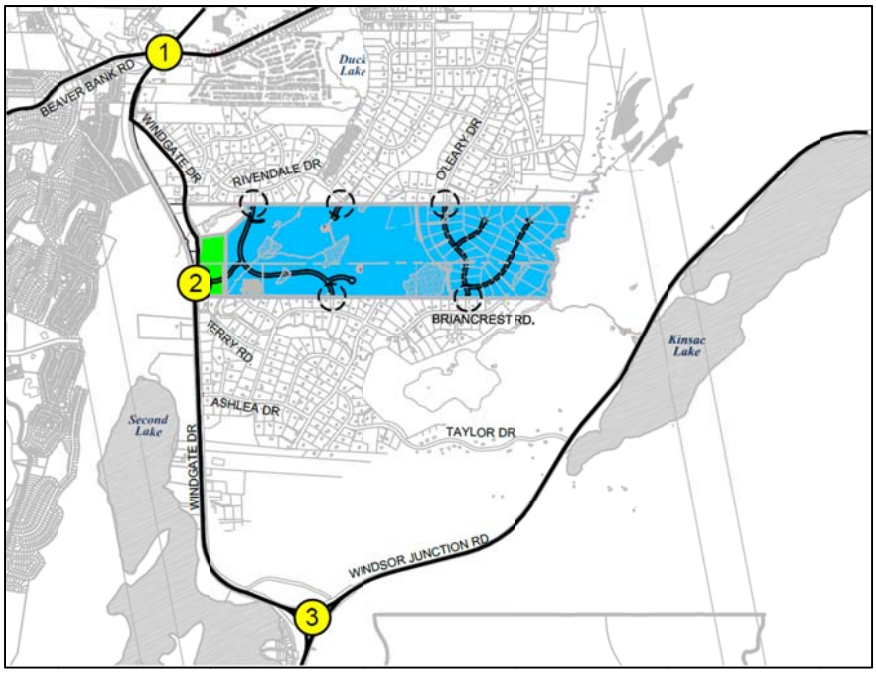
Appendix 5

Traffic Impact Study



FINAL REPORT

Traffic Impact Study:

Proposed "Windgate Village" Mixed Use Development

Beaver Bank, NS

Presented to:
Marque Investments Ltd.

March 2015
Ref# 141-24579

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1.0 Introduction

Background

Plans are being prepared by Marque Investments Ltd. for the development of "Windgate Village", a mixed use residential / commercial subdivision in Beaver Bank, NS. The proposed development is located at PID# 41043597, a large undeveloped parcel located between "Capilano Country Estates" and "Rivendale Estates", two residential subdivisions with frontages along Windgate Drive (See Figure 1).

The proposed development will include a mix of residential and commercial land uses. The south end of the parcel – located adjacent to Windgate Drive – includes commercial developments and a mix of multi-unit, townhouse, and detached single family residential units. The north end of the parcel, which will be accessed via existing residential streets, will comprise detached single family residential units only. It is anticipated that buildout of the development will be completed by 2025.

WSP Canada Inc. has been retained to complete a Traffic Impact Study satisfactory to the Halifax Regional Municipality (HRM).

A Traffic Impact Study Usually Considers Four Questions

A Traffic Impact Study usually consists of determining answers for the following questions:

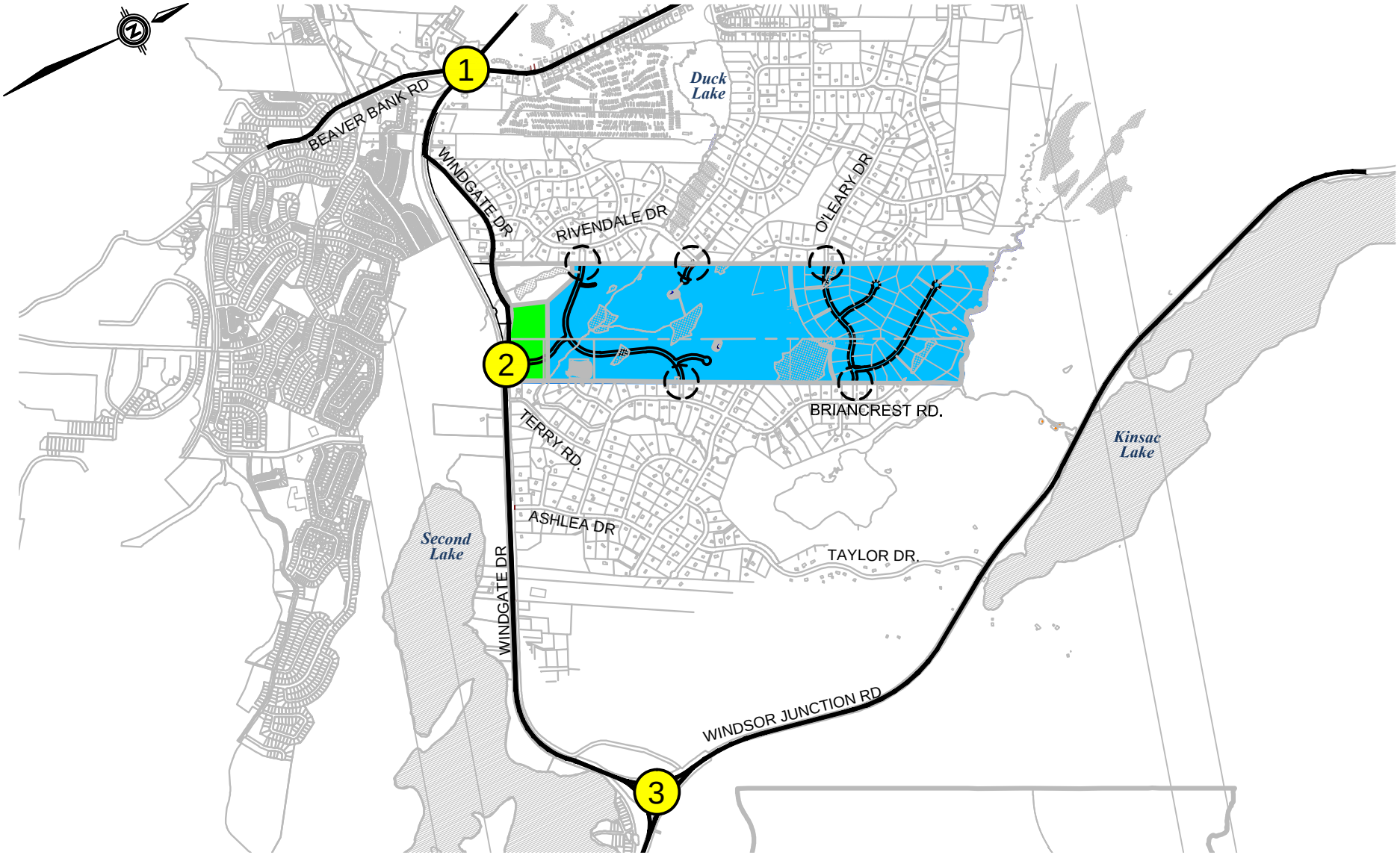
1. **What are the existing traffic situations** on roads adjacent to the study site? How have traffic volumes increased historically?
2. **What traffic changes are expected** at Study Area intersections? How many vehicle trips will be generated by the proposed development during weekday peak hours? How will the traffic be distributed at the exits from the development and to Study Area roads and intersections?
3. **What traffic impacts will occur** on Study Area roads and intersections? How will level of service of roads and intersections be affected?
4. **What road or intersection improvements are required** to mitigate project impacts on Study Area traffic movements?

Study Objectives

The following are the primary objectives of this Study:

1. Develop projected 2025 background weekday AM and PM peak hourly volumes for Study Area roads that do not include trips generated by proposed site development.
2. Estimate the number of weekday AM and PM peak hour trips that will be generated by the proposed development.
3. Distribute and assign site generated trips to Study Area intersections.
4. Add site generated trips to projected 2025 background peak hourly volumes to provide projected volumes that include site generated trips.
5. Evaluate impacts of site generated traffic on the performance and level of service of study intersections.
6. Complete traffic signal warrant analyses, as necessary, for intersections in the vicinity of the proposed development.

7. Complete left-turn lane warrants, as necessary, for intersections on Windgate Drive that access the proposed development.
8. Recommend improvements that may be needed at study intersections to mitigate the impacts of site development.



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TITLE:

FIGURE 1 – STUDY AREA

ACCESS POINTS
RESIDENTIAL DEVELOPMENT
COMMERCIAL DEVELOPMENT

PROJECT NO:	DATE: (YYYY/MM/DD)	SCALE:
141-24579	2015/03/16	1:30,000

1 WINDGATE DR @ BEAVER BANK RD
2 WINDGATE DR @ PROPOSED SITE ACCESS
3 WINDGATE DR @ WINDSOR JUNCTION RD

WSP REF. NO.: ---- K:\DARTMOUTH\2014\141-24579-01 BEAVER BANK, STAGE 2 OPEN SPACE DESIGN\11_ DWG\11.4_CIVIL\11.4.2_PRODUCTION_DRAWINGS\141-24579-01 – TRAFFIC STUDY.DWG I – ANSI A L PRINTED: 2:35 PM 2015/03/16 BY: THEO.GRAHA

2.0 Study Area Descriptions

Site Description

The proposed site is an approximately 83 hectare undeveloped parcel located between "Capilano Country Estates" and "Rivendale Estates", two residential subdivisions between Beaver Bank Road and Windsor Junction Road. The south end of the site will be accessed via a new driveway to Windgate Drive and street connections to Rivendale Drive and Capilano Drive. The north end of the site will be accessed via existing local streets including O'Leary Drive and Briancrest Road. A road connection between the north and south portions of the site is not included in the development concept.

Road and Intersection Descriptions

Windgate Drive is a 2-lane collector road that runs east-west approximately 4.7km between Beaver Bank Road and Windsor Junction Road. In the vicinity of the Study Area, it has gravel shoulders and open ditches; the posted speed limit is 70km/h. Annual average daily traffic volumes on Windgate Drive just west of Rivendale Drive are approximately 3,600 vehicles per day (vpd).

Photo 1: Looking east on Windgate Drive. The proposed development site is to the left of the photo.

Beaver Bank Road is a 2-lane collector road that runs north-south approximately 21km between Lower Sackville and East Uniacke Road. In the vicinity of Windgate Drive, it has curb and gutter with sidewalk on the east side and gravel shoulders and open ditches on the west side. Annual average daily traffic volumes on Beaver Bank Road just north of Windgate Drive are approximately 14,700 vehicles per day (vpd).

The Beaver Bank Road – Windgate Drive intersection is unsignalized, with stop control on Windgate Drive. There is an exclusive left turn lane on the Beaver Bank Road southbound approach; all other approaches are single lane.

