

# 3718 Greenbank Road – Half Moon Bay South – Phase 5

## Transportation Impact Assessment

Step 1 Screening Report

Step 2 Scoping Report

Step 4 Strategy Report (Draft)

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PN: 2018-32

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- Appendix F – Cambrian Road and River Mist Road Westbound Left-Turn Lane Warrant
- Appendix G – 2025 Future Background Synchro Worksheets
- Appendix H – MMLOS Analysis
- Appendix I – 2020 Future Total Synchro Worksheets
- Appendix J – 2025 Future Total Synchro Worksheets

## 1 Screening

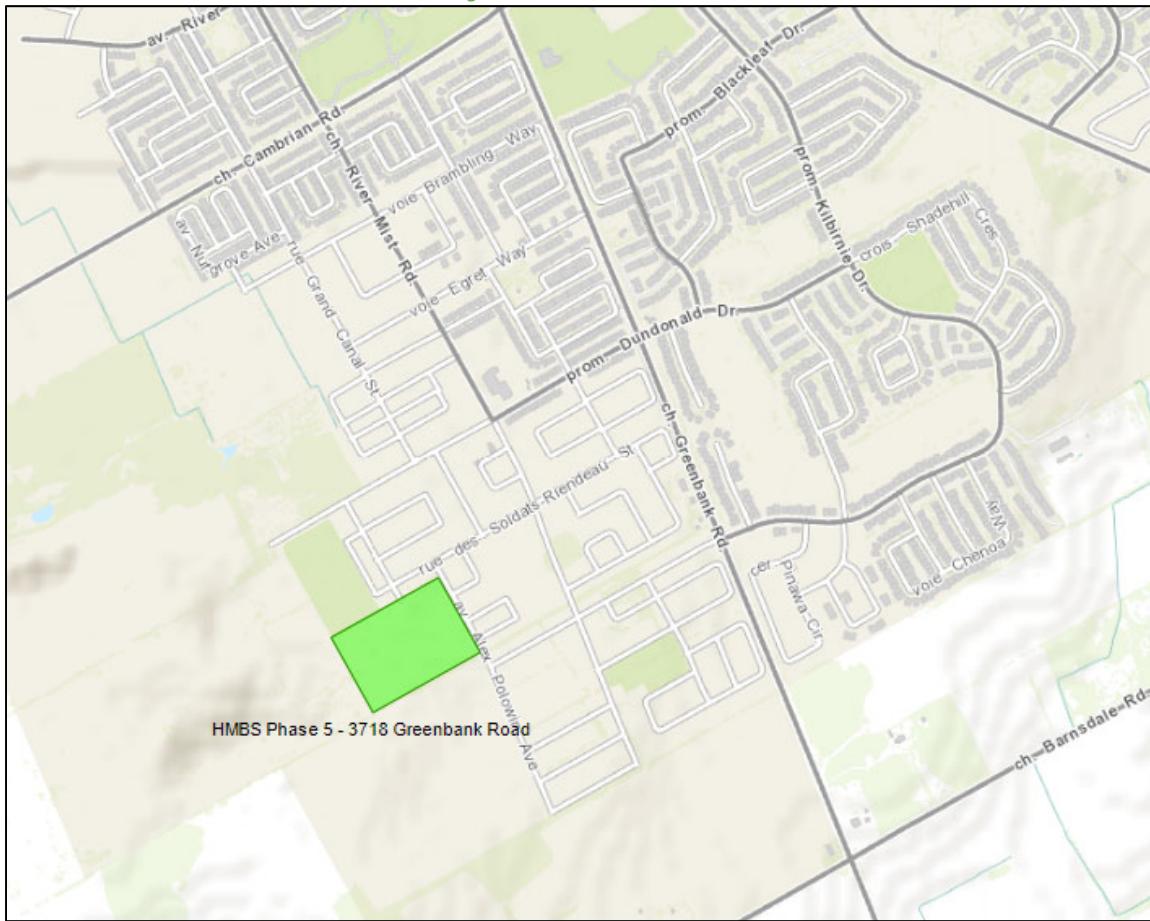
This study has been prepared according to the City of Ottawa's 2017 Transportation Impact Assessment (TIA) Guidelines. Accordingly, a Step 1 Screening Form has been prepared and is included as Appendix A, along with the Certification Form for TIA Study PM. As shown in the Screening Form, a TIA met the Trip Generation and Location triggers and requires the Design Review component and the Network Impact Component.

## 2 Existing and Planned Conditions

### 2.1 Proposed Development

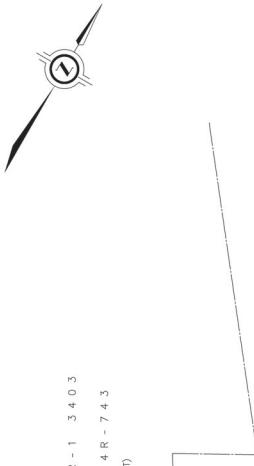
The proposed development, located at 3718 Greenbank Road, is currently a greenfield property within the Barrhaven South Expansion Area (BSEA) and would include a total of 164 residential units, 67 single detached and 97 townhomes. It will be the fifth phase of the adjacent development. While currently zoned as Mineral Aggregate (MR), the BSEA CDP will rezone the land within the site boundary as low/medium residential (mix of R1-5). Access to the proposed development will be provided by the existing phase of the development, using Soldats Riendeau Street, River Mist Road, Dundonald Drive and Kilbirnie Drive to access the adjacent arterial road network. The future Re-Aligned Greenbank Road will border the western edge of the development but is not anticipated to be completed during the horizons of this study. The anticipated full build-out and occupancy horizon is 2020. Figure 1 illustrates the Study Area Context. Figure 2 illustrates the proposed concept plan.

Figure 1: Area Context Plan

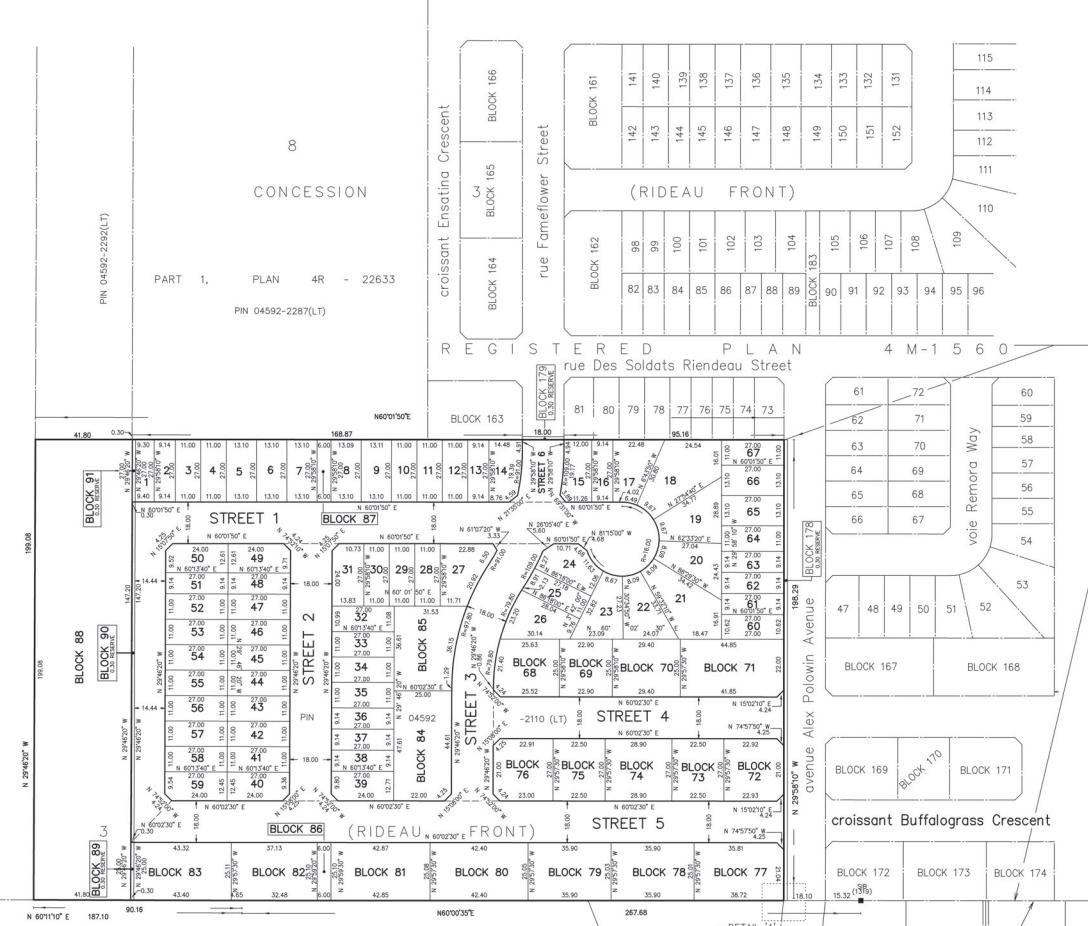


Source: <http://maps.ottawa.ca/geoOttawa/> Accessed: November 14, 2018

PART 2, PLAN 5 R - 1 3403  
 PART 1, PLAN 4 R - 743  
 PIN 04592-0037(LT)



### CONCESSION



### CONCESSION 3 (RIDEAU FRONT)

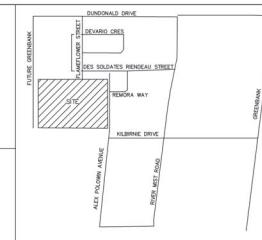
PIN 04592-2105(LT)  
 PART 3, PLAN 4R-2846

REGISTERED PLAN 4M-1552  
 promenade Kilbirnie Drive  
 (dedicated by Registered Plan 4M-1552)

Detail A  
 (See Detail A)

SUBJECT TO THE CONDITIONS, IF ANY SET FORTH IN OUR LETTER DATED  
 2017  
 THIS DRAFT PLAN IS APPROVED BY THE CITY OF OTTAWA UNDER SECTION 51 OF THE PLANNING ACT, THIS DAY OF  
 2018

FELICE PETRI, P. Eng., MANAGER  
 DEVELOPMENT REVIEW SUBURBAN SERVICES  
 PLANNING AND GROWTH MANAGEMENT DEPARTMENT  
 CITY OF OTTAWA



### ADDITIONAL INFORMATION REQUIRED UNDER SECTION 51 OF THE PLANNING ACT.

ADDITIONAL INFORMATION  
 As required under section 51(17) of the Planning Act R.S.O. 2001

- (a) (b) (c) (d) (e) (f) (g) (h) (i) (j) (k) (l) (m) (n) (o) – As shown on this Plan.
- (c) – As shown on this Draft and Key Plan
- (d) – Land to be used in accordance with the Schedule of Land Use.
- (h)(k) – Full Municipal Services
- (i) – Offshore Marine Deposits of clay, silty clay and silt, bedrock
- Ottawa Formation, limestone

### DRAFT PLAN OF SUBDIVISION OF PART OF LOT 8 CONCESSION 3 (RIDEAU FRONT) GEOGRAPHIC TOWNSHIP OF NEPEAN NOW IN THE CITY OF OTTAWA

J.D. BARNES LIMITED  
 © COPYRIGHT 2018

SCALE 1 : 1000  
 0 20 40 60 metres

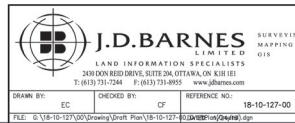
METRIC DISTANCES AND/OR COORDINATES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048.

Schedule of Land Use		
Land Use	Blocks/Lots	AREA (ha)
Singles	Lots 1 to 67	2.23
Regular Townhomes	Blocks 68 to 71, 77 to 85	1.22
Back to Back Townhomes	Blocks 72 to 76	0.34
Walkway	Blocks 86 and 87	0.03
0.30m Reserve	Blocks 89 to 91	0.01
Streets	Street 1 to 6, BLOCK 88	2.63
Total		6.46

### SURVEYOR'S CERTIFICATE

I CERTIFY THAT:  
 1. THIS SURVEY AND PLAN ARE CORRECT AND IN ACCORDANCE WITH THE SURVEYS ACT, THE SURVEYORS ACT AND THE LAND TITLES ACT AND THE REGULATIONS MADE UNDER THEM.  
 2. THE SURVEY WAS COMPLETED ON 2018.

DATE: X  
 ONTARIO LAND SURVEYOR



## 2.2 Existing Conditions

### 2.2.1 Area Road Network

**Greenbank Road:** Greenbank Road is a City of Ottawa arterial road with a two-lane urban cross-section including a bike lane in the northbound direction. The posted speed limit is 60 km/h. The Ottawa Official Plan reserves a 37.5 metre right of way.

**Cambrian Road:** Cambrian Road is a City of Ottawa arterial road with a two-lane urban cross-section and a 50 km/h posted speed limit. The Ottawa Official Plan reserves a 37.5 metre right of way.

**Dundonald Drive:** Dundonald Drive is a City of Ottawa collector road with a two-lane urban with parking lanes on both sides of the road. The unposted speed limit is 50km/h and the right-of-way is 24.0m.

**Kilbirnie Drive:** Kilbirnie Drive is a City of Ottawa collector road with a two-lane urban with a parking lane on one side of the road. The unposted speed limit is 50km/h and the right-of-way is 22.0m.

**River Mist Road:** River Mist Road is a City of Ottawa collector road with a two-lane urban with a parking lane on one side of the road. The unposted speed limit is 50km/h and the right-of-way is 24.0m.

**Soldats Riendeau Street:** Soldats Riendeau Street is a City of Ottawa local road with a two-lane urban with a parking lane on one side of the road. The unposted speed limit is 50km/h and the right-of-way is 18.0m.

**Alex Polowin Avenue:** Alex Polowin Avenue is a City of Ottawa local road with a two-lane urban with a parking lane on one side of the road. The unposted speed limit is 50km/h and the right-of-way is 18.0m.

### 2.2.2 Existing Intersections

#### *Greenbank Road / Dundonald Drive*

The intersection of Greenbank Road and Dundonald Drive is a signalized intersection with shared all movement lanes on the east and west bound approaches, and the north and south bound approaches include an auxiliary left-turn lane, a trough lane and an auxiliary right-turn lane. A multi-use pathway signal and cross-ride is provided on the west side of the intersection and the bike lane transitions to sharrows through the intersection for the northbound approach. No turn restrictions were noted.

#### *Greenbank Road / Kilbirnie Drive*

The intersection of Greenbank Road and Kilbirnie Drive is a minor stop-controlled intersection. The east and west bound approaches consist of shared all movement lanes, and both the north and south bound approaches consist of an auxiliary left-turn lane, through lane and an auxiliary right-turn lane. A northbound bike lane is provided. No turn restrictions were noted.

#### *Cambrian Road / River Mist Road*

The intersection of Cambrian Road and River Mist Road is an all-way stop-controlled intersection with shared movement lanes on all approaches. No turn restrictions were noted.

### 2.2.3 Existing Driveways

Phase 5 of the Half Moon Bay South development will extend/connect to the local road network from the adjacent phases, with Soldats Riendeau Street bordering the phase on the north side and Alex Polowin Avenue on the east side. As a residential development, private driveways are along Soldats Riendeau Street and Alex Polowin Avenue has local road intersections. Currently these intersections and driveways are the sole contributors to the traffic along the roadways. Relative to this low volume the addition of 163 residential units will increase the traffic on the roadways, although this is not a significant impact to the overall roadway operation and capacity.

Figure 3 illustrates the adjacent driveway and local road intersections and additional site photos have been provided in Appendix B.

*Figure 3: Adjacent Driveway and Roadway Locations*



### 2.2.4 Cycling and Pedestrian Facilities

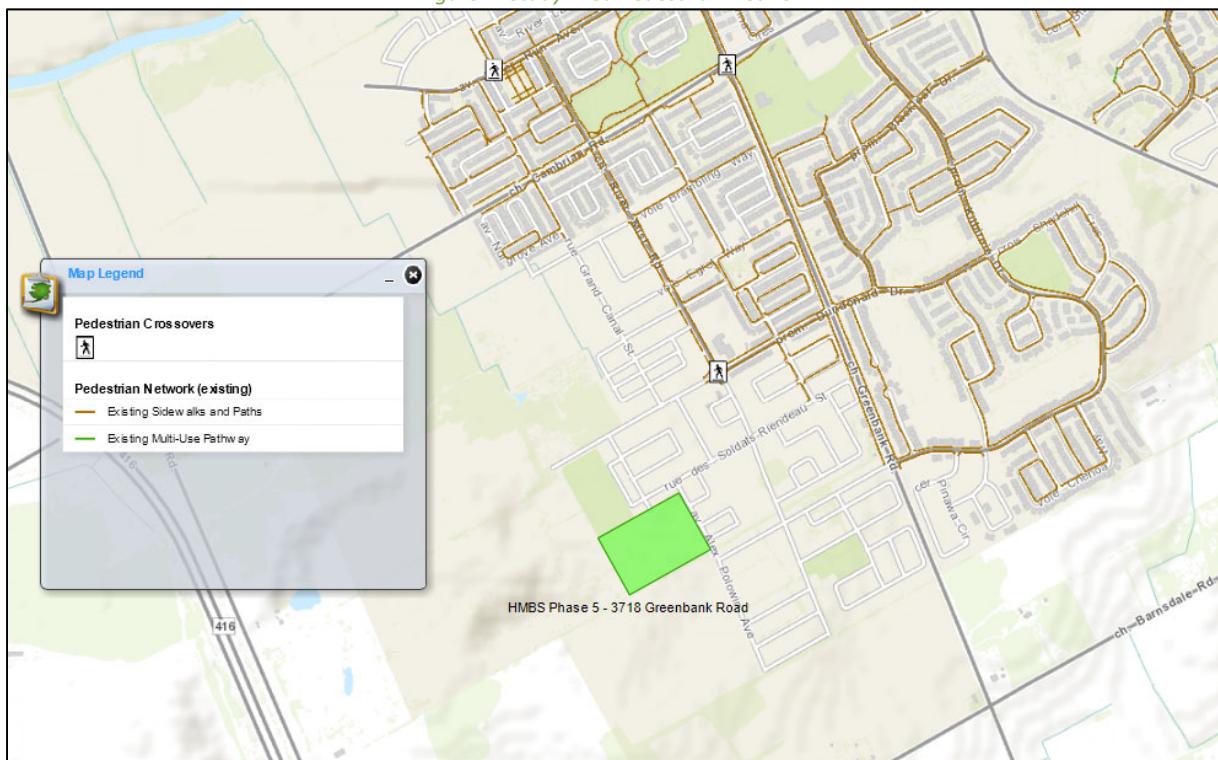
The adjacent development generally provides a sidewalk on one side of the local roads, with sidewalks on both sides of the roadway on Dundonald Drive and River Mist Road, and Cambrian Road. Greenbank Road has a multi-use pathway on the west side of the road and a sidewalk on the east side. Pedestrian cross-overs are provided at the roundabout intersection of Dundonald Drive and River Mist Road.

The cycling facilities in the area are provided along Greenbank Road with a multi-use pathway on the west side and a northbound bike lane. The future Re-Aligned Greenbank Road and the existing Greenbank Road are designated as spine routes and Cambrian Road, River Mist Road, and Dundonald Drive are designated as local routes.

Figure 4 and Figure 5 illustrate the pedestrian and cycling networks in the study area.

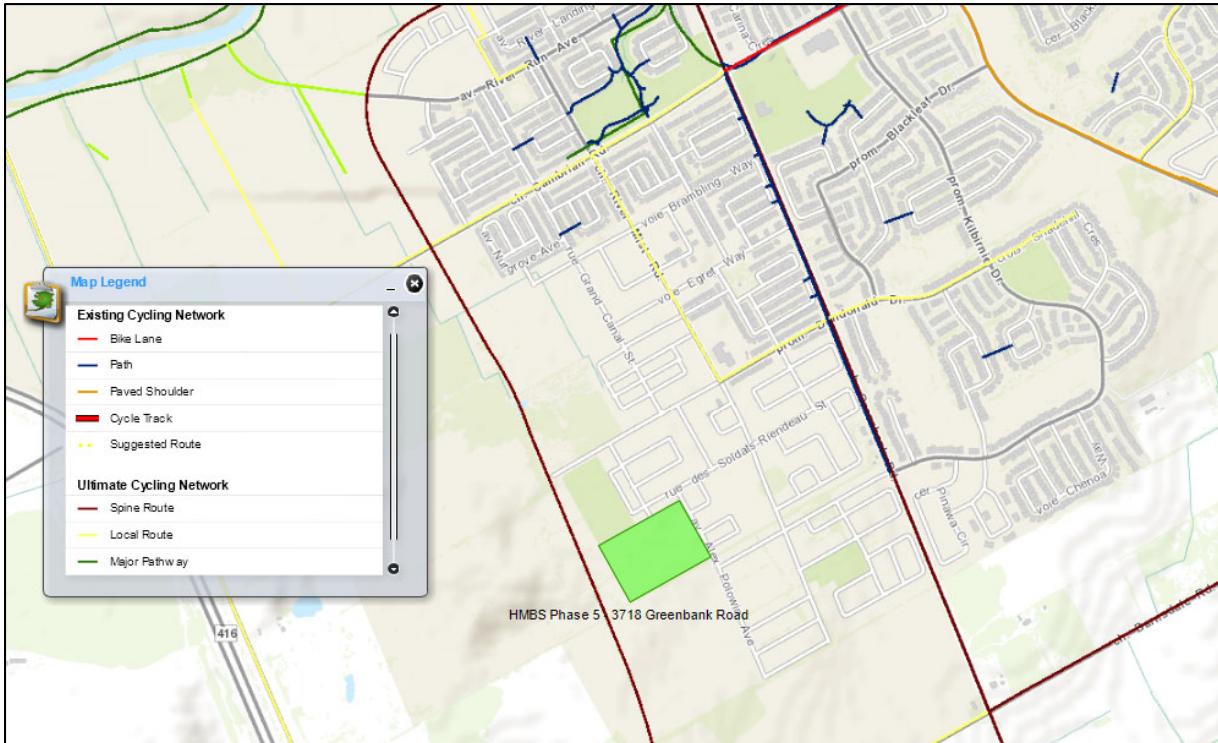
## 3718 Greenbank Road – Half Moon Bay South – Phase 5 Transportation Impact Assessment

Figure 4: Study Area Pedestrian Network



Source: <http://maps.ottawa.ca/geoOttawa/> Accessed: November 14, 2018

Figure 5: Study Area Cycling Network



Source: <http://maps.ottawa.ca/geoOttawa/> Accessed: November 14, 2018

## 2.2.5 Existing Transit

The existing transit service is provided by route #95 that runs along Kilbirnie Drive, River Mist Road and Cambrian Road, from the Minto Recreation Complex, through downtown to Trim Road in Orleans. The nearest stops are located at Kilbirnie Drive/River Mist Road, and Dundonald Drive/River Mist Road, and are over a 500m walking distance from the centre of the subject site.

*Figure 6: Existing Transit Service*



## 2.2.6 Existing Area Traffic Management Measures

There are no existing area traffic management measures within the Study Area.

## 2.2.7 Existing Peak Hour Travel Demand

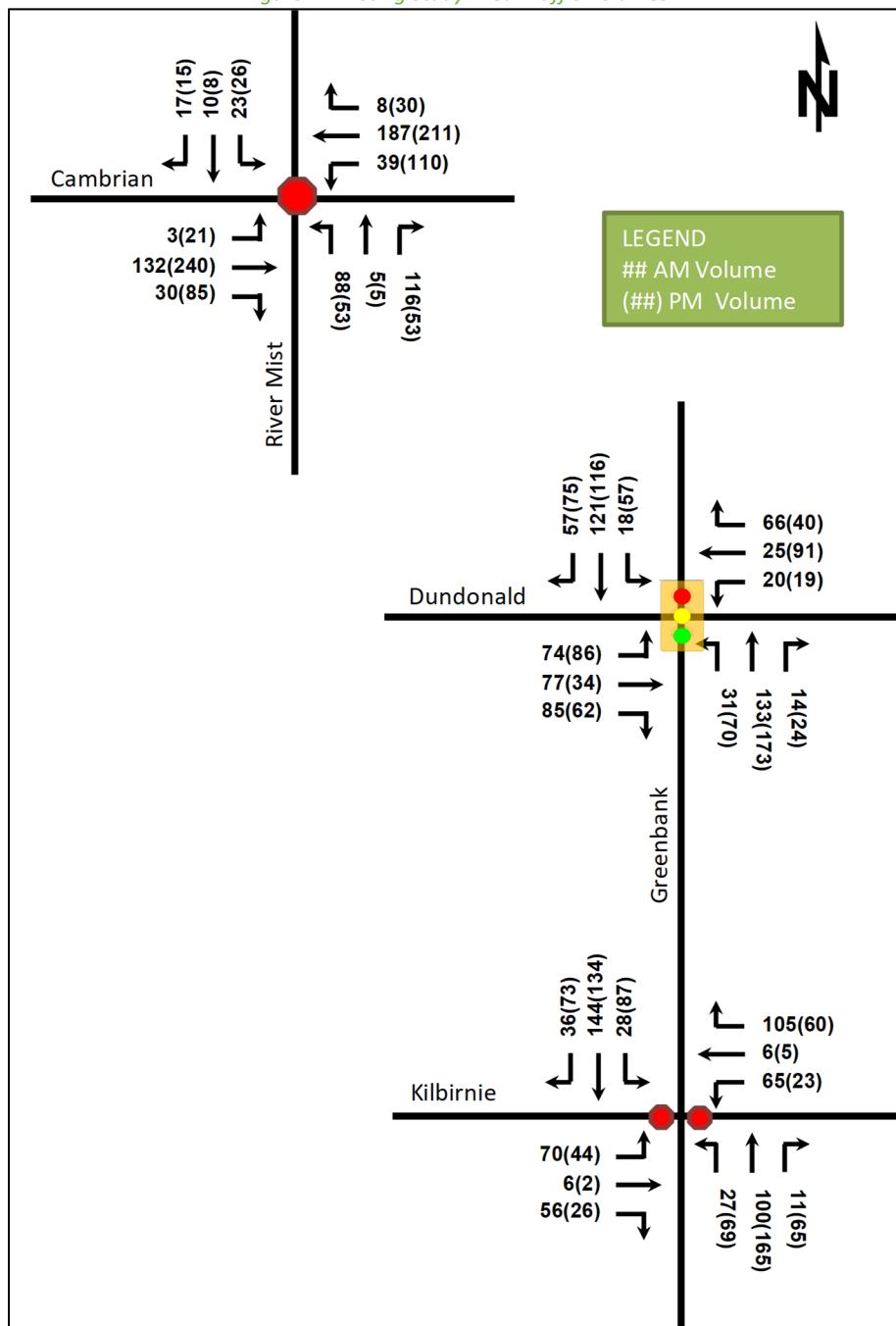
Existing turning movement counts were acquired from area traffic studies for the existing Study Area intersection. Table 1 summarizes the intersection count dates, Figure 7 illustrates the study area traffic volumes.

