

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 licensed¹ or registered¹ 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, the Trip Generation Trigger is satisfied.



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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).

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).



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

Screening May 25, 2018

Figure 1 Concept Plan





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 G	Greenbank
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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

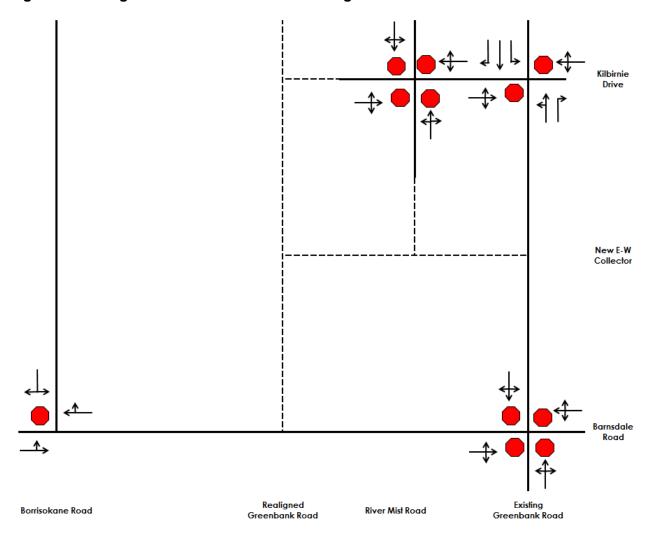
Barnsdale Road is a two-lane arterial with a rural cross-section and a posted speed limit of



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

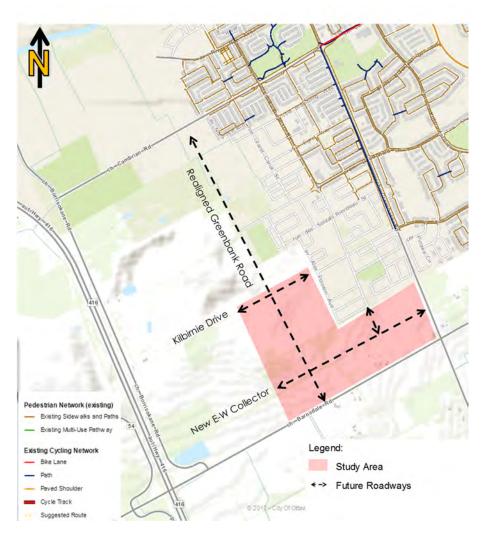
Within the Barrhaven South community there are bicycle paths, paved shoulders, and sidewalks that connect the various communities. There are numerous bicycle paths within the Half Moon Bay community, as well as along Existing Greenbank Road between Cambrian Road and Kilbirnie Drive.

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

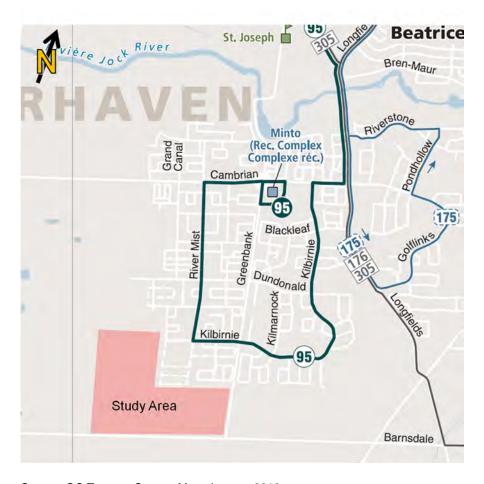
Transit service is provided to the Study Area via route 95. Route 95 is a regular bus route that runs from the Minto Centre Recreation Complex to Trim Road and operates on a 15-minute headway during the morning peak period northbound and during the afternoon peak period southbound.

Figure 4 illustrates existing study area transit routes.



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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.



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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 factor² 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)*



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Figure 5 2018 Existing Traffic Volumes - AM Peak Hour

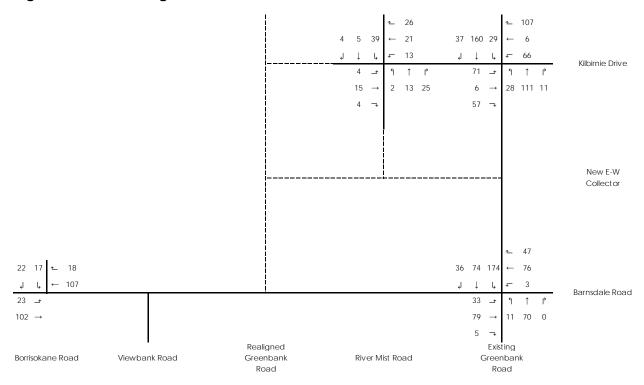
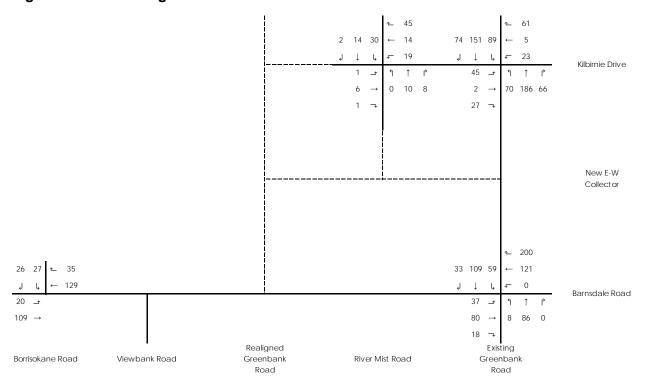


Figure 6 2018 Existing Traffic Volumes - PM Peak Hour





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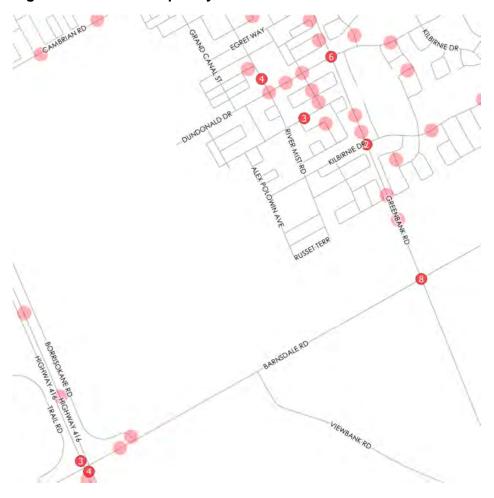
2.1.2.6 Collision History

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





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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

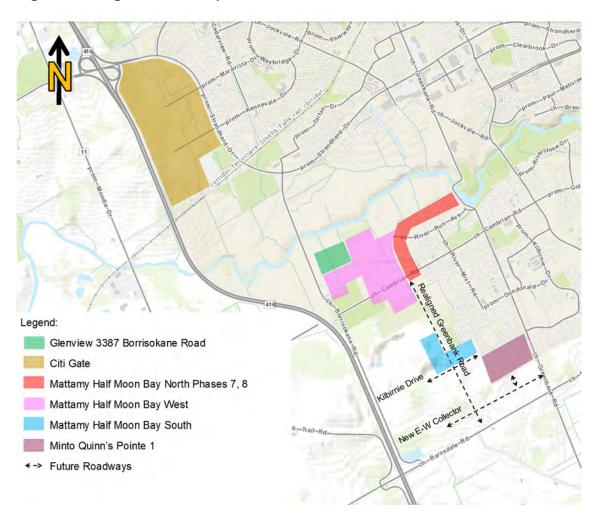


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Development	Location	Size	Build-out
Citi Gate Highway 416 Employment Lands	Between Highway 416 and Strandherd Drive, south of Fallowfield, north of the train tracks	350k sq.ft. GFA (95 ha.) business park	Interim: 2019 Ultimate: 2029
Mattamy's Half 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



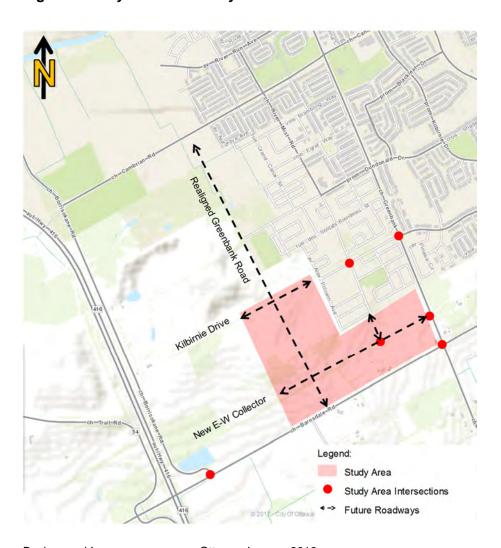
2.2 STUDY AREA AND TIME PERIODS

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



Scoping May 25, 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 Compone	ent		
4.1 Development	4.1.2 Circulation and Access	Only required for site plans	Exempt
Design	4.1.3 New Street Networks	Only required for plans of subdivision	Not exempt
	4.2.1 Parking Supply	Only required for site plans	Exempt
4.2 Parking	4.2.2 Spillover Parking	Only required for site plans where parking supply is 15% below unconstrained demand	Exempt
Network Impact Compon	ent		
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



Forecasting May 25, 2018

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	Independer		eekday <i>l</i> eak Hou		Weekday PM Peak Hour			
	Variable and S	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		eekday eak H		Weekday PM Peak Hour			
					Total	In	Out	Total
	Auto Trip Gen		99	290	389	296	175	466
210 Single Detected Houses	Transit Mode Share	10%	10	29	39	30	18	47
210 – Single Detached Houses	Auto Occupancy	1.1	10	29	39	30	18	47
	Total Person Trips	119	348	467	356	211	560	
	Auto Trip Gen	11	42	53	47	25	73	
220 – Apartment	Transit Mode Share	10%	1	4	5	5	3	7
220 - Apartinent	Auto Occupancy	1	4	5	5	3	7	
	Total Person Trips	Total Person Trips			63	57	31	87
	Auto Trip Gen		28	140	168	135	65	205
230 – Residential Condo / Townhouse	Transit Mode Share	10%	3	14	17	14	7	21
	Auto Occupancy	1.1	3	14	17	14	7	21



Forecasting May 25, 2018

Land Use	Conversion		ekday eak Ho		Weekday PM Peak Hour			
			In	Out	Total	In	Out	Total
	Total Person Trips	Total Person Trips			202	163	79	247
	Auto Trip Gen			135	307	32	40	71
500 Flamantani Oakaal	Transit Mode Share	10%	17	14	31	3	4	7
520 – Elementary School	Auto Occupancy	1.1	17	14	31	3	4	7
	Total Person Trips		206	163	369	38	48	85
	Auto Trip Gen		310	607	917	510	305	815
Total Davalanment	Transit Mode Share	10%	31	61	92	52	32	82
Total Development	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 an			eekday A Peak Hou		Weekday PM Peak Hour			
	Assumed Mode S	hare	In	Out	Total	ln	Out	Total	
	Auto	90%	107	313	420	314	190	504	
210 – Single Detached	Passenger	5%	6	17	23	17	11	28	
Houses	Transit	4%	5	14	19	14	8	22	
	Active	1%	2	3	5	4	2	6	
	Auto	90%	12	45	57	50	28	78	
220 Apartment	Passenger	5%	0	3	3	2	2	4	
220 – Apartment	Transit	4%	1	2	3	2	1	3	
	Active	1%	0	1	1	1	0	1	
	Auto	90%	31	151	182	151	71	222	
230 – Residential Condo	Passenger	5%	2	8	10	8	4	12	
/ Townhouse	Transit	4%	1	7	8	7	3	10	
	Active	1%	0	2	2	1	1	2	
	Auto	90%	185	147	332	34	43	77	
520 – Elementary	Passenger	5%	10	8	18	2	2	4	
School	Transit	4%	8	7	15	1	2	3	
	Active	1%	2	2	4	1	0	1	
Total Davelonment	Auto	90%	335	656	991	549	332	881	
Total Development	Passenger	5%	18	36	54	29	19	48	



Forecasting May 25, 2018

Land Use		Travel Mode and			M r	Weekday PM Peak Hour		
	Assumed Mod	de Share	ln	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

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



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Land Use	Pass-by /		eekday A Peak Hou		Weekday PM Peak Hour			
	Internal Capture	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	
	New Auto Trips	185	147	332	34	43	77	
520 – Elementary	Pass-By Trips	0	0	0	0	0	0	
School	Internal Capture Trips	130	103	233	24	30	54	
	Net New Auto Trips	55	44	99	10	13	23	
	New Auto Trips	335	656	991	549	332	881	
Total Davidenment	Pass-By Trips	0	0	0	0	0	0	
Total Development	Internal Capture Trips	s 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.



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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

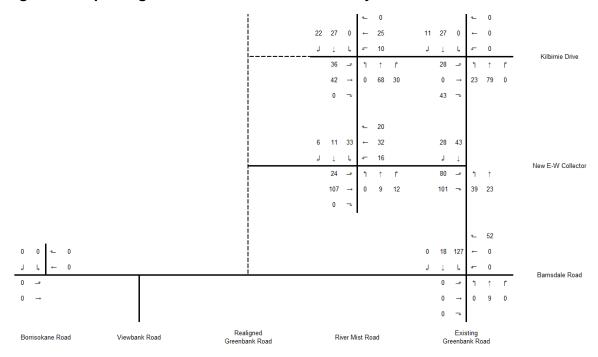
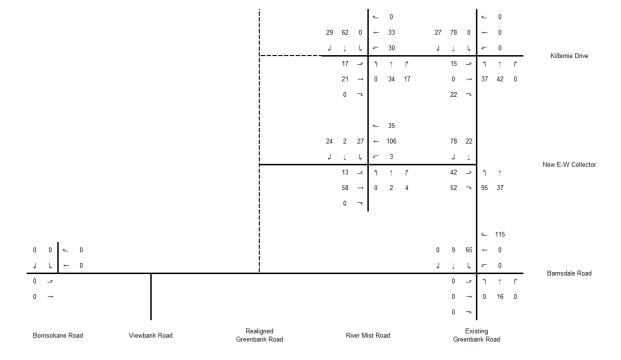


Figure 11 Trip Assignment - 2025 Interim - Weekday PM Peak Hour



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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**.



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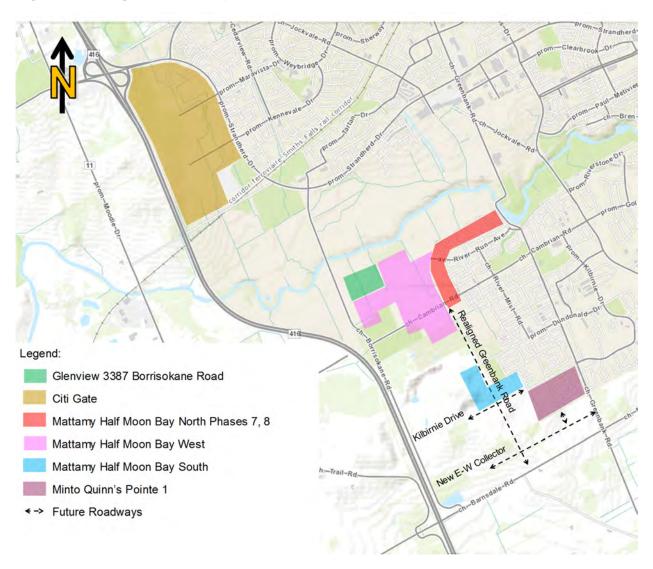
Table 9 Background Developments

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			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.