Windsor Junction Road is a 2-lane collector road that runs north-south approximately 3.5km between Cobequid Road and Fall River Road. In the vicinity of Windgate Drive it has gravel shoulders and open ditches on both sides. Annual average daily traffic volumes on Windsor Junction Road just south of Windgate Drive are approximately 3,700 vehicles per day (vpd).

Road and Intersection Descriptions (Continued)

The Windgate Drive – Windsor Junction Road intersection is unsignalized, with stop control on the Windgate Drive approach. All approaches are single lane.

Rivendale Drive and ***O'Leary Drive*** are 2-lane paved local residential streets located west of the proposed development. Rivendale Drive provides access from the south end of the site to Windgate Drive, and O'Leary Drive will provide access (via other local streets) between the north end of the development and Beaver Bank Road. ***Capilano Drive, Briancrest Road, Terry Road,*** and ***Taylor Drive*** are 2-lane paved local residential streets located east of the proposed development. ***Capilano Drive, Briancrest Road***, ***and Terry Road*** will connect the development south to Windgate Drive, while ***Taylor Drive*** provides a connection northeast toward Fall River. Each street has a posted speed limit of 50km/h.

Public Transportation

Halifax Transit operates Route #400 (formerly Beaver Bank Community Transit) on Beaver Bank Road between Beaver Bank Villa and the Sackville Terminal, where it provides connection to additional routes including the Metrolink service. The route has stops just north of Windgate Drive.

Proposed Site Access (South End of Development)

The south end of the site will be accessed via new street connections to Windgate Drive, Rivendale Drive, and Capilano Drive. The proposed connection to Windgate Drive is located approximately 200m west of Terry Road (See Photo 2 and Photo 3).

Stopping sight distances (SSD) – measured from a driver eye height of 1.05 m to a 150 mm object – were observed on the Windgate Drive eastbound and westbound approaches to a location in the vicinity of the proposed access intersection. Observations indicated SSD greater than 150 meters on the eastbound approach, which exceeds the minimum 134m required for an assumed operating speed of 80km/h on a +1% approach grade. On the westbound approach, observations indicated SSD of approximately 96m, which is less than the recommended minimum of 128m for 80km/h operating speed on a +4% approach grade. Further investigation should be completed to determine a final location, and to determine whether modifications to the existing road profile are necessary to improve sight distance.

Photo 2: Looking east (to the left) on Windgate Drive from the proposed site access Intersection.

Photo 3: Looking west (to the right) on Windgate Drive from the proposed site access Intersection

Connections to Rivendale Drive and Capilano Drive will also provide access to the south end of the development. Sight distance (See Photo 4 to Photo 7) on the approaches at both intersections appears adequate.

Photo 4: Looking south (to the left) on Rivendale Drive from the proposed site access Intersection.

Photo 5: Looking north (to the right) on Rivendale Drive from the proposed site access Intersection

Photo 6: Looking north (to the left) on Capilano Drive from the proposed site access Intersection.

Photo 7: Looking south (to the right) on Capilano Drive from the proposed site access Intersection

Proposed Site Access (North End of Development)

The north end of the site will be accessed via connections to O'Leary Drive and Briancrest Road. O'Leary Drive (Photo 8) will be extended from its existing terminus across the development to connect to Briancrest Road. The proposed O'Leary Drive – Briancrest Road intersection (Photo 9 and Photo 10) will be located approximately 75m north of Vickilynn Lane. Sight distance on both approaches appears adequate.

Photo 8: Looking west on O'Leary Drive from the proposed site access connection.

Photo 9: Looking north (to the right) on Rivendale Drive from the proposed site access Intersection

Photo 10: Looking north (to the left) on Capilano Drive from the proposed site access Intersection.

Traffic Volume Data

HRM Traffic & Right-of-Way Services (TROW) obtained a machine traffic count on Windgate Drive between Beaver Bank Road and Rivendale Drive (just west of the proposed development) during October 2013. Counts indicate Windgate Drive two-way AM and PM peak hour volumes of about 220 and 256 vehicles per hour, respectively. The graphical representation of average weekday hourly volumes during a 24 hour day (Figure 2) illustrates the pronounced 'peaks' of AM and PM peak hour volumes typical of a road with commuter traffic.

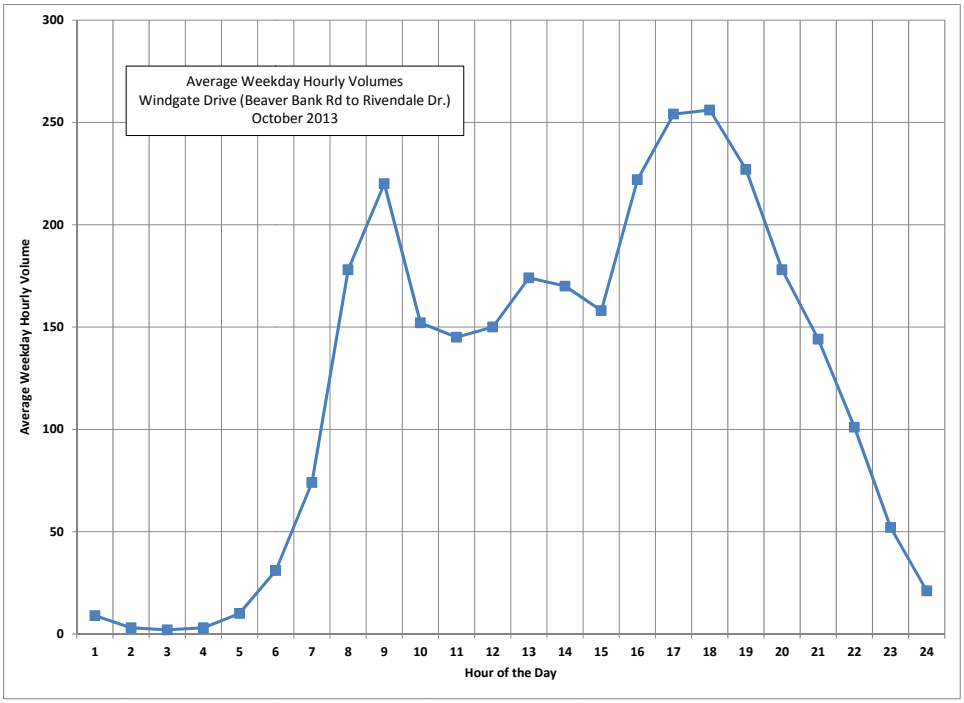


Figure 2: Average Weekday Hourly Volumes – October 2013: Windgate Drive (Beaver Bank Road to Rivendale Drive)

Annual Volume Trends

Historical volume data obtained by HRM between 2011 and 2013 on Windgate Drive (just west of the proposed development) do not indicate a consistent growth trend in volumes. Volumes are in the range of 3,600 vehicles per day. An annual growth rate of 1.0% typical of growth in the Halifax region has been used for the projecting future year traffic volumes for this study.

Manual Traffic Count

Manual traffic counts were obtained during AM and PM peak periods between Wednesday, March 4 and Friday, March 6, 2015 at Windgate Drive intersections at Rivendale Drive and Windsor Junction Road. A count completed by HRM on Friday, August 10, 2012 at the Windgate Drive – Beaver Bank Road intersection was also obtained from HRM TROW. Turning movement counts are tabulated in Tables A-1 to A-3, Appendix A, with peak hour volumes indicated by shaded areas.

Redistribution of Background Volumes

The proposed street connections across the development will provide alternate routing options for existing residents of the area. In some cases, the new east-west connections will shorten the distance required to make certain trips. Overall, it is expected that the potential impact on existing streets and intersections will be minimal, as volumes are relatively low and will likely balance out. Background projections for this Study have incorporated redistribution of volumes based on the presence of the proposed street connections.

Projected 2015 and 2025 Background Volumes

Projected 2025 weekday AM and PM peak hour background volumes, calculated using an annual traffic volume growth rate of 1.0%, are illustrated diagrammatically in Figure A-1 (Boxes A and B), Appendix A.

3.0 Trip Generation, Distribution, and Assignment

Description of Proposed Development

The proposed residential development will include a mix of residential and commercial land uses. The south end of the parcel – located adjacent to Windgate Drive – includes commercial developments, a mix of multi-unit and single family residential units, and a sports field / community park. The north end of the parcel, which will be accessed via existing residential streets, will comprise single family residential units only. Proposed land uses are summarized in Table 3-1.

Table 3-1: Summary of Proposed Developments

Development Area	Access	Proposed Land Uses
1	Windgate Drive Rivendale Drive Capilano Drive	**Residential:** - 46 Detached Single Family Units - 44 Townhouse Units - 120 Apartment Units **Commercial:** - 60,000 SF Specialty Retail
2	O'Leary Drive Briancrest Road	**Residential:** - 55 Detached Single Family Units

The proposed commercial parcel includes approximately 11.5 acres of developable land. The Beaver Bank, Hammonds Plains and Upper Sackville LUB for a C-4 (Highway Commercial Zone) includes the following general limitations for development:

- Minimum lot area – 30,000 SF
- Minimum lot frontage – 100 feet
- Maximum gross floor area on a lot – 10,000 SF

Considering the size and configuration of the commercial parcel, it is estimated that the site will support approximately six lots which will allow construction of up to 60,000 square feet of commercial buildings. Since expected land uses are not known at this time, trip generation estimates have been prepared for a Specialty Retail land use.

Estimation of Total Site Generated Trips

The number of trips that will be generated by the proposed development has been estimated using rates published in *Trip Generation, 9th Edition* (Washington, 2012). Trip generation estimates, which are summarized in Table 3-2, indicate that the proposed development is expected to generate approximately 251 two-way vehicle trips (85 vph entering and 166 vph exiting) during the AM peak hour and 381 two-way vehicle trips (211 vph entering and 170 vph exiting) during the PM peak hour.

