factor	1.00	1.00		1.01	0.55		1.00	1.00			1.00	
Incremental Delay, d2	0.8	2.9		1.9	1.0		1.9	0.3			0.1	
Delay (s)	18.1	24.7		11.9	7.2		22.7	19.5			19.2	
Level of Service	B	C		B	A		C	B			B	
Approach Delay (s)		24.6			7.7			21.4			19.2	
Approach LOS		C			A			C			B	
Intersection Summary												
HCM Average Control Delay	14.8			HCM Level of Service			B					
HCM Volume to Capacity ratio	0.52											
Actuated Cycle Length (s)	80.0			Sum of lost time (s)			15.0					
Intersection Capacity Utilization	60.7%			ICU Level of Service			B					
Analysis Period (min)	15											

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

7: Perth Street & Queen Charlotte Street

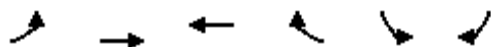
Caivan - Village of Richmond
2021 Future Conditions - Afternoon Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	10	479	10	10	1012	20	0	10	10	20	0	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	521	11	11	1100	22	0	11	11	22	0	11
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type	None								None			
Median storage veh												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1122			532			1130	1691	266	1431	1686	561
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1122			532			1130	1691	266	1431	1686	561
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	98			99			100	88	99	74	100	98
cM capacity (veh/h)	618			1032			151	90	732	83	90	471
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total	271	271	561	572	22	33						
Volume Left	11	0	11	0	0	22						
Volume Right	0	11	0	22	11	11						
cSH	618	1700	1032	1700	160	114						
Volume to Capacity	0.02	0.16	0.01	0.34	0.14	0.28						
Queue Length 95th (m)	0.4	0.0	0.3	0.0	3.7	8.7						
Control Delay (s)	0.7	0.0	0.3	0.0	31.0	48.5						
Lane LOS	A		A		D	E						
Approach Delay (s)	0.3		0.1		31.0	48.5						
Approach LOS					D	E						
Intersection Summary												
Average Delay			1.5									
Intersection Capacity Utilization			54.4%		ICU Level of Service				A			
Analysis Period (min)			15									

HCM Signalized Intersection Capacity Analysis

3: Perth Street & Huntley Road

Caivan - Village of Richmond
2026 Future Conditions - Morning Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Total Lost time (s)	5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1567	3320	3282		1644	1342
Flt Permitted	0.51	1.00	1.00		0.95	1.00
Satd. Flow (perm)	839	3320	3282		1644	1342
Volume (vph)	117	916	352	30	40	71
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	127	996	383	33	43	77
RTOR Reduction (vph)	0	0	8	0	0	53
Lane Group Flow (vph)	127	996	408	0	43	24
Confl. Peds. (#/hr)	1			1		
Heavy Vehicles (%)	9%	3%	2%	12%	4%	14%
Turn Type	Perm				Perm	
Protected Phases		4	8		6	
Permitted Phases	4					6
Actuated Green, G (s)	43.6	43.6	43.6		24.0	24.0
Effective Green, g (s)	45.0	45.0	45.0		25.0	25.0
Actuated g/C Ratio	0.56	0.56	0.56		0.31	0.31
Clearance Time (s)	6.4	6.4	6.4		6.0	6.0
Lane Grp Cap (vph)	472	1868	1846		514	419
v/s Ratio Prot		c0.30	0.12		c0.03	
v/s Ratio Perm	0.15					0.02
v/c Ratio	0.27	0.53	0.22		0.08	0.06
Uniform Delay, d1	9.0	10.9	8.7		19.4	19.3
Progression Factor	1.62	1.44	1.00		1.00	1.00
Incremental Delay, d2	0.6	0.5	0.3		0.3	0.3
Delay (s)	15.3	16.2	9.0		19.7	19.5
Level of Service	B	B	A		B	B
Approach Delay (s)		16.1	9.0		19.6	
Approach LOS		B	A		B	
Intersection Summary						
HCM Average Control Delay			14.6		HCM Level of Service	B
HCM Volume to Capacity ratio			0.37			
Actuated Cycle Length (s)			80.0		Sum of lost time (s)	10.0
Intersection Capacity Utilization			42.7%		ICU Level of Service	A
Analysis Period (min)			15			