*Table 1: Intersection Count Date*

Intersection	Count Date
<b>Greenbank Road &amp; Dundonald Drive</b>	Wednesday, May 24, 2017
<b>Greenbank Road &amp; Kilbirnie Drive</b>	Thursday, November 9, 2017
<b>River Mist Road &amp; Cambrian Road</b>	Wednesday, August 23, 2017

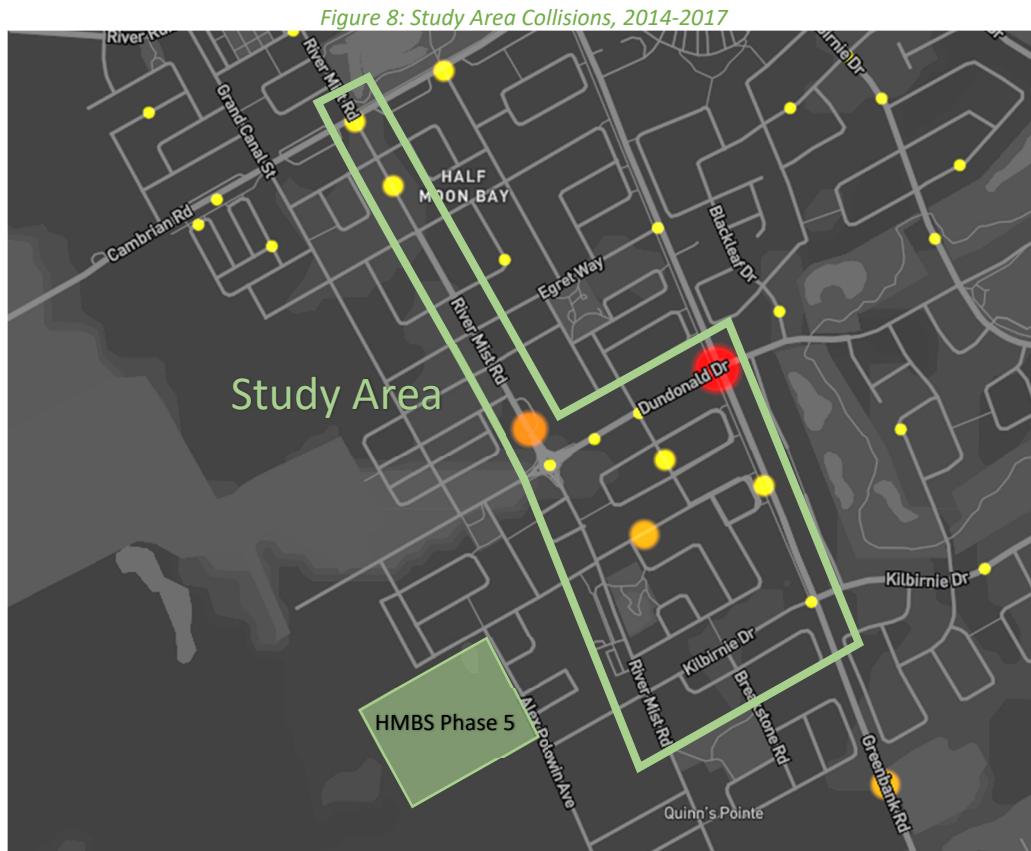
Detailed turning movement count data is included in Appendix C.

Figure 7: Existing Study Area Traffic Volumes



## 2.2.8 Collision Analysis

Collision data has been acquired from OpenData Ottawa for four years prior to the commencement of this TIA for the study area. Figure 8 illustrates the study area collisions and Table 2 summarizes the collisions.



Source: <https://maps.bikeottawa.ca/collisions/> Accessed: November 14, 2018

*Table 2: Study Area Collision Summary*

Total Collisions		Number	%
		36	100%
Classification	Fatality	0	0%
	Non-Fatal Injury	4	11%
	Property Damage Only	32	89%
Initial Impact Type	Angle	11	31%
	Rear end	2	6%
	Sideswipe	0	0%
	Turning Movement	3	8%
	SMV Other	2	6%
	SMV Unattended	18	50%
	Other	0	0%
Road Surface Condition	Dry	22	61%
	Wet	6	17%
	Loose Snow	1	3%
	Slush	2	6%
	Packed Snow	2	6%
	Ice	3	8%
Pedestrian Involved		2	6%

Overall, a low volume of collisions is noted at the study area intersections and road segments with majority under 4 total collisions in four years (orange circles). The intersection of Greenbank Road and Dundonald Drive had a total of 7 collisions and is noted to have included a single pedestrian related collision, having occurred prior to the signalization of the intersection. The other pedestrian related collision occurred along Andre Audet Avenue between Dundonald Drive and Soldats Riendeau Street.

Collision data is included in Appendix D.

## 2.3 Planned Conditions

### 2.3.1 Changes to the Area Transportation Network

#### *Greenbank Road*

The future New Greenbank Road extension, south of Cambrian Road, will pass just east of the proposed development, providing Arterial Road connectivity. However, the timing of this extension is unknown as it is not included in the City of Ottawa's Transportation Master Plan 2031 Affordable Road Network.

#### *Cambrian Road*

The Cambrian Road Widening Environmental Assessment includes a four-lane cross-section along Cambrian Road from Longfields Drive to the future Realigned Greenbank Road. This EA has been approved by Transportation Committee and City Council, but the widening is not considered in the City of Ottawa's Transportation Master Plan 2031 Affordable Road Network and therefore the timing of this widening is unknown.

#### *Bus Rapid Transit*

As part of the road widenings and re-alignments, bus rapid transit stations are also planned for the area. The timing of these is also unknown and have been illustrated in Figure 9.

Figure 9: Future BRT Transit Stations



Source: <http://maps.ottawa.ca/geoOttawa/> Accessed: November 14, 2018

### 2.3.2 Other Study Area Developments

#### *Half Moon Bay West*

North of the proposed development is the Mattamy Development of Half Moon Bay West. This development will include 518 detached homes and 427 townhouses. Construction has not commenced on this subdivision. The trips generated by this site will be accounted for in the traffic projections.

#### *The Meadows Phase 4*

East of the proposed development is the Tamarack Development of the Meadows. Phase 4 has a current development application. This development will not have shared accesses or traffic cross-over but will impact the Study Area intersections. This development will include 50 detached homes and 136 townhouses. The site trips generated by this site will be accounted for in the traffic projections.

#### *The Meadows Phase 5*

North of the proposed development is the Tamarack Development of the Meadows. Phase 5 has a current development application. This development will not have shared accesses or traffic cross-over but will impact the Study Area intersections. The site trips generated by this site will be accounted for in the traffic projections.

#### *Barrhaven South Expansion Lands (Quinn's Pointe 2)*

To the southeast of the proposed development is the Minto Development of Quinn's Pointe 2. The first phase of this development has been constructed. This development will not have shared accesses and site trips generated by this site will be accounted for in the traffic projections.

## 3 Study Area and Time Periods

### 3.1 Study Area

The study area will include the intersections of Greenbank Road/Dundonald Drive, Greenbank Road/Kilbirnie Drive, and Cambrian Road/River Mist Road.

### 3.2 Time Periods

As the proposed development is composed entirely of residential units the AM and PM peak hours will be examined.

### 3.3 Horizon Years

The anticipated build-out year is 2020. As a result, the full build-out plus five years horizon year is 2025.

## 4 Exemption Review

Table 3 summarizes the exemptions for this TIA.

*Table 3: Exemption Review*

Module	Element	Explanation	Exempt/Required
<b>Design Review Component</b>			
<b>4.1 Development Design</b>	4.1.2 Circulation and Access	Only required for site plans	Exempt
	4.2.3 New Street Networks	Only required for plans of subdivision	Required

Module	Element	Explanation	Exempt/Required
<b>4.2 Parking</b>	4.2.1 Parking Supply	Only required for site plans	Exempt
	4.2.2 Spillover Parking	Only required for site plans where parking supply is 15% below unconstrained demand	Exempt
<b>Network Impact Component</b>			
<b>4.5 Transportation Demand Management</b>	All Elements	Not required for site plans expected to have fewer than 60 employees and/or students on location at any given time	<b>Required</b>
<b>4.6 Neighbourhood Traffic Management</b>	4.6.1 Adjacent Neighbourhoods	Only required when the development relies on local or collector streets for access and total volumes exceed ATM capacity thresholds	<b>Required</b>
<b>4.8 Network Concept</b>		Only required when proposed development generates more than 200 person-trips during the peak hour in excess of equivalent volume permitted by established zoning	Exempt

## 5 Development Generated Travel Demand

### 5.1 Trip Generation and Mode Shares

This TIA has been prepared using the vehicle and person trip rates for the residential components using the TRANS Trip Generation Study Report (2009). Table 4 summarizes the person trip rates for the proposed land uses.

Table 4: Trip Generation Person Trip Rates

Dwelling Type	Land Use Code	Peak Hour	Vehicle Trip Rate	Person Trip Rates
<b>Single-Detached</b>	210	AM	0.70	1.27
		PM	0.90	1.41
<b>Townhomes</b>	220	AM	0.54	0.98
		PM	0.71	1.16

Using the above Person Trip rates, the total person trip generation has been estimated. Table 5 below illustrates the total person trip generation by dwelling type.

Table 5: Total Person Trip Generation

Land Use	Units	AM Peak Hour			PM Peak Hour		
		In	Out	Total	In	Out	Total
<b>Single-Detached</b>	67	25	60	85	57	37	94
<b>Townhomes</b>	97	35	60	95	60	53	113
<b>Total Person Trips</b>	<b>60</b>	<b>120</b>	<b>180</b>	<b>117</b>	<b>90</b>	<b>207</b>	

Using the most recent National Capital Region Origin-Destination survey (OD Survey), the existing mode shares for South Nepean were determined and will be applied for the development and are summarized in Table 6.

*Table 6: TOD Mode Share*

<b>Travel Mode</b>	<b>Mode Share</b>
<b>Auto Driver</b>	80%
<b>Auto Passenger</b>	5%
<b>Transit</b>	10%
<b>Non-Auto</b>	5%
<b>Total</b>	100%

Using the above mode shares and person trip rates the person trips by mode have been projected. Table 7 summarizes the trip generation by mode.

*Table 7: Trip Generation by Mode*

<b>Travel Mode</b>	<b>Mode Share</b>	<b>In</b>	<b>Out</b>	<b>Total</b>	<b>In</b>	<b>Out</b>	<b>Total</b>
<b>Auto Driver</b>	80%	48	96	144	94	72	165
<b>Auto Passenger</b>	5%	3	6	9	6	5	11
<b>Transit</b>	10%	7	12	19	12	9	20
<b>Non-Auto Modes</b>	5%	3	6	9	6	5	11
<b>Total</b>	100%	60	120	180	117	90	207

As shown above, 144 AM and 165 PM peak hour two-way vehicle trips are projected as a result of the proposed development.

No trip reductions factors (i.e. synergy, pass-by, etc.) have been applied as the subject.

## 5.2 Trip Distribution

To understand the travel patterns of the subject development the OD Survey has been reviewed to determine the existing travel patterns. Table 8 below summarizes the distribution.

*Table 8: OD Survey Existing Mode Share – South Nepean*

<b>To/From</b>	<b>Percent of Trips</b>
<b>North</b>	80%
<b>South</b>	5%
<b>East</b>	10%
<b>West</b>	5%
<b>Total</b>	100%

## 5.3 Trip Assignment

Using the distribution outlined above, turning movement splits, and access to major transportation infrastructure, the trips generated by the site have been assigned to the Study Area road network using the assignment illustrated in Figure 10 and new site volumes are illustrated in Figure 11.

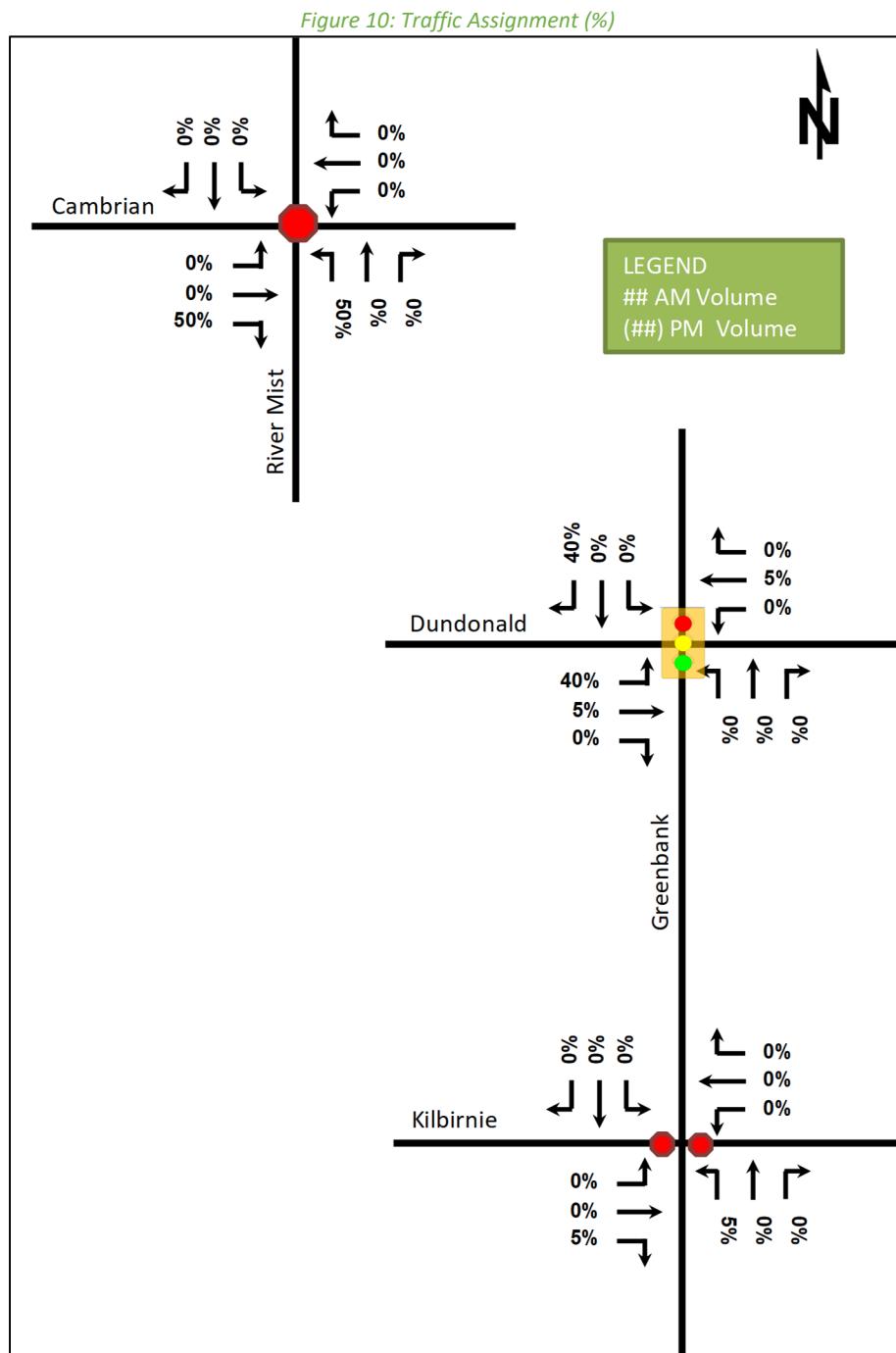
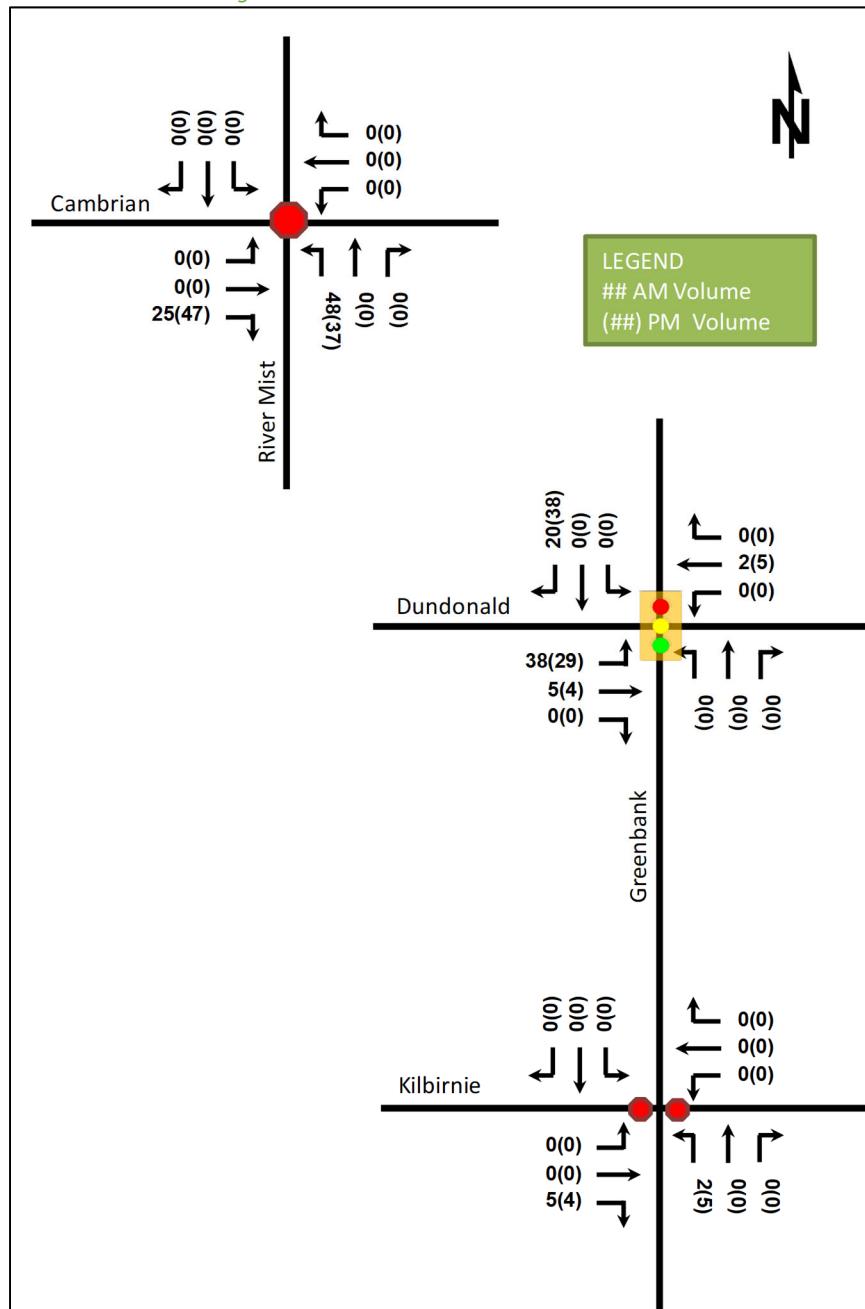


Figure 11: New Site Generation Auto Volumes



## 6 Background Network Travel Demand

### 6.1 Transportation Network Plans

The transportation network plans were discussed in Section 2.3.

### 6.2 Background Growth

A large amount of background traffic has been accounted for through the other developments that have been documented in Sections 2.3.2 and 6.3. To be consistent with the approved transportation impact assessments in the area, a 2% growth rate was applied to the existing volumes along the mainline volumes (e.g. north-south on

Greenbank Road and east-west on Cambrian Road). Figure 12 illustrates the background 2020 study area auto volumes and the Figure 13 illustrates the background 2025 auto volumes. The background development volumes have been included from Section 6.3 below.

Figure 12: Background 2020 Volumes

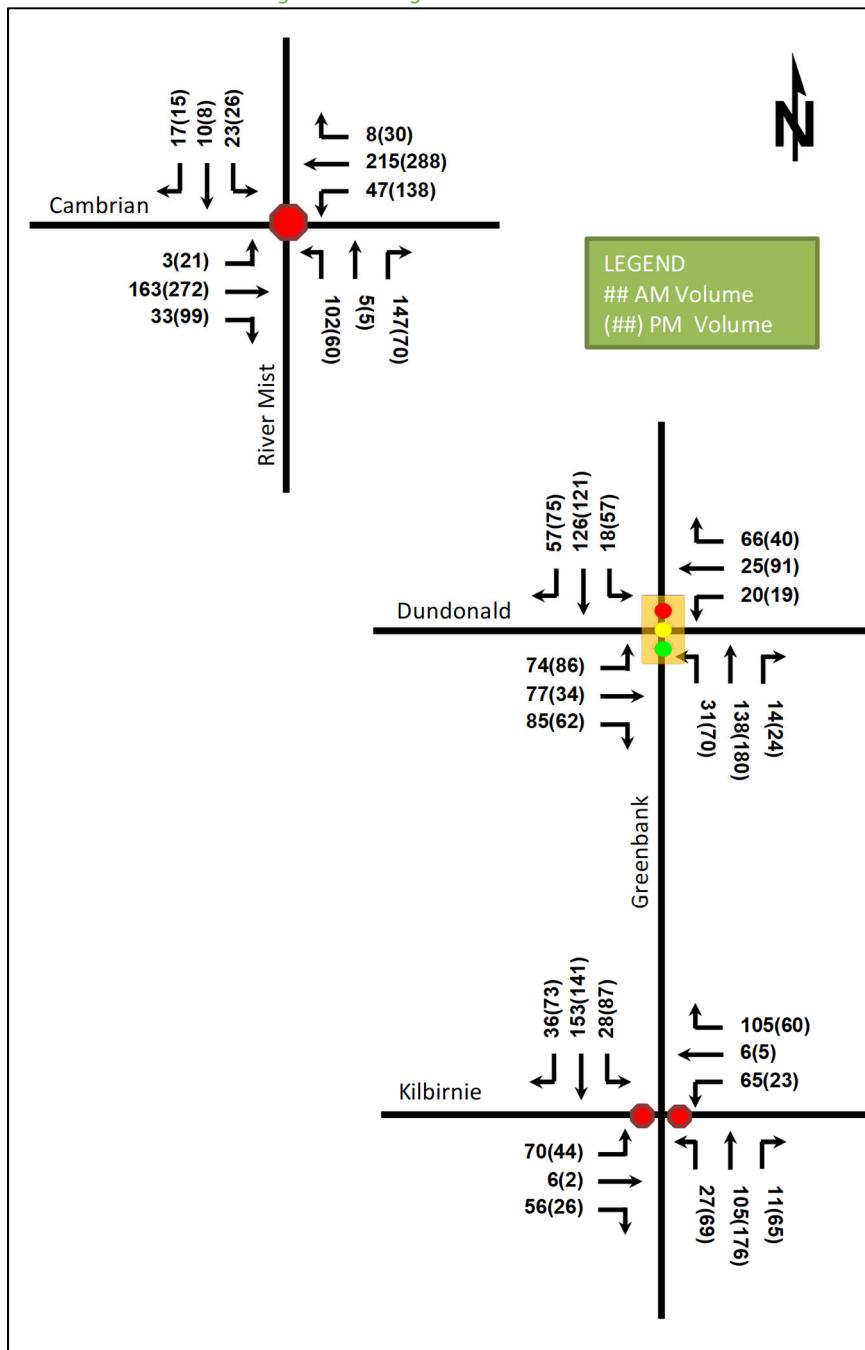
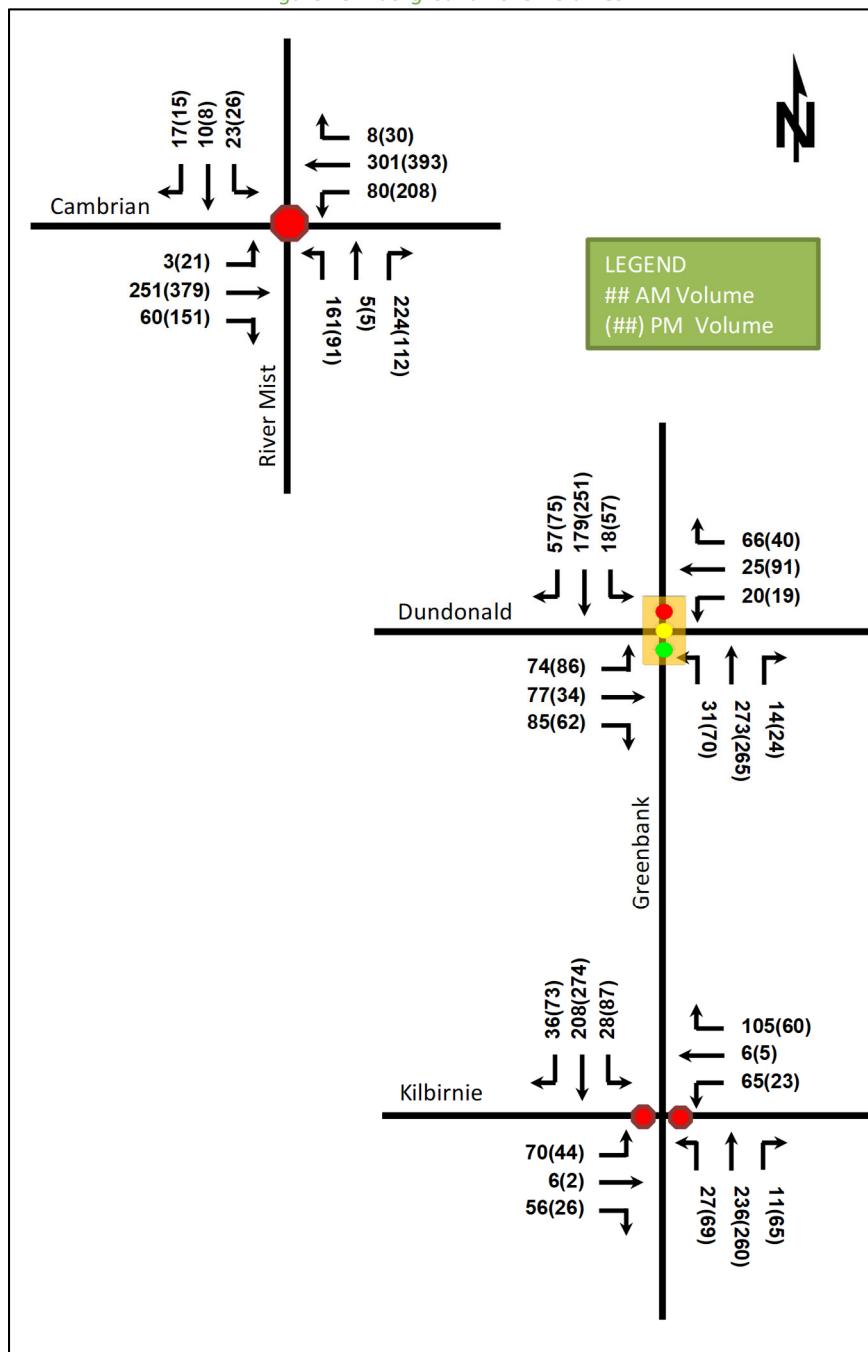


Figure 13: Background 2025 Volumes



### 6.3 Other Developments

The background development volumes have been summarized for the 2020 and 2025 horizons. Mattamy Half Moon Bay West and Tamarack Meadows Phase 4 have been included in the 2020 horizon, and Tamarack Meadows Phase 5 and the Barrhaven South Expansion Area development has been added on for the 2025 horizon.