Table 3-2 - Trip Generation Estimates for Proposed Development

Land Use	Units[2]	Trip Generation Rates[1]				Trips Generated			
		AM Peak		PM Peak		AM Peak		PM Peak	
		In	Out	In	Out	In	Out	In	Out
Trip Generation Estimates for Area 1 (Southern Portion)									
Single Family Residential (ITE Land Use Code 210)[3]	90	0.19	0.56	0.63	0.37	17	50	57	33
Apartment (ITE Land Use Code 222)	120	0.10	0.41	0.40	0.22	12	49	48	26
Specialty Retail[4] (ITE Land Use Code 826)	60	0.76	0.60	1.19	1.52	46	36	71	91
Trip Generation Estimates for Area 1						75	135	176	150
Trip Generation Estimates for Area 2 (Northern Portion)									
Single Family Residential (ITE Land Use Code 210)[3]	55	0.19	0.56	0.63	0.37	10	31	35	20
Total Trip Generation Estimates for Proposed Development						85	166	211	170

Notes:
1. Trip generation rates are 'vehicles per hour per unit' for Single Family Residential (Land Use Code 210), published in *Trip Generation, 9th Edition*, Institute of Transportation Engineers, 2012.
2. Residential units are dwellings. KGLA is 'Gross Leasable Area x 1000 square feet'.
3. The Single Family Residential (Land Use Code 210) has been used to estimate trip generation for townhouse units.
4. The Speciality Retail (Land Use 826) rate for 'Peak Hour of Adjacent Street Traffic, One Hour Between 4 and 6 PM' has been used. Since there is no published rate for the AM peak hour of adjacent street for this Land Use, and since AM peak hour trips to Speciality Retail are generally low, AM trip rates have been assumed to be 50% of the PM rate with reversal of the directional split.

Trip Distribution and Assignment

Based on review of the local street network and development surrounding the site as well as local knowledge of the area, external trips generated by the proposed development have been distributed as summarized in Table 3-3. Assigned site generated trips at Study Area intersections are shown diagrammatically in Figure A-2 (Boxes A and B), Appendix A.

Table 3-3: Trip Distribution Summary

Development Area	Direction	
1 (South)	East – Windgate Drive	45%
	East – Taylor Drive	10%
	West – Windgate Drive	45%
2 (North)	East – Windgate Drive	35%
	East – Taylor Drive	20%
	West – Windgate Drive	10%
	West – O'Leary Drive	35%

Projected 2025 Volumes that Include Site Generated Trips

Site generated trips have been added to the projected 2025 background volumes (Figure A-1, Boxes A and B) to provide projected 2025 volumes that include site generated trips which are illustrated diagrammatically in Figure A-3 (Boxes A and B), Appendix A.

4.0 Intersection Performance Analysis

4.1 Traffic Signal Warrant Analysis

Traffic Signal Warrant Principles

A signal warrant analysis is completed to determine if the installation of traffic signals at an intersection will provide a positive impact on total intersection operation. That is, the benefits in time saved and improved safety that will accrue to vehicles entering from a side street will exceed the impact that signals will have in time lost and potential additional collisions for vehicles approaching the intersection on the main street.

The Canadian Traffic Signal Warrant Matrix Analysis (Transportation Association of Canada (TAC), 2005) considers 100 warrant points as an indication that traffic signals will provide a positive impact. Signal warrant analysis uses vehicular and pedestrian volumes, and intersection, roadway and study area characteristics to calculate a warrant point value.

Traffic Signal Warrant Analysis

Signal warrant analyses were completed for Windgate Drive intersections at Beaver Bank Road and Windsor Junction Road for projected 2025 background traffic with the addition of trips generated by the proposed development. Results, which are summarized in Table 4-1, indicate that traffic signals are not expected to be warranted at either intersection both without and with site development.

Table 4-1: TAC Traffic Signal Warrant Points by Development Scenario

Development Scenario	Intersection	
	Windgate Drive @ Beaver Bank Road	**Windgate Drive @ Windsor Junction Road**
2025 Background <u>without</u> Site Development	63 Points (Signals not warranted) [Table A-4]	(Signals not warranted)
2025 Background <u>with</u> Site Development	88 Points (Signals not warranted) [Table A-5]	21 Points (Signals not warranted) [Table A-6]

4.2 Turn Lane Warrant Analysis

Left Turn Lane Warrant Analysis

Left turn movements on a two lane street may cause both operational and safety problems. Operational problems result as a vehicle stopped waiting for an opportunity to turn across 'heavy' opposing traffic causes a queue of stopped vehicles to form. Safety problems result from rear end collisions when a stopped left turning vehicle is struck by an advancing vehicle, or from head-on or right angle collisions when a left turning vehicle is struck by an opposing vehicle.

The Geometric Design Standards for Ontario Highways Manual contains nomographs for left turn lane analysis for two lane streets. The analysis method, which is normally used by WSP Atlantic to

evaluate need for left turn lanes, uses a series of nomographs that consider speed, advancing volumes, left turns as a percentage of advancing volumes, and opposing volumes. A point, based on 'opposing' and 'advancing' volumes, plotted to the right of the 'warrant line' of the appropriate '% left turns' and 'approach speed' nomograph, indicates that a left turn lane is warranted for the conditions used in the analysis. Similarly, a point that is plotted to the left of the warrant line indicates that a left turn lane is not warranted.

Analysis of left turn lane warrants was completed (Figure A-4, Appendix A) for eastbound left turns from Windgate Drive into the new site access intersection for projected 2025 volumes with the addition of site generated trips. The analysis indicated that left turn lanes are not expected to be warranted based on weekday AM and PM peak hour traffic volumes.

4.3 Int ersection Level of Service Analysis

Intersection Level of Service Analysis

The level or quality of performance of an intersection in terms of traffic movement is determined by a level of service (LOS) analysis. LOS for intersections is defined in terms of delay, which is a measure of driver discomfort and frustration, fuel consumption, and increased travel time.

Level of Service (LOS) Criteria

LOS criteria (Table 4-2) are stated in terms of average control delay per vehicle which includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay.

Table 4-2 - Level of Service (LOS) Criteria for Intersections

LOS	LOS Description	Two Way Stop Controlled (TWSC) Intersections Control Delay (Seconds per Vehicle)
A	Very low delay; most vehicles do not stop **(Excellent)**	Less than 10.0
B	Higher delay; most vehicles stop **(Very Good)**	Between 10.0 and 15.0
C	Higher level of congestion; number of vehicles stopping is significant, although many still pass through intersection without stopping **(Good)**	Between 15.0 and 25.0
D	Congestion becomes noticeable; vehicles must sometimes wait through more than one red light; many vehicles stop **(Satisfactory)**	Between 25.0 and 35.0
E	Vehicles must often wait through more than one red light; considered by many agencies to be the limit of **acceptable** delay	Between 35.0 and 50.0
F	This level is considered to be unacceptable to most drivers; occurs when arrival flow rates exceed the capacity of the intersection **(Unacceptable)**	Greater than 50.0

Intersection Level of Service Analysis

Synchro 8.0 software has been used for performance evaluation of Study Area intersections on Beaver Bank Road for 2025 AM and PM peak hour volumes without and with site development.

Level of service (LOS) analysis results are included in Appendix B and are summarized in Tables 4-3 to 4-5.

Summary Level of Service Analysis

Windgate Drive @ Beaver Bank Road (Table 4-3) – With the exception of the Windgate Drive westbound approach, overall intersection performance is good. Results indicate that the Windgate Drive approach will experience excessive average delay, V/C ratio, and queue lengths – particularly the PM peak hour – both without and with the addition of site generated trips. It is noted that analysis of unsignalized intersections using Synchro software does have limitations that result in it reporting unreasonably poor levels of performance as a movement approaches capacity. For this reason, it is expected that the results indicated for the PM peak hour (both without and with development) are not representative of actual conditions.

Windgate Drive @ Windsor Junction Road (Table 4-4) – Intersection performance is expected to be satisfactory both without and with the addition of site generated trips. All movements operate within HRM acceptable limits.

Windgate Drive @ Proposed Site Access (Table 4-5) – Intersection performance is expected to be satisfactory; all movements operate within HRM acceptable limits.

Table 4-3 - LOS for Beaver Bank Road @ Windgate Drive

LOS Criteria	Control Delay (sec/veh), LOS, v/c Ratio, and 95th% Queue (m) by Intersection Movement				Overall Intersection	
	WB-LR	NB-TR	SB-L	SB-T	Delay	LOS
Weekday AM Peak Hour - Projected 2025 Volumes without Site Development (Page B-1)						
Delay v/c Queue	39.2 0.52 20.2	0.0 0.18 0	8.0 0.04 0.9	0.0 0.49 0	3.6	A
Weekday AM Peak Hour - Projected 2025 Volumes with Site Development (Page B-5)						
Delay v/c Queue	77.8 0.87 51.7	0.0 0.2 0	8.1 0.05 1.2	0.0 0.49 0	10.7	B
Weekday PM Peak Hour - Projected 2025 Volumes without Site Development (Page B-3)						
Delay v/c Queue	288.8 1.41 89.7	0.0 0.71 0.0	11.6 0.06 1.4	0.0 0.28 0.0	26.8	D
Weekday PM Peak Hour - Projected 2025 Volumes with Site Development (Page B-8)						
Delay v/c Queue	747.2 2.45 175.9	0.0 0.76 0	12.5 0.11 2.8	0.0 0.28 0	92.8	F

Table 4-4 - LOS for Windsor Junction Road @ Windgate Drive

LOS Criteria	Control Delay (sec/veh), LOS, v/c Ratio, and 95th% Queue (m) by Intersection Movement			Overall Intersection	
	EB-LR	NB-LT	SB-TR	Delay	LOS
Weekday AM Peak Hour - Projected 2025 Volumes without Site Development (Page B-2)					
Delay v/c Queue	12.1 0.38 13.7	3.1 0.03 0.6	0.0 0.09 0.0	7.3	A
Weekday AM Peak Hour - Projected 2025 Volumes with Site Development (Page B-6)					
Delay v/c Queue	14.1 0.5 21.3	3.7 0.04 0.8	0.0 0.11 0	8.6	A
Weekday PM Peak Hour - Projected 2025 Volumes without Site Development (Page B-4)					
Delay v/c Queue	13.3 0.24 7.0	4.6 0.10 2.4	0.0 0.10 0	5.3	A
Weekday PM Peak Hour - Projected 2025 Volumes with Site Development (Page B-9)					
Delay v/c Queue	17.8 0.44 16.7	5.1 0.12 3.2	0.0 0.14 0	7.2	A

Table 4-5 - LOS for Windgate Drive @ Proposed Site Access Street

LOS Criteria	Control Delay (sec/veh), LOS, v/c Ratio, and 95th% Queue (m) by Intersection Movement			Overall Intersection	
	EB-LT	WB-TR	SB-LR	Delay	LOS
Weekday AM Peak Hour - Projected 2025 Volumes with Site Development (Page B-7)					
Delay	1.1	0.0	10.4	3.0	A
v/c	0.02	0.07	0.13		
Queue	0.5	0.0	3.5		
Weekday PM Peak Hour - Projected 2025 Volumes with Site Development (Page B-10)					
Delay	2.8	0	12.2	3.4	A
v/c	0.06	0.15	0.18		
Queue	1.3	0	12.2		

5.0 Summary, Recommendations, and Conclusions

Description of the Proposed Development

1. Plans are being prepared by Marque Investments Ltd. for the development of "Windgate Village", a mixed use residential / commercial subdivision in Beaver Bank, NS. The proposed development will include a mix of residential and commercial land uses. The south end of the parcel – located adjacent to Windgate Drive – includes commercial developments and a mix of multi-unit, townhouse, and detached single family residential units. The north end of the parcel, which will be accessed via existing residential streets, will comprise detached single family residential units only. It is anticipated that buildout of the development will be completed by 2025.

