Quinn's Pointe 2 Transportation Impact Assessment

Strategy Report

May 25, 2018

Prepared for:

Minto Communities

Prepared by:

Stantec Consulting Ltd.

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[1] or registered[1] professional in good standing, whose field of expertise is either transportation engineering or transportation planning.

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

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[1] 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

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1.0 SCREENING

1.1 SUMMARY OF DEVELOPMENT

Quinn's Pointe is 58 hectares in size and is bordered by Borrisokane Road, Kilbirnie Road, Existing Greenbank Road, and Barnsdale Road to the west, north, east and south, respectively.

Land Use Classification	Code	Phase 1 & 2 2025	Phase 3 2031	Total
Single Detached Houses	210	389	159	548
Residential Condo/Townhouse	230	250	217	467
Apartment (Medium Density)	220		100	100
Elementary School	520	59k sq.ft. GFA		59k sq.ft. GFA

Access to the site will be via Future Greenbank Road, Kilbirnie Drive, New E-W Collector, River Mist Road, and Barnsdale Road.

Figure 1 illustrates the concept plan.

1.2 TRIP GENERATION TRIGGER

Considering the Development's Land Use type and Size (as filled out in the previous section), please refer to the Trip Generation Trigger checks below.

Land Use Type	Minimum Development Size	Triggered
Single-family homes	40 units	Yes
Townhomes or apartments	90 units	Yes
Office	3,500 sq.m.	No
Industrial	5,000 sq.m.	No
Fast-food restaurant or coffee shop	100 sq.m.	No
Destination retail	1,000 sq.m.	No
Gas station or convenience market	75 sq.m	No
Overall		Yes

** If the development has a land use type other than what is presented in the table above, estimates of person-trip generation may be made based on average trip generation characteristics represented in the current edition of the Institute of Transportation Engineers (ITE) Trip Generation Manual*

If the proposed development size is greater than the sizes identified above, <u>the Trip Generation Trigger is satisfied.</u>

1.3 LOCATION TRIGGERS

	Yes	No
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?	✓	
Is the development in a Design Priority Area (DPA) or Transit-oriented Development (TOD) zone?*		✘

**DPA and TOD are identified in the City of Ottawa Official Plan (DPA in Section 2.5.1 and Schedules A and B; TOD in Annex 6). See Chapter 4 for a list of City of Ottawa Planning and Engineering documents that support the completion of TIA).*

If any of the above questions were answered with 'Yes,' the Location Trigger is satisfied.

1.4 SAFETY TRIGGERS

	Yes	No
Are posted speed limits on a boundary street are 80 km/hr or greater?	✓	
Are there any horizontal/vertical curvatures on a boundary street limits sight lines at a proposed driveway?		✘
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)?		✘
Is the proposed driveway within auxiliary lanes of an intersection?		✘
Does the proposed driveway make use of an existing median break that serves an existing site?		✘
Is there is a documented history of traffic operations or safety concerns on the boundary streets within 500 m of the development?		✘
Does the development include a drive-thru facility?		✘

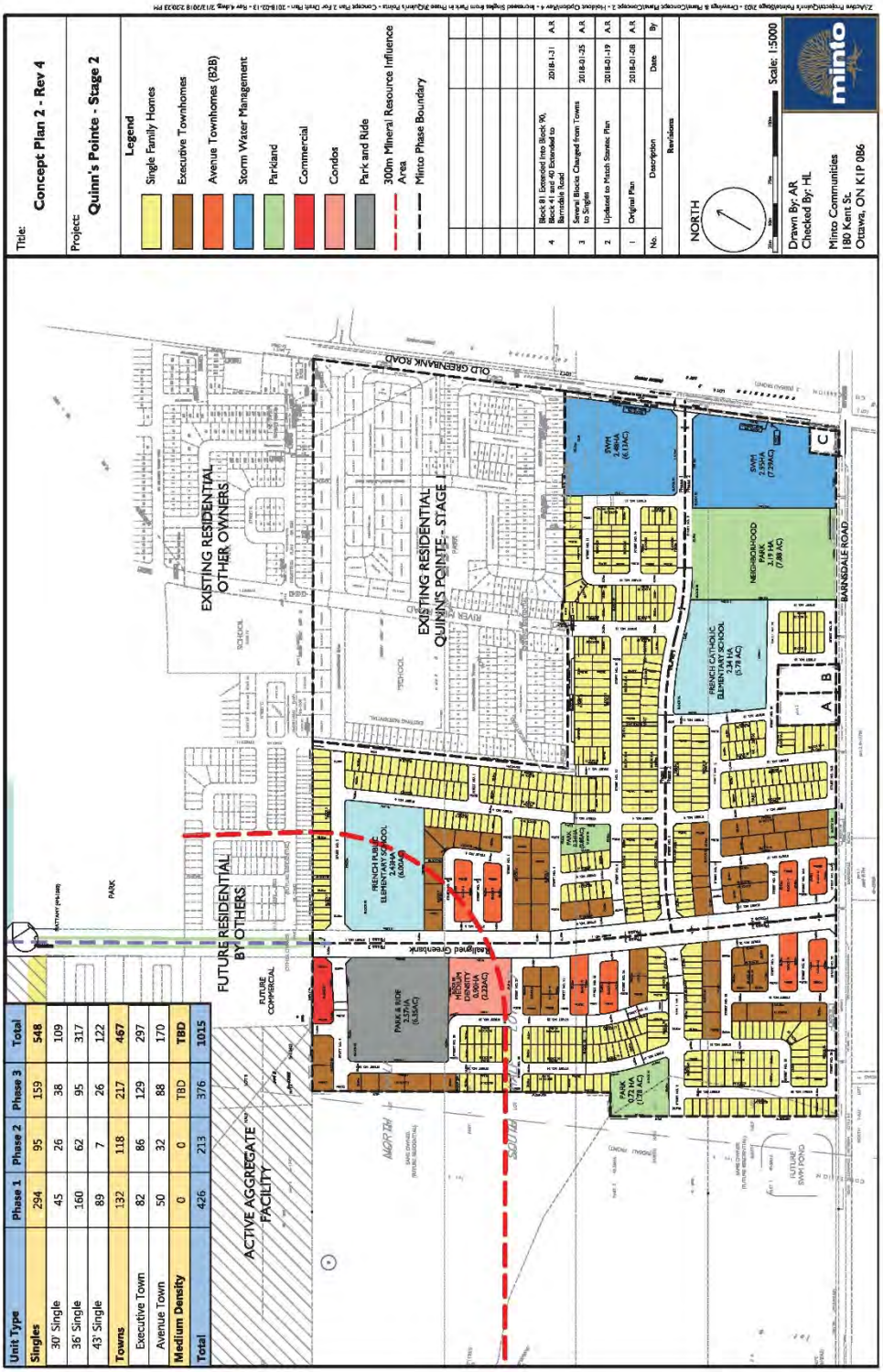
If any of the above questions were answered with 'Yes,' the Safety Trigger is satisfied.

1.5 SUMMARY

	Yes	No
Does the development satisfy the Trip Generation Trigger?	✓	
Does the development satisfy the Location Trigger?	✓	
Does the development satisfy the Safety Trigger?	✓	

If none of the triggers are satisfied, the TIA Study is complete. If one or more of the triggers is satisfied, the TIA Study must continue into the next stage (Screening and Scoping).

Figure 1 Concept Plan



Unit Type	Phase 1	Phase 2	Phase 3	Total
Singles	294	95	159	**548**
30' Single	45	26	38	109
36' Single	160	62	95	317
43' Single	89	7	26	122
Towns	132	118	217	**467**
Executive Town	82	86	129	297
Avenue Town	50	32	88	170
Medium Density	0	0	TBD	**TBD**
Total	426	213	376	**1015**

2.0 SCOPING

2.1 EXISTING AND PLANNED CONDITIONS

2.1.1 Proposed Development

The proposed development is within the Barrhaven South Urban Expansion Study Area and is currently zoned as "General Rural Area" or "Sand and Gravel Resource Area" on Official Plan Schedule A – *Rural Policy Plan*. Following the completion of the Barrhaven South Urban Expansion *Community Design Plan*, all land within the Urban Expansion Study Area will be designated General Urban Area in the Official Plan, which is primarily a residential designation.

The proposed development consists of 548 single-family dwelling units, 467 townhomes, 100 apartment units, and two elementary schools. The development is anticipated to proceed in three phases with full build-out in 2031. Access to the site will be via Future Greenbank Road, Kilbirnie Drive, New E-W Collector, River Mist Road, and Barnsdale Road. No restrictions are proposed at any of the access locations.

2.1.2 Existing Conditions

2.1.2.1 Roads and Traffic Control

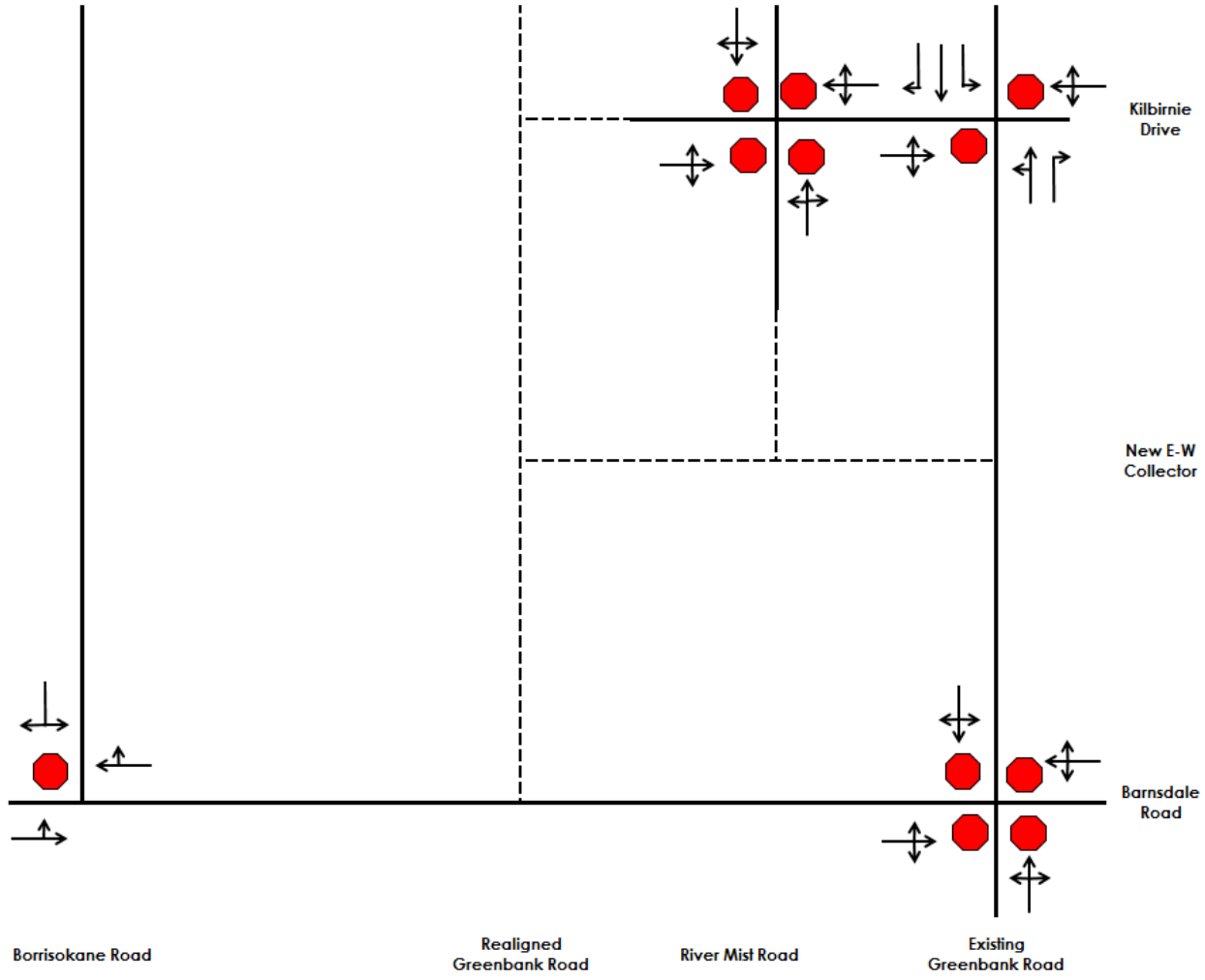
The roadways under consideration in the study area are under the jurisdiction of the City of Ottawa and are described as follows:

Existing Greenbank Road	Existing Greenbank Road is designated as a two-lane arterial north of Barnsdale Road and a two-lane collector south of Barnsdale Road. North of Kilbirnie, Existing Greenbank Road has an urban cross-section with a posted speed of 60km/h and south of Kilbirnie, it has a rural cross-section with a posted speed of 80 km/h.
Cambrian Road	Cambrian Road is a two-lane rural arterial road with a posted speed limit of 70km/h between Borrisokane Road and Seeley's Bay Street. East of Seeley's Bay Street, Cambrian Road transitions to a two-lane urban arterial road with sidewalks along both sides and a posted speed limit of 50km/h.
Borrisokane Road	North of Cambrian Road Borrisokane Road is a two-lane rural arterial road and south of Cambrian Road it is a two-lane rural collector road. Borrisokane Road has a posted speed limit of 80km/h and gravel shoulders are provided along both sides. The intersection with Barnsdale Road is stop-controlled along the Borrisokane Road approach.
Barnsdale Road	Barnsdale Road is a two-lane arterial with a rural cross-section and a posted speed limit of

80 km/h. Trucks are not permitted on Barnsdale Road.

Figure 2 illustrates the existing traffic control and lane configuration at study area intersections.

Figure 2 Existing Traffic Control and Lane Configuration



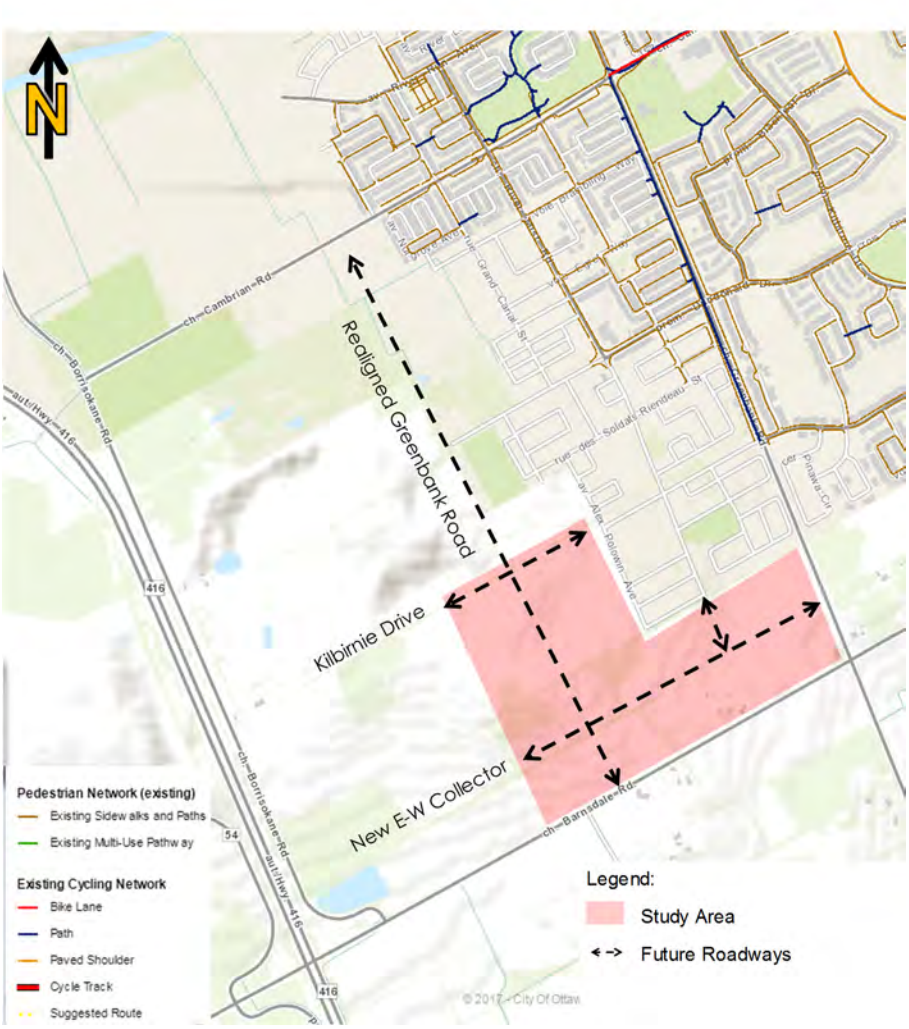
2.1.2.2 Walking and Cycling Network

Within the Barrhaven South community there are bicycle paths, paved shoulders, and sidewalks that connect the various communities. There are numerous bicycle paths within the Half Moon Bay community, as well as along Existing Greenbank Road between Cambrian Road and Kilbirnie Drive.

In terms of pedestrian facilities, there are various sidewalks along the majority of the streets within the Half Moon Bay and Stonebridge communities, including Cambrian Road and Existing Greenbank Road.

Figure 3 illustrates the existing pedestrian and cycling facilities within the study area.

Figure 3 Existing Pedestrian and Cycling Network



Source: geoOttawa, January 2018

2.1.2.3 Transit

Transit service is provided to the Study Area via route 95. Route 95 is a regular bus route that runs from the Minto Centre Recreation Complex to Trim Road and operates on a 15-minute headway during the morning peak period northbound and during the afternoon peak period southbound.

Figure 4 illustrates existing study area transit routes.

Figure 4 Study Area Transit Routes

Source: OC Transpo System Map, January 2018

The *TRANS Committee's 2011 NCR Household Origin-Destination Survey* indicates that approximately 27% of residents traveling from the South Nepean district during the AM Peak Hour use transit as their primary mode of transportation. Similarly, approximately 24% of residents traveling to the South Nepean district during the PM Peak Hour use transit. Roughly 4% of residents traveling within the South Nepean district use transit as their primary travel mode.

As outlined in the City of Ottawa's 2013 Transportation Master Plan, Bus Rapid Transit (BRT) is scheduled to be implemented along Existing Greenbank Road north of the Jock River and along Realigned Greenbank Road south of the Jock River, however, this scheduled upgrade is not included in the City's 2031 Affordable Network, therefore it will occur beyond 2031.

2.1.2.4 Traffic Management

There are no traffic management measures near the subject site.

2.1.2.5 Traffic Volumes

Traffic volumes were updated using traffic counts from late 2017 and early 2018. For the intersection of Borrisokane Road and Barnsdale Road, a growth factor[2] was applied to Stantec's 2015 traffic count and the turning volumes were balanced with the Existing Greenbank Road and Barnsdale Road count (January 2018).

Table 1 lists the traffic counts used for the analysis.

Table 1 Existing Traffic Counts

Location	Source	Date
Borrisokane Road and Barnsdale Road	Stantec	July 23, 2015
Existing Greenbank Road and Kilbirnie Drive	City	November 9, 2017
River Mist Road and Kilbirnie Drive	Stantec	January 9, 2018
Existing Greenbank Road and Barnsdale Road	Stantec	January 10, 2018

Figure 5 and **Figure 6** illustrate 2018 existing AM and PM peak hour traffic volumes at the study area intersections. **Annex 1** contains the traffic data and is provided for reference.

[2] Growth rates were established in the *Barrhaven South Urban Expansion Study Area Community Design Plan, Draft Transportation Master Study (Stantec, September 2017)*

Figure 5 2018 Existing Traffic Volumes - AM Peak Hour

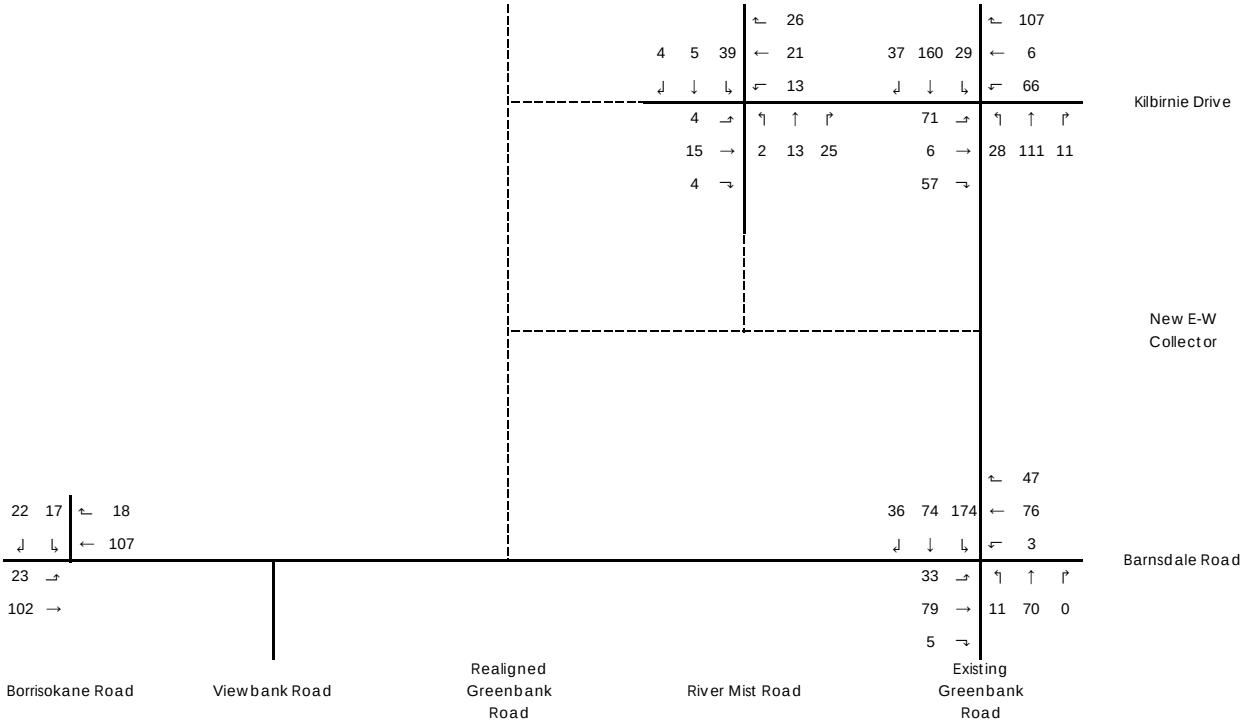
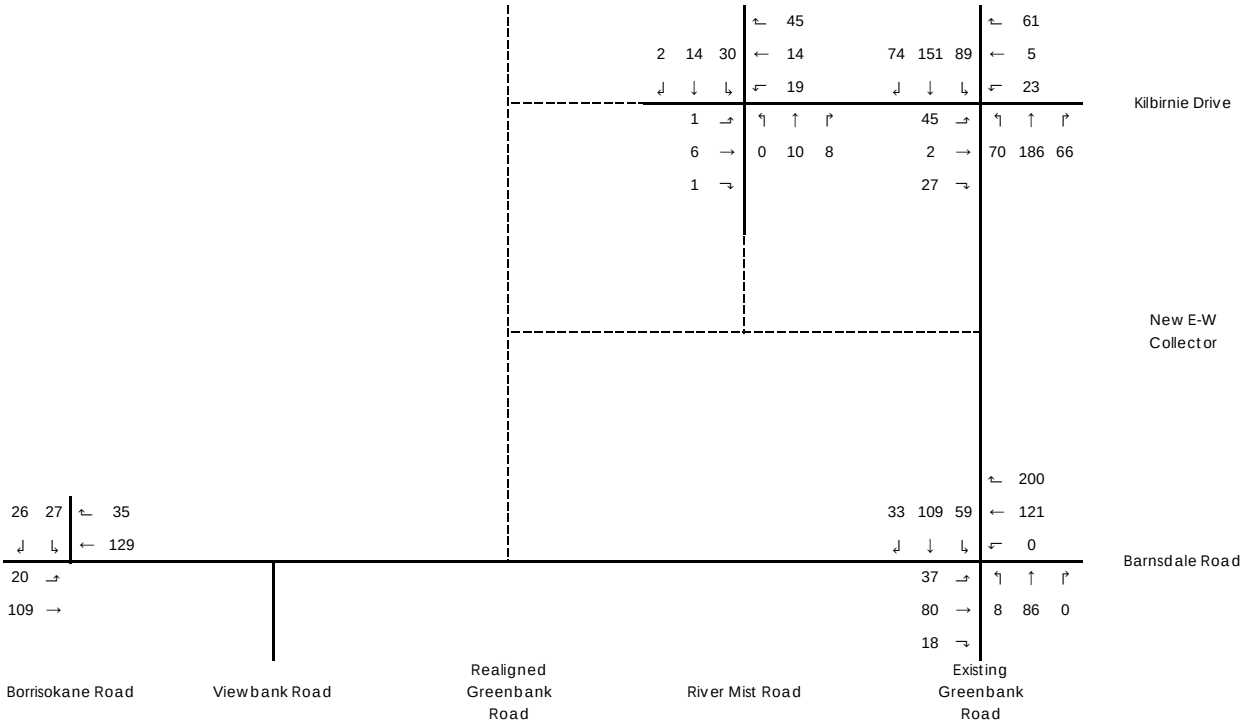


Figure 6 2018 Existing Traffic Volumes - PM Peak Hour



2.1.2.6 Collision History

Three years of collision data from the City of Ottawa's *Open Data* database was reviewed to determine if the streets or intersections surrounding the subject site exhibited a history of collisions. **Figure 7** shows the collision frequency in the study area; circles without a number indicate that there was only one reported collision.

The intersection of Existing Greenbank Road and Barnsdale Road was the only study area intersection or street found to have a history of collisions. There were four reported collisions in 2014, four reported collisions in 2015, and no reported collisions in 2016. The majority of collisions were angle collisions, likely due to the intersection being two-way stop-control. The conversion to an all-way stop-controlled intersection appears to have reduced the number of collisions at the intersection.

A collision pattern has not been observed at study area intersections since the intersection of Existing Greenbank Road and Barnsdale Road was converted to an all-way stop-controlled intersection.

Figure 7 Collision Frequency

2.1.3 Planned Conditions

2.1.3.1 Road Network Improvements

The only significant road network improvement in the study area is the realignment and widening of Greenbank Road.

The *Realigned Greenbank Road and Southwest Transitway Extension Planning and Environmental Assessment* looked at extending Realigned Greenbank Road and the Southwest Transitway south from the formerly planned terminus at Cambrian Road. The recommended plan includes extending both the arterial road and Transitway, running almost parallel to Borrisokane Road, to Barnsdale Road approximately 300m east of Viewbank Road.

The recommended ultimate cross section for Realigned Greenbank Road includes four lanes for vehicles, two lanes down the centre median for buses and transit platforms, and sidewalks and cycle tracks along both sides of the road for a total right-of-way width of 41.5m. The right-of-way is planned to widen slightly to 42.5m to accommodate station platforms and turning lanes at the Cambrian Road and Dundonald Drive intersections.

The EA identified a preliminary location for a park and ride lot on the west side of Realigned Greenbank Road approximately 450m north of Barnsdale Road, however, the location of the park and ride lot was modified slightly through the Community Design Plan process and is now proposed to be located on the south-west corner of Realigned Greenbank Road and the future Kilbirne Drive extension.

In terms of project timing, the TMP identifies the Realigned Greenbank Road and Southwest Transitway Extension to occur beyond 2031.

2.1.3.2 Future Background Developments

The Barrhaven South community has experienced substantial growth over the past few years and that growth is anticipated to continue well into the future. There are numerous developments scheduled to occur near the subject site, as outlined in **Table 2** and as illustrated in **Figure 8** below.

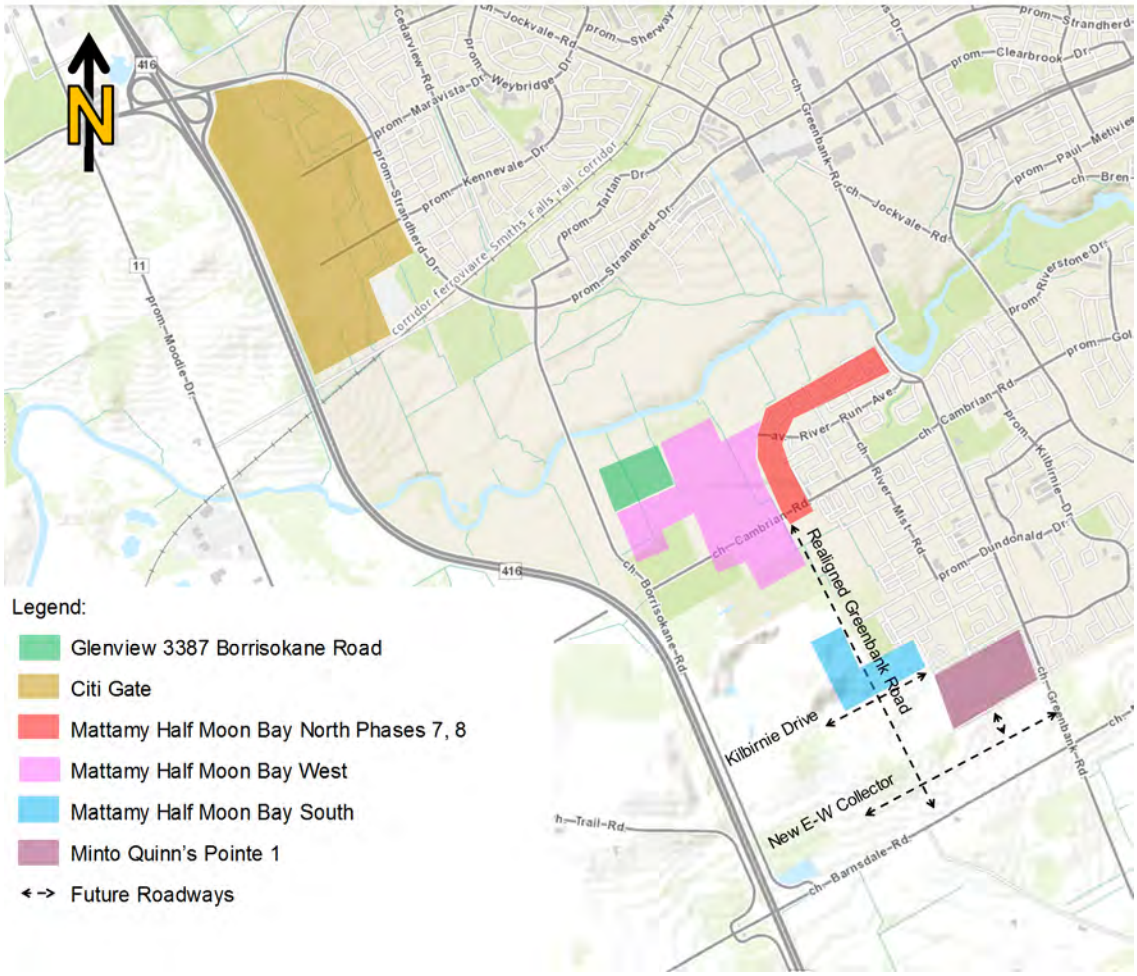
Table 2 Background Developments

Development	Location	Size	Build-out
Mattamy's Half Moon Bay South Phase 4	South of Half Moon Bay South Phase 3, between Realigned Greenbank Road and Existing Greenbank Road	265 residential units	2018
Mattamy's Half Moon Bay North Phases 7, 8	North of Cambrian Road, west of Greenbank Road	471 residential units	2019
Minto's Quinn's Pointe Phase 1	West of Existing Greenbank Road, South of Half Moon Bay South	475 residential units	2019
Glenview's 3387 Borrisokane Road	North of Half Moon Bay West, east of Borrisokane Road, south of the Jock River	288 residential units	2022
Mattamy's Half Moon Bay West	North of Cambrian Road between Borrisokane Road and Realigned Greenbank Road	945 residential units	2024

Development	Location	Size	Build-out
Citi Gate Highway 416 Employment Lands	Between Highway 416 and Strandherd Drive, south of Fallowfield, north of the train tracks	350k sq.ft. GFA (95 ha.) business park	Interim: 2019 Ultimate: 2029
Mattamy's Half Moon Bay South	Between Dundonald Drive and Kilbirne Drive, straddling Realigned Greenbank Road	270 residential units and 69k ft2 GFA specialty retail	Interim: 2025 Ultimate: 2031

These background developments will be explicitly accounted for and added to the roadway network as background traffic volumes. By 2025, the majority of the background developments will be built and occupied with the exception of the Ultimate Phase for the Citi Gate development and the balance of the Mattamy Half Moon Bay South lands, which will be built by the 2031 horizon.

Figure 8 Background Developments



Background imagery source: geoOttawa, January 2018

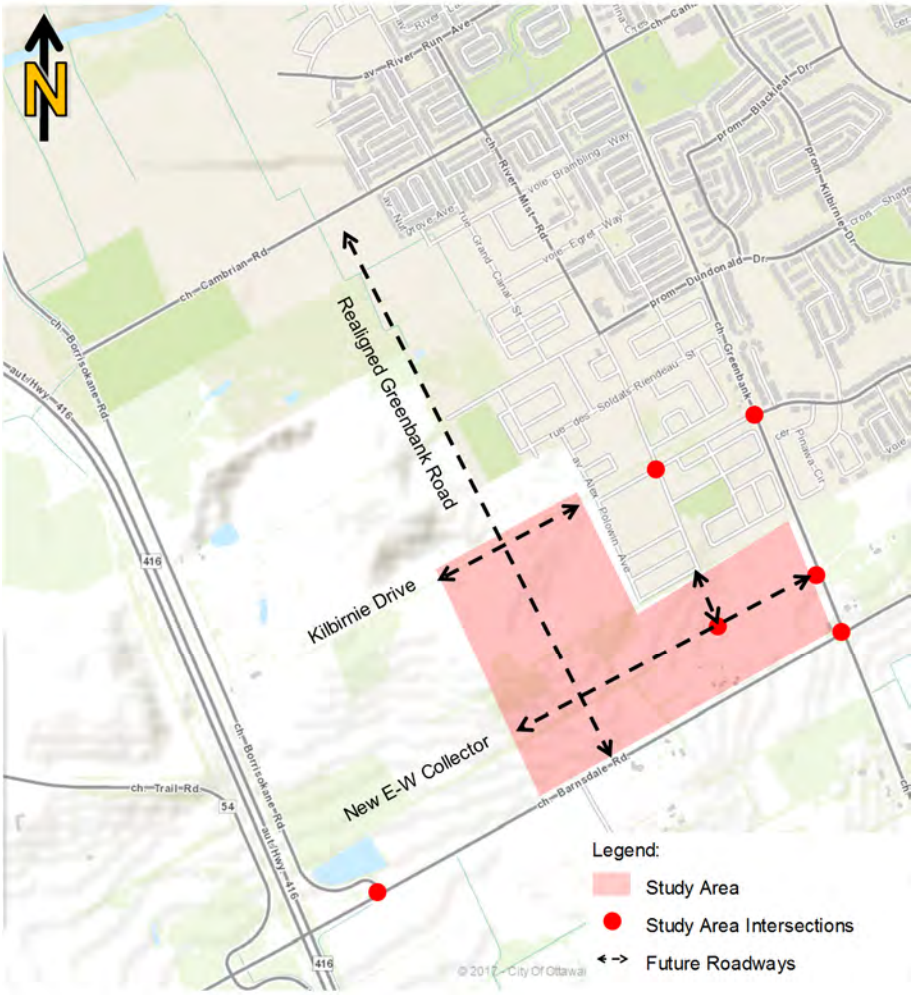
2.2 STUDY AREA AND TIME PERIODS

2.2.1 Study Area

The study area is in the Barrhaven South area of the City of Ottawa at the southern end of the urban boundary. The area is located east of Borrisokane Road, north of Barnsdale Road, west of Existing Greenbank Road, and south of Kilbirnie Drive.

Figure 9 shows the study area and study area intersections.

Figure 9 Study Area and Study Area Intersections



Background Imagery source: geoOttawa, January 2018

2.2.2 Time Periods

The scope of the transportation assessment includes the weekday AM and PM peak hours.

2.2.3 Horizon Years

The scope of the transportation assessment includes the following horizons:

- 2018 existing conditions;
- 2025 future background and total future conditions (Phases 1 and 2);
- 2031 future background and total future condition (build-out of Phases 1, 2 and 3); and,
- 2036 total future conditions (build-out + 5 years).

2.3 EXEMPTIONS REVIEW

Module	Element	Exemption Considerations	Exemption
Design Review Component			
4.1 Development Design	4.1.2 Circulation and Access	Only required for site plans	Exempt
	4.1.3 New Street Networks	Only required for plans of subdivision	Not exempt
4.2 Parking	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
Network Impact Component			
4.5 Transportation Demand Management	All Elements	Not required for site plans expected to have fewer than 60 employees and/or students on location at any given time	Not exempt
4.6 Neighbourhood Traffic Management	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	Not exempt
4.8 Network Concept		Only required when proposed development generates more than 200 person-trips during the peak hour more than the equivalent volume permitted by established zoning	Not exempt

3.0 FORECASTING

3.1 DEVELOPMENT-GENERATED TRAVEL DEMAND

3.1.1 Trip Generation and Mode Shares

Table 3 shows the land uses and the auto trip generation rates for the proposed development. ITE rates were used to remain consistent with the *Transportation Master Study*.

Table 3 Land Uses and Auto Trip Generation Rates

Land Use	Independent Variable and Size		Weekday AM Peak Hour			Weekday PM Peak Hour		
			In	Out	Total	In	Out	Total
210 – Single Detached Houses	Units	548	0.18	0.53	0.71	0.54	0.32	0.85
220 – Apartment	Units	100	0.11	0.42	0.53	0.47	0.25	0.73
230 – Residential Condo / Townhouse	Units	467	0.06	0.3	0.36	0.29	0.14	0.44
520 – Elementary School	GFA (1,000ft^2)	59	2.91	2.29	5.2	0.54	0.67	1.21

The auto trip generation rates were used to forecast the auto trip generation, which was then converted to person trips. The auto trip generation was converted to person trips by assuming that the auto trip generation had an inherent transit mode share of 10% and an auto occupancy of 1.1 persons. By forecasting person trips, the auto mode share for the development can then be used to forecast trip generation for the build-out year for each mode.

Table 4 summarizes the forecasted person trip generation by land use.

Table 4 Conversion to Person Trips

Land Use	Conversion		Weekday AM Peak Hour			Weekday PM Peak Hour		
			In	Out	Total	In	Out	Total
210 – Single Detached Houses	Auto Trip Gen		99	290	389	296	175	466
	Transit Mode Share	10%	10	29	39	30	18	47
	Auto Occupancy	1.1	10	29	39	30	18	47
	Total Person Trips		119	348	467	356	211	560
220 – Apartment	Auto Trip Gen		11	42	53	47	25	73
	Transit Mode Share	10%	1	4	5	5	3	7
	Auto Occupancy	1.1	1	4	5	5	3	7
	Total Person Trips		13	50	63	57	31	87
230 – Residential Condo / Townhouse	Auto Trip Gen		28	140	168	135	65	205
	Transit Mode Share	10%	3	14	17	14	7	21
	Auto Occupancy	1.1	3	14	17	14	7	21

Land Use	Conversion		Weekday AM Peak Hour			Weekday PM Peak Hour		
			In	Out	Total	In	Out	Total
	Total Person Trips		34	168	202	163	79	247
520 – Elementary School	Auto Trip Gen		172	135	307	32	40	71
	Transit Mode Share	10%	17	14	31	3	4	7
	Auto Occupancy	1.1	17	14	31	3	4	7
	Total Person Trips		206	163	369	38	48	85
Total Development	**Auto Trip Gen**		**310**	**607**	**917**	**510**	**305**	**815**
	Transit Mode Share	**10%**	**31**	**61**	**92**	**52**	**32**	**82**
	Auto Occupancy	**1.1**	**31**	**61**	**92**	**52**	**32**	**82**
	Total Person Trips		**372**	**729**	**1,101**	**614**	**369**	**979**

Table 5 lists the trips generated by land use and travel mode. Based on limited existing transit service and active transportation facilities in the immediate study area, it was assumed that the auto mode share will be 90%, passenger mode share will be 5%, transit will be 4% and active modes will be 1%.

Table 5 Trips Generated by Mode and Land Use

Land Use	Travel Mode and Assumed Mode Share		Weekday AM Peak Hour			Weekday PM Peak Hour		
			In	Out	Total	In	Out	Total
210 – Single Detached Houses	Auto	90%	107	313	420	314	190	504
	Passenger	5%	6	17	23	17	11	28
	Transit	4%	5	14	19	14	8	22
	Active	1%	2	3	5	4	2	6
220 – Apartment	Auto	90%	12	45	57	50	28	78
	Passenger	5%	0	3	3	2	2	4
	Transit	4%	1	2	3	2	1	3
	Active	1%	0	1	1	1	0	1
230 – Residential Condo / Townhouse	Auto	90%	31	151	182	151	71	222
	Passenger	5%	2	8	10	8	4	12
	Transit	4%	1	7	8	7	3	10
	Active	1%	0	2	2	1	1	2
520 – Elementary School	Auto	90%	185	147	332	34	43	77
	Passenger	5%	10	8	18	2	2	4
	Transit	4%	8	7	15	1	2	3
	Active	1%	2	2	4	1	0	1
Total Development	**Auto**	**90%**	**335**	**656**	**991**	**549**	**332**	**881**
	Passenger	**5%**	**18**	**36**	**54**	**29**	**19**	**48**

Land Use	Travel Mode and Assumed Mode Share		Weekday AM Peak Hour			Weekday PM Peak Hour		
			In	Out	Total	In	Out	Total
	Transit	**4%**	**15**	**30**	**45**	**24**	**14**	**38**
	Active	**1%**	**4**	**8**	**12**	**7**	**3**	**10**

Of the trips generated by the development, some trips will be "pass-by" trips, which are trips made to the site by existing traffic on the roadway as it passes by the site, e.g. on the way to work or on the way home. Pass-by trips only impact the site access; there is no increase in traffic on external roadways.

Some trips generated by a development may also be captured "internally", which means that the trip origin or destination is within the same development. The purpose of an "internal capture" rate is to avoid double-counting trips generated by a development.

Table 6 outlines the pass-by and internal capture rates assumed for each land use. The pass-by and internal capture rates were obtained from the ITE *Trip Generation Manual*.

Table 6 Pass-By and Internal Capture Rates

Land Use	Pass-By		Internal Capture	
	AM	PM	AM	PM
210 – Single Detached Houses	0%	0%	0%	0%
220 – Apartment	0%	0%	0%	0%
230 – Residential Condo / Townhouse	0%	0%	0%	0%
520 – Elementary School	0%	0%	70%	70%

Table 7 summarizes the forecasted pass-by and internal capture trips by modal share for each land use.

Table 7 Pass-By and Internal Capture

Land Use	Pass-by / Internal Capture	Weekday AM Peak Hour			Weekday PM Peak Hour		
		In	Out	Total	In	Out	Total
210 – Single Detached Houses	New Auto Trips	107	313	420	314	190	504
	Pass-By Trips	0	0	0	0	0	0
	Internal Capture Trips	0	0	0	0	0	0
	Net New Auto Trips	107	313	420	314	190	504
220 – Apartment	New Auto Trips	12	45	57	50	28	78
	Pass-By Trips	0	0	0	0	0	0
	Internal Capture Trips	0	0	0	0	0	0
	Net New Auto Trips	12	45	57	50	28	78
230 – Residential Condo / Townhouse	New Auto Trips	31	151	182	151	71	222
	Pass-By Trips	0	0	0	0	0	0

Land Use	Pass-by / Internal Capture	Weekday AM Peak Hour			Weekday PM Peak Hour		
		In	Out	Total	In	Out	Total
	Internal Capture Trips	0	0	0	0	0	0
	Net New Auto Trips	31	151	182	151	71	222
520 – Elementary School	New Auto Trips	185	147	332	34	43	77
	Pass-By Trips	0	0	0	0	0	0
	Internal Capture Trips	130	103	233	24	30	54
	Net New Auto Trips	55	44	99	10	13	23
Total Development	**New Auto Trips**	**335**	**656**	**991**	**549**	**332**	**881**
	Pass-By Trips	**0**	**0**	**0**	**0**	**0**	**0**
	Internal Capture Trips	**130**	**103**	**233**	**24**	**30**	**54**
	Net New Auto Trips	**205**	**553**	**758**	**525**	**302**	**827**

Following the application of the pass-by and internal capture rates, the development is expected to generate approximately 758 and 827 net new auto trips (two-way) during the weekday AM and PM peak hours, respectively.