Figure 14: Background 2020 Development Volumes

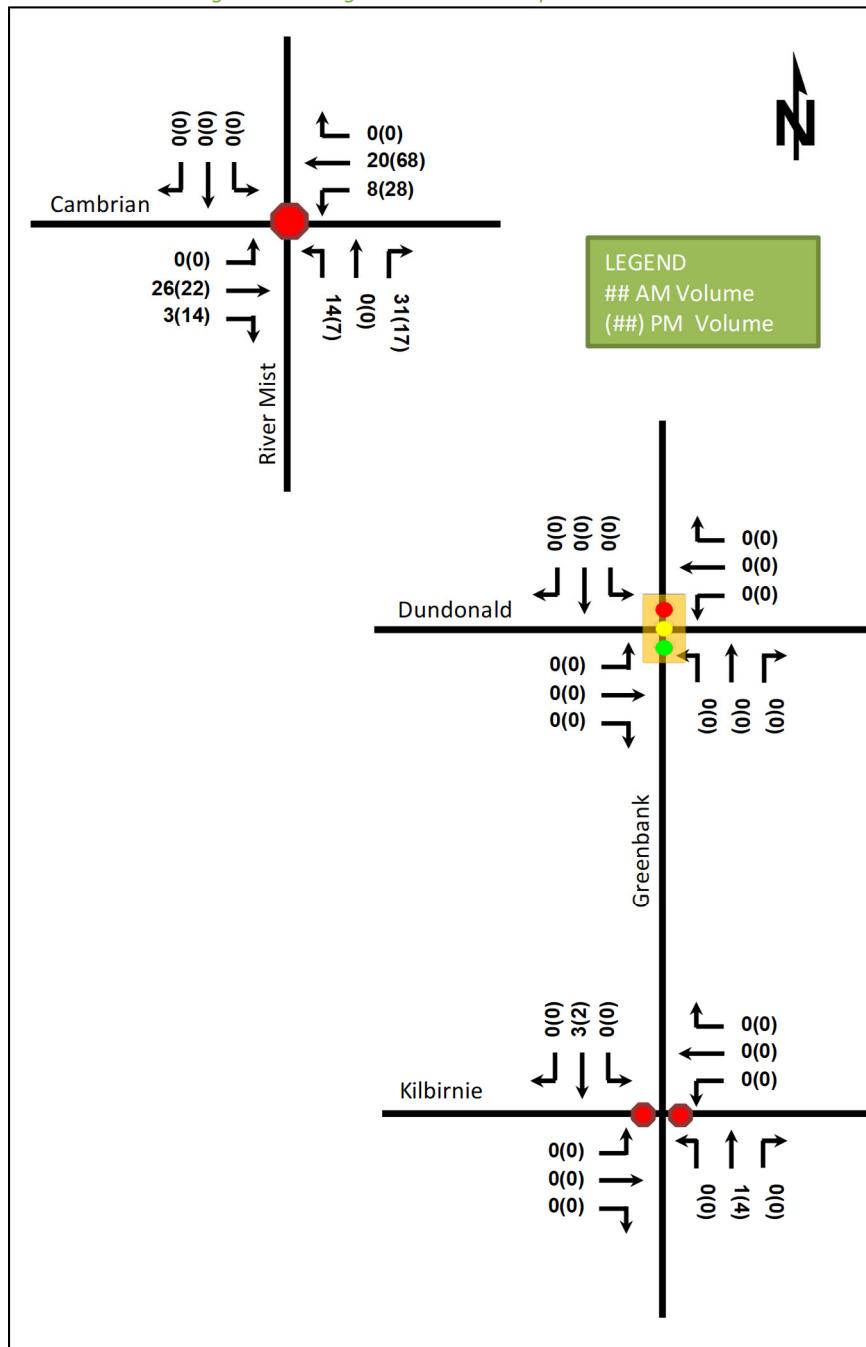
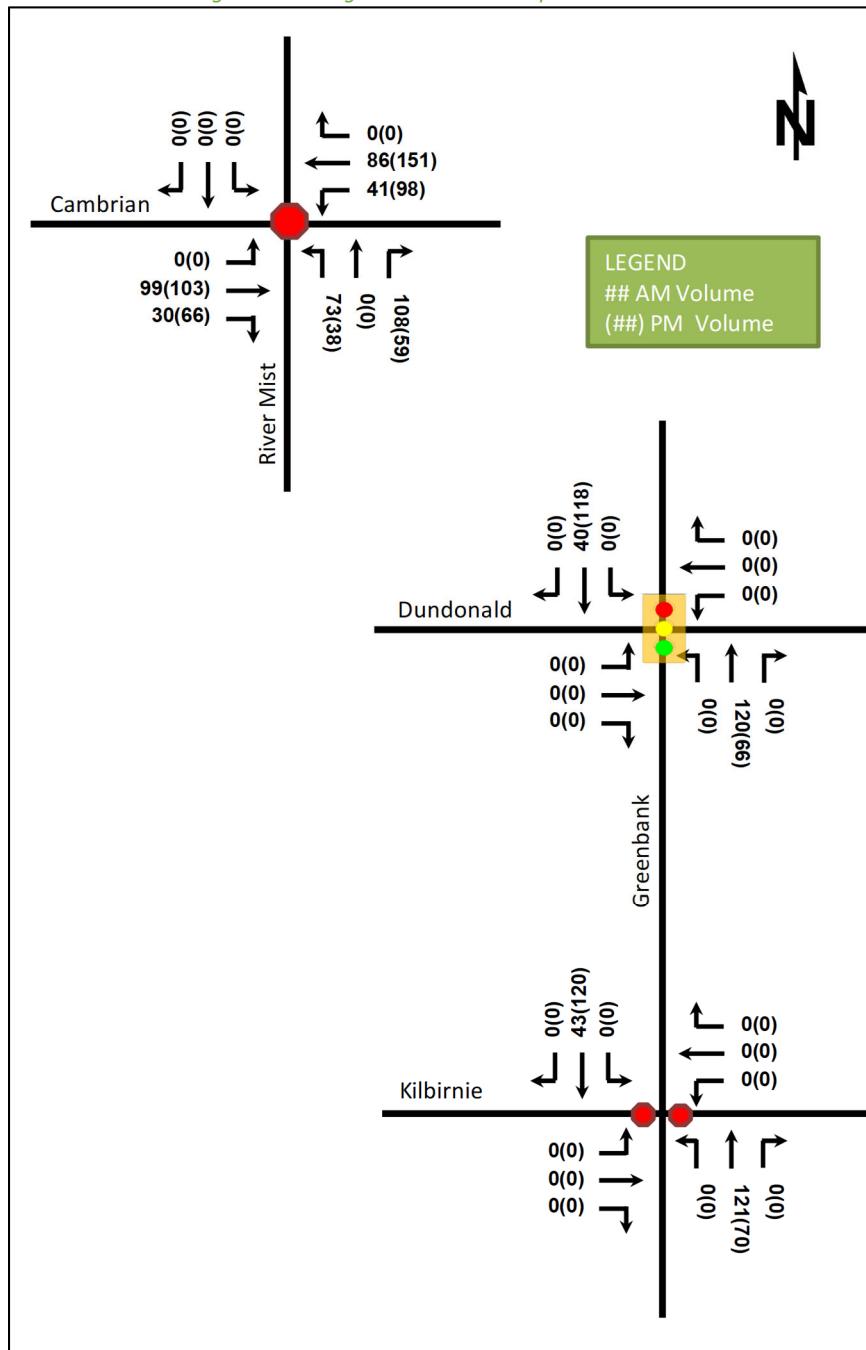


Figure 15: Background 2025 Development Volumes



## 7 Demand Rationalization

### 7.1 Background 2020 Operations

The intersection operations for the background 2020 conditions are summarized in Table 9.

The synchro worksheets for the background 2020 conditions are provided in Appendix E.

Table 9: Background 2020 Intersection Operations

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	Delay	V/C	Q (95 <sup>th</sup> )	LOS	Delay	V/C	Q (95 <sup>th</sup> )
<b>Greenbank Road &amp; Dundonald Drive Signalized</b>	EB	C	25.5	0.65	44.2	C	24.6	0.54	32.1
	WB	B	10.8	0.28	14.9	C	21.3	0.39	26.5
	NBL	C	30.5	0.17	11.8	C	32.0	0.32	19.9
	NBT	B	12.6	0.18	28.4	B	16.4	0.23	34.6
	NBR	A	0.1	0.02	0.0	A	0.1	0.03	0.0
	SBL	C	30.8	0.11	8.3	C	32.0	0.27	17.2
	SBT	B	15.2	0.18	26.7	B	16.6	0.16	24.7
	SBR	A	0.4	0.08	0.7	A	1.9	0.10	3.3
	<b>Overall</b>	<b>B</b>	<b>16.9</b>	-	-	<b>B</b>	<b>19.6</b>	-	-
<b>Greenbank Road &amp; Kilbirnie Drive Unsignalized</b>	EB	B	14.5	0.28	1.1	C	16.9	0.19	0.7
	WB	B	12.8	0.30	1.2	B	12.6	0.16	0.6
	NBL	A	7.7	0.02	0.1	A	7.8	0.05	0.2
	NBT	-	-	-	-	-	-	-	-
	NBR	-	-	-	-	-	-	-	-
	SBL	A	7.5	0.02	0.1	A	7.9	0.07	0.2
	SBT	-	-	-	-	-	-	-	-
	SBR	-	-	-	-	-	-	-	-
	<b>Overall</b>	<b>A</b>	<b>6.9</b>	-	-	<b>A</b>	<b>4.6</b>	-	-
<b>Cambrian Road &amp; River Mist Road Unsignalized</b>	EB	B	10.7	0.32	1.4	B	13.8	0.54	3.3
	WB	B	12.2	0.43	2.2	C	16.6	0.64	4.6
	NB	B	11.6	0.40	1.9	B	10.6	0.22	0.8
	SB	A	9.3	0.09	0.3	A	9.9	0.09	0.3
	<b>Overall</b>	<b>B</b>	<b>11.4</b>	-	-	<b>B</b>	<b>14.4</b>	-	-

The background 2020 intersection operations are forecasted to operate at acceptable levels of service. No rationalization of the proposed development trip generation or background volumes are required for the 2020 horizon.

## 7.2 Background 2025 Operations

The intersection operations for the background 2025 conditions are summarized below in Table 10.

The intersection of Cambrian Road and River Mist Road requires a westbound left-turn lane during the PM peak for potential operational issues by 2025, and using the TAC left-turn warrants, a minimum storage length of 25m is required. This left-turn lane has been included in the following analysis. The left-turn warrant is provided in Appendix F.

The synchro worksheets for the background 2025 conditions are provided in Appendix G.

Table 10: Background 2025 Intersection Operations

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	Delay	V/C	Q (95 <sup>th</sup> )	LOS	Delay	V/C	Q (95 <sup>th</sup> )
<b>Greenbank Road &amp; Dundonald Drive Signalized</b>	EB	C	25.5	0.65	44.2	C	24.6	0.54	32.1
	WB	B	10.8	0.28	14.9	C	21.3	0.39	26.5
	NBL	C	30.5	0.17	11.8	C	32.0	0.32	19.9
	NBT	B	13.9	0.35	55.3	B	17.3	0.34	50.7
	NBR	A	0.1	0.02	0.0	A	0.1	0.03	0.0
	SBL	C	30.8	0.11	8.3	C	32.0	0.27	17.2
	SBT	B	15.5	0.25	36.9	B	17.6	0.33	48.8
	SBR	A	0.4	0.08	0.7	A	1.9	0.10	3.3
	<b>Overall</b>	<b>B</b>	<b>16.7</b>	-	-	<b>B</b>	<b>19.5</b>	-	-
<b>Greenbank Road &amp; Kilbirnie Drive Unsignalized</b>	EB	C	19.3	0.37	1.7	C	23.1	0.27	1.0
	WB	C	16.7	0.39	1.8	C	15.2	0.20	0.7
	NBL	A	7.9	0.02	0.1	A	8.2	0.056	0.2
	NBT	-	-	-	-	-	-	-	-
	NBR	-	-	-	-	-	-	-	-
	SBL	A	7.9	0.02	0.1	A	8.1	0.07	0.2
	SBT	-	-	-	-	-	-	-	-
	SBR	-	-	-	-	-	-	-	-
	<b>Overall</b>	<b>A</b>	<b>6.9</b>	-	-	<b>A</b>	<b>4.3</b>	-	-
<b>Cambrian Road &amp; River Mist Road Unsignalized</b>	EB	C	19.5	0.62	4.2	D	33.7	0.86	9.8
	WBL	B	11.7	0.18	0.7	B	13.6	0.39	1.8
	WBT/R	C	21.4	0.65	4.6	C	23.0	0.72	5.9
	NB	C	24.6	0.74	6.3	B	13.8	0.39	1.8
	SB	B	11.4	0.12	0.4	B	11.4	0.10	0.3
	<b>Overall</b>	<b>C</b>	<b>20.9</b>	-	-	<b>C</b>	<b>24.0</b>	-	-

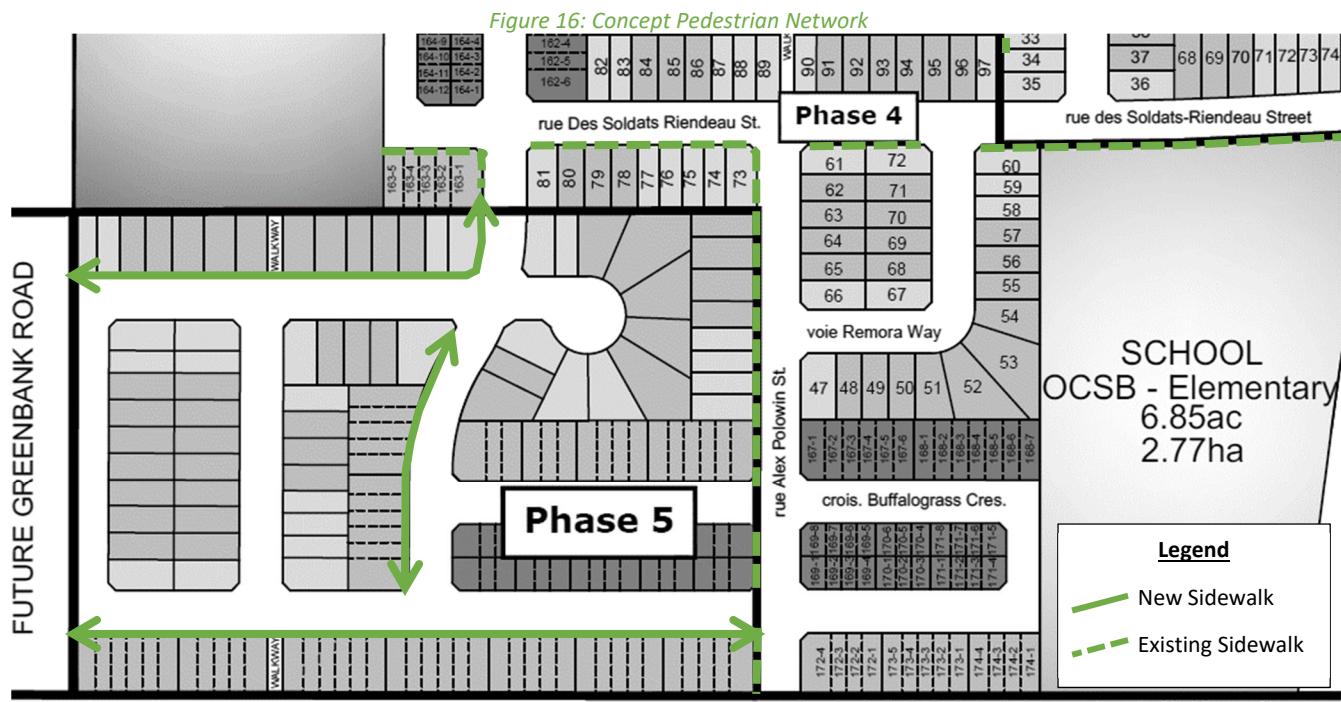
The background 2020 intersection operations are forecasted to operate at acceptable levels of service. As noted previously, the Cambrian Road and River Mist Road intersection will begin to experience capacity issues related to driver delay during the PM peak and the westbound left-turn movement. A westbound left-turn auxiliary lane has been assumed to be in place to support the background developments and traffic growth in the area. The eastbound and westbound approaches will also see increased delay with the background growth. During the AM peak, the northbound approach will also be experienced increased delay for vehicles turning onto Cambrian Road.

Overall, no rationalization of the proposed development trip generation or background volumes are required for the 2025 horizon.

## 8 Development Design

### 8.1 Design for Sustainable Modes

The proposed development is a residential subdivision and therefore auto and bicycle parking areas will be within each resident's home. Figure 16 illustrates the concept active mode network. The plan incorporates the adjacent developments, planned routes on geoOttawa, and the extension of the Barrhaven South Urban Expansion Study Area CDP networks.



## 8.2 New Street Networks

The planned street network will include 18.0 metre local roadways and a 14.5 metre window street on the western edge of the site. The local roads may include a sidewalk on one side, and the window street will need to tie into the eventual sidewalks along the future Re-Aligned Greenbank Road.

No traffic calming measures are recommended for the site.

The internal road intersections are recommended to be stop-controlled on the minor approaches.

## 9 Boundary Street Design

Table 11 summarizes the MMLOS analysis for the boundary road of Alex Polowin Avenue, using the developing community land-use designation. Alex Polowin Avenue meets the MMLOS targets for the area. The MMLOS worksheet has been provided in Appendix H.

*Table 11: Boundary Street MMLOS Analysis*

Segment	Pedestrian LOS		Bicycle LOS		Transit LOS		Truck LOS	
	PLOS	Target	BLOS	Target	TLOS	Target	TrLOS	Target
Alex Polowin Avenue	B	C	B	C	-	N/A	-	N/A

## 10 Access Intersection Design

### 10.1 Location and Design of Access

The proposed access to the subdivision is through the adjacent development local roads. The subdivision is Phase 5 of the Half Moon Bay South Community and was planned to connect through Phase 4 along Fameflower Street, Soldats-Riendeau Street, and Alex Polowin Street.

## 10.2 Access Intersection Control

Based on the projected volumes, minor stop-controlled intersections are recommended at the future intersections. No further traffic control or turn lanes are warranted to address operational issues.

## 10.3 Access Intersection Design

The local road intersections will be shared lanes and formalize the planned intersections within the context of Half Moon Bay South.

# 11 Transportation Demand Management

## 11.1 Context for TDM

The mode shares are heavily focused on auto travel and are anticipated to be achieved and will not impact any adjacent residential, recreational or natural land uses beyond the planned conditions and results of this study.

The subject site is within the Barrhaven South Expansion Area.

Total bedrooms within the development is subject to owner purchasing preferences. No age restrictions are noted.

## 11.2 Need and Opportunity

The subject site has been assumed to rely predominantly on auto travel and those assumptions have been carried through the analysis. Little opportunity is available to shift these modes until major infrastructure projects are completed to increase the transit and active mode network connectivity from South Barrhaven to the rest of the City.

## 11.3 TDM Program

As discussed above, any “suite of post-occupancy TDM measures” are limited in their applicability. It is anticipated that this development will rely predominantly on auto travel and those assumptions have been carried through the analysis.

# 12 Neighbourhood Traffic Management

Overall the site is anticipated to generate approximately 145 to 166 vehicle trips during the peak hours and will access the adjacent roads of Soldats-Riendeau Street, Fameflower Street, and Alex Polowin Street. The 120-vehicle threshold for local roads during a peak hour is a low threshold and will typically be exceeded if a local road is longer than a few blocks or have been designed to collect other minor streets.

The adjacent local roads are designed with an 18.0 metre right-of-way, 8.5 metre pavement width, and on-street parking. Due to the residential driveways and on-street parking, no traffic management features are recommended along Soldats-Riendeau Street, Fameflower Street, and Alex Polowin Street.

# 13 Transit

## 13.1 Route Capacity

Overall, the forecasted new transit trips would result in approximately an 20 passengers during the peak hours, split between inbound and outbound travel.

The existing transit routes are beyond 400 metres and not anticipated to be closer in proximity to the site until Re-Aligned Greenbank Road is constructed.

### 13.2 Transit Priority

No transit priority is required/considered for the study area.

## 14 Network Intersection Design

### 14.1 Network Intersection Control

No changes are proposed to the existing area intersection control.

### 14.2 Network Intersection Design

#### 14.2.1 2020 Future Total Intersection Operations

The 2020 future total intersection volumes are illustrated in Figure 17 and the operations are summarized below in Table 12. The synchro worksheets have been provided in Appendix I.

*Figure 17: 2020 Future Total Traffic Volumes*

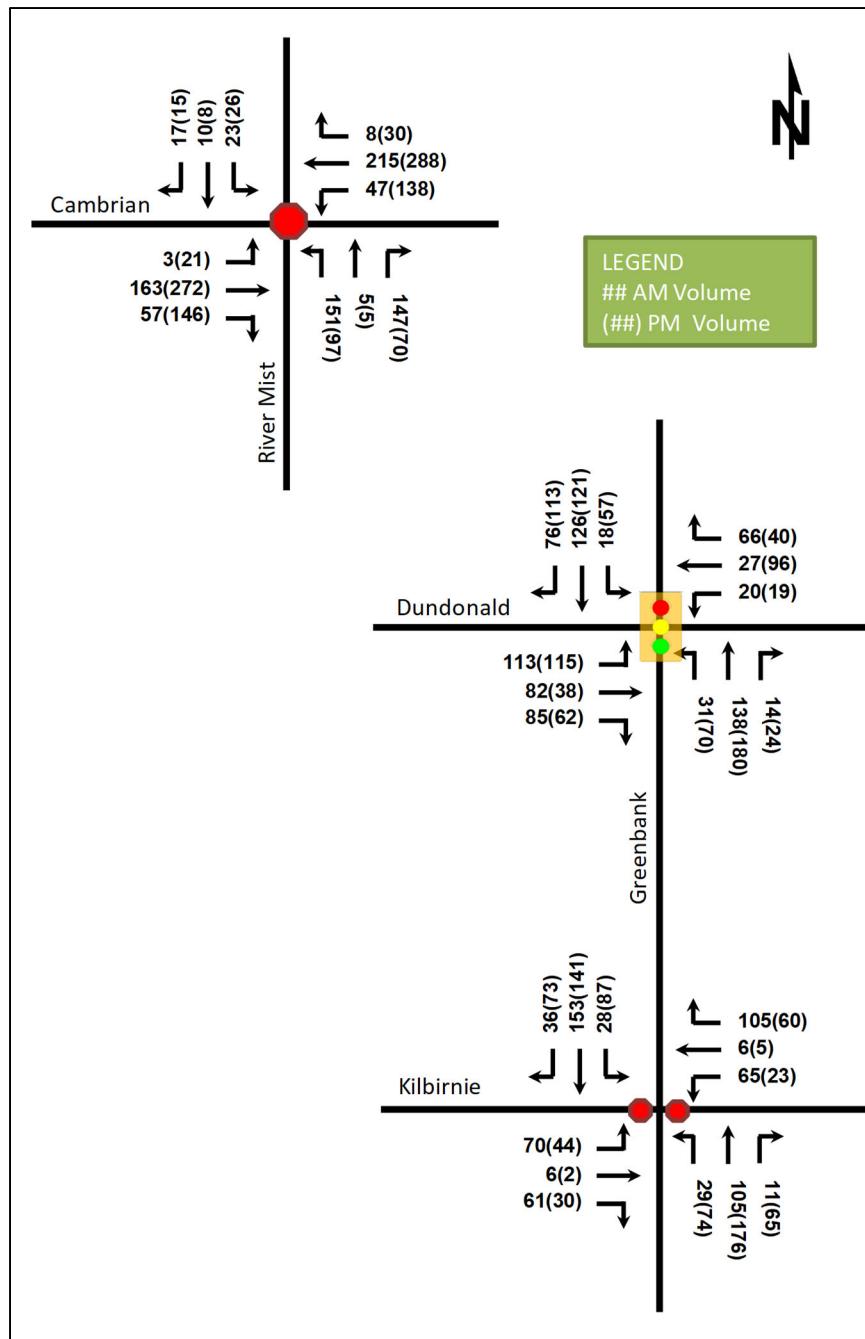


Table 12: Total 2020 Intersection Operations

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	Delay	V/C	Q (95 <sup>th</sup> )	LOS	Delay	V/C	Q (95 <sup>th</sup> )
<b>Greenbank Road &amp; Dundonald Drive Signalized</b>	EB	C	30.0	0.74	56.3	C	27.7	0.61	40.0
	WB	B	11.1	0.29	16.2	C	20.7	0.37	27.4
	NBL	C	31.5	0.18	11.8	C	32.9	0.32	19.9
	NBT	B	13.5	0.19	28.4	B	17.4	0.24	34.6
	NBR	A	0.1	0.02	0.0	A	0.1	0.03	0.0
	SBL	C	31.8	0.11	8.3	C	32.8	0.28	17.2
	SBT	B	16.3	0.19	26.7	B	17.6	0.16	24.7
	SBR	A	1.9	0.12	3.7	A	4.8	0.16	9.0
	<b>Overall</b>	<b>B</b>	<b>19.1</b>	-	-	<b>C</b>	<b>20.5</b>	-	-
<b>Greenbank Road &amp; Kilbirnie Drive Unsignalized</b>	EB	B	14.5	0.29	1.2	C	16.8	0.20	0.7
	WB	B	12.9	0.30	1.3	B	12.7	0.16	0.6
	NBL	A	7.7	0.02	0.1	A	7.8	0.06	0.2
	NBT	-	-	-	-	-	-	-	-
	NBR	-	-	-	-	-	-	-	-
	SBL	A	7.5	0.02	0.1	A	7.9	0.07	0.2
	SBT	-	-	-	-	-	-	-	-
	SBR	-	-	-	-	-	-	-	-
	<b>Overall</b>	<b>A</b>	<b>7.0</b>	-	-	<b>A</b>	<b>4.7</b>	-	-
<b>Cambrian Road &amp; River Mist Road Unsignalized</b>	EB	B	11.6	0.37	1.7	C	16.3	0.63	4.4
	WB	B	13.0	0.46	2.4	C	18.4	0.67	5.1
	NB	B	13.5	0.50	2.8	B	11.8	0.30	1.2
	SB	A	9.6	0.09	0.3	B	10.3	0.09	0.3
	<b>Overall</b>	<b>B</b>	<b>12.6</b>	-	-	<b>C</b>	<b>16.2</b>	-	-

The future total 2020 intersection operate similarly to the background 2020 conditions. No intersection improvements are recommended for the site build-out horizon.

#### 14.2.2 2025 Future Total Intersection Operations

The 2025 future total intersection volumes are illustrated in Figure 18 and the operations are summarized below in Table 13. The synchro worksheets have been provided in Appendix J.