Proposed Site Access

2. Separate site accesses will be provided to the north and south ends of the proposed development. The south end of the site will be accessed via new street connections to Windgate Drive, Rivendale Drive, and Capilano Drive. The north end of the site will be accessed via connections to O'Leary Drive and Briancrest Road.

Description of Study Area Roads

3. ***Windgate Drive*** is a 2-lane collector road that runs east-west approximately 4.7km between Beaver Bank Road and Windsor Junction Road. In the vicinity of the Study Area, it has gravel shoulders and open ditches; the posted speed limit is 70km/h.

   Beaver Bank Road is a 2-lane collector road that runs north-south approximately 21km between Lower Sackville and East Uniacke Road.

   Windsor Junction Road is a 2-lane collector road that runs north-south approximately 3.5km between Cobequid Road and Fall River Road.

   Rivendale Drive and ***O'Leary Drive*** are 2-lane paved local residential streets located west of the proposed development. Rivendale Drive provides access from the south end of the site to Windgate Drive, and O'Leary Drive will provide access (via other local streets) between the north end of the development and Beaver Bank Road. ***Capilano Drive, Briancrest Road, Terry Road,*** and ***Taylor Drive*** are 2-lane paved local residential streets located east of the proposed development. ***Capilano Drive, Briancrest Road***, ***and Terry Road*** will connect the development south to Windgate Drive, while ***Taylor Drive*** provides a connection northeast toward Fall River.

Background Traffic Volumes

4. Projected 2025 weekday AM and PM peak hour background volumes were calculated using an annual traffic volume growth rate of 1.0%.

Estimation of Site Generated Trips for the Proposed Development

5. The proposed development is expected to generate approximately 251 two-way vehicle trips (85 vph entering and 166 vph exiting) during the AM peak hour and 381 two-way vehicle trips (211 vph entering and 170 vph exiting) during the PM peak hour.

Trip Distribution and Assignment

6. External trips generated by the development have been assigned to study area streets and intersections based on review of the local street network and development surrounding the site as well as local knowledge of the area.

Signal Warrant Analysis

7. Signal warrant analyses were completed for Windgate Drive intersections at Beaver Bank Road and Windsor Junction Road for projected 2025 background traffic with the addition of trips generated by the proposed development. Traffic signals are not expected to be warranted at the Beaver Bank Road (88 warrant points) or the Windsor Junction Road (21 warrant points) intersections.

Left Turn Lane Warrant

8. Analysis of left turn lane warrants was completed for eastbound left turns from Windgate Drive into the proposed site access street for projected 2025 volumes with the addition of site generated trips. The analysis indicated that left turn lanes are <u>not</u> expected to be warranted for all scenarios.

Summary - Level of Service Analysis

9. Intersection performance analysis was completed for Windgate Drive intersections at Beaver Bank Road, Windsor Junction Road, and the proposed site access street. Results indicate that intersection performance at the Windgate Drive - Windsor Junction Road and Windgate Drive - proposed site access street intersections are expected to be satisfactory based on 2025 AM and PM peak hour volumes both without and with site development. At the Beaver Bank Road – Windgate Drive intersection, results indicate that the Windgate Drive (westbound) approach will experience excessive average delay, V/C ratio, and queue lengths -- particularly the PM peak hour – both without and with the addition of site generated trips.

Recommendations

10. Further investigation should be completed to determine a final location for the proposed site access road to Windgate Drive, and to determine whether modifications to the existing road profile are necessary to improve sight distance.

11. Consideration should be given to the installation of traffic signals at the Beaver Bank Road – Windgate Drive intersection to accommodate existing traffic demand as well as projected traffic demand (both without and with site development). Though traffic signal warrants were not met, installation of signals will improve unacceptably high delays currently experienced on the Windgate Drive approach during AM and PM peak periods.

Conclusions

12. Site generated trips are not expected to have a significant impact to traffic performance in the Study Area.

Appendix A

Intersection Turning Movement Counts

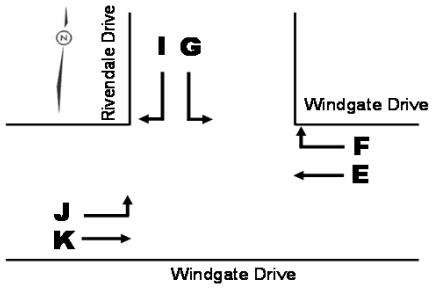
Traffic Volume Diagrams

Traffic Signal Warrants

Table A-1

Windgate Drive
@
Rivendale Drive

Beaver Bank, NS
Wednesday, March 4, 2015



AM Peak Period Volume Data

Time		Windgate Drive Westbound Approach		Rivendale Drive Southbound Approach		Windgate Drive Eastbound Approach		Total Vehicles
		E	F	G	I	J	K	
07:00	07:15	11	0	6	3	1	12	33
07:15	07:30	11	0	8	5	0	14	38
07:30	07:45	21	3	14	11	2	28	79
07:45	08:00	12	2	14	5	1	41	75
08:00	08:15	6	1	8	8	2	29	54
08:15	08:30	21	2	3	8	2	25	61
08:30	08:45	12	2	9	3	4	28	58
08:45	09:00	15	2	12	3	1	25	58
AM Peak Hour		**60**	**8**	**39**	**32**	**7**	**123**	**269**

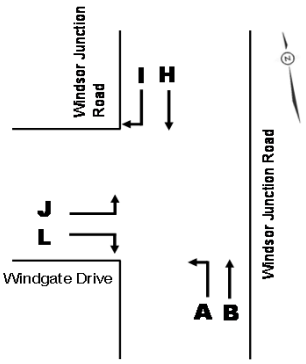
PM Peak Period Volume Data

Time		Windgate Drive Westbound Approach		Rivendale Drive Southbound Approach		Windgate Drive Eastbound Approach		Total Vehicles
		E	F	G	I	J	K	
15:30	15:45	23	5	3	3	10	30	74
15:45	16:00	28	7	3	2	8	20	68
16:00	16:15	37	8	4	5	3	21	78
16:15	16:30	24	5	4	1	7	24	65
16:30	16:45	21	3	4	4	5	33	70
16:45	17:00	15	5	3	0	11	29	63
17:00	17:15	19	7	2	2	5	24	59
17:15	17:30	29	8	4	5	12	24	82
PM Peak Hour		**112**	**25**	**14**	**11**	**28**	**95**	**285**

Table A-2

Windgate Drive
@
Windsor Junction Road

Beaver Bank, NS
Thursday, March 5 (AM Peak) and Friday, March 6 (PM Peak), 2015



AM Peak Period Volume Data

Time		Windsor Junction Road Northbound Approach		Windsor Junction Road Southbound Approach		Windgate Drive Eastbound Approach		Total Vehicles
		A	B	H	I	J	L	
07:00	07:15	4	18	16	2	17	26	83
07:15	07:30	8	8	11	8	21	31	87
07:30	07:45	4	8	23	17	30	43	125
07:45	08:00	9	15	20	11	28	44	127
08:00	08:15	12	16	15	17	30	28	118
08:15	08:30	7	9	17	4	17	23	77
08:30	08:45	6	10	14	7	17	17	71
08:45	09:00	9	14	19	11	32	18	103
AM Peak Hour		**33**	**47**	**69**	**53**	**109**	**146**	**457**

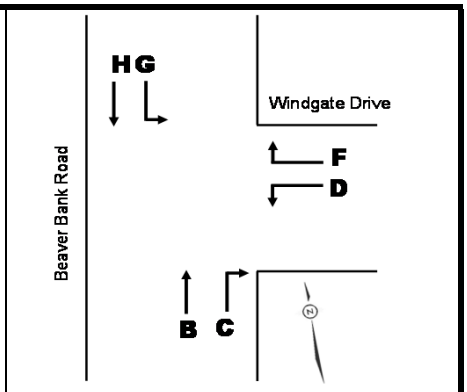
PM Peak Period Volume Data

Time		Windsor Junction Road Northbound Approach		Windsor Junction Road Southbound Approach		Windgate Drive Eastbound Approach		Total Vehicles
		A	B	H	I	J	L	
15:30	15:45	9	14	20	8	8	10	69
15:45	16:00	15	14	17	15	16	11	88
16:00	16:15	10	16	14	21	21	15	97
16:15	16:30	22	19	12	19	15	18	105
16:30	16:45	29	19	14	22	18	8	110
16:45	17:00	27	29	17	21	15	12	121
17:00	17:15	21	24	14	19	17	15	110
17:15	17:30	35	25	17	17	22	7	123
PM Peak Hour		**112**	**97**	**62**	**79**	**72**	**42**	**464**

Table A-3

Beaver Bank Road
@
Windgate Drive*

Beaver Bank, NS
Friday, August 10, 2012



AM Peak Period Volume Data

Time		Beaver Bank Road Northbound Approach		Windgate Drive Westbound Approach		Beaver Bank Road Southbound Approach		Total Vehicles
		B	C	D	F	G	H	
07:00	07:15	38	20	22	3	10	175	268
07:15	07:30	45	22	18	2	13	175	275
07:30	07:45	34	22	20	1	6	162	245
07:45	08:00	53	24	26	2	11	180	296
08:00	08:15	59	18	12	4	8	148	249
08:15	08:30	67	15	16	6	5	134	243
08:30	08:45	70	16	13	6	10	137	252
08:45	09:00	68	22	19	12	7	139	267
AM Peak Hour		**170**	**88**	**86**	**8**	**40**	**692**	**1084**