3.1.2 Trip Distribution

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

Table 8 summarizes the assumed trip distribution for the proposed development.

Table 8 Trip Distribution

Direction	Percentage
North	25%
East	25%
South	5%
West	5%
Internal within the South Nepean District	40%
Total	100%

3.1.3 Trip Assignment

The trips generated by the proposed development was assigned to the boundary road network using a logical pattern of primary roads (i.e. along arterials and collectors).

For assigning site traffic to the boundary road network, Realigned Greenbank Road was assumed to not be in place prior to the ultimate 2036 horizon, which is consistent with the timelines outlined in the City's 2013 Transportation Master Plan. This enables the subject transportation assessment to determine if Realigned Greenbank Road – or portions of it – will be required to support the development.

Figure 10 and **Figure 11** summarize the trip assignment to the study area road network during the weekday AM and PM peak hours, respectively.

Figure 10 Trip Assignment – 2025 Interim – Weekday AM Peak Hour

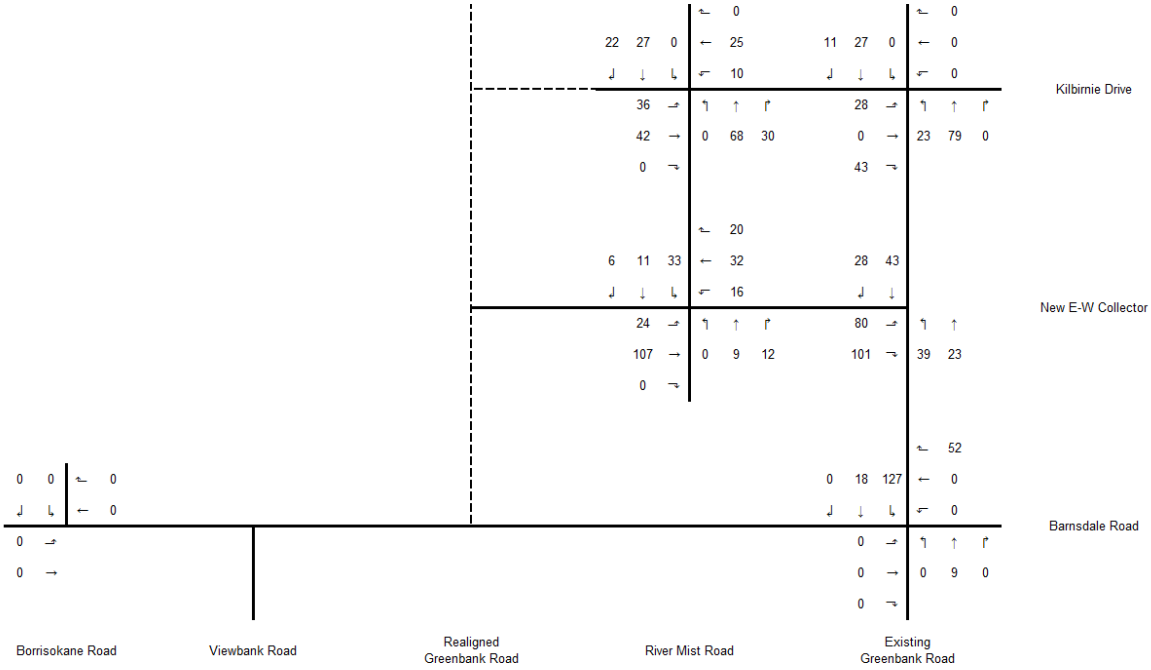
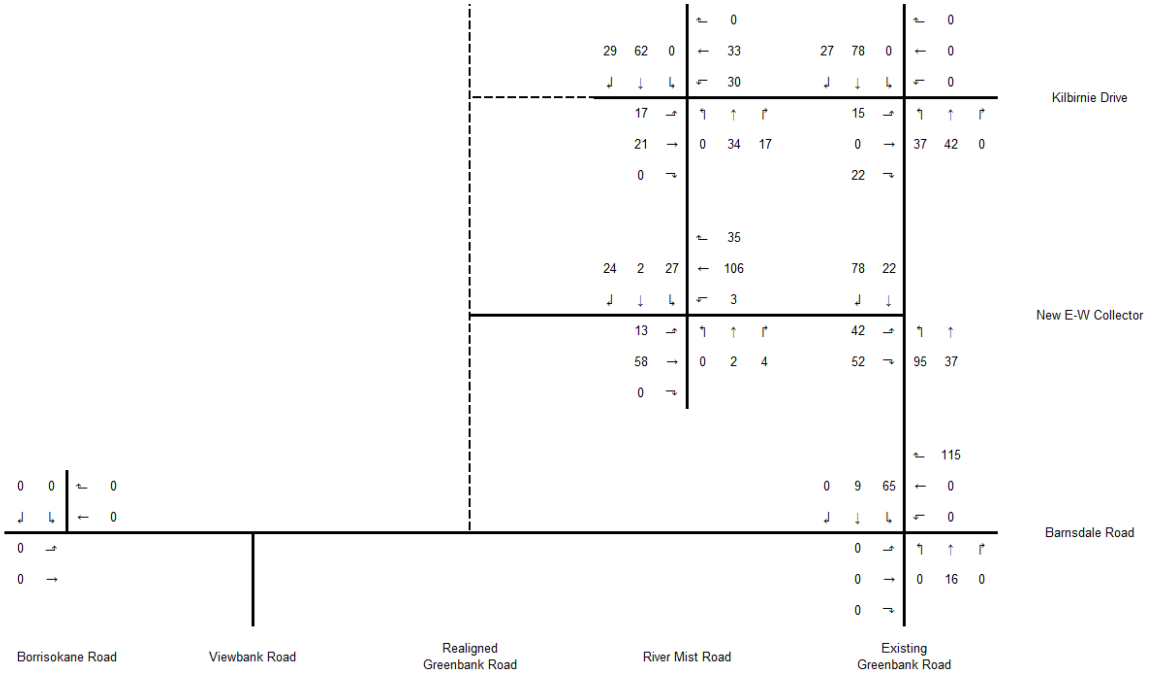


Figure 11 Trip Assignment – 2025 Interim – Weekday PM Peak Hour



3.2 BACKGROUND NETWORK TRAVEL DEMAND

3.2.1 Transportation Network Plans

The only significant road network improvement near the study area is the realignment and widening of Greenbank Road.

The Realigned Greenbank Road and Southwest Transitway Extension Planning and Environmental Assessment looked at extending Realigned Greenbank Road and the Southwest Transitway south from the formerly planned terminus at Cambrian Road. The recommended plan includes extending both the arterial road and Transitway, running almost parallel to Borrisokane Road, to Barnsdale Road approximately 300m east of Viewbank Road.

The recommended cross section for Realigned Greenbank Road includes four lanes for vehicles, two lanes down the centre median for buses and transit platforms, and sidewalks and cycle tracks along both sides of the road for a total right-of-way width of 41.5m. The right-of-way is planned to widen slightly to 42.5m to accommodate station platforms and turning lanes at the Cambrian Road and Dundonald Drive intersections.

The EA identified a preliminary location for a park and ride lot on the west side of Realigned Greenbank Road approximately 450m north of Barnsdale Road, however, the location is to be confirmed as part of the subject CDP.

In terms of project timing, the TMP identifies the Realigned Greenbank Road and Southwest Transitway Extension to occur beyond 2031.

3.2.2 Background Growth

A nominal background growth rate of 2 percent annually was applied to existing traffic volumes to account for traffic growth outside of the study area. This rate of background growth is consistent with the *Barrhaven South Urban Expansion Study Area Community Design Plan, FINAL Transportation Master Study (Stantec, February 2018).* This rate of growth is conservative given most growth within the study area will be explicitly accounted for in **Section 3.2.3**.

3.2.3 Other Developments

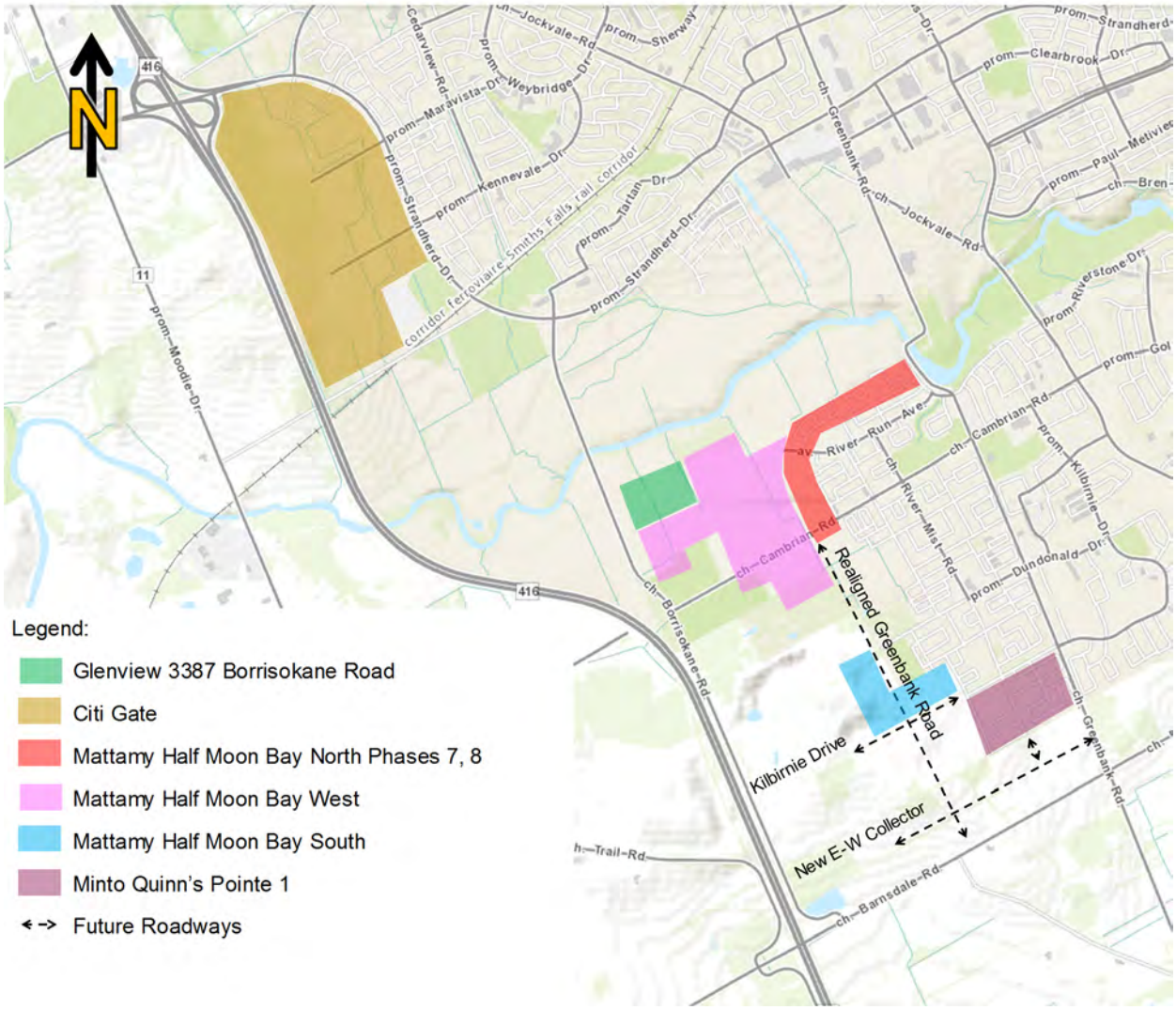
The Barrhaven South community has experienced substantial growth over the past few years and that growth is anticipated to continue well into the future. There are numerous developments scheduled to occur near the subject site, as outlined in **Table 9** and as illustrated in **Figure 12**.

Table 9 Background Developments

Development	Location	Size	Build-out
Mattamy's Half Moon Bay South Phase 4	South of Half Moon Bay South Phase 3, between Realigned Greenbank Road and Existing Greenbank Road	265 residential units	2018
Mattamy's Half Moon Bay North Phases 7, 8	North of Cambrian Road, west of Greenbank Road	471 residential units	2019
Minto's Quinn's Pointe Phase 1	West of Existing Greenbank Road, South of Half Moon Bay South	475 residential units	2019
Glenview's 3387 Borrisokane Road	North of Half Moon Bay West, east of Borrisokane Road, south of the Jock River	288 residential units	2022
Mattamy's Half Moon Bay West	North of Cambrian Road between Borrisokane Road and Realigned Greenbank Road	945 residential units	2024
Citi Gate Highway 416 Employment Lands	Between Highway 416 and Strandherd Drive, south of Fallowfield, north of the train tracks	350k sq.ft. GFA (95 ha.) business park	Interim: 2019 Ultimate: 2029
Mattamy's Half Moon Bay South	Between Dundonald Drive and Kilbirnie Drive, straddling Realigned Greenbank Road	270 residential units and 69k ft2 GFA specialty retail	Interim: 2025 Ultimate: 2031

These background developments were explicitly accounted for and added to the roadway network as background traffic volumes. By 2025, the majority of the background developments will be built and occupied with the exception of the Ultimate Phase for the Citi Gate development and the balance of the Mattamy Half Moon Bay South lands, which will be built by the 2031 horizon.

Figure 12 Background Developments



Background imagery source: geoOttawa, January 2018

3.3 DEMAND RATIONALIZATION

The proposed residential development is not anticipated to encounter any capacity restrictions that can not be resolved through roadway improvements and therefore no demand rationalization is required.

4.0 STRATEGY REPORT

4.1 DEVELOPMENT DESIGN

4.1.1 Design for Sustainable Modes

This section was addresses as part of the *Barrhaven South Urban Expansion Study Area Community Design Plan Transportation Master Study*, section 8.0 *Mobility and Circulation*.

4.1.2 Circulation and Access

Not applicable; exempted during screening and scoping.

4.1.3 New Street Networks

This section was addressed as part of the *Barrhaven South Urban Expansion Study Area Community Design Plan Transportation Master Study*, section 8.0 *Mobility and Circulation*.

4.2 PARKING

4.2.1 Parking Supply

Not applicable; exempted during screening and scoping.

4.2.2 Spillover Parking

Not applicable; exempted during screening and scoping.

4.3 BOUNDARY STREET DESIGN

4.3.1 Design Concept

The multi-modal level of service (MMLOS) was evaluated for Existing Greenbank Road, Barnsdale Road, Kilbirnie Drive, River Mist Road and the new E-W Collector to assist with developing a design concept that maximizes the achievement of the MMLOS objectives. The MMLOS targets for a "Developing Community" seemed most suitable for the study area roadways.

As development progress towards the south it is expected that the existing cross-section for Existing Greenbank Road will also be extended south. Therefore, sidewalks, boulevard and MUP was assumed to be extended to Barnsdale Road by the 2025 horizon.

The Ultimate Cycling Network from the City of Ottawa *Cycling Plan* (2013) designates Existing Greenbank Road as a spine cycling route and Barnsdale Road and River Mist Road as local cycling routes. These roads are therefore

subject to a LOS target of C and B, respectively. Kilbirnie Drive and the New E-W Collector do not have a designation and are therefore subject to a target of D.

None of the boundary roads are truck routes and therefore there is no MMLOS target for the roadways.

Table 10 presents the MMLOS conditions for roadway segments.

Barnsdale Road does not currently have sidewalks or a paved shoulder and therefore the existing LOS is F for cycling and pedestrians. It is important to recognize, however, that given its rural nature there is currently very little pedestrian and cycling activity along Barnsdale Road. The 2013 TMP lists the widening of Barnsdale Road, from Highway 416 to Prince of Whales Drive, as a conceptual project with post-2031 implementation. Once the road is widened, it will be designed with pedestrian and cycling facilities that will meet the City's MMLOS targets for that roadway. In the meantime, the ultimate cross-section for the purposes of the MMLOS in Table 10 is based on the cross-section for Barnsdale Road as established in the Realigned Greenbank Road EA.

Transit service on River Mist Road and Kilbirnie Drive currently experiences medium friction and medium incident potential due to the narrow right-of-way and vehicles parked on the roadway. Similarly, transit service on the New E-W Collector is anticipated to experience medium friction and medium incident potential due to the presence of on-street parking. These three streets, as a result, have a Transit LOS of an E which is lower then the Transit LOS target of D. The only way to resolve the issue would be to prohibit on-street parking which is not likely to be desirable.

Table 10 MMLOS Conditions – Segments

	Segment	Existing Greenbank Road (arterial, spine cycling route)		Barnsdale Road (Arterial, local cycling route)		Kilbirnie Drive (Collector, no cycling designation)		New E-W Collector (Collector, no cycling designation)		River Mist Road (Collector, no cycling designation)		Target
		Existing	Build-out	Existing	Build-out	Existing	Build-out	Existing	Build-out	Existing	Build-out	
Pedestrian	Sidewalk width (m)	2 m	**	None	2 m	2 m	**	N/A	2 m	2 m	**	**C**
	Boulevard width (m)	5 m	**	None	**	None	**	N/A	5.0 m	2 m	**	
	AADT > 3000?	Yes	**	Yes	**	Yes	**	N/A	Yes	Yes	**	
	On-Street parking	No	**	No	No	No	**	N/A	Yes	Yes	**	
	Operating speed	60 kph	**	80 kph	80 kph	50 kph	**	N/A	50 kph	50 kph	**	
	Level of Service	**C**	****	**F**	****	**C**	****	N/A	**B**	**B**	**	
Bicycle	Type of facility	Separated	**	Mixed	**	Mixed	**	N/A	Separated	Mixed	**	**C/B/D/D/B**
	Number of travel lanes	N/A	**	2	**	2	**	N/A	N/A	2	**	
	Bike lane width (m)	N/A	**	N/A	**	N/A	**	N/A	N/A	N/A	**	
	Operating speed (kph)	N/A	**	80 kph	**	50 kph	**	N/A	N/A	50 kph	**	
	Centreline (yes/no)	N/A	**	Yes	**	No	**	N/A	N/A	No	**	
	Bike lane blockage freq.	N/A	**	N/A	**	N/A	**	N/A	N/A	N/A	**	
	Level of Service	**A**	****	**F**	****	**B**	****	N/A	**A**	**B**	****	
Transit	Type of facility	Mixed	**	N/A	**	Mixed	**	N/A	Mixed	Mixed	**	**D**
	Parking/driveway friction	Low	**	N/A	**	Medium	**	N/A	Medium	Medium	**	
	Level of Service	**D**	****	**N/A**	****	**E**	****	N/A	**E**	**E**	****	
Truck	Curb lane width (m)	3.5m	**	3.5m	**	Not applicable		Not applicable		Not applicable		**No Target**
	Number of travel lanes	2	**	2	**							
	Level of Service	**C**	****	**C**	****							

Notes:
Auto LOS is not considered for segments in the MMLOS Guidelines.
"Mixed" means either cyclists or transit operate in a shared lane with general traffic, i.e. they do not have their own dedicated facilities.
The number of travel lanes is two-way, i.e. in both directions.
Bike lane blockage frequency is only applicable when cycling is in mixed traffic and in a commercial area.
The target C/B/D/D/B indicates that the target is C for Existing Greenbank Road, B for Barnsdale Road, D for Kilbirnie Drive, D for the New E-W Collector, and B for River Mist
** means no change between horizons or scenarios.

4.4 ACCESS INTERSECTIONS DESIGN

The proposed development will be accessed from municipal roads and intersections not from private driveways and accesses given that it is a plan of subdivision. **Module 0** is, therefore, not applicable and all the study area intersections will be assessed in **Module 4.9**.

4.5 TRANSPORTATION DEMAND MANAGEMENT

The proposed development is not located in a Design Priority Area (DPA) or Transit-oriented Development (TOD) zone. The proposed development consists of 548 single-family dwelling units, 467 townhomes, 100 apartment units, and two elementary schools. Given that the application for which this TIA is being prepared is a plan of subdivision that includes different land uses, most of the information required in this module is not currently available. Any future TIAs for site plan applications within this subdivision should address this module if applicable.

The City of Ottawa TDM Checklists were used to determine what TDM measures could be implemented based on the available information.

The TDM checklists are contained in **Appendix B**.

As outlined on the checklist contained in the Appendix, enhanced public transit service is recommended through an early transit services agreement between the developer and OC Transpo.

4.6 NEIGHBOURHOOD TRAFFIC MANAGEMENT

4.6.1 Adjacent Neighbourhoods

Until Greenbank Road is realigned, some development traffic is expected to use River Mist Road or Kilbirnie Drive, both of which are classified as collector roadways in the City of Ottawa 2013 TMP.

Table 11 summarizes the AM and PM peak two-way traffic volume forecasts for the collector roads at build-out of the site. Traffic volumes on these roadways are not anticipated to increase following build-out of the site.

Table 11 AM & PM Traffic Volume Forecasts for Collector Roads

	2031 Background Traffic Volume AM Peak (PM Peak)	2031 Total Traffic Volume AM Peak (PM Peak)
River Mist Road	319 veh/hr (400 veh/hr)	438 veh/hr (551 veh/hr)
Kilbirnie Drive	432 veh/hr (544 veh/hr)	470 veh/hr (593 veh/hr)

While the AM and PM peak two-way traffic volume forecasts for both River Mist Road and Kilbirnie Drive are expected to exceed the peak hour two-way traffic volume threshold for collector roads (i.e. 300 veh/hr), the forecasts indicate that future growth and background developments will contribute to this exceedance. The addition of the proposed development generated traffic is, therefore, not expected to change the existing classification of River Mist Road or Kilbirnie Drive and no Neighbourhood Traffic Management (NTM) plan will be required. It is worth noting that when Greenbank is ultimately built and extended, it will help to alleviate some of the current and future traffic on River Mist Road and Kilbirnie Drive.

4.7 TRANSIT

4.7.1 Route Capacity

Until Greenbank Road is realigned, the transit mode share is anticipated to be quite low (5%) and the forecasted transit trips generation for the proposed development is 45 and 38 total transit trips during the AM or PM peak hour. In the future, transit headways are anticipated to remain at 15 minutes during the morning and afternoon peak hours (at least), or four buses every hour. Articulated buses and double-decker buses have seated capacities of 60 and 80 people, respectively, and therefore the hourly transit capacity will be 240 - 320 people per hour. The proposed development is therefore anticipated to occupy between 12% to 19% of transit capacity in the future.

4.7.2 Transit Priority

Transit priority measures were not considered since transit routes do not currently operate on boundary streets, and once Realigned Greenbank Road is constructed, transit measures are already planned for Realigned Greenbank Road which is outside of the scope of this assessment.

4.8 REVIEW OF NETWORK CONCEPT

This section was addressed as part of the *Barrhaven South Urban Expansion Study Area Community Design Plan Transportation Master Study*, section 7.0 *Transportation Improvements and Design Elements*.

4.9 INTERSECTION DESIGN

4.9.1 Intersection Control

As part of the *Barrhaven South Urban Expansion Study Area Community Design Plan Transportation Master Study*, intersection improvements and traffic control upgrades were recommended at three of the subject TIA's study area intersections including: Existing Greenbank Road at Barnsdale Road, Existing Greenbank Road at New E-W Collector, and Barnsdale Road at Borrisokane Road.

Table 12 summarizes the intersection control adopted for each of the study area intersections during each horizon. The intersections controls in Table 12 reflect the default controls assumed as the basis for analysis in the subject TIA. Any intersection improvements triggered through the intersection level of service analysis will be highlighted and adopted accordingly.

Table 12 Initial Intersection Controls at the Study Area Intersections

Intersection	Horizon	Initial Intersection Control	Reference
Barnsdale Road at Borrisokane Road	2018	Minor Stop Control	*Barrhaven South Urban Expansion Study Area Community Design Plan Transportation Master Study*
	2025		
	2031		
Existing Greenbank at Barnsdale Road	2018	All-Way Stop-Controlled	*Barrhaven South Urban Expansion Study Area Community Design Plan Transportation Master Study*
	2025 FBG		
	2025 Total Future	Traffic Signals	
	2031		
Existing Greenbank Road at New E-W Collector	2025	Minor Stop Control	*Barrhaven South Urban Expansion Study Area Community Design Plan Transportation Master Study*
	2031		
Existing Greenbank Road at Kilbirnie Drive	2018	Stop-Controlled along Kilbirnie Drive	Existing Intersection Control
River Mist Road at Kilbirnie Drive	2018	All-Way Stop-Controlled	Existing Intersection Control
River Mist Road at New E-W Collector	2018	All-Way Stop-Controlled	- Intersection between collectors - High expected desire for pedestrian crossings through the New E-W Collector - All-way stop-control recommended

The existing intersection control will be maintained as the default control for the Existing Greenbank Road at Kilbirnie Drive and River Mist Road at Kilbirnie Drive intersections.

The River Mist Road at the New E-W Collector intersection does not currently exist and was not specifically assessed within the *Barrhaven South Urban Expansion Study Area Community Design Plan Transportation Master Study*.

Given that the intersection is between two collectors roads and that there is desire for pedestrians to cross the New E-W Collector from the residential areas from the north side to the school or park areas south of the Collector, an all-way stop control is recommended as the default control for this intersection. Any required improvements or intersection control upgrades triggered through the analysis for any horizon will be highlighted and adopted accordingly.

4.9.2 Intersection Design

An assessment of the study area intersections was undertaken to determine the operational characteristics of the study area intersections under the different horizons identified in the Screening and Scoping report. Intersection operational analysis was facilitated by Synchro 9.0™ software package and the MMLOS analysis was completed for all modes and compared against the City of Ottawa's MMLOS targets.

4.9.2.1 2018 Existing Conditions

Figure 5 and **Figure 6** illustrate 2018 existing AM and PM peak hour traffic volumes at the study area intersections.

All study area intersections are currently operating satisfactorily.

The MMLOS assessment is only applied to signalized intersections. As there are no signalized intersections under the 2018 existing conditions, intersection MMLOS does not apply.

Table 13 summarizes the results of the Synchro analysis for 2018 existing intersection operations.

Figure 2 illustrates the required intersection control and lane configuration to accommodate the 2018 existing conditions.

Appendix C contains detailed intersection performance worksheets.

Table 13 2018 Existing Intersection Operations (Synchro Results)

Scenario	Intersection Control	Approach / Movement		LOS	V/C	Delay (s)	Queue 95th (veh)
Barnsdale Road at Borrisokane Road	Minor Stop Control	EB	Left / Through	A (A)	0.02 (0.02)	1.4 (1.3)	0.1 (0)
		WB	Through / Right	A (A)	0 (0)	0 (0)	0 (0)
		SB	Left / Right	A (B)	0.06 (0.09)	9.9 (10.9)	0.2 (0.3)
		Overall Intersection		**A (A)**	**-**	**1.9 (2.2)**	**-**
Existing Greenbank at Barnsdale Road	All-Way Stop Control	EB	Left / Through / Right	A (A)	0.13 (0.12)	8.9 (9.7)	0.4 (0.7)
		WB	Left / Through / Right	A (B)	0.19 (0.46)	9.0 (11.7)	0.7 (2.5
		NB	Left / Through / Right	A (A)	0.12 (0.16)	8.6 (9.6)	0.4 (0.6)
		SB	Left / Through / Right	B (B)	0.41 (0.33)	10.9 (10.9)	2.0 (1.4)
		Overall Intersection		**A (B)**	**-**	**9.9 (10.9)**	**-**
Existing Greenbank Road at Kilbirnie Drive	Minor Stop Control	EB	Left	C (C)	0.20 (0.20)	16.3 (22.7)	0.7 (0.7)
			Through / Right	B (B)	0.09 (0.04)	10.0 (10.0)	0.3 (0.1)
		WB	Left	B (C)	0.17 (0.09)	14.8 (19.3)	0.6 (0.3)
			Through / Right	A (B)	0.15 (0.10)	9.9 (10.6)	0.5 (0.3)
		NB	Left/ Through	A (A)	0.02 (0.06)	7.7 (7.7)	0.1(0.2)
			Right	A (A)	0 (0)	0 (0)	0 (0)
		SB	Left	A (A)	0.02 (0.07)	7.5 (7.9)	0.1 (0.2)
			Through	A (A)	0 (0)	0 (0)	0 (0)
			Right	A (A)	0 (0)	0 (0)	0 (0)
		Overall Intersection		**A (A)**	**-**	**6.3 (4.6)**	**-**
River Mist Road at Kilbirnie Drive	All-Way Stop Control	EB	Left / Through / Right	A (A)	0.03 (0.01)	7.3 (7.2)	0.1 (0)
		WB	Left / Through / Right	A (A)	0.07 (0.09)	7.3 (7.2)	0.2 (0.3)
		NB	Left / Through / Right	A (A)	0.05 (0.02)	7.0 (7.0)	0.1 (0.1)
		SB	Left / Through / Right	A (A)	0.06 (0.06)	7.6 (7.5)	0.2 (0.2)
		Overall Intersection		**A (A)**	**-**	**7.3 (7.3)**	**-**

Notes:
1. Table format: AM (PM)
2. v/c – represents the anticipated volume divided by the predicted capacity

4.9.2.2 2025 Future Background Conditions

Figure 13 and **Figure 14** illustrate 2025 future background AM and PM peak hour traffic volumes at the study area intersections.

Table 14 summarizes the results of the Synchro analysis for 2025 future background intersection operations and **Appendix C** contains detailed intersection performance worksheets.

It was assumed that the existing gore area at the intersection of Existing Greenbank Road at Kilbirnie Drive will be replaced by a northbound left-turning lane that would mirror the southbound left-turning lane currently provided at the intersection. This is consistent with the recommendations contained in the Transportation Impact Assessment prepared for the initial phase of Minto's Quinn's Pointe in 2014 (i.e. *Minto Barrhaven South TIS Update Addendum #2 – 3872 Greenbank Road, Stantec, October 24, 2014).*

All study area intersections are anticipated to operate acceptably.

The MMLOS assessment is only applied to signalized intersections. As there are no signalized intersections under the 2025 future background conditions, intersection MMLOS does not apply.

Figure 15 illustrates the required intersection control and lane configuration to accommodate the 2025 future background conditions.

Figure 13 2025 Future Background Traffic Volumes - AM Peak Hour

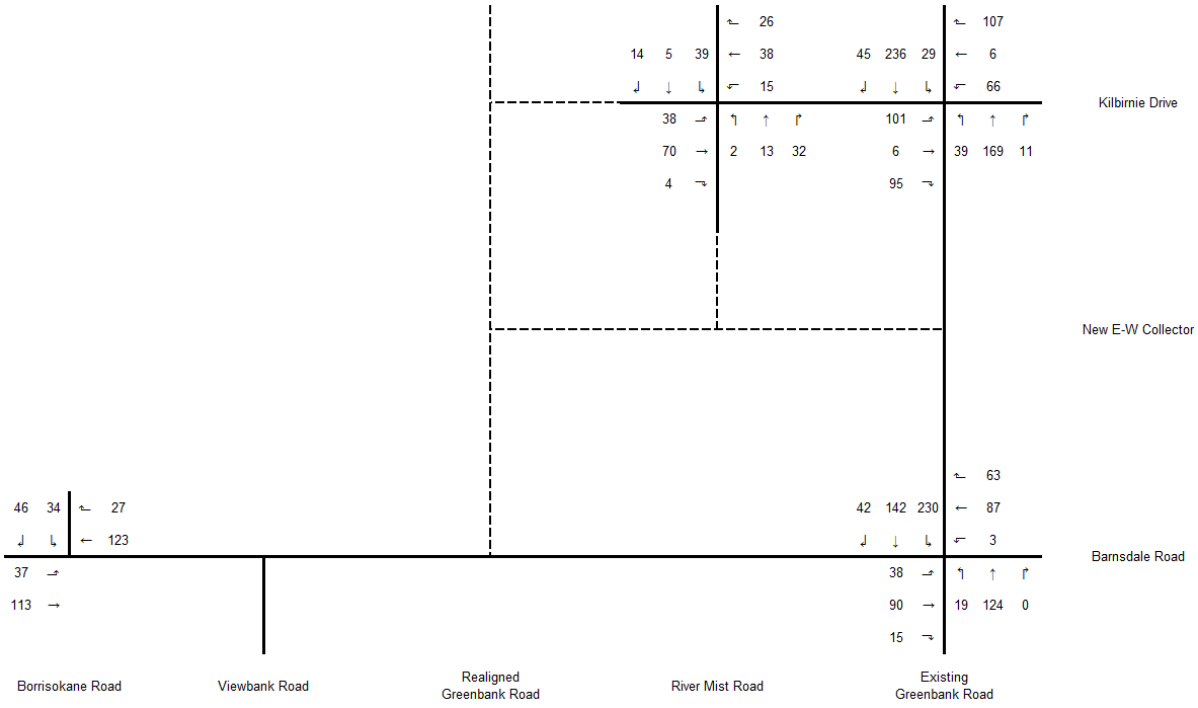


Figure 14 2025 Future Background Traffic Volumes - PM Peak Hour

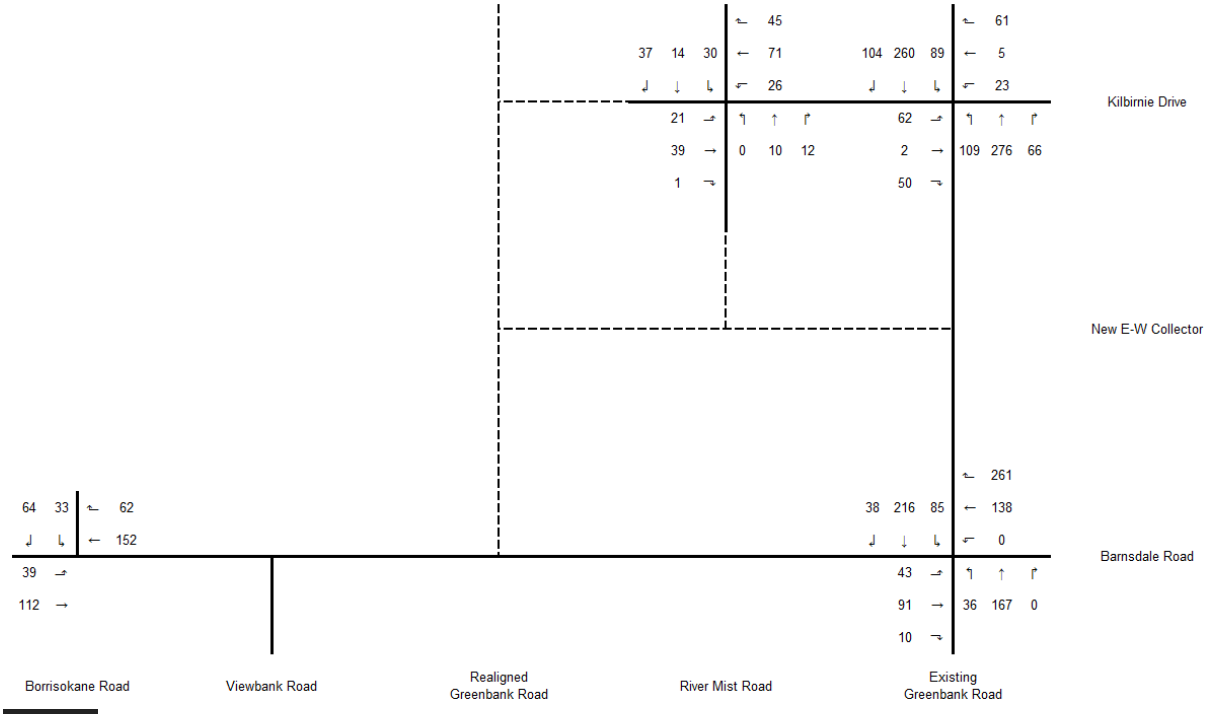
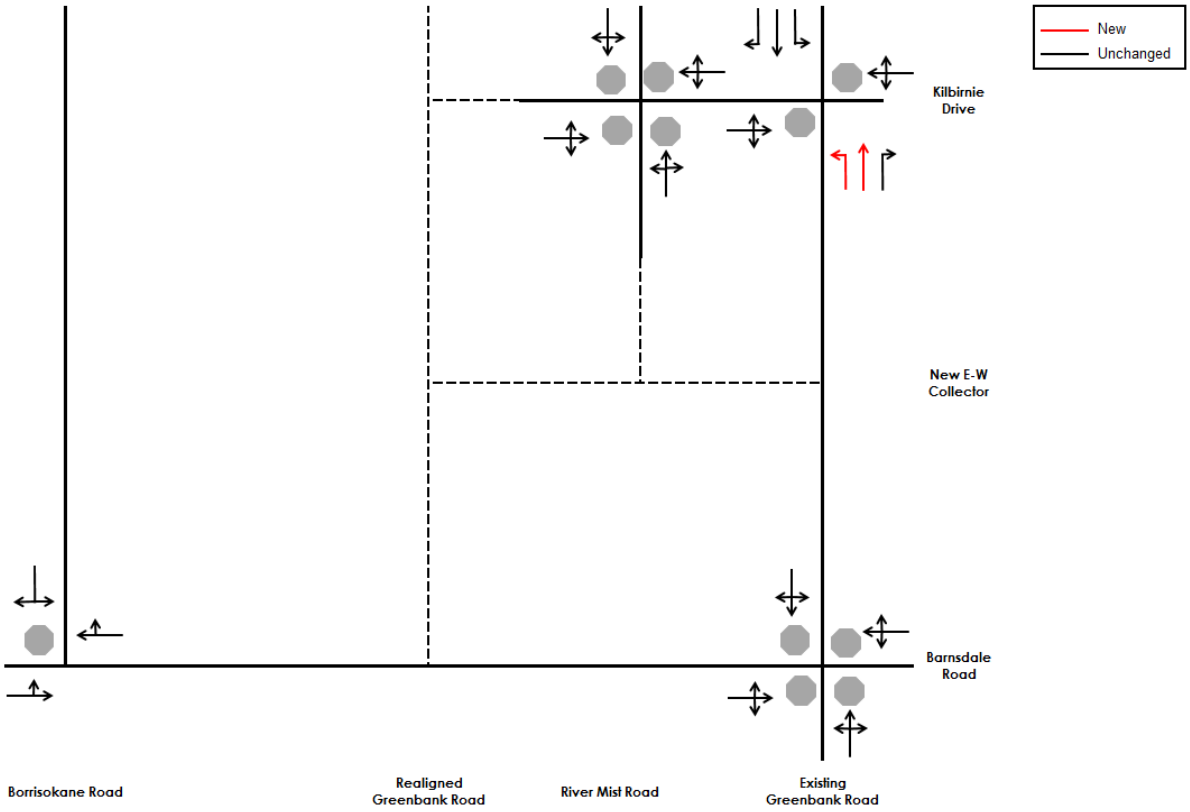


Table 14 2025 Future Background Operations (Synchro Results)

Scenario	Intersection Control	Approach / Movement		LOS	V/C	Delay (s)	Queue 95th (veh)
Barnsdale Road at Borrisokane Road	Minor Stop Control	EB	Left / Through	A (A)	0.03 (0.03)	7.6 (7.8)	0.1 (0.1)
		WB	Through / Right	A (A)	0 (0)	0 (0)	0 (0)
		SB	Left / Right	B (B)	0.11 (0.13)	10.3 (10.6)	0.4 (0.5)
		Overall Intersection		**A (A)**	**-**	**2.9 (2.9)**	**-**
Existing Greenbank at Barnsdale Road	All-Way Stop Control	EB	Left / Through / Right	B (B)	0.23 (0.26)	10.4 (11.7)	0.9 (1.0)
		WB	Left / Through / Right	B (C)	0.23 (0.61)	10.1 (17.0)	0.9 (4.2)
		NB	Left / Through / Right	A (B)	0.22 (0.36)	9.9 (12.8)	0.8 (1.6)
		SB	Left / Through / Right	B (C)	0.58 (0.56)	14.9 (16.4)	3.8 (3.5)
		Overall Intersection		**B (C)**	**-**	**12.4 (15.3)**	**-**
Existing Greenbank Road at Kilbirnie Drive	Minor Stop Control	EB	Left	C (D)	0.30 (0.34)	20.2 (34.4)	1.2 (1.4)
			Through / Right	B (B)	0.14 (0.08)	10.6 (10.6)	0.5 (0.2)
		WB	Left	C (C)	0.19 (0.12)	18.1 (26.5)	0.7 (0.4)
			Through / Right	B (B)	0.14 (0.10)	10.2 (11.3)	0.5 (0.3)
		NB	Left	A (A)	0.10 (0.08)	7.8 (8.0)	0.1 (0.3)
			Through	A (A)	0 (0)	0 (0)	0 (0)
			Right	A (A)	0 (0)	0 (0)	0 (0)
		SB	Left	A (A)	0.02 (0.07)	7.6 (8.0)	0.1 (0.2)
			Through	A (A)	0 (0)	0 (0)	0 (0)
			Right	A (A)	0 (0)	0 (0)	0 (0)
		Overall Intersection		**A (A)**	**-**	**6.6 (5.1)**	**-**
River Mist Road at Kilbirnie Drive	All-Way Stop Control	EB	Left / Through / Right	A (A)	0.13 (0.07)	7.9 (7.7)	0.5 (0.2)
		WB	Left / Through / Right	A (A)	0.09 (0.16)	7.5 (7.9)	0.3 (0.6)
		NB	Left / Through / Right	A (A)	0.05 (0.03)	7.2 (7.4)	0.2 (0.1)
		SB	Left / Through / Right	A (A)	0.07 (0.10)	7.7 (7.6)	0.2 (0.3)
		Overall Intersection		**A (A)**	**-**	**7.6 (7.7)**	**-**

Notes:
1. Table format: AM (PM)
2. v/c – represents the anticipated volume divided by the predicted capacity

Figure 15 2025 Future Background Required Intersection Control and Lane Configuration



4.9.2.3 2025 Total Future Conditions

Figure 16 and **Figure 17** illustrate 2025 total future AM and PM peak hour traffic volumes at the study area intersections.

Table 15 summarizes the results of the Synchro analysis for 2025 total future intersection operations.

Appendix C contains detailed intersection performance worksheets.

By the 2025 total future horizon the New E-W Collector will be in place including its intersections with Existing Greenbank Road and River Mist Road which are now reflected in the intersection operational analysis.

Consistent with the recommendations of the *Barrhaven South Urban Expansion Study Area Community Design Plan Transportation Master Study*, and as shown in **Table 12**, the Existing Greenbank Road at Barnsdale Road intersection will require traffic signals by the 2025 total future horizon including auxiliary left-turning lanes along each approach to the intersection.

Operating under a two-way stop control, the intersection of Existing Greenbank Road at Kilbirnie Drive is anticipated to have significant delays experienced by the eastbound left-turning movement during the PM peak hour. A multi-way stop control warrant analysis was undertaken to assess if an all-way stop control is warranted. Eight-hour traffic volumes collected at this intersection in 2017 by the City of Ottawa were used along with the 2025 total future peak hour projected volumes (i.e. AM and PM peak hours) to obtain the 8-hour 2025 total future traffic volumes required for the warrant. While the warrant also considers the 8-hour pedestrian volumes along the minor roadway, there was no means to obtain these volumes for the 2025 total future horizon. Despite that, the analysis still showed that the intersection meets the volume criterion of the warrant analysis and therefore meets the warrant for the implementation of an all-way stop control. The intersection is anticipated to operate acceptably under an all-way stop control.

All other study area intersections are anticipated to operate acceptably.

Appendix D contains the multi-way stop control warrant analysis provided by the City of Ottawa.

Figure 18 illustrates the required intersection control and lane configuration to accommodate the 2025 total future conditions.