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

4: Perth Street & Commercial Access

Caivan - Village of Richmond
2026 Future Conditions - Morning Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	5.0	5.0		5.0	5.0		5.0	5.0			5.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00			1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00			1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00			1.00	
Frt	1.00	0.99		1.00	1.00		1.00	0.85			1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00			0.98	
Satd. Flow (prot)	1708	3188		1644	3353		1706	1430			1756	
Flt Permitted	0.53	1.00		0.12	1.00		0.74	1.00			0.89	
Satd. Flow (perm)	949	3188		210	3353		1334	1430			1594	
Volume (vph)	10	921	77	36	347	0	52	0	109	10	10	0
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)	11	1001	84	39	377	0	57	0	118	11	11	0
RTOR Reduction (vph)	0	8	0	0	0	0	0	81	0	0	0	0
Lane Group Flow (vph)	11	1077	0	39	377	0	57	37	0	0	22	0
Confl. Peds. (#/hr)	1		2			1	2					3
Heavy Vehicles (%)	0%	6%	4%	4%	2%	0%	0%	0%	7%	0%	0%	0%
Turn Type	Perm		pm+pt		Perm		Perm		Perm		Perm	
Protected Phases	4		3		8		2		6		6	
Permitted Phases	4		8		2		6		6		6	
Actuated Green, G (s)	26.6	26.6		43.6	43.6		24.1	24.1			24.1	
Effective Green, g (s)	28.0	28.0		45.0	45.0		25.0	25.0			25.0	
Actuated g/C Ratio	0.35	0.35		0.56	0.56		0.31	0.31			0.31	
Clearance Time (s)	6.4	6.4		6.4	6.4		5.9	5.9			5.9	
Lane Grp Cap (vph)	332	1116		333	1886		417	447			498	
v/s Ratio Prot	c0.34		0.02		c0.11		0.03					
v/s Ratio Perm	0.01		0.05		c0.04						0.01	
v/c Ratio	0.03	0.97		0.12	0.20		0.14	0.08			0.04	
Uniform Delay, d1	17.1	25.5		11.7	8.6		19.7	19.4			19.2	
Progression Factor	1.00	1.00		0.92	0.70		1.00	1.00			1.00	
Incremental Delay, d2	0.2	19.8		0.7	0.2		0.7	0.4			0.2	
Delay (s)	17.3	45.3		11.4	6.2		20.4	19.8			19.3	
Level of Service	B	D		B	A		C	B			B	
Approach Delay (s)	45.0		6.7		20.0		19.3					
Approach LOS	D		A		B		B					
Intersection Summary												
HCM Average Control Delay			32.8		HCM Level of Service			C				
HCM Volume to Capacity ratio			0.51									
Actuated Cycle Length (s)			80.0		Sum of lost time (s)			15.0				
Intersection Capacity Utilization			54.9%		ICU Level of Service			A				
Analysis Period (min)			15									

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

7: Perth Street & Queen Charlotte Street

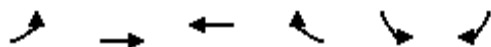
Caivan - Village of Richmond
2026 Future Conditions - Morning Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	0	898	0	10	349	10	0	0	10	20	0	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	976	0	11	379	11	0	0	11	22	0	0
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type	None								None			
Median storage veh												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	390			976			1188	1388	488	905	1383	195
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	390			976			1188	1388	488	905	1383	195
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			98			100	100	98	90	100	100
cM capacity (veh/h)	1165			702			142	139	526	224	140	813
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total	488	488	201	201	11	22						
Volume Left	0	0	11	0	0	22						
Volume Right	0	0	0	11	11	0						
cSH	1165	1700	702	1700	526	224						
Volume to Capacity	0.00	0.29	0.02	0.12	0.02	0.10						
Queue Length 95th (m)	0.0	0.0	0.4	0.0	0.5	2.5						
Control Delay (s)	0.0	0.0	0.7	0.0	12.0	22.8						
Lane LOS			A		B	C						
Approach Delay (s)	0.0		0.4		12.0	22.8						
Approach LOS					B	C						
Intersection Summary												
Average Delay			0.5									
Intersection Capacity Utilization			42.4%	ICU Level of Service				A				
Analysis Period (min)			15									