Noon Peak Period Volume Data

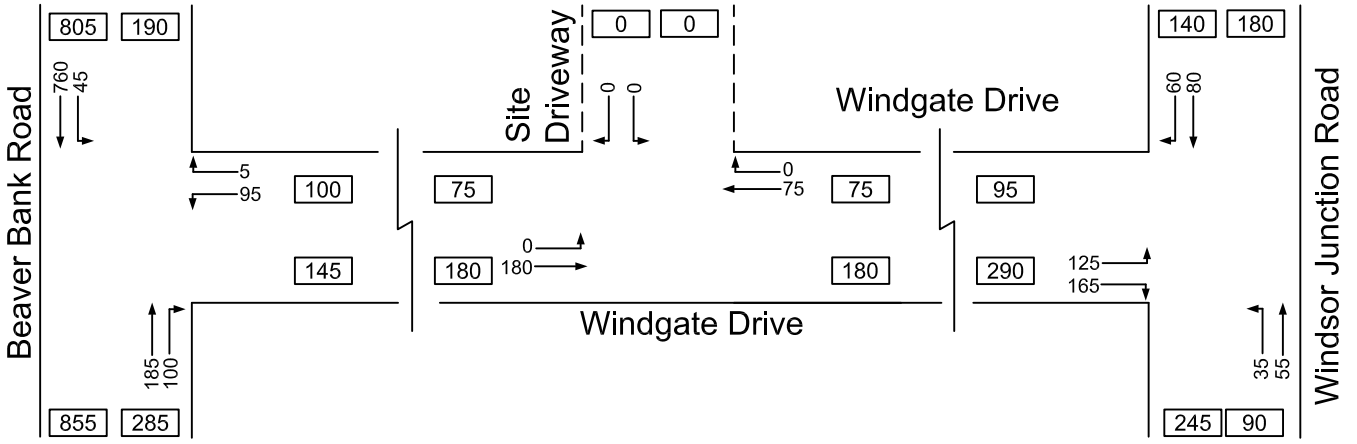
Time		Beaver Bank Road Northbound Approach		Windgate Drive Westbound Approach		Beaver Bank Road Southbound Approach		Total Vehicles
		B	C	D	F	G	H	
11:00	11:15	80	12	14	5	5	71	187
11:15	11:30	83	14	19	2	5	71	194
11:30	11:45	82	21	19	1	5	83	211
11:45	12:00	81	21	19	7	3	80	211
12:00	12:15	84	16	16	4	5	94	219
12:15	12:30	83	27	23	4	5	93	235
12:30	12:45	78	31	16	10	5	87	227
12:45	13:00	75	20	15	3	5	93	211
Noon Peak Hour		**326**	**68**	**71**	**15**	**18**	**305**	**803**

PM Peak Period Volume Data

Time		Beaver Bank Road Northbound Approach		Windgate Drive Westbound Approach		Beaver Bank Road Southbound Approach		Total Vehicles
		B	C	D	F	G	H	
15:30	15:45	163	39	27	6	14	99	348
15:45	16:00	180	37	32	7	7	88	351
16:00	16:15	199	37	25	14	8	90	373
16:15	16:30	233	26	20	12	10	77	378
16:30	16:45	264	46	32	19	7	122	490
16:45	17:00	218	36	24	19	5	109	411
17:00	17:15	181	31	29	14	6	116	377
17:15	17:30	156	25	26	11	6	119	343
PM Peak Hour		**896**	**139**	**105**	**64**	**28**	**424**	**1656**

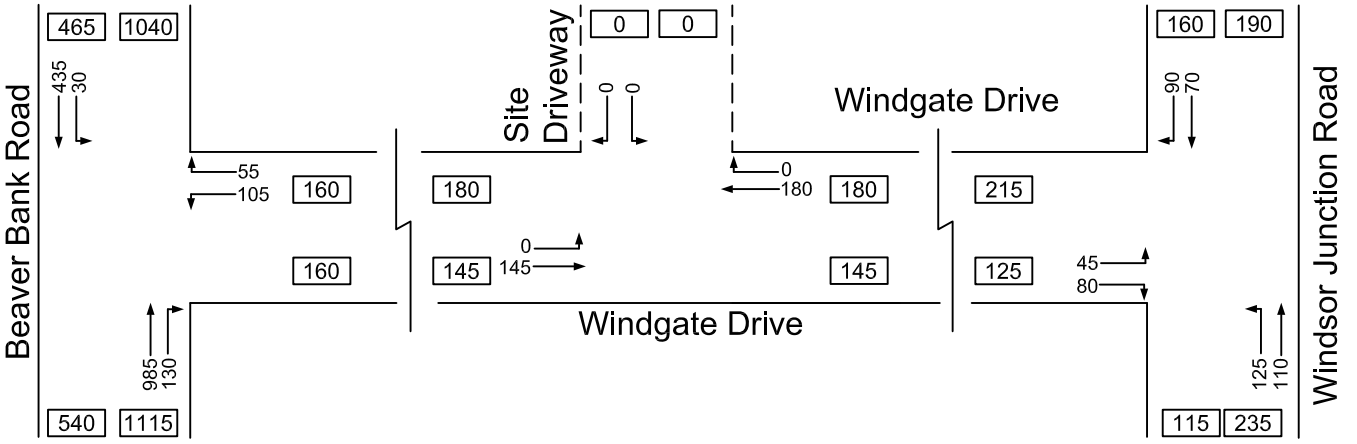
**Count obtained from HALIFAX Traffic & ROW Services.*

A
AM Peak Hour



NOT TO SCALE

B
PM Peak Hour



NOT TO SCALE

WSP
1 SPECTACLE LAKE DRIVE
DARTMOUTH, NOVA SCOTIA
CANADA, B3B 1X7
PHONE: 902 835-9955 ~ FAX: 902 835-1645
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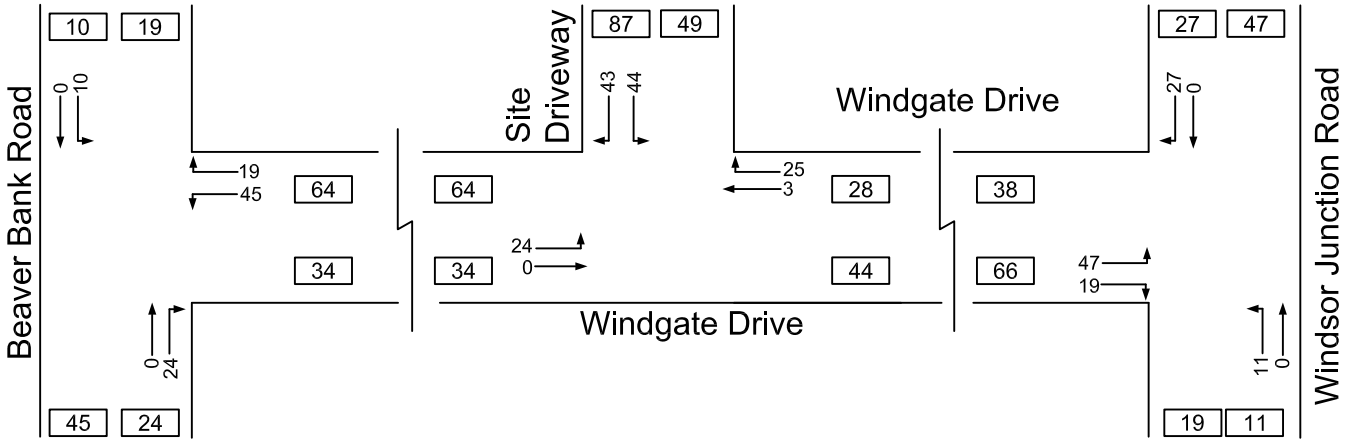
Traffic Impact Study -
Proposed 'Windgate Village' Mixed Use Development
Beaver Bank, NS

Figure A-1

2025 Weekday AM and PM Peak Hour Background Traffic
Without Site Development

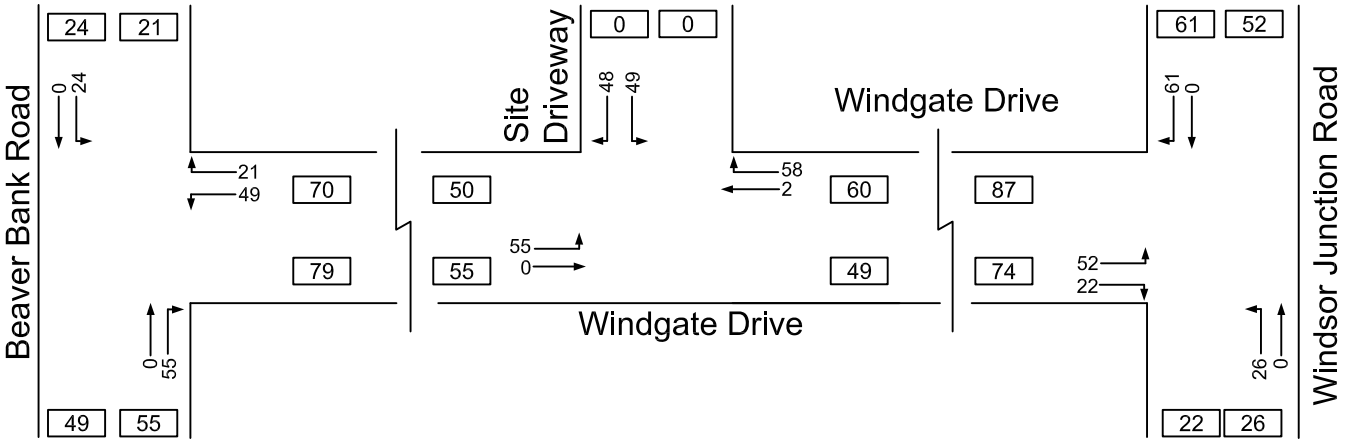
March 2015

A
AM Peak Hour



NOT TO SCALE

B
PM Peak Hour



NOT TO SCALE

WSP
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DARTMOUTH, NOVA SCOTIA
CANADA, B3B 1X7
PHONE: 902 835-9955 ~ FAX: 902 835-1645
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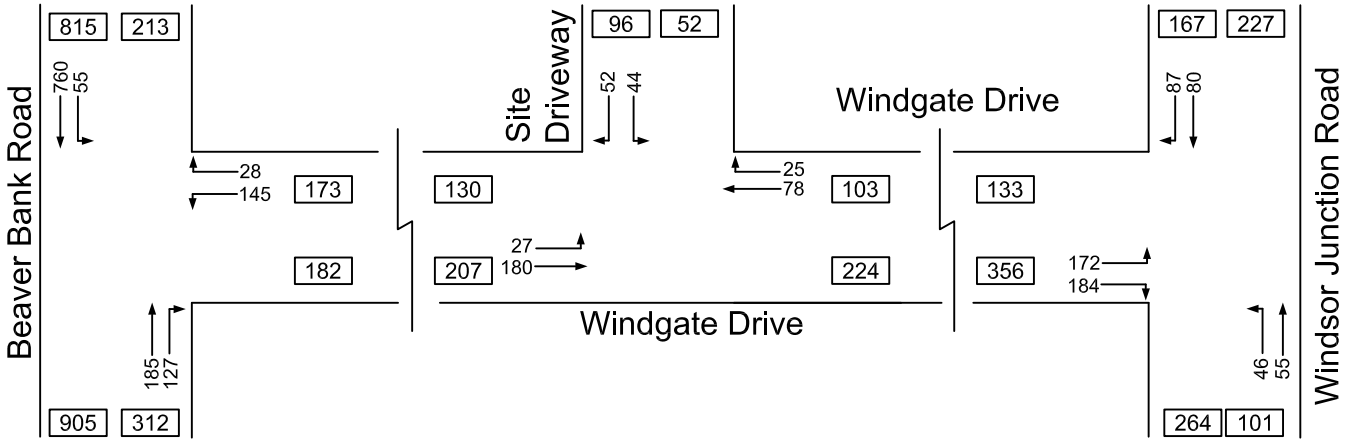
Traffic Impact Study -
Proposed 'Windgate Village' Mixed Use Development
Beaver Bank, NS