Figure 16 2025 Total Future Traffic Volumes - AM Peak Hour

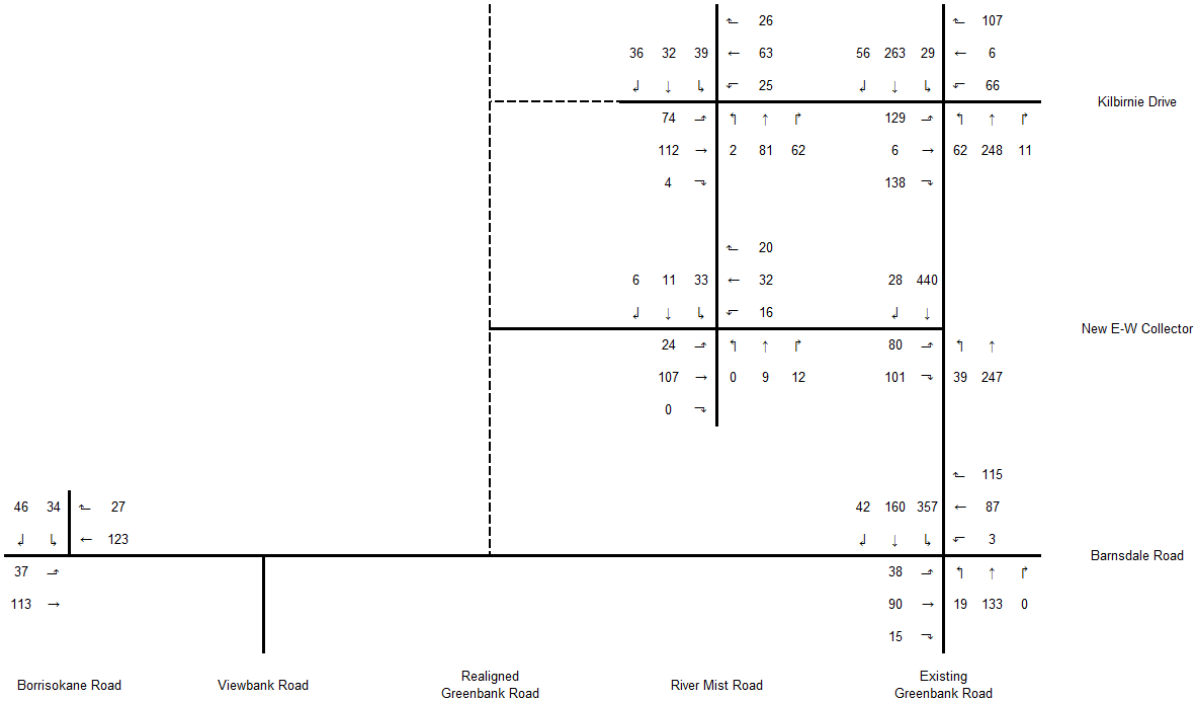


Figure 17 2025 Total Future Traffic Volumes - PM Peak Hour

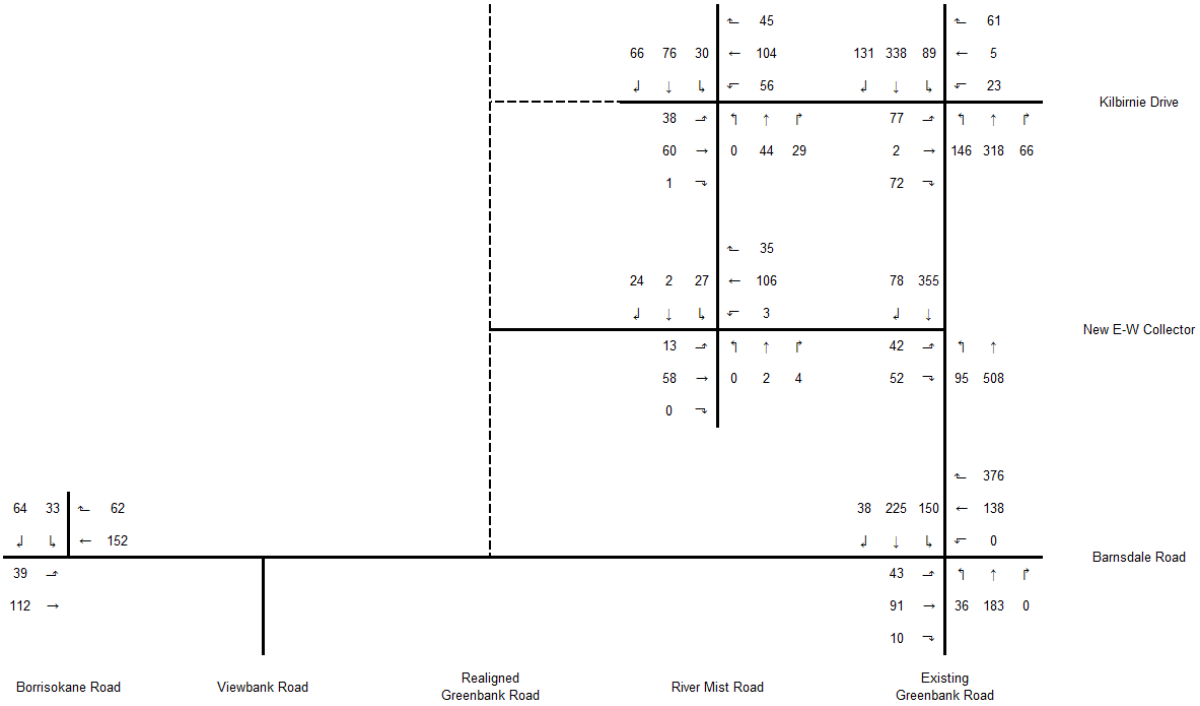


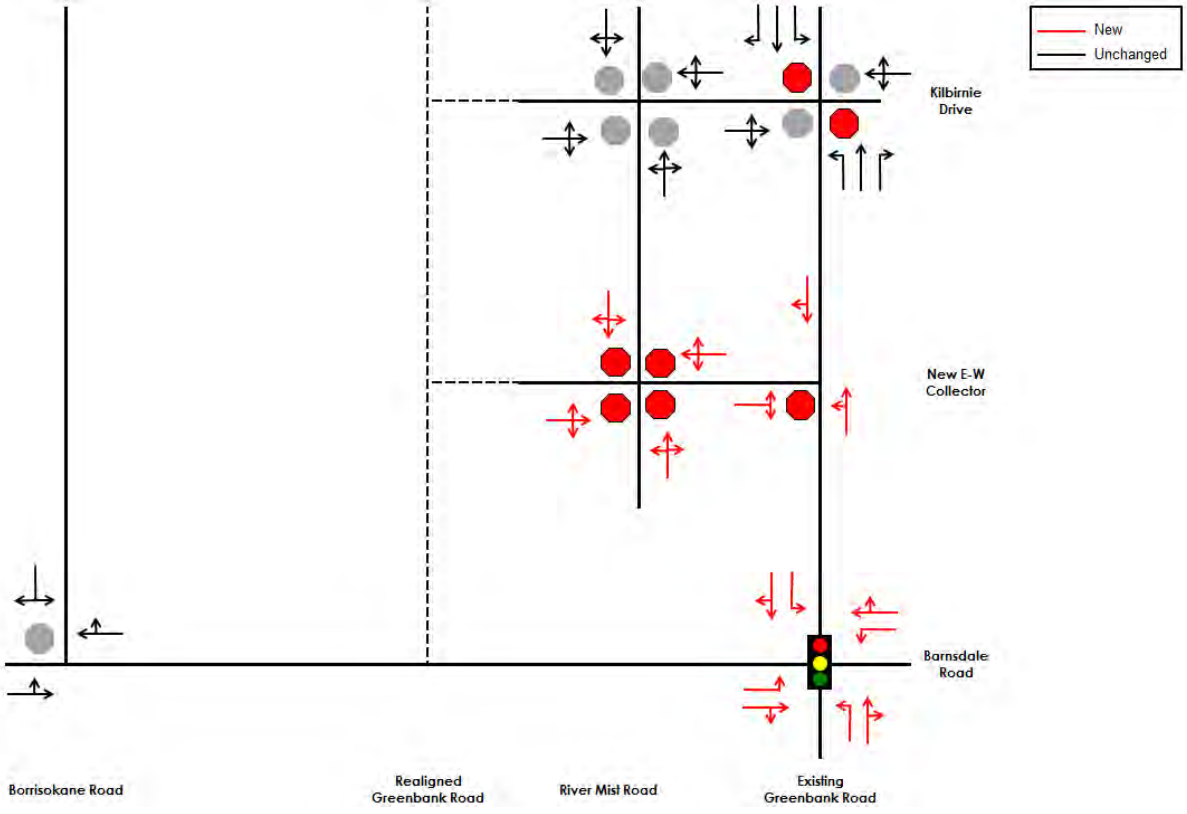
Table 15 2025 Total Future Operations (Synchro Results)

Scenario	Intersection Control	Approach / Movement		LOS	V/C	Delay (s)	Queue 95th (veh)
Barnsdale Road at Borrisokane Road	Minor Stop Control	EB	Left / Through	A (A)	0.03 (0.03)	7.6 (7.8)	0.1 (0.1)
		WB	Through / Right	A (A)	0 (0)	0 (0)	0 (0)
		SB	Left / Right	B (B)	0.11 (0.13)	10.3 (10.6)	0.4 (0.5)
		Overall Intersection		**A (A)**	**-**	**2.9 (2.9)**	**-**
Existing Greenbank at Barnsdale Road	Traffic Signals	EB	Left	A (A)	0.28 (0.32)	34.6 (20.0)	13.6* (9.5)*
			Through / Right	A (A)	0.37 (0.19)	31.0 (12.2)	26.7* (13.7)*
		WB	Left	A (A)	0.02 (0)	27.3 (0)	2.5* (0)*
			Through / Right	B (C)	0.65 (0.79)	30.3 (16.6)	39.2* (46.1)*
		NB	Left	A (A)	0.04 (0.07)	15.7 (10.4)	6.6* (7.3)*
			Through / Right	A (A)	0.16 (0.22)	15.5 (10.6)	27.8* (25.8)*
		SB	Left	A (A)	0.45 (0.28)	7.3 (12.1)	37.7* (24.1)*
			Through / Right	A (A)	0.18 (0.32)	4.6 (11.1)	19.1* (36.0)*
		Overall Intersection		**B (C)**	**0.65 (0.79)**	**15.6 (13.7)**	**-**
Existing Greenbank Road at Kilbirnie Drive	Minor Stop Control	EB	Left	C (F)	0.50 (0.60)	32.1 (67.6)	2.6 (3.0)
			Through / Right	B (B)	0.20 (0.12)	11.2 (11.4)	0.7 (0.4)
		WB	Left	C (E)	0.28 (0.18)	25.7 (39.2)	1.1 (0.6)
			Through / Right	B (B)	0.16 (0.12)	10.9 (12.2)	0.6 (0.4)
		NB	Left	A (A)	0.05 (0.12)	7.9 (8.4)	0.2 (0.4)
			Through	A (A)	0 (0)	0 (0)	0 (0)
			Right	A (A)	0 (0)	0 (0)	0 (0)
		SB	Left	A (A)	0.02 (0.07)	7.8 (8.2)	0.1 (0.2)
			Through	A (A)	0 (0)	0 (0)	0 (0)
			Right	A (A)	0 (0)	0 (0)	0 (0)
		Overall Intersection		**A (A)**	**-**	**8.4 (7.3)**	**-**
	All-Way Stop Control	**Improvement: Implement an All-Way Stop Control**					
		EB	Left	C (B)	0.28 (0.18)	13.7 (13.2)	1.1 (0.7)
			Through / Right	B (B)	0.27 (0.15)	11.9 (11.4)	1.1 (0.5)
		WB	Left	B (B)	0.15 (0.06)	12.3 (12.0)	0.5 (0.2)
			Through / Right	B (B)	0.22 (0.14)	11.7 (11.6)	0.8 (0.5)
		NB	Left	B (B)	0.13 (0.30)	11.7 (13.4)	0.5 (1.3)
			Through	B (C)	0.50 (0.61)	17.1 (20.2)	2.8 (4.1)
			Right	A (A)	0.02 (0.12)	9.4 (9.8)	0.1 (0.4)
		SB	Left	B (B)	0.06 (0.18)	11.0 (11.9)	0.2 (0.7)
			Through	C (C)	0.5. (0.65)	17.7 (21.7)	3.0 (4.6)
			Right	B (B)	0.10 (0.23)	10.0 (10.8)	0.3 (0.9)
		Overall Intersection		**B (C)**	**-**	**14.5 (16.4)**	**-**
River Mist Road at Kilbirnie Drive	All-Way Stop Control	EB	Left / Through / Right	A (A)	0.25 (0.13)	9.3 (8.6)	1.0 (0.5)
		WB	Left / Through / Right	A (B)	0.15 (0.26)	8.5 (9.2)	0.5 (1.0)
		NB	Left / Through / Right	A (A)	0.18 (0.09)	8.6 (8.1)	0.7 (0.3)
		SB	Left / Through / Right	A (A)	0.14 (0.22)	8.5 (8.8)	0.5 (0.8)
		Overall Intersection		**A (A)**	**-**	**8.8 (8.8)**	**-**
Existing Greenbank Road at New E-W Collector	Minor Stop Control	EB	Left	C (C)	0.23 (0.20)	18.4 (26.5)	0.9 (0.7)
			Right	B (C)	0.17 (0.08)	12.1 (11.0)	0.6 (0.3)
		NB	Left / Through	A (A)	0.04 (0.08)	8.4 (8.5)	0.1 (0.3)
		SB	Through / Right	A (A)	0 (0)	0 (0)	0 (0)
		Overall Intersection		**A (A)**	**-**	**3.2 (2.2)**	**-**

Scenario	Intersection Control	Approach / Movement		LOS	V/C	Delay (s)	Queue 95th (veh)
River Mist Road at New E-W Collector	All-Way Stop Control	EB	Left / Through / Right	A (A)	0.15 (0.08)	8.0 (7.6)	0.5 (0.3)
		WB	Left / Through / Right	A (A)	0.08 (0.16)	7.4 (7.7)	0.2 (0.6)
		NB	Left / Through / Right	A (A)	0.02 (0.01)	7.2 (7.1)	0.1 (0)
		SB	Left / Through / Right	A (A)	0.06 (0.06)	7.7 (7.5)	0.2 (0.2)
		Overall Intersection		**A (A)**	**-**	**7.7 (7.6)**	**-**

Notes:
1. Table format: AM (PM)
2. v/c – represents the anticipated volume divided by the predicted capacity
3. ***** - Queue lengths for these movements are in meters

Figure 18 2025 Total Future Required Intersection Control and Lane Configuration



A signalized intersection MMLOS assessment was undertaken for the Existing Greenbank Road at Barnsdale Road intersection given that it is expected to operate as a signalized intersection. The anticipated operations during the AM and PM peak hours were both considered in the assessment and the MMLOS targets for a "Developing Community" were deemed most suitable for the study area roadways.

MMLOS - Existing Greenbank Road at Barnsdale Road Intersection:

It is expected that the existing cross section for Existing Greenbank Road – featuring sidewalks, boulevard and MUP on the west side - will be extended south to Barnsdale Road by the 2025 total future horizon. This general cross-section configuration has been carried for in subsequent future horizons.

The Ultimate Cycling Network from the City of Ottawa *Cycling Plan* (2013) designates Existing Greenbank Road as a spine cycling route and Barnsdale Road as a local cycling route. These roads are therefore subject to a LOS target of C and B, respectively, and the higher of the two targets (i.e. LOS = B) was selected as the target for the intersection.

No transit service is currently provided along Existing Greenbank Road south of Kilbirnie Drive or along Barnsdale Road, and the *Barrhaven South Urban Expansion Study Area Community Design Plan Transportation Master Study* does not propose any new transit services along these two road segments. The Transit LOS (TLOS) assessment, therefore, did not consider this Existing Greenbank Road at Barnsdale Road intersection.

None of these two roads are truck routes and therefore there is no MMLOS target for the them.

Table 16 presents the MMLOS conditions for the signalized intersection of Existing Greenbank Road at Barnsdale Road where it is shown that all modes of transportation meet or exceed the target level of service.

Table 16 2025 Total Future MMLOS - Greenbank Road at Barnsdale Road

Segment		2025 Total Future Traffic				Target
		EB	WB	NB	SB	
PLOS	Lanes crossed	3	3	3	3	C
	Median (yes/no)	No	No	No	No	
	Island refuge >=2.4m (yes/no)	No	No	No	No	
	Left turn phasing	Permissive	Permissive	Permissive	Protected/ Permissive	
	Right turn conflict	Yes	Yes	Yes	Yes	
	RTOR (yes/no)	Yes	Yes	Yes	Yes	
	Leading ped interval (yes/no)	No	No	No	No	
	Right turn corner radius (m)	5-10	5-10	5-10	5-10	
	Crosswalk treatment	Standard	Standard	Standard	Standard	
	Cycle length (s)	90	90	90	90	
	Effective walk time (s)	18	18	18	18	
	PETSI Points	71	71	71	71	
	PETSI Points LOS	C	C	C	C	
	Average Pedestrian Delay (s)	28.8	28.8	28.8	28.8	
	Ped Delay LOS	C	C	C	C	
	Level of Service	C	C	C	C	
	Level of Service	**C**				
BLOS	Type of bike lane	Mixed	Mixed	Separated	Separated	B
	Left-turn - lanes crossed	1	1	NA (Two Stage)	NA (Two Stage)	
	Left-turn - vehicle operating speed (km/hr)	25	25	25	25	
	Right-turn - number of turn lanes	0	0	NA	NA	
	Right-turn - turn lane length (m)	NA (Shared)	NA (Shared)	NA (Shared)	NA (Shared)	
	Right-turn - turning speed (km/hr)	15	15	15	15	
	Right-turn - location of bike lane	NA	NA	MUP	MUP	
	Level of Service	B	B	A	A	
	Level of Service	**B**				
TLOS	Intersection Average Delay (s)	NA				D
	Level of Service	NA				
	Level of Service	NA				
TkLOS	Effective corner radius (m)	<10	<10	<10	<10	No Target
	Number of receiving lanes	1	1	1	1	
	Level of Service	F	F	F	F	
	Level of Service	**F**				
VLOS	Maximum Volume-to-capacity (v/c)	0.37	0.79	0.22	0.45	D
	Level of Service	A	C	A	A	
	Level of Service	**C**				

4.9.2.4 2031 Future Background Conditions

Figure 19 and **Figure 20** illustrate 2031 future background AM and PM peak hour traffic volumes at the study area intersections.

Table 17 summarizes the results of the Synchro analysis for 2031 future background intersection operations and **Appendix C** contains detailed intersection performance worksheets.

Operating under an all-way stop control, the intersection of Existing Greenbank Road at Kilbirnie Drive is anticipated to experience excessive delays by the southbound through movement during the PM peak hour. A traffic signal warrant analysis was undertaken for this intersection to determine if a traffic control signal is warranted. Eight-hour volumes collected at this intersection in 2017 by the City of Ottawa were used along with the 2031 future background peak hour projected volumes (i.e. AM and PM peak hours) to obtain the 8-hour 2031 future background traffic volumes. Based on the forecasted 2031 future background traffic volumes, this intersection meets justification 1, 3, and 4 (i.e. Minimum Vehicular Volume, Combination, 4-Hr volume, respectively) of the warrant analysis and therefore meets the warrants for the implementation of traffic signals. Signal timing parameters, such as cycle length and minimum green times, were assumed based on the parameters outlined in the City of Ottawa Traffic Impact Assessment (TIA) Guidelines and the Ontario Traffic Manual (OTM) book 12 guidelines for amber and all-red clearance were adopted. It was assumed that auxiliary left-turning lanes will be constructed along the eastbound and westbound approaches when the intersection becomes signalized. With the implementation of traffic signals the intersection is anticipated to operate acceptably.

Operating under a two-way stop control along the minor approach, the intersection of Existing Greenbank Road at the New E-W Collector is also anticipated to operate with excessive delays experienced by the eastbound left-turning movement during the PM peak hours. A traffic signal warrant analysis was undertaken for this intersection to determine if a traffic signal control is warranted. 2031 future background peak hour projected volumes (i.e. AM and PM peak hours) at this intersection were used along with the 8-hour projected volumes at the Existing Greenbank Road at Kilbirnie Drive intersection under the 2031 future background horizon to obtain the 8-hour 2031 future background traffic volumes at the Existing Greenbank Road at the New E-W Collector. Based on the forecasted 2031 future background traffic volumes, this intersection meets justification 4 (4-Hr volume) of the warrant analysis and therefore meets the warrants for the implementation of traffic signals. Signal timing parameters, such as cycle length and minimum green times, were assumed based on the parameters outlined in the City of Ottawa Traffic Impact Assessment (TIA) Guidelines and the Ontario Traffic Manual (OTM) book 12 guidelines for amber and all-red clearance were adopted. It was assumed that the eastbound approach will consist of exclusive left-turning and right-turning lanes and that an auxiliary northbound left-turning lane will be added. The intersection is anticipated to operate acceptably once signalized.

Appendix D contains the traffic signal warrant analysis.

Figure 21 illustrates the required intersection control and lane configuration to accommodate the 2031 future background conditions.

Figure 19 2031 Future Background Traffic Volumes - AM Peak Hour

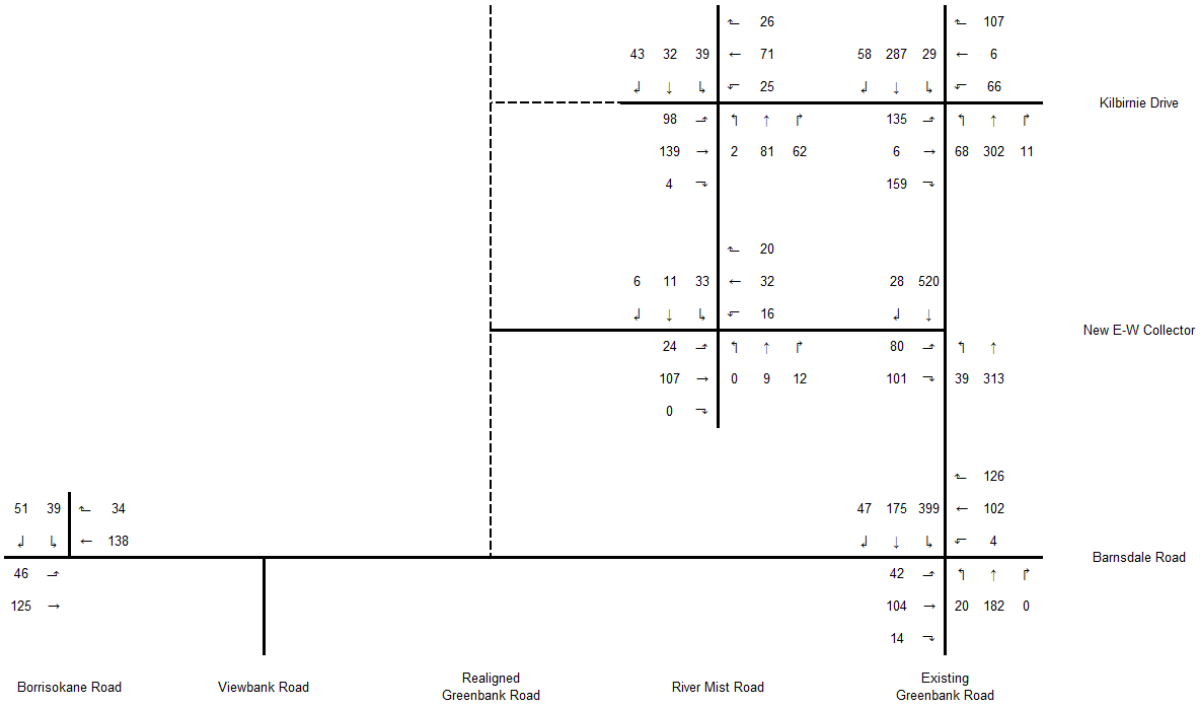


Figure 20 2031 Future Background Traffic Volumes - PM Peak Hour

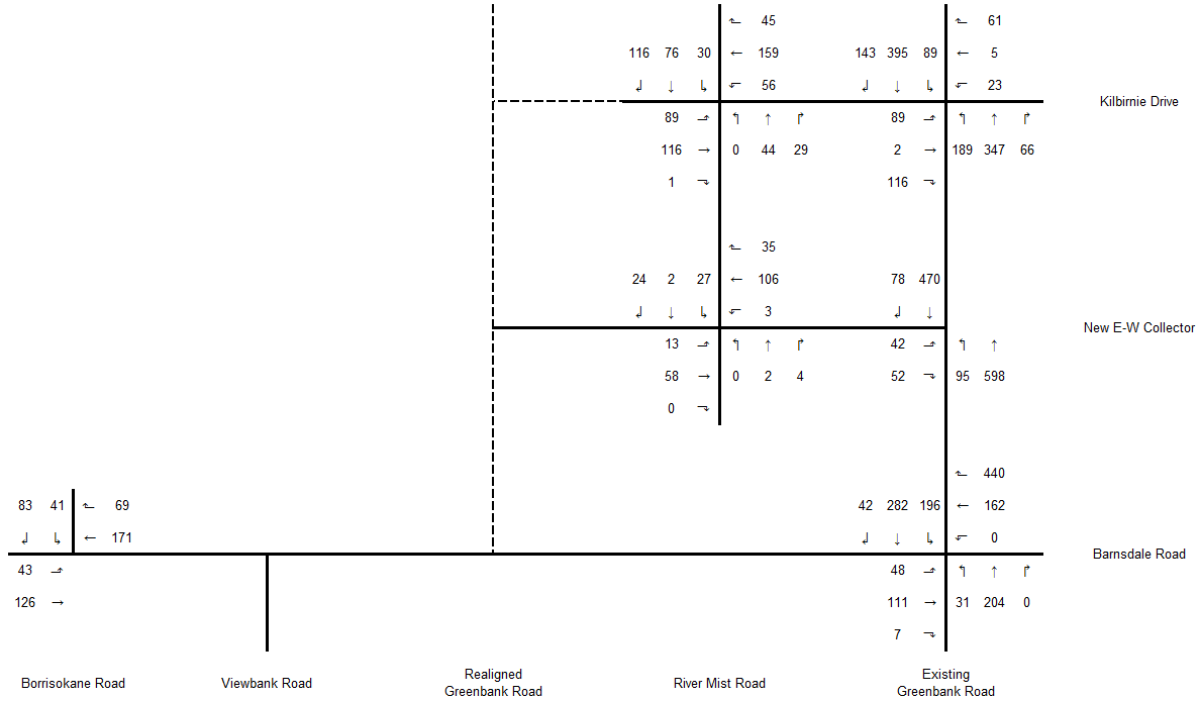


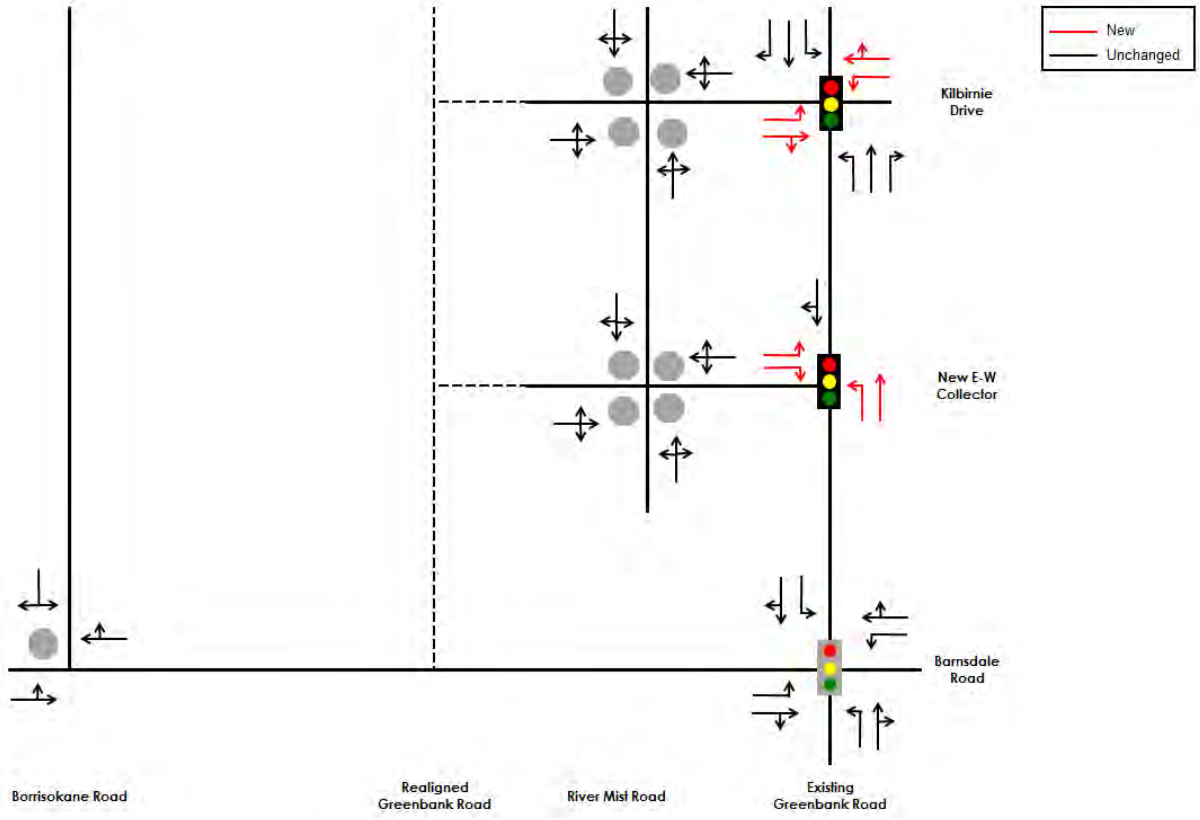
Table 17 2031 Future Background Operations (Synchro Results)

Scenario	Intersection Control	Approach / Movement		LOS	V/C	Delay (s)	Queue 95th (veh)
Barnsdale Road at Borrisokane Road	Minor Stop Control	EB	Left / Through	A (A)	0.03 (0.03)	7.7 (7.8)	0.1 (0.1)
		WB	Through / Right	A (A)	0 (0)	0 (0)	0 (0)
		SB	Left / Right	B (B)	0.12 (0.18)	10.7 (11.2)	0.4 (0.6)
		Overall Intersection		**A (A)**	**-**	**3.1 (3.2)**	**-**
Existing Greenbank at Barnsdale Road	Traffic Signals	EB	Left	A (B)	0.35 (0.62)	39.5 (53.4)	14.9* (15.7)*
			Through / Right	A (A)	0.40 (0.19)	33.9 (16.3)	29.9* (16.7)*
		WB	Left	A (A)	0.02 (0)	28.0 (0)	3.1* (0)*
			Through / Right	C (D)	0.71 (0.84)	36.4 (23.6)	46.2* (66.7)*
		NB	Left	A (A)	0.04 (0.07)	17.6 (17.2)	7.4* (10.1)*
			Through / Right	A (A)	0.22 (0.23)	17.4 (16.4)	40.4* (44.9)*
		SB	Left	A (A)	0.50 (0.35)	5.2 (14.7)	22.0* (35.0)*
			Through / Right	A (A)	0.19 (0.37)	2.1 (13.2)	5.4* (51.0)*
		Overall Intersection		**C (D)**	**0.71 (0.84)**	**16.6 (19.5)**	**-**
Existing Greenbank Road at Kilbirnie Drive	All-Way Stop Control	EB	Left	B (B)	0.31 (0.23)	14.8 (14.5)	1.3 (0.9)
			Through / Right	B (B)	0.33 (0.26)	13.3 (13.5)	1.4 (1.0)
		WB	Left	B (B)	0.16 (0.06)	13.1 (13.0)	0.6 (0.2)
			Through / Right	B (B)	0.23 (0.16)	12.5 (12.7)	0.9 (0.5)
		NB	Left	B (C)	0.15 (0.42)	12.3 (16.6)	0.5 (2.1)
			Through	C (D)	0.63 (0.72)	22.6 (27.8)	4.3 (5.8)
			Right	A (B)	0.02 (0.13)	9.7 (10.6)	0.1 (0.4)
		SB	Left	B (B)	0.07 (0.20)	11.4 (12.7)	0.2 (0.7)
			Through	C (E)	0.61 (0.82)	21.4 (36.4)	3.9 (7.9)
			Right	B (B)	0.11 (0.27)	10.5 (12.0)	0.7 (1.1)
		Overall Intersection		**C (C)**	**-**	**17.3 (22.8)**	**-**
	Traffic Signals	**Improvement: Implement Traffic Signals**					
		EB	Left	A (A)	0.38 (0.51)	23.9 (44.1)	23.2* (25.5)*
			Through / Right	A (A)	0.30 (0.39)	4.5 (10.1)	10.3* (12.9)*
		WB	Left	A (A)	0.44 (0.15)	43.1 (32.7)	20.3* (9.2)*
			Through / Right	A (A)	0.40 (0.25)	11.5 (11.9)	13.3* (10.4)*
		NB	Left	A (A)	0.12 (0.28)	5.0 (5.1)	9.9* (20.3)*
			Through	A (A)	0.29 (0.26)	5.6 (4.2)	30.9* (32.9)*
			Right	A (A)	0.01 (0.06)	0.3 (1.8)	0.4* (2.9)*
		SB	Left	A (A)	0.05 (0.12)	12.5 (4.6)	8.2* (10.9)*
			Through	A (A)	0.28 (0.30)	12.6 (5.0)	53.4* (42.1)*
			Right	A (A)	0.07 (0.13)	2.8 (1.2)	4.9* (5.6)*
		Overall Intersection		**A (A)**	**0.44 (0.51)**	**11.6 (7.7)**	**-**
River Mist Road at Kilbirnie Drive	All-Way Stop Control	EB	Left / Through / Right	B (A)	0.32 (0.29)	10.1 (10.3)	1.4 (1.2)
		WB	Left / Through / Right	A (B)	0.16 (0.36)	8.7 (10.6)	0.6 (1.6)
		NB	Left / Through / Right	A (A)	0.19 (0.11)	8.9 (8.9)	0.7 (0.4)
		SB	Left / Through / Right	A (A)	0.15 (0.30)	8.8 (10.1)	0.5 (1.3)
		Overall Intersection		**B (A)**	**-**	**9.3 (10.2)**	**-**
Existing Greenbank Road at New E-W Collector	Minor Stop Control	EB	Left	C (E)	0.28 (0.27)	22.5 (36.9)	1.1 (1.0)
			Right	B (B)	0.19 (0.09)	13.1 (12.0)	0.7 (0.3)
		NB	Left / Through	A (A)	0.04 (0.09)	8.7 (8.9)	0.1 (0.3)
		SB	Through / Right	A (A)	0 (0)	0 (0)	0 (0)
		Overall Intersection		**A (A)**	**-**	**3.2 (2.2)**	**-**
	Traffic Signals	**Improvement: Implement Traffic Signals**					
		EB	Left	A (A)	0.41 (0.25)	41.6 (38.4)	24.0* (14.5)
			Right	A (A)	0.38 (0.26)	11.4 (13.1)	12.4* (9.0)
		NB	Left	A (A)	0.06 (0.15)	2.6 (2.2)	m2.6* (m5.1)
			Through	A (A)	0.22 (0.42)	2.7 (2.8)	25.3* (41.2)
		SB	Through / Right	A (A)	0.39 (0.39)	3.3 (3.7)	30.3* (43.1)
		Overall Intersection		**A (A)**	**0.41 (0.42)**	**6.7 (4.7)**	**-**

Scenario	Intersection Control	Approach / Movement		LOS	V/C	Delay (s)	Queue 95th (veh)
River Mist Road at New E-W Collector	All-Way Stop Control	EB	Left / Through / Right	A (A)	0.15 (0.08)	8.0 (7.6)	0.5 (0.3)
		WB	Left / Through / Right	A (A)	0.08 (0.16)	7.4 (7.7)	0.2 (0.6)
		NB	Left / Through / Right	A (A)	0.02 (0.01)	7.2 (7.1)	0.1 (0)
		SB	Left / Through / Right	A (A)	0.06 (0.06)	7.7 (7.5)	0.2 (0.2)
		Overall Intersection		**A (A)**	**-**	**7.7 (7.6)**	**-**

Notes:
1. Table format: AM (PM)
2. v/c – represents the anticipated volume divided by the predicted capacity
3. ***** - Queue lengths for these movements are in meters
4. m – Volume for 95th percentile queue is metered by upstream signal

Figure 21 2031 Future Background Required Intersection Control and Lane Configuration



A signalized intersection MMLOS assessment was undertaken at the Existing Greenbank Road at Barnsdale Road intersection, the Existing Greenbank Road at Kilbirnie Drive intersection, and the Existing Greenbank Road at the New E-W Collector given that they are expected to operate as signalized intersections by the 2031 future background horizon. The anticipated operations during the AM and PM peak hours were both considered in the assessment and the MMLOS targets for a "Developing Community" seemed most suitable for the study area roadways.

Existing Greenbank Road at Barnsdale Road Intersection:

Table 18 presents the MMLOS conditions for the signalized intersection of Existing Greenbank Road at Barnsdale Road where it is shown that all modes of transportation meet or exceed the target level of service.

Existing Greenbank Road at Kilbirnie Drive Intersection:

The Ultimate Cycling Network from the City of Ottawa *Cycling Plan* (2013) designates Existing Greenbank Road as a spine cycling route and is therefore subject to a LOS target of C whereas Kilbirnie Drive does not have a designation and is therefore subject to a LOS target of D. the higher of the two targets (i.e. LOS = C) was selected as the target for the intersection.

None of these two roads are truck routes and therefore there is no MMLOS target for the them.

Table 19 presents the MMLOS conditions for the signalized intersection of Existing Greenbank Road at Kilbirnie Drive where it is shown that all modes of transportation meet or exceed the target level of service.

Existing Greenbank Road at New E-W Collector Intersection:

The Ultimate Cycling Network from the City of Ottawa *Cycling Plan* (2013) designates Existing Greenbank Road as a spine cycling route and is therefore subject to a LOS target of C whereas the New E-W Collector does not have a designation and is therefore subject to a LOS target of D. The higher of the two targets (i.e. LOS = C) was selected as the target for the intersection.

It is expected that the existing cross section for Existing Greenbank Road will be extended south as development proceeds south. Therefore the existing sidewalks, boulevard and MUP were assumed to be extended to Barnsdale Road by the 2031 total future horizon. As the intersection of the Existing Greenbank Road at the New E-W Collector will not have an east leg (i.e. it will be a "T" intersection), cyclists travelling eastbound are anticipated to use the future MUP along the west side of Existing Greenbank Road. That said, cyclists are not expected to interact or conflict with eastbound right-turning vehicles and thus, the future eastbound right-turning lane was not considered when assessing the Bicycle LOS (BLOS) along the eastbound approach.

Consistent with the *Barrhaven South Urban Expansion Study Area Community Design Plan Transportation Master Study,* it was assumed that local transit services will be provided along the New E-W Collector and a TLOS assessment was therefore undertaken on the Existing Greenbank Road at the New E-W Collector intersection.

Neither of these two roads are truck routes and therefore there is no MMLOS target for the them.

Table 20 presents the MMLOS conditions for the signalized intersection of Existing Greenbank Road at New E-W Collector where it is shown that all modes of transportation meet or exceed the target level of service.

Table 18 2031 FBG MMLOS - Greenbank Road at Barnsdale Road

Segment		2031 Future Background Traffic				Target
		EB	WB	NB	SB	
PLOS	Lanes crossed	3	3	3	3	C
	Median (yes/no)	No	No	No	No	
	Island refuge >=2.4m (yes/no)	No	No	No	No	
	Left turn phasing	Permissive	Permissive	Permissive	Protected/ Permissive	
	Right turn conflict	Yes	Yes	Yes	Yes	
	RTOR (yes/no)	Yes	Yes	Yes	Yes	
	Leading ped interval (yes/no)	No	No	No	No	
	Right turn corner radius (m)	5-10	5-10	5-10	5-10	
	Crosswalk treatment	Standard	Standard	Standard	Standard	
	Cycle length (s)	90	90	90	90	
	Effective walk time (s)	18	18	18	18	
	PETSI Points	71	71	71	71	
	PETSI Points LOS	C	C	C	C	
	Average Pedestrian Delay (s)	28.8	28.8	28.8	28.8	
	Ped Delay LOS	C	C	C	C	
	Level of Service	C	C	C	C	
	Level of Service	**C**				
BLOS	Type of bike lane	Mixed	Mixed	Separated	Separated	B
	Left-turn - lanes crossed	1	1	NA (Two Stage)	NA (Two Stage)	
	Left-turn - vehicle operating speed (km/hr)	25	25	25	25	
	Right-turn - number of turn lanes	0	0	NA	NA	
	Right-turn - turn lane length (m)	NA (Shared)	NA (Shared)	NA (Shared)	NA (Shared)	
	Right-turn - turning speed (km/hr)	15	15	15	15	
	Right-turn - location of bike lane	NA	NA	MUP	MUP	
	Level of Service	B	B	A	A	
	Level of Service	**B**				
TLOS	Maximum Average Delay (s)	NA				D
	Level of Service	NA				
	Level of Service	NA				
TkLOS	Effective corner radius (m)	<10	<10	<10	<10	No Target
	Number of receiving lanes	1	1	1	1	
	Level of Service	F	F	F	F	
	Level of Service	**F**				
VLOS	Maximum Volume-to-capacity (v/c)	0.62	0.84	0.23	0.50	D
	Level of Service	B	D	A	A	
	Level of Service	**D**				

Table 19 2031 FBG MMLOS - Existing Greenbank Road at Kilbirnie Drive

Segment		2031 Future Background Traffic				Target
		EB	WB	NB	SB	
PLOS	Lanes crossed	4	4	3	3	C
	Median (yes/no)	No	No	No	No	
	Island refuge >=2.4m (yes/no)	No	No	No	No	
	Left turn phasing	Protected/ Permissive	Permissive	Permissive	Permissive	
	Right turn conflict	Yes	Yes	Yes	Yes	
	RTOR (yes/no)	Yes	Yes	Yes	Yes	
	Leading ped interval (yes/no)	No	No	No	No	
	Right turn corner radius (m)	3-5	3-5	3-5	3-5	
	Crosswalk treatment	Standard	Standard	Standard	Standard	
	Cycle length (s)	90	90	90	90	
	Effective walk time (s)	22	22	18	18	
	PETSI Points	61	61	72	72	
	PETSI Points LOS	C	C	C	C	
	Average Pedestrian Delay (s)	25.7	25.7	28.8	28.8	
	Ped Delay LOS	C	C	C	C	
	Level of Service	C	C	C	C	
	Level of Service	**C**				
BLOS	Type of bike lane	Mixed	Mixed	Separated	Separated	C
	Left-turn - lanes crossed	1	1	NA (Two Stage)	NA (Two Stage)	
	Left-turn - vehicle operating speed (km/hr)	25	25	25	25	
	Right-turn - number of turn lanes	0	0	NA	NA	
	Right-turn - turn lane length (m)	NA (Shared)	NA (Shared)	NA (Shared)	NA (Shared)	
	Right-turn - turning speed (km/hr)	15	15	15	15	
	Right-turn - location of bike lane	NA	NA	MUP	MUP	
	Level of Service	B	B	A	A	
	Level of Service	**B**				
TLOS	Maximum Average Delay (s)	26.4	20.1	15.5	13.3	D
	Level of Service	D	D	C	C	
	Level of Service	**D**				
TkLOS	Effective corner radius (m)	<10	<10	<10	<10	No Target
	Number of receiving lanes	1	1	1	1	
	Level of Service	F	F	F	F	
	Level of Service	**F**				
VLOS	Maximum Volume-to-capacity (v/c)	0.51	0.44	0.29	0.30	D
	Level of Service	A	A	A	A	
	Level of Service	**A**				

Table 20 2031 FBG MMLOS - Existing Greenbank Road at New E-W Collector

Segment		2031 Total Future Traffic		Target
		EB	NB / SB	
PLOS	Lanes crossed	2	3	C
	Median (yes/no)	No	No	
	Island refuge >=2.4m (yes/no)	No	No	
	Left turn phasing	Permissive	Permissive	
	Right turn conflict	Yes	Yes	
	RTOR (yes/no)	Yes	Yes	
	Leading ped interval (yes/no)	No	No	
	Right turn corner radius (m)	3-5	3-5	
	Crosswalk treatment	Standard	Standard	
	Cycle length (s)	90	90	
	Effective walk time (s)	18	18	
	PETSI Points	87	72	
	PETSI Points LOS	B	C	
	Average Pedestrian Delay (s)	28.8	28.8	
	Ped Delay LOS	C	C	
	Level of Service	C	C	
	Level of Service	**C**		
BLOS	Type of bike lane	Mixed	Separated	C
	Left-turn - lanes crossed	1	NA	
	Left-turn - vehicle operating speed (km/hr)	25	25	
	Right-turn - number of turn lanes	NA	NA	
	Right-turn - turn lane length (m)	NA	NA (Shared)	
	Right-turn - turning speed (km/hr)	NA	15	
	Right-turn - location of bike lane	NA	MUP	
	Level of Service	B	A	
	Level of Service	**B**		
TLOS	Maximum Average Delay (s)	21.3	13.8	D
	Level of Service	D	C	
	Level of Service	**D**		
TkLOS	Effective corner radius (m)	<10	<10	No Target
	Number of receiving lanes	1	1	
	Level of Service	F	F	
	Level of Service	**F**		
VLOS	Maximum Volume-to-capacity (v/c)	0.41	0.56	D
	Level of Service	A	A	
	Level of Service	**A**		

4.9.2.5 **2031 Total Future Conditions**

Figure 22 and **Figure 23** illustrate 2031 total future AM and PM peak hour traffic volumes at the study area intersections.