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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.



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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



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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 onstreet 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.



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Table 10 MMLOS Conditions – Segments

	Segment	Existing Greenbank Road Segment (arterial, spine cycling route)		(Arteri	Barnsdale Road Kilbirnie Drive (Arterial, local (Collector, no cycling cycling route) 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	
	Sidewalk width (m)	2 m	**	None	2 m	2 m	**	N/A	2 m	2 m	**	
ے	Boulevard width (m)	5 m	**	None	**	None	**	N/A	5.0 m	2 m	**	
stria	AADT > 3000?	Yes	**	Yes	**	Yes	**	N/A	Yes	Yes	**	
- Pedestrian	On-Street parking	No	**	No	No	No	**	N/A	Yes	Yes	**	С
مّ	Operating speed	60 kph	**	80 kph	80 kph	50 kph	**	N/A	50 kph	50 kph	**	
	Level of Service	С	**	F	**	С	**	N/A	В	В	**	
	Type of facility	Separated	**	Mixed	**	Mixed	**	N/A	Separated	Mixed	**	
	Number of travel lanes	N/A	**	2	**	2	**	N/A	N/A	2	**	C/B/D/D/B
(I)	Bike lane width (m)	N/A	**	N/A	**	N/A	**	N/A	N/A	N/A	**	
Bicycle	Operating speed (kph)	N/A	**	80 kph	**	50 kph	**	N/A	N/A	50 kph	**	
商	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	Α	**	F	**	В	**	N/A	Α	В	**	
.=	Type of facility	Mixed	**	N/A	**	Mixed	**	N/A	Mixed	Mixed	**	
Transit	Parking/driveway friction	Low	**	N/A	**	Medium	**	N/A	Medium	Medium	**	D
F	Level of Service	D	**	N/A	**	E	**	N/A	E	E	**	
	Curb lane width (m)	3.5m	**	3.5m	**							
Truck	Number of travel lanes	2	**	2	**	Not applicable		le Not applicable		Not applicable		No Target
-	Level of Service	С	**	С	**							Jan 3

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.



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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.



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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.



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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		Barrhaven South Urban Expansion Study Area Community Design Plan Transportation Master Study		
	2025	Minor Stop Control			
	2031				
Existing Greenbank at Barnsdale Road	2018	All-Way Stop-	Barrhaven South Urban Expansion Study Area Community Design Plan Transportation Master Study		
	2025 FBG	Controlled			
	2025 Total Future	Traffic Signals			
	2031				
Existing Greenbank Road at New E-W Collector	2025	Minor Stop	Barrhaven South Urban Expansion Study Area Community Design		
	2031	Control	Plan Transportation Master Study		
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.



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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 9.0TM 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.



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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.



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Table 13 2018 Existing Intersection Operations (Synchro Results)

Scenario	Intersection Control	Approach / Movement		LOS	V/C	Delay (s)	Queue 95 th (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)	-
		ЕВ	Left	C (C)	0.20 (0.20)	16.3 (22.7)	0.7 (0.7)
Existing Greenbank Road at Kilbirnie Drive	Minor Stop Control		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) v/c – represents the anticipated volume divided by the predicted capacity

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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

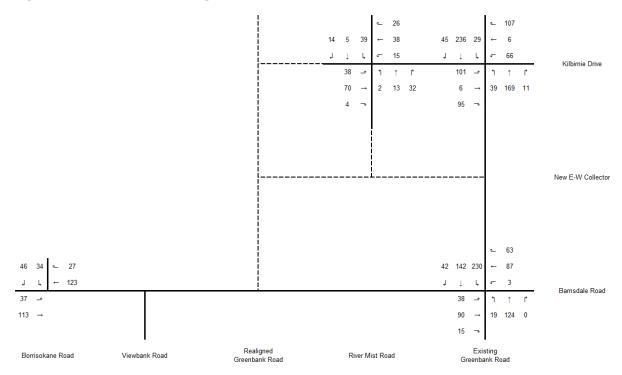
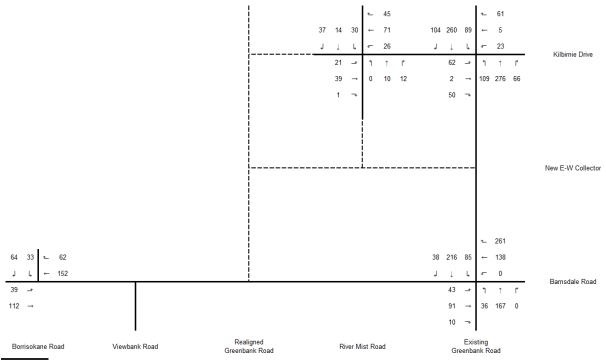


Figure 14 2025 Future Background Traffic Volumes - PM Peak Hour



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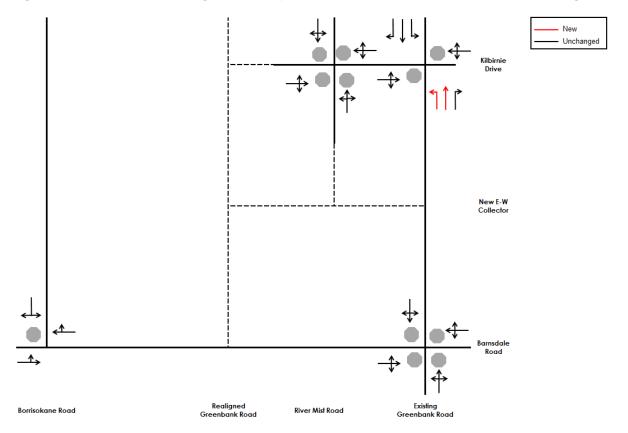
Table 14 2025 Future Background Operations (Synchro Results)

Scenario	Intersection Control	Ap	proach / Movement	Los	V/C	Delay (s)	Queue 95 th (veh)
Barnsdale		EB	Left / Through	A (A)	0.03 (0.03)	7.6 (7.8)	0.1 (0.1)
Road at	Minor Stop	WB	Through / Right	A (A)	0 (0)	0 (0)	0 (0)
Borrisokane	Control	SB	Left / Right	B (B)	0.11 (0.13)	10.3 (10.6)	0.4 (0.5)
Road		0	verall Intersection	A (A)	-	2.9 (2.9)	-
		EB	Left / Through / Right	B (B)	0.23 (0.26)	10.4 (11.7)	0.9 (1.0)
Existing		WB	Left / Through / Right	B (C)	0.23 (0.61)	10.1 (17.0)	0.9 (4.2)
Greenbank at Barnsdale	All-Way Stop Control	NB	Left / Through / Right	A (B)	0.22 (0.36)	9.9 (12.8)	0.8 (1.6)
Road	Control	SB	Left / Through / Right	B (C)	0.58 (0.56)	14.9 (16.4)	3.8 (3.5)
		0	verall Intersection	B (C)	-	12.4 (15.3)	-
		EB	Left	C (D)	0.30 (0.34)	20.2 (34.4)	1.2 (1.4)
		ED	Through / Right	B (B)	0.14 (0.08)	10.6 (10.6)	- 1.2 (1.4) 0.5 (0.2) 0.7 (0.4) 0.5 (0.3) 0.1 (0.3)
		WB	Left	C (C)	0.19 (0.12)	18.1 (26.5)	0.7 (0.4)
Existing		WB	Through / Right	B (B)	0.14 (0.10)	10.2 (11.3)	0.5 (0.3)
Greenbank			Left	A (A)	0.10 (0.08)	7.8 (8.0)	0.1 (0.3)
Road at	Minor Stop Control	NB	Through	A (A)	0 (0)	0 (0)	0 (0)
Kilbirnie	Control		Right	A (A)	0 (0)	0 (0)	0 (0)
Drive			Left	A (A)	0.02 (0.07)	7.6 (8.0)	0.1 (0.2)
		SB	Through	A (A)	0 (0)	0 (0)	0 (0)
			Right	A (A)	0 (0)	0 (0)	0 (0)
		0	verall Intersection	A (A)	-	6.6 (5.1)	-
		EB	Left / Through / Right	A (A)	0.13 (0.07)	7.9 (7.7)	0.5 (0.2)
River Mist	A II	All-Way Stop NB	Left / Through / Right	A (A)	0.09 (0.16)	7.5 (7.9)	0.3 (0.6)
Road at Kilbirnie	All-Way Stop Control		Left / Through / Right	A (A)	0.05 (0.03)	7.2 (7.4)	0.2 (0.1)
Drive	Control	SB	Left / Through / Right	A (A)	0.07 (0.10)	7.7 (7.6)	0.2 (0.3)
2		0	verall Intersection	A (A)	-	7.6 (7.7)	-

Notes:

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

Figure 15 2025 Future Background Required Intersection Control and Lane Configuration



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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

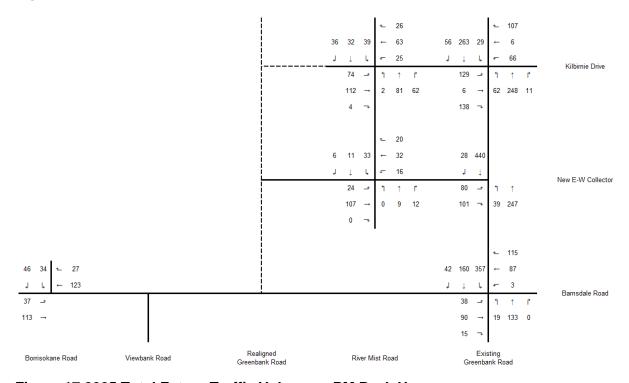


Figure 17 2025 Total Future Traffic Volumes - PM Peak Hour

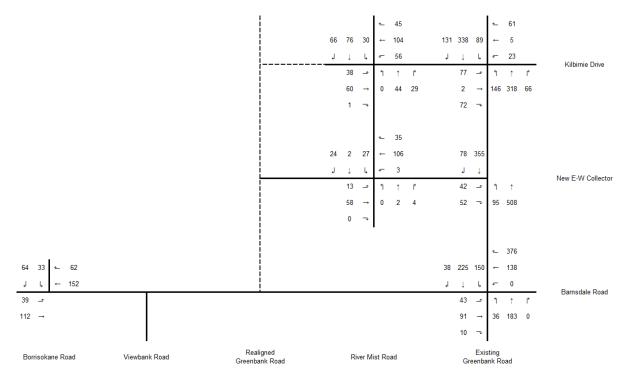


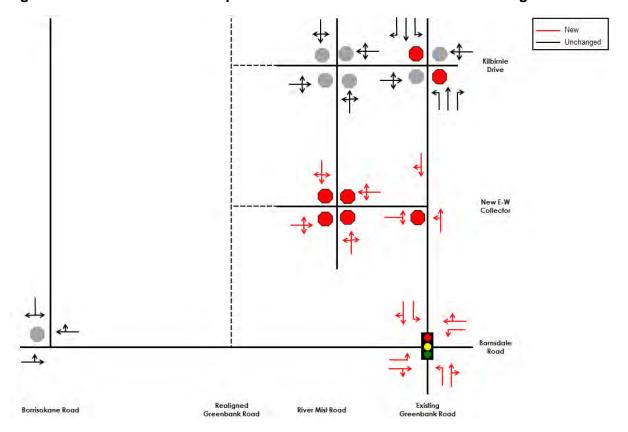
Table 15 2025 Total Future Operations (Synchro Results)

Barnsdale Road at Borrisokane Road Minor Stop Borrisokane Road Control Sep	ue 95 th
Minor Stop Control Minor Stop Road at Borrisokane Road Minor Stop Road Minor Stop Greenbank at Barnsdale Road Minor Stop Control Minor Stop Cont	/eh)
Control SB	(0.1)
Road Powerall Intersection A (A) - 2.9 (2.9)	(0)
Existing Greenbank at Barnsdale Road	(0.5)
Existing Greenbank at Barnsdale Road Traffic Signals September 1.5 (190.000	+ (0.5)+
Existing Greenbank at Barnsdale Road NB	* (9.5)*
Traffic Signals Road Roa	
Traffic Signals Road Roa	5* (0)*
NB	
Note	(7.3)*
Name	, ,
B (C) 0.65 (0.79) 15.6 (13.7)	
Barriang	(36.0)"
Minor Stop Control WB	-
Minor Stop Control Minor Stop Control Left	(3.0)
Minor Stop Control	(0.4)
Minor Stop Control NB	(0.6)
Minor Stop Control NB	
Right	0.4)
Existing Greenbank Road at Kilbirnie Drive All-Way Stop Control	(0)
SB	. ,
Right	(0.2)
Company Comp	(0)
Road at Kilbirnie Drive EB	- -
Left C (B) 0.28 (0.18) 13.7 (13.2) 1.1 Through / Right B (B) 0.27 (0.15) 11.9 (11.4) 1.1 WB	_
Drive EB	(0.7)
All-Way Stop Control	(0.7)
All-Way Stop Control All-Way Stop Control All-Way Stop Control NB Through / Right B (B) 0.22 (0.14) 11.7 (11.6) 0.8 Left B (B) 0.13 (0.30) 11.7 (13.4) 0.5 Right A (A) 0.02 (0.12) 9.4 (9.8) 0.1 Left B (B) 0.06 (0.18) 11.0 (11.9) 0.2 Right B (B) 0.10 (0.23) 10.0 (10.8) 0.3 Overall Intersection B (C) - 14.5 (16.4) EB Left / Through / Right A (A) 0.25 (0.13) 9.3 (8.6) 1.0 WB Left / Through / Right A (B) 0.15 (0.26) 8.5 (9.2) 0.5 NB Left / Through / Right A (A) 0.14 (0.22) 8.5 (8.8) 0.5 Overall Intersection A (A) - 8.8 (8.8) Left C (C) 0.23 (0.20) 18.4 (26.5) 0.9	5 (0.2)
All-Way Stop Control	8 (0.5)
Control NB	i (1.3)
Right	3 (4.1)
Left B (B) 0.06 (0.18) 11.0 (11.9) 0.28 SB Through C (C) 0.5. (0.65) 17.7 (21.7) 3.09 Right B (B) 0.10 (0.23) 10.0 (10.8) 0.38 Overall Intersection B (C) - 14.5 (16.4) River Mist Road at Kilbirnie Drive All-Way Stop Control SB Left / Through / Right A (A) 0.25 (0.13) 9.3 (8.6) 1.09 NB Left / Through / Right A (A) 0.15 (0.26) 8.5 (9.2) 0.58 NB Left / Through / Right A (A) 0.18 (0.09) 8.6 (8.1) 0.78 SB Left / Through / Right A (A) 0.14 (0.22) 8.5 (8.8) 0.58 Overall Intersection A (A) - 8.8 (8.8) EB Left C (C) 0.23 (0.20) 18.4 (26.5) 0.98 Control Co	(0.4)
SB	2 (0.7)
Right B (B) 0.10 (0.23) 10.0 (10.8) 0.30	(4.6)
NB Left / Through / Right A (A) 0.15 (0.13) 9.3 (8.6) 1.0	3 (0.9)
River Mist Road at Kilbirnie Drive All-Way Stop Control All-Way Stop Control SB Left / Through / Right A (A) 0.25 (0.13) 9.3 (8.6) 1.0	-
NB Left / Through / Right A (B) 0.15 (0.26) 8.5 (9.2) 0.5 (9.2)	(0.5)
NB	i (1.0)
SB Left / Through / Right A (A) 0.14 (0.22) 8.5 (8.8) 0.5	' (0.3)
Overall Intersection A (A) - 8.8 (8.8) Left C (C) 0.23 (0.20) 18.4 (26.5) 0.9	5 (0.8)
Left C (C) 0.23 (0.20) 18.4 (26.5) 0.9	-
Full of the state	(0.7)
	6 (0.3)
Greenbank Minor Stop NB Left / Through A (A) 0.04 (0.08) 8.4 (8.5) 0.1	(0.3)
Road at New Control	(0.0)
Overall Intersection A (A) - 3.2 (2.2)	(-)