Figure A-2

Estimated Site Generated Trips

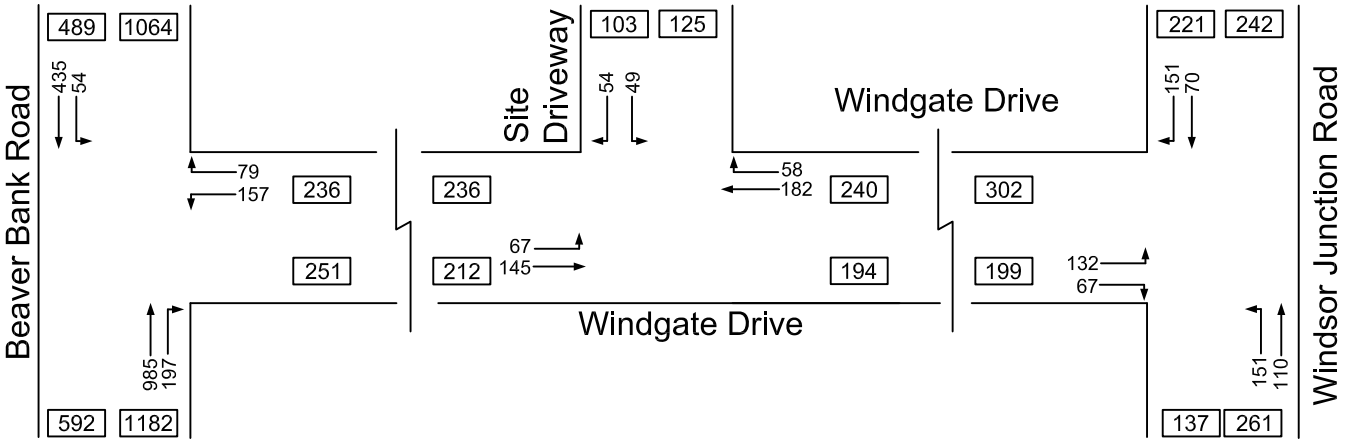
March 2015

A
AM Peak Hour



NOT TO SCALE

B
PM Peak Hour



NOT TO SCALE

WSP
1 SPECTACLE LAKE DRIVE
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CANADA, B3B 1X7
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Traffic Impact Study -
Proposed 'Windgate Village' Mixed Use Development
Beaver Bank, NS

Figure A-3

Projected 2025 AM and PM Peak Hour Background Traffic
With Added Site Generated Trips and Diverted Trips

March 2015

2005 Canadian Traffic Signal Warrant Matrix Analysis

Table A-4: Beaver Bank Road @ Windgate Drive

Projected 2025 Background Traffic Volumes without Site Development

Main Street (name)	Beaver Bank Road	Direction (EW or NS)	NS	Date:	March 2015
Side Street (name)	Windgate Drive	Direction (EW or NS)	EW	City:	Halifax NS

Lane Configuration		Excl LT	Th & LT	Through or Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes	
Beaver Bank Road	NB				1			1	
Beaver Bank Road	SB		1				1,000	1	
Windgate Drive	WB			1					
	EB								

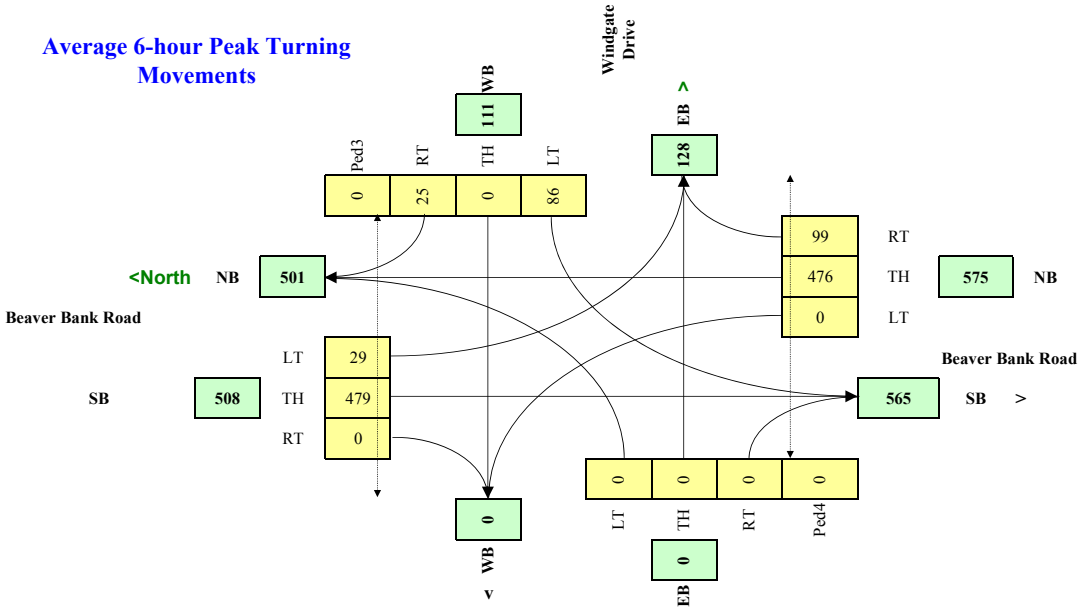
Other input		Speed (Km/h)	Trucks %	Bus Rt (y/n)	Median (m)
Beaver Bank Road	NS	50	2.0%	n	0.0
Windgate Drive	EW	50	2.0%	n	

	Ped1 NS W Side	Ped2 NS E Side	Ped3 EW N Side	Ped4 EW S side
7:00 :00 - 8	0	0	0	0
8:00 :00 - 9	0	0	0	0
11:30 2:30 - 1	0	0	0	0
12:30 3:30 - 1	0	0	0	0
15:30 6:30 - 1	0	0	0	0
16:30 7:30 - 1	0	0	0	0
Total 6-hour (eak) p	**0**	**0**	**0**	**0**
Average 6-hour (eak) b	**0**	**0**	**0**	**0**

Demographics		
Elementary School	(y/n)	y
Senior's Complex	(y/n)	n
Pathway o chool t S	y/n)	(n
Metro rea opulation P	#)	(300,000
Central usiness District D	(y/n)	n

Traffic Input	NB LT	NB Th	NB RT	SB LT	SB Th	SB RT	WB LT	WB Th	WB RT	EB LT	EB Th	EB RT
7:00 - 8:00	0	185	100	45	760	0	95	0	5	0	0	0
8:00 - 9:00	0	140	75	35	570	0	70	0	5	0	0	0
11:30 - 12:30	0	360	75	20	335	0	80	0	15	0	0	0
12:30 - 13:30	0	350	105	20	405	0	75	0	25	0	0	0
15:30 - 16:30	0	985	130	30	435	0	105	0	55	0	0	0
16:30 - 17:30	0	835	110	25	370	0	90	0	45	0	0	0
Total (6-hour peak)	**0**	**2,855**	**595**	**175**	**2,875**	**0**	**515**	**0**	**150**	**0**	**0**	**0**
Average (6-hour peak)	**0**	**476**	**99**	**29**	**479**	**0**	**86**	**0**	**25**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F(X_{v\text{-}p}) L) / K_2] \times C_i$$

W =	63	63	0
		Veh	*Ped*

NOT Warranted

2005 Canadian Traffic Signal Warrant Matrix Analysis

Table A-5: Beaver Bank Road @ Windgate Drive

Projected 2025 Background Traffic Volumes with Site Development

Main Street (name)	Beaver Bank Road	Direction (EW or NS)	NS	Date:	March 2015
Side Street (name)	Windgate Drive	Direction (EW or NS)	EW	City:	Halifax NS

Lane Configuration		Excl LT	Th & LT	Through or Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes	
Beaver Bank Road	NB				1			1	
Beaver Bank Road	SB		1				1,000	1	
Windgate Drive	WB			1					
	EB								

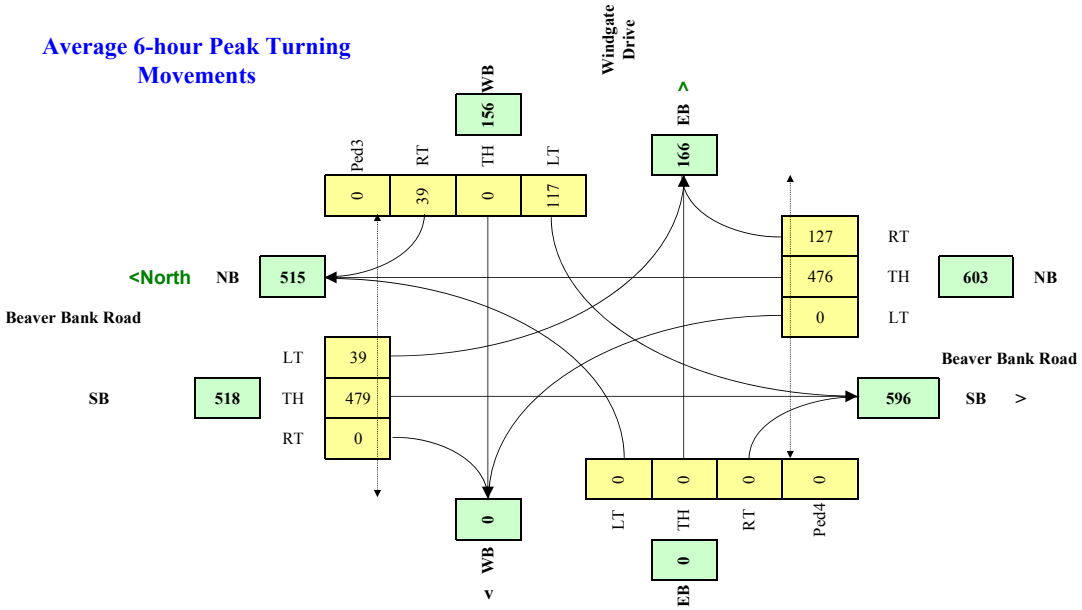
Other input		Speed (Km/h)	Trucks %	Bus Rt (y/n)	Median (m)
Beaver Bank Road	NS	50	2.0%	n	0.0
Windgate Drive	EW	50	2.0%	n	