Table 21 summarizes the results of the Synchro analysis for 2031 total future intersection operations.

Appendix C contains detailed intersection performance worksheets.

Figure 24 illustrates the required intersection control and lane configuration to accommodate the 2031 total future conditions.

All study area intersections are anticipated to operate acceptably.

Figure 22 2031 Total Future Traffic Volumes - AM Peak Hour

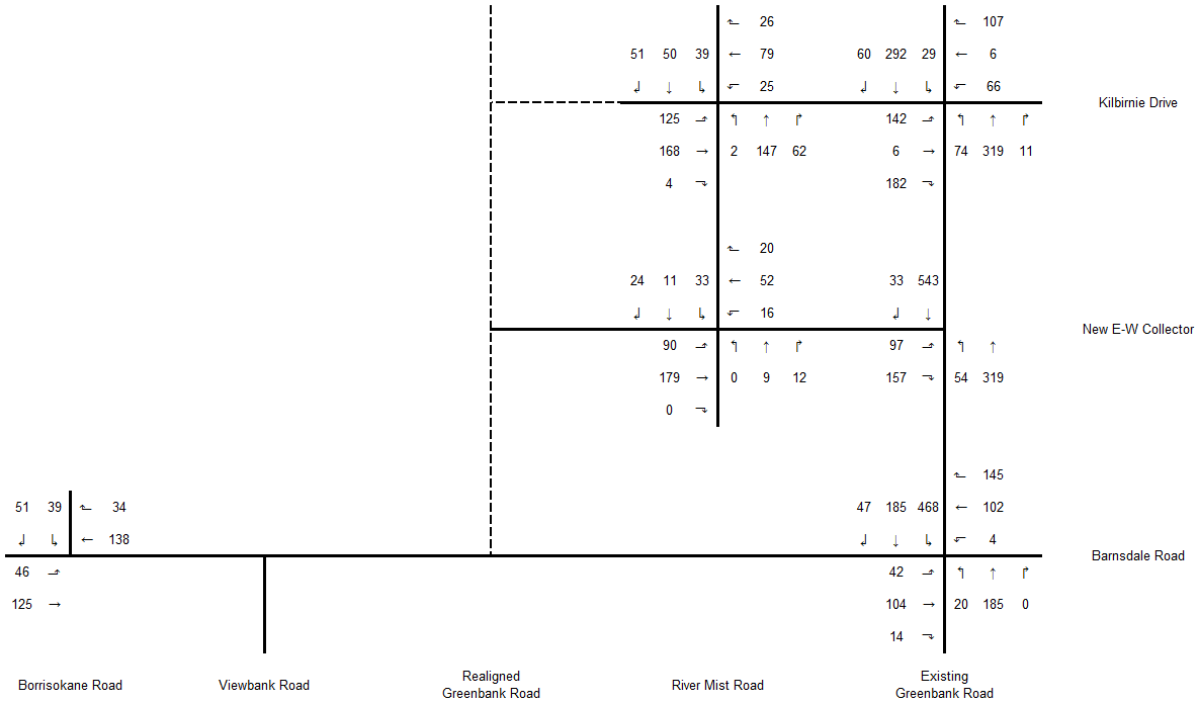


Figure 23 2031 Total Future Traffic Volumes - PM Peak Hour

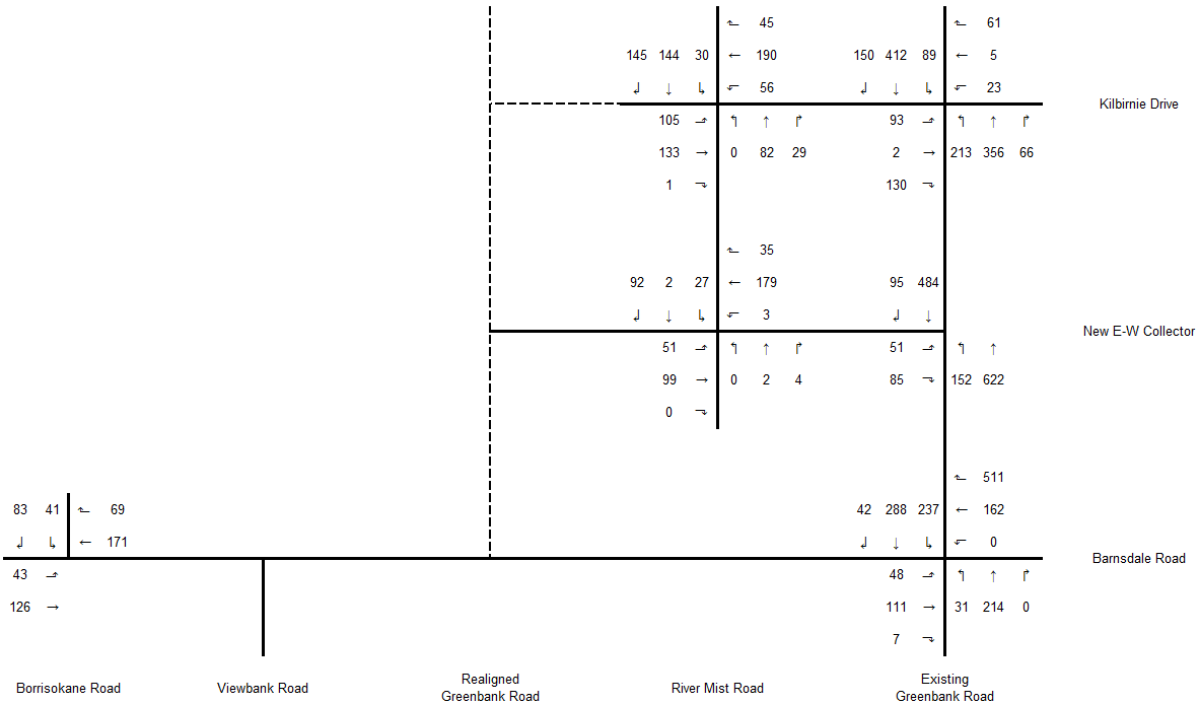
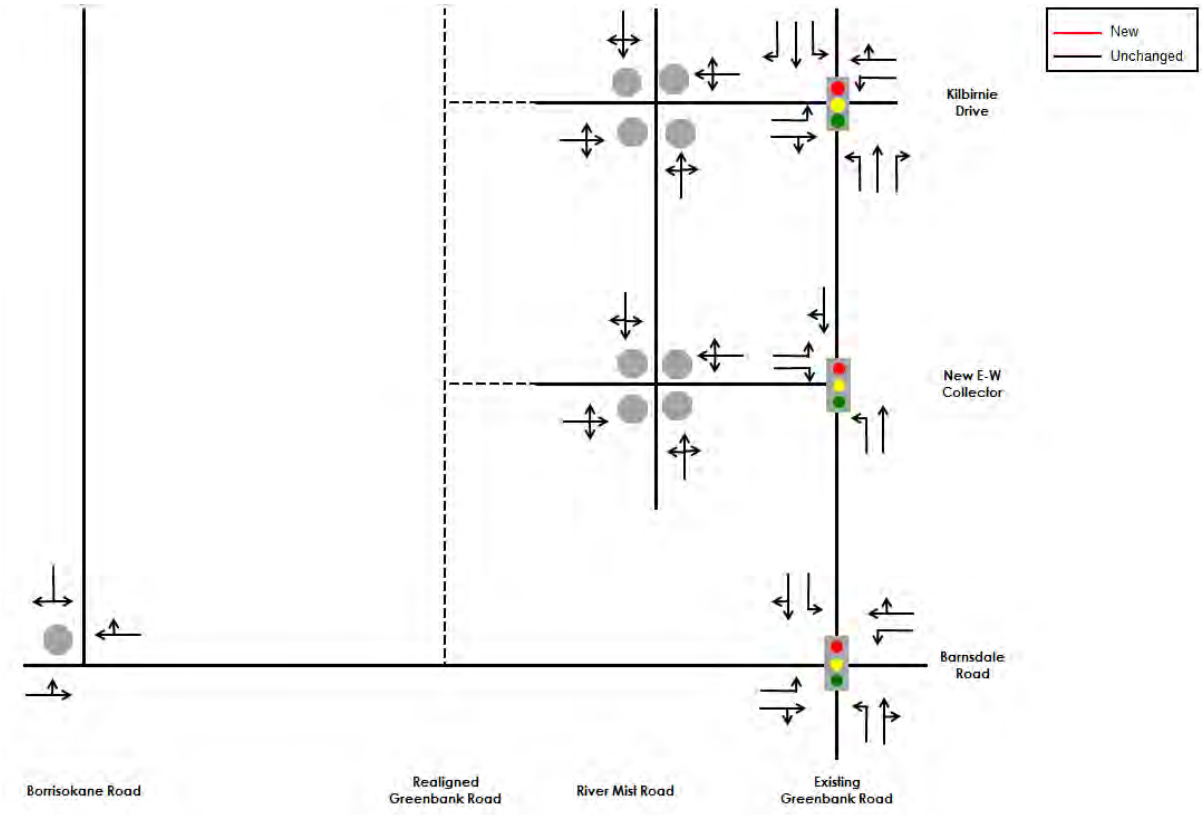


Table 21 2031 Total Future Operations (Synchro Results)

Scenario	Intersection Control	Approach / Movement		LOS	V/C	Delay (s)	Queue 95th (veh)
Barnsdale Road at Borrisokane Road	Minor Stop Control	EB	Left / Through	A (A)	0.03 (0.03)	7.7 (7.8)	0.1 (0.1)
		WB	Through / Right	A (A)	0 (0)	0 (0)	0 (0)
		SB	Left / Right	B (B)	0.12 (0.18)	10.7 (11.2)	0.4 (0.6)
		Overall Intersection		**A (A)**	**-**	**3.1 (3.2)**	**-**
Existing Greenbank at Barnsdale Road	Traffic Signals	EB	Left	A (B)	0.38 (0.62)	40.8 (51.1)	15.1* (15.7)*
			Through / Right	A (A)	0.39 (0.17)	33.1 (14.0)	29.7* (14.9)*
		WB	Left	A (A)	0.02 (0)	27.5 (0)	3.1* (0)*
			Through / Right	C (D)	0.73 (0.85)	36.6 (22.2)	48.8* (69.8)*
		NB	Left	A (A)	0.04 (0.07)	20.4 (19.9)	8.0* (10.9)*
			Through / Right	A (A)	0.24 (0.26)	19.9 (19.2)	44.5* (50.0)*
		SB	Left	A (A)	0.58 (0.47)	7.5 (20.9)	50.0* (#72.8)*
			Through / Right	A (A)	0.20 (0.40)	2.6 (16.3)	9.2* (58.0)*
		Overall Intersection		**C (D)**	**0.73 (0.85)**	**17.4 (20.7)**	**-**
Existing Greenbank Road at Kilbirnie Drive	Traffic Signals	EB	Left	A (A)	0.39 (0.53)	23.8 (44.6)	23.9* (26.5)*
			Through / Right	A (A)	0.33 (0.42)	4.4 (10.0)	10.8* (13.6)*
		WB	Left	A (A)	0.45 (0.16)	43.5 (33.0)	20.3* (9.2)*
			Through / Right	A (A)	0.40 (0.25)	11.4 (11.8)	13.3* (10.4)*
		NB	Left	A (A)	0.13 (0.32)	5.3 (5.4)	8.4* (23.3)*
			Through	A (A)	0.31 (0.27)	6.0 (4.2)	29.9* (32.6)*
			Right	A (A)	0.01 (0.06)	0.2 (1.6)	0.2* (2.9)*
		SB	Left	A (A)	0.05 (0.13)	12.9 (4.7)	8.3* (11.0)*
			Through	A (A)	0.28 (0.31)	13.0 (5.2)	55.1* (44.3)*
			Right	A (A)	0.07 (0.13)	3.0 (1.2)	5.3* (5.7)*
		Overall Intersection		**A (A)**	**0.45 (0.53)**	**11.6 (7.8)**	**-**
River Mist Road at Kilbirnie Drive	All-Way Stop Control	EB	Left / Through / Right	B (B)	0.42 (0.38)	11.9 (12.3)	2.1 (1.8)
		WB	Left / Through / Right	A (B)	0.19 (0.45)	9.5 (12.9)	0.7 (2.3)
		NB	Left / Through / Right	B (B)	0.30 (0.18)	10.3 (10.2)	1.3 (0.7)
		SB	Left / Through / Right	A (B)	0.20 (0.48)	9.6 (13.2)	0.8 (2.6)
		Overall Intersection		**B (B)**	**-**	**10.7 (12.5)**	**-**
Existing Greenbank Road at New E-W Collector	Traffic Signals	EB	Left	A (A)	0.47 (0.29)	42.9 (39.2)	28.0* (16.9*)
			Right	A (A)	0.49 (0.36)	11.1 (12.4)	15.1* (11.5*)
		NB	Left	A (A)	0.10 (0.25)	4.1 (3.0)	m7.6* (m12.3*)
			Through	A (A)	0.24 (0.44)	4.2 (3.3)	48.5* (55.4*)
		SB	Through / Right	A (A)	0.43 (0.41)	4.0 (4.0)	34.4* (46.3*)
		Overall Intersection		**A (A)**	**0.49 (0.44)**	**8.1 (5.3)**	**-**
River Mist Road at New E-W Collector	All-Way Stop Control	EB	Left / Through / Right	A (A)	0.32 (0.19)	9.3 (8.6)	1.4 (0.7)
		WB	Left / Through / Right	A (A)	0.11 (0.26)	7.8 (8.8)	0.4 (1.0)
		NB	Left / Through / Right	A (A)	0.03 (0.01)	7.6 (7.6)	0.1 (0)
		SB	Left / Through / Right	A (A)	0.09 (0.15)	8.1 (8.1)	0.3 (0.5)
		Overall Intersection		**A (A)**	**-**	**8.7 (8.6)**	**-**

Notes:
1. Table format: AM (PM)
2. v/c – represents the anticipated volume divided by the predicted capacity
3. # - 95th percentile volume exceeds capacity, queue may be longer
4. * - Queue lengths for these movements are in meters
5. m – Volume for 95th percentile queue is metered by upstream signal

Figure 24 2031 Total Future Required Intersection Control and Lane Configuration



A signalized intersection MMLOS assessment was undertaken on the Existing Greenbank Road at Barnsdale Road intersection, the Existing Greenbank Road at Kilbirnie Drive intersection and the Existing Greenbank Road at the New E-W Collector intersection as they are all expected to be operating as signalized intersections by the 2031 total future horizon. The anticipated operations during the AM and PM peak hours were both considered in the assessment and the MMLOS targets for a "Developing Community" seemed most suitable for the study area roadways.

Existing Greenbank Road at Barnsdale Road Intersection:

Table 22 presents the MMLOS conditions for the signalized intersection of Existing Greenbank Road at Barnsdale Road where it is shown that all modes of transportation meet or exceed the target level of service.

Existing Greenbank Road at Kilbirnie Drive Intersection:

Table 23 presents the MMLOS conditions for the signalized intersection of Existing Greenbank Road at Kilbirnie Drive where it is shown that all modes of transportation meet or exceed the target level of service.

Existing Greenbank Road at New E-W Collector Intersection:

Table 24 presents the MMLOS conditions for the signalized intersection of Existing Greenbank Road at the New E-W Collector where it is shown that all modes of transportation meet or exceed the target level of service.

Table 22 2031 Total Future MMLOS - Existing Greenbank Road at Barnsdale Road

Segment		2031 Total Future Traffic				Target
		EB	WB	NB	SB	
PLOS	Lanes crossed	3	3	3	3	C
	Median (yes/no)	No	No	No	No	
	Island refuge >=2.4m (yes/no)	No	No	No	No	
	Left turn phasing	Permissive	Permissive	Permissive	Protected/ Permissive	
	Right turn conflict	Yes	Yes	Yes	Yes	
	RTOR (yes/no)	Yes	Yes	Yes	Yes	
	Leading ped interval (yes/no)	No	No	No	No	
	Right turn corner radius (m)	5-10	5-10	5-10	5-10	
	Crosswalk treatment	Standard	Standard	Standard	Standard	
	Cycle length (s)	90	90	90	90	
	Effective walk time (s)	18	18	18	18	
	PETSI Points	71	71	71	71	
	PETSI Points LOS	C	C	C	C	
	Average Pedestrian Delay (s)	28.8	28.8	28.8	28.8	
	Ped Delay LOS	C	C	C	C	
	Level of Service	C	C	C	C	
	Level of Service	**C**				
BLOS	Type of bike lane	Mixed	Mixed	Separated	Separated	B
	Left-turn - lanes crossed	1	1	NA (Two Stage)	NA (Two Stage)	
	Left-turn - vehicle operating speed (km/hr)	25	25	25	25	
	Right-turn - number of turn lanes	0	0	NA	NA	
	Right-turn - turn lane length (m)	NA (Shared)	NA (Shared)	NA (Shared)	NA (Shared)	
	Right-turn - turning speed (km/hr)	15	15	15	15	
	Right-turn - location of bike lane	NA	NA	MUP	MUP	
	Level of Service	B	B	A	A	
	Level of Service	**B**				
TLOS	Maximum Average Delay (s)	NA				D
	Level of Service	NA				
	Level of Service	NA				
TkLOS	Effective corner radius (m)	<10	<10	<10	<10	No Target
	Number of receiving lanes	1	1	1	1	
	Level of Service	F	F	F	F	
	Level of Service	**F**				
VLOS	Maximum Volume-to-capacity (v/c)	0.62	0.85	0.26	0.58	D
	Level of Service	B	D	A	A	
	Level of Service	**D**				

Table 23 2031 Total Future MMLOS - Existing Greenbank Road at Kilbirnie Drive

Segment		2031 Total Future Traffic				Target
		EB	WB	NB	SB	
PLOS	Lanes crossed	4	4	3	3	C
	Median (yes/no)	No	No	No	No	
	Island refuge >=2.4m (yes/no)	No	No	No	No	
	Left turn phasing	Protected/ Permissive	Permissive	Permissive	Permissive	
	Right turn conflict	Yes	Yes	Yes	Yes	
	RTOR (yes/no)	Yes	Yes	Yes	Yes	
	Leading ped interval (yes/no)	No	No	No	No	
	Right turn corner radius (m)	3-5	3-5	3-5	3-5	
	Crosswalk treatment	Standard	Standard	Standard	Standard	
	Cycle length (s)	90	90	90	90	
	Effective walk time (s)	22	22	18	18	
	PETSI Points	61	61	72	72	
	PETSI Points LOS	C	C	C	C	
	Average Pedestrian Delay (s)	25.7	25.7	28.8	28.8	
	Ped Delay LOS	C	C	C	C	
	Level of Service	C	C	C	C	
	Level of Service	**C**				
BLOS	Type of bike lane	Mixed	Mixed	Separated	Separated	C
	Left-turn - lanes crossed	1	1	NA (Two Stage)	NA (Two Stage)	
	Left-turn - vehicle operating speed (km/hr)	25	25	25	25	
	Right-turn - number of turn lanes	0	0	NA	NA	
	Right-turn - turn lane length (m)	NA (Shared)	NA (Shared)	NA (Shared)	NA (Shared)	
	Right-turn - turning speed (km/hr)	15	15	15	15	
	Right-turn - location of bike lane	NA	NA	MUP	MUP	
	Level of Service	B	B	A	A	
	Level of Service	**B**				
TLOS	Maximum Average Delay (s)	27.2	20.7	15.7	13.2	D
	Level of Service	D	D	C	C	
	Level of Service	**D**				
TkLOS	Effective corner radius (m)	<10	<10	<10	<10	No Target
	Number of receiving lanes	1	1	1	1	
	Level of Service	F	F	F	F	
	Level of Service	**F**				
VLOS	Maximum Volume-to-capacity (v/c)	0.53	0.45	0.34	0.31	D
	Level of Service	A	A	A	A	
	Level of Service	**A**				

Table 24 2031 Total Future MMLOS - Existing Greenbank Road at New E-W Collector

Segment		2031 Total Future Traffic		Target
		EB	NB / SB	
PLOS	Lanes crossed	2	3	C
	Median (yes/no)	No	No	
	Island refuge >=2.4m (yes/no)	No	No	
	Left turn phasing	Permissive	Permissive	
	Right turn conflict	Yes	Yes	
	RTOR (yes/no)	Yes	Yes	
	Leading ped interval (yes/no)	No	No	
	Right turn corner radius (m)	3-5	3-5	
	Crosswalk treatment	Standard	Standard	
	Cycle length (s)	90	90	
	Effective walk time (s)	18	18	
	PETSI Points	87	72	
	PETSI Points LOS	B	C	
	Average Pedestrian Delay (s)	28.8	28.8	
	Ped Delay LOS	C	C	
	Level of Service	C	C	
	Level of Service	**C**		
BLOS	Type of bike lane	Mixed	Separated	C
	Left-turn - lanes crossed	1	NA	
	Left-turn - vehicle operating speed (km/hr)	25	25	
	Right-turn - number of turn lanes	NA	NA	
	Right-turn - turn lane length (m)	NA	NA (Shared)	
	Right-turn - turning speed (km/hr)	NA	15	
	Right-turn - location of bike lane	NA	MUP	
	Level of Service	B	A	
	Level of Service	**B**		
TLOS	Maximum Average Delay (s)	21.3	13.8	D
	Level of Service	D	C	
	Level of Service	**D**		
TkLOS	Effective corner radius (m)	<10	<10	No Target
	Number of receiving lanes	1	1	
	Level of Service	F	F	
	Level of Service	**F**		
VLOS	Maximum Volume-to-capacity (v/c)	0.4	0.69	D
	Level of Service	A	B	
	Level of Service	**B**		

4.9.2.6 2036 Ultimate Conditions

Figure 25 and **Figure 26** illustrate 2036 ultimate AM and PM peak hour traffic volumes at the study area intersections.

Table 25 summarizes the results of the Synchro analysis for 2036 ultimate intersection operations.

All study area intersections are anticipated to operate acceptably.

Appendix C contains detailed intersection performance worksheets.

Figure 27 illustrates the required intersection control and lane configuration to accommodate the 2036 ultimate conditions.

Figure 25 2036 Ultimate Traffic Volumes - AM Peak Hour

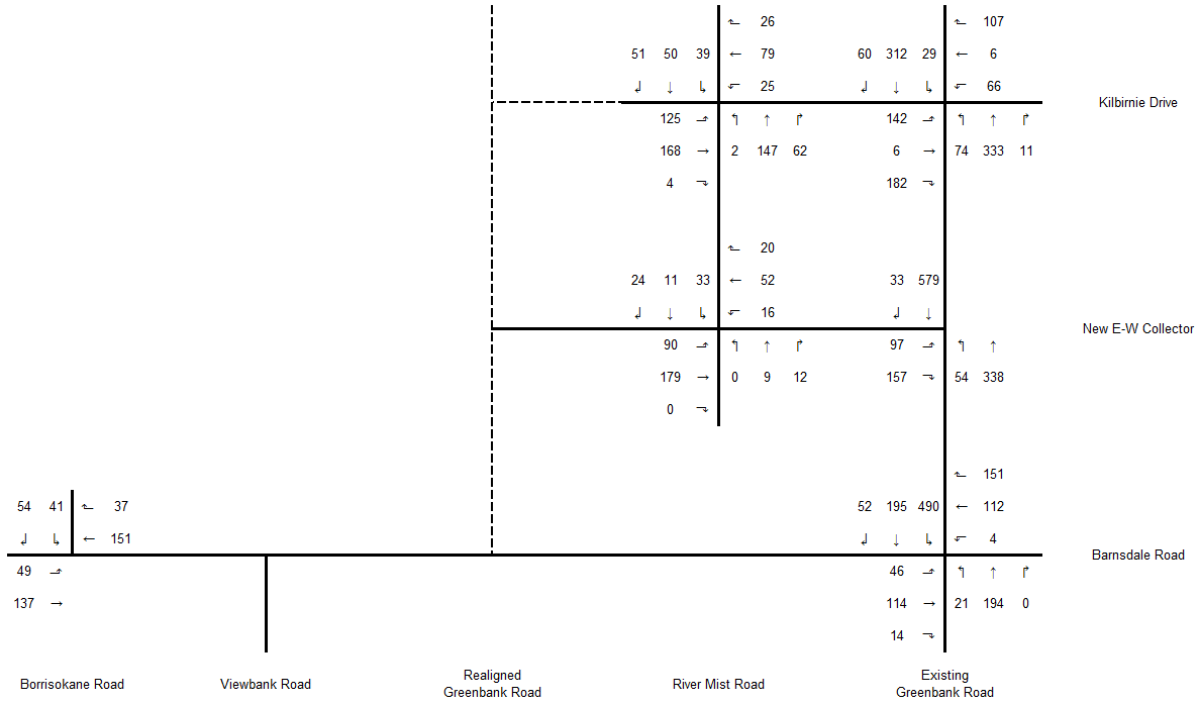


Figure 26 2036 Ultimate Traffic Volumes - PM Peak Hour

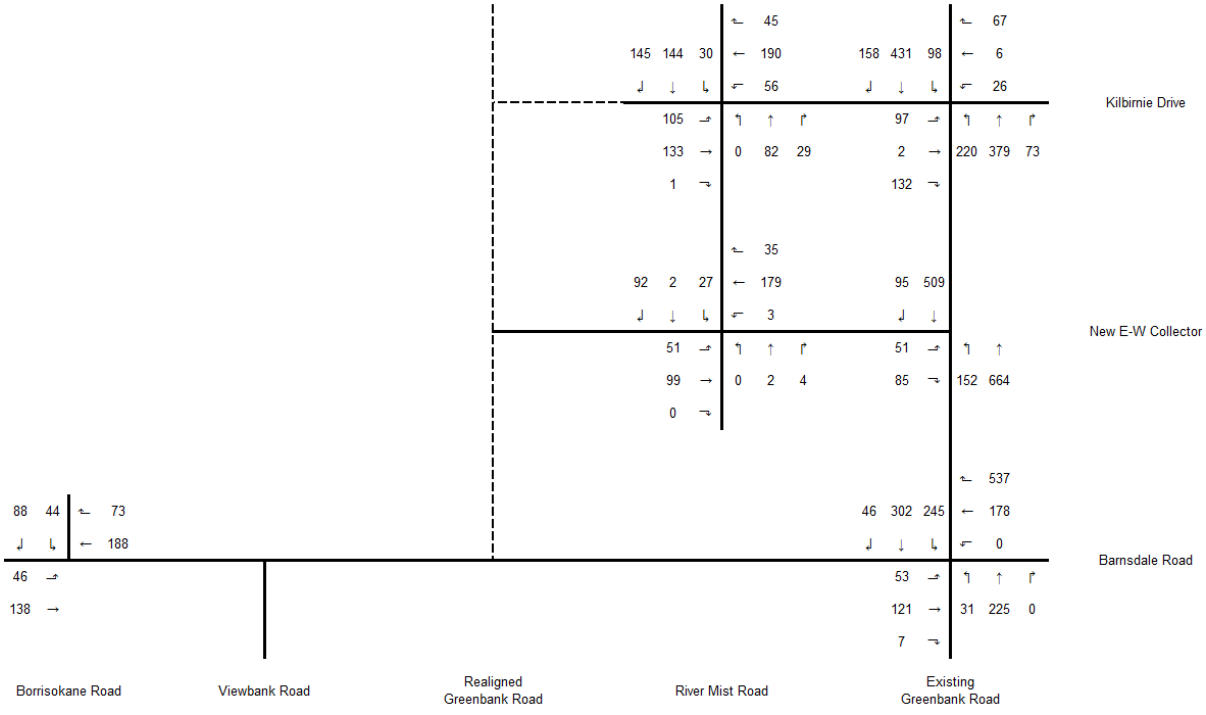
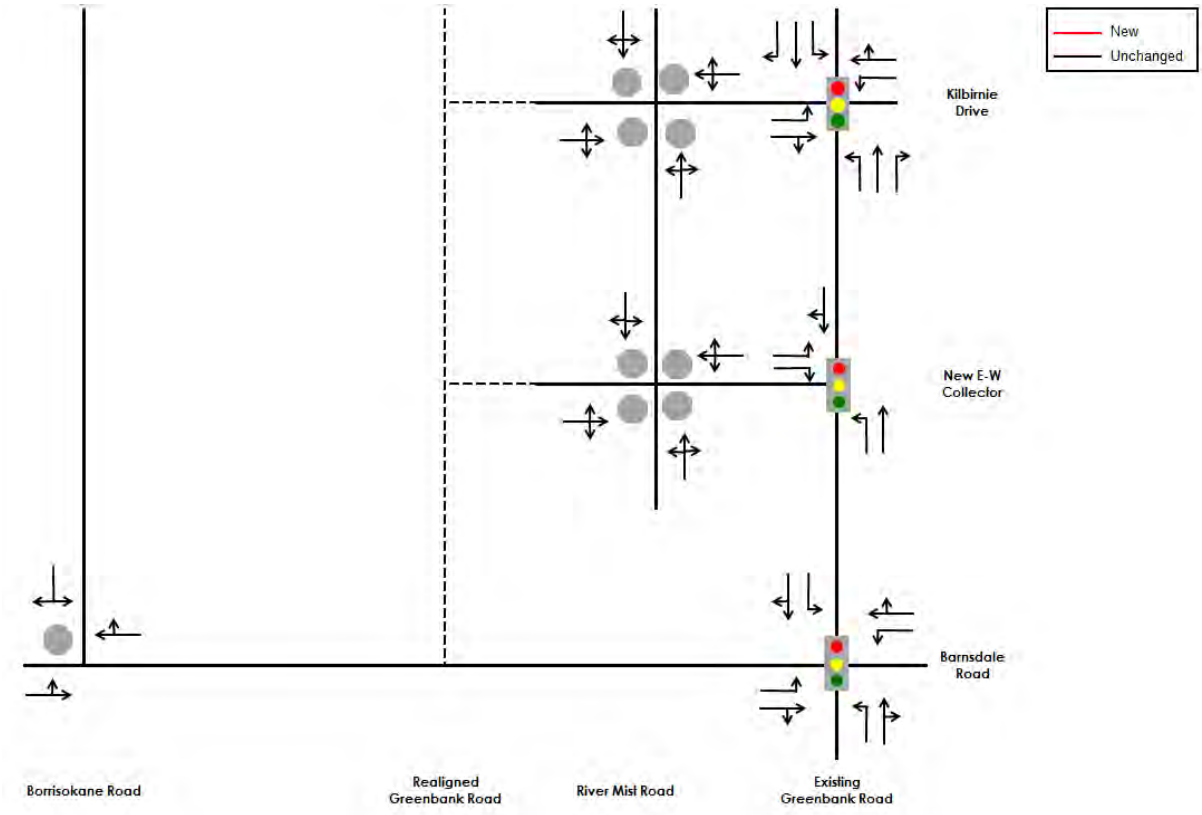


Table 25 2036 Ultimate Operations (Synchro Results)

Scenario	Intersection Control	Approach / Movement		LOS	V/C	Delay (s)	Queue 95th (veh)
Barnsdale Road at Borrisokane Road	Minor Stop Control	EB	Left / Through	A (A)	0.04 (0.04)	7.7 (7.9)	0.1 (0.1)
		WB	Through / Right	A (A)	0 (0)	0 (0)	0 (0)
		SB	Left / Right	B (B)	0.14 (0.19)	10.9 (11.5)	0.5 (0.7)
		Overall Intersection		**A (A)**	**-**	**3.0 (3.3)**	**-**
Existing Greenbank at Barnsdale Road	Traffic Signals	EB	Left	A (A)	0.42 (0.60)	42.9 (43.7)	16.5* (17.1)*
			Through / Right	A (A)	0.40 (0.17)	33.0 (12.4)	31.9* (15.3)*
		WB	Left	A (A)	0.02 (0)	27.0 (0)	3.1* (0)*
			Through / Right	C (D)	0.76 (0.86)	39.1 (22.4)	53.7* (81.0)*
		NB	Left	A (A)	0.05 (0.09)	21.1 (22.2)	8.3* (11.2)*
			Through / Right	A (A)	0.26 (0.29)	21.0 (21.7)	46.5* (53.7)*
		SB	Left	B (A)	0.62 (0.55)	8.7 (25.8)	60.6* (#84.3)*
			Through / Right	A (A)	0.21 (0.46)	2.8 (19.6)	9.9* (#92.6)*
		Overall Intersection		**C (D)**	**0.76 (0.86)**	**18.7 (22.1)**	**-**
Existing Greenbank Road at Kilbirnie Drive	Traffic Signals	EB	Left	A (A)	0.39 (0.53)	23.8 (44.6)	23.9* (26.5)*
			Through / Right	A (A)	0.33 (0.42)	4.4 (10.0)	10.8* (13.6)*
		WB	Left	A (A)	0.45 (0.16)	43.5 (33.0)	20.3* (9.2)*
			Through / Right	A (A)	0.40 (0.25)	11.4 (11.8)	13.3* (10.4)*
		NB	Left	A (A)	0.13 (0.33)	5.1 (5.4)	7.4* (22.6)*
			Through	A (A)	0.32 (0.29)	5.9 (4.2)	34.3* (36.0)*
			Right	A (A)	0.01 (0.06)	0.1 (1.0)	0.1* (1.8)*
		SB	Left	A (A)	0.05 (0.13)	12.9 (4.7)	8.3* (11.0)*
			Through	A (A)	0.30 (0.33)	13.2 (5.3)	59.3* (46.6)*
			Right	A (A)	0.07 (0.13)	3.0 (1.2)	5.3* (5.7)*
		Overall Intersection		**A (A)**	**0.45 (0.53)**	**11.6 (7.7)**	**-**
River Mist Road at Kilbirnie Drive	All-Way Stop Control	EB	Left / Through / Right	B (B)	0.42 (0.38)	11.9 (12.3)	2.1 (1.8)
		WB	Left / Through / Right	A (C)	0.19 (0.45)	9.5 (12.9)	0.7 (2.3)
		NB	Left / Through / Right	B (B)	0.30 (0.18)	10.3 (10.2)	1.3 (0.7)
		SB	Left / Through / Right	A (C)	0.20 (0.48)	9.6 (13.1)	0.8 (2.6)
		Overall Intersection		**B (A)**	**-**	**10.7 (12.5)**	**-**
Existing Greenbank Road at New E-W Collector	Traffic Signals	EB	Left	A (A)	0.47 (0.29)	42.9 (39.2)	28.0* (16.9*)
			Right	A (A)	0.49 (0.36)	11.1 (12.4)	15.1* (11.5*)
		NB	Left	A (A)	0.10 (0.26)	4.4 (3.2)	m7.8* (m12.3*)
			Through	A (A)	0.25 (0.47)	4.5 (3.7)	55.3* (65.2*)
		SB	Through / Right	A (A)	0.46 (0.43)	4.3 (4.1)	38.1* (55.0*)
		Overall Intersection		**A (A)**	**0.49 (0.47)**	**8.2 (5.5)**	**-**
River Mist Road at New E-W Collector	All-Way Stop Control	EB	Left / Through / Right	A (A)	0.32 (0.19)	9.3 (8.6)	1.4 (0.7)
		WB	Left / Through / Right	A (A)	0.11 (0.26)	7.8 (8.8)	0.4 (1.0)
		NB	Left / Through / Right	A (A)	0.03 (0.01)	7.6 (7.6)	0.1 (0)
		SB	Left / Through / Right	A (A)	0.09 (0.15)	8.1 (8.1)	0.3 (0.5)
		Overall Intersection		**A (A)**	**-**	**8.7 (8.6)**	**-**

Notes:
1. Table format: AM (PM)
2. v/c – represents the anticipated volume divided by the predicted capacity
3. # - 95th percentile volume exceeds capacity, queue may be longer
4. * - Queue lengths for these movements are in meters
5. m – Volume for 95th percentile queue is metered by upstream signal

Figure 27 2036 Ultimate Required Intersection Control and Lane Configuration



A signalized intersection MMLOS assessment was undertaken on the Existing Greenbank Road at Barnsdale Road intersection, the Existing Greenbank Road at Kilbirnie Drive intersection, And the Existing Greenbank Road at the New E-W Collector intersection as they are all expected to be operating as signalized intersections by the 2036 ultimate horizon. The anticipated operations during the AM and PM peak hours were both considered in the assessment and the MMLOS targets for a "Developing Community" seemed most suitable for the study area roadways.

Existing Greenbank Road at Barnsdale Road Intersection:

Table 26 presents the MMLOS conditions for the signalized intersection of Existing Greenbank Road at Kilbirnie Drive where it is shown that all modes of transportation meet or exceed the target level of service.

Existing Greenbank Road at Kilbirnie Drive Intersection:

Table 27 presents the MMLOS conditions for the signalized intersection of Existing Greenbank Road at Kilbirnie Drive where it is shown that all modes of transportation meet or exceed the target level of service.

Existing Greenbank Road at New E-W Collector Intersection:

Table 28 presents the MMLOS conditions for the signalized intersection of Existing Greenbank Road at Kilbirnie Drive where it is shown that all modes of transportation meet or exceed the target level of service.

Table 26 2036 Ultimate MMLOS – Existing Greenbank Road at Barnsdale Road

Segment		2031 Total Future Traffic				Target
		EB	WB	NB	SB	
PLOS	Lanes crossed	3	3	3	3	C
	Median (yes/no)	No	No	No	No	
	Island refuge >=2.4m (yes/no)	No	No	No	No	
	Left turn phasing	Permissive	Permissive	Permissive	Protected/ Permissive	
	Right turn conflict	Yes	Yes	Yes	Yes	
	RTOR (yes/no)	Yes	Yes	Yes	Yes	
	Leading ped interval (yes/no)	No	No	No	No	
	Right turn corner radius (m)	5-10	5-10	5-10	5-10	
	Crosswalk treatment	Standard	Standard	Standard	Standard	
	Cycle length (s)	90	90	90	90	
	Effective walk time (s)	18	18	18	18	
	PETSI Points	71	71	71	71	
	PETSI Points LOS	C	C	C	C	
	Average Pedestrian Delay (s)	28.8	28.8	28.8	28.8	
	Ped Delay LOS	C	C	C	C	
	Level of Service	C	C	C	C	
	Level of Service	**C**				
BLOS	Type of bike lane	Mixed	Mixed	Separated	Separated	B
	Left-turn - lanes crossed	1	1	NA (Two Stage)	NA (Two Stage)	
	Left-turn - vehicle operating speed (km/hr)	25	25	25	25	
	Right-turn - number of turn lanes	0	0	NA	NA	
	Right-turn - turn lane length (m)	NA (Shared)	NA (Shared)	NA (Shared)	NA (Shared)	
	Right-turn - turning speed (km/hr)	15	15	15	15	
	Right-turn - location of bike lane	NA	NA	MUP	MUP	
	Level of Service	B	B	A	A	
	Level of Service	**B**				
TLOS	Maximum Average Delay (s)	NA				D
	Level of Service	NA				
	Level of Service	NA				
TkLOS	Effective corner radius (m)	<10	<10	<10	<10	No Target
	Number of receiving lanes	1	1	1	1	
	Level of Service	F	F	F	F	
	Level of Service	**F**				
VLOS	Maximum Volume-to-capacity (v/c)	0.60	0.86	0.29	0.62	D
	Level of Service	A	D	A	B	
	Level of Service	**D**				

Table 27 2036 Ultimate MMLOS – Existing Greenbank Road at Kilbirnie Drive

Segment		2031 Total Future Traffic				Target
		EB	WB	NB	SB	
PLOS	Lanes crossed	4	4	3	3	C
	Median (yes/no)	No	No	No	No	
	Island refuge >=2.4m (yes/no)	No	No	No	No	
	Left turn phasing	Protected/ Permissive	Permissive	Permissive	Permissive	
	Right turn conflict	Yes	Yes	Yes	Yes	
	RTOR (yes/no)	Yes	Yes	Yes	Yes	
	Leading ped interval (yes/no)	No	No	No	No	
	Right turn corner radius (m)	3-5	3-5	3-5	3-5	
	Crosswalk treatment	Standard	Standard	Standard	Standard	
	Cycle length (s)	90	90	90	90	
	Effective walk time (s)	22	22	18	18	
	PETSI Points	61	61	72	72	
	PETSI Points LOS	C	C	C	C	
	Average Pedestrian Delay (s)	25.7	25.7	28.8	28.8	
	Ped Delay LOS	C	C	C	C	
	Level of Service	C	C	C	C	
	Level of Service	**C**				
BLOS	Type of bike lane	Mixed	Mixed	Separated	Separated	C
	Left-turn - lanes crossed	1	1	NA (Two Stage)	NA (Two Stage)	
	Left-turn - vehicle operating speed (km/hr)	25	25	25	25	
	Right-turn - number of turn lanes	0	0	NA	NA	
	Right-turn - turn lane length (m)	NA (Shared)	NA (Shared)	NA (Shared)	NA (Shared)	
	Right-turn - turning speed (km/hr)	15	15	15	15	
	Right-turn - location of bike lane	NA	NA	MUP	MUP	
	Level of Service	B	B	A	A	
	Level of Service	**B**				
TLOS	Maximum Average Delay (s)	26.5	20.3	16.4	13.9	D
	Level of Service	D	D	C	C	
	Level of Service	**D**				
TkLOS	Effective corner radius (m)	<10	<10	<10	<10	No Target
	Number of receiving lanes	1	1	1	1	
	Level of Service	F	F	F	F	
	Level of Service	**F**				
VLOS	Maximum Volume-to-capacity (v/c)	0.53	0.45	0.33	0.33	D
	Level of Service	A	A	A	A	
	Level of Service	**A**				

Table 28 2036 Ultimate MMLOS – Existing Greenbank Road at New E-W Collector

Segment		2031 Total Future Traffic		Target
		EB	NB / SB	
PLOS	Lanes crossed	2	3	C
	Median (yes/no)	No	No	
	Island refuge >=2.4m (yes/no)	No	No	
	Left turn phasing	Permissive	Permissive	
	Right turn conflict	Yes	Yes	
	RTOR (yes/no)	Yes	Yes	
	Leading ped interval (yes/no)	No	No	
	Right turn corner radius (m)	3-5	3-5	
	Crosswalk treatment	Standard	Standard	
	Cycle length (s)	90	90	
	Effective walk time (s)	18	18	
	PETSI Points	87	72	
	PETSI Points LOS	B	C	
	Average Pedestrian Delay (s)	28.8	28.8	
	Ped Delay LOS	C	C	
	Level of Service	C	C	
	Level of Service	**C**		
BLOS	Type of bike lane	Mixed	Separated	C
	Left-turn - lanes crossed	1	NA	
	Left-turn - vehicle operating speed (km/hr)	25	25	
	Right-turn - number of turn lanes	NA	NA	
	Right-turn - turn lane length (m)	NA	NA (Shared)	
	Right-turn - turning speed (km/hr)	NA	15	
	Right-turn - location of bike lane	NA	MUP	
	Level of Service	B	A	
	Level of Service	**B**		
TLOS	Maximum Average Delay (s)	21.8	13.1	D
	Level of Service	D	C	
	Level of Service	**C**		
TkLOS	Effective corner radius (m)	<10	<10	No Target
	Number of receiving lanes	1	1	
	Level of Service	F	F	
	Level of Service	**F**		
VLOS	Maximum Volume-to-capacity (v/c)	0.49	0.72	D
	Level of Service	A	C	
	Level of Service	**C**		

4.9.3 Summary of Required Road Improvements

Error! Reference source not found. provides a summary of the road improvements required in each horizon at the study area intersections to accommodate the proposed development.