HCM Signalized Intersection Capacity Analysis

3: Perth Street & Huntley Road

Caivan - Village of Richmond
2026 Future Conditions - Afternoon Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Total Lost time (s)	5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1569	3320	3316		1644	1342
Flt Permitted	0.13	1.00	1.00		0.95	1.00
Satd. Flow (perm)	222	3320	3316		1644	1342
Volume (vph)	100	555	1147	50	40	133
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	109	603	1247	54	43	145
RTOR Reduction (vph)	0	0	4	0	0	39
Lane Group Flow (vph)	109	603	1297	0	43	107
Confl. Peds. (#/hr)	1			1		
Heavy Vehicles (%)	9%	3%	2%	12%	4%	14%
Turn Type	Perm				Perm	
Protected Phases		4	8		6	
Permitted Phases	4					6
Actuated Green, G (s)	43.6	43.6	43.6		24.0	24.0
Effective Green, g (s)	45.0	45.0	45.0		25.0	25.0
Actuated g/C Ratio	0.56	0.56	0.56		0.31	0.31
Clearance Time (s)	6.4	6.4	6.4		6.0	6.0
Lane Grp Cap (vph)	125	1868	1865		514	419
v/s Ratio Prot		0.18	0.39		0.03	
v/s Ratio Perm	c0.49					c0.08
v/c Ratio	0.87	0.32	0.70		0.08	0.25
Uniform Delay, d1	15.0	9.4	12.6		19.4	20.5
Progression Factor	1.72	1.06	1.00		1.00	1.00
Incremental Delay, d2	44.9	0.4	2.2		0.3	1.5
Delay (s)	70.7	10.3	14.7		19.7	22.0
Level of Service	E	B	B		B	C
Approach Delay (s)		19.6	14.7		21.5	
Approach LOS		B	B		C	
Intersection Summary						
HCM Average Control Delay			16.9		HCM Level of Service	B
HCM Volume to Capacity ratio			0.65			
Actuated Cycle Length (s)			80.0		Sum of lost time (s)	10.0
Intersection Capacity Utilization			57.7%		ICU Level of Service	B
Analysis Period (min)			15			

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

4: Perth Street & Commercial Access

Caivan - Village of Richmond

2026 Future Conditions - Afternoon Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	5.0	5.0		5.0	5.0		5.0	5.0			5.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00			1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00			0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00			1.00	
Frt	1.00	0.97		1.00	1.00		1.00	0.85			0.93	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00			0.98	
Satd. Flow (prot)	1709	3139		1644	3348		1706	1430			1625	
Flt Permitted	0.25	1.00		0.21	1.00		0.74	1.00			0.89	
Satd. Flow (perm)	447	3139		360	3348		1334	1430			1488	
Volume (vph)	10	564	120	128	1042	10	116	0	80	10	0	10
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)	11	613	130	139	1133	11	126	0	87	11	0	11
RTOR Reduction (vph)	0	22	0	0	1	0	0	60	0	0	8	0
Lane Group Flow (vph)	11	721	0	139	1143	0	126	27	0	0	14	0
Confl. Peds. (#/hr)	1		2			1	2					3
Heavy Vehicles (%)	0%	6%	4%	4%	2%	0%	0%	0%	7%	0%	0%	0%
Turn Type	Perm		pm+pt		Perm		Perm		Perm		Perm	
Protected Phases	4		3		8		2		6		6	
Permitted Phases	4		8		2		6		6		6	
Actuated Green, G (s)	26.6	26.6		43.6	43.6		24.1	24.1			24.1	
Effective Green, g (s)	28.0	28.0		45.0	45.0		25.0	25.0			25.0	
Actuated g/C Ratio	0.35	0.35		0.56	0.56		0.31	0.31			0.31	
Clearance Time (s)	6.4	6.4		6.4	6.4		5.9	5.9			5.9	
Lane Grp Cap (vph)	156	1099		395	1883		417	447			465	
v/s Ratio Prot		0.23		0.05	c0.34			0.02				
v/s Ratio Perm	0.02			0.15			c0.09				0.01	
v/c Ratio	0.07	0.66		0.35	0.61		0.30	0.06			0.03	
Uniform Delay, d1	17.3	21.9		10.0	11.6		20.9	19.3			19.1	
Progression Factor	1.00	1.00		1.04	0.56		1.00	1.00			1.00	
Incremental Delay, d2	0.9	3.1		1.8	1.1		1.9	0.3			0.1	
Delay (s)	18.2	25.0		12.3	7.6		22.7	19.5			19.2	
Level of Service	B	C		B	A		C	B			B	
Approach Delay (s)		24.9			8.1			21.4			19.2	
Approach LOS		C			A			C			B	
Intersection Summary												
HCM Average Control Delay	15.1			HCM Level of Service			B					
HCM Volume to Capacity ratio	0.50											
Actuated Cycle Length (s)	80.0			Sum of lost time (s)			10.0					
Intersection Capacity Utilization	62.4%			ICU Level of Service			B					
Analysis Period (min)	15											