	Ped1 NS W Side	Ped2 NS E Side	Ped3 EW N Side	Ped4 EW S side
7:00 :00 - 8	0	0	0	0
8:00 :00 - 9	0	0	0	0
11:30 2:30 - 1	0	0	0	0
12:30 3:30 - 1	0	0	0	0
15:30 6:30 - 1	0	0	0	0
16:30 7:30 - 1	0	0	0	0
Total 6-hour (eak) p	**0**	**0**	**0**	**0**
Average 6-hour (eak) b	**0**	**0**	**0**	**0**

Demographics		
Elementary School	(y/n)	y
Senior's Complex	(y/n)	n
Pathway o chool t S	y/n)	(n
Metro rea opulation P	#)	(300,000
Central usiness District D	(y/n)	n

Traffic Input	NB			SB			WB			EB		
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT
7:00 - 8:00	0	185	125	55	760	0	145	0	30	0	0	0
8:00 - 9:00	0	140	95	40	570	0	110	0	20	0	0	0
11:30 - 12:30	0	360	75	20	335	0	80	0	15	0	0	0
12:30 - 13:30	0	350	105	20	405	0	75	0	25	0	0	0
15:30 - 16:30	0	985	195	55	435	0	155	0	80	0	0	0
16:30 - 17:30	0	835	165	45	370	0	135	0	65	0	0	0
Total (6-hour peak)	**0**	**2,855**	**760**	**235**	**2,875**	**0**	**700**	**0**	**235**	**0**	**0**	**0**
Average (6-hour peak)	**0**	**476**	**127**	**39**	**479**	**0**	**117**	**0**	**39**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F(X_{v\text{-}p}) L) / K_2] \times C_i$$

W =	88	88	0
		Veh	*Ped*

NOT Warranted

2005 Canadian Traffic Signal Warrant Matrix Analysis

Table A-6: Windsor Junction Road @ Windgate Drive

Projected 2025 Background Traffic Volumes with Site Development

Main Street (name)	Windsor Junction Road	Direction (EW or NS)	NS	Date:	March 2015
Side Street (name)	Windgate Drive	Direction (EW or NS)	EW	City:	Halifax NS

Lane Configuration		Excl LT	Th & LT	Through or Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes	
Windsor Junction Road	NB		1					1	
Windsor Junction Road	SB				1		1,000	1	
Windgate Drive	WB								
	EB			1					

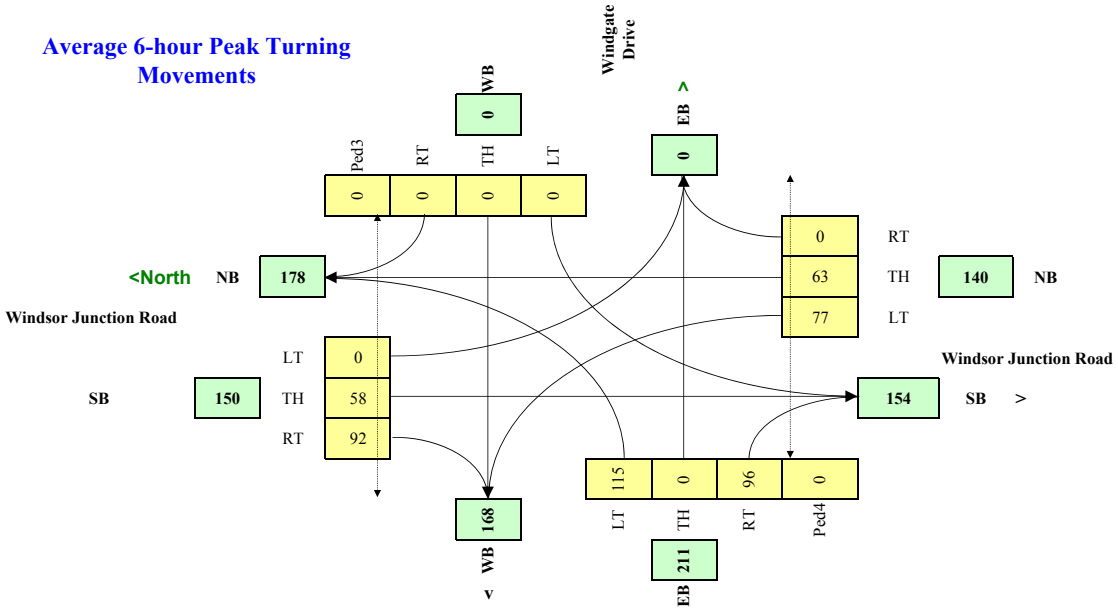
Other input		Speed (Km/h)	Trucks %	Bus Rt (y/n)	Median (m)
Windsor Junction Road	NS	50	2.0%	n	0.0
Windgate Drive	EW	50	2.0%	n	

	Ped1 NS W Side	Ped2 NS E Side	Ped3 EW N Side	Ped4 EW S side
7:00 :00 - 8	0	0	0	0
8:00 :00 - 9	0	0	0	0
11:30 2:30 - 1	0	0	0	0
12:30 3:30 - 1	0	0	0	0
15:30 6:30 - 1	0	0	0	0
16:30 7:30 - 1	0	0	0	0
Total 6-hour (eak) p	**0**	**0**	**0**	**0**
Average 6-hour (eak) b	**0**	**0**	**0**	**0**

Demographics		
Elementary School	(y/n)	y
Senior's Complex	(y/n)	n
Pathway o chool t S	y/n)	(n
Metro rea opulation P	#)	(300,000
Central usiness District D	(y/n)	n

Traffic Input	NB			SB			WB			EB		
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT
7:00 - 8:00	45	55	0	0	80	85	0	0	0	170	0	185
8:00 - 9:00	35	40	0	0	60	65	0	0	0	130	0	140
11:30 - 12:30	50	40	0	0	40	60	0	0	0	75	0	65
12:30 - 13:30	50	40	0	0	40	60	0	0	0	75	0	65
15:30 - 16:30	150	110	0	0	70	150	0	0	0	130	0	65
16:30 - 17:30	130	95	0	0	60	130	0	0	0	110	0	55
Total (6-hour peak)	**460**	**380**	**0**	**0**	**350**	**550**	**0**	**0**	**0**	**690**	**0**	**575**
Average (6-hour peak)	**77**	**63**	**0**	**0**	**58**	**92**	**0**	**0**	**0**	**115**	**0**	**96**