Figure 18: 2025 Future Total Traffic Volumes

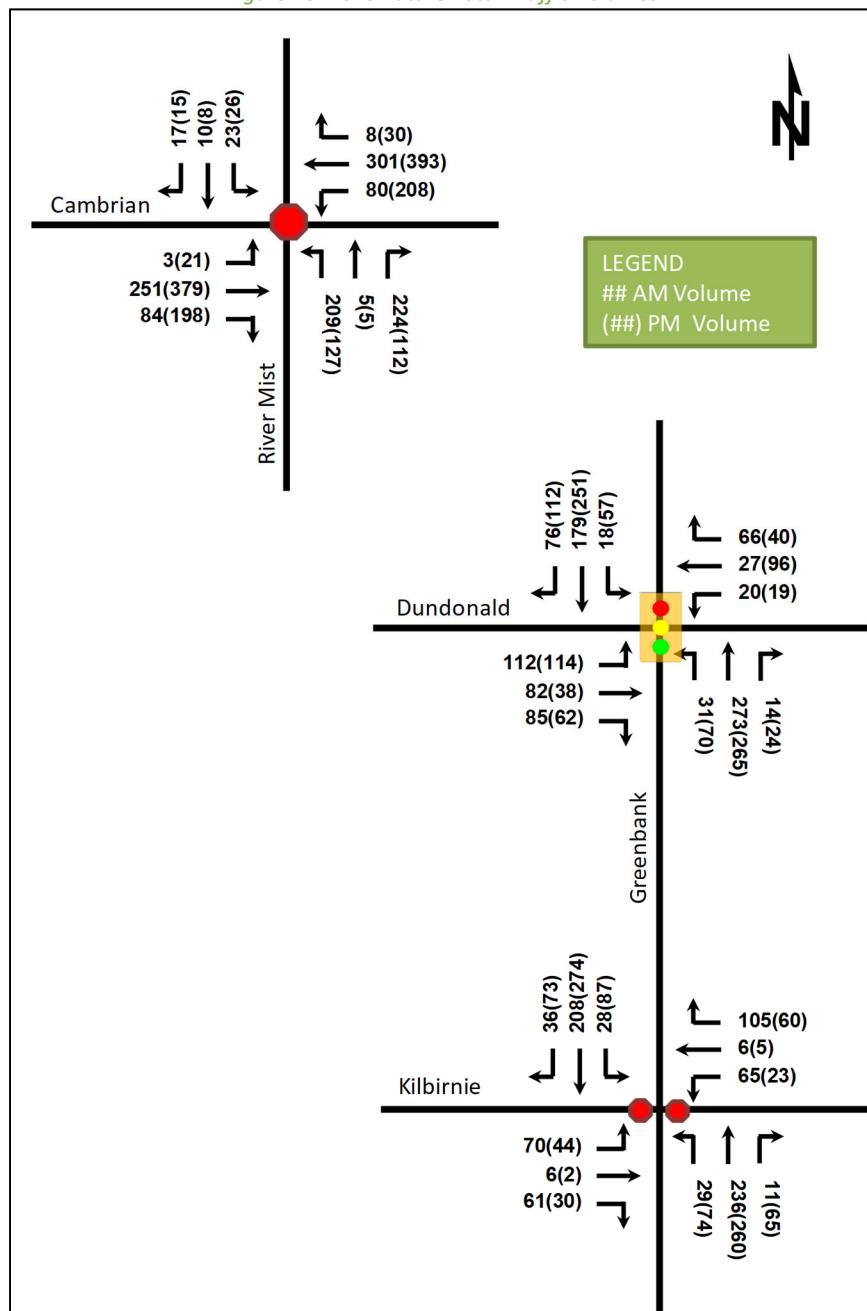


Table 13: Total 2025 Intersection Operations

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	Delay	V/C	Q (95 <sup>th</sup> )	LOS	Delay	V/C	Q (95 <sup>th</sup> )
<b>Greenbank Road &amp; Dundonald Drive Signalized</b>	EB	C	30.2	0.74	56.4	B	29.3	0.64	41.2
	WB	B	10.5	0.26	15.2	B	29.5	0.63	44.1
	NBL	C	31.5	0.18	11.8	C	33.1	0.32	19.9
	NBT	B	15.0	0.37	55.3	B	18.9	0.36	50.7
	NBR	A	0.1	0.02	0.0	A	0.1	0.03	0.0
	SBL	C	31.8	0.11	8.3	C	33.1	0.28	17.2
	SBT	B	16.7	0.26	36.9	B	19.2	0.35	48.8
	SBR	A	1.9	0.12	3.7	A	4.8	0.17	9.0
	<b>Overall</b>	<b>B</b>	<b>18.7</b>	-	-	<b>C</b>	<b>22.5</b>	-	-
<b>Greenbank Road &amp; Kilbirnie Drive Unsignalized</b>	EB	C	19.4	0.38	1.7	D	23.1	0.28	1.1
	WB	C	16.9	0.40	1.9	C	15.4	0.20	0.8
	NBL	A	7.9	0.03	0.1	A	8.2	0.06	0.2
	NBT	-	-	-	-	-	-	-	-
	NBR	-	-	-	-	-	-	-	-
	SBL	A	7.9	0.02	0.1	A	8.1	0.07	0.2
	SBT	-	-	-	-	-	-	-	-
	SBR	-	-	-	-	-	-	-	-
	<b>Overall</b>	<b>A</b>	<b>7.1</b>	-	-	<b>A</b>	<b>4.4</b>	-	-
<b>Cambrian Road &amp; River Mist Road Unsignalized</b>	EB	C	24.0	0.70	5.5	F	57.2	0.97	14.5
	WBL	B	12.3	0.19	0.7	B	14.7	0.41	2.0
	WBT/R	C	24.4	0.69	5.2	D	27.6	0.76	6.9
	NB	E	37.2	0.86	9.5	C	16.3	0.48	2.5
	SB	B	12.1	0.12	0.4	B	12.0	0.11	0.4
	<b>Overall</b>	<b>D</b>	<b>27.6</b>	-	-	<b>D</b>	<b>35.1</b>	-	-

The study area intersection operations see an increased delay with the additional background development traffic and growth. The intersection of Cambrian Road and River Mist Road eastbound approach will experience a delay of over 50 seconds during the PM peak. The separation of the right-turn volume to an auxiliary lane is a potential improvement for this intersection. Table 14 summarizes the PM peak operations for the Cambrian Road and River Mist Road intersection with an eastbound auxiliary right-turn lane.

Table 14: Total 2025 Intersection Operations

Intersection	Lane	PM Peak Hour			
		LOS	Delay	V/C	Q (95 <sup>th</sup> )
<b>Cambrian Road &amp; River Mist Road Unsignalized</b>	EBL/T	D	25.1	0.73	6.0
	EBR	B	11.4	0.32	1.4
	WBL	B	14.4	0.41	1.9
	WBT/R	D	26.3	0.75	6.6
	NB	C	15.3	0.46	2.3
	SB	B	11.5	0.10	0.3
	<b>Overall</b>	<b>C</b>	<b>20.2</b>	-	-

The addition of the eastbound-right turn lane would improve the intersection operations at the Cambrian Road and River Mist Road intersection. Once Cambrian Road is widened, the additional eastbound lane would provide a similar benefit for the intersection.

#### 14.2.3 Intersection MMLOS

Table 15 summarizes the MMLOS analysis for the Greenbank Road and Dundonald Drive intersection. No existing MMLOS analysis has been provided as the intersection is currently a minor stop-controlled intersection. The MMLOS worksheet has been provided in Appendix F.

*Table 15: 2025 Future Signalized MMLOS Analysis*

Intersection	Pedestrian LOS		Bicycle LOS		Transit LOS		Truck LOS		Auto LOS	
	PLOS	Target	BLOS	Target	TLOS	Target	TrLOS	Target	ALOS	Target
Greenbank Road & Dundonald Drive	D	C	F	C	E	D	-	N/A	B	D

The Greenbank Road and Dundonald Drive intersection does not meet the pedestrian, bicycle, or transit MMLOS targets for a developing community. The crossing distance across Greenbank Road limits the ability of this intersection to meet the target and would require a road narrowing to improve the PLOS. For the BLOS, the mixed traffic operation on the east/west approaches result in a BLOS D, and the on-street bike lane for the northbound approach is a BLOS F. If the northbound traffic uses the multi-use pathway along the west side of Greenbank Road, the facility provides a PLOS A. The TLOS is limited by the delays to transit vehicles on the eastbound approach.

No modifications are recommended for this intersection as a Greenbank Road would need to be narrowed for the pedestrian LOS, a multi-use pathway is already provided for cycling, and the intersection timing is currently free. The Traffic Services Department may revise the signal timing to reduce the delay on transit vehicles.

#### 14.2.4 Recommended Design Elements

The study area intersection of Cambrian Road and River Mist Road operations in the 2025 future total conditions indicate the need to provide a right-turn lane in the eastbound direction. This is in addition to the westbound left-turn lane identified during the background conditions for 2025.

The Cambrian Road is currently 11.0 metres wide along the mainline segments and the curb radii at the stop bar locations provide an effective width of 14.0 metres. A revision of the pavement markings at this intersection would allow for the inclusion of the eastbound shared left-turn/through lane and right-turn lane. To accommodate both the eastbound right-turn and westbound left-turn, the intersection would need to be widened.

### 15 Summary of Improvements Indicated and Modifications Options

The following summarizes the analysis and results presented in this TIA report:

#### Proposed Site and Screening

- The proposed site includes 164 units, split approximately between 67 single detached homes and 97 townhomes
- Access will be provided from the development through the previous phases of the Half Moon Bay South development, accessing Greenbank Road at Dundonald Drive and Kilbirnie Drive, and Cambrian Road at River Mist Road
- The development is proposed to be completed as a single phase by 2020
- The Trip Generation and Location triggers were met for the TIA Screening

#### Existing Conditions

- The adjacent local road network consists of 18.0 metre right-of-way roads, with a sidewalk, and on-street parking with (un)posted 50 km/h speed limits

- Pedestrian and cycling facilities are provided along the local roads, and transit facilities are provided beyond a 400-metre linear distance from the proposed development
- No collision issues were noted in the study area

### **Development Generated Travel Demand**

- The proposed development is forecasted to generate 181 people two-way trips during the AM peak and 208 people two-way trips during the PM peak
- Based on the study area travel patterns, a total of 145 two-way vehicle trips will be generated during the AM peak and 166 two-way vehicles trips during the PM peak
- 95% of the traffic is estimated to travel north of the site (ultimately 80% north, 10% east, and 5% west) and 5% to the south of the site

### **Background Conditions**

- The background developments of Half Moon Bay West and Tamarack Meadows Phase 4 were included within the 2020 horizon, and Tamarack Meadows Phase 5 and the Barrhaven South Expansion Area were included in the 2025 horizon
- A westbound left-turn lane was noted to be required due to background traffic at the Cambrian Road and River Mist Road intersection by the 2025 horizon

### **Development Design**

- The development roads are 18.0 metre local roads and a 14.5 metre window street is located on the west side of the development
- The internal road intersections are recommended to be minor stop-controlled
- No traffic calming measures are recommended within the development

### **Boundary Street Design**

- The existing and future Alex Polowin Road meets the targets for MMLOS
- No improvements are recommended

### **Access Intersections Design**

- The access intersections are local road to local road intersections, as planned through the draft plan of the Half Moon Bay South development
- Minor stop-controlled intersections are recommended for the connections to Soldats-Riendeau Street and Alex Polowin Street

### **TDM**

- The lack of supporting infrastructure limits the potential for TDM measures to reduce the auto reliance anticipated for the proposed development
- Beyond the study horizons, the transit network along Re-Aligned Greenbank Road and the associated cycling and pedestrian networks will begin to produce the connectivity required to see a mode shift from the proposed development

### **Neighbourhood Traffic Management**

- No traffic management features are recommended for Soldats-Riendeau Street, Fameflower Street, or Alex Polowin Street

## Transit

- No transit service is provided on the boundary road network, nor future route plans include the proposed development at this time
- To meet minimum area transit use, half of a single bus, or equivalent capacity, would be required to support the proposed development during the AM and PM peak hours

## Network Intersection Design

- An eastbound approach was noted to have delays above 50 seconds due to background and development traffic at the Cambrian Road and River Mist Road intersection by the 2025 horizon
- An auxiliary right-turn lane would reduce the delay at the intersection and improve the eastbound approach level of service

## 16 Next Steps

Following the circulation and review of this Step 4 Strategy Report, any comments received from City Staff will be incorporated into the Step 5 TIA Report. Once sign-off has been received from City Transportation Project Manager for all Steps of the TIA process, a signed and stamped final report will be provided to City staff.

# **Appendix A**

TIA Screening Form and PM Certification Form

City of Ottawa 2017 TIA Guidelines  
Step 1 - Screening Form

Date: Sept. 25, 2018  
Project Number: 2018-32  
Project Reference: Mattamy HMBS Phase 5

1.1 Description of Proposed Development	
Municipal Address	3718 Greenbank Road
Description of Location	Ward 21 - PIN 045922110
Land Use Classification	Residential
Development Size	163 units (69 singles, 94 townhomes)
Accesses	Existing HMBS, Ultimately Realigned Greenbank
Phase of Development	Single Phase
Buildout Year	2020
TIA Requirement	Full TIA Required

1.2 Trip Generation Trigger		
Land Use Type	Townhomes or apartments	
Development Size	94	Units
Trip Generation Trigger	Yes	

1.3 Location Triggers		
Does the development propose a new driveway to a boundary street that is designated as part of the City's Transit Priority, Rapid Transit or Spine Bicycle Networks?		Yes
Is the development in a Design Priority Area (DPA) or Transit-oriented Development (TOD) zone?	No	
Location Trigger	Yes	

1.4. Safety Triggers		
Are posted speed limits on a boundary street are 80 km/hr or greater?	No	
Are there any horizontal/vertical curvatures on a boundary street limits sight lines at a proposed driveway?	No	
Is the proposed driveway within the area of influence of an adjacent traffic signal or roundabout (i.e. within 300 m of intersection in rural conditions, or within 150 m of intersection in urban/ suburban conditions)?	No	Ultimately. Not during build-out or +5 year horizon.
Is the proposed driveway within auxiliary lanes of an intersection?	No	
Does the proposed driveway make use of an existing median break that serves an existing site?	No	
Is there is a documented history of traffic operations or safety concerns on the boundary streets within 500 m of the development?	No	
Does the development include a drive-thru facility?	No	
Safety Trigger	No	



## **TIA Plan Reports**

On 14 June 2017, the Council of the City of Ottawa adopted new Transportation Impact Assessment (TIA) Guidelines. In adopting the guidelines, Council established a requirement for those preparing and delivering transportation impact assessments and reports to sign a letter of certification.

Individuals submitting TIA reports will be responsible for all aspects of development-related transportation assessment and reporting, and undertaking such work, in accordance and compliance with the City of Ottawa's Official Plan, the Transportation Master Plan and the Transportation Impact Assessment (2017) Guidelines.

By submitting the attached TIA report (and any associated documents) and signing this document, the individual acknowledges that s/he meets the four criteria listed below.

### **CERTIFICATION**

1. I have reviewed and have a sound understanding of the objectives, needs and requirements of the City of Ottawa's Official Plan, Transportation Master Plan and the Transportation Impact Assessment (2017) Guidelines;
2. I have a sound knowledge of industry standard practice with respect to the preparation of transportation impact assessment reports, including multi modal level of service review;
3. I have substantial experience (more than 5 years) in undertaking and delivering transportation impact studies (analysis, reporting and geometric design) with strong background knowledge in transportation planning, engineering or traffic operations; and
4. I am either a licensed<sup>1</sup> or registered<sup>2</sup> professional in good standing, whose field of expertise [check  appropriate field(s)] is either transportation engineering  or transportation planning .

<sup>1,2</sup> License of registration body that oversees the profession is required to have a code of conduct and ethics guidelines that will ensure appropriate conduct and representation for transportation planning and/or transportation engineering works.

Dated at Ottawa this 20 day of September, 2018.  
(City)

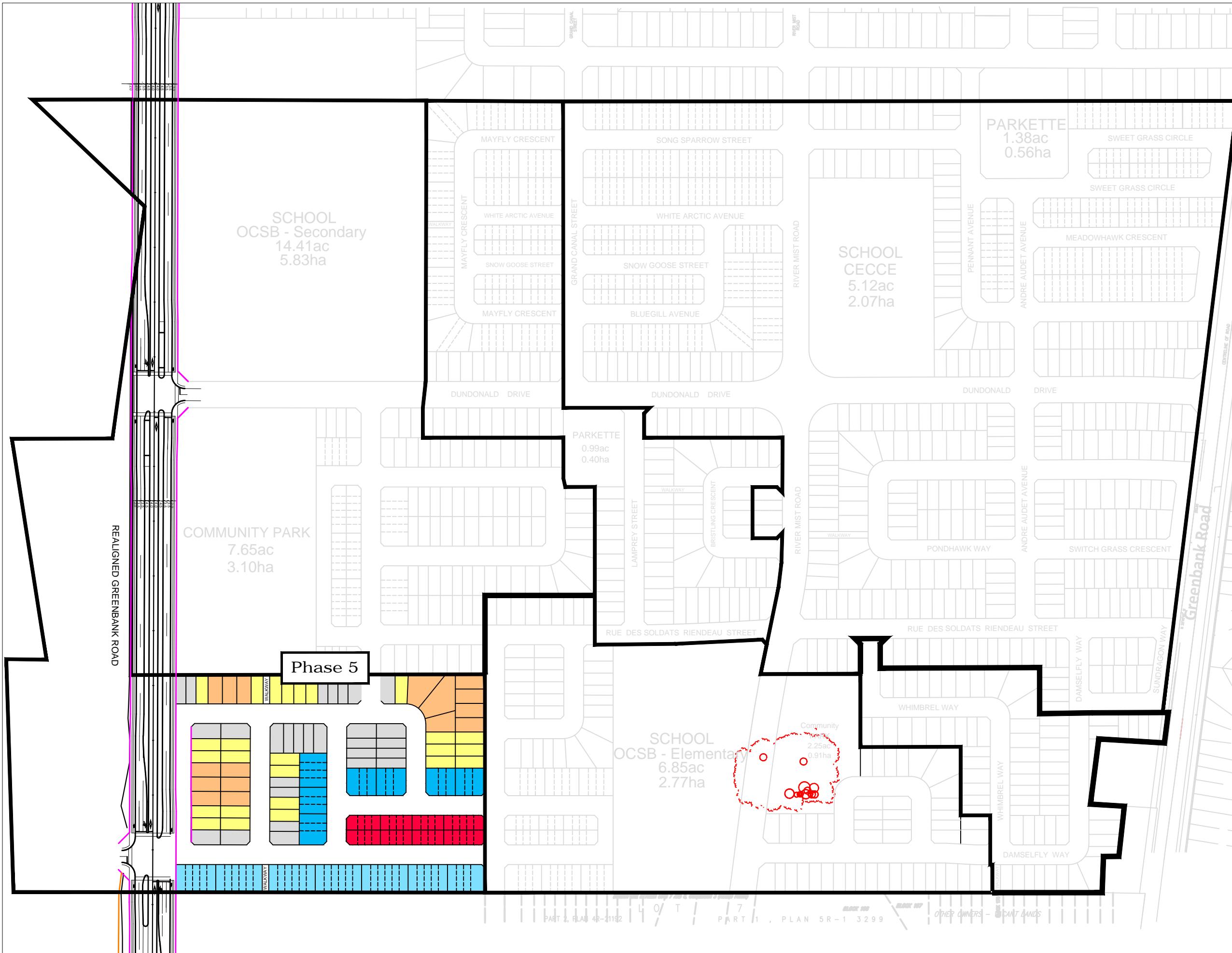
Name: Andrew Harte  
(Please Print)

Professional Title: Professional Engineer

  
Signature of Individual certifier that s/he meets the above four criteria

<b>Office Contact Information (Please Print)</b>
Address: 13 Markham Avenue
City / Postal Code: Ottawa / K2G 3Z1
Telephone / Extension: (613) 697-3797
E-Mail Address: Andrew.Harte@CGHTransportation.com





# Half Moon Bay

## South

### Phase 5

#### Coloured Plan

September 16th, 2014

### Unit Type

-  30' Single
  -  36' Single
  -  43' Single
  -  21' Townhomes
  -  23' Townhomes
  -  21' Villagehomes

HMBS Phase 5 Lot Count

<b>34</b>	<b>BTB Townhomes</b>	<b>(21%)</b>
<b>38</b>	<b>21' Townhomes</b>	<b>(23%)</b>
<b>22</b>	<b>23' Townhomes</b>	<b>(14%)</b>
<b>17</b>	<b>30' Singles</b>	<b>(10%)</b>
<b>11</b>	<b>30' Singles Corner</b>	<b>(7%)</b>
<b>25</b>	<b>36 Singles</b>	<b>(15%)</b>
<b>16</b>	<b>43' Singles</b>	<b>(10%)</b>
<b>163</b>	<b>TOTAL</b>	<b>94 Townhomes (58%)</b>
		<b>69 Singles (42%)</b>

# Appendix B

Adjacent Driveway and Local Road Intersections



#1

Alex Polowin South at Remora



#2

Alex Polowin Mailbox between  
Remora and Buffalo Grass



#3

Alex Polowin South at  
Buffalograss



#4

Buffalograss East



#5

Alex Polowin North



#6

Alex Polowin North to Soldats  
Riendeau



#7

Soldats Riendeau East at Alex Polowin



#8

Soldats Riendeau West of Alex Polowin



#9

Soldats Riendeau at  
Fameflower Northeast



#10

Fameflower South



#11

Kilbirnie East of Alex Polowin



#12

Kilbirnie East of River Mist



# Appendix C

Turning Movement Counts

**Ottawa** **Transportation Services - Traffic Services** **W.O.** 37049  
**Turning Movement Count - 15 Minute Summary Report**

**DUNDONALD DR @ GREENBANK RD**

**Survey Date:** Wednesday, May 24, 2017 **Total Observed U-Turns**

GREENBANK RD												DUNDONALD DR											
Northbound						Southbound						Eastbound						Westbound					
Time Period	LT	ST	N	RT	TOT	LT	ST	R	S	STR	TOT	LT	ST	RT	E	W	STR	TOT	Grand Total				
07:00-07:15	7	26	3	36	1	32	12	45	81	25	20	21	66	3	4	11	18	84	165				
07:15-07:30	8	25	2	35	6	32	13	51	86	25	33	26	84	4	5	9	18	102	188				
07:30-07:45	9	30	5	44	4	30	8	42	86	17	15	25	57	4	8	11	23	80	166				
07:45-08:00	4	35	2	41	5	26	15	46	87	8	17	18	44	6	6	17	29	73	160				
08:00-08:15	10	43	5	58	3	33	21	57	115	24	12	16	52	6	6	29	41	93	208				
08:15-08:30	5	39	3	47	7	27	12	46	93	23	17	18	58	3	6	17	26	84	177				
08:30-08:45	8	32	4	44	3	29	9	41	86	16	10	24	50	4	5	16	25	75	160				
08:45-09:00	2	40	1	43	4	27	7	38	81	19	11	12	42	3	10	12	25	67	148				
09:00-09:15	13	45	4	62	9	34	14	57	119	22	20	10	52	3	15	20	38	90	209				
09:15-09:30	4	23	2	29	6	24	17	47	76	19	3	12	34	1	3	11	15	49	125				
09:30-09:45	3	37	3	43	1	21	16	38	81	8	5	10	23	2	1	8	11	34	115				
09:45-10:00	2	26	2	30	2	10	16	28	58	7	4	6	17	3	4	6	13	30	88				
11:30-11:45	3	23	0	28	2	32	6	42	68	18	3	8	29	2	4	2	8	37	105				
11:45-12:00	5	31	1	37	5	19	13	37	74	13	3	5	21	0	5	2	7	28	102				
12:00-12:15	7	22	3	32	9	24	16	49	81	21	2	3	26	1	4	5	10	36	117				
12:15-12:30	9	23	2	34	1	26	5	32	66	9	3	6	18	3	2	6	11	29	95				
12:30-12:45	5	21	2	28	4	24	21	49	77	19	3	8	30	1	5	1	7	37	114				
12:45-13:00	3	22	2	27	2	24	12	38	65	12	9	6	27	2	8	4	14	41	106				
13:00-13:15	4	38	3	45	4	21	14	39	84	16	6	7	29	1	8	4	13	42	126				
13:15-13:30	7	21	4	32	1	22	9	32	64	13	3	7	23	3	2	2	7	30	94				
15:00-15:15	10	32	4	46	6	23	15	44	90	9	2	5	16	3	4	7	14	30	120				
15:15-15:30	17	29	4	50	2	21	23	46	96	19	8	5	32	3	8	8	19	51	147				
15:30-15:45	17	36	2	55	7	18	16	41	96	16	10	7	33	4	12	10	26	59	155				
15:45-16:00	14	31	3	48	16	36	20	72	120	31	12	21	64	4	17	9	30	94	214				
16:00-16:15	13	36	5	54	9	40	14	63	117	7	5	12	24	1	10	9	20	44	161				
16:15-16:30	20	30	5	55	9	38	14	61	116	13	3	14	30	5	14	5	24	54	170				
16:30-16:45	15	49	4	68	12	27	25	64	132	21	8	10	39	1	21	6	28	67	199				
16:45-17:00	21	45	3	69	12	25	24	61	130	14	5	3	22	5	23	14	42	64	194				
17:00-17:15	29	48	2	79	15	32	17	64	143	25	9	15	49	5	17	5	27	76	219				
17:15-17:30	16	39	6	61	6	32	15	53	114	21	8	10	39	4	22	14	40	79	193				
17:30-17:45	9	33	9	51	11	29	21	61	112	25	9	18	52	5	22	10	37	89	201				
17:45-18:00	16	53	7	76	25	23	22	70	146	15	8	19	42	5	30	11	46	88	234				
<b>TOTAL:</b>	315	1063	107	1485	209	861	484	1554	3039	550	286	387	1224	100	311	301	712	1936	4975				

Note: U-Turns are included in Totals.