Scenario	Intersection Control	Ар	proach / Movement	Los	V/C	Delay (s)	Queue 95 th (veh)
		EB	Left / Through / Right	A (A)	0.15 (0.08)	8.0 (7.6) 0.5 (0.7.4 (7.7) 0.2 (0.7.2 (7.1) 0.1 (0.7.2 (7	0.5 (0.3)
River Mist	A II 147 Or	WB	Left / Through / Right	A (A)	0.08 (0.16)	7.4 (7.7)	0.2 (0.6)
Road at New	All-Way Stop Control	NB	Left / Through / Right	A (A)	0.02 (0.01)	7.2 (7.1)	0.1 (0)
E-W Collector	Control	SB	Left / Through / Right	A (A)	0.06 (0.06)	7.7 (7.5)	(7.1) 0.1 (0) (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



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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

	Comment		2025 Total F	uture Traffic		Tannat
	Segment	EB	WB	NB	SB	Target
	Lanes crossed	3	3	3	3	
	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	
တ္ထ	Right turn corner radius (m)	5-10	5-10	5-10	5-10	_
PLOS	Crosswalk treatment	Standard	Standard	Standard	Standard	С
	Cycle length (s)	90	90	90	90	
	Effective walk time (s)	18	18	18	18	
	PETSI Points	71	71	71	71	
	PETSI Points LOS	С	С	С	С	
	Average Pedestrian Delay (s)	28.8	28.8	28.8	28.8	
	Ped Delay LOS	С	С	С	С	
	Level of Service	С	С	С	С	
	Level of Service	С				
	Type of bike lane	Mixed	Mixed	Separated	Separated	
	Left-turn - lanes crossed	1	1	NA (Two Stage)	NA (Two Stage)	
	Left-turn - vehicle operating speed (km/hr)	25	25	25	25	
SC	Right-turn - number of turn lanes	0	0	NA	NA	_
BLOS	Right-turn - turn lane length (m)	NA (Shared)	NA (Shared)	NA (Shared)	NA (Shared)	В
	Right-turn - turning speed (km/hr)	15	15	15	15	
	Right-turn - location of bike lane	NA	NA	MUP	MUP	
	Level of Service	В	В	Α	Α	
	Level of Service		E	3		
w	Intersection Average Delay (s)		N	A		
TLOS	Level of Service		N	A		D
-	Level of Service		N	A		
	Effective corner radius (m)	<10	<10	<10	<10	
TKLOS	Number of receiving lanes	1	1	1	1	No
본	Level of Service	F	F	F	F	Target
	Level of Service		F	-		
W	Maximum Volume-to-capacity (v/c)	0.37	0.79	0.22	0.45	
VLOS	Level of Service	Α	С	Α	Α	D
>	Level of Service		(•		-



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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

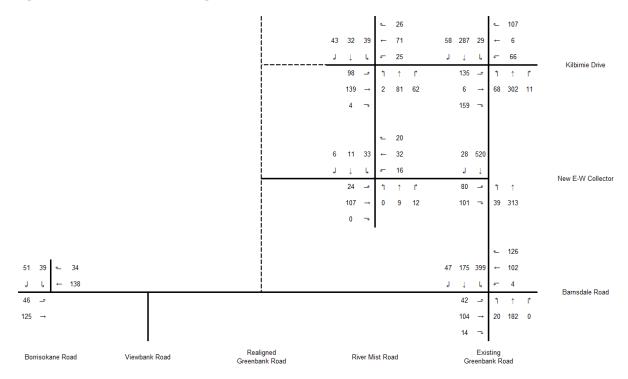


Figure 20 2031 Future Background Traffic Volumes - PM Peak Hour

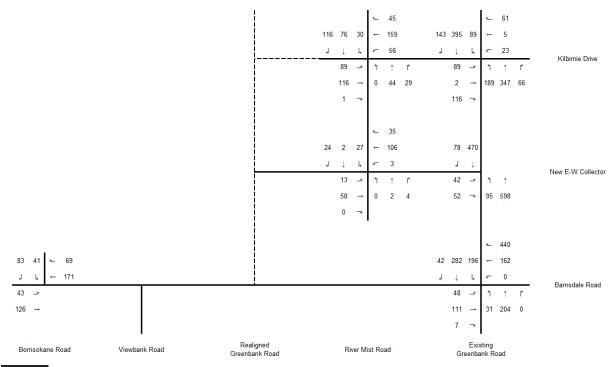


Table 17 2031 Future Background Operations (Synchro Results)