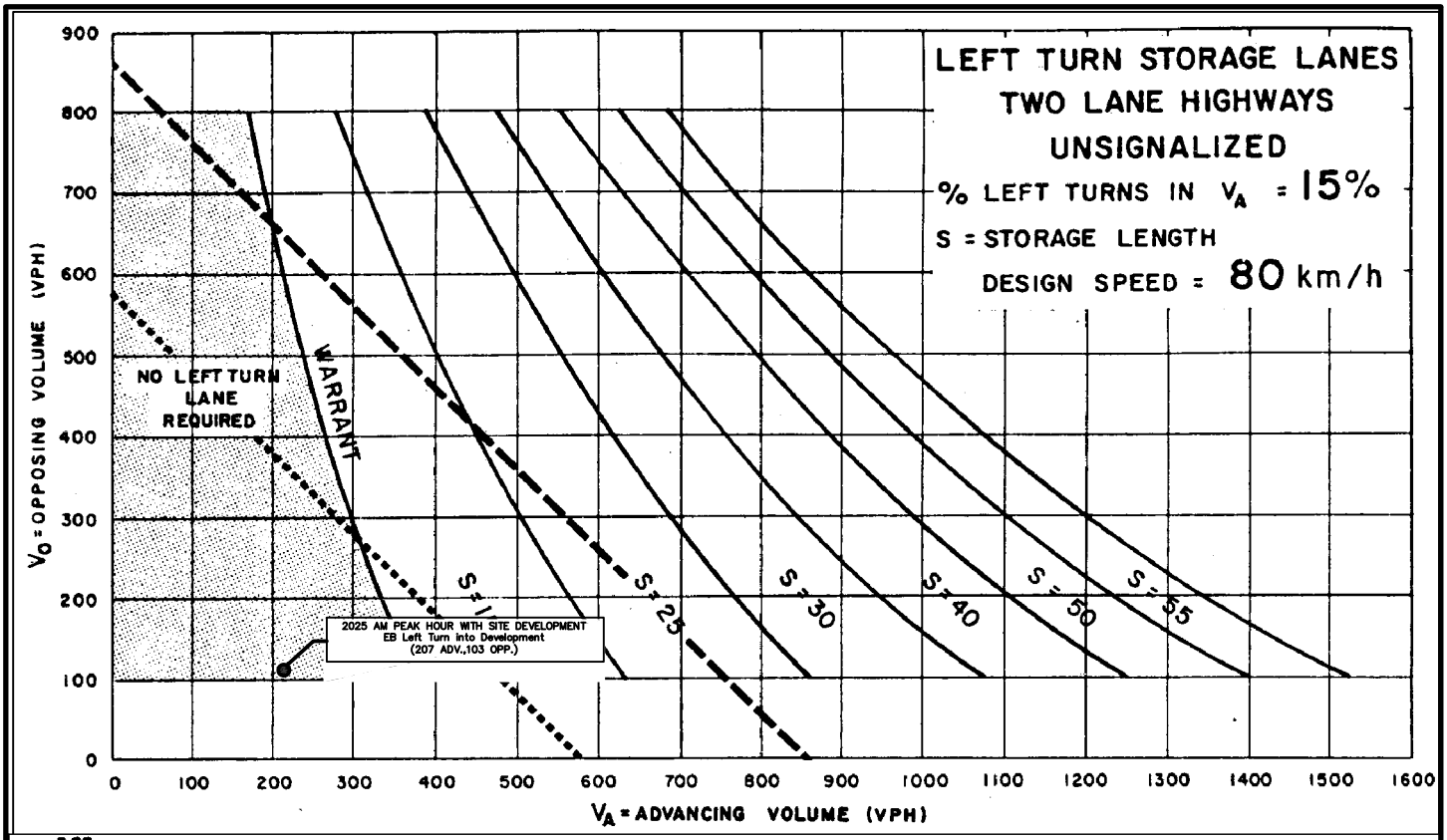
Average 6-hour Peak Turning Movements

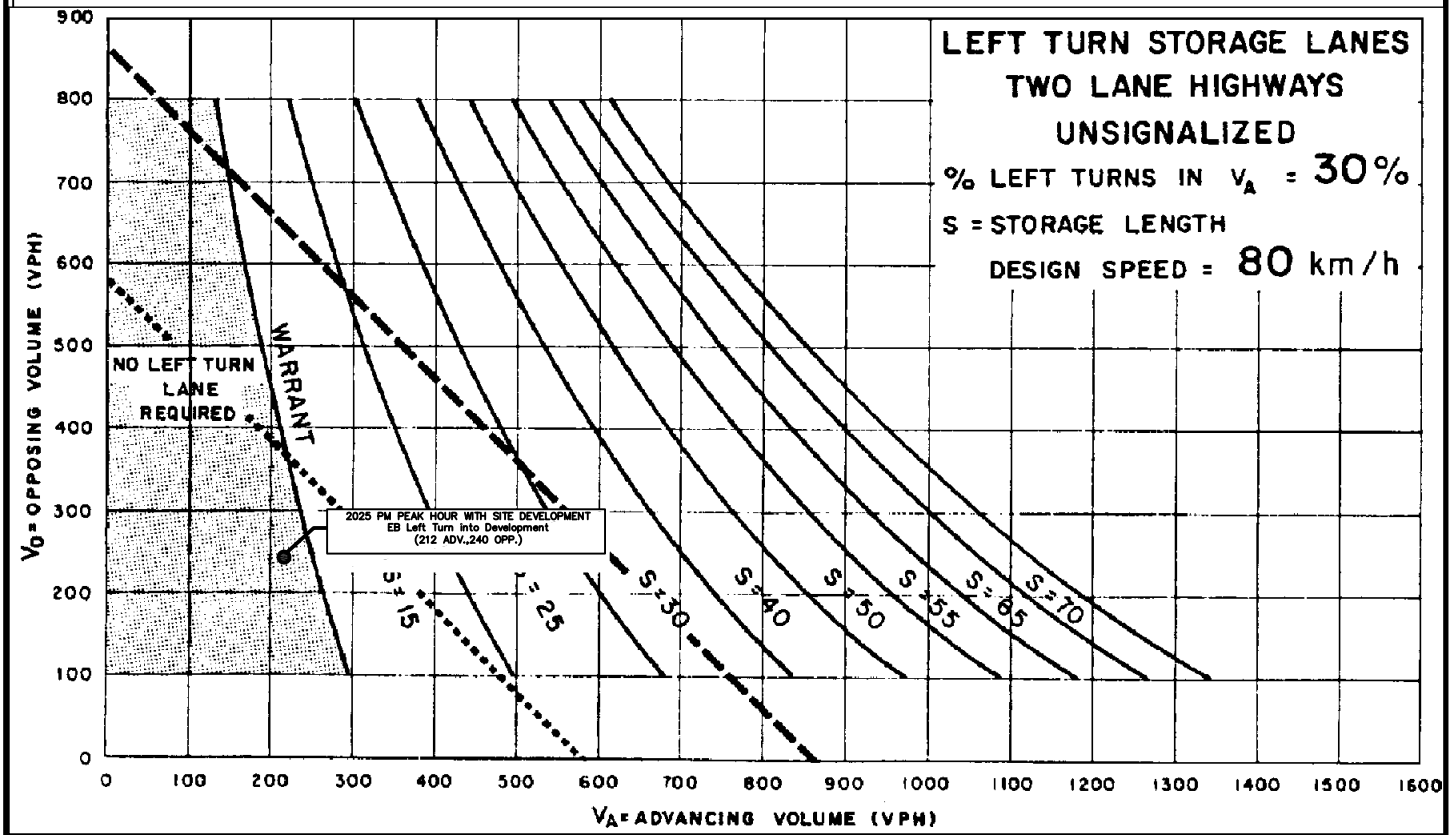


$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F(X_{v\text{-}p}) L) / K_2] \times C_i$$

W =	21	21	0
		Veh	*Ped*

NOT Warranted





WSP
1 SPECTACLE LAKE DRIVE
DARTMOUTH, NOVA SCOTIA
CANADA, B3B 1X7
PHONE: 902 835-9955 ~ FAX: 902 835-1645
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Traffic Impact Study -
Proposed 'Windgate Village' Mixed Use Development
Beaver Bank, NS

Figure A-4

Left Turn Lane Warrant - Windgate Drive @ Proposed Site Access
2025 Weekday AM and PM Peak Hour Background Traffic
With Site Generated Trips

March 2015

Appendix B

Intersection Performance Analysis

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	95	5	185	100	45	760
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	103	5	201	109	49	826
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	1179	255			310	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1179	255			310	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	49	99			96	
cM capacity (veh/h)	202	783			1251	

Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	109	310	49	826
Volume Left	103	0	49	0
Volume Right	5	109	0	0
cSH	210	1700	1251	1700
Volume to Capacity	0.52	0.18	0.04	0.49
Queue Length 95th (m)	20.2	0.0	0.9	0.0
Control Delay (s)	39.2	0.0	8.0	0.0
Lane LOS	E		A	
Approach Delay (s)	39.2	0.0	0.4	
Approach LOS	E			

Intersection Summary			
Average Delay	3.6		
Intersection Capacity Utilization	52.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	125	165	35	55	80	60
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	136	179	38	60	87	65
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	255	120	152			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	255	120	152			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	81	81	97			
cM capacity (veh/h)	714	932	1429			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	315	98	152
Volume Left	136	38	0
Volume Right	179	0	65
cSH	823	1429	1700
Volume to Capacity	0.38	0.03	0.09
Queue Length 95th (m)	13.7	0.6	0.0
Control Delay (s)	12.1	3.1	0.0
Lane LOS	B	A	
Approach Delay (s)	12.1	3.1	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	7.3		
Intersection Capacity Utilization	39.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	105	55	985	130	30	435
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	114	60	1071	141	33	473
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	1679	1141			1212	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1679	1141			1212	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	0	76			94	
cM capacity (veh/h)	98	244			576	

Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	174	1212	33	473
Volume Left	114	0	33	0
Volume Right	60	141	0	0
cSH	124	1700	576	1700
Volume to Capacity	1.41	0.71	0.06	0.28
Queue Length 95th (m)	89.7	0.0	1.4	0.0
Control Delay (s)	288.8	0.0	11.6	0.0
Lane LOS	F		B	
Approach Delay (s)	288.8	0.0	0.8	
Approach LOS	F			

Intersection Summary			
Average Delay	26.8		
Intersection Capacity Utilization	75.6%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	80	45	125	110	70	90
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	87	49	136	120	76	98
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	516	125	174			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	516	125	174			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	81	95	90			
cM capacity (veh/h)	469	926	1403			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	136	255	174
Volume Left	87	136	0
Volume Right	49	0	98
cSH	570	1403	1700
Volume to Capacity	0.24	0.10	0.10
Queue Length 95th (m)	7.0	2.4	0.0
Control Delay (s)	13.3	4.6	0.0
Lane LOS	B	A	
Approach Delay (s)	13.3	4.6	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	5.3		
Intersection Capacity Utilization	39.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	145	28	185	127	55	760
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	158	30	201	138	60	826
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	1216	270			339	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1216	270			339	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	17	96			95	
cM capacity (veh/h)	190	769			1220	

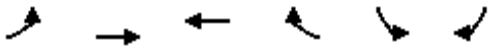
Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	188	339	60	826
Volume Left	158	0	60	0
Volume Right	30	138	0	0
cSH	217	1700	1220	1700
Volume to Capacity	0.87	0.20	0.05	0.49
Queue Length 95th (m)	51.7	0.0	1.2	0.0
Control Delay (s)	77.8	0.0	8.1	0.0
Lane LOS	F		A	
Approach Delay (s)	77.8	0.0	0.5	
Approach LOS	F			

Intersection Summary			
Average Delay	10.7		
Intersection Capacity Utilization	56.4%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	172	184	46	55	80	87
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	187	200	50	60	87	95
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	294	134	182			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	294	134	182			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	72	78	96			
cM capacity (veh/h)	672	915	1394			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	387	110	182
Volume Left	187	50	0
Volume Right	200	0	95
cSH	779	1394	1700
Volume to Capacity	0.50	0.04	0.11
Queue Length 95th (m)	21.3	0.8	0.0
Control Delay (s)	14.1	3.7	0.0
Lane LOS	B	A	
Approach Delay (s)	14.1	3.7	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	8.6		
Intersection Capacity Utilization	45.8%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	27	180	78	25	44	52
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	29	196	85	27	48	57
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	112				353	98
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	112				353	98
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	98				92	94
cM capacity (veh/h)	1478				632	958

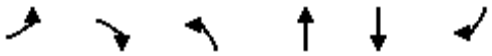
Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	225	112	104
Volume Left	29	0	48
Volume Right	0	27	57
cSH	1478	1700	775
Volume to Capacity	0.02	0.07	0.13
Queue Length 95th (m)	0.5	0.0	3.5
Control Delay (s)	1.1	0.0	10.4
Lane LOS	A		B
Approach Delay (s)	1.1	0.0	10.4
Approach LOS			B

Intersection Summary			
Average Delay	3.0		
Intersection Capacity Utilization	29.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	157	79	985	197	54	435
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	171	86	1071	214	59	473
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	1768	1178			1285	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1768	1178			1285	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	0	63			89	
cM capacity (veh/h)	82	232			540	

Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	257	1285	59	473
Volume Left	171	0	59	0
Volume Right	86	214	0	0
cSH	105	1700	540	1700
Volume to Capacity	2.45	0.76	0.11	0.28
Queue Length 95th (m)	175.9	0.0	2.8	0.0
Control Delay (s)	747.2	0.0	12.5	0.0
Lane LOS	F		B	
Approach Delay (s)	747.2	0.0	1.4	
Approach LOS	F			

Intersection Summary			
Average Delay	92.8		
Intersection Capacity Utilization	84.0%	ICU Level of Service	E
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	132	67	151	110	70	151
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	143	73	164	120	76	164
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	606	158	240			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	606	158	240			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	64	92	88			
cM capacity (veh/h)	403	887	1326			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	216	284	240
Volume Left	143	164	0
Volume Right	73	0	164
cSH	494	1326	1700
Volume to Capacity	0.44	0.12	0.14
Queue Length 95th (m)	16.7	3.2	0.0
Control Delay (s)	17.8	5.1	0.0
Lane LOS	C	A	
Approach Delay (s)	17.8	5.1	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	7.2		
Intersection Capacity Utilization	48.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	67	145	182	58	49	54
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	73	158	198	63	53	59
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	261				533	229
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	261				533	229
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	94				89	93
cM capacity (veh/h)	1304				479	810

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	230	261	112
Volume Left	73	0	53
Volume Right	0	63	59
cSH	1304	1700	610
Volume to Capacity	0.06	0.15	0.18
Queue Length 95th (m)	1.3	0.0	5.1
Control Delay (s)	2.8	0.0	12.2
Lane LOS	A		B
Approach Delay (s)	2.8	0.0	12.2
Approach LOS			B

Intersection Summary			
Average Delay	3.4		
Intersection Capacity Utilization	40.5%	ICU Level of Service	A
Analysis Period (min)	15		