2017-Aug-17

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

2017-Aug-17

Page 1 of 1

**Ottawa** **Transportation Services - Traffic Services** **W.O.** 37049  
**Turning Movement Count - Cyclist Volume Report**

**DUNDONALD DR @ GREENBANK RD**

**Survey Date:** Wednesday, May 24, 2017 **Total Observed U-Turns**

GREENBANK RD												DUNDONALD DR											
Northbound						Southbound						Eastbound						Westbound					
Time Period	LT	ST	N	RT	TOT	LT	ST	R	S	STR	TOT	LT	ST	RT	E	W	STR	TOT	Grand Total				
07:00-07:15	7	26	3	36	1	32	12	45	81	25	20	21	66	3	4	11	18	84	165				
07:15-07:30	8	25	2	35	6	32	13	51	86	25	33	26	84	4	5	9	18	102	188				
07:30-07:45	9	30	5	44	4	30	8	42	86	17	15	25	57	4	8	11	23	80	166				
07:45-08:00	4	35	2	41	5	26	15	46	87	8	17	18	44	6	6	17	29	73	160				
08:00-08:15	10	43	5	58	3	33	21	57	115	24	12	16	52	6	6	29	41	93	208				
08:15-08:30	5	39	3	47	7	27	12	46	93	23	17	18	58	3	6	17	26	84	177				
08:30-08:45	8	32	4	44	3	29	9	41	86	16	10	24	50	4	5	16	25	75	160				
08:45-09:00	2	40	1	43	4	27	7	38	81	19	11	12	42	3	10	12	25	67	148				
09:00-09:15	13	45	4	62	9	34	14	57	119	22	20	10	52	3	15	20	38	90	209				
09:15-09:30	4	23	2	29	6	24	17	47	76	19	3	12	34	1	3	11	15	49	125				
09:30-09:45	3	37	3	43	1	21	16	38	81	8	5	10	23	2	1	8	11	34	115				
09:45-10:00	2	26	2	30	2	10	16	28	58	7	4	6	17	3	4	6	13	30	88				
11:30-11:45	3	23	0	28	2	32	6	42	68	18	3	8	29	2	4	2	8	37	105				
11:45-12:00	5	31	1	37	5	19	13	37	74	13	3	5	21	0	5	2	7	28	102				
12:00-12:15	7	22	3	32	9	24	16	49	81	21	2	3	26	1	4	5	10	36	117				
12:15-12:30	9	23	2	34	1	26	5	32	66	9	3	6	18	3	2	6	11	29	95				
12:30-12:45	5	21	2	28	4	24	21	49	77	19	3	8	30	1	5	1	7	37	114				
12:45-13:00	3	22	2	27	2	24	12	38	65	12	9	6	27	2	8	4	14	41	106				
13:00-13:15	4	38	3	45	4	21	14	39	84	16	6	7	29	1	8	4	13	42	126				
13:15-13:30	7	21	4	32	1	22	9	32	64	13	3	7	23	3	2	2	7	30	94				
15:00-15:15	10	32	4	46	6	23	15	44	90	9	2	5	16	3	4	7	14	30	120				
15:15-15:30	17	29	4	50	2	21	23	46	96	19	8	5	32	3	8	8	19	51	147				
15:30-15:45	17	36	2	55	7	18	16	41	96	16	10	7	33	4	12	10	26	59	155				
15:45-16:00	14	31	3	48	16	36	20	72	120	31	12	21	64	4	17	9	30	94	214				
16:00-16:15	13	36	5	54	9	40	14	63	117	7	5	12	24	1	10	9	20	44	161				
16:15-16:30	20	30	5	55	9	38	14	61	116	13	3	14	30	5	14	5	24	54	170				
16:																							

**Ottawa** Transportation Services - Traffic Services  
Turning Movement Count - Full Study Diagram



Transportation Services - Traffic Services

W.O.  
37049

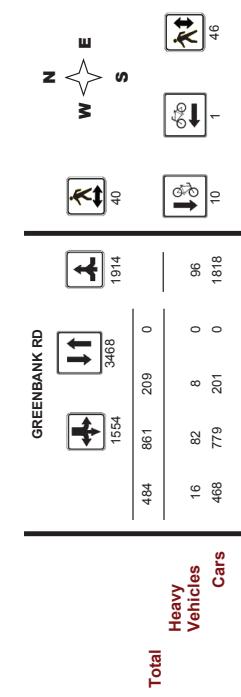
Turning Movement Count - Heavy Vehicle Report

DUNDONALD DR @ GREENBANK RD

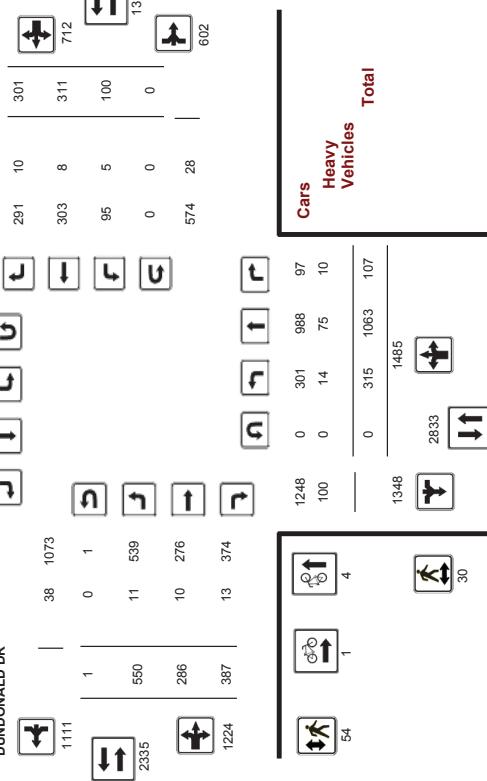
Survey Date: Wednesday, May 24, 2017

WO#: 37049

Device: Midvision



DUNDONALD DR



Survey Date: Wednesday, May 24, 2017

GREENBANK RD

DUNDONALD DR @ GREENBANK RD

Survey Date: Wednesday, May 24, 2017

DUNDONALD DR

Time Period	Northbound			Southbound			Eastbound			Westbound			STR TOT	STR TOT	W TOT	STR TOT	Grand Total
	LT	ST	RT	N	LT	ST	RT	S	STR TOT	LT	ST	RT					
07:00 - 08:00	0	6	3	9	4	18	1	23	32	1	0	3	4	0	2	6	38
08:00 - 09:00	5	13	1	19	1	7	2	10	29	0	1	1	2	1	1	5	7
09:00 - 10:00	3	9	1	13	0	8	4	12	25	1	1	4	6	0	3	1	36
11:30 - 12:30	0	7	1	8	0	10	5	15	23	2	0	0	2	0	0	1	3
12:30 - 13:30	0	10	3	13	1	11	1	13	26	4	4	2	10	0	2	1	26
15:00 - 16:00	6	14	1	21	2	12	3	17	38	3	3	1	7	1	0	2	13
16:00 - 17:00	0	8	0	8	0	13	0	13	21	0	1	2	3	3	0	2	10
17:00 - 18:00	0	8	0	8	0	3	0	3	11	0	0	0	0	0	0	0	8
<b>Sub Total</b>	<b>14</b>	<b>75</b>	<b>10</b>	<b>99</b>	<b>8</b>	<b>82</b>	<b>16</b>	<b>106</b>	<b>205</b>	<b>11</b>	<b>10</b>	<b>13</b>	<b>34</b>	<b>5</b>	<b>8</b>	<b>10</b>	<b>23</b>
<b>Heavy Vehicles</b>	<b>16</b>	<b>82</b>	<b>8</b>	<b>96</b>	<b>1</b>	<b>10</b>	<b>1</b>	<b>10</b>	<b>31</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Cars</b>	<b>468</b>	<b>779</b>	<b>201</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>11</b>
<b>Total</b>	<b>484</b>	<b>861</b>	<b>209</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>262</b>

Heavy Vehicles include Buses, Single-Unit Trucks and Articulated Trucks. Further, they ARE included in the Turning Movement Count Summary.

Comments

2017-Aug-17

Page 1 of 1

2017-Aug-1

Page 1 of 1



## Transportation Services - Traffic Services

Work Order  
37049

### Turning Movement Count - Pedestrian Volume Report

DUNDONALD DR @ GREENBANK RD										
Count Date:	Wednesday, May 24, 2017			Start Time:	07:00			Grand Total		
Time Period	NB Approach (E or W Crossing)	SB Approach (E or W Crossing)	Total	EB Approach (N or S Crossing)	WB Approach (N or S Crossing)	Total	LT	ST	RT	TOT
07:00 - 07:15	0	1	1	2	0	2	3	4	5	5
07:15 - 07:30	0	1	1	1	3	4	1	4	4	4
07:30 - 07:45	1	2	3	1	0	1	0	1	0	1
07:45 - 08:00	1	0	1	2	1	3	0	1	0	1
<b>07:00 - 08:00</b>	<b>2</b>	<b>4</b>	<b>6</b>	<b>6</b>	<b>4</b>	<b>10</b>	<b>16</b>			
08:00 - 08:15	0	0	0	0	1	1	2	2	2	2
08:15 - 08:30	1	2	3	1	0	1	0	1	0	1
08:30 - 08:45	0	3	3	1	1	2	2	5	5	5
08:45 - 09:00	1	0	1	6	0	6	6	7	7	7
<b>08:00 - 09:00</b>	<b>2</b>	<b>5</b>	<b>7</b>	<b>9</b>	<b>2</b>	<b>11</b>	<b>18</b>			
09:00 - 09:15	0	2	2	1	0	1	3			
09:15 - 09:30	0	0	0	3	0	3	0	3	3	3
09:30 - 09:45	1	2	3	0	1	1	1	1	1	1
09:45 - 10:00	1	1	2	0	0	0	0	0	0	0
<b>09:00 - 10:00</b>	<b>2</b>	<b>5</b>	<b>7</b>	<b>4</b>	<b>1</b>	<b>5</b>	<b>12</b>			
11:30 - 11:45	0	0	0	0	0	0	0	0	0	0
11:45 - 12:00	0	0	0	0	0	0	0	0	0	0
12:00 - 12:15	0	0	0	0	0	0	0	0	0	0
12:15 - 12:30	1	0	1	0	1	1	0	1	1	1
<b>11:30 - 12:30</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>5</b>	<b>5</b>	<b>5</b>
12:30 - 12:45	1	1	2	0	0	2	2	2	2	2
12:45 - 13:00	0	0	0	1	1	1	1	1	1	1
13:00 - 13:15	0	0	0	4	1	5	1	5	5	5
13:15 - 13:30	0	0	0	1	0	1	0	1	1	1
<b>12:30 - 13:30</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>1</b>	<b>3</b>	<b>1</b>	<b>4</b>	<b>5</b>	<b>5</b>
15:00 - 15:15	0	0	0	0	0	0	1	1	1	1
15:15 - 15:30	1	2	3	4	1	5	1	5	5	5
15:30 - 15:45	1	2	3	1	2	3	1	2	3	3
15:45 - 16:00	5	4	9	6	7	13	7	13	22	22
<b>15:00 - 16:00</b>	<b>7</b>	<b>8</b>	<b>15</b>	<b>11</b>	<b>11</b>	<b>22</b>	<b>11</b>	<b>22</b>	<b>37</b>	<b>37</b>
16:00 - 16:15	1	0	1	0	0	0	0	0	0	0
16:15 - 16:30	3	3	6	6	6	6	6	6	12	18
16:30 - 16:45	6	1	7	3	4	7	1	7	14	14
<b>16:00 - 17:00</b>	<b>10</b>	<b>6</b>	<b>16</b>	<b>10</b>	<b>10</b>	<b>20</b>	<b>10</b>	<b>20</b>	<b>36</b>	<b>36</b>
17:00 - 17:15	1	4	5	1	2	3	2	3	3	3
17:15 - 17:30	3	2	5	2	4	6	2	4	11	11
17:30 - 17:45	0	3	3	3	5	8	1	5	11	11
17:45 - 18:00	1	2	3	1	1	2	1	2	5	5
<b>17:00 - 18:00</b>	<b>5</b>	<b>11</b>	<b>16</b>	<b>7</b>	<b>12</b>	<b>19</b>	<b>6</b>	<b>19</b>	<b>35</b>	<b>35</b>
Total .....	30	40	70	54	46	100	46	100	170	170

Comment:

2017-Aug-17

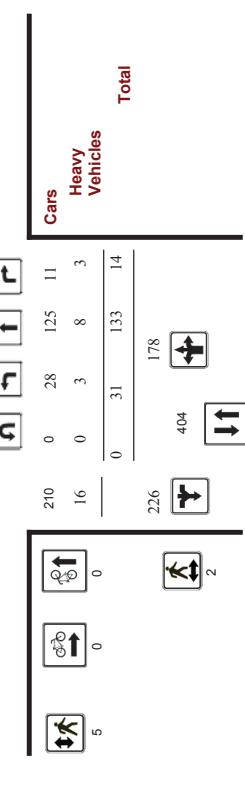
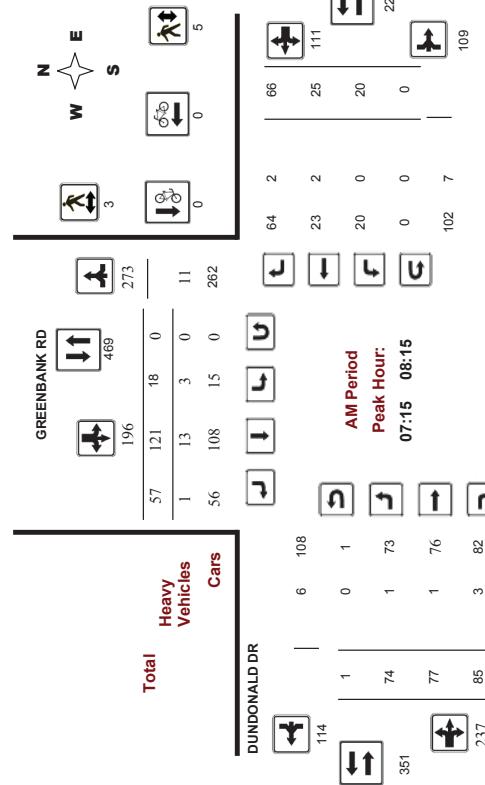
DUNDONALD DR @ GREENBANK RD										
Full Study										
GREENBANK RD										
Survey Date:	Wednesday, May 24, 2017			Northbound:	0	Southbound:	0	WB:	0	
				Eastbound:	1	Westbound:	1	RT:	0	
Total Observed U-Turns				STR:	0	LT:	0	ST:	0	
DUNDONALD DR				RT:	0	EB:	0	RT:	0	
Grand Total				TOT:	0	TOT:	0	TOT:	0	
Comments:	Note: These volumes are calculated by multiplying the totals by the appropriate expansion factor.									
Avg 12hr	394	130	134	1858	261	1077	605	1944	3602	688
Eq 12hr	438	1478	149	2064	291	1197	673	2160	4224	764
Avg 24hr	516	1742	175	2434	343	1411	733	2547	4981	901
	Note: These volumes are calculated by multiplying the Average Daily 12 hr. totals by 12 to 24 expansion factor.									1,31

**Ottawa** Transportation Services - Traffic Services  
**Turning Movement Count - Full Study Peak Hour Diagram**  
**DUNDONALD DR @ GREENBANK RD**

**Ottawa** Transportation Services - Traffic Services  
**Turning Movement Count - Full Study Peak Hour Diagram**  
**DUNDONALD DR @ GREENBANK RD**

Survey Date: Wednesday, May 24, 2017  
Start Time: 07:00

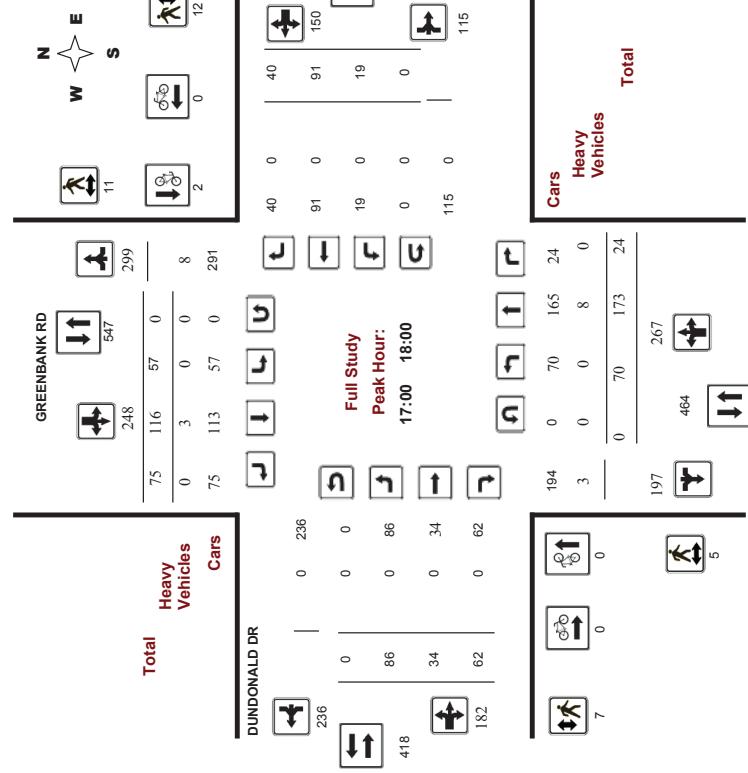
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Comments

Survey Date: Wednesday, May 24, 2017  
Start Time: 07:00

WO No: 37049  
Device: Movision



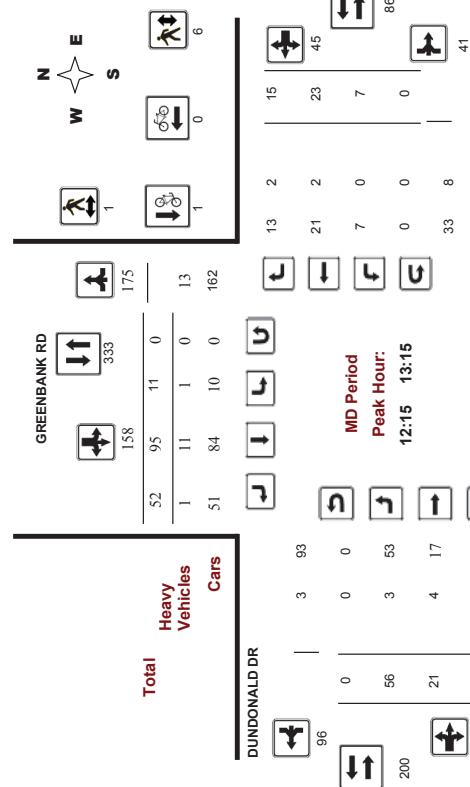
Comments

**Ottawa** Transportation Services - Traffic Services  
**Turning Movement Count - Full Study Peak Hour Diagram**  
**DUNDONALD DR @ GREENBANK RD**

**Ottawa** Transportation Services - Traffic Services  
**Turning Movement Count - Full Study Peak Hour Diagram**  
**DUNDONALD DR @ GREENBANK RD**

Survey Date: Wednesday, May 24, 2017  
Start Time: 07:00

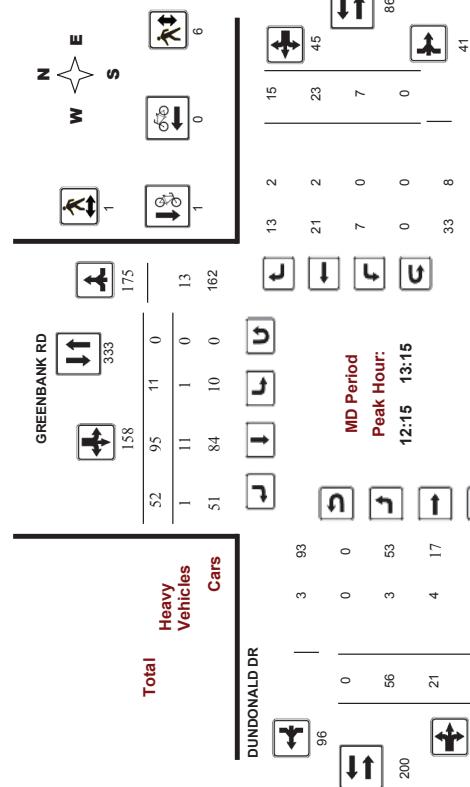
WO No: 37049  
Device: Movision



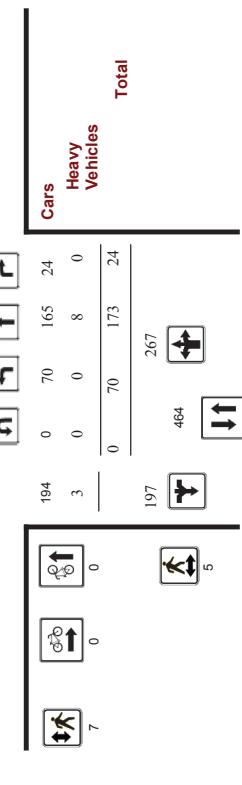
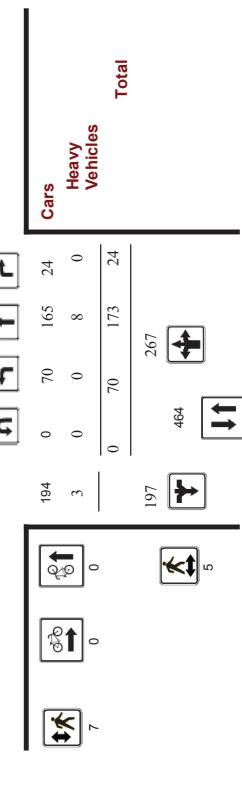
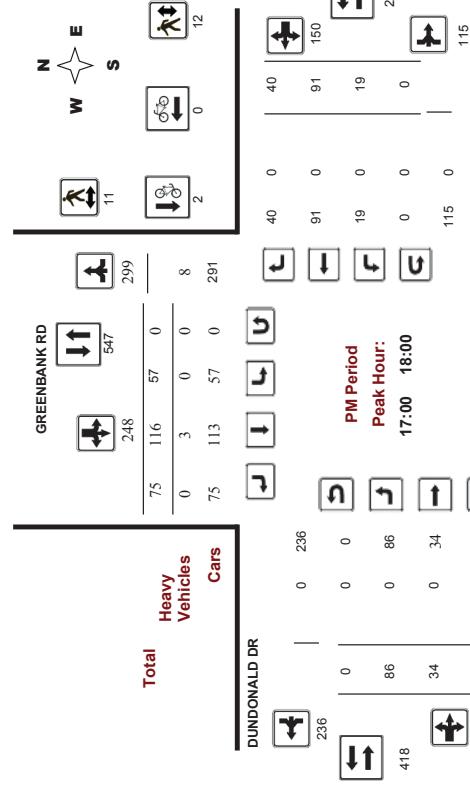
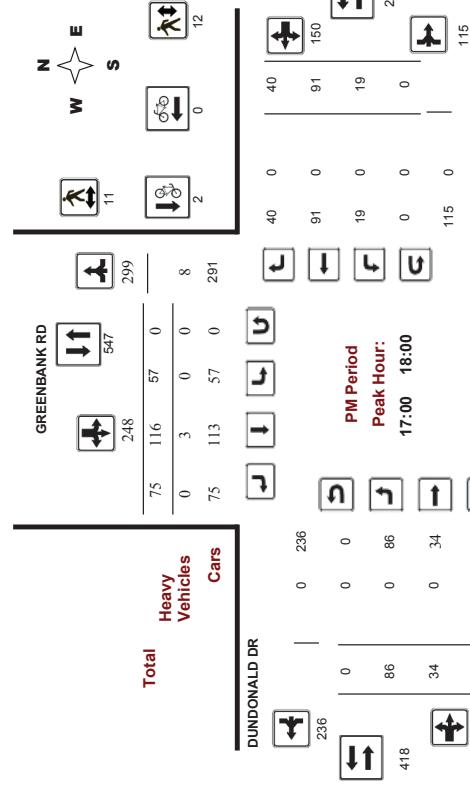
Comments

Survey Date: Wednesday, May 24, 2017  
Start Time: 07:00

WO No: 37049  
Device: Movision



Comments



Comments



Transportation Services - Traffic Services

Work Order  
37049

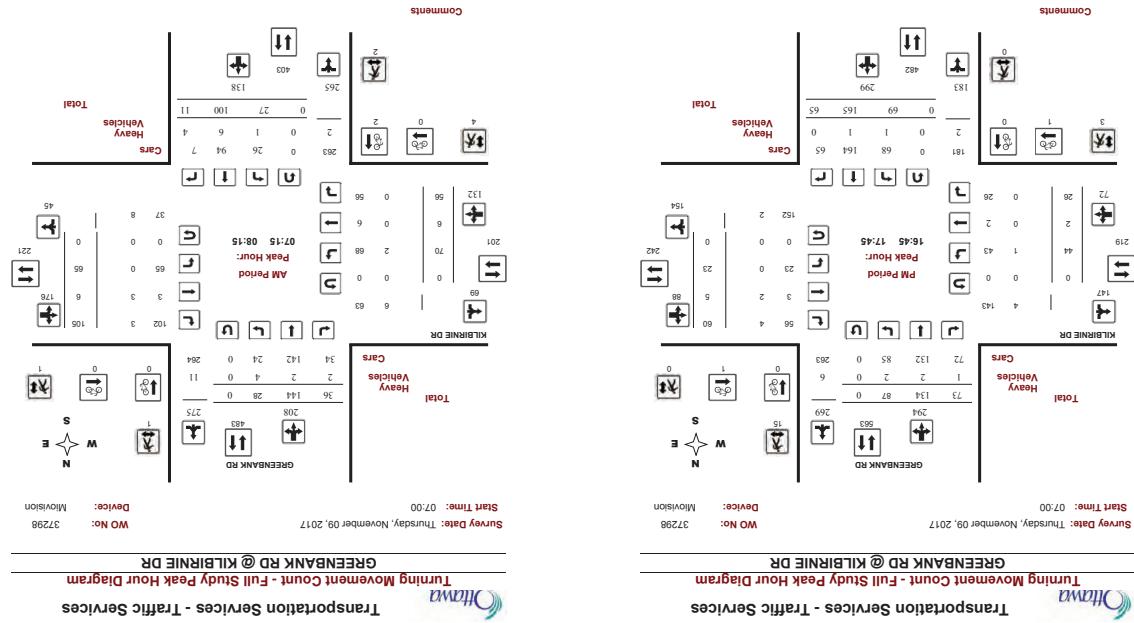
Turning Movement Count - 15 Min U-Turn Total Report

**Survey Date:** Wednesday May 24 2017

Survey Date:		Wednesday, May 27, 2017				Total	
Time Period	Time	Northbound U-Turn Total	Southbound U-Turn Total	Eastbound U-Turn Total	Westbound U-Turn Total	Total	
07:00	07:15	0	0	0	0	0	0
07:15	07:30	0	0	0	0	0	0
07:30	07:45	0	0	0	0	0	0
07:45	08:00	0	0	1	0	1	1
08:00	08:15	0	0	0	0	0	0
08:15	08:30	0	0	0	0	0	0
08:30	08:45	0	0	0	0	0	0
08:45	09:00	0	0	0	0	0	0
09:00	09:15	0	0	0	0	0	0
09:15	09:30	0	0	0	0	0	0
09:30	09:45	0	0	0	0	0	0
09:45	10:00	0	0	0	0	0	0
10:00	11:15	0	0	0	0	0	0
11:15	11:30	0	0	0	0	0	0
11:30	11:45	0	0	0	0	0	0
11:45	12:00	0	0	0	0	0	0
12:00	12:15	0	0	0	0	0	0
12:15	12:30	0	0	0	0	0	0
12:30	12:45	0	0	0	0	0	0
12:45	13:00	0	0	0	0	0	0
13:00	13:15	0	0	0	0	0	0
13:15	13:30	0	0	0	0	0	0
13:30	13:45	0	0	0	0	0	0
13:45	14:00	0	0	0	0	0	0
14:00	14:15	0	0	0	0	0	0
14:15	14:30	0	0	0	0	0	0
14:30	14:45	0	0	0	0	0	0
14:45	15:00	0	0	0	0	0	0
15:00	15:15	0	0	0	0	0	0
15:15	15:30	0	0	0	0	0	0
15:30	15:45	0	0	0	0	0	0
15:45	16:00	0	0	0	0	0	0
16:00	16:15	0	0	0	0	0	0
16:15	16:30	0	0	0	0	0	0
16:30	16:45	0	0	0	0	0	0
16:45	17:00	0	0	0	0	0	0
17:00	17:15	0	0	0	0	0	0
17:15	17:30	0	0	0	0	0	0
17:30	17:45	0	0	0	0	0	0
17:45	18:00	0	0	0	0	0	0
	Total	0	0	1	0	0	1