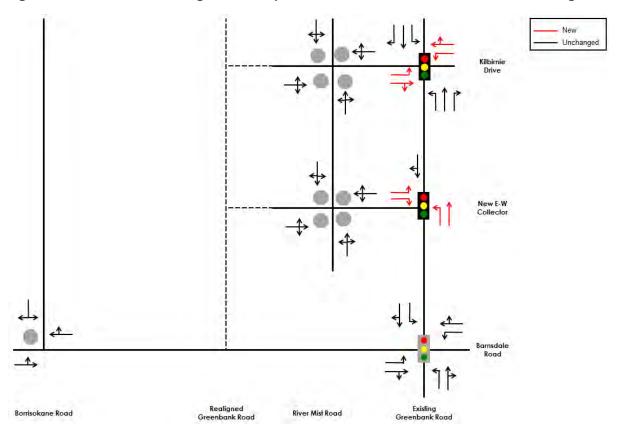
Scenario	Intersection	Ар	proach / Movement	LOS	V/C	Delay (s)	Queue 95 th
Dannadala	Control	EB	Left / Through	A (A)	0.03 (0.03)	7.7 (7.8)	(veh) 0.1 (0.1)
Barnsdale Road at	Minor Stop	WB	Through / Right	A (A)	0.03 (0.03)	0 (0)	0 (0)
Borrisokane	Control	SB	Left / Right	B (B)	0.12 (0.18)	10.7 (11.2)	0.4 (0.6)
Road	00		verall Intersection	A (A)	-	3.1 (3.2)	o.+ (o.o)
			Left	A (B)	0.35 (0.62)	39.5 (53.4)	14.9* (15.7)*
		EB	Through / Right	A (A)	0.40 (0.19)	33.9 (16.3)	29.9* (16.7)*
Eviatina			Left	A (A)	0.02 (0)	28.0 (0)	3.1* (0)*
Existing Greenbank		WB	Through / Right	C (D)	0.71 (0.84)	36.4 (23.6)	46.2* (66.7)*
at	Traffic Signals		Left	A (A)	0.04 (0.07)	17.6 (17.2)	7.4* (10.1)*
Barnsdale		NB	Through / Right	A (A)	0.22 (0.23)	17.4 (16.4)	40.4* (44.9)*
Road			Left	A (A)	0.50 (0.35)	5.2 (14.7)	22.0* (35.0)*
		SB	Through / Right	A (A)	0.19 (0.37)	2.1 (13.2)	5.4* (51.0)*
		0	verall Intersection	C (D)	0.71 (0.84)	16.6 (19.5)	-
			Left	B (B)	0.31 (0.23)	14.8 (14.5)	1.3 (0.9)
		EB	Through / Right	B (B)	0.33 (0.26)	13.3 (13.5)	1.4 (1.0)
		MD	Left	B (B)	0.16 (0.06)	13.1 (13.0)	0.6 (0.2)
		WB	Through / Right	B (B)	0.23 (0.16)	12.5 (12.7)	0.9 (0.5)
	A II AM Ot		Left	B (C)	0.15 (0.42)	12.3 (16.6)	0.5 (2.1)
	All-Way Stop Control	NB	Through	C (D)	0.63 (0.72)	22.6 (27.8)	4.3 (5.8)
	Control		Right	A (B)	0.02 (0.13)	9.7 (10.6)	0.1 (0.4)
			Left	B (B)	0.07 (0.20)	11.4 (12.7)	0.2 (0.7)
		SB	Through	C (E)	0.61 (0.82)	21.4 (36.4)	3.9 (7.9)
Existing			Right	B (B)	0.11 (0.27)	10.5 (12.0)	0.7 (1.1)
Greenbank		0	verall Intersection	C (C)	-	17.3 (22.8)	-
Road at					plement Traffic		
Kilbirnie		EB	Left	A (A)	0.38 (0.51)	23.9 (44.1)	23.2* (25.5)*
Drive			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)*
	Traffic Signals		Left	A (A)	0.12 (0.28)	5.0 (5.1)	9.9* (20.3)*
	· ·	NB	Through	A (A)	0.29 (0.26)	5.6 (4.2) 0.3 (1.8)	30.9* (32.9)*
			Right	A (A)	0.01 (0.06)	0.3 (1.8)	0.4* (2.9)*
			1 - 0	` '			
		CD	Left	A (A)	0.05 (0.12)	12.5 (4.6)	8.2* (10.9)*
		SB	Through	A (A) A (A)	0.05 (0.12) 0.28 (0.30)	12.5 (4.6) 12.6 (5.0)	8.2* (10.9)* 53.4* (42.1)*
			Through Right	A (A) A (A) A (A)	0.05 (0.12) 0.28 (0.30) 0.07 (0.13)	12.5 (4.6) 12.6 (5.0) 2.8 (1.2)	8.2* (10.9)*
_		0	Through Right verall Intersection	A (A) A (A) A (A) A (A)	0.05 (0.12) 0.28 (0.30) 0.07 (0.13) 0.44 (0.51)	12.5 (4.6) 12.6 (5.0) 2.8 (1.2) 11.6 (7.7)	8.2* (10.9)* 53.4* (42.1)* 4.9* (5.6)*
River Mist		O EB	Through Right verall Intersection Left / Through / Right	A (A) A (A) A (A) A (A) B (A)	0.05 (0.12) 0.28 (0.30) 0.07 (0.13) 0.44 (0.51) 0.32 (0.29)	12.5 (4.6) 12.6 (5.0) 2.8 (1.2) 11.6 (7.7) 10.1 (10.3)	8.2* (10.9)* 53.4* (42.1)* 4.9* (5.6)* - 1.4 (1.2)
Road at	All-Way Stop	EB WB	Through Right verall Intersection Left / Through / Right Left / Through / Right	A (A) A (A) A (A) A (A) B (A) A (B)	0.05 (0.12) 0.28 (0.30) 0.07 (0.13) 0.44 (0.51) 0.32 (0.29) 0.16 (0.36)	12.5 (4.6) 12.6 (5.0) 2.8 (1.2) 11.6 (7.7) 10.1 (10.3) 8.7 (10.6)	8.2* (10.9)* 53.4* (42.1)* 4.9* (5.6)* - 1.4 (1.2) 0.6 (1.6)
Road at Kilbirnie	All-Way Stop Control	EB WB NB	Through Right verall Intersection Left / Through / Right Left / Through / Right Left / Through / Right	A (A) A (A) A (A) A (A) B (A) A (B) A (A)	0.05 (0.12) 0.28 (0.30) 0.07 (0.13) 0.44 (0.51) 0.32 (0.29) 0.16 (0.36) 0.19 (0.11)	12.5 (4.6) 12.6 (5.0) 2.8 (1.2) 11.6 (7.7) 10.1 (10.3) 8.7 (10.6) 8.9 (8.9)	8.2* (10.9)* 53.4* (42.1)* 4.9* (5.6)* - 1.4 (1.2) 0.6 (1.6) 0.7 (0.4)
Road at		O EB WB NB SB	Through Right verall Intersection Left / Through / Right	A (A) A (A) A (A) A (A) B (A) A (B) A (A) A (A)	0.05 (0.12) 0.28 (0.30) 0.07 (0.13) 0.44 (0.51) 0.32 (0.29) 0.16 (0.36)	12.5 (4.6) 12.6 (5.0) 2.8 (1.2) 11.6 (7.7) 10.1 (10.3) 8.7 (10.6) 8.9 (8.9) 8.8 (10.1)	8.2* (10.9)* 53.4* (42.1)* 4.9* (5.6)* - 1.4 (1.2) 0.6 (1.6)
Road at Kilbirnie		O EB WB NB SB	Through Right verall Intersection Left / Through / Right Left / Through / Right Left / Through / Right	A (A) A (A) A (A) B (A) A (B) A (A) A (B) A (A) B (A) A (A)	0.05 (0.12) 0.28 (0.30) 0.07 (0.13) 0.44 (0.51) 0.32 (0.29) 0.16 (0.36) 0.19 (0.11) 0.15 (0.30)	12.5 (4.6) 12.6 (5.0) 2.8 (1.2) 11.6 (7.7) 10.1 (10.3) 8.7 (10.6) 8.9 (8.9) 8.8 (10.1) 9.3 (10.2)	8.2* (10.9)* 53.4* (42.1)* 4.9* (5.6)* - 1.4 (1.2) 0.6 (1.6) 0.7 (0.4) 0.5 (1.3) -
Road at Kilbirnie	Control	O EB WB NB SB	Through Right verall Intersection Left / Through / Right verall Intersection	A (A) A (A) A (A) A (A) B (A) A (B) A (A) A (A)	0.05 (0.12) 0.28 (0.30) 0.07 (0.13) 0.44 (0.51) 0.32 (0.29) 0.16 (0.36) 0.19 (0.11) 0.15 (0.30)	12.5 (4.6) 12.6 (5.0) 2.8 (1.2) 11.6 (7.7) 10.1 (10.3) 8.7 (10.6) 8.9 (8.9) 8.8 (10.1)	8.2* (10.9)* 53.4* (42.1)* 4.9* (5.6)* - 1.4 (1.2) 0.6 (1.6) 0.7 (0.4) 0.5 (1.3)
Road at Kilbirnie	Control Minor Stop	O EB WB NB SB	Through Right verall Intersection Left / Through / Right verall Intersection Left Right Left / Through	A (A) A (A) A (A) B (A) A (B) A (A) B (A) C (E)	0.05 (0.12) 0.28 (0.30) 0.07 (0.13) 0.44 (0.51) 0.32 (0.29) 0.16 (0.36) 0.19 (0.11) 0.15 (0.30)	12.5 (4.6) 12.6 (5.0) 2.8 (1.2) 11.6 (7.7) 10.1 (10.3) 8.7 (10.6) 8.9 (8.9) 8.8 (10.1) 9.3 (10.2) 22.5 (36.9)	8.2* (10.9)* 53.4* (42.1)* 4.9* (5.6)* - 1.4 (1.2) 0.6 (1.6) 0.7 (0.4) 0.5 (1.3) - 1.1 (1.0)
Road at Kilbirnie Drive	Control	O EB WB NB SB O	Through Right verall Intersection Left / Through / Right verall Intersection Left Right	A (A) A (A) A (A) B (A) A (B) A (A) B (A) C (E) B (B)	0.05 (0.12) 0.28 (0.30) 0.07 (0.13) 0.44 (0.51) 0.32 (0.29) 0.16 (0.36) 0.19 (0.11) 0.15 (0.30) - 0.28 (0.27) 0.19 (0.09)	12.5 (4.6) 12.6 (5.0) 2.8 (1.2) 11.6 (7.7) 10.1 (10.3) 8.7 (10.6) 8.9 (8.9) 8.8 (10.1) 9.3 (10.2) 22.5 (36.9) 13.1 (12.0)	8.2* (10.9)* 53.4* (42.1)* 4.9* (5.6)* - 1.4 (1.2) 0.6 (1.6) 0.7 (0.4) 0.5 (1.3) - 1.1 (1.0) 0.7 (0.3)
Road at Kilbirnie Drive Existing	Control Minor Stop	O EB WB NB SB O EB NB SB	Through Right verall Intersection Left / Through / Right verall Intersection Left Right Left / Through Through / Right verall Intersection	A (A) A (A) A (A) B (A) A (B) A (A) B (A) A (B) A (A) A (A) B (A) A (A) B (A) A (A) A (A) A (A) A (A)	0.05 (0.12) 0.28 (0.30) 0.07 (0.13) 0.44 (0.51) 0.32 (0.29) 0.16 (0.36) 0.19 (0.11) 0.15 (0.30) - 0.28 (0.27) 0.19 (0.09) 0.04 (0.09) 0 (0)	12.5 (4.6) 12.6 (5.0) 2.8 (1.2) 11.6 (7.7) 10.1 (10.3) 8.7 (10.6) 8.9 (8.9) 8.8 (10.1) 9.3 (10.2) 22.5 (36.9) 13.1 (12.0) 8.7 (8.9) 0 (0) 3.2 (2.2)	8.2* (10.9)* 53.4* (42.1)* 4.9* (5.6)* - 1.4 (1.2) 0.6 (1.6) 0.7 (0.4) 0.5 (1.3) - 1.1 (1.0) 0.7 (0.3) 0.1 (0.3)
Road at Kilbirnie Drive Existing Greenbank	Control Minor Stop	O EB WB NB SB O EB NB SB	Through Right verall Intersection Left / Through / Right verall Intersection Left Right Left / Through Through / Right verall Intersection	A (A) A (A) A (A) B (A) A (B) A (A) B (A) A (B) A (A) A (A) B (A) A (A) B (A) A (A) A (A) A (A) A (A)	0.05 (0.12) 0.28 (0.30) 0.07 (0.13) 0.44 (0.51) 0.32 (0.29) 0.16 (0.36) 0.19 (0.11) 0.15 (0.30) - 0.28 (0.27) 0.19 (0.09) 0.04 (0.09)	12.5 (4.6) 12.6 (5.0) 2.8 (1.2) 11.6 (7.7) 10.1 (10.3) 8.7 (10.6) 8.9 (8.9) 8.8 (10.1) 9.3 (10.2) 22.5 (36.9) 13.1 (12.0) 8.7 (8.9) 0 (0) 3.2 (2.2)	8.2* (10.9)* 53.4* (42.1)* 4.9* (5.6)* - 1.4 (1.2) 0.6 (1.6) 0.7 (0.4) 0.5 (1.3) - 1.1 (1.0) 0.7 (0.3) 0.1 (0.3) 0 (0)
Road at Kilbirnie Drive Existing Greenbank Road at	Control Minor Stop	O EB WB NB SB O EB NB SB	Through Right verall Intersection Left / Through / Right Left / Through / Right Left / Through / Right verall Intersection Left Right Left / Through Through / Right verall Intersection Left Right Left / Through Through / Right verall Intersection Improve Left	A (A) A (A) A (A) B (A) A (B) A (A) A (A) B (A) A (A) A (A) B (A) A (A) B (A) C (E) B (B) A (A) A (A) A (A) A (A) A (A) A (A)	0.05 (0.12) 0.28 (0.30) 0.07 (0.13) 0.44 (0.51) 0.32 (0.29) 0.16 (0.36) 0.19 (0.11) 0.15 (0.30) - 0.28 (0.27) 0.19 (0.09) 0.04 (0.09) 0 (0) - colement Traffic 0.41 (0.25)	12.5 (4.6) 12.6 (5.0) 2.8 (1.2) 11.6 (7.7) 10.1 (10.3) 8.7 (10.6) 8.9 (8.9) 8.8 (10.1) 9.3 (10.2) 22.5 (36.9) 13.1 (12.0) 8.7 (8.9) 0 (0) 3.2 (2.2)	8.2* (10.9)* 53.4* (42.1)* 4.9* (5.6)* - 1.4 (1.2) 0.6 (1.6) 0.7 (0.4) 0.5 (1.3) - 1.1 (1.0) 0.7 (0.3) 0.1 (0.3) 0 (0) - 24.0* (14.5)
Road at Kilbirnie Drive Existing Greenbank	Minor Stop Control	O EB WB NB SB O EB NB SB	Through Right verall Intersection Left / Through / Right Left / Through / Right Left / Through / Right Verall Intersection Left Right Left / Through Through / Right Verall Intersection Left Right Left / Through Through / Right Verall Intersection Improve Left Right	A (A) A (A) A (A) B (A) A (B) A (A) A (A) B (A) A (A) A (A) B (A) A (A) B (A) A (A) B (A) A (A) B (A) A (A) A (A) A (A) A (A) A (A)	0.05 (0.12) 0.28 (0.30) 0.07 (0.13) 0.44 (0.51) 0.32 (0.29) 0.16 (0.36) 0.19 (0.11) 0.15 (0.30) - 0.28 (0.27) 0.19 (0.09) 0.04 (0.09) 0 (0) - 0lement Traffic 0.41 (0.25) 0.38 (0.26)	12.5 (4.6) 12.6 (5.0) 2.8 (1.2) 11.6 (7.7) 10.1 (10.3) 8.7 (10.6) 8.9 (8.9) 8.8 (10.1) 9.3 (10.2) 22.5 (36.9) 13.1 (12.0) 8.7 (8.9) 0 (0) 3.2 (2.2) Signals 41.6 (38.4) 11.4 (13.1)	8.2* (10.9)* 53.4* (42.1)* 4.9* (5.6)* - 1.4 (1.2) 0.6 (1.6) 0.7 (0.4) 0.5 (1.3) - 1.1 (1.0) 0.7 (0.3) 0.1 (0.3) 0 (0) - 24.0* (14.5) 12.4* (9.0)
Road at Kilbirnie Drive Existing Greenbank Road at New E-W	Control Minor Stop	O EB WB NB SB O EB NB SB	Through Right verall Intersection Left / Through / Right Left / Through / Right Left / Through / Right Verall Intersection Left Right Left / Through Through / Right Verall Intersection Left Right Left / Through Through / Right Verall Intersection Improve Left Right Left Right Left Left	A (A) A (A) A (A) B (A) A (B) A (A) A (A) B (A) A (A) A (A) B (A) A (A) B (A) A (A) B (A) A (A)	0.05 (0.12) 0.28 (0.30) 0.07 (0.13) 0.44 (0.51) 0.32 (0.29) 0.16 (0.36) 0.19 (0.11) 0.15 (0.30) - 0.28 (0.27) 0.19 (0.09) 0.04 (0.09) 0 (0) - 0lement Traffic 0.41 (0.25) 0.38 (0.26) 0.06 (0.15)	12.5 (4.6) 12.6 (5.0) 2.8 (1.2) 11.6 (7.7) 10.1 (10.3) 8.7 (10.6) 8.9 (8.9) 8.8 (10.1) 9.3 (10.2) 22.5 (36.9) 13.1 (12.0) 8.7 (8.9) 0 (0) 3.2 (2.2) Signals 41.6 (38.4) 11.4 (13.1) 2.6 (2.2)	8.2* (10.9)* 53.4* (42.1)* 4.9* (5.6)* - 1.4 (1.2) 0.6 (1.6) 0.7 (0.4) 0.5 (1.3) - 1.1 (1.0) 0.7 (0.3) 0.1 (0.3) 0 (0) - 24.0* (14.5) 12.4* (9.0) m2.6* (m5.1)
Road at Kilbirnie Drive Existing Greenbank Road at New E-W	Minor Stop Control	O EB WB NB SB O EB NB SB NB	Through Right verall Intersection Left / Through / Right verall Intersection Left Right Left / Through Through / Right verall Intersection Improve Left Right Left Through	A (A) A (A) A (A) B (A) A (B) A (A) A (A) B (A) A (A) A (A) B (A) A (A) B (A) A (A)	0.05 (0.12) 0.28 (0.30) 0.07 (0.13) 0.44 (0.51) 0.32 (0.29) 0.16 (0.36) 0.19 (0.11) 0.15 (0.30) - 0.28 (0.27) 0.19 (0.09) 0.04 (0.09) 0 (0) - colement Traffic 0.41 (0.25) 0.38 (0.26) 0.06 (0.15) 0.22 (0.42)	12.5 (4.6) 12.6 (5.0) 2.8 (1.2) 11.6 (7.7) 10.1 (10.3) 8.7 (10.6) 8.9 (8.9) 8.8 (10.1) 9.3 (10.2) 22.5 (36.9) 13.1 (12.0) 8.7 (8.9) 0 (0) 3.2 (2.2) Signals 41.6 (38.4) 11.4 (13.1) 2.6 (2.2) 2.7 (2.8)	8.2* (10.9)* 53.4* (42.1)* 4.9* (5.6)* - 1.4 (1.2) 0.6 (1.6) 0.7 (0.4) 0.5 (1.3) - 1.1 (1.0) 0.7 (0.3) 0.1 (0.3) 0 (0) - 24.0* (14.5) 12.4* (9.0) m2.6* (m5.1) 25.3* (41.2)
Road at Kilbirnie Drive Existing Greenbank Road at New E-W	Minor Stop Control	O EB WB NB SB O EB NB SB SB SB	Through Right verall Intersection Left / Through / Right Left / Through / Right Left / Through / Right Verall Intersection Left Right Left / Through Through / Right Verall Intersection Left Right Left / Through Through / Right Verall Intersection Improve Left Right Left Right Left Left	A (A) A (A) A (A) B (A) A (B) A (A) A (A) B (A) A (A) A (A) B (A) A (A) B (A) A (A) B (A) A (A)	0.05 (0.12) 0.28 (0.30) 0.07 (0.13) 0.44 (0.51) 0.32 (0.29) 0.16 (0.36) 0.19 (0.11) 0.15 (0.30) - 0.28 (0.27) 0.19 (0.09) 0.04 (0.09) 0 (0) - 0lement Traffic 0.41 (0.25) 0.38 (0.26) 0.06 (0.15)	12.5 (4.6) 12.6 (5.0) 2.8 (1.2) 11.6 (7.7) 10.1 (10.3) 8.7 (10.6) 8.9 (8.9) 8.8 (10.1) 9.3 (10.2) 22.5 (36.9) 13.1 (12.0) 8.7 (8.9) 0 (0) 3.2 (2.2) Signals 41.6 (38.4) 11.4 (13.1) 2.6 (2.2)	8.2* (10.9)* 53.4* (42.1)* 4.9* (5.6)* - 1.4 (1.2) 0.6 (1.6) 0.7 (0.4) 0.5 (1.3) - 1.1 (1.0) 0.7 (0.3) 0.1 (0.3) 0 (0) - 24.0* (14.5) 12.4* (9.0) m2.6* (m5.1)



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Scenario	Intersection Control	Ар	proach / Movement	LOS	V/C	Delay (s)	Queue 95 th (veh)
		EB	Left / Through / Right	A (A)	0.15 (0.08)	8.0 (7.6)	0.5 (0.3)
River Mist	A II . \A/= Ct==	WB	Left / Through / Right	A (A)	0.08 (0.16)	7.4 (7.7)	(veh)
Road at New E-W	All-Way Stop Control	NB	Left / Through / Right	A (A)	0.02 (0.01)	7.2 (7.1)	0.1 (0)
Collector	Control	SB	Left / Through / Right	A (A)	0.06 (0.06)	7.7 (7.5)	(veh) 0.5 (0.3) 0.2 (0.6) 0.1 (0)
001100101		0	verall 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 95 th 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.



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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

	2		2031 Future Bac	kground Traffic			
	Segment	EB	WB	NB	SB	Target	
	Lanes crossed	3	3	3	3		
	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		
တ္ထ	Right turn corner radius (m)	5-10	5-10	5-10	5-10	_	
PLOS	Crosswalk treatment	Standard	Standard	Standard	Standard	С	
	Cycle length (s)	90	90	90	90		
	Effective walk time (s)	18	18	18	18		
	PETSI Points	71	71	71	71		
	PETSI Points LOS	С	С	С	С		
	Average Pedestrian Delay (s)	28.8	28.8	28.8	28.8		
	Ped Delay LOS	С	С	С	С		
	Level of Service	С	С	С	С		
	Level of Service	С					
	Type of bike lane	Mixed	Mixed	Separated	Separated		
	Left-turn - lanes crossed	1	1	NA (Two Stage)	NA (Two Stage)		
	Left-turn - vehicle operating speed (km/hr)	25	25	25	25		
တ္ထ	Right-turn - number of turn lanes	0	0	NA	NA		
BLOS	Right-turn - turn lane length (m)	NA (Shared)	NA (Shared)	NA (Shared)	NA (Shared)	В	
	Right-turn - turning speed (km/hr)	15	15	15	15		
	Right-turn - location of bike lane	NA	NA	MUP	MUP		
	Level of Service	В	В	А	Α		
	Level of Service		E	3			
(0	Maximum Average Delay (s)		N	A			
TLOS	Level of Service		N	A		D	
-	Level of Service		N	A			
	Effective corner radius (m)	<10	<10	<10	<10		
SO	Number of receiving lanes	1	1	1	1	No	
TKLOS	Level of Service	F	F	F	F	Target	
	Level of Service		F				
(0	Maximum Volume-to-capacity (v/c)	0.62	0.84	0.23	0.50		
VLOS	Level of Service	В	D	А	Α	D	
>	Level of Service)			

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

	2		2031 Future Bac	kground Traffic			
	Segment	EB	WB	NB	SB	Target	
	Lanes crossed	4	4	3	3		
	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		
တ္ထ	Right turn corner radius (m)	3-5	3-5	3-5	3-5	_	
PLOS	Crosswalk treatment	Standard	Standard	Standard	Standard	С	
	Cycle length (s)	90	90	90	90		
	Effective walk time (s)	22	22	18	18		
	PETSI Points	61	61	72	72		
	PETSI Points LOS	С	С	С	С		
	Average Pedestrian Delay (s)	25.7	25.7	28.8	28.8		
	Ped Delay LOS	С	С	С	С		
	Level of Service	С	С	С	С		
	Level of Service		•	;			
	Type of bike lane	Mixed	Mixed	Separated	Separated		
	Left-turn - lanes crossed	1	1	NA (Two Stage)	NA (Two Stage)		
	Left-turn - vehicle operating speed (km/hr)	25	25	25	25		
တ္ထ	Right-turn - number of turn lanes	0	0	NA	NA		
BLOS	Right-turn - turn lane length (m)	NA (Shared)	NA (Shared)	NA (Shared)	NA (Shared)	С	
	Right-turn - turning speed (km/hr)	15	15	15	15		
	Right-turn - location of bike lane	NA	NA	MUP	MUP		
	Level of Service	В	В	Α	Α		
	Level of Service		E	3			
(0	Maximum Average Delay (s)	26.4	20.1	15.5	13.3		
TLOS	Level of Service	D	D	С	С	D	
-	Level of Service)			
	Effective corner radius (m)	<10	<10	<10	<10		
SO	Number of receiving lanes	1	1	1	1	No	
TKLOS	Level of Service	F	F	F	F	Target	
, i	Level of Service		F				
(0	Maximum Volume-to-capacity (v/c)	0.51	0.44	0.29	0.30		
VLOS	Level of Service	Α	Α	Α	А	D	
>	Level of Service		Į.	À.			