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

7: Perth Street & Queen Charlotte Street

Caivan - Village of Richmond
2026 Future Conditions - Afternoon Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	10	494	10	10	1069	20	0	10	10	20	0	10
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	537	11	11	1162	22	0	11	11	22	0	11
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type	None								None			
Median storage veh												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1184			548			1178	1770	274	1501	1764	592
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1184			548			1178	1770	274	1501	1764	592
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	98			99			100	86	98	70	100	98
cM capacity (veh/h)	586			1018			139	80	724	73	81	450
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total	279	279	592	603	22	33						
Volume Left	11	0	11	0	0	22						
Volume Right	0	11	0	22	11	11						
cSH	586	1700	1018	1700	144	101						
Volume to Capacity	0.02	0.16	0.01	0.35	0.15	0.32						
Queue Length 95th (m)	0.5	0.0	0.3	0.0	4.1	10.0						
Control Delay (s)	0.7	0.0	0.3	0.0	34.3	56.9						
Lane LOS	A		A		D	F						
Approach Delay (s)	0.3		0.1		34.3	56.9						
Approach LOS					D	F						
Intersection Summary												
Average Delay			1.6									
Intersection Capacity Utilization			56.1%		ICU Level of Service				B			
Analysis Period (min)			15									



GENIVAR

Intersection Performance Analysis Summary Report Two Lane Roundabout

Project Name: Caivan Richmond TB

Project Number: 111-18482-00

Date of Analysis: June 17, 2011

Intersection: Perth Street/N-S Spine Road

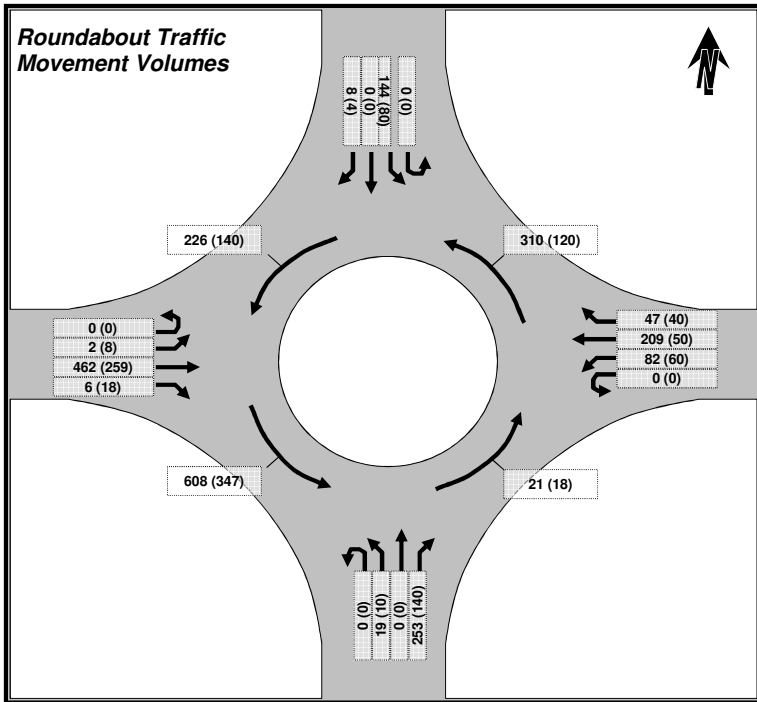
Scenario: Full Build Out

Horizon Year: 2021 Horizon

Time of Day: Peak Hours (AM and PM)