It is recommended that the southbound auxiliary left-turning lane at the Existing Greenbank Road at Barnsdale Road gets designed with a storage that can accommodate the expected queue length under the 2035 ultimate conditions (i.e. 85 meters).

Table 29 Summary of Required Road Improvements at The Study Area Intersections

INTERSECTION	EXISTING TRAFFIC CONTROL	2025 FUTURE BACKGROUND	2025 TOTAL FUTURE	2031 FUTURE BACKGROUND	2031 TOTAL FUTURE	2036 ULTIMATE
Barnsdale Road at Borrisokane Road	Minor Stop Control	N/A	N/A	N/A	N/A	N/A
Existing Greenbank at Barnsdale Road	All-Way Stop Control	N/A	Traffic signals with left turn auxiliary lanes	N/A	N/A	N/A
Existing Greenbank Road at Kilbirnie Drive	Minor Stop Control	Addition of northbound left turn auxiliary lane	All-Way Stop Control	Traffic signals with left turn auxiliary lanes along the minor approach	N/A	N/A
River Mist Road at Kilbirnie Drive	All-Way Stop Control	N/A	N/A	N/A	N/A	N/A
Existing Greenbank Road at New E-W Collector	N/A	N/A	Minor Stop Control	Traffic signals with a left turn auxiliary lane along the minor approach	N/A	N/A
River Mist Road at New E-W Collector	N/A	N/A	All-Way Stop Control	N/A	N/A	N/A

5.0 CONCLUSIONS – FUTURE ROADWAY MODIFICATION APPROVAL AT REGISTRATION

This Transportation Impact Assessment is being submitted to support a planning application for *Draft Plan Approval* of Minto's Quinn's Pointe 2 residential development in Barrhaven South. It is anticipated that development will proceed in three phases with full build-out expected by 2031. Accordingly, and at the time of *Registration*, each phase of development will be supported by a future Transportation Impact Assessment specific to the phase that is being registered.

Currently, and with the application being for *Draft Plan Approval*, it is premature to prepare and submit Road Modification Approval (RMA) for the transportation improvements identified in this report. The purpose of an RMA is to identify property requirements (i.e. impacts to right-of-way), potential utility / infrastructure impacts, and capital cost estimates so that the proponent can dedicate land (i.e. right-of-way) and provide securities to the approval authority. However, land and securities are not dedicated at the *Draft Plan Approval* stage. Furthermore, to properly develop functional designs and cost estimates associated with the RMA, the subdivision design must be developed to a sufficient level of detail. At the Draft Plan stage, the subdivision design has not advanced to the point where it can adequately inform the RMA process.

At the time of *Registration*, the Transportation Impact Assessment will address the RMA requirements of the specific phase of development being registered. This will avoid duplication of efforts and time associated with having to prepare and process two RMAs for the same intersections (i.e. one RMA to support *Draft Plan Approval*, and then another RMA to support *Registration*), it will allow for more detailed and accurate input into the RMA given that the plan of subdivision will have advanced to a detailed stage – including producing more refined capital costs for the purposes of identifying securities - and it will also reduce approval authority review efforts including only having to proceed with Municipal Consent Circulation once.

In consideration of the required road improvements identified in this report, and in consideration of the intent of the City's Transportation Impact Assessment Guidelines as it relates to the Road Modification Approval process, the proposed development should be permitted to proceed with *Draft Plan Approval*.

APPENDICES

APPENDIX A TRAFFIC DATA

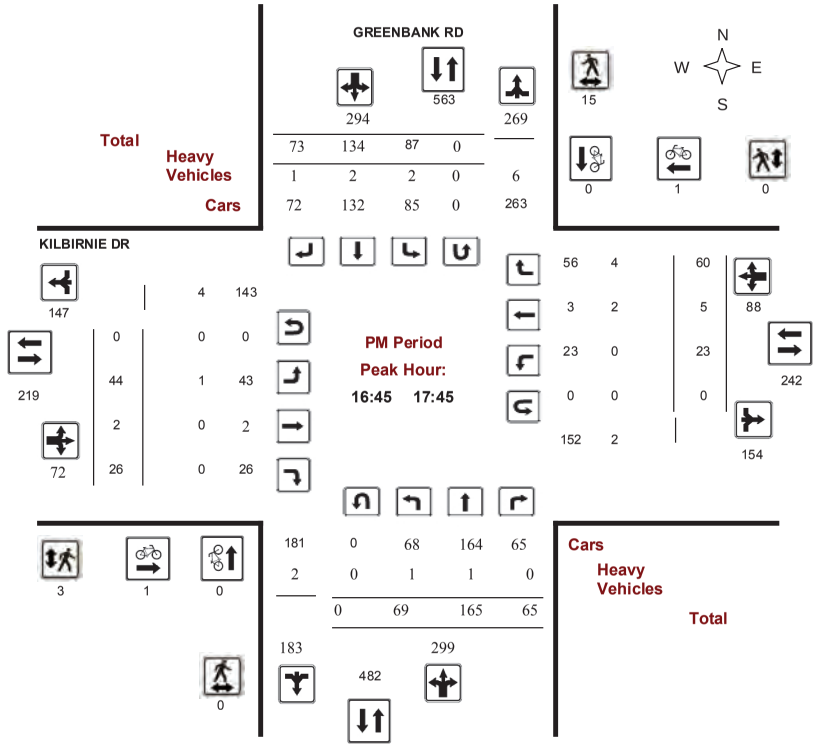
Transportation Services - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram

GREENBANK RD @ KILBIRNIE DR

Survey Date: Thursday, November 09, 2017 **WO No:** 37298

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



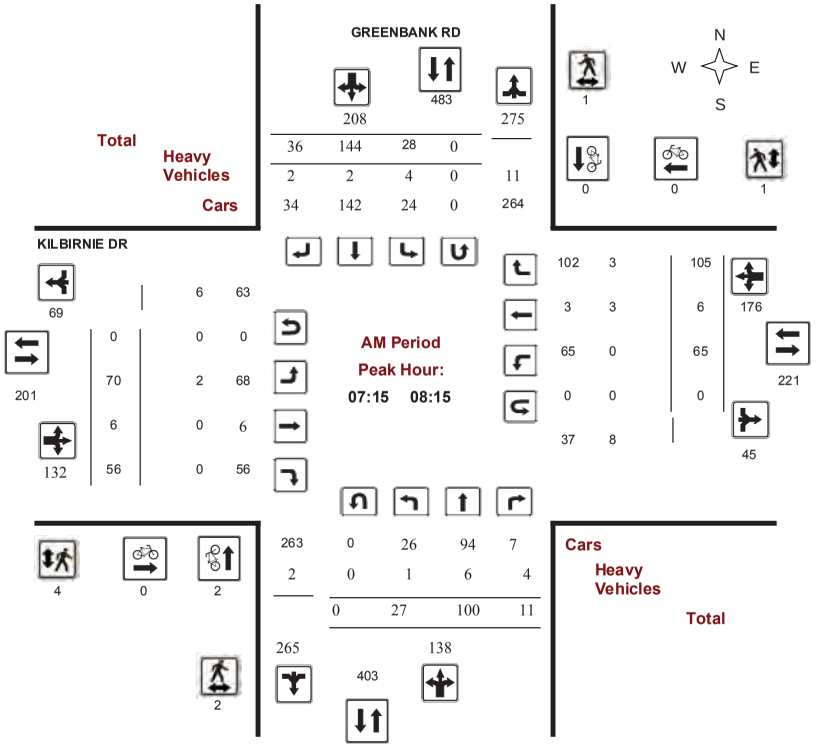
Transportation Services - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram

GREENBANK RD @ KILBIRNIE DR

Survey Date: Thursday, November 09, 2017 **WO No:** 37298

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



Turning Movement Count Report

Report Generated Using Turning Movement Count for Android by PortableStudies.com

Study Information

Study Summary

Count Name
Greenbank Road and Barnsdale Road Weekday AM Peak Hour
Location
Greenbank Road and Barnsdale Road, Ottawa, ON
Performed By
ERS
Date
January 10, 2018

Notes

U = U Turn L = Left Turn T = Thru R = Right Turn
P1 = Pedestrian Direction 1 P2 = Pedestrian Direction 2
Veh = Total Vehicles for Approach

Peak Hour Volume	
569	
% Bank 1	**% Bank 2**
97.4%	2.6%
% Bank 3	**% Bank 4**
0.0%	0.0%
Pedestrians Volume	
0	

Peak Hour Data

Time Period	Eastbound							Westbound							Northbound							Southbound							Total Vehicles	Total Pedestrians
	U	L	T	R	P1	P2	Veh	U	L	T	R	P1	P2	Veh	U	L	T	R	P1	P2	Veh	U	L	T	R	P1	P2	Veh		
7:15 AM	0	10	22	0	0	0	32	0	3	19	7	0	0	29	0	2	17	0	0	0	19	0	51	19	9	0	0	79	159	0
7:30 AM	0	13	23	0	0	0	36	0	0	22	4	0	0	26	0	1	22	0	0	0	23	0	43	17	10	0	0	70	155	0
7:45 AM	0	6	21	3	0	0	30	0	0	18	12	0	0	30	0	2	10	0	0	0	12	0	40	15	7	0	0	62	134	0
8:00 AM	0	4	13	2	0	0	19	0	0	15	14	0	0	29	0	6	9	0	0	0	15	0	32	16	10	0	0	58	121	0

Vehicle Movement Summary

Movement / Details	Eastbound							Westbound							Northbound							Southbound							Entire Intersection	
	U	L	T	R	P1	P2	Veh	U	L	T	R	P1	P2	Veh	U	L	T	R	P1	P2	Veh	U	L	T	R	P1	P2	Veh	Vehicles	Pedestrians
Movement Volume	0	33	79	5	0	0	117	0	3	74	37	0	0	114	0	11	58	0	0	0	69	0	166	67	36	0	0	269	569	0
PHF	-	0.63	0.86	0.42	-	-	0.81	-	0.25	0.84	0.66	-	-	0.95	-	0.46	0.66	-	-	-	0.75	-	0.81	0.88	0.90	-	-	0.85	0.89	-
% Bank 1	0.0%	84.8%	100.0%	80.0%				0.0%	66.7%	100.0%	94.6%				0.0%	81.8%	94.8%	0.0%				0.0%	99.4%	100.0%	100.0%					
% Bank 2	0.0%	15.2%	0.0%	20.0%				0.0%	33.3%	0.0%	5.4%				0.0%	18.2%	5.2%	0.0%				0.0%	0.6%	0.0%	0.0%				**Need a custom report?**	
% Bank 3	0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	0.0%	0.0%				**Contact:**	
% Bank 4	0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	0.0%	0.0%				**support@portablestudies.com**	

Turning Movement Count Report

Report Generated Using Turning Movement Count for Android by PortableStudies.com

Study Information

Study Summary

Count Name
Greenbank Road and Barnsdale Road Weekday PM Peak Hour
Location
Greenbank Road and Barnsdale Road, Ottawa, ON
Performed By
ERS
Date
January 10, 2018

Notes

U = U Turn L = Left Turn T = Thru R = Right Turn
P1 = Pedestrian Direction 1 P2 = Pedestrian Direction 2
Veh = Total Vehicles for Approach

Peak Hour Volume	
715	
% Bank 1	**% Bank 2**
99.2%	0.8%
% Bank 3	**% Bank 4**
0.0%	0.0%
Pedestrians Volume	
0	

Peak Hour Data

Time Period	Eastbound							Westbound							Northbound							Southbound							Total Vehicles	Total Pedestrians
	U	L	T	R	P1	P2	Veh	U	L	T	R	P1	P2	Veh	U	L	T	R	P1	P2	Veh	U	L	T	R	P1	P2	Veh		
4:30 PM	0	6	30	6	0	0	42	0	0	27	39	0	0	66	0	2	21	0	0	0	23	0	18	28	13	0	0	59	190	0
4:45 PM	0	14	21	4	0	0	39	0	0	39	55	0	0	94	0	1	22	0	0	0	23	0	15	30	9	0	0	54	210	0
5:00 PM	0	8	13	6	0	0	27	0	0	25	42	0	0	67	0	3	16	0	0	0	19	0	9	22	4	0	0	35	148	0
5:15 PM	0	9	16	2	0	0	27	0	0	30	49	0	0	79	0	2	21	0	0	0	23	0	12	19	7	0	0	38	167	0

Vehicle Movement Summary

Movement / Details	Eastbound							Westbound							Northbound							Southbound							Entire Intersection	
	U	L	T	R	P1	P2	Veh	U	L	T	R	P1	P2	Veh	U	L	T	R	P1	P2	Veh	U	L	T	R	P1	P2	Veh	Vehicles	Pedestrians
Movement Volume	0	37	80	18	0	0	135	0	0	121	185	0	0	306	0	8	80	0	0	0	88	0	54	99	33	0	0	186	715	0
PHF	-	0.66	0.67	0.75	-	-	0.80	-	-	0.78	0.84	-	-	0.81	-	0.67	0.91	-	-	-	0.96	-	0.75	0.83	0.63	-	-	0.79	0.85	-
% Bank 1	0.0%	100.0%	96.3%	100.0%				0.0%	0.0%	100.0%	100.0%				0.0%	75.0%	100.0%	0.0%				0.0%	100.0%	100.0%	97.0%					
% Bank 2	0.0%	0.0%	3.8%	0.0%				0.0%	0.0%	0.0%	0.0%				0.0%	25.0%	0.0%	0.0%				0.0%	0.0%	0.0%	3.0%				**Need a custom report?**	
% Bank 3	0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	0.0%	0.0%				**Contact:**	
% Bank 4	0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	0.0%	0.0%				**support@portablestudies.com**	

Turning Movement Count Report

Report Generated Using Turning Movement Count for Android by PortableStudies.com

Study Information

Study Summary

Count Name
River Mist and Kilbirnie Drive - Weekday AM Peak Hour
Location
River Mist Road and Kilbirnie Drive, Ottawa, ON
Performed By
ERS
Date
January 9, 2018

Notes

U = U Turn L = Left Turn T = Thru R = Right Turn
P1 = Pedestrian Direction 1 P2 = Pedestrian Direction 2
Veh = Total Vehicles for Approach

Peak Hour Volume	
171	
% Bank 1	**% Bank 2**
91.2%	8.8%
% Bank 3	**% Bank 4**
0.0%	0.0%
Pedestrians Volume	
5	

Peak Hour Data

Time Period	Eastbound							Westbound							Northbound							Southbound							Total Vehicles	Total Pedestrians
	U	L	T	R	P1	P2	Veh	U	L	T	R	P1	P2	Veh	U	L	T	R	P1	P2	Veh	U	L	T	R	P1	P2	Veh		
7:15 AM	0	0	2	0	0	1	2	0	3	5	7	0	0	15	0	2	2	7	0	0	11	0	14	2	0	1	0	16	44	2
7:30 AM	0	0	7	1	0	2	8	0	5	8	8	0	0	21	0	0	6	6	0	0	12	0	11	1	0	0	0	12	53	2
7:45 AM	0	4	4	1	0	1	9	0	2	7	6	0	0	15	0	0	2	4	0	0	6	0	12	1	3	0	0	16	46	1
8:00 AM	0	0	2	2	0	0	4	0	3	1	5	0	0	9	0	0	3	8	0	0	11	0	2	1	1	0	0	4	28	0

Vehicle Movement Summary

Movement / Details	Eastbound							Westbound							Northbound							Southbound							Entire Intersection	
	U	L	T	R	P1	P2	Veh	U	L	T	R	P1	P2	Veh	U	L	T	R	P1	P2	Veh	U	L	T	R	P1	P2	Veh	Vehicles	Pedestrians
Movement Volume	0	4	15	4	0	4	23	0	13	21	26	0	0	60	0	2	13	25	0	0	40	0	39	5	4	1	0	48	171	5
PHF	-	0.25	0.54	0.50	-	0.50	0.64	-	0.65	0.66	0.81	-	-	0.71	-	0.25	0.54	0.78	-	-	0.83	-	0.70	0.63	0.33	0.25	-	0.75	0.81	0.63
% Bank 1	0.0%	100.0%	100.0%	100.0%				0.0%	100.0%	85.7%	73.1%				0.0%	100.0%	92.3%	100.0%				0.0%	89.7%	100.0%	100.0%					
% Bank 2	0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	14.3%	26.9%				0.0%	0.0%	7.7%	0.0%				0.0%	10.3%	0.0%	0.0%				**Need a custom report?**	
% Bank 3	0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	0.0%	0.0%				**Contact:**	
% Bank 4	0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	0.0%	0.0%				**support@portablestudies.com**	

Turning Movement Count Report

Report Generated Using Turning Movement Count for Android by PortableStudies.com

Study Information

Study Summary

Count Name
River Mist and Kilbirnie Drive - Weekday PM Peak Hour
Location
River Mist Road and Kilbirnie Drive, Ottawa, ON
Performed By
ERS
Date
January 9, 2018

Notes

U = U Turn L = Left Turn T = Thru R = Right Turn
P1 = Pedestrian Direction 1 P2 = Pedestrian Direction 2
Veh = Total Vehicles for Approach

Peak Hour Volume	
146	
% Bank 1	**% Bank 2**
95.9%	4.1%
% Bank 3	**% Bank 4**
0.0%	0.0%
Pedestrians Volume	
9	

Peak Hour Data

Time Period	Eastbound							Westbound							Northbound							Southbound							Total Vehicles	Total Pedestrians
	U	L	T	R	P1	P2	Veh	U	L	T	R	P1	P2	Veh	U	L	T	R	P1	P2	Veh	U	L	T	R	P1	P2	Veh		
4:45 PM	0	1	3	0	0	0	4	0	1	9	12	0	0	22	0	0	5	1	0	0	6	0	13	1	1	0	0	15	47	0
5:00 PM	0	0	2	0	0	0	2	0	5	1	9	0	0	15	0	0	2	1	0	0	3	0	6	2	0	1	0	8	28	1
5:15 PM	0	0	0	0	0	0	0	0	4	2	10	1	2	16	0	0	1	4	0	0	5	0	5	9	1	1	0	15	36	4
5:30 PM	0	0	1	1	2	0	2	0	8	1	13	0	0	22	0	0	2	2	2	0	4	0	5	2	0	0	0	7	35	4

Vehicle Movement Summary

Movement / Details	Eastbound							Westbound							Northbound							Southbound							Entire Intersection	
	U	L	T	R	P1	P2	Veh	U	L	T	R	P1	P2	Veh	U	L	T	R	P1	P2	Veh	U	L	T	R	P1	P2	Veh	Vehicles	Pedestrians
Movement Volume	0	1	6	1	2	0	8	0	18	13	44	1	2	75	0	0	10	8	2	0	18	0	29	14	2	2	0	45	146	9
PHF	-	0.25	0.50	0.25	0.25	-	0.50	-	0.56	0.36	0.85	0.25	0.25	0.85	-	-	0.50	0.50	0.25	-	0.75	-	0.56	0.39	0.50	0.50	-	0.75	0.78	0.56
% Bank 1	0.0%	100.0%	83.3%	100.0%				0.0%	100.0%	92.3%	95.5%				0.0%	0.0%	100.0%	100.0%				0.0%	93.1%	100.0%	100.0%					
% Bank 2	0.0%	0.0%	16.7%	0.0%				0.0%	0.0%	7.7%	4.5%				0.0%	0.0%	0.0%	0.0%				0.0%	6.9%	0.0%	0.0%				**Need a custom report?**	
% Bank 3	0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	0.0%	0.0%				**Contact:**	
% Bank 4	0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	0.0%	0.0%				**support@portablestudies.com**	

Intersection:	**Borrisokane at Barnsdale**													
Date:	**23-Jul-15**													
	NBL	**NBT**	**NBR**	**SBL**	**SBT**	**SBR**	**EBL**	**EBT**	**EBR**	**WBL**	**WBT**	**WBR**	**Total**	**Hour**
7:15 - 7:30	0	0	0	2	0	3	4	26	0	0	27	2	64	
7:30 - 7:45	0	0	0	6	0	6	4	23	0	0	26	4	69	
7:45 - 8:00	0	0	0	3	0	4	4	20	0	0	25	3	59	
8:00 - 8 :15	0	0	0	2	0	4	6	25	0	0	23	5	65	257
8:15 - 8:30	0	0	0	2	0	5	2	19	0	0	18	2	48	241
8:30 - 8:45	0	0	0	4	0	3	4	16	0	0	19	1	47	219
Peak Hour	**0**	**0**	**0**	**13**	**0**	**17**	**18**	**94**	**0**	**0**	**101**	**14**		
	NBL	**NBT**	**NBR**	**SBL**	**SBT**	**SBR**	**EBL**	**EBT**	**EBR**	**WBL**	**WBT**	**WBR**	**Total**	**Hour**
3:45 - 4:00	0	0	0	5	0	6	3	29	0	0	19	4	66	
4:00 - 4:15	0	0	0	2	0	7	3	26	0	0	21	4	63	
4:15 - 4:30	0	0	0	4	0	8	1	29	0	0	31	5	78	
4:30 - 4:45	0	0	0	4	0	3	7	23	0	0	27	4	68	275
4:45 - 5:00	0	0	0	3	0	5	4	20	0	0	28	8	68	277
5:00 - 5:15	0	0	0		0	6	5	17	7	0	26	4	65	279
Peak Hour	**0**	**0**	**0**	**11**	**0**	**22**	**17**	**89**	**7**	**0**	**112**	**21**		

APPENDIX B TDM CHECKLISTS

TDM-Supportive Development Design and Infrastructure Checklist:
Residential Developments (multi-family or condominium)

Legend

REQUIRED	The Official Plan or Zoning By-law provides related guidance that must be followed
BASIC	The measure is generally feasible and effective, and in most cases would benefit the development and its users
BETTER	The measure could maximize support for users of sustainable modes, and optimize development performance

		TDM-supportive design & infrastructure measures: *Residential developments*	Check if completed & add descriptions, explanations or plan/drawing references
	1.	**WALKING & CYCLING: ROUTES**	
	1.1	**Building location & access points**	
BASIC	1.1.1	Locate building close to the street, and do not locate parking areas between the street and building entrances	☐ N/A
BASIC	1.1.2	Locate building entrances in order to minimize walking distances to sidewalks and transit stops/stations	☐ N/A
BASIC	1.1.3	Locate building doors and windows to ensure visibility of pedestrians from the building, for their security and comfort	☐ N/A
	1.2	**Facilities for walking & cycling**	
REQUIRED	1.2.1	Provide convenient, direct access to stations or major stops along rapid transit routes within 600 metres; minimize walking distances from buildings to rapid transit; provide pedestrian-friendly, weather-protected (where possible) environment between rapid transit accesses and building entrances; ensure quality linkages from sidewalks through building entrances to integrated stops/stations *(see Official Plan policy 4.3.3)*	☑
REQUIRED	1.2.2	Provide safe, direct and attractive pedestrian access from public sidewalks to building entrances through such measures as: reducing distances between public sidewalks and major building entrances; providing walkways from public streets to major building entrances; within a site, providing walkways along the front of adjoining buildings, between adjacent buildings, and connecting areas where people may congregate, such as courtyards and transit stops; and providing weather protection through canopies, colonnades, and other design elements wherever possible *(see Official Plan policy 4.3.12)*	☑

TDM-supportive design & infrastructure measures: *Residential developments*			Check if completed & add descriptions, explanations or plan/drawing references
REQUIRED	1.2.3	Provide sidewalks of smooth, well-drained walking surfaces of contrasting materials or treatments to differentiate pedestrian areas from vehicle areas, and provide marked pedestrian crosswalks at intersection sidewalks *(see Official Plan policy 4.3.10)*	☑
REQUIRED	1.2.4	Make sidewalks and open space areas easily accessible through features such as gradual grade transition, depressed curbs at street corners and convenient access to extra-wide parking spaces and ramps *(see Official Plan policy 4.3.10)*	☑
REQUIRED	1.2.5	Include adequately spaced inter-block/street cycling and pedestrian connections to facilitate travel by active transportation. Provide links to the existing or planned network of public sidewalks, multi-use pathways and on-road cycle routes. Where public sidewalks and multi-use pathways intersect with roads, consider providing traffic control devices to give priority to cyclists and pedestrians *(see Official Plan policy 4.3.11)*	☑
BASIC	1.2.6	Provide safe, direct and attractive walking routes from building entrances to nearby transit stops	☑
BASIC	1.2.7	Ensure that walking routes to transit stops are secure, visible, lighted, shaded and wind-protected wherever possible	☑
BASIC	1.2.8	Design roads used for access or circulation by cyclists using a target operating speed of no more than 30 km/h, or provide a separated cycling facility	☒ Roads inside the plan of subdivision will have an operating speed of 40-50 km/h
	1.3	**Amenities for walking & cycling**	
BASIC	1.3.1	Provide lighting, landscaping and benches along walking and cycling routes between building entrances and streets, sidewalks and trails	☑
BASIC	1.3.2	Provide wayfinding signage for site access (where required, e.g. when multiple buildings or entrances exist) and egress (where warranted, such as when directions to reach transit stops/stations, trails or other common destinations are not obvious)	☐ N/A

		TDM-supportive design & infrastructure measures: *Residential developments*	Check if completed & add descriptions, explanations or plan/drawing references
	2.	**WALKING & CYCLING: END-OF-TRIP FACILITIES**	
	2.1	**Bicycle parking**	
REQUIRED	2.1.1	Provide bicycle parking in highly visible and lighted areas, sheltered from the weather wherever possible *(see Official Plan policy 4.3.6)*	☐ N/A
REQUIRED	2.1.2	Provide the number of bicycle parking spaces specified for various land uses in different parts of Ottawa; provide convenient access to main entrances or well-used areas *(see Zoning By-law Section 111)*	☐ N/A
REQUIRED	2.1.3	Ensure that bicycle parking spaces and access aisles meet minimum dimensions; that no more than 50% of spaces are vertical spaces; and that parking racks are securely anchored *(see Zoning By-law Section 111)*	☐ N/A
BASIC	2.1.4	Provide bicycle parking spaces equivalent to the expected number of resident-owned bicycles, plus the expected peak number of visitor cyclists	☐ N/A
	2.2	**Secure bicycle parking**	
REQUIRED	2.2.1	Where more than 50 bicycle parking spaces are provided for a single residential building, locate at least 25% of spaces within a building/structure, a secure area (e.g. supervised parking lot or enclosure) or bicycle lockers *(see Zoning By-law Section 111)*	☐ N/A
BETTER	2.2.2	Provide secure bicycle parking spaces equivalent to at least the number of units at condominiums or multi-family residential developments	☐ N/A
	2.3	**Bicycle repair station**	
BETTER	2.3.1	Provide a permanent bike repair station, with commonly used tools and an air pump, adjacent to the main bicycle parking area (or secure bicycle parking area, if provided)	☐ N/A
	3.	**TRANSIT**	
	3.1	**Customer amenities**	
BASIC	3.1.1	Provide shelters, lighting and benches at any on-site transit stops	☐ N/A
BASIC	3.1.2	Where the site abuts an off-site transit stop and insufficient space exists for a transit shelter in the public right-of-way, protect land for a shelter and/or install a shelter	☐ N/A
BETTER	3.1.3	Provide a secure and comfortable interior waiting area by integrating any on-site transit stops into the building	☐ N/A

		TDM-supportive design & infrastructure measures: *Residential developments*	Check if completed & add descriptions, explanations or plan/drawing references
	4.	**RIDESHARING**	
	4.1	**Pick-up & drop-off facilities**	
BASIC	4.1.1	Provide a designated area for carpool drivers (plus taxis and ride-hailing services) to drop off or pick up passengers without using fire lanes or other no-stopping zones	☐ N/A
	5.	**CARSHARING & BIKESHARING**	
	5.1	**Carshare parking spaces**	
BETTER	5.1.1	Provide up to three carshare parking spaces in an R3, R4 or R5 Zone for specified residential uses *(see Zoning By-law Section 94)*	☐ N/A
	5.2	**Bikeshare station location**	
BETTER	5.2.1	Provide a designated bikeshare station area near a major building entrance, preferably lighted and sheltered with a direct walkway connection	☐ N/A
	6.	**PARKING**	
	6.1	**Number of parking spaces**	
REQUIRED	6.1.1	Do not provide more parking than permitted by zoning, nor less than required by zoning, unless a variance is being applied for	☐ N/A
BASIC	6.1.2	Provide parking for long-term and short-term users that is consistent with mode share targets, considering the potential for visitors to use off-site public parking	☐ N/A
BASIC	6.1.3	Where a site features more than one use, provide shared parking and reduce the cumulative number of parking spaces accordingly *(see Zoning By-law Section 104)*	☐ N/A
BETTER	6.1.4	Reduce the minimum number of parking spaces required by zoning by one space for each 13 square metres of gross floor area provided as shower rooms, change rooms, locker rooms and other facilities for cyclists in conjunction with bicycle parking *(see Zoning By-law Section 111)*	☐ N/A
	6.2	**Separate long-term & short-term parking areas**	
BETTER	6.2.1	Provide separate areas for short-term and long-term parking (using signage or physical barriers) to permit access controls and simplify enforcement (i.e. to discourage residents from parking in visitor spaces, and vice versa)	☐ N/A

TDM Measures Checklist:
Residential Developments (multi-family, condominium or subdivision)

Legend

BASIC — The measure is generally feasible and effective, and in most cases would benefit the development and its users

BETTER — The measure could maximize support for users of sustainable modes, and optimize development performance

★ — The measure is one of the most dependably effective tools to encourage the use of sustainable modes

		TDM measures: *Residential developments*	Check if proposed & add descriptions
	1.	**TDM PROGRAM MANAGEMENT**	
	1.1	**Program coordinator**	
BASIC ★	1.1.1	Designate an internal coordinator, or contract with an external coordinator	X
	1.2	**Travel surveys**	
BETTER	1.2.1	Conduct periodic surveys to identify travel-related behaviours, attitudes, challenges and solutions, and to track progress	X
	2.	**WALKING AND CYCLING**	
	2.1	**Information on walking/cycling routes & destinations**	
BASIC	2.1.1	Display local area maps with walking/cycling access routes and key destinations at major entrances *(multi-family, condominium)*	X
	2.2	**Bicycle skills training**	
BETTER	2.2.1	Offer on-site cycling courses for residents, or subsidize off-site courses	X

		TDM measures: *Residential developments*	Check if proposed & add descriptions
		3. TRANSIT	
		3.1 Transit information	
BASIC		3.1.1 Display relevant transit schedules and route maps at entrances *(multi-family, condominium)*	☒
BETTER		3.1.2 Provide real-time arrival information display at entrances *(multi-family, condominium)*	☒
		3.2 Transit fare incentives	
BASIC	★	3.2.1 Offer PRESTO cards preloaded with one monthly transit pass on residence purchase/move-in, to encourage residents to use transit	☒
BETTER		3.2.2 Offer at least one year of free monthly transit passes on residence purchase/move-in	☒
		3.3 Enhanced public transit service	
BETTER	★	3.3.1 Contract with OC Transpo to provide early transit services until regular services are warranted by occupancy levels *(subdivision)*	☑
		3.4 Private transit service	
BETTER		3.4.1 Provide shuttle service for seniors homes or lifestyle communities (e.g. scheduled mall or supermarket runs)	☒
		4. CARSHARING & BIKESHARING	
		4.1 Bikeshare stations & memberships	
BETTER		4.1.1 Contract with provider to install on-site bikeshare station *(multi-family)*	☒
BETTER		4.1.2 Provide residents with bikeshare memberships, either free or subsidized *(multi-family)*	☒
		4.2 Carshare vehicles & memberships	
BETTER		4.2.1 Contract with provider to install on-site carshare vehicles and promote their use by residents	☒
BETTER		4.2.2 Provide residents with carshare memberships, either free or subsidized	☒
		5. PARKING	
		5.1 Priced parking	
BASIC	★	5.1.1 Unbundle parking cost from purchase price *(condominium)*	☒
BASIC	★	5.1.2 Unbundle parking cost from monthly rent *(multi-family)*	☒

TDM measures: *Residential developments*				Check if proposed & add descriptions
		6.	**TDM MARKETING & COMMUNICATIONS**	
		6.1	**Multimodal travel information**	
BASIC	★	6.1.1	Provide a multimodal travel option information package to new residents	☒
		6.2	**Personalized trip planning**	
BETTER	★	6.2.1	Offer personalized trip planning to new residents	☒

APPENDIX C INTERSECTION PERFORMANCE WORKSHEETS

C.1 2018 EXISTING CONDITIONS

Intersection	
Int Delay, s/veh	1.9

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	23	98	107	18	17	22
Future Vol, veh/h	23	98	107	18	17	22
Conflicting Peds, #/hr	5	0	0	5	5	5
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	26	109	119	20	19	24

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	144	0	-	0	299	139
Stage 1	-	-	-	-	134	-
Stage 2	-	-	-	-	165	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1438	-	-	-	692	909
Stage 1	-	-	-	-	892	-
Stage 2	-	-	-	-	864	-
Platoon blocked, %		-	-			
Mov Cap-1 Maneuver	1431	-	-	-	673	901
Mov Cap-2 Maneuver	-	-	-	-	673	-
Stage 1	-	-	-	-	888	-
Stage 2	-	-	-	-	844	-

Approach	EB	WB	SB
HCM Control Delay, s	1.4	0	9.9
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1431	-	-	-	785
HCM Lane V/C Ratio	0.018	-	-	-	0.055
HCM Control Delay (s)	7.6	0	-	-	9.9
HCM Lane LOS	A	A	-	-	A
HCM 95th %tile Q(veh)	0.1	-	-	-	0.2

Intersection	
Intersection Delay, s/veh	9.9
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	79	0	3	76	47	11	70	0	174	74	36
Future Vol, veh/h	0	79	0	3	76	47	11	70	0	174	74	36
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
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	88	0	3	84	52	12	78	0	193	82	40
Number of Lanes	0	1	0	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	8.9	9	8.6	10.9
HCM LOS	A	A	A	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	14%	0%	2%	61%
Vol Thru, %	86%	100%	60%	26%
Vol Right, %	0%	0%	37%	13%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	81	79	126	284
LT Vol	11	0	3	174
Through Vol	70	79	76	74
RT Vol	0	0	47	36
Lane Flow Rate	90	88	140	316
Geometry Grp	1	1	1	1
Degree of Util (X)	0.122	0.124	0.187	0.407
Departure Headway (Hd)	4.898	5.084	4.799	4.648
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	727	701	743	770
Service Time	2.958	3.145	2.853	2.695
HCM Lane V/C Ratio	0.124	0.126	0.188	0.41
HCM Control Delay	8.6	8.9	9	10.9
HCM Lane LOS	A	A	A	B
HCM 95th-tile Q	0.4	0.4	0.7	2

Intersection	
Int Delay, s/veh	6.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	71	6	57	66	6	107	28	111	11	29	160	37
Future Vol, veh/h	71	6	57	66	6	107	28	111	11	29	160	37
Conflicting Peds, #/hr	5	0	5	5	0	5	5	0	5	5	0	5
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	200	-	-	200	-	-	-	-	450	450	-	450
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	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
Mvmt Flow	79	7	63	73	7	119	31	123	12	32	178	41

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	500	438	188	473	438	133	183	0	0	128	0	0
Stage 1	247	247	-	191	191	-	-	-	-	-	-	-
Stage 2	253	191	-	282	247	-	-	-	-	-	-	-
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	-	-
Pot Cap-1 Maneuver	481	512	854	501	512	916	1392	-	-	1458	-	-
Stage 1	757	702	-	811	742	-	-	-	-	-	-	-
Stage 2	751	742	-	725	702	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	396	484	846	439	484	907	1386	-	-	1451	-	-
Mov Cap-2 Maneuver	396	484	-	439	484	-	-	-	-	-	-	-
Stage 1	735	683	-	788	721	-	-	-	-	-	-	-
Stage 2	628	721	-	647	683	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	13.3	11.7	1.4	1
HCM LOS	B	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1386	-	-	396	790	439	867	1451	-	-
HCM Lane V/C Ratio	0.022	-	-	0.199	0.089	0.167	0.145	0.022	-	-
HCM Control Delay (s)	7.7	0	-	16.3	10	14.8	9.9	7.5	-	-
HCM Lane LOS	A	A	-	C	B	B	A	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	0.7	0.3	0.6	0.5	0.1	-	-

Intersection	
Intersection Delay, s/veh	7.3
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	4	15	4	13	21	26	2	13	25	39	5	4
Future Vol, veh/h	4	15	4	13	21	26	2	13	25	39	5	4
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
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	4	17	4	14	23	29	2	14	28	43	6	4
Number of Lanes	0	1	0	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	7.3	7.3	7	7.6
HCM LOS	A	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	5%	17%	22%	81%
Vol Thru, %	33%	65%	35%	10%
Vol Right, %	62%	17%	43%	8%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	40	23	60	48
LT Vol	2	4	13	39
Through Vol	13	15	21	5
RT Vol	25	4	26	4
Lane Flow Rate	44	26	67	53
Geometry Grp	1	1	1	1
Degree of Util (X)	0.047	0.029	0.072	0.063
Departure Headway (Hd)	3.769	4.085	3.906	4.241
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	943	870	911	841
Service Time	1.82	2.141	1.956	2.285
HCM Lane V/C Ratio	0.047	0.03	0.074	0.063
HCM Control Delay	7	7.3	7.3	7.6
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0.1	0.1	0.2	0.2

Intersection	
Int Delay, s/veh	2.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	20	98	134	30	20	41
Future Vol, veh/h	20	98	134	30	20	41
Conflicting Peds, #/hr	5	0	0	5	5	5
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	22	109	149	33	22	46

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	187	0	-	0	329	176
Stage 1	-	-	-	-	171	-
Stage 2	-	-	-	-	158	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1387	-	-	-	665	867
Stage 1	-	-	-	-	859	-
Stage 2	-	-	-	-	871	-
Platoon blocked, %		-	-			
Mov Cap-1 Maneuver	1381	-	-	-	648	859
Mov Cap-2 Maneuver	-	-	-	-	648	-
Stage 1	-	-	-	-	855	-
Stage 2	-	-	-	-	852	-

Approach	EB	WB	SB
HCM Control Delay, s	1.3	0	10.1
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1381	-	-	-	776
HCM Lane V/C Ratio	0.016	-	-	-	0.087
HCM Control Delay (s)	7.6	0	-	-	10.1
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0.3

Intersection	
Intersection Delay, s/veh	10.9
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	37	80	0	0	121	200	8	86	0	59	109	33
Future Vol, veh/h	37	80	0	0	121	200	8	86	0	59	109	33
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
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	41	89	0	0	134	222	9	96	0	66	121	37
Number of Lanes	0	1	0	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	9.7	11.7	9.6	10.9
HCM LOS	A	B	A	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	9%	32%	0%	29%
Vol Thru, %	91%	68%	38%	54%
Vol Right, %	0%	0%	62%	16%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	94	117	321	201
LT Vol	8	37	0	59
Through Vol	86	80	121	109
RT Vol	0	0	200	33
Lane Flow Rate	104	130	357	223
Geometry Grp	1	1	1	1
Degree of Util (X)	0.161	0.195	0.465	0.328
Departure Headway (Hd)	5.54	5.395	4.692	5.286
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	647	664	774	679
Service Time	3.579	3.431	2.692	3.32
HCM Lane V/C Ratio	0.161	0.196	0.461	0.328
HCM Control Delay	9.6	9.7	11.7	10.9
HCM Lane LOS	A	A	B	B
HCM 95th-tile Q	0.6	0.7	2.5	1.4

Intersection	
Int Delay, s/veh	4.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	45	2	27	23	5	61	70	186	66	89	151	74
Future Vol, veh/h	45	2	27	23	5	61	70	186	66	89	151	74
Conflicting Peds, #/hr	5	0	5	5	0	5	5	0	5	5	0	5
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	200	-	-	200	-	-	-	-	450	450	-	450
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	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
Mvmt Flow	50	2	30	26	6	68	78	207	73	99	168	82

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	775	738	178	754	738	217	173	0	0	212	0	0
Stage 1	371	371	-	367	367	-	-	-	-	-	-	-
Stage 2	404	367	-	387	371	-	-	-	-	-	-	-
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	-	-
Pot Cap-1 Maneuver	315	346	865	326	346	823	1404	-	-	1358	-	-
Stage 1	649	620	-	653	622	-	-	-	-	-	-	-
Stage 2	623	622	-	637	620	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	253	296	857	278	296	815	1397	-	-	1352	-	-
Mov Cap-2 Maneuver	253	296	-	278	296	-	-	-	-	-	-	-
Stage 1	603	572	-	606	578	-	-	-	-	-	-	-
Stage 2	525	578	-	565	572	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	17.7	12.8	1.7	2.2
HCM LOS	C	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1397	-	-	253	758	278	719	1352	-	-
HCM Lane V/C Ratio	0.056	-	-	0.198	0.043	0.092	0.102	0.073	-	-
HCM Control Delay (s)	7.7	0	-	22.7	10	19.3	10.6	7.9	-	-
HCM Lane LOS	A	A	-	C	B	C	B	A	-	-
HCM 95th %tile Q(veh)	0.2	-	-	0.7	0.1	0.3	0.3	0.2	-	-

Intersection	
Intersection Delay, s/veh	7.3
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	1	6	1	19	14	45	0	10	8	30	14	2
Future Vol, veh/h	1	6	1	19	14	45	0	10	8	30	14	2
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
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	1	7	1	21	16	50	0	11	9	33	16	2
Number of Lanes	0	1	0	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	7.2	7.2	7	7.5
HCM LOS	A	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	0%	12%	24%	65%
Vol Thru, %	56%	75%	18%	30%
Vol Right, %	44%	12%	58%	4%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	18	8	78	46
LT Vol	0	1	19	30
Through Vol	10	6	14	14
RT Vol	8	1	45	2
Lane Flow Rate	20	9	87	51
Geometry Grp	1	1	1	1
Degree of Util (X)	0.022	0.01	0.091	0.06
Departure Headway (Hd)	3.872	4.073	3.766	4.22
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	919	873	947	847
Service Time	1.917	2.123	1.805	2.255
HCM Lane V/C Ratio	0.022	0.01	0.092	0.06
HCM Control Delay	7	7.2	7.2	7.5
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0.1	0	0.3	0.2

C.2 2025 FUTURE BACKGROUND CONDITIONS

Intersection	
Int Delay, s/veh	2.9

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	37	113	123	27	34	46
Future Vol, veh/h	37	113	123	27	34	46
Conflicting Peds, #/hr	5	0	0	5	5	5
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	37	113	123	27	34	46