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

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



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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

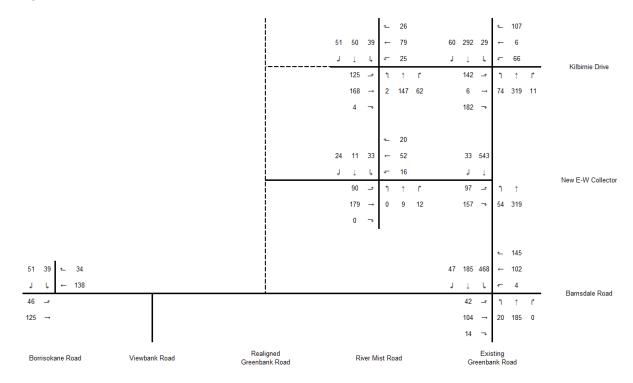
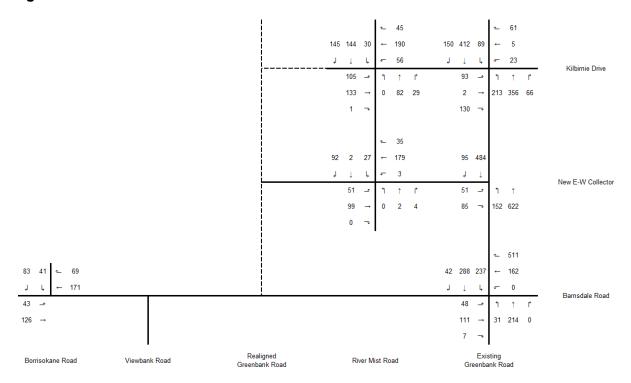


Figure 23 2031 Total Future Traffic Volumes - PM Peak Hour



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Table 21 2031 Total Future Operations (Synchro Results)

Scenario	Intersection Control	Ap	proach / Movement	LOS	V/C	Delay (s)	Queue 95 th (veh)
Barnsdale		EB	Left / Through	A (A)	0.03 (0.03)	7.7 (7.8)	0.1 (0.1)
Road at	Minor Stop	WB	Through / Right	A (A)	0 (0)	0 (0)	0 (0)
Borrisokane	Control	SB	Left / Right	B (B)	0.12 (0.18)	10.7 (11.2)	0.4 (0.6)
Road		0	verall Intersection	A (A)	-	3.1 (3.2)	-
		EB	Left	A (B)	0.38 (0.62)	40.8 (51.1)	15.1* (15.7)*
		EB	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)*
Existing		VVD	Through / Right	C (D)	0.73 (0.85)	36.6 (22.2)	48.8* (69.8)*
Greenbank at Barnsdale	Traffic Signals	NB	Left	A (A)	0.04 (0.07)	20.4 (19.9)	8.0* (10.9)*
Road		NR	Through / Right	A (A)	0.24 (0.26)	19.9 (19.2)	15.1* (15.7)* 15.1* (15.7)* 29.7* (14.9)* 3.1* (0)* 48.8* (69.8)* 15.1* (50.0)* 44.5* (50.0)* 15.0* (#72.8)* 15.0* (13.6)* 15.0* (13.6)* 15.0* (13.6)* 15.0* (13.6)* 15.0* (13.6)* 15.0* (13.6)* 15.0* (13.6)* 15.0* (13.6)* 15.0* (13.6)* 15.0* (13.6)* 15.0* (13.6)* 15.0* (13.6)* 16.0* (13.6)* 17.0* (13.6)* 18.4* (23.3)* 18.4* (23.3)* 18.4* (23.3)* 18.5* (11.0)* 18.5* (11.0)* 18.5* (11.0)* 18.5* (11.0)* 18.6* (13.6)* 19.6* (13.6)* 19.7* (23.6)* 19.8* (26.6)* 19.8* (26.6)* 19.9* (26.6)* 19.9* (26.6)* 19.9* (26.6)* 10.9*
		SB	Left	A (A)	0.58 (0.47)	7.5 (20.9)	50.0* (#72.8)*
		28	Through / Right	A (A)	0.20 (0.40)	2.6 (16.3)	9.2* (58.0)*
		0	verall Intersection	C (D)	0.73 (0.85)	17.4 (20.7)	-
		EB	Left	A (A)	0.39 (0.53)	23.8 (44.6)	23.9* (26.5)*
		ED	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)	0 (0) 2) 0.4 (0.6) - 1) 15.1* (15.7)* 2) 29.7* (14.9)* 3.1* (0)* 2) 48.8* (69.8)* 3) 8.0* (10.9)* 2) 44.5* (50.0)* 3) 50.0* (#72.8)* 3) 13.3* (10.4)* 8.4* (23.3)* 29.9* (32.6)* 0.2* (2.9)* 38.3* (11.0)* 39.2* (58.0)* 0.2* (2.9)* 31.3* (10.4)* 32.9* (32.6)* 33.3* (10.4)* 34.4* (43.3)* 35.3* (5.7)* 36.3* (5.7)* 37.3* (5.7)* 38.4* (11.0)* 39.5* (11.8) 39.7* (2.3) 39.9* (32.6)* 39.9* (32.6)* 39.9* (32.6)* 39.9* (32.6)* 39.9* (32.6)* 39.9* (32.6)* 39.9* (32.6)* 39.9* (32.6)* 30.7* (32.6)* 30.7* (32.6)* 31.3* (32.6)* 32.1* (1.8) 33.1* (11.5*) 34.4* (46.3*) 34.4* (46.3*) 34.4* (46.3*)
Existing		VVD	Through / Right	A (A)	0.40 (0.25)	11.4 (11.8)	13.3* (10.4)*
Greenbank			Left	A (A)	0.13 (0.32)	5.3 (5.4)	8.4* (23.3)*
Road at	Traffic Signals	NB	Through	A (A)	0.31 (0.27)	6.0 (4.2)	29.9* (32.6)*
Kilbirnie			Right	A (A)	0.01 (0.06)	0.2 (1.6)	0.2* (2.9)*
Drive			Left	A (A)	0.05 (0.13)	12.9 (4.7)	8.3* (11.0)*
		SB	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)*
		0	Overall Intersection		0.45 (0.53)	11.6 (7.8)	-
		EB	Left / Through / Right	B (B)	0.42 (0.38)	11.9 (12.3)	2.1 (1.8)
	A II . \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	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)
Drive	ver Mist Road at Gontrol Control Control SB Thin R Overall Inters EB Left / Thro WB Left / Thro NB Left / Thro SB Left / Thro Overall Inters	Left / Through / Right	A (B)	0.20 (0.48)	9.6 (13.2)	0.8 (2.6)	
		0	verall Intersection	B (B)	-	10.7 (12.5)	-
		EB	Left	A (A)	0.47 (0.29)	42.9 (39.2)	28.0* (16.9*)
Existing		LD	Right	A (A)	0.49 (0.36)	11.1 (12.4)	` '
Greenbank	Traffic Signals	NB	Left	A (A)	0.10 (0.25)	4.1 (3.0)	m7.6* (m12.3*)
Road at New	Trainic Oignais	IND	Through	A (A)	0.24 (0.44)	4.2 (3.3)	48.5* (55.4*)
E-W Collector		SB	Through / Right	A (A)	0.43 (0.41)	4.0 (4.0)	34.4* (46.3*)
			verall Intersection	A (A)	0.49 (0.44)	8.1 (5.3)	-
		EB	Left / Through / Right	A (A)	0.32 (0.19)	9.3 (8.6)	1.4 (0.7)
River Mist	All-Way Stop	WB	Left / Through / Right	A (A)	0.11 (0.26)	7.8 (8.8)	0.4 (1.0)
Road at New	Control	NB	Left / Through / Right	A (A)	0.03 (0.01)	7.6 (7.6)	0.1 (0)
E-W Collector	22	SB	Left / Through / Right	A (A)	0.09 (0.15)	8.1 (8.1)	0.3 (0.5)
Notes:		0	verall Intersection	A (A)	-	8.7 (8.6)	-

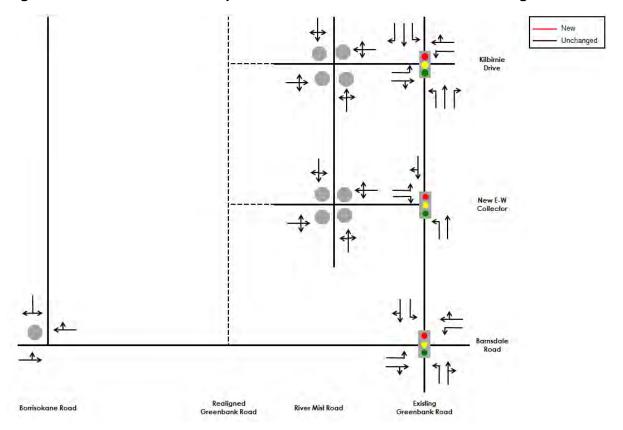
Notes:

- 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



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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

	Commont		2031 Total F	2031 Total Future Traffic				
	Segment	EB	WB	NB	SB	Target		
	Lanes crossed	3	3	3	3			
	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			
တ္ထ	Right turn corner radius (m)	5-10	5-10	5-10	5-10	_		
PLOS	Crosswalk treatment	Standard	Standard	Standard	Standard	С		
	Cycle length (s)	90	90	90	90			
	Effective walk time (s)	18	18	18	18			
	PETSI Points	71	71	71	71			
	PETSI Points LOS	С	С	С	С			
	Average Pedestrian Delay (s)	28.8	28.8	28.8	28.8			
	Ped Delay LOS	С	С	С	С			
	Level of Service	С	С	С	С			
	Level of Service	С						
	Type of bike lane	Mixed	Mixed	Separated	Separated			
	Left-turn - lanes crossed	1	1	NA (Two Stage)	NA (Two Stage)			
	Left-turn - vehicle operating speed (km/hr)	25	25	25	25			
SC	Right-turn - number of turn lanes	0	0	NA	NA	_		
BLOS	Right-turn - turn lane length (m)	NA (Shared)	NA (Shared)	NA (Shared)	NA (Shared)	В		
	Right-turn - turning speed (km/hr)	15	15	15	15			
	Right-turn - location of bike lane	NA	NA	MUP	MUP			
	Level of Service	В	В	Α	Α			
	Level of Service		E	3				
w	Maximum Average Delay (s)		N	A				
TLOS	Level of Service		N	A		D		
-	Level of Service		N	A				
	Effective corner radius (m)	<10	<10	<10	<10			
TKLOS	Number of receiving lanes	1	1	1	1	No		
본	Level of Service	F	F	F	F	Target		
	Level of Service		F	-				
W	Maximum Volume-to-capacity (v/c)	0.62	0.85	0.26	0.58			
VLOS	Level of Service	В	D	Α	Α	D		
>	Level of Service		Г)		_		



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

	Sogment		2031 Total F	uture Traffic		Target	
	Segment	EB	WB	NB	SB	rarget	
	Lanes crossed	4	4	3	3		
	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		
တ္ထ	Right turn corner radius (m)	3-5	3-5	3-5	3-5		
PLOS	Crosswalk treatment	Standard	Standard	Standard	Standard	С	
	Cycle length (s)	90	90	90	90		
	Effective walk time (s)	22	22	18	18		
	PETSI Points	61	61	72	72		
	PETSI Points LOS	С	С	С	С		
	Average Pedestrian Delay (s)	25.7	25.7	28.8	28.8		
	Ped Delay LOS	С	С	С	С		
	Level of Service	С	С	С	С		
	Level of Service	;					
	Type of bike lane	Mixed	Mixed	Separated	Separated		
	Left-turn - lanes crossed	1	1	NA (Two Stage)	NA (Two Stage)		
	Left-turn - vehicle operating speed (km/hr)	25	25	25	25		
တ္ထ	Right-turn - number of turn lanes	0	0	NA	NA	_	
BLOS	Right-turn - turn lane length (m)	NA (Shared)	NA (Shared)	NA (Shared)	NA (Shared)	С	
	Right-turn - turning speed (km/hr)	15	15	15	15		
	Right-turn - location of bike lane	NA	NA	MUP	MUP		
	Level of Service	В	В	Α	Α		
	Level of Service		E	3			
m	Maximum Average Delay (s)	27.2	20.7	15.7	13.2		
TLOS	Level of Service	D	D	С	С	D	
-	Level of Service		1)			
	Effective corner radius (m)	<10	<10	<10	<10		
SO	Number of receiving lanes	1	1	1	1	No	
TKLOS	Level of Service	F	F	F	F	Target	
	Level of Service	F					
(0	Maximum Volume-to-capacity (v/c)	0.53	0.45	0.34	0.31		
VLOS	Level of Service	Α	Α	Α	Α	D	
>	Level of Service	A A A A					



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

Commont		2031 Total Fu				
	Segment	EB	NB / SB	Target		
	Lanes crossed	2	3			
	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]		
W	Right turn corner radius (m)	3-5	3-5			
PLOS	Crosswalk treatment	Standard	Standard	С		
	Cycle length (s)	90	90			
	Effective walk time (s)	18	18			
	PETSI Points	87	72			
	PETSI Points LOS	В	С			
	Average Pedestrian Delay (s)	28.8	28.8			
	Ped Delay LOS	С	С			
	Level of Service	С	С			
	Level of Service C					
	Type of bike lane	Mixed	Separated			
	Left-turn - lanes crossed	1	NA			
	Left-turn - vehicle operating speed (km/hr)	25	25			
m	Right-turn - number of turn lanes	NA	NA			
BLOS	Right-turn - turn lane length (m)	NA	NA (Shared)	С		
- ш	Right-turn - turning speed (km/hr)	NA	15			
	Right-turn - location of bike lane	NA	MUP			
	Level of Service	В	Α			
	Level of Service	В				
W	Maximum Average Delay (s)	21.3	13.8			
TLOS	Level of Service	D	С	D		
-	Level of Service	D				
	Effective corner radius (m)	<10	<10			
TKLOS	Number of receiving lanes	1	1	No		
	Level of Service	F	F	Target		
	Level of Service	F				
(0	Maximum Volume-to-capacity (v/c)	0.4	0.69			
NLOS	Level of Service	А	В	D		
	Level of Service	В				



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4.9.2.6 2036 Ultimate Conditions



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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