File:

Roundabout Traffic Movement Volumes



Performance Characteristics

North Leg

Degree of Saturation	0.07 (0.04)
Control Delay	1.6 (1.6)
Queue Length (50th Percentile)	0.1 (0)
Queue Length (95th Percentile)	0 (0)

South Leg

Degree of Saturation	0.14 (0.07)
Control Delay	1.7 (1.6)
Queue Length (50th Percentile)	0.1 (0.1)
Queue Length (95th Percentile)	0 (0)

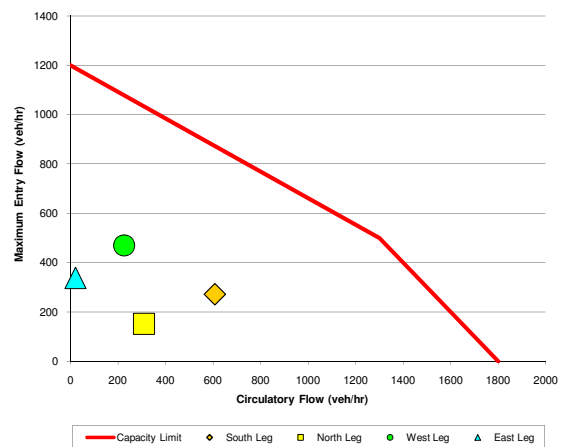
East Leg

Degree of Saturation	0.21 (0.12)
Control Delay	1.9 (1.7)
Queue Length (50th Percentile)	0.2 (0.1)
Queue Length (95th Percentile)	0 (0)

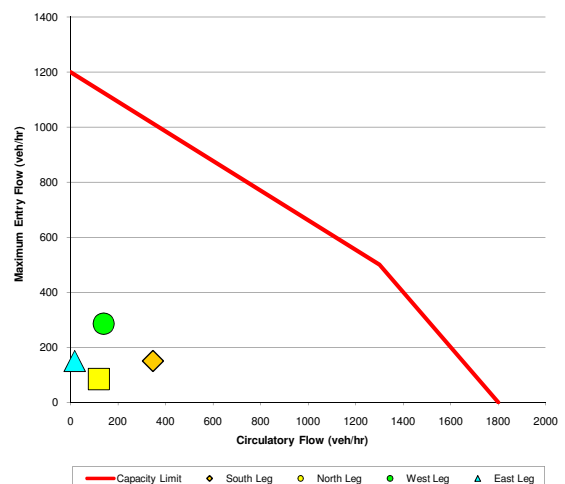
West Leg

Degree of Saturation	0.21 (0.12)
Control Delay	1.9 (1.7)
Queue Length (50th Percentile)	0.2 (0.1)
Queue Length (95th Percentile)	0 (0)