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	155	0	-	0	334	147
Stage 1	-	-	-	-	142	-
Stage 2	-	-	-	-	192	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1425	-	-	-	661	900
Stage 1	-	-	-	-	885	-
Stage 2	-	-	-	-	841	-
Platoon blocked, %		-	-			
Mov Cap-1 Maneuver	1418	-	-	-	637	892
Mov Cap-2 Maneuver	-	-	-	-	637	-
Stage 1	-	-	-	-	881	-
Stage 2	-	-	-	-	814	-

Approach	EB	WB	SB
HCM Control Delay, s	1.9	0	10.3
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1418	-	-	-	762
HCM Lane V/C Ratio	0.026	-	-	-	0.105
HCM Control Delay (s)	7.6	0	-	-	10.3
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0.1	-	-	-	0.4

Intersection	
Intersection Delay, s/veh	12.4
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	38	90	15	3	87	63	19	124	0	230	142	42
Future Vol, veh/h	38	90	15	3	87	63	19	124	0	230	142	42
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	38	90	15	3	87	63	19	124	0	230	142	42
Number of Lanes	0	1	0	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	10.4	10.1	9.9	14.9
HCM LOS	B	B	A	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	13%	27%	2%	56%
Vol Thru, %	87%	63%	57%	34%
Vol Right, %	0%	10%	41%	10%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	143	143	153	414
LT Vol	19	38	3	230
Through Vol	124	90	87	142
RT Vol	0	15	63	42
Lane Flow Rate	143	143	153	414
Geometry Grp	1	1	1	1
Degree of Util (X)	0.215	0.225	0.23	0.584
Departure Headway (Hd)	5.406	5.657	5.414	5.074
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	664	633	661	716
Service Time	3.449	3.703	3.46	3.074
HCM Lane V/C Ratio	0.215	0.226	0.231	0.578
HCM Control Delay	9.9	10.4	10.1	14.9
HCM Lane LOS	A	B	B	B
HCM 95th-tile Q	0.8	0.9	0.9	3.8

Intersection	
Int Delay, s/veh	6.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	101	6	95	66	6	107	39	169	11	29	236	45
Future Vol, veh/h	101	6	95	66	6	107	39	169	11	29	236	45
Conflicting Peds, #/hr	5	0	5	5	0	5	5	0	5	5	0	5
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	200	-	-	200	-	-	500	-	375	500	-	375
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	101	6	95	66	6	107	39	169	11	29	236	45

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	608	551	246	602	551	179	241	0	0	174	0	0
Stage 1	299	299	-	252	252	-	-	-	-	-	-	-
Stage 2	309	252	-	350	299	-	-	-	-	-	-	-
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	-	-
Pot Cap-1 Maneuver	408	442	793	412	442	864	1326	-	-	1403	-	-
Stage 1	710	666	-	752	698	-	-	-	-	-	-	-
Stage 2	701	698	-	666	666	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	337	416	786	341	416	856	1320	-	-	1396	-	-
Mov Cap-2 Maneuver	337	416	-	341	416	-	-	-	-	-	-	-
Stage 1	686	649	-	726	674	-	-	-	-	-	-	-
Stage 2	587	674	-	565	649	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	15.4	13.1	1.4	0.7
HCM LOS	C	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1320	-	-	337	747	341	810	1396	-	-
HCM Lane V/C Ratio	0.03	-	-	0.3	0.135	0.194	0.14	0.021	-	-
HCM Control Delay (s)	7.8	-	-	20.2	10.6	18.1	10.2	7.6	-	-
HCM Lane LOS	A	-	-	C	B	C	B	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	1.2	0.5	0.7	0.5	0.1	-	-

Intersection	
Intersection Delay, s/veh	7.6
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	38	70	4	15	38	26	2	13	32	39	5	14
Future Vol, veh/h	38	70	4	15	38	26	2	13	32	39	5	14
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	38	70	4	15	38	26	2	13	32	39	5	14
Number of Lanes	0	1	0	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	7.9	7.5	7.2	7.7
HCM LOS	A	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	4%	34%	19%	67%
Vol Thru, %	28%	62%	48%	9%
Vol Right, %	68%	4%	33%	24%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	47	112	79	58
LT Vol	2	38	15	39
Through Vol	13	70	38	5
RT Vol	32	4	26	14
Lane Flow Rate	47	112	79	58
Geometry Grp	1	1	1	1
Degree of Util (X)	0.052	0.131	0.089	0.071
Departure Headway (Hd)	4.02	4.225	4.044	4.395
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	896	839	873	820
Service Time	2.022	2.298	2.129	2.396
HCM Lane V/C Ratio	0.052	0.133	0.09	0.071
HCM Control Delay	7.2	7.9	7.5	7.7
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0.2	0.5	0.3	0.2

Intersection	
Int Delay, s/veh	2.9

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	39	112	152	62	33	64
Future Vol, veh/h	39	112	152	62	33	64
Conflicting Peds, #/hr	5	0	0	5	5	5
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	39	112	152	62	33	64

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	219	0	-	0	383	193
Stage 1	-	-	-	-	188	-
Stage 2	-	-	-	-	195	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1350	-	-	-	620	849
Stage 1	-	-	-	-	844	-
Stage 2	-	-	-	-	838	-
Platoon blocked, %		-	-			
Mov Cap-1 Maneuver	1344	-	-	-	595	841
Mov Cap-2 Maneuver	-	-	-	-	595	-
Stage 1	-	-	-	-	840	-
Stage 2	-	-	-	-	808	-

Approach	EB	WB	SB
HCM Control Delay, s	2	0	10.6
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1344	-	-	-	737
HCM Lane V/C Ratio	0.029	-	-	-	0.132
HCM Control Delay (s)	7.8	0	-	-	10.6
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0.1	-	-	-	0.5

Intersection	
Intersection Delay, s/veh	15.3
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	43	91	10	0	138	261	36	167	0	85	216	38
Future Vol, veh/h	43	91	10	0	138	261	36	167	0	85	216	38
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	43	91	10	0	138	261	36	167	0	85	216	38
Number of Lanes	0	1	0	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	11.7	17	12.8	16.4
HCM LOS	B	C	B	C

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	18%	30%	0%	25%
Vol Thru, %	82%	63%	35%	64%
Vol Right, %	0%	7%	65%	11%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	203	144	399	339
LT Vol	36	43	0	85
Through Vol	167	91	138	216
RT Vol	0	10	261	38
Lane Flow Rate	203	144	399	339
Geometry Grp	1	1	1	1
Degree of Util (X)	0.355	0.257	0.614	0.563
Departure Headway (Hd)	6.288	6.433	5.541	5.975
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	570	557	654	603
Service Time	4.337	4.489	3.562	4
HCM Lane V/C Ratio	0.356	0.259	0.61	0.562
HCM Control Delay	12.8	11.7	17	16.4
HCM Lane LOS	B	B	C	C
HCM 95th-tile Q	1.6	1	4.2	3.5

Intersection	
Int Delay, s/veh	5.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	62	2	50	23	5	61	109	276	66	89	260	104
Future Vol, veh/h	62	2	50	23	5	61	109	276	66	89	260	104
Conflicting Peds, #/hr	5	0	5	5	0	5	5	0	5	5	0	5
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	200	-	-	200	-	-	450	-	450	450	-	450
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	62	2	50	23	5	61	109	276	66	89	260	104

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	975	942	270	968	942	286	265	0	0	281	0	0
Stage 1	443	443	-	499	499	-	-	-	-	-	-	-
Stage 2	532	499	-	469	443	-	-	-	-	-	-	-
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	-	-
Pot Cap-1 Maneuver	231	263	769	233	263	753	1299	-	-	1282	-	-
Stage 1	594	576	-	554	544	-	-	-	-	-	-	-
Stage 2	531	544	-	575	576	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	183	222	762	190	222	746	1293	-	-	1276	-	-
Mov Cap-2 Maneuver	183	222	-	190	222	-	-	-	-	-	-	-
Stage 1	541	533	-	505	496	-	-	-	-	-	-	-
Stage 2	440	496	-	496	533	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	23.5	15.2	1.9	1.6
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1293	-	-	183	697	190	633	1276	-	-
HCM Lane V/C Ratio	0.084	-	-	0.339	0.075	0.121	0.104	0.07	-	-
HCM Control Delay (s)	8	-	-	34.4	10.6	26.5	11.3	8	-	-
HCM Lane LOS	A	-	-	D	B	D	B	A	-	-
HCM 95th %tile Q(veh)	0.3	-	-	1.4	0.2	0.4	0.3	0.2	-	-

Intersection	
Intersection Delay, s/veh	7.7
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	21	39	1	26	71	45	5	10	12	30	14	37
Future Vol, veh/h	21	39	1	26	71	45	5	10	12	30	14	37
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	39	1	26	71	45	5	10	12	30	14	37
Number of Lanes	0	1	0	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	7.7	7.9	7.4	7.6
HCM LOS	A	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	19%	34%	18%	37%
Vol Thru, %	37%	64%	50%	17%
Vol Right, %	44%	2%	32%	46%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	27	61	142	81
LT Vol	5	21	26	30
Through Vol	10	39	71	14
RT Vol	12	1	45	37
Lane Flow Rate	27	61	142	81
Geometry Grp	1	1	1	1
Degree of Util (X)	0.032	0.073	0.158	0.095
Departure Headway (Hd)	4.235	4.291	4.014	4.207
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	850	823	882	857
Service Time	2.238	2.381	2.092	2.208
HCM Lane V/C Ratio	0.032	0.074	0.161	0.095
HCM Control Delay	7.4	7.7	7.9	7.6
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0.1	0.2	0.6	0.3

C.3 2025 TOTAL FUTURE CONDITIONS

Intersection	
Int Delay, s/veh	2.9

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	37	113	123	27	34	46
Future Vol, veh/h	37	113	123	27	34	46
Conflicting Peds, #/hr	5	0	0	5	5	5
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	37	113	123	27	34	46

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	155	0	-	0	334	147
Stage 1	-	-	-	-	142	-
Stage 2	-	-	-	-	192	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1425	-	-	-	661	900
Stage 1	-	-	-	-	885	-
Stage 2	-	-	-	-	841	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1418	-	-	-	637	892
Mov Cap-2 Maneuver	-	-	-	-	637	-
Stage 1	-	-	-	-	881	-
Stage 2	-	-	-	-	814	-

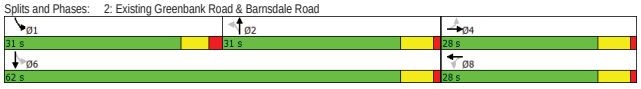
Approach	EB	WB	SB
HCM Control Delay, s	1.9	0	10.3
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1418	-	-	-	762
HCM Lane V/C Ratio	0.026	-	-	-	0.105
HCM Control Delay (s)	7.6	0	-	-	10.3
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0.1	-	-	-	0.4

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	38	90	15	3	87	115	19	133	0	357	169	42
Future Volume (vph)	38	90	15	3	87	115	19	133	0	357	169	42
Satd. Flow (prot)	1658	1701	0	1658	1567	0	1658	1745	0	1658	1682	0
Flt Permitted	0.490			0.689			0.626			0.580		
Satd. Flow (perm)	848	1701	0	1189	1567	0	1082	1745	0	1003	1682	0
Satd. Flow (RTOR)		9			70						27	
Lane Group Flow (vph)	38	105	0	3	202	0	19	133	0	357	211	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		4			8			2		1	6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		2	2		1	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0		10.0	10.0		5.0	10.0	
Minimum Split (s)	23.6	23.6		23.6	23.6		23.6	23.6		11.0	23.6	
Total Split (s)	28.0	28.0		28.0	28.0		31.0	31.0		31.0	62.0	
Total Split (%)	31.1%	31.1%		31.1%	31.1%		34.4%	34.4%		34.4%	68.9%	
Yellow Time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.0	4.6	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		2.0	1.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	5.6	5.6		5.6	5.6		5.6	5.6		6.0	5.6	
Lead/Lag							Lag	Lag		Lead		
Lead-Lag Optimize?							Yes	Yes		Yes		
Recall Mode	None	None		None	None		Max	Max		None	Max	
Act Effct Green (s)	13.2	13.2		13.2	13.2		37.8	37.8		56.1	56.5	
Actuated g/C Ratio	0.16	0.16		0.16	0.16		0.47	0.47		0.69	0.70	
v/c Ratio	0.28	0.37		0.02	0.65		0.04	0.16		0.45	0.18	
Control Delay	34.6	31.0		27.3	30.3		15.7	15.5		7.3	4.6	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	34.6	31.0		27.3	30.3		15.7	15.5		7.3	4.6	
LOS	C	C		C	C		B	B		A	A	
Approach Delay		31.9			30.2			15.5			6.3	
Approach LOS		C			C			B			A	

Intersection Summary			
Cycle Length: 90			
Actuated Cycle Length: 80.9			
Natural Cycle: 60			
Control Type: Semi Act-Uncoord			
Maximum v/c Ratio: 0.65			
Intersection Signal Delay: 15.6		Intersection LOS: B	
Intersection Capacity Utilization 75.8%		ICU Level of Service D	
Analysis Period (min) 15			

Splits and Phases: 2: Existing Greenbank Road & Barnsdale Road



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	38	105	3	202	19	133	357	211
v/c Ratio	0.28	0.37	0.02	0.65	0.04	0.16	0.45	0.18
Control Delay	34.6	31.0	27.3	30.3	15.7	15.5	7.3	4.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	34.6	31.0	27.3	30.3	15.7	15.5	7.3	4.6
Queue Length 50th (m)	5.2	13.2	0.4	18.8	1.5	10.8	17.2	7.6
Queue Length 95th (m)	13.6	26.7	2.5	39.2	6.6	27.8	37.7	19.1
Internal Link Dist (m)		999.3		579.2		705.1		181.0
Turn Bay Length (m)	37.5		37.5		37.5		37.5	
Base Capacity (vph)	235	478	329	485	505	814	898	1182
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.16	0.22	0.01	0.42	0.04	0.16	0.40	0.18

Intersection Summary

Intersection	
Int Delay, s/veh	8.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	129	6	138	66	6	107	62	248	11	29	263	56
Future Vol, veh/h	129	6	138	66	6	107	62	248	11	29	263	56
Conflicting Peds, #/hr	5	0	5	5	0	5	5	0	5	5	0	5
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	200	-	-	200	-	-	500	-	375	500	-	375
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	100	100	100	100	100	100	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	129	6	138	66	6	107	62	248	11	29	263	56

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	760	703	273	775	703	258	268	0	0	253	0	0
Stage 1	326	326	-	377	377	-	-	-	-	-	-	-
Stage 2	434	377	-	398	326	-	-	-	-	-	-	-
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	-	-
Pot Cap-1 Maneuver	323	362	766	315	362	781	1296	-	-	1312	-	-
Stage 1	687	648	-	644	616	-	-	-	-	-	-	-
Stage 2	600	616	-	628	648	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	258	334	759	239	334	774	1290	-	-	1306	-	-
Mov Cap-2 Maneuver	258	334	-	239	334	-	-	-	-	-	-	-
Stage 1	651	631	-	610	584	-	-	-	-	-	-	-
Stage 2	485	584	-	495	631	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	21.1	16.4	1.5	0.7
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1290	-	-	258	721	239	723	1306	-	-
HCM Lane V/C Ratio	0.048	-	-	0.5	0.2	0.276	0.156	0.022	-	-
HCM Control Delay (s)	7.9	-	-	32.1	11.2	25.7	10.9	7.8	-	-
HCM Lane LOS	A	-	-	D	B	D	B	A	-	-
HCM 95th %tile Q(veh)	0.2	-	-	2.6	0.7	1.1	0.6	0.1	-	-

Intersection	
Intersection Delay, s/veh	14.5
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	129	6	138	66	6	107	62	248	11	29	263	56
Future Vol, veh/h	129	6	138	66	6	107	62	248	11	29	263	56
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	129	6	138	66	6	107	62	248	11	29	263	56
Number of Lanes	1	1	0	1	1	0	1	1	1	1	1	1

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	2	3	3
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	3	3	2	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	3	3	2	2
HCM Control Delay	12.8	11.9	15.8	15.9
HCM LOS	B	B	C	C

Lane	NBLn1	NBLn2	NBLn3	EBLn1	EBLn2	WBLn1	WBLn2	SBLn1	SBLn2	SBLn3
Vol Left, %	100%	0%	0%	100%	0%	100%	0%	100%	0%	0%
Vol Thru, %	0%	100%	0%	0%	4%	0%	5%	0%	100%	0%
Vol Right, %	0%	0%	100%	0%	96%	0%	95%	0%	0%	100%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	62	248	11	129	144	66	113	29	263	56
LT Vol	62	0	0	129	0	66	0	29	0	0
Through Vol	0	248	0	0	6	0	6	0	263	0
RT Vol	0	0	11	0	138	0	107	0	0	56
Lane Flow Rate	62	248	11	129	144	66	113	29	263	56
Geometry Grp	8	8	8	8	8	8	8	8	8	8
Degree of Util (X)	0.134	0.5	0.02	0.282	0.268	0.149	0.219	0.062	0.526	0.101
Departure Headway (Hd)	7.763	7.252	6.538	7.88	6.701	8.147	6.974	7.713	7.203	6.489
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	462	496	547	455	536	440	514	464	500	552
Service Time	5.508	4.997	4.282	5.63	4.451	5.9	4.726	5.46	4.95	4.235
HCM Lane V/C Ratio	0.134	0.5	0.02	0.284	0.269	0.15	0.22	0.063	0.526	0.101
HCM Control Delay	11.7	17.1	9.4	13.7	11.9	12.3	11.7	11	17.7	10
HCM Lane LOS	B	C	A	B	B	B	B	B	C	A
HCM 95th-tile Q	0.5	2.8	0.1	1.1	1.1	0.5	0.8	0.2	3	0.3

Intersection	
Intersection Delay, s/veh	8.8
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	74	112	4	25	63	26	2	81	62	39	32	36
Future Vol, veh/h	74	112	4	25	63	26	2	81	62	39	32	36
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	74	112	4	25	63	26	2	81	62	39	32	36
Number of Lanes	0	1	0	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	9.3	8.5	8.6	8.5
HCM LOS	A	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	1%	39%	22%	36%
Vol Thru, %	56%	59%	55%	30%
Vol Right, %	43%	2%	23%	34%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	145	190	114	107
LT Vol	2	74	25	39
Through Vol	81	112	63	32
RT Vol	62	4	26	36
Lane Flow Rate	145	190	114	107
Geometry Grp	1	1	1	1
Degree of Util (X)	0.183	0.249	0.148	0.14
Departure Headway (Hd)	4.534	4.72	4.659	4.702
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	789	758	767	760
Service Time	2.577	2.763	2.704	2.747
HCM Lane V/C Ratio	0.184	0.251	0.149	0.141
HCM Control Delay	8.6	9.3	8.5	8.5
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0.7	1	0.5	0.5

Intersection	
Int Delay, s/veh	3.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	80	101	39	247	440	28
Future Vol, veh/h	80	101	39	247	440	28
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	200	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	80	101	39	247	440	28

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	779	454	468	0	-	0
Stage 1	454	-	-	-	-	-
Stage 2	325	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	364	606	1094	-	-	-
Stage 1	640	-	-	-	-	-
Stage 2	732	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	349	606	1094	-	-	-
Mov Cap-2 Maneuver	349	-	-	-	-	-
Stage 1	640	-	-	-	-	-
Stage 2	702	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	14.9	1.1	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1094	-	349	606	-	-
HCM Lane V/C Ratio	0.036	-	0.229	0.167	-	-
HCM Control Delay (s)	8.4	0	18.4	12.1	-	-
HCM Lane LOS	A	A	C	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.9	0.6	-	-

Intersection	
Intersection Delay, s/veh	7.7
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	24	107	0	16	32	20	0	9	12	33	11	6
Future Vol, veh/h	24	107	0	16	32	20	0	9	12	33	11	6
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	24	107	0	16	32	20	0	9	12	33	11	6
Number of Lanes	0	1	0	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	8	7.4	7.2	7.7
HCM LOS	A	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	0%	18%	24%	66%
Vol Thru, %	43%	82%	47%	22%
Vol Right, %	57%	0%	29%	12%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	21	131	68	50
LT Vol	0	24	16	33
Through Vol	9	107	32	11
RT Vol	12	0	20	6
Lane Flow Rate	21	131	68	50
Geometry Grp	1	1	1	1
Degree of Util (X)	0.024	0.151	0.076	0.062
Departure Headway (Hd)	4.083	4.145	4.027	4.453
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	882	858	879	809
Service Time	2.085	2.205	2.103	2.454
HCM Lane V/C Ratio	0.024	0.153	0.077	0.062
HCM Control Delay	7.2	8	7.4	7.7
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0.1	0.5	0.2	0.2

Intersection	
Int Delay, s/veh	2.9

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	39	112	152	62	33	64
Future Vol, veh/h	39	112	152	62	33	64
Conflicting Peds, #/hr	5	0	0	5	5	5
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	39	112	152	62	33	64

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	219	0	-	0	383	193
Stage 1	-	-	-	-	188	-
Stage 2	-	-	-	-	195	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1350	-	-	-	620	849
Stage 1	-	-	-	-	844	-
Stage 2	-	-	-	-	838	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1344	-	-	-	595	841
Mov Cap-2 Maneuver	-	-	-	-	595	-
Stage 1	-	-	-	-	840	-
Stage 2	-	-	-	-	808	-

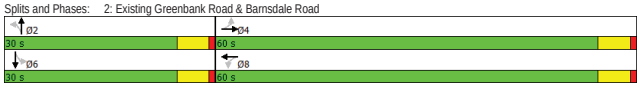
Approach	EB	WB	SB
HCM Control Delay, s	2	0	10.6
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1344	-	-	-	737
HCM Lane V/C Ratio	0.029	-	-	-	0.132
HCM Control Delay (s)	7.8	0	-	-	10.6
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0.1	-	-	-	0.5

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	43	91	10	0	138	376	36	183	0	150	225	38
Future Volume (vph)	43	91	10	0	138	376	36	183	0	150	225	38
Satd. Flow (prot)	1658	1713	0	1745	1516	0	1658	1745	0	1658	1699	0
Flt Permitted	0.253						0.597			0.642		
Satd. Flow (perm)	439	1713	0	1745	1516	0	1034	1745	0	1110	1699	0
Satd. Flow (RTOR)		10			276						9	
Lane Group Flow (vph)	43	101	0	0	514	0	36	183	0	150	263	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	23.6	23.6		23.6	23.6		23.6	23.6		23.6	23.6	
Total Split (s)	60.0	60.0		60.0	60.0		30.0	30.0		30.0	30.0	
Total Split (%)	66.7%	66.7%		66.7%	66.7%		33.3%	33.3%		33.3%	33.3%	
Yellow Time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	5.6	5.6		5.6	5.6		5.6	5.6		5.6	5.6	
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	None	None		None	None		Max	Max		Max	Max	
Act Effct Green (s)	15.8	15.8			15.8		24.7	24.7		24.7	24.7	
Actuated g/C Ratio	0.31	0.31			0.31		0.48	0.48		0.48	0.48	
v/c Ratio	0.32	0.19			0.79		0.07	0.22		0.28	0.32	
Control Delay	20.0	12.2			16.6		10.4	10.6		12.1	11.1	
Queue Delay	0.0	0.0			0.0		0.0	0.0		0.0	0.0	
Total Delay	20.0	12.2			16.6		10.4	10.6		12.1	11.1	
LOS	B	B			B		B	B		B	B	
Approach Delay		14.5			16.6			10.6			11.5	
Approach LOS		B			B			B			B	

Intersection Summary			
Cycle Length: 90			
Actuated Cycle Length: 51.8			
Natural Cycle: 50			
Control Type: Semi Act-Uncoord			
Maximum v/c Ratio: 0.79			
Intersection Signal Delay: 13.7		Intersection LOS: B	
Intersection Capacity Utilization 75.5%		ICU Level of Service D	
Analysis Period (min) 15			

Splits and Phases: 2: Existing Greenbank Road & Barnsdale Road



Lane Group	EBL	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	43	101	514	36	183	150	263
v/c Ratio	0.32	0.19	0.79	0.07	0.22	0.28	0.32
Control Delay	20.0	12.2	16.6	10.4	10.6	12.1	11.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.0	12.2	16.6	10.4	10.6	12.1	11.1
Queue Length 50th (m)	3.0	6.0	17.7	1.6	8.5	7.3	12.4
Queue Length 95th (m)	9.5	13.7	46.1	7.3	25.8	24.1	36.0
Internal Link Dist (m)		999.3	579.2		705.1		181.0
Turn Bay Length (m)	37.5			37.5		37.5	
Base Capacity (vph)	428	1669	1484	492	831	528	814
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.06	0.35	0.07	0.22	0.28	0.32

Intersection Summary

Intersection	
Intersection Delay, s/veh	16.4
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	77	2	72	23	5	61	146	318	66	89	338	131
Future Vol, veh/h	77	2	72	23	5	61	146	318	66	89	338	131
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	77	2	72	23	5	61	146	318	66	89	338	131
Number of Lanes	1	1	0	1	1	0	1	1	1	1	1	1

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	2	3	3
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	3	3	2	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	3	3	2	2
HCM Control Delay	12.3	11.7	17	17.6
HCM LOS	B	B	C	C

Lane	NBLn1	NBLn2	NBLn3	EBLn1	EBLn2	WBLn1	WBLn2	SBLn1	SBLn2	SBLn3
Vol Left, %	100%	0%	0%	100%	0%	100%	0%	100%	0%	0%
Vol Thru, %	0%	100%	0%	0%	3%	0%	8%	0%	100%	0%
Vol Right, %	0%	0%	100%	0%	97%	0%	92%	0%	0%	100%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	146	318	66	77	74	23	66	89	338	131
LT Vol	146	0	0	77	0	23	0	89	0	0
Through Vol	0	318	0	0	2	0	5	0	338	0
RT Vol	0	0	66	0	72	0	61	0	0	131
Lane Flow Rate	146	318	66	77	74	23	66	89	338	131
Geometry Grp	8	8	8	8	8	8	8	8	8	8
Degree of Util (X)	0.303	0.615	0.115	0.183	0.151	0.056	0.14	0.184	0.651	0.226
Departure Headway (Hd)	7.471	6.964	6.254	8.538	7.347	8.772	7.612	7.436	6.929	6.219
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	482	518	573	420	488	408	471	483	521	578
Service Time	5.21	4.703	3.993	6.288	5.096	6.525	5.365	5.176	4.668	3.958
HCM Lane V/C Ratio	0.303	0.614	0.115	0.183	0.152	0.056	0.14	0.184	0.649	0.227
HCM Control Delay	13.4	20.2	9.8	13.2	11.4	12	11.6	11.9	21.7	10.8
HCM Lane LOS	B	C	A	B	B	B	B	B	C	B
HCM 95th-tile Q	1.3	4.1	0.4	0.7	0.5	0.2	0.5	0.7	4.6	0.9

Intersection	
Intersection Delay, s/veh	16.4
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	77	2	72	23	5	61	146	318	66	89	338	131
Future Vol, veh/h	77	2	72	23	5	61	146	318	66	89	338	131
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	77	2	72	23	5	61	146	318	66	89	338	131
Number of Lanes	1	1	0	1	1	0	1	1	1	1	1	1

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	2	3	3
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	3	3	2	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	3	3	2	2
HCM Control Delay	12.3	11.7	17	17.6
HCM LOS	B	B	C	C

Lane	NBLn1	NBLn2	NBLn3	EBLn1	EBLn2	WBLn1	WBLn2	SBLn1	SBLn2	SBLn3
Vol Left, %	100%	0%	0%	100%	0%	100%	0%	100%	0%	0%
Vol Thru, %	0%	100%	0%	0%	3%	0%	8%	0%	100%	0%
Vol Right, %	0%	0%	100%	0%	97%	0%	92%	0%	0%	100%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	146	318	66	77	74	23	66	89	338	131
LT Vol	146	0	0	77	0	23	0	89	0	0
Through Vol	0	318	0	0	2	0	5	0	338	0
RT Vol	0	0	66	0	72	0	61	0	0	131
Lane Flow Rate	146	318	66	77	74	23	66	89	338	131
Geometry Grp	8	8	8	8	8	8	8	8	8	8
Degree of Util (X)	0.303	0.615	0.115	0.183	0.151	0.056	0.14	0.184	0.651	0.226
Departure Headway (Hd)	7.471	6.964	6.254	8.538	7.347	8.772	7.612	7.436	6.929	6.219
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	482	518	573	420	488	408	471	483	521	578
Service Time	5.21	4.703	3.993	6.288	5.096	6.525	5.365	5.176	4.668	3.958
HCM Lane V/C Ratio	0.303	0.614	0.115	0.183	0.152	0.056	0.14	0.184	0.649	0.227
HCM Control Delay	13.4	20.2	9.8	13.2	11.4	12	11.6	11.9	21.7	10.8
HCM Lane LOS	B	C	A	B	B	B	B	B	C	B
HCM 95th-tile Q	1.3	4.1	0.4	0.7	0.5	0.2	0.5	0.7	4.6	0.9

Intersection	
Intersection Delay, s/veh	10
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	38	87	1	106	154	45	0	44	56	30	76	66
Future Vol, veh/h	38	87	1	106	154	45	0	44	56	30	76	66
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	38	87	1	106	154	45	0	44	56	30	76	66
Number of Lanes	0	1	0	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	9.2	11	8.7	9.5
HCM LOS	A	B	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	0%	30%	35%	17%
Vol Thru, %	44%	69%	50%	44%
Vol Right, %	56%	1%	15%	38%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	100	126	305	172
LT Vol	0	38	106	30
Through Vol	44	87	154	76
RT Vol	56	1	45	66
Lane Flow Rate	100	126	305	172
Geometry Grp	1	1	1	1
Degree of Util (X)	0.135	0.176	0.401	0.234
Departure Headway (Hd)	4.866	5.027	4.735	4.903
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	729	707	756	726
Service Time	2.946	3.103	2.797	2.975
HCM Lane V/C Ratio	0.137	0.178	0.403	0.237
HCM Control Delay	8.7	9.2	11	9.5
HCM Lane LOS	A	A	B	A
HCM 95th-tile Q	0.5	0.6	1.9	0.9

Intersection	
Int Delay, s/veh	2.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	42	52	95	508	355	78
Future Vol, veh/h	42	52	95	508	355	78
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	42	52	95	508	355	78

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1092	394	433	0	-	0
Stage 1	394	-	-	-	-	-
Stage 2	698	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	237	655	1127	-	-	-
Stage 1	681	-	-	-	-	-
Stage 2	494	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	209	655	1127	-	-	-
Mov Cap-2 Maneuver	209	-	-	-	-	-
Stage 1	681	-	-	-	-	-
Stage 2	436	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	19.9	1.3	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1127	-	335	-	-
HCM Lane V/C Ratio	0.084	-	0.281	-	-
HCM Control Delay (s)	8.5	0	19.9	-	-
HCM Lane LOS	A	A	C	-	-
HCM 95th %tile Q(veh)	0.3	-	1.1	-	-

Intersection	
Intersection Delay, s/veh	7.6
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	13	58	0	3	106	35	0	2	4	27	2	24
Future Vol, veh/h	13	58	0	3	106	35	0	2	4	27	2	24
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	13	58	0	3	106	35	0	2	4	27	2	24
Number of Lanes	0	1	0	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	7.6	7.7	7.1	7.5
HCM LOS	A	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	0%	18%	2%	51%
Vol Thru, %	33%	82%	74%	4%
Vol Right, %	67%	0%	24%	45%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	6	71	144	53
LT Vol	0	13	3	27
Through Vol	2	58	106	2
RT Vol	4	0	35	24
Lane Flow Rate	6	71	144	53
Geometry Grp	1	1	1	1
Degree of Util (X)	0.007	0.082	0.158	0.061
Departure Headway (Hd)	4.052	4.182	3.948	4.137
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	889	850	903	852
Service Time	2.052	2.24	1.996	2.232
HCM Lane V/C Ratio	0.007	0.084	0.159	0.062
HCM Control Delay	7.1	7.6	7.7	7.5
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0	0.3	0.6	0.2

C.4 2031 FUTURE BACKGROUND CONDITIONS

Intersection	
Int Delay, s/veh	3.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	46	125	138	34	39	51
Future Vol, veh/h	46	125	138	34	39	51
Conflicting Peds, #/hr	5	0	0	5	5	5
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	46	125	138	34	39	51

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	177	0	-	0	382	165
Stage 1	-	-	-	-	160	-
Stage 2	-	-	-	-	222	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1399	-	-	-	620	879
Stage 1	-	-	-	-	869	-
Stage 2	-	-	-	-	815	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1392	-	-	-	592	871
Mov Cap-2 Maneuver	-	-	-	-	592	-
Stage 1	-	-	-	-	865	-
Stage 2	-	-	-	-	782	-

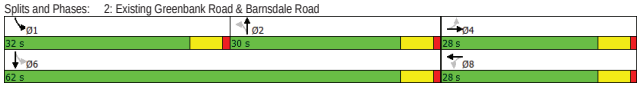
Approach	EB	WB	SB
HCM Control Delay, s	2.1	0	10.7
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1392	-	-	-	723
HCM Lane V/C Ratio	0.033	-	-	-	0.124
HCM Control Delay (s)	7.7	0	-	-	10.7
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0.1	-	-	-	0.4

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	42	104	14	4	102	126	20	182	0	399	175	47
Future Volume (vph)	42	104	14	4	102	126	20	182	0	399	175	47
Satd. Flow (prot)	1658	1707	0	1658	1572	0	1658	1745	0	1658	1678	0
Flt Permitted	0.437			0.681			0.620			0.558		
Satd. Flow (perm)	756	1707	0	1176	1572	0	1072	1745	0	966	1678	0
Satd. Flow (RTOR)		7			66						29	
Lane Group Flow (vph)	42	118	0	4	228	0	20	182	0	399	222	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		4			8			2		1	6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		2	2		1	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0		10.0	10.0		5.0	10.0	
Minimum Split (s)	23.6	23.6		23.6	23.6		23.6	23.6		10.6	23.6	
Total Split (s)	28.0	28.0		28.0	28.0		30.0	30.0		32.0	62.0	
Total Split (%)	31.1%	31.1%		31.1%	31.1%		33.3%	33.3%		35.6%	68.9%	
Yellow Time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	5.6	5.6		5.6	5.6		5.6	5.6		5.6	5.6	
Lead/Lag							Lag	Lag		Lead		
Lead-Lag Optimize?							Yes	Yes		Yes		
Recall Mode	None	None		None	None		Max	Max		None	Max	
Act Effct Green (s)	14.5	14.5		14.5	14.5		36.7	36.7		56.5	56.5	
Actuated g/C Ratio	0.18	0.18		0.18	0.18		0.45	0.45		0.69	0.69	
v/c Ratio	0.32	0.38		0.02	0.69		0.04	0.23		0.51	0.19	
Control Delay	35.6	31.4		26.8	33.3		17.9	18.0		8.5	5.1	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	35.6	31.4		26.8	33.3		17.9	18.0		8.5	5.1	
LOS	D	C		C	C		B	B		A	A	
Approach Delay		32.5			33.2			18.0			7.3	
Approach LOS		C			C			B			A	

Intersection Summary			
Cycle Length: 90			
Actuated Cycle Length: 82.3			
Natural Cycle: 60			
Control Type: Semi Act-Uncoord			
Maximum v/c Ratio: 0.69			
Intersection Signal Delay: 17.3		Intersection LOS: B	
Intersection Capacity Utilization 79.6%		ICU Level of Service D	
Analysis Period (min) 15			

Splits and Phases: 2: Existing Greenbank Road & Barnsdale Road



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	42	118	4	228	20	182	399	222
v/c Ratio	0.32	0.38	0.02	0.69	0.04	0.23	0.51	0.19
Control Delay	35.6	31.4	26.8	33.3	17.9	18.0	8.5	5.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	35.6	31.4	26.8	33.3	17.9	18.0	8.5	5.1
Queue Length 50th (m)	5.8	15.5	0.5	23.7	1.6	16.3	21.2	8.8
Queue Length 95th (m)	14.8	29.7	3.1	45.9	7.4	40.4	46.4	21.7
Internal Link Dist (m)		999.3		579.2		705.1		181.0
Turn Bay Length (m)	37.5		37.5		37.5		37.5	
Base Capacity (vph)	206	470	320	476	477	777	885	1161
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.20	0.25	0.01	0.48	0.04	0.23	0.45	0.19

Intersection Summary

Intersection	
Intersection Delay, s/veh	17.3
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	135	6	159	66	6	107	68	302	11	29	287	58
Future Vol, veh/h	135	6	159	66	6	107	68	302	11	29	287	58
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	135	6	159	66	6	107	68	302	11	29	287	58
Number of Lanes	1	1	0	1	1	0	1	1	1	1	1	1

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	2	3	3
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	3	3	2	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	3	3	2	2
HCM Control Delay	14	12.7	20.4	18.9
HCM LOS	B	B	C	C

Lane	NBLn1	NBLn2	NBLn3	EBLn1	EBLn2	WBLn1	WBLn2	SBLn1	SBLn2	SBLn3
Vol Left, %	100%	0%	0%	100%	0%	100%	0%	100%	0%	0%
Vol Thru, %	0%	100%	0%	0%	4%	0%	5%	0%	100%	0%
Vol Right, %	0%	0%	100%	0%	96%	0%	95%	0%	0%	100%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	68	302	11	135	165	66	113	29	287	58
LT Vol	68	0	0	135	0	66	0	29	0	0
Through Vol	0	302	0	0	6	0	6	0	287	0
RT Vol	0	0	11	0	159	0	107	0	0	58
Lane Flow Rate	68	302	11	135	165	66	113	29	287	58
Geometry Grp	8	8	8	8	8	8	8	8	8	8
Degree of Util (X)	0.152	0.634	0.021	0.311	0.325	0.158	0.234	0.065	0.605	0.111
Departure Headway (Hd)	8.065	7.553	6.836	8.284	7.099	8.645	7.468	8.103	7.591	6.874
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	444	477	522	433	505	414	479	441	474	520
Service Time	5.83	5.318	4.601	6.053	4.867	6.424	5.245	5.871	5.359	4.642
HCM Lane V/C Ratio	0.153	0.633	0.021	0.312	0.327	0.159	0.236	0.066	0.605	0.112
HCM Control Delay	12.3	22.6	9.7	14.8	13.3	13.1	12.5	11.4	21.4	10.5
HCM Lane LOS	B	C	A	B	B	B	B	B	C	B
HCM 95th-tile Q	0.5	4.3	0.1	1.3	1.4	0.6	0.9	0.2	3.9	0.4

Lanes, Volumes, Timings
3: Existing Greenbank Road & Kilbirnie Drive

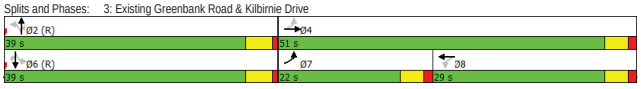
2031 FBG Conditions with Improvements
AM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	135	6	159	66	6	107	68	302	11	29	287	58
Future Volume (vph)	135	6	159	66	6	107	68	302	11	29	287	58
Satd. Flow (prot)	1658	1449	0	1658	1455	0	1658	1745	1483	1658	1745	1483
Flt Permitted	0.449			0.653			0.558			0.545		
Satd. Flow (perm)	777	1449	0	1130	1455	0	967	1745	1435	945	1745	1435
Satd. Flow (RTOR)		159			107				75			75
Lane Group Flow (vph)	135	165	0	66	113	0	68	302	11	29	287	58
Turn Type	pm+pt	NA		Perm	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	7	4			8			2			6	
Permitted Phases	4			8			2		2	6		6
Detector Phase	7	4		8	8		2	2	2	6	6	6
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	9.6	26.6		26.6	26.6		22.7	22.7	22.7	22.7	22.7	22.7
Total Split (s)	22.0	51.0		29.0	29.0		39.0	39.0	39.0	39.0	39.0	39.0
Total Split (%)	24.4%	56.7%		32.2%	32.2%		43.3%	43.3%	43.3%	43.3%	43.3%	43.3%
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)	1.3	1.3		1.3	1.3		1.0	1.0	1.0	1.0	1.0	1.0
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)	4.6	4.6		4.6	4.6		4.7	4.7	4.7	4.7	4.7	4.7
Lead/Lag	Lead			Lag	Lag							
Lead-Lag Optimize?	Yes			Yes	Yes							
Recall Mode	None	None		None	None		C-Max	C-Max	C-Max	C-Max	C-Max	C-Max
Act Effct Green (s)	26.9	26.9		11.9	11.9		53.8	53.8	53.8	53.8	53.8	53.8
Actuated g/C Ratio	0.30	0.30		0.13	0.13		0.60	0.60	0.60	0.60	0.60	0.60
v/c Ratio	0.38	0.30		0.44	0.40		0.12	0.29	0.01	0.05	0.28	0.07
Control Delay	23.9	4.5		43.1	11.5		5.0	5.6	0.3	12.5	12.6	2.8
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.9	4.5		43.1	11.5		5.0	5.6	0.3	12.5	12.6	2.8
LOS	C	A		D	B		A	A	A	B	B	A
Approach Delay		13.3			23.1			5.3			11.1	
Approach LOS		B			C			A			B	

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 90
Offset: 13 (14%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.44
Intersection Signal Delay: 11.6 — Intersection LOS: B
Intersection Capacity Utilization 53.8% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 3: Existing Greenbank Road & Kilbirnie Drive



Queues
3: Existing Greenbank Road & Kilbirnie Drive

2031 FBG Conditions with Improvements
AM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	135	165	66	113	68	302	11	29	287	58
v/c Ratio	0.38	0.30	0.44	0.40	0.12	0.29	0.01	0.05	0.28	0.07
Control Delay	23.9	4.5	43.1	11.5	5.0	5.6	0.3	12.5	12.6	2.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.9	4.5	43.1	11.5	5.0	5.6	0.3	12.5	12.6	2.8
Queue Length 50th (m)	17.4	0.7	10.9	0.9	3.8	17.6	0.0	2.0	22.7	0.0
Queue Length 95th (m)	23.2	10.3	20.3	13.3	9.9	30.9	0.4	8.2	53.4	4.9
Internal Link Dist (m)		360.1		212.9		511.5			369.2	
Turn Bay Length (m)	20.0		20.0		50.0		37.5	50.0		37.5
Base Capacity (vph)	419	824	306	472	577	1042	887	564	1042	887
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.32	0.20	0.22	0.24	0.12	0.29	0.01	0.05	0.28	0.07

Intersection Summary

HCM 2010 AWSC
4: River Mist Road & Kilbirnie Drive

2031 FBG Conditions
AM Peak Hour

Intersection	
Intersection Delay, s/veh	9.3
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	98	139	4	25	71	26	2	81	62	39	32	43
Future Vol, veh/h	98	139	4	25	71	26	2	81	62	39	32	43
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	98	139	4	25	71	26	2	81	62	39	32	43
Number of Lanes	0	1	0	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	10.1	8.7	8.9	8.8
HCM LOS	B	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	1%	41%	20%	34%
Vol Thru, %	56%	58%	58%	28%
Vol Right, %	43%	2%	21%	38%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	145	241	122	114
LT Vol	2	98	25	39
Through Vol	81	139	71	32
RT Vol	62	4	26	43
Lane Flow Rate	145	241	122	114
Geometry Grp	1	1	1	1
Degree of Util (X)	0.189	0.319	0.161	0.153
Departure Headway (Hd)	4.696	4.767	4.76	4.829
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	760	750	749	739
Service Time	2.75	2.819	2.819	2.886
HCM Lane V/C Ratio	0.191	0.321	0.163	0.154
HCM Control Delay	8.9	10.1	8.7	8.8
HCM Lane LOS	A	B	A	A
HCM 95th-tile Q	0.7	1.4	0.6	0.5

HCM 2010 TWSC
5: Existing Greenbank Road & New E-W Collector

2031 FBG Conditions
AM Peak Hour

Intersection	
Int Delay, s/veh	3.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	80	101	39	313	520	28
Future Vol, veh/h	80	101	39	313	520	28
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	200	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	80	101	39	313	520	28

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	925	534	548	0	-	0
Stage 1	534	-	-	-	-	-
Stage 2	391	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	299	546	1021	-	-	-
Stage 1	588	-	-	-	-	-
Stage 2	683	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	285	546	1021	-	-	-
Mov Cap-2 Maneuver	285	-	-	-	-	-
Stage 1	588	-	-	-	-	-
Stage 2	652	-	-	-	-	-

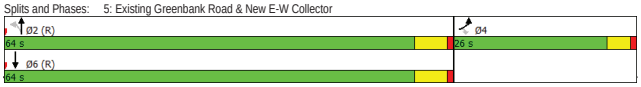
Approach	EB	NB	SB
HCM Control Delay, s	17.3	1	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1021	-	285	546	-	-
HCM Lane V/C Ratio	0.038	-	0.281	0.185	-	-
HCM Control Delay (s)	8.7	0	22.5	13.1	-	-
HCM Lane LOS	A	A	C	B	-	-
HCM 95th %tile Q(veh)	0.1	-	1.1	0.7	-	-

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	80	101	39	313	520	28
Future Volume (vph)	80	101	39	313	520	28
Satd. Flow (prot)	1658	1483	1658	1745	1733	0
Flt Permitted	0.950		0.441			
Satd. Flow (perm)	1658	1483	770	1745	1733	0
Satd. Flow (RTOR)		101			6	
Lane Group Flow (vph)	80	101	39	313	548	0
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Detector Phase	4	4	2	2	6	
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	
Minimum Split (s)	22.3	22.3	23.6	23.6	23.6	
Total Split (s)	26.0	26.0	64.0	64.0	64.0	
Total Split (%)	28.9%	28.9%	71.1%	71.1%	71.1%	
Yellow Time (s)	3.3	3.3	4.6	4.6	4.6	
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	4.3	4.3	5.6	5.6	5.6	
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None	C-Max	C-Max	C-Max	
Act Effct Green (s)	10.6	10.6	72.7	72.7	72.7	
Actuated g/C Ratio	0.12	0.12	0.81	0.81	0.81	
v/c Ratio	0.41	0.38	0.06	0.22	0.39	
Control Delay	41.6	11.4	2.6	2.7	3.3	
Queue Delay	0.0	0.0	0.0	0.0	0.0	
Total Delay	41.6	11.4	2.6	2.7	3.3	
LOS	D	B	A	A	A	
Approach Delay	24.8			2.7	3.3	
Approach LOS	C			A	A	

Intersection Summary			
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 4 (4%), Referenced to phase 2:NBTL and 6:SBT, Start of Green			
Natural Cycle: 55			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.41			
Intersection Signal Delay: 6.7		Intersection LOS: A	
Intersection Capacity Utilization 47.1%		ICU Level of Service A	
Analysis Period (min) 15			

Splits and Phases: 5: Existing Greenbank Road & New E-W Collector



Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	80	101	39	313	548
v/c Ratio	0.41	0.38	0.06	0.22	0.39
Control Delay	41.6	11.4	2.6	2.7	3.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	41.6	11.4	2.6	2.7	3.3
Queue Length 50th (m)	13.2	0.0	0.7	6.5	14.3
Queue Length 95th (m)	24.0	12.4	m2.6	25.3	30.3
Internal Link Dist (m)	345.6			181.0	28.7
Turn Bay Length (m)	37.5		37.5		
Base Capacity (vph)	399	434	621	1408	1400
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.20	0.23	0.06	0.22	0.39

Intersection Summary
m Volume for 95th percentile queue is metered by upstream signal.