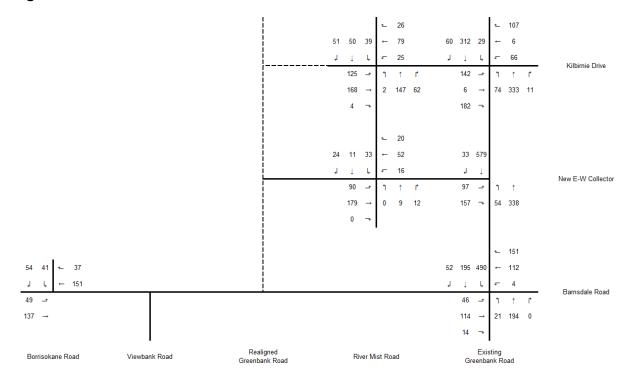
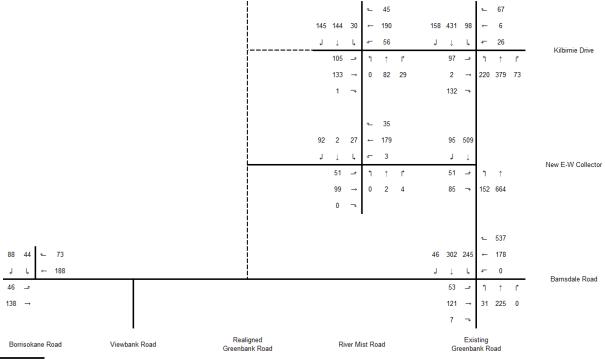


Figure 26 2036 Ultimate Traffic Volumes - PM Peak Hour



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Table 25 2036 Ultimate Operations (Synchro Results)

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

Notes:

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

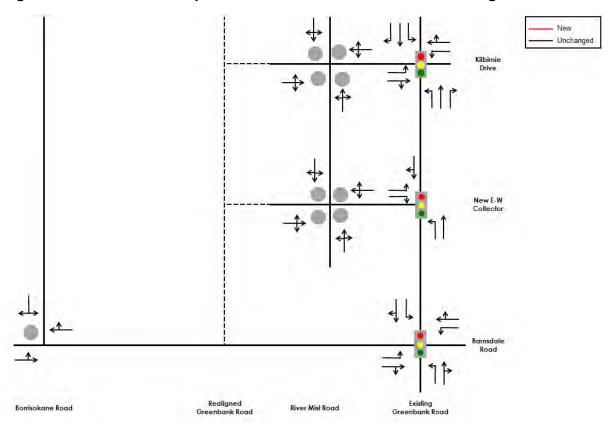
- 2. v/c represents the anticipated volume divided by the predicted so
 3. # 95th percentile volume exceeds capacity, queue may be longer
 4. * Queue lengths for these movements are in meters

 (**-05th percentile queue is metered by upstream significant to the control of the percentile queue is metered by the control of the con 5. m – Volume for 95th percentile queue is metered by upstream signal



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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

Soment		2031 Total Future Traffic					
	Segment	EB	WB	NB	SB	Target	
	Lanes crossed	3	3	3	3		
	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	_	
တ္ထ	Right turn corner radius (m)	5-10	5-10	5-10	5-10		
PLOS	Crosswalk treatment	Standard	Standard	Standard	Standard	С	
	Cycle length (s)	90	90	90	90		
	Effective walk time (s)	18	18	18	18		
	PETSI Points	71	71	71	71		
	PETSI Points LOS	С	С	С	С		
	Average Pedestrian Delay (s)	28.8	28.8	28.8	28.8		
	Ped Delay LOS	С	С	С	С		
	Level of Service	С	С	С	С		
	Level of Service C						
	Type of bike lane	Mixed	Mixed	Separated	Separated	-	
	Left-turn - lanes crossed	1	1	NA (Two Stage)	NA (Two Stage)		
	Left-turn - vehicle operating speed (km/hr)	25	25	25	25		
တ္ထ	Right-turn - number of turn lanes	0	0	NA	NA		
BLOS	Right-turn - turn lane length (m)	NA (Shared)	NA (Shared)	NA (Shared)	NA (Shared)	В	
	Right-turn - turning speed (km/hr)	15	15	15	15		
	Right-turn - location of bike lane	NA	NA	MUP	MUP		
	Level of Service	В	В	Α	Α		
	Level of Service	В					
(0	Maximum Average Delay (s)	NA					
TLOS	Level of Service		N	A		D	
-	Level of Service	NA					
	Effective corner radius (m)	<10	<10	<10	<10		
TKLOS	Number of receiving lanes	1	1	1	1	No	
	Level of Service	F	F	F	F	Target	
·	Level of Service	F					
m	Maximum Volume-to-capacity (v/c)	0.60	0.86	0.29	0.62		
VLOS	Level of Service	Α	D	Α	В	D	
>	Level of Service)			



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

Samuent		2031 Total Future Traffic					
	Segment	EB	WB	NB	SB	Target	
	Lanes crossed	4	4	3	3		
	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		
SC	Right turn corner radius (m)	3-5	3-5	3-5	3-5		
PLOS	Crosswalk treatment	Standard	Standard	Standard	Standard	С	
	Cycle length (s)	90	90	90	90		
	Effective walk time (s)	22	22	18	18		
	PETSI Points	61	61	72	72		
	PETSI Points LOS	С	С	С	С		
	Average Pedestrian Delay (s)	25.7	25.7	28.8	28.8		
	Ped Delay LOS	С	С	С	С		
	Level of Service	С	С	С	С		
	Level of Service C						
	Type of bike lane	Mixed	Mixed	Separated	Separated		
	Left-turn - lanes crossed	1	1	NA (Two Stage)	NA (Two Stage)		
	Left-turn - vehicle operating speed (km/hr)	25	25	25	25		
တ္ထ	Right-turn - number of turn lanes	0	0	NA	NA		
BLOS	Right-turn - turn lane length (m)	NA (Shared)	NA (Shared)	NA (Shared)	NA (Shared)	С	
	Right-turn - turning speed (km/hr)	15	15	15	15		
	Right-turn - location of bike lane	NA	NA	MUP	MUP		
	Level of Service	В	В	Α	Α		
	Level of Service B						
W	Maximum Average Delay (s)	26.5	20.3	16.4	13.9		
TLOS	Level of Service	D	D	С	С	D	
	Level of Service	D					
	Effective corner radius (m)	<10	<10	<10	<10		
TKLOS	Number of receiving lanes	1	1	1	1	No	
	Level of Service	F	F	F	F	Target	
	Level of Service F						
m	Maximum Volume-to-capacity (v/c)	0.53	0.45	0.33	0.33		
VLOS	Level of Service	Α	Α	Α	Α	D	
>	Level of Service		P	\			



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

Commont		2031 Total Fu			
	Segment	EB	NB / SB	Target	
	Lanes crossed	2	3		
	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]	
W	Right turn corner radius (m)	3-5	3-5		
PLOS	Crosswalk treatment	Standard	Standard	С	
	Cycle length (s)	90	90		
	Effective walk time (s)	18	18		
	PETSI Points	87	72		
	PETSI Points LOS	В	С		
	Average Pedestrian Delay (s)	28.8	28.8		
	Ped Delay LOS	С	С		
	Level of Service	С	С		
	Level of Service C				
	Type of bike lane	Mixed	Separated		
	Left-turn - lanes crossed	1	NA		
	Left-turn - vehicle operating speed (km/hr)	25	25		
m	Right-turn - number of turn lanes	NA	NA		
BLOS	Right-turn - turn lane length (m)	NA	NA (Shared)	С	
- ш	Right-turn - turning speed (km/hr)	NA	15		
	Right-turn - location of bike lane	NA	MUP		
	Level of Service	В	Α		
	Level of Service	В			
W	Maximum Average Delay (s)	21.8	13.1		
TLOS	Level of Service	D	С	D	
-	Level of Service	С			
	Effective corner radius (m)	<10	<10		
TKLOS	Number of receiving lanes	1	1	No	
	Level of Service	F	F	Target	
	Level of Service	F			
(0	Maximum Volume-to-capacity (v/c)	0.49	0.72		
NLOS	Level of Service	А	С	D	
	Level of Service	С		1	



Strategy Report May 25, 2018

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



Conclusions – Future Roadway Modification Approval at Registration May 25, 2018

5.0 CONCLUSIONS - FUTURE ROADWAY MODIFICATION APPROVAL AT REGISTRATION

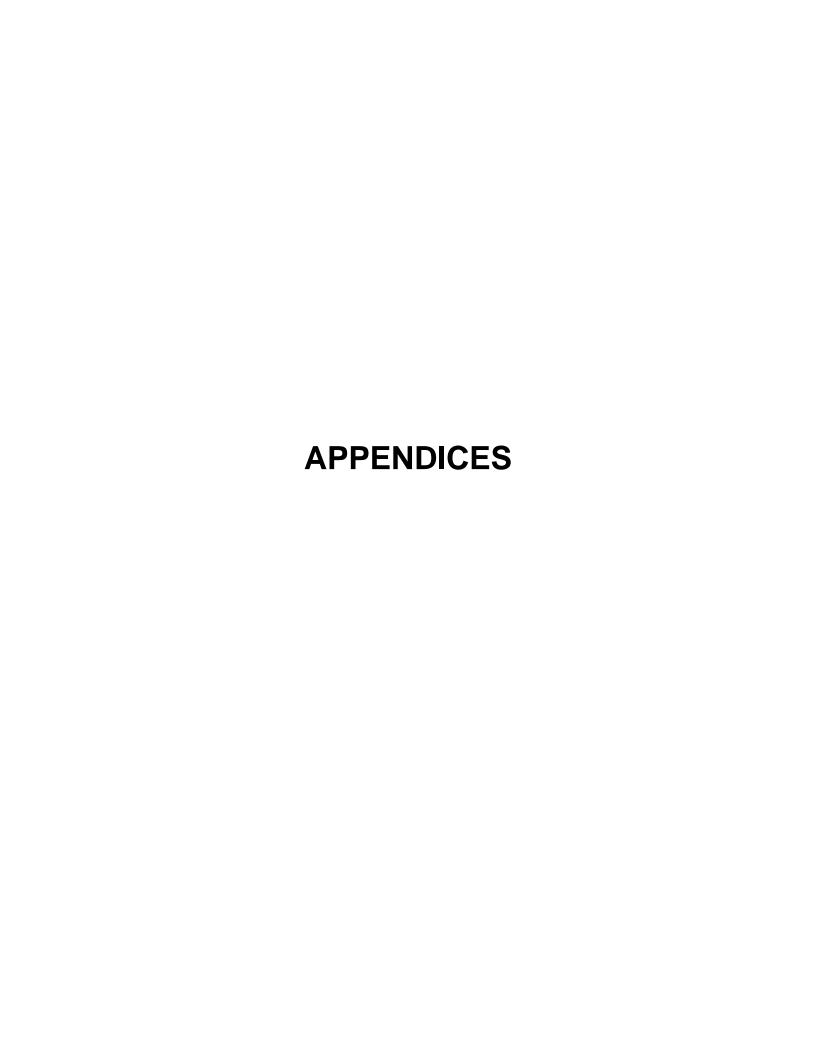
This Transportation Impact Assessment is being submitted to support a planning application for *Draft Plan Approval* of Minto's Quinn's Pointe 2 residential development in Barrhaven South. It is anticipated that development will proceed in three phases with full build-out expected by 2031. Accordingly, 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*.





Appendix A Traffic Data May 25, 2018

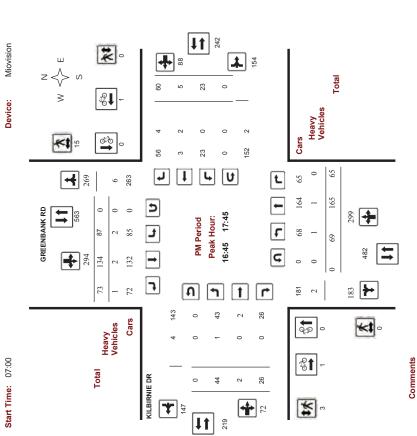
APPENDIX A TRAFFIC DATA





Transportation Services - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram **GREENBANK RD @ KILBIRNIE DR**



2018-Jan-04

Transportation Services - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram **GREENBANK RD @ KILBIRNIE DR** 37298

WO No:

Survey Date: Thursday, November 09, 2017

37298

WO No:

Survey Date: Thursday, November 09, 2017

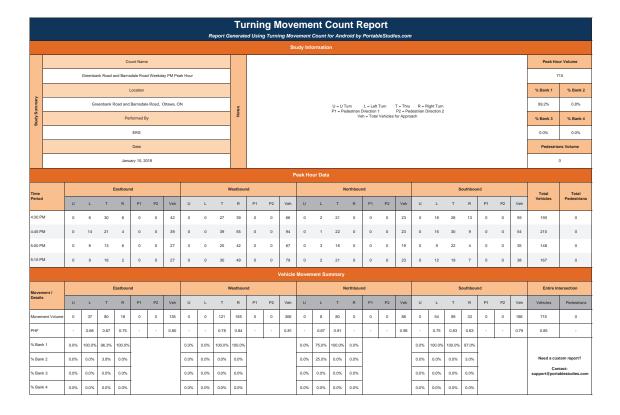
11 ½ Miovision * Z ≫ 4 P 1 105 **#** Device: Cars ≪t ঐ **→** 102 U ٦ Ļ **4** 522 t 264 100 46 <u>ح</u> د GREENBANK RD **←** 138 07:15 08:15 Peak Hour: AM Period t 28 24 56 27 **=** Ç 403 \$08 508 144 142 0 0 7 **₹** 36 263 34 រា ٣ Cars **€ *** Heavy Vehicles Start Time: 07:00 **%1** -Total KILBIRNIE DR 99 20 9 * ***** 8 <u>3</u>2 11 201

Comments

2018-Jan-04 Page 4 of 4

Page 1 of 4

									Re	port G									epo Portab		ies.com									
														St	udy Inf	ormatio	n													
				Co	unt Name	•																							Peak Hor	ur Volume
		Greenba	nk Road a	and Barns	dale Roa	d Weekd	ay AM Pe	ak Hour																					5	69
				ı	Location																								% Bank 1	% Bank 2
Summary		Gre	enbank F	Road and	Barnsdal	e Road,	Ottawa, O	N			8						U = U	Turn	L = Left	Turn	T = Thru	R = R	ight Turn						97.4%	2.6%
Study Su				Per	formed B	у					Notes						P1 = P		Direction eh = Total		P2 = Per for Appro	destrian D ach	tirection 2						% Bank 3	% Bank 4
os -					ERS																								0.0%	0.0%
					Date																								Pedestria	ins Volume
				Janu	ary 10, 20)18																								0
														F	eak Ho	ur Data														
Time				Eastboun	ıd					٧	Vestboun	d					,	orthbou	nd					s	outhbour	nd			Total	Total
Period	U	L	т	R	P1	P2	Veh	U	L	т	R	P1	P2	Veh	U	L	т	R	P1	P2	Veh	U	L	т	R	P1	P2	Veh	Vehicles	Pedestrians
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
														/ehicle	Moven	nent Su			•		•				,					
Movement /				Eastboun	ıd					٧	Vestboun	d					,	orthbou	nd					s	outhbour	nd			Entire In	tersection
Details	U	L	Т	R	P1	P2	Veh	U	L	т	R	P1	P2	Veh	U	L	т	R	P1	P2	Veh	U	L	Т	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								269	569	0								
PHF	-	0.63	0.86	0.42	-	-	0.81	-	0.25	0.84	0.66	3 0.95 - 0.46 0.86 0.75 - 0.81 0.88 0.90 0.85								0.85	0.89									
% Bank 1	0.0%	84.8%	100.0%	80.0%		•		0.0%	66.7%	100.0%	94.6%																			
% Bank 2	0.0%	15.2%	0.0%	20.0%	Ī			0.0%	33.3%	0.0%	5.4%										Need a cus	stom report?								
% Bank 3	0.0%	0.0%	0.0%	0.0%	İ			0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	0.0%	0.0%					ntact: ablestudies.com
% Bank 4	0.0%	0.0%	0.0%	0.0%	İ			0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	0.0%	0.0%				0.0%	0.0%	0.0%	0.0%					