Capacity Analysis - Two-Lane Roundabout
Morning Peak Hour



Capacity Analysis - Two-Lane Roundabout
Afternoon Peak Hour





GENIVAR

Intersection Performance Analysis Summary Report Two Lane Roundabout

Project Name: Caivan Richmond TB

Project Number: 111-18482-00

Date of Analysis: June 17, 2011

Intersection: Perth Street/N-S Spine Road

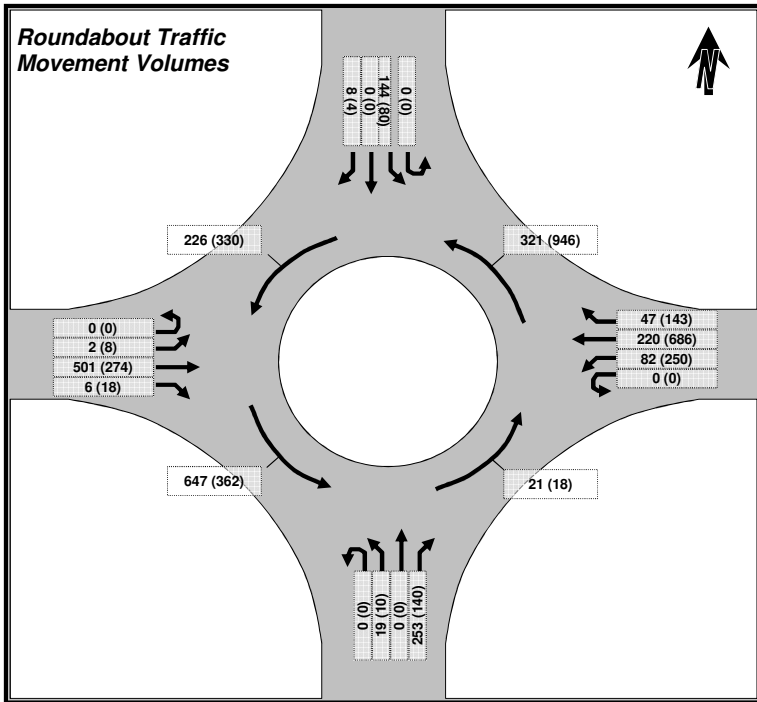
Scenario: Full Build Out + 5 Years

Horizon Year: 2026 Horizon

Time of Day: Peak Hours (AM and PM)

File:

Roundabout Traffic Movement Volumes



Performance Characteristics

North Leg

Degree of Saturation	0.07 (0.05)
Control Delay	1.6 (1.6)
Queue Length (50th Percentile)	0.1 (0)
Queue Length (95th Percentile)	0 (0)

South Leg

Degree of Saturation	0.14 (0.07)
Control Delay	1.7 (1.6)
Queue Length (50th Percentile)	0.1 (0.1)
Queue Length (95th Percentile)	0 (0)

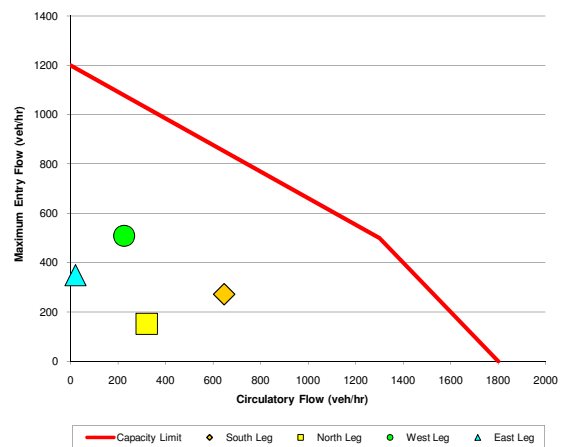
East Leg

Degree of Saturation	0.23 (0.14)
Control Delay	1.9 (1.7)
Queue Length (50th Percentile)	0.3 (0.1)
Queue Length (95th Percentile)	0 (0)

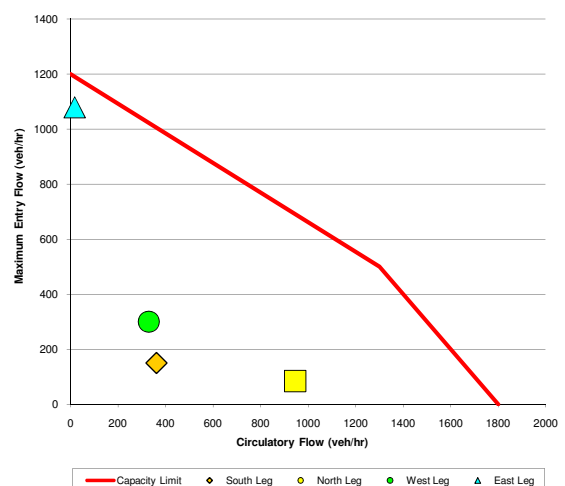
West Leg

Degree of Saturation	0.23 (0.14)
Control Delay	1.9 (1.7)
Queue Length (50th Percentile)	0.3 (0.1)
Queue Length (95th Percentile)	0 (0)