Intersection	
Intersection Delay, s/veh	7.7
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	24	107	0	16	32	20	0	9	12	33	11	6
Future Vol, veh/h	24	107	0	16	32	20	0	9	12	33	11	6
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	24	107	0	16	32	20	0	9	12	33	11	6
Number of Lanes	0	1	0	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	8	7.4	7.2	7.7
HCM LOS	A	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	0%	18%	24%	66%
Vol Thru, %	43%	82%	47%	22%
Vol Right, %	57%	0%	29%	12%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	21	131	68	50
LT Vol	0	24	16	33
Through Vol	9	107	32	11
RT Vol	12	0	20	6
Lane Flow Rate	21	131	68	50
Geometry Grp	1	1	1	1
Degree of Util (X)	0.024	0.151	0.076	0.062
Departure Headway (Hd)	4.083	4.145	4.027	4.453
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	882	858	879	809
Service Time	2.085	2.205	2.103	2.454
HCM Lane V/C Ratio	0.024	0.153	0.077	0.062
HCM Control Delay	7.2	8	7.4	7.7
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0.1	0.5	0.2	0.2

Intersection	
Int Delay, s/veh	3.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	43	126	171	69	41	83
Future Vol, veh/h	43	126	171	69	41	83
Conflicting Peds, #/hr	5	0	0	5	5	5
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	43	126	171	69	41	83

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	245	0	-	0	428	216
Stage 1	-	-	-	-	211	-
Stage 2	-	-	-	-	217	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1321	-	-	-	584	824
Stage 1	-	-	-	-	824	-
Stage 2	-	-	-	-	819	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1315	-	-	-	558	816
Mov Cap-2 Maneuver	-	-	-	-	558	-
Stage 1	-	-	-	-	820	-
Stage 2	-	-	-	-	787	-

Approach	EB	WB	SB
HCM Control Delay, s	2	0	11.2
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1315	-	-	-	708
HCM Lane V/C Ratio	0.033	-	-	-	0.175
HCM Control Delay (s)	7.8	0	-	-	11.2
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0.1	-	-	-	0.6

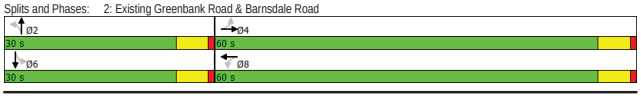
Lanes, Volumes, Timings
2: Existing Greenbank Road & Barnsdale Road

2031 FBG Conditions
PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	48	111	7	0	162	440	31	204	0	196	282	42
Future Volume (vph)	48	111	7	0	162	440	31	204	0	196	282	42
Satd. Flow (prot)	1658	1726	0	1745	1517	0	1658	1745	0	1658	1705	0
Flt Permitted	0.197						0.535			0.630		
Satd. Flow (perm)	343	1726	0	1745	1517	0	928	1745	0	1090	1705	0
Satd. Flow (RTOR)		6			275						8	
Lane Group Flow (vph)	48	118	0	0	602	0	31	204	0	196	324	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	23.6	23.6		23.6	23.6		23.6	23.6		23.6	23.6	
Total Split (s)	60.0	60.0		60.0	60.0		30.0	30.0		30.0	30.0	
Total Split (%)	66.7%	66.7%		66.7%	66.7%		33.3%	33.3%		33.3%	33.3%	
Yellow Time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	5.6	5.6		5.6	5.6		5.6	5.6		5.6	5.6	
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	None	None		None	None		Max	Max		Max	Max	
Act Effct Green (s)	20.3	20.3			20.3		25.0	25.0		25.0	25.0	
Actuated g/C Ratio	0.36	0.36			0.36		0.44	0.44		0.44	0.44	
v/c Ratio	0.39	0.19			0.84		0.08	0.27		0.41	0.43	
Control Delay	22.5	11.5			19.6		13.8	14.0		17.3	15.5	
Queue Delay	0.0	0.0			0.0		0.0	0.0		0.0	0.0	
Total Delay	22.5	11.5			19.6		13.8	14.0		17.3	15.5	
LOS	C	B			B		B	B		B	B	
Approach Delay		14.7			19.6			14.0			16.2	
Approach LOS		B			B			B			B	

Intersection Summary			
Cycle Length: 90			
Actuated Cycle Length: 56.7			
Natural Cycle: 50			
Control Type: Semi Act-Uncoord			
Maximum v/c Ratio: 0.84			
Intersection Signal Delay: 17.0		Intersection LOS: B	
Intersection Capacity Utilization 82.9%		ICU Level of Service E	
Analysis Period (min) 15			

Splits and Phases: 2: Existing Greenbank Road & Barnsdale Road



Queues
2: Existing Greenbank Road & Barnsdale Road

2031 FBG Conditions
PM Peak Hour

Lane Group	EBL	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	48	118	602	31	204	196	324
v/c Ratio	0.39	0.19	0.84	0.08	0.27	0.41	0.43
Control Delay	22.5	11.5	19.6	13.8	14.0	17.3	15.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	22.5	11.5	19.6	13.8	14.0	17.3	15.5
Queue Length 50th (m)	3.5	7.5	28.2	1.7	12.4	12.8	20.7
Queue Length 95th (m)	11.0	15.3	62.2	8.1	35.4	39.6	56.6
Internal Link Dist (m)		999.3	579.2		705.1		181.0
Turn Bay Length (m)	37.5			37.5		37.5	
Base Capacity (vph)	318	1601	1427	408	768	480	755
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.15	0.07	0.42	0.08	0.27	0.41	0.43

Intersection Summary

HCM 2010 AWSC
3: Existing Greenbank Road & Kilbirnie Drive

2031 FBG Conditions
PM Peak Hour

Intersection	
Intersection Delay, s/veh	22.8
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	89	2	116	23	5	61	189	347	66	89	395	143
Future Vol, veh/h	89	2	116	23	5	61	189	347	66	89	395	143
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	89	2	116	23	5	61	189	347	66	89	395	143
Number of Lanes	1	1	0	1	1	0	1	1	1	1	1	1

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	2	3	3
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	3	3	2	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	3	3	2	2
HCM Control Delay	13.9	12.8	22.4	27.5
HCM LOS	B	B	C	D

Lane	NBLn1	NBLn2	NBLn3	EBLn1	EBLn2	WBLn1	WBLn2	SBLn1	SBLn2	SBLn3
Vol Left, %	100%	0%	0%	100%	0%	100%	0%	100%	0%	0%
Vol Thru, %	0%	100%	0%	0%	2%	0%	8%	0%	100%	0%
Vol Right, %	0%	0%	100%	0%	98%	0%	92%	0%	0%	100%
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	189	347	66	89	118	23	66	89	395	143
LT Vol	189	0	0	89	0	23	0	89	0	0
Through Vol	0	347	0	0	2	0	5	0	395	0
RT Vol	0	0	66	0	116	0	61	0	0	143
Lane Flow Rate	189	347	66	89	118	23	66	89	395	143
Geometry Grp	8	8	8	8	8	8	8	8	8	8
Degree of Util (X)	0.422	0.725	0.125	0.225	0.259	0.061	0.154	0.198	0.821	0.269
Departure Headway (Hd)	8.034	7.524	6.811	9.118	7.916	9.583	8.417	7.994	7.485	6.772
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cap	448	479	525	392	452	373	424	449	482	529
Service Time	5.795	5.286	4.572	6.895	5.692	7.372	6.205	5.755	5.245	4.532
HCM Lane V/C Ratio	0.422	0.724	0.126	0.227	0.261	0.062	0.156	0.198	0.82	0.27
HCM Control Delay	16.6	27.8	10.6	14.5	13.5	13	12.7	12.7	36.4	12
HCM Lane LOS	C	D	B	B	B	B	B	B	E	B
HCM 95th-tile Q	2.1	5.8	0.4	0.9	1	0.2	0.5	0.7	7.9	1.1

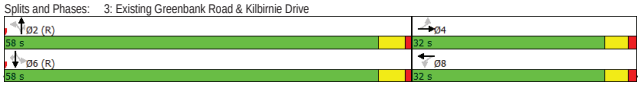
Lanes, Volumes, Timings
3: Existing Greenbank Road & Kilbirnie Drive

2031 FBG Conditions with Improvements
PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	89	2	116	23	5	61	189	347	66	89	395	143
Future Volume (vph)	89	2	116	23	5	61	189	347	66	89	395	143
Satd. Flow (prot)	1658	1445	0	1658	1461	0	1658	1745	1483	1658	1745	1483
Flt Permitted	0.714			0.638			0.517			0.548		
Satd. Flow (perm)	1234	1445	0	1104	1461	0	897	1745	1435	950	1745	1435
Satd. Flow (RTOR)		116			61				66			143
Lane Group Flow (vph)	89	118	0	23	66	0	189	347	66	89	395	143
Turn Type	Perm	NA		Perm	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2		2	6		6
Detector Phase	4	4		8	8		2	2	2	6	6	6
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	26.6	26.6		26.6	26.6		22.7	22.7	22.7	22.7	22.7	22.7
Total Split (s)	32.0	32.0		32.0	32.0		58.0	58.0	58.0	58.0	58.0	58.0
Total Split (%)	35.6%	35.6%		35.6%	35.6%		64.4%	64.4%	64.4%	64.4%	64.4%	64.4%
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)	1.3	1.3		1.3	1.3		1.0	1.0	1.0	1.0	1.0	1.0
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)	4.6	4.6		4.6	4.6		4.7	4.7	4.7	4.7	4.7	4.7
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	None	None		None	None		C-Max	C-Max	C-Max	C-Max	C-Max	C-Max
Act Effct Green (s)	12.8	12.8		12.8	12.8		67.9	67.9	67.9	67.9	67.9	67.9
Actuated g/C Ratio	0.14	0.14		0.14	0.14		0.75	0.75	0.75	0.75	0.75	0.75
v/c Ratio	0.51	0.39		0.15	0.25		0.28	0.26	0.06	0.12	0.30	0.13
Control Delay	44.1	10.1		32.7	11.9		5.1	4.2	1.8	4.6	5.0	1.2
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	44.1	10.1		32.7	11.9		5.1	4.2	1.8	4.6	5.0	1.2
LOS	D	B		C	B		A	A	A	A	A	A
Approach Delay		24.8			17.3			4.2			4.1	
Approach LOS		C			B			A			A	

Intersection Summary			
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 14 (16%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 55			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.51			
Intersection Signal Delay: 7.7		Intersection LOS: A	
Intersection Capacity Utilization 57.5%		ICU Level of Service B	
Analysis Period (min) 15			

Splits and Phases: 3: Existing Greenbank Road & Kilbirnie Drive



Queues
3: Existing Greenbank Road & Kilbirnie Drive

2031 FBG Conditions with Improvements
PM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	89	118	23	66	189	347	66	89	395	143
v/c Ratio	0.51	0.39	0.15	0.25	0.28	0.26	0.06	0.12	0.30	0.13
Control Delay	44.1	10.1	32.7	11.9	5.1	4.2	1.8	4.6	5.0	1.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	44.1	10.1	32.7	11.9	5.1	4.2	1.8	4.6	5.0	1.2
Queue Length 50th (m)	14.6	0.3	3.6	0.8	3.8	6.9	0.0	3.1	16.3	0.0
Queue Length 95th (m)	25.5	12.9	9.2	10.4	20.3	32.9	2.9	10.9	42.1	5.6
Internal Link Dist (m)		360.1		212.9		511.5			369.2	
Turn Bay Length (m)	37.5		37.5		50.0		37.5	50.0		37.5
Base Capacity (vph)	375	520	336	487	676	1316	1099	717	1316	1118
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.24	0.23	0.07	0.14	0.28	0.26	0.06	0.12	0.30	0.13

Intersection Summary

HCM 2010 AWSC
4: River Mist Road & Kilbirnie Drive

2031 FBG Conditions
PM Peak Hour

Intersection	
Intersection Delay, s/veh	10.2
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	89	116	1	56	159	45	0	44	29	30	76	116
Future Vol, veh/h	89	116	1	56	159	45	0	44	29	30	76	116
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	89	116	1	56	159	45	0	44	29	30	76	116
Number of Lanes	0	1	0	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	10.3	10.6	8.9	10.1
HCM LOS	B	B	A	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	0%	43%	22%	14%
Vol Thru, %	60%	56%	61%	34%
Vol Right, %	40%	0%	17%	52%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	73	206	260	222
LT Vol	0	89	56	30
Through Vol	44	116	159	76
RT Vol	29	1	45	116
Lane Flow Rate	73	206	260	222
Geometry Grp	1	1	1	1
Degree of Util (X)	0.106	0.29	0.351	0.301
Departure Headway (Hd)	5.243	5.065	4.861	4.873
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	688	700	731	730
Service Time	3.243	3.16	2.95	2.959
HCM Lane V/C Ratio	0.106	0.294	0.356	0.304
HCM Control Delay	8.9	10.3	10.6	10.1
HCM Lane LOS	A	B	B	B
HCM 95th-tile Q	0.4	1.2	1.6	1.3

HCM 2010 TWSC
5: Existing Greenbank Road & New E-W Collector

2031 FBG Conditions
PM Peak Hour

Intersection	
Int Delay, s/veh	2.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	42	52	95	598	470	78
Future Vol, veh/h	42	52	95	598	470	78
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	200	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	42	52	95	598	470	78

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1297	509	548	0	-	0
Stage 1	509	-	-	-	-	-
Stage 2	788	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	179	564	1021	-	-	-
Stage 1	604	-	-	-	-	-
Stage 2	448	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	154	564	1021	-	-	-
Mov Cap-2 Maneuver	154	-	-	-	-	-
Stage 1	604	-	-	-	-	-
Stage 2	386	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	23.1	1.2	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1021	-	154	564	-	-
HCM Lane V/C Ratio	0.093	-	0.273	0.092	-	-
HCM Control Delay (s)	8.9	0	36.9	12	-	-
HCM Lane LOS	A	A	E	B	-	-
HCM 95th %tile Q(veh)	0.3	-	1	0.3	-	-

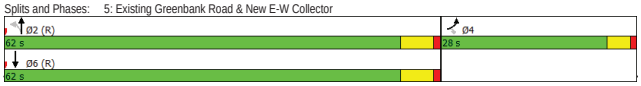
Lanes, Volumes, Timings
5: Existing Greenbank Road & New E-W Collector

2031 FBG Conditions with Improvements
PM Peak Hour

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	42	52	95	598	470	78
Future Volume (vph)	42	52	95	598	470	78
Satd. Flow (prot)	1658	1483	1658	1745	1712	0
Flt Permitted	0.950		0.445			
Satd. Flow (perm)	1658	1483	777	1745	1712	0
Satd. Flow (RTOR)		52			18	
Lane Group Flow (vph)	42	52	95	598	548	0
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Detector Phase	4	4	2	2	6	
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	
Minimum Split (s)	28.0	28.0	28.0	28.0	28.0	
Total Split (s)	28.0	28.0	62.0	62.0	62.0	
Total Split (%)	31.1%	31.1%	68.9%	68.9%	68.9%	
Yellow Time (s)	3.3	3.3	4.6	4.6	4.6	
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	4.3	4.3	5.6	5.6	5.6	
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None	C-Max	C-Max	C-Max	
Act Effct Green (s)	9.3	9.3	73.9	73.9	73.9	
Actuated g/C Ratio	0.10	0.10	0.82	0.82	0.82	
v/c Ratio	0.25	0.26	0.15	0.42	0.39	
Control Delay	38.4	13.1	2.2	2.8	3.7	
Queue Delay	0.0	0.0	0.0	0.0	0.0	
Total Delay	38.4	13.1	2.2	2.8	3.7	
LOS	D	B	A	A	A	
Approach Delay	24.4			2.7	3.7	
Approach LOS	C			A	A	

Intersection Summary
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBT, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.42
Intersection Signal Delay: 4.7 Intersection LOS: A
Intersection Capacity Utilization 53.7% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 5: Existing Greenbank Road & New E-W Collector



Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	42	52	95	598	548
v/c Ratio	0.25	0.26	0.15	0.42	0.39
Control Delay	38.4	13.1	2.2	2.8	3.7
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	38.4	13.1	2.2	2.8	3.7
Queue Length 50th (m)	7.0	0.0	1.5	10.9	17.8
Queue Length 95th (m)	14.5	9.0	m5.1	41.2	43.1
Internal Link Dist (m)	345.6			181.0	28.7
Turn Bay Length (m)	37.5		37.5		
Base Capacity (vph)	436	428	638	1432	1408
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.10	0.12	0.15	0.42	0.39

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Intersection	
Intersection Delay, s/veh	7.6
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	13	58	0	3	106	35	0	2	4	27	2	24
Future Vol, veh/h	13	58	0	3	106	35	0	2	4	27	2	24
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	13	58	0	3	106	35	0	2	4	27	2	24
Number of Lanes	0	1	0	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	7.6	7.7	7.1	7.5
HCM LOS	A	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	0%	18%	2%	51%
Vol Thru, %	33%	82%	74%	4%
Vol Right, %	67%	0%	24%	45%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	6	71	144	53
LT Vol	0	13	3	27
Through Vol	2	58	106	2
RT Vol	4	0	35	24
Lane Flow Rate	6	71	144	53
Geometry Grp	1	1	1	1
Degree of Util (X)	0.007	0.082	0.158	0.061
Departure Headway (Hd)	4.052	4.182	3.948	4.137
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	889	850	903	852
Service Time	2.052	2.24	1.996	2.232
HCM Lane V/C Ratio	0.007	0.084	0.159	0.062
HCM Control Delay	7.1	7.6	7.7	7.5
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0	0.3	0.6	0.2

C.5 2031 TOTAL FUTURE CONDITIONS

Intersection	
Int Delay, s/veh	3.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	46	125	138	34	39	51
Future Vol, veh/h	46	125	138	34	39	51
Conflicting Peds, #/hr	5	0	0	5	5	5
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	46	125	138	34	39	51

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	177	0	-	0	382	165
Stage 1	-	-	-	-	160	-
Stage 2	-	-	-	-	222	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1399	-	-	-	620	879
Stage 1	-	-	-	-	869	-
Stage 2	-	-	-	-	815	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1392	-	-	-	592	871
Mov Cap-2 Maneuver	-	-	-	-	592	-
Stage 1	-	-	-	-	865	-
Stage 2	-	-	-	-	782	-

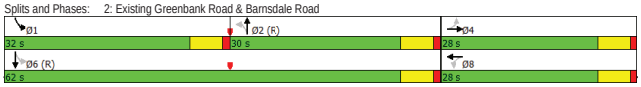
Approach	EB	WB	SB
HCM Control Delay, s	2.1	0	10.7
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1392	-	-	-	723
HCM Lane V/C Ratio	0.033	-	-	-	0.124
HCM Control Delay (s)	7.7	0	-	-	10.7
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0.1	-	-	-	0.4

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	42	104	14	4	102	145	20	185	0	468	185	47
Future Volume (vph)	42	104	14	4	102	145	20	185	0	468	185	47
Satd. Flow (prot)	1658	1707	0	1658	1561	0	1658	1745	0	1658	1682	0
Flt Permitted	0.368			0.681			0.614			0.562		
Satd. Flow (perm)	637	1707	0	1176	1561	0	1062	1745	0	973	1682	0
Satd. Flow (RTOR)		7			76						27	
Lane Group Flow (vph)	42	118	0	4	247	0	20	185	0	468	232	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		4			8			2		1	6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		2	2		1	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0		10.0	10.0		5.0	10.0	
Minimum Split (s)	23.6	23.6		23.6	23.6		23.6	23.6		10.6	23.6	
Total Split (s)	28.0	28.0		28.0	28.0		30.0	30.0		32.0	62.0	
Total Split (%)	31.1%	31.1%		31.1%	31.1%		33.3%	33.3%		35.6%	68.9%	
Yellow Time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	5.6	5.6		5.6	5.6		5.6	5.6		5.6	5.6	
Lead/Lag							Lag	Lag		Lead		
Lead-Lag Optimize?							Yes	Yes		Yes		
Recall Mode	None	None		None	None		C-Max	C-Max		None	C-Max	
Act Effct Green (s)	15.8	15.8		15.8	15.8		40.4	40.4		63.0	63.0	
Actuated g/C Ratio	0.18	0.18		0.18	0.18		0.45	0.45		0.70	0.70	
v/c Ratio	0.38	0.39		0.02	0.73		0.04	0.24		0.58	0.20	
Control Delay	40.8	33.1		27.5	36.6		20.4	19.9		7.5	2.6	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	40.8	33.1		27.5	36.6		20.4	19.9		7.5	2.6	
LOS	D	C		C	D		C	B		A	A	
Approach Delay		35.1			36.4			19.9			5.9	
Approach LOS		D			D			B			A	

Intersection Summary			
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 40 (44%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 65			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.73			
Intersection Signal Delay: 17.4		Intersection LOS: B	
Intersection Capacity Utilization 84.7%		ICU Level of Service E	
Analysis Period (min) 15			

Splits and Phases: 2: Existing Greenbank Road & Barnsdale Road



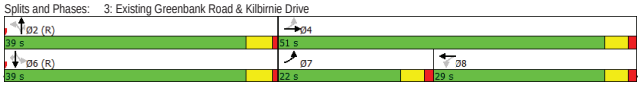
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	42	118	4	247	20	185	468	232
v/c Ratio	0.38	0.39	0.02	0.73	0.04	0.24	0.58	0.20
Control Delay	40.8	33.1	27.5	36.6	20.4	19.9	7.5	2.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	40.8	33.1	27.5	36.6	20.4	19.9	7.5	2.6
Queue Length 50th (m)	6.5	17.2	0.6	28.2	1.8	18.5	8.1	2.6
Queue Length 95th (m)	15.1	29.7	3.1	48.8	8.0	44.5	50.0	9.2
Internal Link Dist (m)		999.3		579.2		705.1		181.0
Turn Bay Length (m)	37.5		37.5		37.5		37.5	
Base Capacity (vph)	158	430	292	445	476	782	881	1185
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.27	0.27	0.01	0.56	0.04	0.24	0.53	0.20

Intersection Summary

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	142	6	182	66	6	107	74	319	11	29	292	60
Future Volume (vph)	142	6	182	66	6	107	74	319	11	29	292	60
Satd. Flow (prot)	1658	1449	0	1658	1455	0	1658	1745	1483	1658	1745	1483
Flt Permitted	0.449			0.639			0.553			0.530		
Satd. Flow (perm)	777	1449	0	1106	1455	0	958	1745	1435	919	1745	1435
Satd. Flow (RTOR)		182			107				75			75
Lane Group Flow (vph)	142	188	0	66	113	0	74	319	11	29	292	60
Turn Type	pm+pt	NA		Perm	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	7	4			8			2			6	
Permitted Phases	4			8			2		2	6		6
Detector Phase	7	4		8	8		2	2	2	6	6	6
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	9.6	26.6		26.6	26.6		22.7	22.7	22.7	22.7	22.7	22.7
Total Split (s)	22.0	51.0		29.0	29.0		39.0	39.0	39.0	39.0	39.0	39.0
Total Split (%)	24.4%	56.7%		32.2%	32.2%		43.3%	43.3%	43.3%	43.3%	43.3%	43.3%
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)	1.3	1.3		1.3	1.3		1.0	1.0	1.0	1.0	1.0	1.0
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)	4.6	4.6		4.6	4.6		4.7	4.7	4.7	4.7	4.7	4.7
Lead/Lag	Lead			Lag	Lag							
Lead-Lag Optimize?	Yes			Yes	Yes							
Recall Mode	None	None		None	None		C-Max	C-Max	C-Max	C-Max	C-Max	C-Max
Act Effct Green (s)	27.4	27.4		11.9	11.9		53.3	53.3	53.3	53.3	53.3	53.3
Actuated g/C Ratio	0.30	0.30		0.13	0.13		0.59	0.59	0.59	0.59	0.59	0.59
v/c Ratio	0.39	0.33		0.45	0.40		0.13	0.31	0.01	0.05	0.28	0.07
Control Delay	23.8	4.4		43.5	11.4		5.3	6.0	0.2	12.9	13.0	3.0
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.8	4.4		43.5	11.4		5.3	6.0	0.2	12.9	13.0	3.0
LOS	C	A		D	B		A	A	A	B	B	A
Approach Delay		12.8			23.3			5.7			11.4	
Approach LOS		B			C			A			B	

Intersection Summary			
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 12 (13%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 60			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.45			
Intersection Signal Delay: 11.6		Intersection LOS: B	
Intersection Capacity Utilization 55.2%		ICU Level of Service B	
Analysis Period (min) 15			

Splits and Phases: 3: Existing Greenbank Road & Kilbirnie Drive



Queues
3: Existing Greenbank Road & Kilbirnie Drive

2031 Total Future Conditions
AM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	142	188	66	113	74	319	11	29	292	60
v/c Ratio	0.39	0.33	0.45	0.40	0.13	0.31	0.01	0.05	0.28	0.07
Control Delay	23.8	4.4	43.5	11.4	5.3	6.0	0.2	12.9	13.0	3.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.8	4.4	43.5	11.4	5.3	6.0	0.2	12.9	13.0	3.0
Queue Length 50th (m)	18.2	0.7	10.9	0.9	4.2	19.0	0.0	2.0	23.5	0.0
Queue Length 95th (m)	23.9	10.8	20.3	13.3	8.4	29.9	0.2	8.3	55.1	5.3
Internal Link Dist (m)		360.1		212.9		511.5			369.2	
Turn Bay Length (m)	20.0		20.0		50.0		37.5	50.0		37.5
Base Capacity (vph)	423	835	299	472	567	1033	880	544	1033	880
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.34	0.23	0.22	0.24	0.13	0.31	0.01	0.05	0.28	0.07

Intersection Summary

HCM 2010 AWSC
4: River Mist Road & Kilbirnie Drive

2031 Total Future Conditions
AM Peak Hour

Intersection	
Intersection Delay, s/veh	10.7
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	125	168	4	25	79	26	2	147	62	39	50	51
Future Vol, veh/h	125	168	4	25	79	26	2	147	62	39	50	51
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	125	168	4	25	79	26	2	147	62	39	50	51
Number of Lanes	0	1	0	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	11.9	9.5	10.3	9.6
HCM LOS	B	A	B	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	1%	42%	19%	28%
Vol Thru, %	70%	57%	61%	36%
Vol Right, %	29%	1%	20%	36%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	211	297	130	140
LT Vol	2	125	25	39
Through Vol	147	168	79	50
RT Vol	62	4	26	51
Lane Flow Rate	211	297	130	140
Geometry Grp	1	1	1	1
Degree of Util (X)	0.3	0.426	0.189	0.204
Departure Headway (Hd)	5.115	5.167	5.237	5.238
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	703	701	685	685
Service Time	3.148	3.167	3.271	3.273
HCM Lane V/C Ratio	0.3	0.424	0.19	0.204
HCM Control Delay	10.3	11.9	9.5	9.6
HCM Lane LOS	B	B	A	A
HCM 95th-tile Q	1.3	2.1	0.7	0.8

Lanes, Volumes, Timings
5: Existing Greenbank Road & New E-W Collector

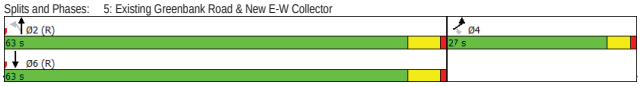
2031 Total Future Conditions
AM Peak Hour

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	97	157	54	319	543	33
Future Volume (vph)	97	157	54	319	543	33
Satd. Flow (prot)	1658	1483	1658	1745	1731	0
Flt Permitted	0.950		0.419			
Satd. Flow (perm)	1658	1483	731	1745	1731	0
Satd. Flow (RTOR)		157			7	
Lane Group Flow (vph)	97	157	54	319	576	0
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Detector Phase	4	4	2	2	6	
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	
Minimum Split (s)	22.3	22.3	23.6	23.6	23.6	
Total Split (s)	27.0	27.0	63.0	63.0	63.0	
Total Split (%)	30.0%	30.0%	70.0%	70.0%	70.0%	
Yellow Time (s)	3.3	3.3	4.6	4.6	4.6	
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	4.3	4.3	5.6	5.6	5.6	
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None	C-Max	C-Max	C-Max	
Act Effct Green (s)	11.2	11.2	68.9	68.9	68.9	
Actuated g/C Ratio	0.12	0.12	0.77	0.77	0.77	
v/c Ratio	0.47	0.49	0.10	0.24	0.43	
Control Delay	42.9	11.1	4.1	4.2	4.0	
Queue Delay	0.0	0.0	0.0	0.0	0.0	
Total Delay	42.9	11.1	4.1	4.2	4.0	
LOS	D	B	A	A	A	
Approach Delay	23.3			4.2	4.0	
Approach LOS	C			A	A	

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 90
Offset: 2 (2%), Referenced to phase 2:NBTL and 6:SBT, Start of Green
Natural Cycle: 55
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.49
Intersection Signal Delay: 8.1 Intersection LOS: A
Intersection Capacity Utilization 55.0% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 5: Existing Greenbank Road & New E-W Collector



Queues
5: Existing Greenbank Road & New E-W Collector

2031 Total Future Conditions
AM Peak Hour

Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	97	157	54	319	576
v/c Ratio	0.47	0.49	0.10	0.24	0.43
Control Delay	42.9	11.1	4.1	4.2	4.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	42.9	11.1	4.1	4.2	4.0
Queue Length 50th (m)	16.0	0.0	1.0	6.1	17.3
Queue Length 95th (m)	28.0	15.1	m7.6	48.5	34.4
Internal Link Dist (m)	345.6			181.0	28.7
Turn Bay Length (m)	37.5		37.5		
Base Capacity (vph)	418	491	559	1335	1326
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.23	0.32	0.10	0.24	0.43

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Intersection	
Intersection Delay, s/veh	8.7
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	90	179	0	16	52	20	0	9	12	33	11	24
Future Vol, veh/h	90	179	0	16	52	20	0	9	12	33	11	24
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	90	179	0	16	52	20	0	9	12	33	11	24
Number of Lanes	0	1	0	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	9.3	7.8	7.6	8.1
HCM LOS	A	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	0%	33%	18%	49%
Vol Thru, %	43%	67%	59%	16%
Vol Right, %	57%	0%	23%	35%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	21	269	88	68
LT Vol	0	90	16	33
Through Vol	9	179	52	11
RT Vol	12	0	20	24
Lane Flow Rate	21	269	88	68
Geometry Grp	1	1	1	1
Degree of Util (X)	0.026	0.316	0.106	0.088
Departure Headway (Hd)	4.475	4.223	4.325	4.644
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	803	839	832	775
Service Time	2.485	2.317	2.335	2.65
HCM Lane V/C Ratio	0.026	0.321	0.106	0.088
HCM Control Delay	7.6	9.3	7.8	8.1
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0.1	1.4	0.4	0.3

Intersection	
Int Delay, s/veh	3.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	43	126	171	69	41	83
Future Vol, veh/h	43	126	171	69	41	83
Conflicting Peds, #/hr	5	0	0	5	5	5
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	43	126	171	69	41	83

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	245	0	-	0	428	216
Stage 1	-	-	-	-	211	-
Stage 2	-	-	-	-	217	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1321	-	-	-	584	824
Stage 1	-	-	-	-	824	-
Stage 2	-	-	-	-	819	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1315	-	-	-	558	816
Mov Cap-2 Maneuver	-	-	-	-	558	-
Stage 1	-	-	-	-	820	-
Stage 2	-	-	-	-	787	-

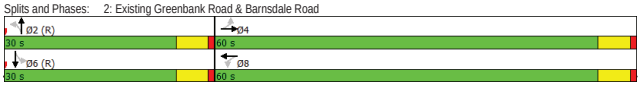
Approach	EB	WB	SB
HCM Control Delay, s	2	0	11.2
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1315	-	-	-	708
HCM Lane V/C Ratio	0.033	-	-	-	0.175
HCM Control Delay (s)	7.8	0	-	-	11.2
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0.1	-	-	-	0.6

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	48	111	7	0	162	511	31	214	0	237	288	42
Future Volume (vph)	48	111	7	0	162	511	31	214	0	237	288	42
Satd. Flow (prot)	1658	1726	0	1745	1508	0	1658	1745	0	1658	1705	0
Flt Permitted	0.112						0.498			0.614		
Satd. Flow (perm)	195	1726	0	1745	1508	0	864	1745	0	1062	1705	0
Satd. Flow (RTOR)		6			319						8	
Lane Group Flow (vph)	48	118	0	0	673	0	31	214	0	237	330	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	23.6	23.6		23.6	23.6		23.6	23.6		28.6	28.6	
Total Split (s)	60.0	60.0		60.0	60.0		30.0	30.0		30.0	30.0	
Total Split (%)	66.7%	66.7%		66.7%	66.7%		33.3%	33.3%		33.3%	33.3%	
Yellow Time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	5.6	5.6		5.6	5.6		5.6	5.6		5.6	5.6	
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	None	None		None	None		C-Max	C-Max		C-Max	C-Max	
Act Effct Green (s)	35.6	35.6			35.6		43.2	43.2		43.2	43.2	
Actuated g/C Ratio	0.40	0.40			0.40		0.48	0.48		0.48	0.48	
v/c Ratio	0.62	0.17			0.85		0.07	0.26		0.47	0.40	
Control Delay	51.1	14.0			22.2		19.9	19.2		20.9	16.3	
Queue Delay	0.0	0.0			0.0		0.0	0.0		0.0	0.0	
Total Delay	51.1	14.0			22.2		19.9	19.2		20.9	16.3	
LOS	D	B			C		B	B		C	B	
Approach Delay		24.7			22.2			19.3			18.3	
Approach LOS		C			C			B			B	

Intersection Summary			
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 39 (43%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 60			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.85			
Intersection Signal Delay: 20.7		Intersection LOS: C	
Intersection Capacity Utilization 85.5%		ICU Level of Service E	
Analysis Period (min) 15			

Splits and Phases: 2: Existing Greenbank Road & Barnsdale Road



Lane Group	EBL	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	48	118	673	31	214	237	330
v/c Ratio	0.62	0.17	0.85	0.07	0.26	0.47	0.40
Control Delay	51.1	14.0	22.2	19.9	19.2	20.9	16.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.1	14.0	22.2	19.9	19.2	20.9	16.3
Queue Length 50th (m)	6.5	12.1	57.4	2.8	21.3	23.7	31.7
Queue Length 95th (m)	15.7	14.9	69.8	10.9	50.0	#72.8	58.0
Internal Link Dist (m)		999.3	579.2		705.1		181.0
Turn Bay Length (m)	37.5			37.5		37.5	
Base Capacity (vph)	117	1045	1037	414	836	509	821
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.41	0.11	0.65	0.07	0.26	0.47	0.40

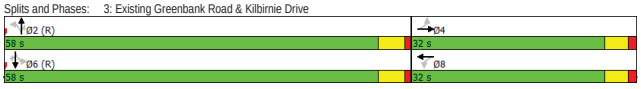
Intersection Summary
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	93	2	130	23	5	61	213	356	66	89	412	150
Future Volume (vph)	93	2	130	23	5	61	213	356	66	89	412	150
Satd. Flow (prot)	1658	1443	0	1658	1461	0	1658	1745	1483	1658	1745	1483
Flt Permitted	0.714			0.595			0.506			0.542		
Satd. Flow (perm)	1234	1443	0	1030	1461	0	878	1745	1435	940	1745	1435
Satd. Flow (RTOR)		130			61				66			150
Lane Group Flow (vph)	93	132	0	23	66	0	213	356	66	89	412	150
Turn Type	Perm	NA		Perm	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2		2	6		6
Detector Phase	4	4		8	8		2	2	2	6	6	6
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	26.6	26.6		26.6	26.6		22.7	22.7	22.7	22.7	22.7	22.7
Total Split (s)	32.0	32.0		32.0	32.0		58.0	58.0	58.0	58.0	58.0	58.0
Total Split (%)	35.6%	35.6%		35.6%	35.6%		64.4%	64.4%	64.4%	64.4%	64.4%	64.4%
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)	1.3	1.3		1.3	1.3		1.0	1.0	1.0	1.0	1.0	1.0
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)	4.6	4.6		4.6	4.6		4.7	4.7	4.7	4.7	4.7	4.7
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	None	None		None	None		C-Max	C-Max	C-Max	C-Max	C-Max	C-Max
Act Effct Green (s)	13.0	13.0		13.0	13.0		67.7	67.7	67.7	67.7	67.7	67.7
Actuated g/C Ratio	0.14	0.14		0.14	0.14		0.75	0.75	0.75	0.75	0.75	0.75
v/c Ratio	0.53	0.42		0.16	0.25		0.32	0.27	0.06	0.13	0.31	0.13
Control Delay	44.6	10.0		33.0	11.8		5.4	4.2	1.6	4.7	5.2	1.2
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	44.6	10.0		33.0	11.8		5.4	4.2	1.6	4.7	5.2	1.2
LOS	D	B		C	B		A	A	A	A	A	A
Approach Delay		24.3			17.2			4.3			4.2	
Approach LOS		C			B			A			A	

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 90
Offset: 17 (19%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.53
Intersection Signal Delay: 7.8 — Intersection LOS: A
Intersection Capacity Utilization 65.6% — ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 3: Existing Greenbank Road & Kilbirnie Drive



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	93	132	23	66	213	356	66	89	412	150
v/c Ratio	0.53	0.42	0.16	0.25	0.32	0.27	0.06	0.13	0.31	0.13
Control Delay	44.6	10.0	33.0	11.8	5.4	4.2	1.6	4.7	5.2	1.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	44.6	10.0	33.0	11.8	5.4	4.2	1.6	4.7	5.2	1.2
Queue Length 50th (m)	15.3	0.3	3.6	0.8	5.1	8.2	0.1	3.2	17.6	0.0
Queue Length 95th (m)	26.5	13.6	9.2	10.4	23.3	32.6	2.9	11.0	44.3	5.7
Internal Link Dist (m)		360.1		212.9		511.5			369.2	
Turn Bay Length (m)	37.5		37.5		50.0		37.5	50.0		37.5
Base Capacity (vph)	375	529	313	487	660	1313	1096	707	1313	1117
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.25	0.25	0.07	0.14	0.32	0.27	0.06	0.13	0.31	0.13

Intersection Summary

Intersection	
Intersection Delay, s/veh	12.5
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	105	133	1	56	190	45	0	82	29	30	144	145
Future Vol, veh/h	105	133	1	56	190	45	0	82	29	30	144	145
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	105	133	1	56	190	45	0	82	29	30	144	145
Number of Lanes	0	1	0	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	12.3	12.9	10.2	13.2
HCM LOS	B	B	B	B

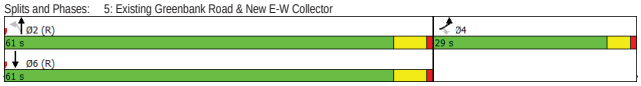
Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	0%	44%	19%	9%
Vol Thru, %	74%	56%	65%	45%
Vol Right, %	26%	0%	15%	45%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	111	239	291	319
LT Vol	0	105	56	30
Through Vol	82	133	190	144
RT Vol	29	1	45	145
Lane Flow Rate	111	239	291	319
Geometry Grp	1	1	1	1
Degree of Util (X)	0.18	0.38	0.445	0.475
Departure Headway (Hd)	5.844	5.722	5.504	5.363
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	609	626	652	670
Service Time	3.919	3.78	3.56	3.421
HCM Lane V/C Ratio	0.182	0.382	0.446	0.476
HCM Control Delay	10.2	12.3	12.9	13.2
HCM Lane LOS	B	B	B	B
HCM 95th-tile Q	0.7	1.8	2.3	2.6

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	51	85	152	622	484	95
Future Volume (vph)	51	85	152	622	484	95
Satd. Flow (prot)	1658	1483	1658	1745	1707	0
Flt Permitted	0.950		0.427			
Satd. Flow (perm)	1658	1483	745	1745	1707	0
Satd. Flow (RTOR)		85			20	
Lane Group Flow (vph)	51	85	152	622	579	0
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Detector Phase	4	4	2	2	6	
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	
Minimum Split (s)	28.0	28.0	28.0	28.0	28.0	
Total Split (s)	29.0	29.0	61.0	61.0	61.0	
Total Split (%)	32.2%	32.2%	67.8%	67.8%	67.8%	
Yellow Time (s)	3.3	3.3	4.6	4.6	4.6	
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	4.3	4.3	5.6	5.6	5.6	
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None	C-Max	C-Max	C-Max	
Act Effct Green (s)	9.6	9.6	73.6	73.6	73.6	
Actuated g/C Ratio	0.11	0.11	0.82	0.82	0.82	
v/c Ratio	0.29	0.36	0.25	0.44	0.41	
Control Delay	39.2	12.4	3.0	3.3	4.0	
Queue Delay	0.0	0.0	0.0	0.0	0.0	
Total Delay	39.2	12.4	3.0	3.3	4.0	
LOS	D	B	A	A	A	
Approach Delay	22.5			3.3	4.0	
Approach LOS	C			A	A	