017-Aug-17

Page 1 of 1





# Appendix D

Collision Data

Record	Location	X	Y	Date	Time	Environment	Road_Surface	Traffic_Control	Collision_Location	Light	Collision_Classification	Impact_type
1903	DUNDONALD DR @ GREENBANK RD	365090.6441	5012122.311	2014-09-25	16:02	01 - Clear	01 - Dry	02 - Stop sign	02 - Intersection related	01 - Daylight	02 - Non-fatal injury	07 - SMV other
2240	DUNDONALD DR @ GREENBANK RD	365090.6441	5012122.311	2014-07-24	16:07	01 - Clear	01 - Dry	02 - Stop sign	03 - At intersection	01 - Daylight	02 - Non-fatal injury	05 - Turning movement
8226	DUNDONALD DR @ GREENBANK RD	365090.6441	5012122.311	2014-06-24	13:00	02 - Rain	02 - Wet	02 - Stop sign	03 - At intersection	01 - Daylight	03 - P.D. only	05 - Turning movement
9398	KILBIRNIE DR btwn Continuation of KILBIRNIE DR & SANDGATE RDG	365915.4773	5011900.139	2014-08-03	15:46	01 - Clear	01 - Dry	10 - No control	01 - Non intersection	01 - Daylight	03 - P.D. only	06 - SMV unattended vehicle
10143	DUNDONALD DR @ GREENBANK RD	365090.6441	5012122.311	2014-11-05	18:20	01 - Clear	01 - Dry	02 - Stop sign	03 - At intersection	07 - Dark	03 - P.D. only	02 - Angle
13592	RIVER MIST RD btwn DUNDONALD DR & WHITE ARCTIC	364714.9791	5011998.489	2014-01-14	6:00	01 - Clear	01 - Dry	10 - No control	04 - At/near private drive	07 - Dark	03 - P.D. only	06 - SMV unattended vehicle
13908	CAMBRIAN RD @ RIVER MIST RD	364357.1859	5012611.708	2014-06-07	7:48	01 - Clear	01 - Dry	03 - At intersection	01 - Daylight	03 - P.D. only	05 - Turning movement	
13913	RIVER MIST RD btwn DUNDONALD DR & WHITE ARCTIC	364714.9791	5011998.489	2014-02-07	21:43	01 - Clear	05 - Packed snow	10 - No control	04 - At/near private drive	07 - Dark	03 - P.D. only	06 - SMV unattended vehicle
13920	RIVER MIST RD btwn DUNDONALD DR & WHITE ARCTIC	364714.9791	5011998.489	2014-07-17	11:30	01 - Clear	01 - Dry	10 - No control	04 - At/near private drive	01 - Daylight	03 - P.D. only	06 - SMV unattended vehicle
13963	DUNDONALD DR @ GREENBANK RD	365090.6441	5012122.311	2014-05-19	15:42	01 - Clear	01 - Dry	02 - Stop sign	03 - At intersection	01 - Daylight	03 - P.D. only	02 - Angle
14349	RIVER MIST RD btwn BRAMBLING WAY & RIVER ROCK AVE	364415.0397	5012518.186	2014-11-19	9:53	01 - Clear	06 - Ice	10 - No control	01 - Non intersection	01 - Daylight	03 - P.D. only	03 - Rear end
3960	DES SOLDATS-RIENDEAU ST btwn ANDRE AUDET AVE & RIVER MIST RD	364947.678	5011788.769	2015-01-05	15:15	01 - Clear	06 - Ice	10 - No control	01 - Non intersection	01 - Daylight	03 - P.D. only	06 - SMV unattended vehicle
3962	DES SOLDATS-RIENDEAU ST btwn ANDRE AUDET AVE & RIVER MIST RD	364947.678	5011788.769	2015-03-03	16:47	03 - Snow	05 - Packed snow	10 - No control	04 - At/near private drive	01 - Daylight	03 - P.D. only	06 - SMV unattended vehicle
4038	DUNDONALD DR btwn ANDRE AUDET AVE & RIVER MIST RD	364845.4792	5011979.537	2015-02-17	9:36	01 - Clear	01 - Dry	10 - No control	04 - At/near private drive	01 - Daylight	03 - P.D. only	06 - SMV unattended vehicle
10123	RIVER MIST RD btwn BRAMBLING WAY & RIVER ROCK AVE	364434.9645	5012485.54	2015-06-24	11:06	01 - Clear	01 - Dry	10 - No control	04 - At/near private drive	01 - Daylight	03 - P.D. only	06 - SMV unattended vehicle
10445	CAMBRIAN RD @ RIVER MIST RD	364357.1859	5012611.708	2015-09-04	7:15	01 - Clear	01 - Dry	02 - Stop sign	02 - Intersection related	01 - Daylight	03 - P.D. only	02 - Angle
12243	DUNDONALD DR @ GREENBANK RD	365090.6441	5012122.311	2015-10-09	14:10	01 - Clear	01 - Dry	02 - Stop sign	03 - At intersection	01 - Daylight	03 - P.D. only	02 - Angle
456	ANDRE AUDET AVE @ DUNDONALD DR	364934.617	5012032.691	2016-06-22	17:23	01 - Clear	01 - Dry	02 - Stop sign	03 - At intersection	01 - Daylight	03 - P.D. only	02 - Angle
1864	BLACKLEAF DR btwn CHEYENNE WAY/KENNACRAIG PRIV S & DUNDONALD DR	365215.3079	5012239.134	2016-01-14	12:45	03 - Snow	04 - Slush	10 - No control	04 - At/near private drive	01 - Daylight	03 - P.D. only	06 - SMV unattended vehicle
4220	DES SOLDATS-RIENDEAU ST btwn ANDRE AUDET AVE & RIVER MIST RD	364947.678	5011788.769	2016-03-10	8:39	01 - Clear	01 - Dry	10 - No control	01 - Non intersection	01 - Daylight	03 - P.D. only	06 - SMV unattended vehicle
4381	DUNDONALD DR @ GREENBANK RD	365090.6441	5012122.311	2016-02-20	14:55	02 - Rain	02 - Wet	02 - Stop sign	03 - At intersection	01 - Daylight	03 - P.D. only	02 - Angle
4382	DUNDONALD DR @ RIVER MIST RD	364756.3412	5011926.383	2016-04-22	8:50	01 - Clear	01 - Dry	11 - Roundabout	03 - At intersection	01 - Daylight	03 - P.D. only	02 - Angle
5516	GREENBANK RD @ KILBIRNIE DR	365285.2559	5011656.861	2016-12-01	6:47	01 - Clear	02 - Wet	02 - Stop sign	03 - At intersection	07 - Dark	02 - Non-fatal injury	02 - Angle
11771	RIVER MIST RD btwn DUNDONALD DR & WHITE ARCTIC	364714.9791	5011998.489	2016-03-22	0:00	01 - Clear	01 - Dry	10 - No control	01 - Non intersection	00 - Unknown	03 - P.D. only	06 - SMV unattended vehicle
482	ANDRE AUDET AVE @ DUNDONALD DR	364934.61700	5012032.69100	2017-12-01	13:51	01 - Clear	01 - Dry	02 - Stop sign	03 - At intersection	01 - Daylight	03 - P.D. only	02 - Angle
3457	CENTERRA CRT btwn END & KILBIRNIE DR	365312.41530	5011768.38240	2017-03-26	15:32	01 - Clear	02 - Wet	10 - No control	04 - At/near private drive	01 - Daylight	03 - P.D. only	06 - SMV unattended vehicle
4383	DES SOLDATS-RIENDEAU ST btwn ANDRE AUDET AVE & RIVER MIST RD	364883.16400	5011750.42900	2017-03-04	5:45	01 - Clear	01 - Dry	10 - No control	01 - Non intersection	07 - Dark	03 - P.D. only	06 - SMV unattended vehicle
4542	DUNDONALD DR @ GREENBANK RD	365090.64410	5012122.31100	2017-05-17	15:19	01 - Clear	01 - Dry	02 - Stop sign	03 - At intersection	01 - Daylight	03 - P.D. only	03 - Rear end
4543	DUNDONALD DR @ GREENBANK RD	365090.64410	5012122.31100	2017-04-19	16:43	02 - Rain	02 - Wet	02 - Stop sign	02 - Intersection related	01 - Daylight	03 - P.D. only	07 - SMV other
4544	DUNDONALD DR btwn LAMPREY ST & RIVER MIST RD	364650.97510	5011867.22940	2017-01-05	9:53	01 - Clear	06 - Ice	10 - No control	01 - Non intersection	01 - Daylight	03 - P.D. only	06 - SMV unattended vehicle
5698	GREENBANK RD @ KILBIRNIE DR	365285.25590	5011656.86110	2017-08-19	11:36	01 - Clear	01 - Dry	02 - Stop sign	03 - At intersection	01 - Daylight	02 - Non-fatal injury	02 - Angle
8964	KILBIRNIE DR btwn BREAKSTONE RD & GREENBANK RD	365228.44560	5011629.42890	2017-12-25	11:57	03 - Snow	03 - Loose snow	10 - No control	01 - Non intersection	01 - Daylight	03 - P.D. only	06 - SMV unattended vehicle
8965	KILBIRNIE DR btwn GREENBANK RD & KILMARNOCK WAY	365492.82248	5011699.59063	2017-09-17	0:41	01 - Clear	01 - Dry	10 - No control	04 - At/near private drive	07 - Dark	03 - P.D. only	06 - SMV unattended vehicle
11120	OSNABROOK PRIV btwn DUNDONALD DR & KILBIRNIE DR	365547.34637	5012190.19654	2017-08-28	7:00	01 - Clear	01 - Dry	10 - No control	04 - At/near private drive	01 - Daylight	03 - P.D. only	06 - SMV unattended vehicle
12194	RIVER MIST RD btwn BRAMBLING WAY & RIVER ROCK AVE	364432.21400	5012488.31611	2017-07-14	19:51	01 - Clear	02 - Wet	10 - No control	01 - Non intersection	01 - Daylight	03 - P.D. only	06 - SMV unattended vehicle
12195	RIVER MIST RD btwn DAMSELFLY WAY & DES SOLDATS-RIENDEAU ST	364911.71000	5011575.09500	2017-12-20	20:41	03 - Snow	04 - Slush	10 - No control	04 - At/near private drive	07 - Dark	03 - P.D. only	02 - Angle

# Appendix E

2020 Future Background Synchro Worksheets

HCM 2010 AWSC  
1: River Mist & Cambrian

01-10-2019

Lanes, Volumes, Timings  
2: Greenbank & Dundonald

01-10-2019

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	40%	2%	17%	46%
Vol Thru, %	2%	82%	80%	20%
Vol Right, %	58%	17%	3%	34%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	254	199	270	50
LT Vol	102	3	47	23
Through Vol	5	163	215	10
RT Vol	147	33	8	17
Lane Flow Rate	282	221	300	56
Geometry Grp	1	1	1	1
Degree of Util (X)	0.402	0.32	0.433	0.088
Departure Headway (Hd)	5.126	5.206	5.201	5.677
Convergence Y/N	Yes	Yes	Yes	Yes
Cap	703	690	683	630
Service Time	3.158	3.241	3.233	3.721
HCM Lane V/C Ratio	0.401	0.32	0.433	0.089
HCM Control Delay	11.6	10.7	12.2	9.3
HCM Lane LOS	B	B	B	A
HCM 95thile Q	1.9	1.4	2.2	0.3

	Intersection Delay, s/veh	Intersection LOS	Approach	EB	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Traffic Vol, veh/h	3	163	33	47	215	8	102	5	147	23	10	17	4	77	77	
Future Vol, veh/h	3	163	33	47	215	8	102	5	147	23	10	17	4	77	20	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0	262	0	
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2	0	123	34	
Mvmt Flow	3	181	37	52	239	9	113	6	163	26	11	19	0	153	16	
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0	0	Prot	NA	
Approach	EB	WB	NB	SB	NB	SB	NB	SB	NB	NB	SB	NB	SB	4	4	
Opposing Approach	WB	EB	SB	EB	EB	SB	EB	SB	EB	SB	EB	EB	SB	4	4	
Opposing Lanes	1	1	1	1	1	1	1	1	1	1	1	1	1	3.3	3.3	
Conflicting Approach Left	SB	NB	EB	EB	EB	WB	EB	EB	WB	WB	EB	EB	WB	3.0	3.0	
Conflicting Lanes Left	1	1	1	1	1	1	1	1	1	1	1	1	1	0.0	0.0	
Conflicting Approach Right	NB	SB	EB	EB	EB	WB	EB	EB	WB	EB	EB	EB	WB	6.3	6.3	
Conflicting Lanes Right	1	1	1	1	1	1	1	1	1	1	1	1	1	Lead/Lag?	Lead/Lag?	
HCM Control Delay	10.7	12.2	11.6	9.3	12.2	11.6	11.6	9.3	12.2	11.6	9.3	12.2	11.6	Vehicle Extension(s)	3.0	
HCM LOS	B	B	B	A	B	B	B	A	B	B	B	B	Recall Mode	None	3.0	
Lane	NBLn1	EBLn1	WBLn1	SBLn1												
Walk Time (s)					7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Flash Don't Walk (s)					200	200	200	200	200	200	200	200	200	150	150	150
Pedestrian Calls (#/hr)					2	2	2	3	3	3	3	3	3	5	5	5
Act Elct Green (s)					15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	27.0	27.0	27.0
Actuated g/C Ratio					0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
%C Ratio					0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.28	0.17	0.17
Control Delay					25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	10.8	30.5	30.5
Queue Delay					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay					25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	10.8	30.5	30.5
LOS					C	C	C	C	C	C	C	C	C	B	A	A
Approach Delay					25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	10.8	14.6	14.6
Approach LOS					C	C	C	C	C	C	C	C	C	B	B	B
Queue Length 50th (m)					16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2	3.2	2.6	2.6
Queue Length 95th (m)					44.2	44.2	44.2	44.2	44.2	44.2	44.2	44.2	44.2	11.8	28.4	28.4
Internal Link Dist (m)					369.8	369.8	369.8	369.8	369.8	369.8	369.8	369.8	369.8	119.4	475.6	475.6
Turn Bay Length (m)														90.0	263	263
Base Capacity (vph)														50.0	145.0	145.0
Storage Cap Reductn														0	0	0
Spillback Cap Reductn														0	0	0
Storage Cap Reductn														0	0	0
Reduced v/c Ratio														0.37	0.17	0.17

Intersection Summary

Cycle Length: 79.5

Actuated Cycle Length: 59.7

Natural Cycle: 80

Control Type: Semi Act-Uncoord

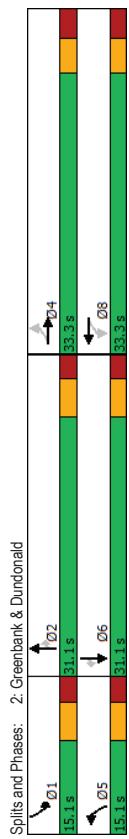
Lanes, Volumes, Timings  
2: Greenbank & Dundonald

01-10-2019

HCM 2010 TWSC  
2: Greenbank & Dundonald  
3: Greenbank & Kilbirnie

01-10-2019

Maximum V/C Ratio: 0.65  
Intersection Capacity Utilization: 48.7%  
Analysis Period (min) 15



Intersection LOS: B  
ICU Level of Service A

Movement	Int Delay /s/veh						NBL	NBT	NBR	WBL	WBT	SBL	SBR
	EBL	EBT	EBR	VBL	VBT	SBT							
Lane Configurations	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓	6	6	6	105	27	105	11
Traffic Vol /veh/h	70	6	6	65	6	65	6	6	6	105	27	105	11
Future Vol /veh/h	70	6	6	65	6	65	6	6	6	105	27	105	11
Conflicting Peds. #/hr	0	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free						
RT Channelized	-	-	-	-	-	-	-	-	-	-	-	-	-
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage. #	-	-	-	-	-	-	-	-	-	-	-	-	-
Grade, %	-	-	-	-	-	-	-	-	-	-	-	-	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2	2
Wmrt Flow	78	7	62	72	7	117	30	117	12	31	170	40	-

Major/Major	Minor2		Major1	Major2
	Minor1	Minor2		
Conflicting Flow All	497	441	190	464
Stage 1	252	252	-	177
Stage 2	245	189	-	287
Critical Hwy	7.12	6.52	6.22	7.12
Critical Hwy Sig 1	6.12	5.52	6.12	5.52
Critical Hwy Sig 2	6.12	5.52	6.12	5.52
Follow-up Hwy	3.518	4.018	3.318	3.518
Pot Cap-Maneuver	483	510	852	508
Stage 1	752	698	-	825
Stage 2	759	744	-	720
Platoon blocked, %	-	-	-	-
Mov Cap-1 Maneuver	405	488	852	483
Mov Cap-2 Maneuver	405	488	-	451
Stage 1	735	683	-	807
Stage 2	644	728	-	647
Approach	EB	WB	NB	SB
HCM Control Delay, s	14.5	12.8	1.5	1
HCM LOS	B	B	-	-

Minor Lane	Major Lane	Minor Mvmt	NBL	NBT	NBR	EBln1	EBln1WBln1	SBL	SBT	SBR
Capacity (veh/h)	-	-	-	526	655	1457	-	-	-	-
HCM Lane V/C Ratio	0.022	-	-	0.279	0.299	0.021	-	-	-	-
HCM Control Delay (s)	7.7	-	-	145	128	7.5	-	-	-	-
HCM Lane LOS	A	-	-	B	B	A	-	-	-	-
HCM 95th %tile Q(veh)	0.1	-	-	1.1	12	0.1	-	-	-	-

HCM 2010 AWSC  
1: River Mist & Cambrian

01-10-2019

Lanes, Volumes, Timings  
2: Greenbank & Dundonald

01-10-2019

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	44%	5%	30%	53%
Vol Thru, %	4%	69%	16%	
Vol Right, %	52%	25%	7%	31%
Sign Control	Stop	Stop	Stop	
Traffic Vol by Lane	135	392	456	49
LT Vol	60	21	138	26
Through Vol	5	272	288	8
RT Vol	70	99	30	15
Lane Flow Rate	135	392	456	49
Geometry Grp	1	1	1	
Degree of Util(X)	0.22	0.542	0.639	0.085
Departure Headway (Hd)	5.879	4.974	5.045	6.246
Convergence Y/N	Yes	Yes	Yes	Yes
Cap	609	725	716	572
Service Time	3.926	3.005	3.074	4.301
HCM Lane V/C Ratio	0.222	0.541	0.637	0.086
HCM Control Delay	10.6	13.8	16.6	9.9
HCM Lane LOS	B	B	C	A
HCM 95thile Q	0.8	3.3	4.6	0.3

Lane Group	Lane Configurations	Traffic Volume (vph)	FUTURE VOLUME (VPH)	WBT	WBL	NBT	NBR	WBT	WBL	NBT	NBR	SBL	SBR
Movement													
Lane Configurations													
Traffic Vol /vphh	21	272	99	138	288	30	60	5	70	26	8	15	
Future Vol /vphh	21	272	99	138	288	30	60	5	70	26	8	15	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2	
Mvmt Flow	21	272	99	138	288	30	60	5	70	26	8	15	
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0	
Approach	EB	WB	NB	SB	SB	NB	SB	SB	NB	SB	NB	SB	
Opposing Approach	WB	EB	SB	NB	NB	EB	SB	SB	EB	SB	EB	SB	
Opposing Lanes	1	1	1	1	1	1	1	1	1	1	1	1	
Conflicting Approach Left	SB	NB	EB	WB	WB	EB	SB	SB	EB	SB	EB	SB	
Conflicting Lanes Left	1	1	1	1	1	1	1	1	1	1	1	1	
Conflicting Approach Right	NB	SB	WB	EB	EB	WB	SB	SB	WB	EB	WB	SB	
Conflicting Lanes Right	1	1	1	1	1	1	1	1	1	1	1	1	
HCM Control Delay	13.8		16.6		10.6		9.9						
HCM LOS	B		C		B		A						
Lane	NBLn1	EBLn1	WBLn1	SBLn1									
Vol Left, %	44%	5%	30%	53%									
Vol Thru, %	4%	69%	16%										
Vol Right, %	52%	25%	7%	31%									
Sign Control	Stop	Stop	Stop	Stop									
Traffic Vol by Lane	135	392	456	49									
LT Vol	60	21	138	26									
Through Vol	5	272	288	8									
R/T Vol	70	99	30	15									
Lane Flow Rate	135	392	456	49									
Geometry Grp	1	1	1	1									
Degree of Util(X)	0.22	0.542	0.639	0.085									
Departure Headway (Hd)	5.879	4.974	5.045	6.246									
Convergence Y/N	Yes	Yes	Yes	Yes									
Cap	609	725	716	572									
Service Time	3.926	3.005	3.074	4.301									
HCM Lane V/C Ratio	0.222	0.541	0.637	0.086									
HCM Control Delay	10.6	13.8	16.6	9.9									
HCM Lane LOS	B	B	C	A									
HCM 95thile Q	0.8	3.3	4.6	0.3									

Cycle Length: 88.5	Actuated Cycle length: 63.3	Natural Cycle: 80	Control Type: Semi-Act-Uncoord	Maximum v/c Ratio: 0.54
HMBS Ph 5 TIA - 3718 Greenbank Road PM Peak Hour Future Background 2020	Synchro 10 Light Report	Page 2		
HMBS Ph 5 TIA - 3718 Greenbank Road PM Peak Hour Future Background 2020	Synchro 10 Light Report	Page 3		

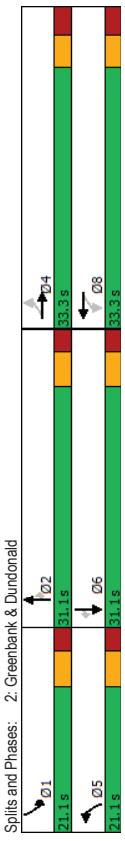
Lanes, Volumes, Timings  
2: Greenbank & Dundonald

01-10-2019

Intersection Signal Delay: 19.6  
Intersection Capacity Utilization 54.5%  
Analysis Period (min) 15

HCM 2010 TWSC  
3: Greenbank & Killbirnie

01-10-2019



Intersection LOS: B  
ICU Level of Service A

Intersection 4.6

Int Delay/s/veh

Movement EBL EBT EBR VBL WBT NBL NBT SBL SBT SBR

Movement	EBL	EBT	EBC	VBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations	44	2	26	23	5	60	69	176	65	141
Traffic Vol/veh/h	44	2	26	23	5	60	69	176	65	141
Future Vol/veh/h	44	2	26	23	5	60	69	176	65	141
Conflicting Peds. #/hr	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free
RT Channelized	-	-	-	-	-	-	-	-	-	-
Storage Length	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	-	-	-	-	-	-	-	-	-
Grade, %	-	-	-	-	-	-	-	-	-	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2
Wmrt Flow	44	2	26	23	5	60	69	176	65	141

Major/Major

Minor/2

Minor1

Major1

Minor2

Major2

Conflicting Flow All	731	731	178	680	702	214	0	241	0	0
Stage 1	352	352	-	314	314	-	-	-	-	-
Stage 2	379	379	-	366	388	-	-	-	-	-
Critical Hwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12
Critical Hwy Sig 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-
Critical Hwy Sig 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-
Follow-up Hwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218
Pot Cap-Maneuver	337	349	865	365	362	867	1386	-	-	1326
Stage 1	665	632	-	687	656	-	-	-	-	-
Stage 2	643	615	-	663	689	-	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	283	309	865	322	321	867	1386	-	-	1326
Mov Cap-2 Maneuver	283	309	-	322	321	-	-	-	-	-
Stage 1	631	590	-	661	623	-	-	-	-	-
Stage 2	563	584	-	590	569	-	-	-	-	-

Approach EB WB NB NBR EBL n1WBn1 SBL SBT SBR

HCM Control Delay, s

16.9

12.6

1.7

2.3

C B

HCM LOS

Minor Lane Major Mvmt

NBL NBT NBR EBL n1WBn1 SBL SBT SBR

Capacity (veh/h)

1356

-

375

563

1326

-

0.051

-

0.192

0.156

0.066

-

16.9

12.6

7.9

-

A

-

C

B

-

A

-

0.2

-

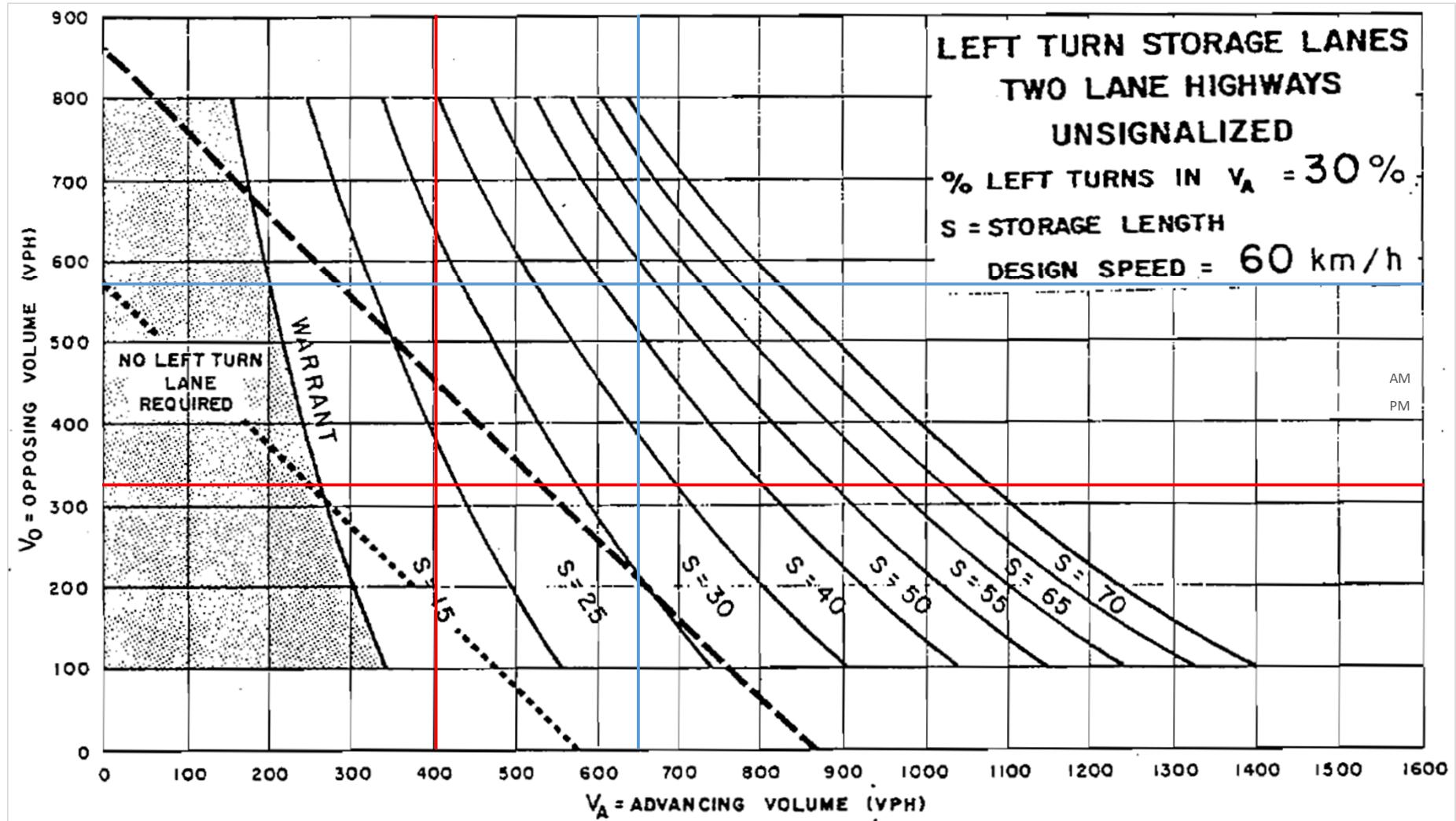
0.6

0.2

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# **Appendix F**

Cambrian Road and River Mist Road Westbound Left-Turn Lane Warrant



# Appendix G

2025 Future Background Synchro Worksheets

HCM 2010 AWSC 1: River Mist & Cambrian									
Intersection Delay, s/veh		20.9		C		Intersection LOS		Intersection LOS	
Movement	EBL	EBR	WBL	WBR	NBL	NBT	NBR	SBL	SBR
Lane Configurations									
Traffic Vol./veh/h	3	251	60	80	301	8	161	5	224
Future Vol./veh/h	3	251	60	80	301	8	161	5	224
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles, %	0	2	2	2	2	2	2	2	2
Peak Mmt Flow	3	279	67	89	334	9	179	6	249
Number of Lanes	0	1	0	1	1	0	1	0	1
Approach	EB	WB	NB	SB	SB	NB	NB	SB	SB
Opposing Approach	WB	EB	SB	SB	1	1	1	WB	WB
Opposing Lanes	2	1	1	1	1	1	1	2	2
Conflicting Approach Left	SB	NB	EB	EB	1	1	1	EB	EB
Conflicting Lanes Left	1	1	1	1	1	1	1	2	2
Conflicting Approach Right	NB	SB	WB	WB	1	2	2	1	1
Conflicting Lanes Right	1	1	1	1	19.4	24.6	24.6	11.4	11.4
HCM Control Delay	19.5	C	C	C	C	C	C	B	B
HCM LOS	C	C	C	C	C	C	C	B	B
Lane	NBLn1	EBLn1	WBLn1	WBLn2	SBLn1				
Vol Left, %	41%	1%	100%	0%	46%				
Vol Thru, %	1%	80%	0%	97%	20%				
Vol Right, %	57%	19%	0%	3%	34%				
Sign Control	Stop	Stop	Stop	Stop	Stop				
Traffic Vol by Lane	390	314	80	309	50				
LT Vol	161	3	80	0	23				
Through Vol	5	251	0	301	10				
RT Vol	224	60	0	8	17				
Lane Flow Rate	433	349	89	343	56				
Geometry Grp	2	5	7	7	2				
Degree of Util (X)	0.738	0.621	0.181	0.65	0.114				
Departure Headway (Hd)	6.133	6.408	7.347	6.817	7.408				
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes				
Cap	589	562	488	529	482				
Service Time	4.176	4.461	5.101	4.57	5.486				
HCM Lane V/C Ratio	0.735	0.621	0.182	0.648	0.116				
HCM Control Delay	24.6	19.5	11.7	21.4	11.4				
HCM Lane LOS	C	C	B	C	B				
HCM 95th-ile Q	63	42	0.7	46	0.4				