									Re	eport <u>G</u>									Repo Portab		ies.com									_
														St	udy Inf	ormatic	n													
				Co	unt Name	•																							Peak Hor	ur Volume
		Rive	Mist and	Kilbimie	Drive - W	eekday A	M Peak H	our																					1	71
				ı	Location																								% Bank 1	% Bank 2
Summary		F	iver Mist	Road and	Kilbirnie	Drive, O	ttawa, ON				80						U = U		L = Left Direction		T = Thru	R = R destrian D	ight Turn						91.2%	8.8%
Study Si				Per	formed B	у					Not						P1 = Pi	Ve	eh = Total	Vehicles	for Appro	ach	irection 2						% Bank 3	% Bank 4
*					ERS																								0.0%	0.0%
					Date																								Pedestria	ns Volume
				Janu	ary 9, 20	18																								5
															eak Ho	ur Data														
Time			- 1	Eastboun	ıd					v	Vestbour	d					•	orthbou	nd					s	outhboun	ıd			Total	Total
Period	U	L	Т	R	P1	P2	Veh	U	L	Т	R	P1	P2	Veh	U	L	Т	R	P1	P2	Veh	U	L	Т	R	P1	P2	Veh	Vehicles	Pedestrians
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
													١	/ehicle	Moven	nent Su	mmary													
Movement / Details			-	Eastboun	ıd					٧	Vestbour	d					,	4orthbou	nd					s	outhboun	ıd			Entire In	tersection
Details	U	L	Т	R	P1	P2	Veh	U	L	Т	R	P1	P2	Veh	U	L	Т	R	P1	P2	Veh	U	L	Т	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								0.75	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%	96 0.0% 0.0% 7.7% 0.0% 0.0% 0.0% 0.0% 0.0%											tom 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%					itact: iblestudies.com
% 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%					

									Re	eport G					eme						es.com									
															udy Inf															
				Co	ount Name	•																							Peak Ho	ur Volume
		Rive	r Mist and	Kilbimie	Drive - W	eekday P	M Peak H	our																					1	46
					Location																								% Bank 1	% Bank 2
Study Sum mary		-	River Mist	Road and	d Kilbirnie	Drive, O	ttawa, ON				Notes						U = U	Turn edestrian		Turn	T = Thru	R = R	tight Turn Direction 2						95.9%	4.1%
Study S				Pe	rformed B	у					No						P1 = Pi		h = Total				Airection 2						% Bank 3	% Bank 4
					ERS																								0.0%	0.0%
					Date																								Pedestria	ins Volume
				Jan	uary 9, 20	18																								9
															eak Ho	ur Data														
Time				Eastbour	nd					,	Vestboun	d					,	orthbou	nd						outhbou	nd			Total	Total
Period	U	L	т	R	P1	P2	Veh	U	L	Т	R	P1	P2	Veh	U	L	т	R	P1	P2	Veh	U	L	т	R	P1	P2	Veh	Vehicles	Pedestrians
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	Moven	nent Su	mmary													
Movement /				Eastbour	nd					١	Vestboun	d					,	orthbou	nd					8	outhbou	nd			Entire In	tersection
Details	U	L	т	R	P1	P2	Veh	U	L	Т	R	P1	P2	Veh	U	L	т	R	P1	P2	Veh	U	L	т	R	P1	P2	Veh	Vehicles	Pedestrians
Movement Volu	me 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%					stom 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%					ntact: ablestudies.com
% 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%					

Intersection:	Borrisokane at Barnsdale	e at Barnsd	ale											
<u>Date:</u>	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	56	0	0	27	2	64	
7:30 - 7:45	0	0	0	9	0	9	4	23	0	0	56	4	69	
7:45 - 8:00	0	0	0	3	0	4	4	20	0	0	25	3	29	
8:00 - 8:15	0	0	0	2	0	4	9	25	0	0	23	2	65	257
8:15 - 8:30	0	0	0	2	0	2	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	멾	EBT	EBR	WBL	WBT	WBR	Total	Hour
3:45 - 4:00	0	0	0	2	0	9	3	29	0	0	19	4	99	
4:00 - 4:15	0	0	0	2	0	7	3	56	0	0	21	4	63	
4:15 - 4:30	0	0	0	4	0	∞	1	29	0	0	31	2	78	
4:30 - 4:45	0	0	0	4	0	3	7	23	0	0	27	4	89	275
4:45 - 5:00	0	0	0	3	0	2	4	20	0	0	28	8	89	277
5:00 - 5:15	0	0	0		0	9	2	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 May 25, 2018

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-s	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-s	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 onroad 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	1
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-s	upportive design & infrastructure measures: Residential developments	Check if completed & add descriptions, explanations or plan/drawing references
	2.	WALKING & CYCLING: END-OF-TRIP FACILI	TIES
	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 multifamily 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-s	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 The measure is generally feasible and effective, and in most cases would benefit the development and its users 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 & des	tinations
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)	X
BETTER	3.1.2	Provide real-time arrival information display at entrances (multi-family, condominium)	X
	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	X
BETTER	3.2.2	Offer at least one year of free monthly transit passes on residence purchase/move-in	X
	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)	X
	4.	CARSHARING & BIKESHARING	
	4.1	Bikeshare stations & memberships	
BETTER	4.1.1	Contract with provider to install on-site bikeshare station (<i>multi-family</i>)	X
BETTER	4.1.2	Provide residents with bikeshare memberships, either free or subsidized (multi-family)	X
	4.2	Carshare vehicles & memberships	
BETTER	4.2.1	Contract with provider to install on-site carshare vehicles and promote their use by residents	X
BETTER	4.2.2	Provide residents with carshare memberships, either free or subsidized	X
	5.	PARKING	
	5.1	Priced parking	
BASIC	★ 5.1.1	Unbundle parking cost from purchase price (condominium)	X
BASIC	★ 5.1.2	Unbundle parking cost from monthly rent (multi-family)	X

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

Appendix C Intersection Performance Worksheets May 25, 2018

APPENDIX C INTERSECTION PERFORMANCE WORKSHEETS



Appendix C Intersection Performance Worksheets May 25, 2018

C.1 2018 EXISTING CONDITIONS



WB

14% 0% 86% 100%

90 88 140 316 1 1 1 1 0.122 0.124 0.187 0.407 4.898 5.084 4.799 4.648 Yes Yes Yes Yes 727 701 743 770 2.958 3.145 2.853 2.950 0.124 0.126 0.188 0.41 8.6 8.9 9 10.9 A A A B 0.4 0.4 0.7 2

2% 60% 61% 26%

Intersection
Intersection Delay, s/veh
Intersection LOS

Movement Lane Configurations Traffic Vol, veh/h Future Vol, veh/h

Peak Hour Factor Heavy Vehicles, % Mvmt Flow Number of Lanes

Approach
Opposing Approach
Opposing Lanes
Conflicting Approach Left
Conflicting Lanes Left
Conflicting Approach Right
Conflicting Lanes Right
HCM Control Delay
HCM LOS

Vol Thru, %
Vol Right, %
Sigin Control
Traffic Vol by Lane
LT Vol
Through Vol
RT Vol
Lane Flow Rate
Geometry Grp
Degree of Util (X)
Departure Headway (Hd)
Cap
Service Time
HCM Lane WC Ratio
HCM Control Delay
HCM Lane LOS
HCM 95ih-lile Q

Approach

Lane Vol Left, % Vol Thru, %

193

40

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SB

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1.9					
FRI	FRT	WRT	WRR	SRI	SBR
LDL			TI DIC		ODIC
23	98	107	18	17	22
23	98	107	18	17	22
5	0	0	5	5	5
Free	Free	Free	Free	Stop	Stop
-	None		None	-	None
-				0	
e,# -	0	0		0	
-	0	0		0	
90	90	90	90	90	90
2	2	2	2	2	2
26	109	119	20	19	24
Major1	- 1	Major2		Minor2	
144	0	-	0	299	139
-				134	
-				165	
4.12				6.42	6.22
-	-			5.42	-
				5.42	
2.218	-	-	-	3.518	
					909
	-	-	-		-
				864	
	-	-			
		-	-		901
-	-	-			-
		-	-		
	-	-	-	844	-
EB		WB		SB	
1.4		0		9.9	
				Α	
mt	FBI	FBT	WBT	WBR	SBLn1
		LDI.		WDIC	785
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:)	0.018 7.6 A	0 A			9.9 A
n)	7.6	0	-	-	9.9
	233 23 5 Free e, #	EBL EBT	Tebl. EBT WBT W	TEBL EBT WBT WBR WBR	EBL EBT WBT WBR SBL

05/25/2018 Synchro 9 Report 05/25/2018 Synchro 9 Report

HCM 2010 TWSC 3: Existing Greenbank Road & Kilbirnie Drive

2018 Existing Conditions AM Peak Hour

Intersection												
Int Delay, s/veh	6.3											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ሻ	ĥ		٦	ĥ			4	ř	ሻ	†	7
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

	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	В			В									

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	NBLn1\	NBLn2	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	Α	-	С	В	В	Α	A	-	
HCM 95th %tile O(veh)	0.1			0.7	0.3	0.6	0.5	0.1		

HCM 2010 AWSC 4: River Mist Road & Kilbirnie Drive

2018 Existing Conditions AM Peak Hour

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		4			4			4			4	
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	C
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	Α			Α			Α			Α		
Lane		NBLn1	EBLn1		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							
		943	870	911	841 2.285							
Сар												
Service Time		1.82	2.141	1.956								
Service Time HCM Lane V/C Ratio		0.047	0.03	0.074	0.063							
Service Time HCM Lane V/C Ratio HCM Control Delay		0.047	0.03 7.3	0.074 7.3	0.063 7.6							
Service Time HCM Lane V/C Ratio		0.047	0.03	0.074	0.063							

| Movement | Lane Configurations | Lane Configurations | Lane Configurations | Lane Configurations | Lane Configurations | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configuration | Lane Configu

4.12

EBL EBT WBT WBR SBL SBR

329 171 - 158 -- 6.42 6.22

5.42 6.22 5.42 -5.42 -3.518 3.318 665 867 859 -871 -

776 0.087 10.1

EBT WBT WBR SBLn1

Intersection Int Delay, s/veh

Movement

Major/Minor
Conflicting Flow All
Stage 1
Stage 2
Critical Hdwy

Platoon blocked. %

Critical Hdwy Stg 1
Critical Hdwy Stg 2
Follow-up Hdwy 2.218
Pot Cap-1 Maneuver Stage 1
Stage 2
Plateon blocked %

Mov Cap-1 Maneuver 1381
Mov Cap-2 Maneuver Stage 1 Stage 2 -

Approach EB HCM Control Delay, s 1.3 HCM LOS

Minor Lane/Major Mvmt Capacity (veh/h) HCM Lane V/C Ratio HCM Control Delay (s) HCM Lane LOS HCM 95th %tile Q(veh)

Intersection									
Intersection Delay, s/veh	10.9								
Intersection LOS	В								
Movement	EBL EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL
Lane Configurations	4		WDL	4	WDIC	INDL	4	NUN	JDL
Traffic Vol. veh/h	37 80		0	121	200	8	86	0	59
Future Vol. veh/h	37 80		0	121	200	8	86	0	59
				0.90	0.90		0.90	0.90	
Peak Hour Factor			0.90			0.90			0.90
Heavy Vehicles, %	2 2		2	2	2	2	2	2	2
Mvmt Flow	41 89		0	134	222	9	96	0	66
Number of Lanes	0 1	0	0	1	0	0	1	0	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	Α			В		Α			В
	NRI n1	FRI n1	WRI n1						
Lane	NBLn1		WBLn1	SBLn1					
Lane Vol Left, %	9%	32%	0%	SBLn1 29%					
Lane Vol Left, % Vol Thru, %	9% 91%	32% 68%	0% 38%	SBLn1 29% 54%					
Lane Vol Left, % Vol Thru, % Vol Right, %	9% 91% 0%	32% 68% 0%	0% 38% 62%	SBLn1 29% 54% 16%					
Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control	9% 91% 0% Stop	32% 68% 0% Stop	0% 38% 62% Stop	SBLn1 29% 54% 16% Stop					
Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane	9% 91% 0% Stop 94	32% 68% 0% Stop 117	0% 38% 62% Stop 321	SBLn1 29% 54% 16% Stop 201					
Eane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol	9% 91% 0% Stop 94	32% 68% 0% Stop 117 37	0% 38% 62% Stop 321 0	SBLn1 29% 54% 16% Stop 201 59					
Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol	9% 91% 0% Stop 94 8	32% 68% 0% Stop 117 37 80	0% 38% 62% Stop 321 0	SBLn1 29% 54% 16% Stop 201 59 109					
Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol	9% 91% 0% Stop 94 8 86	32% 68% 0% Stop 117 37 80	0% 38% 62% Stop 321 0 121 200	SBLn1 29% 54% 16% Stop 201 59 109 33					
Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate	9% 91% 0% Stop 94 8 86 0	32% 68% 0% Stop 117 37 80 0	0% 38% 62% Stop 321 0 121 200 357	SBLn1 29% 54% 16% Stop 201 59 109 33 223					
Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol TrY Vol RT Vol Lane Flow Rate Geometry Grp	9% 91% 0% Stop 94 8 86 0 104	32% 68% 0% Stop 117 37 80 0 130	0% 38% 62% Stop 321 0 121 200 357	SBLn1 29% 54% 16% Stop 201 59 109 33 223					
Lane Vol Left. % Vol Tybr., % Vol Tybr., % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X)	9% 91% 0% Stop 94 8 86 0 104	32% 68% 0% Stop 117 37 80 0 130 1	0% 38% 62% Stop 321 0 121 200 357 1 0.465	SBLn1 29% 54% 16% Stop 201 59 109 33 223 1 0.328					
Lane Vol Left, % Vol Thur, % Vol Right, % Sign Control Traffic Vol by Lane LET Vol Through Vol RT Vol Lane Flow Geometry Grome Degree of Util (X) Degree of Util (X)	9% 91% 0% Stop 94 8 86 0 104 1 1 0.161	32% 68% 0% Stop 117 37 80 0 130 1 0.195 5.395	0% 38% 62% Stop 321 0 121 200 357 1 0.465 4.692	SBLn1 29% 54% 16% Stop 201 59 109 33 223 1 0.328 5.286					
Lane Vol Left. % Vol Thru, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grip Degree of Ulit (X) Departure Headway (Hd)	9% 91% 0% Stopp 94 8 86 0 104 1 0.161 5.54	32% 68% 0% Stop 117 37 80 0 130 1 0.195 5.395 Yes	0% 38% 62% Stop 321 0 121 200 357 1 0.465 4.692 Yes	SBLn1 29% 54% 16% Stop 201 59 109 33 223 1 0.328 5.286 Yes					
Lane Vol Left, % Vol Thru, % Vol Ripht, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Uilt (X) Departure Headway (Hd) Convergence, Y/N Cap	9% 91% 0% Stopp 94 8 86 0 104 1 0.161 5.54 Yes	32% 68% 0% Stop 117 37 80 0 130 1 0.195 5.395 Yes 664	0% 38% 62% Stop 321 0 121 200 357 1 0.465 4.692 Yes 774	SBLn1 29% 54% 16% Stop 201 59 109 33 223 1 0.328 5.286 Yes 679					
Lane Vol Left. % Vol Thu, % Vol Thu, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Uli (X) Departure Headway (Hd) Cane Flow Cane Service Time	9% 91% 0% Stop 94 8 86 0 104 1 1 0.161 5.54 Yes 647 3.579	32% 68% 0% Stop 117 37 80 0 130 1 0.195 5.395 Yes 664 3.431	0% 38% 62% Stop 321 0 121 200 357 1 0.465 4.692 Yes 774 2.692	\$BLn1 29% 54% 16% \$top 201 59 109 33 223 1 0.328 5.286 Yes 679 3.32					
Lane Vol Left, % Vol Thru, % Vol Ripht, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Through Vol RT Vol Degrear Ull (X) Degrature Headway (Hd) Convergence, Y/N Cap Service Time HCM Lane VIC Railo	9% 91% 0% Stop 94 86 0 104 1 0.161 5.54 Yes 647 3.579 0.161	32% 68% 0% Stop 117 37 80 0 130 1 0.195 5.395 Yes 664 3.431 0.196	0% 38% 62% Stop 321 0 121 200 357 1 0.4652 4.6692 Yes 774 2.692 0.461	SBLn1 29% 54% 16% Stop 201 59 109 33 223 1 0.328 5.286 Yes 679 3.32 0.328					
Lane Vol Left. % Vol Tkint. % Vol Tkint. % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Convergence, Y/N Cap Service Time HCM Lane Flox Ratio HCM Control Delay	9% 91% 0% Slop 94 86 0 104 1 0.161 5.54 Yes 647 3.579 0.161	32% 68% 0% Stop 117 37 80 0 130 1 0.195 5.395 Yes 664 3.431 0.196 9.7	0% 38% 62% Stop 321 0 121 200 357 1 0.465 4.692 Yes 774 2.692 0.461 11.7	SBLn1 29% 54% 16% Stop 201 199 33 223 10.328 5.286 Yes 679 3.32 0.328 10.9					
Lane Vol Left, % Vol Thru, % Vol Ripht, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Through Vol RT Vol Degrear Ull (X) Degrature Headway (Hd) Convergence, Y/N Cap Service Time HCM Lane VIC Railo	9% 91% 0% Stop 94 86 0 104 1 0.161 5.54 Yes 647 3.579 0.161	32% 68% 0% Stop 117 37 80 0 130 1 0.195 5.395 Yes 664 3.431 0.196	0% 38% 62% Stop 321 0 121 200 357 1 0.4652 4.6692 Yes 774 2.692 0.461	SBLn1 29% 54% 16% Stop 201 59 109 33 223 1 0.328 5.286 Yes 679 3.32 0.328					