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 90
Offset: 6 (7%), Referenced to phase 2:NBTL and 6:SBT, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.44
Intersection Signal Delay: 5.3 — Intersection LOS: A
Intersection Capacity Utilization 59.0% — ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 5: Existing Greenbank Road & New E-W Collector



Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	51	85	152	622	579
v/c Ratio	0.29	0.36	0.25	0.44	0.41
Control Delay	39.2	12.4	3.0	3.3	4.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	39.2	12.4	3.0	3.3	4.0
Queue Length 50th (m)	8.4	0.0	2.4	10.2	19.8
Queue Length 95th (m)	16.9	11.5	m12.3	55.4	46.3
Internal Link Dist (m)	345.6			181.0	28.7
Turn Bay Length (m)	37.5		37.5		
Base Capacity (vph)	455	468	609	1427	1399
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.11	0.18	0.25	0.44	0.41

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Intersection	
Intersection Delay, s/veh	8.6
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	51	99	0	3	179	35	0	2	4	27	2	92
Future Vol, veh/h	51	99	0	3	179	35	0	2	4	27	2	92
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	51	99	0	3	179	35	0	2	4	27	2	92
Number of Lanes	0	1	0	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	8.6	8.8	7.6	8.1
HCM LOS	A	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	0%	34%	1%	22%
Vol Thru, %	33%	66%	82%	2%
Vol Right, %	67%	0%	16%	76%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	6	150	217	121
LT Vol	0	51	3	27
Through Vol	2	99	179	2
RT Vol	4	0	35	92
Lane Flow Rate	6	150	217	121
Geometry Grp	1	1	1	1
Degree of Util (X)	0.008	0.188	0.259	0.146
Departure Headway (Hd)	4.5	4.514	4.289	4.348
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	795	795	838	825
Service Time	2.53	2.537	2.31	2.371
HCM Lane V/C Ratio	0.008	0.189	0.259	0.147
HCM Control Delay	7.6	8.6	8.8	8.1
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0	0.7	1	0.5

C.6 2036 ULTIMATE CONDITIONS

Intersection	
Int Delay, s/veh	3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	49	137	151	37	41	54
Future Vol, veh/h	49	137	151	37	41	54
Conflicting Peds, #/hr	5	0	0	5	5	5
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	49	137	151	37	41	54

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	193	0	-	0	415	180
Stage 1	-	-	-	-	175	-
Stage 2	-	-	-	-	240	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1380	-	-	-	594	863
Stage 1	-	-	-	-	855	-
Stage 2	-	-	-	-	800	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1374	-	-	-	566	855
Mov Cap-2 Maneuver	-	-	-	-	566	-
Stage 1	-	-	-	-	851	-
Stage 2	-	-	-	-	765	-

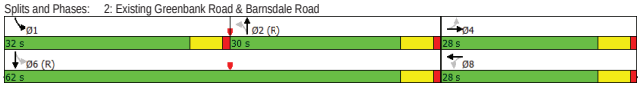
Approach	EB	WB	SB
HCM Control Delay, s	2	0	10.9
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1374	-	-	-	701
HCM Lane V/C Ratio	0.036	-	-	-	0.136
HCM Control Delay (s)	7.7	0	-	-	10.9
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0.1	-	-	-	0.5

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	46	114	14	4	112	151	21	194	0	490	195	52
Future Volume (vph)	46	114	14	4	112	151	21	194	0	490	195	52
Satd. Flow (prot)	1658	1711	0	1658	1565	0	1658	1745	0	1658	1678	0
Flt Permitted	0.345			0.674			0.606			0.547		
Satd. Flow (perm)	598	1711	0	1164	1565	0	1048	1745	0	947	1678	0
Satd. Flow (RTOR)		7			72						29	
Lane Group Flow (vph)	46	128	0	4	263	0	21	194	0	490	247	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		4			8			2		1	6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		2	2		1	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0		10.0	10.0		5.0	10.0	
Minimum Split (s)	23.6	23.6		23.6	23.6		23.6	23.6		10.6	23.6	
Total Split (s)	28.0	28.0		28.0	28.0		30.0	30.0		32.0	62.0	
Total Split (%)	31.1%	31.1%		31.1%	31.1%		33.3%	33.3%		35.6%	68.9%	
Yellow Time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	5.6	5.6		5.6	5.6		5.6	5.6		5.6	5.6	
Lead/Lag							Lag	Lag		Lead		
Lead-Lag Optimize?							Yes	Yes		Yes		
Recall Mode	None	None		None	None		C-Max	C-Max		None	C-Max	
Act Effct Green (s)	16.5	16.5		16.5	16.5		38.9	38.9		62.3	62.3	
Actuated g/C Ratio	0.18	0.18		0.18	0.18		0.43	0.43		0.69	0.69	
v/c Ratio	0.42	0.40		0.02	0.76		0.05	0.26		0.62	0.21	
Control Delay	42.9	33.0		27.0	39.1		21.1	21.0		8.7	2.8	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	42.9	33.0		27.0	39.1		21.1	21.0		8.7	2.8	
LOS	D	C		C	D		C	C		A	A	
Approach Delay		35.6			39.0			21.0			6.8	
Approach LOS		D			D			C			A	

Intersection Summary		
Cycle Length: 90		
Actuated Cycle Length: 90		
Offset: 39 (43%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green		
Natural Cycle: 65		
Control Type: Actuated-Coordinated		
Maximum v/c Ratio: 0.76		
Intersection Signal Delay: 18.7	Intersection LOS: B	
Intersection Capacity Utilization 87.0%	ICU Level of Service E	
Analysis Period (min) 15		

Splits and Phases: 2: Existing Greenbank Road & Barnsdale Road



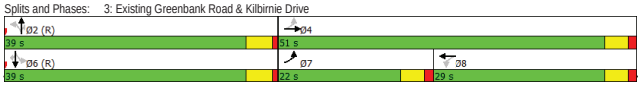
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	46	128	4	263	21	194	490	247
v/c Ratio	0.42	0.40	0.02	0.76	0.05	0.26	0.62	0.21
Control Delay	42.9	33.0	27.0	39.1	21.1	21.0	8.7	2.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	42.9	33.0	27.0	39.1	21.1	21.0	8.7	2.8
Queue Length 50th (m)	7.1	18.5	0.6	31.5	2.0	20.6	11.9	2.4
Queue Length 95th (m)	16.5	31.9	3.1	53.7	8.3	46.5	60.6	9.9
Internal Link Dist (m)		999.3		579.2		705.1		181.0
Turn Bay Length (m)	37.5		37.5		37.5		37.5	
Base Capacity (vph)	148	431	289	443	453	754	864	1170
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.31	0.30	0.01	0.59	0.05	0.26	0.57	0.21

Intersection Summary

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	142	6	182	66	6	107	74	333	11	29	312	60
Future Volume (vph)	142	6	182	66	6	107	74	333	11	29	312	60
Satd. Flow (prot)	1658	1449	0	1658	1455	0	1658	1745	1483	1658	1745	1483
Flt Permitted	0.449			0.639			0.536			0.519		
Satd. Flow (perm)	777	1449	0	1106	1455	0	929	1745	1435	900	1745	1435
Satd. Flow (RTOR)		182			107				75			75
Lane Group Flow (vph)	142	188	0	66	113	0	74	333	11	29	312	60
Turn Type	pm+pt	NA		Perm	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	7	4			8			2			6	
Permitted Phases	4			8			2		2	6		6
Detector Phase	7	4		8	8		2	2	2	6	6	6
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	9.6	26.6		26.6	26.6		22.7	22.7	22.7	22.7	22.7	22.7
Total Split (s)	22.0	51.0		29.0	29.0		39.0	39.0	39.0	39.0	39.0	39.0
Total Split (%)	24.4%	56.7%		32.2%	32.2%		43.3%	43.3%	43.3%	43.3%	43.3%	43.3%
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)	1.3	1.3		1.3	1.3		1.0	1.0	1.0	1.0	1.0	1.0
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)	4.6	4.6		4.6	4.6		4.7	4.7	4.7	4.7	4.7	4.7
Lead/Lag	Lead			Lag	Lag							
Lead-Lag Optimize?	Yes			Yes	Yes							
Recall Mode	None	None		None	None		C-Max	C-Max	C-Max	C-Max	C-Max	C-Max
Act Effct Green (s)	27.4	27.4		11.9	11.9		53.3	53.3	53.3	53.3	53.3	53.3
Actuated g/C Ratio	0.30	0.30		0.13	0.13		0.59	0.59	0.59	0.59	0.59	0.59
v/c Ratio	0.39	0.33		0.45	0.40		0.13	0.32	0.01	0.05	0.30	0.07
Control Delay	23.8	4.4		43.5	11.4		5.1	5.9	0.1	12.9	13.2	3.0
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.8	4.4		43.5	11.4		5.1	5.9	0.1	12.9	13.2	3.0
LOS	C	A		D	B		A	A	A	B	B	A
Approach Delay		12.8			23.3			5.6			11.6	
Approach LOS		B			C			A			B	

Intersection Summary		
Cycle Length: 90		
Actuated Cycle Length: 90		
Offset: 12 (13%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green		
Natural Cycle: 60		
Control Type: Actuated-Coordinated		
Maximum v/c Ratio: 0.45		
Intersection Signal Delay: 11.6	Intersection LOS: B	
Intersection Capacity Utilization 55.9%	ICU Level of Service B	
Analysis Period (min) 15		

Splits and Phases: 3: Existing Greenbank Road & Kilbirnie Drive



Queues
3: Existing Greenbank Road & Kilbirnie Drive

2036 Ultimate
AM Peak Hour

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	142	188	66	113	74	333	11	29	312	60
v/c Ratio	0.39	0.33	0.45	0.40	0.13	0.32	0.01	0.05	0.30	0.07
Control Delay	23.8	4.4	43.5	11.4	5.1	5.9	0.1	12.9	13.2	3.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.8	4.4	43.5	11.4	5.1	5.9	0.1	12.9	13.2	3.0
Queue Length 50th (m)	18.2	0.7	10.9	0.9	4.2	20.1	0.0	2.0	25.5	0.0
Queue Length 95th (m)	23.9	10.8	20.3	13.3	7.4	34.3	0.1	8.3	59.3	5.3
Internal Link Dist (m)		360.1		212.9		511.5			369.2	
Turn Bay Length (m)	20.0		20.0		50.0		37.5	50.0		37.5
Base Capacity (vph)	423	835	299	472	550	1033	880	533	1033	880
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.34	0.23	0.22	0.24	0.13	0.32	0.01	0.05	0.30	0.07

Intersection Summary

HCM 2010 AWSC
4: River Mist Road & Kilbirnie Drive

2036 Ultimate
AM Peak Hour

Intersection	
Intersection Delay, s/veh	10.7
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	125	168	4	25	79	26	2	147	62	39	50	51
Future Vol, veh/h	125	168	4	25	79	26	2	147	62	39	50	51
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	125	168	4	25	79	26	2	147	62	39	50	51
Number of Lanes	0	1	0	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	11.9	9.5	10.3	9.6
HCM LOS	B	A	B	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	1%	42%	19%	28%
Vol Thru, %	70%	57%	61%	36%
Vol Right, %	29%	1%	20%	36%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	211	297	130	140
LT Vol	2	125	25	39
Through Vol	147	168	79	50
RT Vol	62	4	26	51
Lane Flow Rate	211	297	130	140
Geometry Grp	1	1	1	1
Degree of Util (X)	0.3	0.426	0.189	0.204
Departure Headway (Hd)	5.115	5.167	5.237	5.238
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	703	701	685	685
Service Time	3.148	3.167	3.271	3.273
HCM Lane V/C Ratio	0.3	0.424	0.19	0.204
HCM Control Delay	10.3	11.9	9.5	9.6
HCM Lane LOS	B	B	A	A
HCM 95th-tile Q	1.3	2.1	0.7	0.8

Lanes, Volumes, Timings
5: Existing Greenbank Road & New E-W Collector

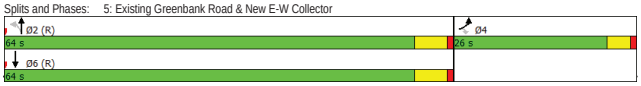
2036 Ultimate
AM Peak Hour

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	97	157	54	338	579	33
Future Volume (vph)	97	157	54	338	579	33
Satd. Flow (prot)	1658	1483	1658	1745	1733	0
Flt Permitted	0.950		0.400			
Satd. Flow (perm)	1658	1483	698	1745	1733	0
Satd. Flow (RTOR)		157			6	
Lane Group Flow (vph)	97	157	54	338	612	0
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Detector Phase	4	4	2	2	6	
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	
Minimum Split (s)	22.3	22.3	23.6	23.6	23.6	
Total Split (s)	26.0	26.0	64.0	64.0	64.0	
Total Split (%)	28.9%	28.9%	71.1%	71.1%	71.1%	
Yellow Time (s)	3.3	3.3	4.6	4.6	4.6	
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	4.3	4.3	5.6	5.6	5.6	
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None	C-Max	C-Max	C-Max	
Act Effct Green (s)	11.2	11.2	68.9	68.9	68.9	
Actuated g/C Ratio	0.12	0.12	0.77	0.77	0.77	
v/c Ratio	0.47	0.49	0.10	0.25	0.46	
Control Delay	42.9	11.1	4.4	4.5	4.3	
Queue Delay	0.0	0.0	0.0	0.0	0.0	
Total Delay	42.9	11.1	4.4	4.5	4.3	
LOS	D	B	A	A	A	
Approach Delay	23.3			4.5	4.3	
Approach LOS	C			A	A	

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 90
Offset: 89 (99%), Referenced to phase 2:NBTL and 6:SBT, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.49
Intersection Signal Delay: 8.2 Intersection LOS: A
Intersection Capacity Utilization 57.0% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 5: Existing Greenbank Road & New E-W Collector



Queues
5: Existing Greenbank Road & New E-W Collector

2036 Ultimate
AM Peak Hour

Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	97	157	54	338	612
v/c Ratio	0.47	0.49	0.10	0.25	0.46
Control Delay	42.9	11.1	4.4	4.5	4.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	42.9	11.1	4.4	4.5	4.3
Queue Length 50th (m)	16.0	0.0	1.1	6.7	19.6
Queue Length 95th (m)	28.0	15.1	m7.8	55.3	38.1
Internal Link Dist (m)	345.6			181.0	28.7
Turn Bay Length (m)	37.5		37.5		
Base Capacity (vph)	399	476	534	1335	1328
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.24	0.33	0.10	0.25	0.46

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Intersection	
Intersection Delay, s/veh	8.7
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	90	179	0	16	52	20	0	9	12	33	11	24
Future Vol, veh/h	90	179	0	16	52	20	0	9	12	33	11	24
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	90	179	0	16	52	20	0	9	12	33	11	24
Number of Lanes	0	1	0	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	9.3	7.8	7.6	8.1
HCM LOS	A	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	0%	33%	18%	49%
Vol Thru, %	43%	67%	59%	16%
Vol Right, %	57%	0%	23%	35%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	21	269	88	68
LT Vol	0	90	16	33
Through Vol	9	179	52	11
RT Vol	12	0	20	24
Lane Flow Rate	21	269	88	68
Geometry Grp	1	1	1	1
Degree of Util (X)	0.026	0.316	0.106	0.088
Departure Headway (Hd)	4.475	4.223	4.325	4.644
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	803	839	832	775
Service Time	2.485	2.317	2.335	2.65
HCM Lane V/C Ratio	0.026	0.321	0.106	0.088
HCM Control Delay	7.6	9.3	7.8	8.1
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0.1	1.4	0.4	0.3

Intersection	
Int Delay, s/veh	3.3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	46	138	188	73	44	88
Future Vol, veh/h	46	138	188	73	44	88
Conflicting Peds, #/hr	5	0	0	5	5	5
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	46	138	188	73	44	88

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	266	0	-	0	465	235
Stage 1	-	-	-	-	230	-
Stage 2	-	-	-	-	235	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1298	-	-	-	556	804
Stage 1	-	-	-	-	808	-
Stage 2	-	-	-	-	804	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1292	-	-	-	529	797
Mov Cap-2 Maneuver	-	-	-	-	529	-
Stage 1	-	-	-	-	804	-
Stage 2	-	-	-	-	769	-

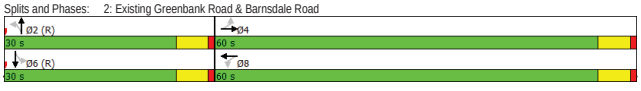
Approach	EB	WB	SB
HCM Control Delay, s	2	0	11.5
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1292	-	-	-	682
HCM Lane V/C Ratio	0.036	-	-	-	0.194
HCM Control Delay (s)	7.9	0	-	-	11.5
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0.1	-	-	-	0.7

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	53	121	7	0	178	537	31	225	0	245	302	46
Future Volume (vph)	53	121	7	0	178	537	31	225	0	245	302	46
Satd. Flow (prot)	1658	1728	0	1745	1510	0	1658	1745	0	1658	1703	0
Flt Permitted	0.116						0.461			0.592		
Satd. Flow (perm)	202	1728	0	1745	1510	0	800	1745	0	1025	1703	0
Satd. Flow (RTOR)		6			305						8	
Lane Group Flow (vph)	53	128	0	0	715	0	31	225	0	245	348	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	23.6	23.6		23.6	23.6		23.6	23.6		28.6	28.6	
Total Split (s)	60.0	60.0		60.0	60.0		30.0	30.0		30.0	30.0	
Total Split (%)	66.7%	66.7%		66.7%	66.7%		33.3%	33.3%		33.3%	33.3%	
Yellow Time (s)	4.6	4.6		4.6	4.6		4.6	4.6		4.6	4.6	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	5.6	5.6		5.6	5.6		5.6	5.6		5.6	5.6	
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	None	None		None	None		C-Max	C-Max		C-Max	C-Max	
Act Effct Green (s)	39.4	39.4			39.4		39.4	39.4		39.4	39.4	
Actuated g/C Ratio	0.44	0.44			0.44		0.44	0.44		0.44	0.44	
v/c Ratio	0.60	0.17			0.86		0.09	0.29		0.55	0.46	
Control Delay	43.7	12.4			22.4		22.2	21.7		25.8	19.6	
Queue Delay	0.0	0.0			0.0		0.0	0.0		0.0	0.0	
Total Delay	43.7	12.4			22.4		22.2	21.7		25.8	19.6	
LOS	D	B			C		C	C		C	B	
Approach Delay		21.5			22.4			21.8			22.2	
Approach LOS		C			C			C			C	

Intersection Summary		
Cycle Length: 90		
Actuated Cycle Length: 90		
Offset: 41 (46%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green		
Natural Cycle: 60		
Control Type: Actuated-Coordinated		
Maximum v/c Ratio: 0.86		
Intersection Signal Delay: 22.1	Intersection LOS: C	
Intersection Capacity Utilization 89.8%	ICU Level of Service E	
Analysis Period (min) 15		

Splits and Phases: 2: Existing Greenbank Road & Barnsdale Road



Lane Group	EBL	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	53	128	715	31	225	245	348
v/c Ratio	0.60	0.17	0.86	0.09	0.29	0.55	0.46
Control Delay	43.7	12.4	22.4	22.2	21.7	25.8	19.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	43.7	12.4	22.4	22.2	21.7	25.8	19.6
Queue Length 50th (m)	6.6	12.0	64.0	3.1	25.0	24.5	31.3
Queue Length 95th (m)	17.1	15.3	81.0	11.2	53.7	#84.3	#92.6
Internal Link Dist (m)		999.3	579.2		705.1		181.0
Turn Bay Length (m)	37.5			37.5		37.5	
Base Capacity (vph)	122	1046	1033	350	763	448	750
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.43	0.12	0.69	0.09	0.29	0.55	0.46

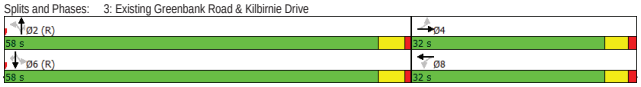
Intersection Summary
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	93	2	130	23	5	61	213	379	66	89	431	150
Future Volume (vph)	93	2	130	23	5	61	213	379	66	89	431	150
Satd. Flow (prot)	1658	1443	0	1658	1461	0	1658	1745	1483	1658	1745	1483
Flt Permitted	0.714			0.595			0.494			0.527		
Satd. Flow (perm)	1234	1443	0	1030	1461	0	857	1745	1435	914	1745	1435
Satd. Flow (RTOR)		130			61				66			150
Lane Group Flow (vph)	93	132	0	23	66	0	213	379	66	89	431	150
Turn Type	Perm	NA		Perm	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2		2	6		6
Detector Phase	4	4		8	8		2	2	2	6	6	6
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	26.6	26.6		26.6	26.6		22.7	22.7	22.7	22.7	22.7	22.7
Total Split (s)	32.0	32.0		32.0	32.0		58.0	58.0	58.0	58.0	58.0	58.0
Total Split (%)	35.6%	35.6%		35.6%	35.6%		64.4%	64.4%	64.4%	64.4%	64.4%	64.4%
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)	1.3	1.3		1.3	1.3		1.0	1.0	1.0	1.0	1.0	1.0
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)	4.6	4.6		4.6	4.6		4.7	4.7	4.7	4.7	4.7	4.7
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	None	None		None	None		C-Max	C-Max	C-Max	C-Max	C-Max	C-Max
Act Effct Green (s)	13.0	13.0		13.0	13.0		67.7	67.7	67.7	67.7	67.7	67.7
Actuated g/C Ratio	0.14	0.14		0.14	0.14		0.75	0.75	0.75	0.75	0.75	0.75
v/c Ratio	0.53	0.42		0.16	0.25		0.33	0.29	0.06	0.13	0.33	0.13
Control Delay	44.6	10.0		33.0	11.8		5.4	4.2	1.0	4.7	5.3	1.2
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	44.6	10.0		33.0	11.8		5.4	4.2	1.0	4.7	5.3	1.2
LOS	D	B		C	B		A	A	A	A	A	A
Approach Delay		24.3			17.2			4.3			4.3	
Approach LOS		C			B			A			A	

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 90
Offset: 11 (12%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.53
Intersection Signal Delay: 7.7 — Intersection LOS: A
Intersection Capacity Utilization 66.6% — ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 3: Existing Greenbank Road & Kilbirnie Drive



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	93	132	23	66	213	379	66	89	431	150
v/c Ratio	0.53	0.42	0.16	0.25	0.33	0.29	0.06	0.13	0.33	0.13
Control Delay	44.6	10.0	33.0	11.8	5.4	4.2	1.0	4.7	5.3	1.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	44.6	10.0	33.0	11.8	5.4	4.2	1.0	4.7	5.3	1.2
Queue Length 50th (m)	15.3	0.3	3.6	0.8	10.3	18.0	0.3	3.2	18.7	0.0
Queue Length 95th (m)	26.5	13.6	9.2	10.4	22.6	36.0	1.8	11.0	46.6	5.7
Internal Link Dist (m)		360.1		212.9		511.5			369.2	
Turn Bay Length (m)	37.5		37.5		50.0		37.5	50.0		37.5
Base Capacity (vph)	375	529	313	487	645	1313	1096	688	1313	1117
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.25	0.25	0.07	0.14	0.33	0.29	0.06	0.13	0.33	0.13

Intersection Summary

Intersection

Intersection Delay, s/veh	12.5
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	105	133	1	56	190	45	0	82	29	30	144	145
Future Vol, veh/h	105	133	1	56	190	45	0	82	29	30	144	145
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	105	133	1	56	190	45	0	82	29	30	144	145
Number of Lanes	0	1	0	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	12.3	12.9	10.2	13.2
HCM LOS	B	B	B	B

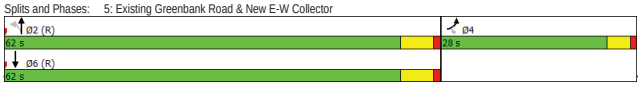
Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	0%	44%	19%	9%
Vol Thru, %	74%	56%	65%	45%
Vol Right, %	26%	0%	15%	45%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	111	239	291	319
LT Vol	0	105	56	30
Through Vol	82	133	190	144
RT Vol	29	1	45	145
Lane Flow Rate	111	239	291	319
Geometry Grp	1	1	1	1
Degree of Util (X)	0.18	0.38	0.445	0.475
Departure Headway (Hd)	5.844	5.722	5.504	5.363
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	609	626	652	670
Service Time	3.919	3.78	3.56	3.421
HCM Lane V/C Ratio	0.182	0.382	0.446	0.476
HCM Control Delay	10.2	12.3	12.9	13.2
HCM Lane LOS	B	B	B	B
HCM 95th-tile Q	0.7	1.8	2.3	2.6

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	51	85	152	664	509	95
Future Volume (vph)	51	85	152	664	509	95
Satd. Flow (prot)	1658	1483	1658	1745	1708	0
Flt Permitted	0.950		0.414			
Satd. Flow (perm)	1658	1483	722	1745	1708	0
Satd. Flow (RTOR)		85			20	
Lane Group Flow (vph)	51	85	152	664	604	0
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Detector Phase	4	4	2	2	6	
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	
Minimum Split (s)	28.0	28.0	28.0	28.0	28.0	
Total Split (s)	28.0	28.0	62.0	62.0	62.0	
Total Split (%)	31.1%	31.1%	68.9%	68.9%	68.9%	
Yellow Time (s)	3.3	3.3	4.6	4.6	4.6	
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	4.3	4.3	5.6	5.6	5.6	
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None	C-Max	C-Max	C-Max	
Act Effct Green (s)	9.6	9.6	73.6	73.6	73.6	
Actuated g/C Ratio	0.11	0.11	0.82	0.82	0.82	
v/c Ratio	0.29	0.36	0.26	0.47	0.43	
Control Delay	39.2	12.4	3.2	3.7	4.1	
Queue Delay	0.0	0.0	0.0	0.0	0.0	
Total Delay	39.2	12.4	3.2	3.7	4.1	
LOS	D	B	A	A	A	
Approach Delay	22.5			3.6	4.1	
Approach LOS	C			A	A	

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 90
Offset: 8 (9%), Referenced to phase 2:NBTL and 6:SBT, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.47
Intersection Signal Delay: 5.5 — Intersection LOS: A
Intersection Capacity Utilization 60.3% — ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 5: Existing Greenbank Road & New E-W Collector



Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	51	85	152	664	604
v/c Ratio	0.29	0.36	0.26	0.47	0.43
Control Delay	39.2	12.4	3.2	3.7	4.1
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	39.2	12.4	3.2	3.7	4.1
Queue Length 50th (m)	8.4	0.0	2.1	9.8	21.3
Queue Length 95th (m)	16.9	11.5	m12.3	65.2	55.0
Internal Link Dist (m)	345.6			181.0	28.7
Turn Bay Length (m)	37.5		37.5		
Base Capacity (vph)	436	453	590	1427	1400
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.12	0.19	0.26	0.47	0.43

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Intersection	
Intersection Delay, s/veh	8.6
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	51	99	0	3	179	35	0	2	4	27	2	92
Future Vol, veh/h	51	99	0	3	179	35	0	2	4	27	2	92
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	51	99	0	3	179	35	0	2	4	27	2	92
Number of Lanes	0	1	0	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	8.6	8.8	7.6	8.1
HCM LOS	A	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	0%	34%	1%	22%
Vol Thru, %	33%	66%	82%	2%
Vol Right, %	67%	0%	16%	76%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	6	150	217	121
LT Vol	0	51	3	27
Through Vol	2	99	179	2
RT Vol	4	0	35	92
Lane Flow Rate	6	150	217	121
Geometry Grp	1	1	1	1
Degree of Util (X)	0.008	0.188	0.259	0.146
Departure Headway (Hd)	4.5	4.514	4.289	4.348
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	795	795	838	825
Service Time	2.53	2.537	2.31	2.371
HCM Lane V/C Ratio	0.008	0.189	0.259	0.147
HCM Control Delay	7.6	8.6	8.8	8.1
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0	0.7	1	0.5

APPENDIX D INTERSECTION CONTROL WARRANTS

D.1 MULTIWAY STOP-CONTROL WARRANT ANALYSIS

5/25/2018

Multi-Way Stop Control Warrant Analysis
Urban Arterial

INTERSECTION: **Existing Greenbank Road at Kilbirnie Drive - 2025 FBG**

DATE OF COUNT USED: 9-Nov-17
NUMBER OF LEGS: 4

LENGTH OF STUDY IN hours: **8**

Criteria:

Volume: Total vehicle volume for all approaches exceeds an AVERAGE of 500 vehicles per hour over heaviest 8-hour period (between 7am and 6pm) **AND**
Total minor street volume (including pedestrians crossing the major) exceeds 200 each hour over same 8-hr period
OR

Collision: Where an avg of 3 or more collisions considered preventable by all-way stop controls (I.e. right angle) has occurred during 3 yr period
OR

Visibility: Where the sight distance from a point 2.7m from the edge of the major street is less than
55m to the left
60m from the right

	Total Vol all approaches		Veh Vol from Minor	Ped Vol Xing Major	Total Minor St Vol	
Hour 1	1192	100%	437		437	100%
Hour 2	1121	100%	452		452	100%
Hour 3	866	100%	270		270	100%
Hour 4	870	100%	225		225	100%
Hour 5	786	100%	164		164	100%
Hour 6	1218	100%	260		260	100%
Hour 7	1285	100%	260		260	100%
Hour 8	1328	100%	240		240	100%
Total Volume Warrant		**100.0%**	**Minor Approach Warrant:**			**100.0%**

Volume Criteria Met :	**YES**
Percent Volume Criteria Met:	**100.0%**

Directional Split: (Four-Legged 65/35) Criteria Met: (Yes/No) **No**
(Three-Legged 75/25) Criteria Met: (Yes/No) **N/A**

1083.25 288.50 27%

Collision Data:

Total number of preventable collisions in past 3 years **1** **No**

Visibility:

Is visibility restricted at this intersection? (yes/no) **N**

Comments:

D.2 TRAFFIC SIGNAL WARRANT ANALYSIS

Input Data Sheet

Analysis Sheet | Results Sheet | Proposed Collision

GO TO Justification:

What are the intersecting roadways? Existing Greenbank Road and Kilbirnie Drive 2031 FBG

What is the direction of the Main Road street? North-South

When was the data collected? Predicted

Justification 1 - 4: Volume Warrants

a.- Number of lanes on the Main Road? 2 or more

b.- Number of lanes on the Minor Road? 1

c.- How many approaches? 4

d.- What is the operating environment? Urban **Population >= 10,000 AND Speed < 70 km/hr**

e.- What is the eight hour vehicle volume at the intersection? (Please fill in table below)

Hour Ending	Main Northbound Approach			Minor Eastbound Approach			Main Southbound Approach			Minor Westbound Approach			Pedestrians Crossing Main Road
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
8:00	60	394	5	120	5	182	30	333	37	66	4	89	0
9:00	68	302	11	135	6	159	29	287	58	66	6	107	0
10:00	63	341	4	101	4	127	26	212	36	21	3	35	0
12:30	43	384	12	91	1	87	32	235	32	21	2	39	0
13:30	61	175	19	65	3	74	38	337	76	12	9	38	0
16:00	153	285	44	89	12	148	67	438	102	24	10	45	0
17:00	158	366	73	83	2	167	64	395	100	21	7	54	0
18:00	189	347	66	89	2	116	89	395	143	23	5	61	0
Total	**795**	**2,594**	**234**	**773**	**35**	**1,060**	**375**	**2,632**	**584**	**254**	**46**	**468**	**0**

Justification 5: Collision Experience

Preceding Months	Number of Collisions*
1-12	0
13-24	0
25-36	1

***** Include only collisions that are susceptable to correction through the installation of traffic signal control

Justification 6: Pedestrian Volume

a.- Please fill in table below summarizing total pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Factored 8 hour pedestrian volume	0		0		0		0		
% Assigned to crossing rate	100%		50%		0%		0%		
Net 8 Hour Pedestrian Volume at Crossing									0
Net 8 Hour Vehicular Volume on Street Being Crossed									6,411

b.- Please fill in table below summarizing delay to pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Total 8 hour pedestrians delayed greater than 10 seconds	0	0	0	0	0	0	0	0	
Factored volume of total pedestrians	0		0		0		0		
Factored volume of delayed pedestrians	0		0		0		0		
% Assigned to Crossing Rate	100%		50%		0%		0%		
Net 8 Hour Volume of Total Pedestrians									0
Net 8 Hour Volume of Delayed Pedestrians									0

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Existing Greenbank Road and Kilbirnie Drive 2031 - FBG Count Date: Predicted

Justification 1: Minimum Vehicle Volumes

Restricted Flow Urban Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 Lanes		2 or More Lanes		Hour Ending									
Flow Condition	FREE FLOW ☐	RESTR. FLOW ☐	FREE FLOW ☐	RESTR. FLOW ☑	8:00	9:00	10:00	12:30	13:30	16:00	17:00	18:00		
1A	480	720	600	900	1,325	1,234	973	979	907	1,417	1,490	1,525		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
1B	120	170	120	170	466	479	291	241	201	328	334	296		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
Restricted Flow Signal Justification 1:					Both 1A and 1B 100% Fulfilled each of 8 hours ☑ Yes ☐ No Lesser of 1A or 1B at least 80% fulfilled each of 8 hours ☑ Yes ☐ No									

Justification 2: Delay to Cross Traffic

Restricted Flow Urban Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 lanes		2 or More lanes		Hour Ending									
Flow Condition	FREE FLOW ☐	RESTR. FLOW ☐	FREE FLOW ☐	RESTR. FLOW ☑	8:00	9:00	10:00	12:30	13:30	16:00	17:00	18:00		
2A	480	720	600	900	859	755	682	738	706	1,089	1,156	1,229		
	COMPLIANCE %				95	84	76	82	78	100	100	100	716	89
2B	50	75	50	75	191	207	126	114	86	125	111	117		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
Restricted Flow Signal Justification 2:					Both 2A and 2B 100% fulfilled each of 8 hours ☐ Yes ☑ No Lesser of 2A or 2B at least 80% fulfilled each of 8 hours ☑ Yes ☐ No									

Justification 3: Combination

Combination Justification 1 and 2

Justification Satisfied 80% or More				Two Justifications Satisfied 80% or More	
Justification 1	Minimum Vehicle Volume	YES ☑	NO ☐	YES ☑	NO ☐
Justification 2	Delay Cross Traffic	YES ☑	NO ☐	JUSTIFIED	

Justification 4: Four Hour Volume

Justification	Time Period	Total Volume of Both Approaches (Main)	Heaviest Minor Approach	Required Value	Average % Compliance	Overall % Compliance
		X	Y (actual)	Y (warrant threshold)		
Justification 4	8:00	859	307	250	100 %	100 %
	16:00	1,089	249	166	100 %	
	17:00	1,156	252	148	100 %	
	18:00	1,229	207	131	100 %	

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Existing Greenbank Road and Kilbirnie Drive 2031 - FBG Count Date: Predicted

Justification 5: Collision Experience

Justification	Preceding Months	% Fulfillment	Overall % Compliance
Justification 5	1-12	0 %	7 %
	13-24	0 %	
	25-36	20 %	

Justification 6: Pedestrian Volume

Pedestrian Volume Analysis

8 Hour Vehicular Volume V_8		Net 8 Hour Pedestrian Volume				
		< 200	200 - 275	276 - 475	476 - 1000	>1000
Justification 6A	< 1440					
	1440 - 2600					
	2601 - 7000	Not Justified				
	> 7000					

Pedestrian Delay Analysis

Net Total 8 Hour Volume of Total Pedestrians		Net Total 8 Hour Volume of Delayed Pedestrians		
		< 75	75 - 130	> 130
Justification 6B	< 200	Not Justified		
	200 - 300			
	> 300			

Results Sheet

Input Sheet | Analysis Sheet | Proposed Collision

GO TO Justification:

Intersection: Existing Greenbank Road and Kilbirnie Drive 2031 - F Count Date: Predicted

Summary Results

Justification			Compliance		Signal Justified? YES	Signal Justified? NO
1. Minimum Vehicular Volume	A	Total Volume	100	%	☑	☐
	B	Crossing Volume	100	%		
2. Delay to Cross Traffic	A	Main Road	89	%	☐	☑
	B	Crossing Road	100	%		
3. Combination	A	Justificaton 1	100	%	☑	☐
	B	Justification 2	89	%		
4. 4-Hr Volume			100	%	☑	☐
5. Collision Experience			7	%	☐	☑
6. Pedestrians	A	Volume	Justification not met		☐	☑
	B	Delay	Justification not met			

Input Data Sheet

Analysis Sheet | Results Sheet | Proposed Collision

GO TO Justification:

What are the intersecting roadways? Existing Greenbank Road and New Collector E-W 2031 - Total Future

What is the direction of the Main Road street? North-South

When was the data collected? Predicted

Justification 1 - 4: Volume Warrants

a.- Number of lanes on the Main Road? 1

b.- Number of lanes on the Minor Road? 1

c.- How many approaches? 3

d.- What is the operating environment? Urban **Population >= 10,000 AND Speed < 70 km/hr**

e.- What is the eight hour vehicle volume at the intersection? (Please fill in table below)

Hour Ending	Main Northbound Approach			Minor Eastbound Approach			Main Southbound Approach			Minor Westbound Approach			Pedestrians Crossing Main Road
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
8:00	35	409	0	71	0	116	0	603	18	0	0	0	0
9:00	39	313	0	80	0	101	0	520	28	0	0	0	0
10:00	36	354	0	60	0	81	0	384	17	0	0	0	0
12:30	25	398	0	54	0	55	0	425	16	0	0	0	0
13:30	31	301	0	31	0	33	0	401	42	0	0	0	0
16:00	77	492	0	42	0	67	0	521	56	0	0	0	0
17:00	80	631	0	39	0	75	0	470	55	0	0	0	0
18:00	95	598	0	42	0	52	0	470	78	0	0	0	0
Total	**418**	**3,496**	**0**	**419**	**0**	**580**	**0**	**3,794**	**310**	**0**	**0**	**0**	**0**

Justification 5: Collision Experience

Preceding Months	Number of Collisions*
1-12	0
13-24	0
25-36	1

***** Include only collisions that are susceptable to correction through the installation of traffic signal control

Justification 6: Pedestrian Volume

a.- Please fill in table below summarizing total pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Factored 8 hour pedestrian volume	0		0		0		0		
% Assigned to crossing rate	100%		50%		0%		0%		
Net 8 Hour Pedestrian Volume at Crossing									0
Net 8 Hour Vehicular Volume on Street Being Crossed									6,411

b.- Please fill in table below summarizing delay to pedestrians crossing major roadway at the intersection or in proximity to the intersection (zones). Please reference Section 4.8 of the Manual for further explanation and graphical representation.

	Zone 1		Zone 2		Zone 3 (if needed)		Zone 4 (if needed)		Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Total 8 hour pedestrians delayed greater than 10 seconds	0	0	0	0	0	0	0	0	
Factored volume of total pedestrians	0		0		0		0		
Factored volume of delayed pedestrians	0		0		0		0		
% Assigned to Crossing Rate	100%		50%		0%		0%		
Net 8 Hour Volume of Total Pedestrians									0
Net 8 Hour Volume of Delayed Pedestrians									0

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Existing Greenbank Road and New Collector E-W 2031 - Tota Count Date: Predicted

Justification 1: Minimum Vehicle Volumes

Restricted Flow Urban Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 Lanes		2 or More Lanes		Hour Ending									
Flow Condition	FREE FLOW ☐	RESTR. FLOW ☑	FREE FLOW ☐	RESTR. FLOW ☐	8:00	9:00	10:00	12:30	13:30	16:00	17:00	18:00		
1A	480	720	600	900	1,252	1,081	932	973	839	1,255	1,350	1,335		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
1B	180	255	180	255	187	181	141	109	64	109	114	94		
	COMPLIANCE %				73	71	55	43	25	43	45	37	392	49
Restricted Flow Signal Justification 1:					Both 1A and 1B 100% Fulfilled each of 8 hours					Yes ☐		No ☑		
					Lesser of 1A or 1B at least 80% fulfilled each of 8 hours					Yes ☐		No ☑		

Justification 2: Delay to Cross Traffic

Restricted Flow Urban Conditions

Justification	Guidance Approach Lanes				Percentage Warrant								Total Across	Section Percent
	1 lanes		2 or More lanes		Hour Ending									
Flow Condition	FREE FLOW ☐	RESTR. FLOW ☑	FREE FLOW ☐	RESTR. FLOW ☐	8:00	9:00	10:00	12:30	13:30	16:00	17:00	18:00		
2A	480	720	600	900	1,065	900	791	864	775	1,146	1,236	1,241		
	COMPLIANCE %				100	100	100	100	100	100	100	100	800	100
2B	50	75	50	75	71	80	60	54	31	42	39	42		
	COMPLIANCE %				95	100	80	72	41	56	52	56	552	69
Restricted Flow Signal Justification 2:					Both 2A and 2B 100% fulfilled each of 8 hours					Yes ☐		No ☑		
					Lesser of 2A or 2B at least 80% fulfilled each of 8 hours					Yes ☐		No ☑		

Justification 3: Combination

Combination Justification 1 and 2

Justification Satisfied 80% or More				Two Justifications Satisfied 80% or More	
Justification 1	Minimum Vehicle Volume	YES ☐	NO ☑	YES ☐	NO ☑
Justification 2	Delay Cross Traffic	YES ☐	NO ☑		NOT JUSTIFIED

Justification 4: Four Hour Volume

Justification	Time Period	Total Volume of Both Approaches (Main)	Heaviest Minor Approach	Required Value	Average % Compliance	Overall % Compliance
		X	Y (actual)	Y (warrant threshold)		
Justification 4	8:00	1,065	187	90	100 %	100 %
	16:00	1,146	109	78	100 %	
	17:00	1,236	114	80	100 %	
	18:00	1,241	94	80	100 %	

Analysis Sheet

Input Sheet | Results Sheet | Proposed Collision

GO TO Justification:

Intersection: Existing Greenbank Road and New Collector E-W 2031 - Tota Count Date: Predicted

Justification 5: Collision Experience

Justification	Preceding Months	% Fulfillment	Overall % Compliance
Justification 5	1-12	0 %	7 %
	13-24	0 %	
	25-36	20 %	

Justification 6: Pedestrian Volume

Pedestrian Volume Analysis

8 Hour Vehicular Volume V_8		Net 8 Hour Pedestrian Volume				
		< 200	200 - 275	276 - 475	476 - 1000	>1000
Justification 6A	< 1440					
	1440 - 2600					
	2601 - 7000	Not Justified				
	> 7000					

Pedestrian Delay Analysis

Net Total 8 Hour Volume of Total Pedestrians		Net Total 8 Hour Volume of Delayed Pedestrians		
		< 75	75 - 130	> 130
Justification 6B	< 200	Not Justified		
	200 - 300			
	> 300			

Results Sheet

Input Sheet | Analysis Sheet | Proposed Collision

GO TO Justification:

Intersection: Existing Greenbank Road and New Collector E-W 20 Count Date: Predicted

Summary Results

Justification			Compliance		Signal Justified? YES	Signal Justified? NO
1. Minimum Vehicular Volume	A	Total Volume	100	%	☐	☑
	B	Crossing Volume	49	%		
2. Delay to Cross Traffic	A	Main Road	100	%	☐	☑
	B	Crossing Road	69	%		
3. Combination	A	Justificaton 1	49	%	☐	☑
	B	Justification 2	69	%		
4. 4-Hr Volume			100	%	☑	☐
5. Collision Experience			7	%	☐	☑
6. Pedestrians	A	Volume	Justification not met		☐	☑
	B	Delay	Justification not met			