HMBS Ph 5 TIA - 3718 Greenbank Road AM Peak Hour Future Background 2025

Light Report

Lanes, Volumes, Timings 2: Greenbank & Dundonald											
Lane Group	EBL	E BT	WBL	W BT	NBL	N BT	SBL	S BT	S BR	↑	↓
Lane Configurations											
Traffic Volume (vph)	74	77	20	25	31	273	14	18	179	57	
Future Volume (vph)	74	77	20	25	31	273	14	18	179	57	
Lane Group Flow (vph)	0	262	0	123	34	303	16	20	199	63	
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	Perm	NA	Perm	
Protected Phases	4	4	8	8	5	2	2	1	6	6	
Permitted Phases	4	4	8	8	5	2	2	1	6	6	
Detection Phase											
Switch Phase											
Minimum Initial (s)	100	100	100	100	50	100	100	50	100	100	
Minimum Split (s)	33.3	33.3	33.3	33.3	11.1	31.1	11.1	31.1	31.1	31.1	
Total Split (s)	33.3	33.3	33.3	33.3	15.1	31.1	15.1	31.1	31.1	31.1	
Total Split (%)	41.9%	41.9%	41.9%	41.9%	19.0%	39.1%	19.0%	39.1%	39.1%	39.1%	
Maximum Green (s)	27.0	27.0	27.0	27.0	9.0	25.0	9.0	25.0	25.0	25.0	
Yellow Time (s)	3.3	3.3	3.3	3.3	3.7	3.7	3.7	3.7	3.7	3.7	
All-Red Time (s)	3.0	3.0	3.0	3.0	2.4	2.4	2.4	2.4	2.4	2.4	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	6.3	6.3	6.3	6.3	6.1	6.1	6.1	6.1	6.1	6.1	
Lead-Lag Optimize?											
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None	None	None	None	Max	Max	Max	Max	Max	
Walk Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	
Flash Don't Walk (s)	20.0	20.0	20.0	20.0	15.0	15.0	15.0	15.0	15.0	15.0	
Pedestrian Calls (#/hr)	2	2	3	3	5	5	5	5	5	5	
Act Effct Green (s)	15.4		15.4	7.0	29.2	29.2	6.5	26.7	26.7		
Actuated g/C Ratio	0.26		0.26	0.17	0.49	0.49	0.11	0.45	0.45	0.45	
v/C Ratio	0.66		0.28	0.17	0.35	0.02	0.11	0.25	0.25	0.25	
Control Delay	26.5		10.8	30.5	13.9	0.1	30.8	15.5	15.5	0.4	
Queue Delay	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	25.5		10.8	30.5	13.9	0.1	30.8	15.5	15.5	0.4	
LOS	C	B	C	B	A	C	B	A			
Approach Delay	25.5	10.8		14.8				13.2			
Approach LOS	C	B	B	B	B	B	B	B			
Queue Length 50th (m)	16.2		3.2	2.6	13.8	0.0	15	8.5	8.5	0.0	
Queue Length 95th (m)	44.2		14.9	11.8	55.3	0.0	8.3	36.9	36.9	0.7	
Internal Link Dist (m)	369.8		119.4		475.6			719.1			
Turn Bay Length (m)											
Base Capacity (vph)	703		739	263	863	799	263	789	789	742	
Starvation Cap Reductn	0		0	0	0	0	0	0	0	0	
Spillback Cap Reductn	0		0	0	0	0	0	0	0	0	
Storage Cap Reductn	0		0	0	0	0	0	0	0	0	
Reduced v/C Ratio	0.37		0.17	0.13	0.35	0.02	0.08	0.25	0.08		

Lanes, Volumes, Timings  
2: Greenbank & Dundonald

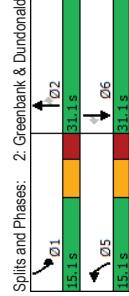
01-10-2019

HCM 2010 TWSC  
2: Greenbank & Dundonald  
3: Greenbank & Kilbirnie

01-10-2019

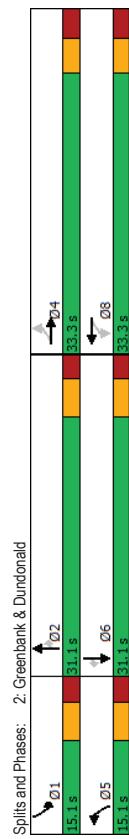
Maximum V/C Ratio: 0.65  
Intersection Capacity Utilization 55.5%

Analysis Period (min) 15



Intersection LOS: B  
ICU Level of Service B

01-10-2019



Intersection		Int Delay /s/veh	6.9								
Movement	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR	
Lane Configurations	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓	
Traffic Vol /veh/h	70	6	56	65	6	105	27	236	11	28	
Future Vol /veh/h	70	6	56	65	6	105	27	236	11	28	
Conflicting Peds. #/hr	0	0	0	0	0	0	0	0	0	0	
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	
RT Channelized	-	-	-	-	-	-	-	-	-	-	
Storage Length	-	-	-	-	-	-	-	-	-	-	
Veh in Median Storage. #	-	0	-	0	-	0	-	400	-	250	
Grade, %	-	0	-	0	-	0	-	0	-	0	
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	
Wmrt Flow	78	7	62	72	7	117	30	262	12	31	

Major/Major	Minor2	Minor1	Major1	Major2
Conflicting Flow All	703	647	251	670
Stage 1	313	313	-	322
Stage 2	390	334	-	348
Critical Hwy	7.12	6.52	6.22	7.12
Critical Hwy Sig 1	6.12	5.52	6.12	5.52
Critical Hwy Sig 2	6.12	5.52	6.12	5.52
Follow-up Hwy	3.518	4.018	3.318	3.518
Pot Cap-Maneuver	352	390	788	371
Stage 1	698	657	-	651
Stage 2	634	643	-	644
Platoon blocked, %	-	-	-	-
Mov Cap-1 Maneuver	284	372	788	325
Mov Cap-2 Maneuver	284	372	-	325
Stage 1	682	641	-	636
Stage 2	521	628	-	594
Approach	EB	WB	NB	SB
HCM Control Delay, s	19.3	16.7	0.8	0.8
HCM LOS	C	C	C	C

HCM 2010 AWSC  
1: River Mist & Cambrian

01-10-2019

Lanes, Volumes, Timings  
2: Greenbank & Dundonald

01-10-2019

Lane	NBLn1	EBLn1	WBLn1	SBLn1	NBLn2	EBLn2	WBLn2	SBLn2
Vol Left, %	44%	4%	100%	0%	53%			
Vol Thru, %	2%	69%	0%	93%	16%			
Vol Right, %	54%	27%	0%	7%	31%			
Sign Control	Stop	Stop	Stop	Stop	Stop			
Traffic Vol Lane	208	551	208	423	49			
LT Vol	91	21	208	0	26			
Through Vol	5	379	0	393	8			
RT Vol	112	151	0	30	15			
Lane Flow Rate	208	551	208	423	49			
Geometry Grp	2	5	7	7	2			
Degree of Util(X)	0.383	0.86	0.385	0.717	0.102			
Departure Headway (Hd)	6.632	5.62	6.665	6.106	7.528			
Convergence Y/N	Yes	Yes	Yes	Yes	Yes			
Cap	539	639	537	588	479			
Service Time	4.729	3.695	4.449	3.889	5.528			
HCM Lane V/C Ratio	0.386	0.862	0.387	0.719	0.102			
HCM Control Delay	13.8	33.7	13.6	23	11.4			
HCM Lane LOS	B	D	B	C	B			
HCM 95thile Q	1.8	9.8	1.8	5.9	0.3			

Lane Group	Lane Configurations	Traffic Volume (vph)	FUTURE VOLUME (vph)	WBL	WBT	NBL	NBT	WBR	NBR	SBL	SBT	SBR
Approach	Approach	Approach	Approach	Approach	Approach	Approach	Approach	Approach	Approach	Approach	Approach	Approach
Opposing Approach	Opposing Approach	Opposing Approach	Opposing Approach	Opposing Approach	Opposing Approach	Opposing Approach	Opposing Approach	Opposing Approach	Opposing Approach	Opposing Approach	Opposing Approach	Opposing Approach
Opposing Lanes	Opposing Lanes	Opposing Lanes	Opposing Lanes	Opposing Lanes	Opposing Lanes	Opposing Lanes	Opposing Lanes	Opposing Lanes	Opposing Lanes	Opposing Lanes	Opposing Lanes	Opposing Lanes
Conflicting Approach Left	Conflicting Approach Left	Conflicting Approach Left	Conflicting Approach Left	Conflicting Approach Left	Conflicting Approach Left	Conflicting Approach Left	Conflicting Approach Left	Conflicting Approach Left	Conflicting Approach Left	Conflicting Approach Left	Conflicting Approach Left	Conflicting Approach Left
Conflicting Lanes Left	Conflicting Lanes Left	Conflicting Lanes Left	Conflicting Lanes Left	Conflicting Lanes Left	Conflicting Lanes Left	Conflicting Lanes Left	Conflicting Lanes Left	Conflicting Lanes Left	Conflicting Lanes Left	Conflicting Lanes Left	Conflicting Lanes Left	Conflicting Lanes Left
Conflicting Approach Right	Conflicting Approach Right	Conflicting Approach Right	Conflicting Approach Right	Conflicting Approach Right	Conflicting Approach Right	Conflicting Approach Right	Conflicting Approach Right	Conflicting Approach Right	Conflicting Approach Right	Conflicting Approach Right	Conflicting Approach Right	Conflicting Approach Right
Conflicting Lanes Right	Conflicting Lanes Right	Conflicting Lanes Right	Conflicting Lanes Right	Conflicting Lanes Right	Conflicting Lanes Right	Conflicting Lanes Right	Conflicting Lanes Right	Conflicting Lanes Right	Conflicting Lanes Right	Conflicting Lanes Right	Conflicting Lanes Right	Conflicting Lanes Right
HCM Control Delay	33.7	19.9	13.8	11.4	11.4							
HCM LOS	D	C	B	B	B							
Number of Lanes	0	1	0	1	1	0	1	0	1	0	1	0
Approach	EB	WB	NB	SB	SB	NB	SB	SB	NB	SB	SB	SB
Opposing Approach	WB	EB	SB	NB	NB	EB	SB	SB	EB	SB	SB	SB
Opposing Lanes	2	1	1	1	1	1	1	1	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB	WB	EB	WB	WB	EB	WB	WB	WB
Conflicting Lanes Left	1	1	1	1	1	1	1	1	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB	EB	WB	EB	EB	WB	EB	EB	EB
Conflicting Lanes Right	1	1	2	1	1	2	1	1	2	1	1	1
HCM Control Delay	33.7	19.9	13.8	11.4	11.4	13.8	11.4	11.4	13.8	11.4	11.4	11.4
HCM LOS	D	C	B	B	B	C	B	B	C	B	B	B
Lead/Lag Optimized?	Yes											
Lead/Lag	Lead	Lag	Lag	Lag								
Lead-Lag Optimize?	Yes											
Recall Mode	None	Max	Max	Max								
Act Effect Green (s)	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	8.3	27.9	27.9
Actuated g/C Ratio	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.13	0.44	0.44
v/c Ratio	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.39	0.32	0.34
Control Delay	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	21.3	31.1	31.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	21.3	32.0	32.0
LOS	C	C	C	C	C	C	C	C	C	C	C	C
Approach Delay	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	21.3	32.0	32.0
Approach LOS	C	C	C	C	C	C	C	C	C	C	C	C
Queue Length 50th (m)	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	12.3	7.1	7.1
Queue Length 95th (m)	32.1	32.1	32.1	32.1	32.1	32.1	32.1	32.1	32.1	26.5	19.9	19.9
Internal Link Dist (m)	369.8	369.8	369.8	369.8	369.8	369.8	369.8	369.8	369.8	119.4	476.6	476.6
Turn Bay Length (m)										90.0	50.0	50.0
Base Capacity (vph)	619	619	619	619	619	619	619	619	619	411	727	727
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.17	0.34	0.34
Intersection Summary												
Cycle Length: 88.5												
Actuated Cycle length: 63.3												
Natural Cycle: 80												
Control Type: Semi-Auto-Uncoord												
Maximum v/c Ratio: 0.54												

HMBS Ph 5 TIA - 3718 Greenbank Road PM Peak Hour Future Background 2025	Synchro 10 Light Report
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Synchro 10 Light Report

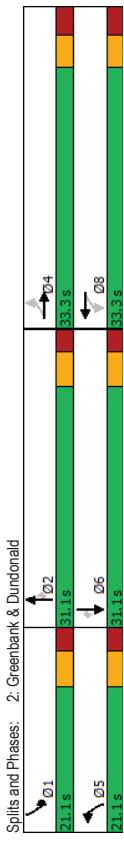
Page 3

Lanes, Volumes, Timings  
2: Greenbank & Dundonald

01-10-2019

Intersection Signal Delay: 19.5  
Intersection Capacity Utilization 59.2%  
Analysis Period (min) 15

Intersection LOS: B  
ICU Level of Service B



HCM 2010 TWSC  
3: Greenbank & Killbirnie

01-10-2019

Intersection Signal Delay: 19.5  
Intersection Capacity Utilization 59.2%  
Analysis Period (min) 15

Intersection LOS: B  
ICU Level of Service B

Intersection		Int Delay /s/veh	4.3								
Movement	EBL	EBT	EBR	VBL	WBL	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	44	2	26	23	5	60	69	260	65	87	274
Traffic Vol /veh/h	44	2	26	23	5	60	69	260	65	87	274
Future Vol /veh/h	44	2	26	23	5	60	69	260	65	87	274
Conflicting Peds. #/hr	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	None	-	-	None	-	-
RT Channelized	-	-	-	-	-	-	-	-	-	-	-
Storage Length	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage. #	-	0	-	0	-	0	-	0	-	0	-
Grade, %	-	0	-	0	-	0	-	0	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2
Wmrt Flow	44	2	26	23	5	60	69	260	65	87	274
Major/Major		Minor2		Major1		Major2		Major1		Major2	
Conflicting Flow All	948	948	311	887	919	260	347	0	325	0	0
Stage 1	485	485	-	398	398	-	-	-	-	-	-
Stage 2	463	463	-	499	521	-	-	-	-	-	-
Critical Hwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	4.12	-	-
Critical Hwy Sig 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-
Critical Hwy Sig 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-
Follow-up Hwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	2.218	-	-
Pot Cap-Maneuver	241	261	729	261	271	779	1212	-	1235	-	-
Stage 1	563	552	-	628	603	-	-	-	-	-	-
Stage 2	579	564	-	554	532	-	-	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	198	229	729	226	238	779	1212	-	1235	-	-
Mov Cap-2 Maneuver	198	229	-	226	238	-	-	-	-	-	-
Stage 1	531	513	-	592	569	-	-	-	-	-	-
Stage 2	500	532	-	495	495	-	-	-	-	-	-
Approach		EB		WB		NB		SB		SB	
HCM Control Delay, s	23.1	-	C	15.2	-	C	-	1.4	-	1.6	-
HCM LOS	-	-	-	-	-	-	-	-	-	-	-
Minor Lane/Major Mvmt		NBL		NBT		NBR		EBL		WBLn1	
Capacity (veh/h)	1212	-	-	270	440	1235	-	-	-	-	-
HCM Lane V/C Ratio	0.057	-	-	0.267	0.2	0.07	-	-	-	-	-
HCM Control Delay (s)	8.2	-	-	23.1	15.2	8.1	-	-	-	-	-
HCM Lane LOS	A	-	-	C	C	A	-	-	-	-	-
HCM 95th %tile Q(veh)	0.2	-	-	1	0.7	0.2	-	-	-	-	-

# Appendix H

MMLOS Analysis

## Multi-Modal Level of Service - Intersections Form

Consultant Scenario Comments	CGH Transportation Existing and Future 2025	Project Date	2018-32 10-Jan-19

INTERSECTIONS		Greenbank and Dundonald			
Crossing Side		NORTH	SOUTH	EAST	WEST
Pedestrian	Lanes	4	4	0 - 2	0 - 2
	Median	No Median - 2.4 m	No Median - 2.4 m	No Median - 2.4 m	No Median - 2.4 m
	Conflicting Left Turns	Permissive	Permissive	Protected	Protected
	Conflicting Right Turns	Permissive or yield control	Permissive or yield control	Permissive or yield control	Permissive or yield control
	Right Turns on Red (RToR) ?	RTOR allowed	RTOR allowed	RTOR allowed	RTOR allowed
	Ped Signal Leading Interval?	No	No	No	No
	Right Turn Channel	No Channel	No Channel	No Channel	No Channel
	Corner Radius	10-15m	10-15m	10-15m	10-15m
	Crosswalk Type	Std transverse markings	Std transverse markings	Std transverse markings	Std transverse markings
	<b>PETSI Score</b>	<b>53</b>	<b>53</b>	<b>93</b>	<b>93</b>
	<b>Ped. Exposure to Traffic LoS</b>	<b>D</b>	<b>D</b>	<b>A</b>	<b>A</b>
	Cycle Length				
Bicycle	Effective Walk Time				
	<b>Average Pedestrian Delay</b>				
	<b>Pedestrian Delay LoS</b>	-	-	-	-
	<b>Level of Service</b>	<b>D</b>	<b>D</b>	<b>A</b>	<b>A</b>
		<b>D</b>			
Approach From		NORTH	SOUTH	EAST	WEST
Transit	Bicycle Lane Arrangement on Approach	Curb Bike Lane, Cycletrack or MUP	Pocket Bike Lane	Mixed Traffic	Mixed Traffic
	Right Turn Lane Configuration	Not Applicable	> 50 m Introduced right turn lane	≤ 50 m	≤ 50 m
	Right Turning Speed	Not Applicable	>25 to 30 km/h	≤ 25 km/h	≤ 25 km/h
	<b>Cyclist relative to RT motorists</b>	<b>Not Applicable</b>	<b>D</b>	<b>D</b>	<b>D</b>
	<b>Separated or Mixed Traffic</b>	<b>Separated</b>	<b>Separated</b>	<b>Mixed Traffic</b>	<b>Mixed Traffic</b>
	Left Turn Approach	2-stage, LT box	≥ 2 lanes crossed	No lane crossed	No lane crossed
	Operating Speed	≥ 60 km/h	≥ 60 km/h	> 40 to ≤ 50 km/h	> 40 to ≤ 50 km/h
	<b>Left Turning Cyclist</b>	<b>A</b>	<b>F</b>	<b>B</b>	<b>B</b>
	<b>Level of Service</b>	<b>A</b>	<b>F</b>	<b>D</b>	<b>D</b>
		<b>F</b>			
Truck	Average Signal Delay	≤ 20 sec	≤ 20 sec	≤ 40 sec	≤ 20 sec
	<b>Level of Service</b>	<b>C</b>	<b>C</b>	<b>E</b>	<b>C</b>
		<b>E</b>			
	Effective Corner Radius	10 - 15 m	10 - 15 m	10 - 15 m	10 - 15 m
Auto	Number of Receiving Lanes on Departure from Intersection	≥ 2	≥ 2	1	1
	<b>Level of Service</b>	<b>B</b>	<b>B</b>	<b>E</b>	<b>E</b>
		<b>E</b>			
Auto	Volume to Capacity Ratio	0.61 - 0.70			
	<b>Level of Service</b>	<b>B</b>			

## Multi-Modal Level of Service - Segments Form

Consultant Scenario Comments	CGH Transportation	Project Date	2018-32		
	Existing and Future 2025		10-Jan-19		
SEGMENTS	Street A	Re-Aligned Greenbank	Alex Polowin	Section	
		1	2	3	
Pedestrian	Sidewalk Width	≥ 2 m	1.8 m		
	Boulevard Width	0.5 - 2 m	< 0.5 m		
	Avg Daily Curb Lane Traffic Volume	> 3000	≤ 3000		
	Operating Speed	> 60 km/h	> 30 to 50 km/h		
	On-Street Parking	no	yes		
	<b>Exposure to Traffic PLoS</b>		<b>E</b>	<b>B</b>	-
	Effective Sidewalk Width				
	Pedestrian Volume				
	<b>Crowding PLoS</b>		-	-	-
	<b>Level of Service</b>		-	-	-
Bicycle	Type of Cycling Facility	Curbside Bike Lane	Mixed Traffic		
	Number of Travel Lanes	2 ea. dir. (w median)	≤ 2 (no centreline)		
	Operating Speed	>50 to 70 km/h	>40 to <50 km/h		
	<b># of Lanes &amp; Operating Speed LoS</b>		<b>C</b>	<b>B</b>	-
	Bike Lane (+ Parking Lane) Width	≥ 1.8 m			
	<b>Bike Lane Width LoS</b>		<b>A</b>	-	-
	Bike Lane Blockages	Rare			
	<b>Blockage LoS</b>		<b>A</b>	-	-
	Median Refuge Width (no median = < 1.8 m)	≥ 1.8 m refuge	< 1.8 m refuge		
	No. of Lanes at Unsignalized Crossing	4-5 lanes	≤ 3 lanes		
	Sidestreet Operating Speed	>50 to 60 km/h	>40 to 50 km/h		
	<b>Unsignalized Crossing - Lowest LoS</b>		<b>C</b>	<b>A</b>	-
Transit	<b>Level of Service</b>		<b>C</b>	<b>B</b>	-
	Facility Type	A	Segregated ROW		
	Friction or Ratio Transit:Posted Speed				
	<b>Level of Service</b>		<b>A</b>	-	-
Truck	Truck Lane Width	A	≤ 3.5 m		
	Travel Lanes per Direction		> 1		
	<b>Level of Service</b>		<b>A</b>	-	-

# Appendix I

2020 Future Total Synchro Worksheets

HCM 2010 AWSC									
1: River Mist & Cambrian									
Intersection LOS									
Movement	EBL	EBT	EPR	WBL	WBT	NBL	NBT	SBL	SBR
Lane Configurations	4+	4+	4+	5	47	215	8	151	5
Traffic Vol./veh/h	3	163	57	215	8	151	5	147	23
Future Vol./veh/h	3	163	57	215	8	151	5	147	23
Park Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles, %	2	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Mvmt Flow	3	181	63	52	239	9	168	6	163
Number of Lanes	0	1	0	0	1	0	0	1	0
Approach	EB		WB		NB		SB		
Opposing Approach	WB		EB		SB		NB		
Opposing Lanes	1		1		1		1		
Conflicting Approach Left	SB		NB		EB		WB		
Conflicting Lanes Left	1		1		1		1		
Conflicting Approach Right	NB		SB		WB		EB		
Conflicting Lanes Right	1		1		1		1		
HCM Control Delay	11.6		13		13.5		9.6		
HCM LOS	B		B		B		A		
Lane	NBLn1	EBLn1	WBLn1	SBLn1					
Vol Left, %	50%	1%	17%	46%					
Vol Thru, %	2%	73%	80%	20%					
Vol Right, %	49%	26%	3%	34%					
Sign Control	Stop	Stop	Stop	Stop					
Traffic Vol by Lane									
LT Vol	303	223	270	50					
Through Vol	151	3	47	23					
RT Vol	5	163	215	10					
Lane Flow Rate	147	57	8	17					
Geometry Grp	337	248	300	56					
Degree of Util (X)	1	1	1	1					
Departure Headway (hd)	0.497	0.37	0.454	0.091					
Convergence, Y/N	Yes	Yes	Yes	Yes					
Cap	677	669	660	602					
Service Time	3.362	3.417	3.492	3.992					
HCM Lane V/C Ratio	0.498	0.371	0.455	0.093					
HCM Lane Delay	13.5	11.6	13	9.6					
HCM Lane LOS	B	B	B	A					
HCM 35th-Hile Q	28	1.7	24	0.3					

HCM 2010 AWSC  
1: River Mist & Cambria

01-16-2019

Lanes, Volumes, Timings 2: Greenbank & Dunderdonald											
Lane Group	EBL	E BT	WBL	WBT	NBL	NBT	SBL	SBT	SBR		
Lane Configurations	113	82	27	25	31	138	14	18	126	76	↑
Traffic Volume (vph)	113	82	27	25	31	138	14	18	126	76	↑
Lane Group Flow (vph)	0	311	0	131	34	153	16	20	140	84	↑
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	Perm	NA	Perm	
Protected Phases	4	4	8	8	5	2	2	1	6	6	
Permitted Phases	4	4	8	8	5	2	2	1	6	6	
Detection Phase											
Switch-Phase											
Minimum Initial (s)	10.0	10.0	10.0	10.0	5.0	100	100	5.0	100	100	
Minimum Split (s)	33.3	33.3	33.3	33.3	11.1	31.1	31.1	11.1	31.1	31.1	
Total Split (s)	33.3	33.3	33.3	33.3	15.1	31.1	31.1	15.1	31.1	31.1	
Total Split (%)	41.9%	41.9%	41.9%	41.9%	19.0%	39.1%	39.1%	19.0%	39.1%	39.1%	
Maximum Green (s)	27.0	27.0	27.0	27.0	9.0	25.0	25.0	9.0	25.0	25.0	
Yellow Time (s)	3.3	3.3	3.3	3.3	3.7	3.7	3.7	3.7	3.7	3.7	
All-Red Time (s)	3.0	3.0	3.0	3.0	2.4	2.4	2.4	2.4	2.4	2.4	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	6.3	6.3	6.3	6.3	6.1	6.1	6.1	6.1	6.1	6.1	
Leading Lag					Lead	Lag	Lag	Lag	Lag	Lag	
Leading Optimize?					Yes	Yes	Yes	Yes	Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None	None	None	None	Max	Max	Max	Max	Max	
Walk Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	
Flash Don't Walk (s)	20.0	20.0	20.0	20.0	20.0	15.0	15.0	15.0	15.0	15.0	
Detention Calls (#/hr)	2	2	3	3	3	5	5	5	5	5	
Act Efficient Green (s)	17.4	17.4	17.4	17.4	7.0	28.6	28.6	6.6	26.2	26.2	
Actuated/GC Ratio	0.28	0.28	0.11	0.47	0.47	0.11	0.47	0.11	0.43	0.43	
V/C Ratio	0.74	0.29	0.18	0.19	0.02	0.11	0.19	0.02	0.12	0.12	
Control Delay	30.0	11.1	31.5	13.5	0.1	31.8	16.3	0.1	31.8	16.3	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	30.0	11.1	31.5	13.5	0.1	31.8	16.3	0.1	31.8	16.3	
LOS	C	B	C	A	C	B	A	C	B	A	
Approach Delay	30.0	11.1	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	
Approach LOS	C	B	B	B	B	B	B	B	B	B	
Queue Length 50th (m)	21.6	3.7	2.8	7.2	0.0	1.6	6.6	0.0	0.0	0.0	
Queue Length 85th (m)	56.3	16.2	11.8	28.4	0.0	8.3	26.7	3.7	0.0	0.0	
Internal Link Dist (m)	369.8	119.4	475.6	475.6	475.6	475.6	475.6	475.6	475.6	475.6	
Turn Bay Length (m)	66.6	69.9	256.8	82.5	77.0	238	75.5	71.6	75.5	71.6	
Base Capacity (vph)	0	0	0	0	0	0	0	0	0	0	
Stabilization Cap Reducn	0	0	0	0	0	0	0	0	0	0	
Spillback Cap Reducn	0	0	0	0	0	0	0	0	0	0	
Storage Cap Reducn	0	0	0	0	0	0	0	0	0	0	
Reduced v/C Ratio	0.47	0.19	0.13	0.19	0.02	0.08	0.19	0.12	0.19	0.12	