Capacity Analysis - Two-Lane Roundabout
Morning Peak Hour



Capacity Analysis - Two-Lane Roundabout
Afternoon Peak Hour





Appendix B – Transit Information

Date: June 16, 2011

Route 283 Downtown <-> Richmond & Munster Hamlet**Weekday – Direction: Downtown**

Note: Route 283 Downtown - the first two morning trips will serve Bayshore Station 'on request' on

Mnster Flewel lyn	McBean Perth	Fallow field Stplhl	Hurd man	Blair S tn
05:35	05:53	06:15	06:50	
06:05	06:23	06:46	07:21	
06:35	06:54	07:17	07:54	08:01
	07:25	07:50	08:28	

Weekday – Direction: Richmond & Munster Hamlet

Note: Route 283 Downtown - the first two morning trips will serve Bayshore Station 'on request' on

Hurd man	Albert Kent	McBean Perth	Mnster Flewel lyn
15:35	15:46	16:39	
16:05	16:16	17:09	17:28
16:40	16:50	17:39	17:58
17:30	17:40	18:29	



Appendix C – Trip Generation Tables

Traffic Generation

Project: Village of Richmond - Caivan

Selected Traffic Generation Method:

Fitted Curve Traffic Generation Rates

Table 1: Traffic Generation Characteristics (using formulas)

	Potential Build-Out Units	Trips					
		Morning Peak Hour			Afternoon Peak Hour		
		Total	Inbound	Outbound	Total	Inbound	Outbound
Zone 1	330	201	49	152	234	150	84
Single Family Detached	214	154	40	114	183	117	66
Condominium / Townhouse	116	47	9	38	51	33	18
Apartment / Quadraplexes	0	0	0	0	0	0	0
Low-Rise Condominium / Townhouse	0	0	0	0	0	0	0
Zone 2	670	408	99	309	476	305	171
Single Family Detached	436	313	82	232	373	238	134
Condominium / Townhouse	234	95	18	77	104	66	37
Apartment / Quadraplexes	0	0	0	0	0	0	0
Low-Rise Condominium / Townhouse	0	0	0	0	0	0	0
Totals	1,000	609	148	461	710	455	256
Single Family Detached	650	467	122	346	555	355	200
Condominium / Townhouse	350	142	27	115	155	99	56
Apartment / Quadraplexes	0	0	0	0	0	0	0
Low-Rise Condominium / Townhouse	0	0	0	0	0	0	0

Traffic Generation Rates
Project: Village of Richmond - Mattamy

Table 1: Traffic Generation Characteristics

		Traffic Generation Rates								Units	ITE Reference
		Morning Peak Hour				Afternoon Peak Hour					
		Trip Rate		%	%	Trip Rate		%	%		
		Average	Formula			Average	Formula				
Residential	Single Family Detached	0.77	T = 0.7(X) + 12.37	26%	74%	1.02	Ln(T) = 0.88 Ln(X) + .62	64%	36%	Dwelling Units	Land Use 210
	Condominium / Townhouse	0.44	Ln(T) = 0.82 Ln(X) + 0.15	19%	81%	0.52	(T) = 0.34 (X) + 35.87	64%	36%	Dwelling Units	Land Use 230
	Apartment / Quadraplexes	0.55	T = 0.54(X) + 2.45	29%	71%	0.67	T = 0.60(X) + 14.91	67%	33%	Dwelling Units	Land Use 220
	Low-Rise Condominium / Townhouse	0.54	Ln(T) = 0.90 Ln(X) - 0.07	18%	82%	0.52	Ln(T) = 0.89 Ln(X) - 0.07	55%	45%	Dwelling Units	Land Use 231
Commercial	Service Station	12.27	T = 9.810(X) + 18.865	51%	49%	14.56	N/A	51%	49%	Vehicle Fueling Positions	Land Use 844
	Convenience Market (Open 15-16 Hours)	31.02	T = 291.630(X) - 662.095	50%	50%	34.57	T = 175.882(X) - 358.940	49%	51%	100 ft² Gross Floor Area	Land Use 852