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HMBS Ph 5 TIA - 3718 Greenbank Road AM Peak Hour Future Total 2020  
Synchro 10 Light Report  
Page 2

Intersection Summary	Cycle Length: 79.5	Actuated Cycle Length: 61.1	Natural Cycle: 30	Control Type: Semi Act-Uncoord	HMBS Ph 5 TIA - 3718 Greerbank Road AM Peak Hour Future	Total 2020	Synchro 10 Light Report	Page 3
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Lanes, Volumes, Timings  
2: Greenbank & Dundonald

01-16-2019

Maximum v/c Ratio: 0.74      Intersection Signal Delay: 19.1      Intersection Capacity Utilization 51.2%

Analysis Period (min) 15

Splitting and Phases: 2. Greenbank & Dundonald

Phase	Green Time (s)	Red Time (s)	Total Cycle (s)
Q1	02	31.15	33.15
Q2	06	31.15	33.15
Q3	04	33.35	33.35
Q4	08	33.35	33.35

Intersection LOS: B  
ICU Level of Service A

Lanes, Volumes, Timings  
2: Greenbank & Dundonald

Maximum v/c Ratio: 0.74  
Intersection Signal Delay: 19.1  
Intersection Capacity Utilization 51.2%  
Analysis Period (min) 15

01-16-2019

1

Intersection											
Int Delay, s/veh		7									
Movement	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR	
Lane Configurations											
Traffic Vol./veh/h	70	6	61	65	6	106	29	105	11	28	153
Future Vol./veh/h	70	6	61	65	6	105	29	105	11	28	153
Conflicting Peds./#/hr	0	0	0	0	0	0	0	0	0	0	36
Sign Control	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	
R/T Channelized	-	-	None	-	-	None	-	None	-	None	
Veh in Median Storage #	-	-	-	-	-	-	400	-	250	800	-
Grade, %	-	0	-	-	0	-	-	0	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	-
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	78	7	68	72	7	117	32	117	12	31	170
Major/Minor											
Conflicting Flow All	501	445	190	471	453	117	210	0	129	0	0
Stage 1	252	252	-	181	181	-	-	-	-	-	-
Stage 2	249	193	-	290	272	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	2.218	-	-
Plat/Maneuver	480	508	852	503	503	935	1361	-	1457	-	-
Stage 1	752	698	-	821	750	-	-	-	-	-	-
Stage 2	755	741	-	718	685	-	-	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	402	486	852	443	481	935	1361	-	1457	-	-
Mov Cap-2 Maneuver	402	486	-	443	481	-	-	-	-	-	-
Stage 1	734	683	-	801	732	-	-	-	-	-	-
Stage 2	639	723	-	641	671	-	-	-	-	-	-
Approach											
HCM Control Delay, s	14.5	-	B	12.9	-	1.5	-	B	1	-	-
HCM LOS											
Minor Lane/Major Mvmt											
Capacity (veh/h)	1361	-	-	531	648	1457	-	-	-	-	-
HCM Lane V/C Ratio	0.024	-	-	0.287	0.302	0.021	-	-	-	-	-
HCM Control Delay (s)	7.7	-	-	14.5	12.9	7.5	-	-	-	-	-
HCM Lane LOS	A	-	-	B	B	A	-	-	-	-	-
HCM 95th %ile Q(veh)	0.1	-	-	1.2	1.3	0.1	-	-	-	-	-

HCM 2010 TWSC  
3: Greenbank & Kilbirnie

Intersection  
Index Delay Risk 7

01-16-2019

100

HCM 2010 AWSC 1: River Mist & Cambrian									
Intersection Delay, s/veh		16.2							
Intersection LOS		C							
<b>Intersection</b>									
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL
Lane Configurations	4	4	4	4	4	4	4	4	4
Traffic Vol./veh/h	21	272	146	138	288	30	97	5	70
Future Vol./veh/h	21	272	146	138	288	30	97	5	70
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2
Peak Flow	21	272	146	138	288	30	97	5	70
Number of Lanes	0	1	0	0	1	0	1	0	1
Approach	EB	WB	WB	NB	SB	SB	NB	NB	SB
Opposing Approach	WB	EB	EB	SB	SB	SB	WB	WB	WB
Opposing Lanes	1	1	1	1	1	1	1	1	1
Conflicting Approach Left	SB	NB	NB	EB	EB	EB	EB	EB	EB
Conflicting Lanes Left	1	1	1	1	1	1	1	1	1
Conflicting Approach Right	NB	SB	WB						
Conflicting Lanes Right	1	1	1	1	1	1	1	1	1
HCM Control Delay	16.3	18.4	11.8	10.3	B	B	B	B	B
HCM LOS	C	C	C	C	C	C	C	C	C
Lane	NBLn1	EBLn1	WBLn1	NBLn1	EBLn1	WBLn1	NBLn1	EBLn1	WBLn1
Vol Left, %	56%	5%	30%	53%	5%	30%	53%	5%	30%
Vol Thru, %	3%	62%	63%	16%	3%	62%	63%	3%	62%
Vol Right, %	41%	33%	7%	31%	41%	33%	7%	41%	33%
Sign Control	Stop								
Traffic Vol by Lane	172	439	456	49	172	439	456	49	172
LT Vol	97	21	138	26	97	21	138	26	97
Through Vol	5	272	288	8	5	272	288	8	5
RT Vol	70	146	30	15	70	146	30	15	70
Lane Flow Rate	172	439	456	49	172	439	456	49	172
Geometry Grp	1	1	1	1	1	1	1	1	1
Degree of Util (X)	0.233	0.623	0.669	0.089	0.233	0.623	0.669	0.089	0.233
Departure Headway (Hd)	6.142	5.112	5.281	6.545	6.142	5.112	5.281	6.545	6.142
Convergence, Y/N	Yes								
Cap	583	702	684	544	583	702	684	544	583
Service Time	4.205	3.158	3.325	4.626	4.205	3.158	3.325	4.626	4.205
HCM Lane V/C Ratio	0.285	0.625	0.667	0.09	0.285	0.625	0.667	0.09	0.285
HCM Control Delay	11.8	16.3	18.4	10.3	11.8	16.3	18.4	10.3	11.8
HCM Lane LOS	B	C	C	B	B	C	C	B	B
HCM 95th-ile Q	12	4.4	5.1	0.3	12	4.4	5.1	0.3	12

RMBS PH3 | A - 3 / 18 Greenbank Road FM Peak Hour Future Total 2020

Archiro 10 Light Report Dec 22 2

HMBSPH 5 | A - 3 / 18 Greenba

HMBSPH 3 | A - 3 | 18 Greenbank Road PM Peak Hour Future Total 2020

Synchro 10 Light Report  
Report 2

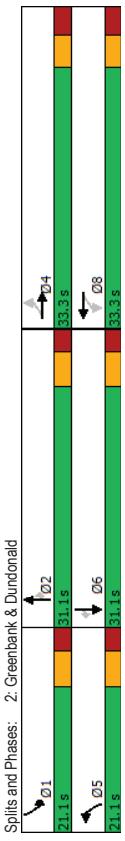
synchro 10 Light Report Page 3

Lanes, Volumes, Timings												01-16-2019
2: Greenbank & Dundonald												
Lane Group	EBL	EBR	WBL	WBR	NBL	NBT	NSB	SBL	SBT	SBR		
Lane Configurations												
Traffic Volume (vph)	115	38	62	19	96	40	70	180	24	57	121	113
Future Volume (vph)	115	38	62	19	96	40	70	180	24	57	121	113
Stationary Flow (prot)	0	1662	0	0	1693	0	1676	1765	1500	1676	1765	1500
F/F Permit	0.783				0.942	0.950			0.950			
Solid Flow (perm)	0	1388	0	0	1604	0	1676	1765	1500	1676	1765	1500
Solid Flow (RTOR)	25				21			120			120	
Lane Group Flow (vph)	0	215	0	0	155	0	70	180	24	57	121	113
Turn Type												
Protected Phases	4				8			5	2	2	1	6
Permitted Phases	4	4	8	8	5	2	2	1	6	6	6	6
Detector Phase												
Switch Phase												
Minimum Initial (s)	10.0	10.0	10.0	10.0	5.0	10.0	5.0	10.0	5.0	10.0	10.0	10.0
Minimum Split (s)	33.3	33.3	33.3	33.3	11.1	31.1	11.1	31.1	11.1	31.1	31.1	31.1
Total Split (s)	33.3	33.3	33.3	33.3	21.1	31.1	21.1	31.1	21.1	31.1	31.1	31.1
Total Split (%)	38.9%	38.9%	38.9%	38.9%	24.7%	36.4%	24.7%	36.4%	24.7%	36.4%	36.4%	36.4%
Yellow Time (s)	3.3	3.3	3.3	3.3	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
All-Red Time (s)	3.0	3.0	3.0	3.0	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Lost Time Adjust (s)	0.0				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost time (s)	6.3				6.3	6.1	6.1	6.1	6.1	6.1	6.1	6.1
Lead/Lag (s)						Lead	Lag	Lead	Lag	Lead	Lag	Lag
Lead-Lag Optimize?						Yes						
Recall Mode						None	Max	None	Max	None	Max	Max
Act. Effect Green (s)	16.1				16.1	8.4	27.2	27.2	7.9	26.8	26.8	26.8
Actuated g/C Ratio	0.25				0.25	0.13	0.42	0.42	0.12	0.42	0.42	0.42
v/c Ratio	0.61				0.37	0.32	0.24	0.24	0.03	0.28	0.16	0.16
Control Delay	27.7				20.7	32.9	17.4	0.1	32.8	17.6	4.8	4.8
Queue Delay	0.0				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	27.7				20.7	32.9	17.4	0.1	32.8	17.6	4.8	4.8
LOS	C				C	C	A	A	C	B	A	A
Approach Delay	27.7				20.7	19.8	19.8	19.8	19.8	15.6		
Approach LOS	C				C	C	B	B	B	B		
Queue Length 50ft (m)	19.8				13.0	7.5	13.8	0.0	6.1	9.1	0.0	
Queue Length 95ft (m)	40.0				27.4	19.9	34.6	0.0	17.2	24.7	9.0	
Inferred Link List (m)	368.8				119.4		475.6			719.1		
Turn Bay Length (m)											1000	
Base Capacity (vph)	594				713		407	704	407	737	696	
Stationary Cap Reduct	0				0		0	0	0	0	0	
Spillback Cap Reduct	0				0		0	0	0	0	0	
Storage Cap Reduct	0				0		0	0	0	0	0	
Reduced v/c Ratio	0.36				0.22		0.17	0.24	0.03	0.14	0.16	0.16
Intersection Summary												Cycle length: 85.5

Lanes, Volumes, Timings  
2: Greenbank & Dundonald

01-16-2019  
Intersection Signal Delay: 20.5  
Intersection Capacity Utilization 56.7%  
Analysis Period (min) 15

01-16-2019  
Intersection LOS: C  
ICU Level of Service B



HCM 2010 TWSC  
3: Greenbank & Killbirnie

01-16-2019  
Intersection

	Int Delay /s/veh	4.7	Movement	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations			↑↓				↑↓		↑	↑	↑	↑	↑	↑
Traffic Vol /veh/h	44	2	30	23	5	60	74	176	65	87	141	73		
Future Vol /veh/h	44	2	30	23	5	60	74	176	65	87	141	73		
Conflicting Peds. #/hr	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free							
RT Channelized	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	0	-	0	-	0	-	0	-	0	-	-
Grade, %	-	0	-	0	-	0	-	0	-	0	-	0	-	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Wmrt Flow	44	2	30	23	5	60	74	176	65	87	141	73		
Major/Major	Minor2	Minor1	Major1	Minor2	Minor1	Major1	Major2	Major1	Major2	Major1	Major2	Major1	Major2	Major1
Conflicting Flow All	741	741	178	692	712	176	214	0	0	241	0	0	0	0
Stage 1	352	352	-	324	324	-	-	-	-	-	-	-	-	-
Stage 2	389	389	-	368	388	-	-	-	-	-	-	-	-	-
Critical Hwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-	-	-
Critical Hwy Sig 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-	-	-
Critical Hwy Sig 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-	-	-
Follow-up Hwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-	-	-
Pot Cap-Maneuver	332	344	865	338	338	867	1386	-	-	1326	-	-	-	-
Stage 1	665	632	-	688	650	-	-	-	-	-	-	-	-	-
Stage 2	635	608	-	652	609	-	-	-	-	-	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	278	304	865	313	316	867	1386	-	-	1326	-	-	-	-
Mov Cap-2 Maneuver	278	304	-	313	316	-	-	-	-	-	-	-	-	-
Stage 1	628	590	-	650	614	-	-	-	-	-	-	-	-	-
Stage 2	554	575	-	586	569	-	-	-	-	-	-	-	-	-
Approach	EB	WB	NB	SB	SBR									
HCM Control Delay, s	16.3		12.7		1.8									
HCM LOS	C		B											

# Appendix J

2025 Future Total Synchro Worksheets

HCM 2010 AWSC  
1: River Mist & Cambria

Lanes, Volumes, Timings  
2: Greenbank & Dundonald

Lanes, Volumes, Timings  
2: Greenbank & Dundonald  
01-16-2019

Intersection Summary						Synchro 10 Light Report
Cycle Length:	79.5					Page 3
Actuated Cycle Length:	61.1					
Natural Cycle:	80					
Control Type:	Semi Act-Uncoord					
		HMBS Ph 5 TIA - 3718 Greenbank Road AM Peak Hour Future Total 2025				

HMBSS Ph 5 | A - 3/18 Greenbank Road AM Peak Hour Future Total 2025

"mchro 10 Light Report

Syncro 10 Light Report

Lanes, Volumes, Timings  
2: Greenbank & Dundonald

01-16-2019

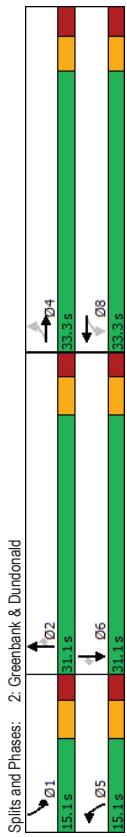
HCM 2010 TWSC  
2: Greenbank & Dundonald  
3: Greenbank & Killbirnie  
01-16-2019

Maximum V/C Ratio: 0.74

Intersection Capacity Utilization 58.0%

Analysis Period (min) 15

01-16-2019



	Intersection LOS: B		Intersection LOS: B		Intersection LOS: B		Intersection LOS: B		Intersection LOS: B		Intersection LOS: B		Intersection LOS: B	
	ICU Level of Service B		ICU Level of Service B		ICU Level of Service B		ICU Level of Service B		ICU Level of Service B		ICU Level of Service B		ICU Level of Service B	
Spots and Phases:	2: Greenbank & Dundonald													
15.1s	01	02												
15.1s	05	06												
15.1s	01	02												
15.1s	05	06												
Int Delay/s/veh	7.1		7.1		7.1		7.1		7.1		7.1		7.1	
Movement	EBL	EBT	EBR	VBL	VBT	VBR	NBL	NBT	NBR	SBL	SBT	SBR		
Lane Configurations	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓
Traffic Vol/veh/h	70	6	61	65	6	105	29	236	11	28	208	36		
Future Vol/veh/h	70	6	61	65	6	105	29	236	11	28	208	36		
Conflicting Peds. #/hr	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	0	-	0	-	0	-	0	-	0	-	-
Grade, %	-	0	-	0	-	0	-	0	-	0	-	0	-	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Wmrt Flow	78	7	68	72	7	117	32	262	12	31	231	40		
Major/Minor	Minor2	Minor1	Major1	Minor2	Minor1	Major1	Minor2	Minor1	Major1	Minor2	Minor1	Major1	Minor2	Minor1
Conflicting Flow All	70/7	65/1	25/1	67/7	65/9	26/2	27/1	0	0	27/4	0	0		
Stage 1	31/3	31/3	-	32/6	-	-	-	-	-	-	-	-	-	-
Stage 2	33/4	33/8	-	35/1	33/3	-	-	-	-	-	-	-	-	-
Critical Hwy	7.1/2	6.5/2	6.2/2	7.1/2	6.5/2	6.2/2	4.1/2	-	-	4.1/2	-	-	-	-
Critical Hwy Sig 1	6.1/2	5.5/2	-	6.1/2	5.5/2	-	-	-	-	-	-	-	-	-
Critical Hwy Sig 2	6.1/2	5.5/2	-	6.1/2	5.5/2	-	-	-	-	-	-	-	-	-
Follow-up Hwy	3.51/8	4.01/8	3.31/8	3.51/8	4.01/8	3.31/8	2.21/8	-	-	2.21/8	-	-	-	-
Pot Cap-Maneuver	35/0	38/8	7/88	36/7	38/4	7/77	12/92	-	-	12/89	-	-	-	-
Stage 1	69/8	65/7	-	68/7	64/8	-	-	-	-	-	-	-	-	-
Stage 2	63/1	64/1	-	66/6	64/4	-	-	-	-	-	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	28/2	36/9	7/88	31/9	36/6	7/77	12/92	-	-	12/89	-	-	-	-
Mov Cap-2 Maneuver	28/2	36/9	-	31/9	36/6	-	-	-	-	-	-	-	-	-
Stage 1	68/1	64/1	-	67/0	63/2	-	-	-	-	-	-	-	-	-
Stage 2	51/7	62/5	-	58/8	62/9	-	-	-	-	-	-	-	-	-
Approach	EB	WB	NB	SB	NB	SB								
HCM Control Delay, s	19.4	16.9	0.8	0.8	0.8	0.8								
HCM LOS	C	C	C	C	C	C								
Minor Lane/Major Mvmt	NBL	NBT	NBR	EBln1	EBrn1	WBln1	SBl	SBT	SBR					
Capacity (veh/h)	1292	-	-	401	435	1289	-	-	-	-	-	-	-	-
HCM Lane V/C Ratio	0.025	-	-	0.38	0.35	0.024	-	-	-	-	-	-	-	-
HCM Control Delay (s)	7.9	-	-	19.4	16.9	7.9	-	-	-	-	-	-	-	-
HCM Lane LOS	A	-	-	C	C	A	-	-	-	-	-	-	-	-
HCM 95th %tile Q(veh)	0.1	-	-	1.7	1.9	0.1	-	-	-	-	-	-	-	-

HCM 2010 AWSC 1: River Mist & Cambrian									
Intersection Delay, s/veh		35.1		E		Intersection LOS			
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBL
Lane Configurations									
Traffic Vol./veh/h	21	379	198	208	393	30	128	5	112
Future Vol./veh/h	21	379	198	208	393	30	128	5	112
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2
Peak Flow	21	379	198	208	393	30	128	5	112
Number of Lanes	0	1	0	1	1	0	0	1	0
Approach	EB	WB	NB	SB	SB	NB	NB	SB	SB
Opposing Approach	WB	EB	SB	SB	SB	SB	SB	SB	SB
Opposing Lanes	2	1	1	1	1	1	1	1	1
Conflicting Approach Left	SB	NB	EB	EB	EB	WB	WB	EB	EB
Conflicting Lanes Left	1	1	1	1	1	1	1	1	1
Conflicting Approach Right	NB	SB	WB	WB	WB	EB	EB	EB	EB
Conflicting Lanes Right	1	1	2	2	2	1	1	1	1
HCM Control Delay	57.2	23.3	16.3	12	12	12	12	12	12
HCM LOS	F	C	C	B	B	B	B	B	B
Lane	NBLn1	EBLn1	WBLn1	WBLn2	SBLn1				
Vol Left, %	52%	4%	100%	0%	53%				
Vol Through, %	2%	63%	0%	93%	16%				
Vol Right, %	46%	33%	0%	7%	31%				
Sign Control	Stop	Stop	Stop	Stop	Stop				
Traffic Vol by Lane	245	596	206	423	49				
LT Vol	128	21	208	0	26				
Through Vol	5	379	0	393	8				
RT Vol	112	198	0	30	15				
Lane Flow Rate	245	598	208	423	49				
Geometry Grp	2	5	7	7	2				
Degree of Util (X)	0.476	0.986	0.409	0.766	0.109				
Departure Headway (Hd)	7.001	5.936	7.077	6.515	7.974				
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes				
Cap	514	616	508	554	447				
Service Time	5.058	3.936	4.828	4.266	6.059				
HCM Lane V/C Ratio	0.477	0.971	0.409	0.764	0.111				
HCM Control Delay	16.3	57.2	14.7	27.6	12				
HCM Lane LOS	C	G	B	D	B				
HCM 95th-lile Q	25	14.5	2	6.9	0.4				

RMBS PH3 | A - 3 / 18 Greenbank Road FM Peak Hour Future Total 2025

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HMBSPH 5 | A - 3 / 8 Greenba

HMBS PH 3 | A - 3 | 8 Greenbank Road PM Peak Hour Future 10am 2025

HMB5 Pn 3 IIA - 3 / 18 Greenbank Road PM Peak Hour Future Total 2025  
Syncro 10 Light Report Page 2

synchro 10 Light Report Page 3

Lanes, Volumes, Timings  
2: Greenbank & Dundonald

01-16-2019

HCM 2010 TWSC  
3: Greenbank & Killbirnie

01-16-2019

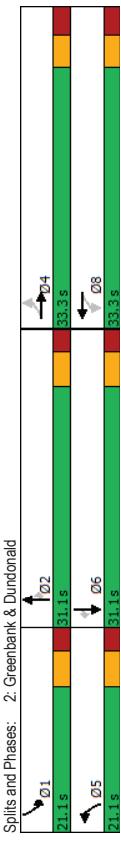
Intersection Signal Delay: 22.5

Intersection Capacity Utilization 82.5%

Analysis Period (min) 15

Intersection LOS: C

ICU Level of Service A



Intersection		Int Delay /s/veh	4.4	Movement	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Configurations				↑↓						↑	↑	↑	↑	↑
Traffic Vol /veh/h	44	2	30	23	5	60	74	260	65	87	274	73		
Future Vol /veh/h	44	2	30	23	5	60	74	260	65	87	274	73		
Conflicting Peds. #/hr	0	0	0	0	0	0	0	0	0	0	0	0	0	
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free	
RT Channelized	-	-	-	-	-	-	-	-	-	-	-	-	-	
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-	-	
Veh in Median Storage. #	-	0	-	0	-	0	-	400	-	250	800	-	-	
Grade, %	-	0	-	0	-	0	-	0	-	0	-	0	-	
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100	100	
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2	2	
Wmrt Flow	44	2	30	23	5	60	74	260	65	87	274	73		
Major/Major		Minor2	Minor1	Major1	Major2	Minor1	Major1	Minor2	Major2	Minor1	Major1	Minor2	Major2	
Conflicting Flow All	958	958	311	909	929	260	347	0	0	325	0	0	0	
Stage 1	485	485	-	408	408	-	-	-	-	-	-	-	-	
Stage 2	473	473	-	501	521	-	-	-	-	-	-	-	-	
Critical Hwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-	-	
Critical Hwy Sig 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-	-	
Critical Hwy Sig 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-	-	
Follow-up Hwy	3,518	4,018	3,318	3,518	4,018	3,318	2,218	-	-	2,218	-	-	-	
Pot Cap-Maneuver	237	257	729	256	288	779	1,235	-	-	1,235	-	-	-	
Stage 1	563	552	-	620	597	-	-	-	-	-	-	-	-	
Stage 2	572	558	-	552	532	-	-	-	-	-	-	-	-	
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-	-	
Mov Cap-1 Maneuver	194	224	729	220	234	779	1,212	-	-	1,235	-	-	-	
Mov Cap-2 Maneuver	194	224	-	220	234	-	-	-	-	-	-	-	-	
Stage 1	529	513	-	582	561	-	-	-	-	-	-	-	-	
Stage 2	491	524	-	490	495	-	-	-	-	-	-	-	-	
Approach		EB	WB	NB	SB									
HCM Control Delay, s	23.1		15.4		1.5									
HCM LOS	C	C	C	C	C									
Minor Lane/Major Mvmt		NBL	NBT	NBR	EBL	n1WBLn1	SBL	SBT	SBR					
Capacity (veh/h)	1212	-	-	274	434	1235	-	-	-					
HCM Lane V/C Ratio	0.061	-	-	0.277	0.203	0.07	-	-	-					
HCM Control Delay (s)	8.2	-	-	23.1	15.4	8.1	-	-	-					
HCM Lane LOS	A	-	-	C	C	A	-	-	-					
HCM 95th %tile Q(veh)	0.2	-	-	1.1	0.8	0.2	-	-	-					

	Intersection Delay, s/veh		2022		C	
	Intersection LOS					
Movement	EBL	EBT	EBL	EBR	WBL	WBR
Lane Configurations	21	379	198	208	393	30
Traffic Vol/veh/h	Future Vol/veh/h	21	379	198	393	30
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	21	379	198	208	393	30
Number of Lanes	0	1	1	1	0	0
Approach	EB	WB	WB	NB	SB	SB
Opposing Approach	WB	EB	SB	NB	WB	WB
Opposing Lanes	2	2	1	1	1	1
Conflicting Approach Left	SB	NB	EB	EB	WB	WB
Conflicting Lanes Left	1	1	2	2	2	2
Conflicting Approach Right	NB	SB	WB	WB	EB	EB
Conflicting Lanes Right	1	1	2	2	2	2
HCM Control Delay	20.6	22.4	15.3	11.5		
HCM LOS	C	C	C	B	B	B

Lane	NBLn1	EBLn1	EBLn2	WBLn1	WBLn2	SBLn1
Vol Left, %	52%	5%	0%	100%	0%	53%
Vol Thru, %	2%	95%	0%	0%	93%	16%
Vol Right, %	46%	0%	100%	0%	7%	31%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	245	400	198	208	423	49
LT Vol	128	21	0	208	0	26
Through Vol	5	379	0	0	393	8
RT Vol	112	0	198	0	30	15
Lane Flow Rate	245	400	198	208	423	49
Geometry Grp	2	7	7	7	7	2
Degree of Util(X)	0.454	0.728	0.32	0.402	0.752	0.104
Departure Headway (Hd)	6.664	6.556	5.816	6.959	6.399	7.641
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes
Cap	537	548	612	514	563	472
Service Time	4.757	4.354	3.613	4.755	4.194	5.641
HCM Lane V/C Ratio	0.456	0.73	0.324	0.405	0.751	0.104
HCM Control Delay	15.3	25.1	11.4	14.4	26.3	11.5
HCM Lane LOS	C	D	B	B	D	B
HCM 95thile Q	2.3	6	14	19	6.6	0.3