05/25/2018 Synchro 9 Report 05/25/2018 Synchro 9 Report

HCM 2010 TWSC 3: Existing Greenbank Road & Kilbirnie Drive

1381 0.016 7.6 A

2018 Existing Conditions PM Peak Hour

Intersection												
Int Delay, s/veh	4.6											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
	EDL	1d3	EDK	WDL	1000	NON	IVDL	IND I	NDK	SDL	JDI	JDK *
Lane Configurations Traffic Vol. veh/h	45	2	27	23	5	61	70	186	66	89	151	74
	45	2	27	23	5	61	70	186	66	89	151	74
Future Vol, veh/h	45	0	5	23 5	0	5	70	186	5	89 5	151	74 5
Conflicting Peds, #/hr	Stop	-	Stop	Stop	Stop	Stop	Free	-	-	Free	-	Free
Sign Control RT Channelized		Stop			Stop	None	Free	Free	Free	Free	Free	None
	200		None	200				-		450		450
Storage Length		-		200	-			-	450	450	-	450
Veh in Median Storage	2,# -	0			0	-		0			0	- 1
Grade, % Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	50	2	30		6	68	78	207	73	99	168	82
Mvmt Flow	50	2	30	26	6	80	78	207	13	99	108	82
	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	FB			WB			NB			SB		
HCM Control Delay, s	17.7			12.8			1.7			2.2		
HCM LOS	17.7			12.0 B			1.7			2.2		
I ICINI EUS	C			В								
Minor Lane/Major Mvn	nt	NBL	NBT	NBR		EBLn2\			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		Α	Α	-	С	В	С	В	Α	-	-	
HCM 95th %tile Q(veh)	0.2			0.7	0.1	0.3	0.3	0.2	-	-	

HCM 2010 AWSC 4: River Mist Road & Kilbirnie Drive

2018 Existing Conditions PM Peak Hour

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		4			4			4			4	
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	Α			Α				Α		Α		
Lane		NBLn1	EBLn1	WBLn1	SBLn1							
Vol Left, %		0%	12%	24%	65%							
Vol Left, % Vol Thru, %		0% 56%	12% 75%	24% 18%	65% 30%							
Vol Left, % Vol Thru, % Vol Right, %		0% 56% 44%	12% 75% 12%	24% 18% 58%	65% 30% 4%							
Vol Left, % Vol Thru, % Vol Right, % Sign Control		0% 56% 44% Stop	12% 75% 12% Stop	24% 18% 58% Stop	65% 30% 4% Stop							
Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane		0% 56% 44% Stop 18	12% 75% 12% Stop 8	24% 18% 58% Stop 78	65% 30% 4% Stop 46							
Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol		0% 56% 44% Stop 18	12% 75% 12% Stop 8	24% 18% 58% Stop 78 19	65% 30% 4% Stop 46 30							
Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol		0% 56% 44% Stop 18 0	12% 75% 12% Stop 8 1	24% 18% 58% Stop 78 19	65% 30% 4% Stop 46 30 14							
Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Trhrough Vol RT Vol		0% 56% 44% Stop 18 0 10	12% 75% 12% Stop 8 1 6	24% 18% 58% Stop 78 19 14 45	65% 30% 4% Stop 46 30 14							
Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate		0% 56% 44% Stop 18 0 10 8	12% 75% 12% Stop 8 1 6	24% 18% 58% Stop 78 19 14 45 87	65% 30% 4% Stop 46 30 14 2							
Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp		0% 56% 44% Stop 18 0 10 8 20	12% 75% 12% Stop 8 1 6 1 9	24% 18% 58% Stop 78 19 14 45 87	65% 30% 4% Stop 46 30 14 2 51							
Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Vitil (X)		0% 56% 44% Stop 18 0 10 8 20 1	12% 75% 12% Stop 8 1 6 1 9	24% 18% 58% Stop 78 19 14 45 87 1	65% 30% 4% Stop 46 30 14 2 51 1							
Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd)		0% 56% 44% Stop 18 0 10 8 20 1 0.022 3.872	12% 75% 12% Stop 8 1 6 1 9 1 0.01 4.073	24% 18% 58% Stop 78 19 14 45 87 1 0.091 3.766	65% 30% 4% Stop 46 30 14 2 51 1 0.06 4.22							
Vol Left, % Vol Thu, % Vol Thu, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rale Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, Y/N		0% 56% 44% Stop 18 0 10 8 20 1 0.022 3.872 Yes	12% 75% 12% Stop 8 1 6 1 9 1 0.01 4.073 Yes	24% 18% 58% Stop 78 19 14 45 87 1 0.091 3.766 Yes	65% 30% 4% Stop 46 30 14 2 51 1 0.06 4.22 Yes							
Vol Left, % Vol Thru, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Traffic Vol by Lane LT Vol Trough Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Degrature Headway (Hd) Convergence, YiN Cap		0% 56% 44% Stop 18 0 10 8 20 1 0.022 3.872 Yes 919	12% 75% 12% Stop 8 1 6 1 9 1 0.01 4.073 Yes 873	24% 18% 58% Stop 78 19 14 45 87 1 0.091 3.766 Yes 947	65% 30% 4% Stop 46 30 14 2 51 1 0.06 4.22 Yes 847							
Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol RT Voi RT Voi Lane Flow Rate Geometry Grp Degree of Util (X) Convergence, Y/N Cap Service Time		0% 56% 44% Stop 18 0 10 8 20 1 0.022 3.872 Yes 919 1.917	12% 75% 12% Stop 8 1 6 1 9 1 0.01 4.073 Yes 873 2.123	24% 18% 58% Stop 78 19 14 45 87 1 0.091 3.766 Yes 947 1.805	65% 30% 4% Stop 46 30 14 2 51 1 0.06 4.22 Yes 847 2.255							
Vol Left, % Vol Thru, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Trough Vol RT Vol Lane Flow Rate Geometry Grp Degree of Ulii (X) Departure Headway (Hd) Convergence, Y/N Cap Service Time HCM Lane ViC Ratio		0% 56% 44% Stop 18 0 10 8 20 1 0.022 3.872 Yes 919 1.917 0.022	12% 75% 12% Stop 8 1 6 1 9 1 0.01 4.073 Yes 873 2.123 0.01	24% 18% 58% Stop 78 19 14 45 87 1 0.091 3.766 Yes 947 1.805 0.092	65% 30% 4% Stop 46 30 14 2 51 1 0.06 4.22 Yes 847 2.255 0.06							
Vol Left, % Vol Thru, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Convergence, Y/N Geometry Grp Despress of Util (X) Convergence, Y/N Geometry Grp Despress of Util (X) Despress of Util		0% 56% 44% Stop 18 0 10 8 20 1 0.022 7 919 1.917	12% 75% 12% Stop 8 1 6 1 9 1 0.01 4.073 Yes 873 2.123 0.01 7.2	24% 18% 58% Stop 78 19 14 45 87 1 0.091 3.766 Yes 947 1.805 0.092 7.2	65% 30% 4% Stop 46 30 14 2 51 1 0.06 4.22 Yes 847 2.255 0.06 7.5							
Vol Left, % Vol Thru, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol RT Vol RT Vol RT Vol Lane Flow Rale Geometry Grp Degree of Util (X) Convergence, Y/N Cap Service Time		0% 56% 44% Stop 18 0 10 8 20 1 0.022 3.872 Yes 919 1.917 0.022	12% 75% 12% Stop 8 1 6 1 9 1 0.01 4.073 Yes 873 2.123 0.01	24% 18% 58% Stop 78 19 14 45 87 1 0.091 3.766 Yes 947 1.805 0.092	65% 30% 4% Stop 46 30 14 2 51 1 0.06 4.22 Yes 847 2.255 0.06							

Appendix C Intersection Performance Worksheets May 25, 2018

C.2 2025 FUTURE BACKGROUND CONDITIONS



HCM 2010 AWSC 2: Existing Greenbank Road & Barnsdale Road

Delay, s/veh	2.9			_	_							section Delay, s/veh	12.4									_
iy, siveli												section LOS	12.4 B									
nt	EBL EBT V										IIILEI	SECTION FOR	D									
onfigurations	4	Þ	W.																			
Vol, veh/h		123 27	34 46									ement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBI
Vol, veh/h		123 27	34 46									e Configurations		4			4			4		
licting Peds, #/hr		0 5	5 5									fic Vol, veh/h	38	90	15	3	87	63	19	124	0	23
Control	Free Free F	Free Free S	top Stop								Futu	re Vol, veh/h	38	90	15	3	87	63	19	124	0	23
hannelized	- None	- None	- None								Peal	k Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
age Length			0 -								Hea	vy Vehicles, %	2	2	2	2	2	2	2	2	2	
in Median Storage	e,# - 0	0 -	0 -									nt Flow	38	90	15	3	87	63	19	124	0	23
ide, %	- 0	0 -	0 -								Num	ber of Lanes	0	1	0	0	- 1	0	0	1	0	
k Hour Factor	100 100	100 100	100 100								0		EB			WB			NB			SI
avy Vehicles, %	2 2	2 2	2 2									roach										
nt Flow	37 113	123 27	34 46									osing Approach	WB			EB			SB			N
												osing Lanes	_1			1			1			
(h A)	Mariant MA	10 840	2									flicting Approach Left				NB			EB			WI
			or2		_							flicting Lanes Left	1			- 1			1			
nflicting Flow All	155 0		334 147									flicting Approach Righ	nt NB			SB			WB			E
Stage 1			142 -									flicting Lanes Right	1			- 1			1			
Stage 2			192 -									1 Control Delay	10.4			10.1			9.9			14.
ical Hdwy	4.12 -										HCN	I LOS	В			В			Α			Е
itical Hdwy Stg 1		5																				
itical Hdwy Stg 2		5									Lane	3		NBLn1	EBLn1	WRI n1	SRI n1					
llow-up Hdwy		3.										Left. %		13%	27%	2%	56%					
Cap-1 Maneuver												Thru. %		87%	63%	57%	34%					
Stage 1			885 -									Right. %		0%	10%	41%	10%					
Stage 2			841 -									Control		Stop	Stop	Stop	Stop					
toon blocked, %												fic Vol by Lane		143	143	153	414					
v Cap-1 Maneuver			637 892								LT V			143	38	3	230					
/ Cap-2 Maneuver			637 -									ugh Vol		124	90	87	142					
Stage 1			881 -								RT \			124	15	63	42					
Stage 2			814 -									Flow Rate		143	143	153	414					
												metry Grp		143	143	153	414					
oroach	EB	WB	SB									ree of Util (X)		0.215	0.225	0.23	0.584					
M Control Delay, s			0.3	_	_	_	_	_				arture Headway (Hd)		5.406	5.657	5.414	5.074					
M LOS	1.9	U	0.3 B												Yes		Yes					
M LUS			В									vergence, Y/N		Yes	633	Yes	716					
											Cap			664		661						
or Lane/Major Myn	mt EBL I	EBT WBT W	BR SBLn1									rice Time		3.449	3.703	3.46	3.074					
pacity (veh/h)	1418											I Lane V/C Ratio		0.215	0.226	0.231	0.578					
M Lane V/C Ratio	0.026											1 Control Delay		9.9	10.4	10.1	14.9					
M Control Delay (si			- 10.3									I Lane LOS		Α	В	В	В					
		Α -	- B								HCN	1 95th-tile Q		0.8	0.9	0.9	3.8					
M Lane LOS	A																					

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HCM 2010 TWSC 3: Existing Greenbank Road & Kilbirnie Drive 2025 FBG Conditions AM Peak Hour HCM 2010 AWSC 4: River Mist Road & Kilbirnie Drive 2025 FBG Conditions

AM Peak Hour

3: Existing Gree	enbai	IK INC	au &	KIIDII	THE L	JIIVE							AIVI PEAK HUI
Intersection													
Int Delay, s/veh	6.6												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations	ሻ	ß		٦	ß		ሻ	†	7	ሻ	↑	7	
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	e,# -	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	240	252	252	1/7	241	U	U	174	U	U	
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	0.22	6.12	5.52	0.22	4.12			4.12			
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	175	752	698	004	1320			1403			
Stage 2	701	698		666	666								
Platoon blocked. %	701	070		000	000								
Mov Cap-1 Maneuver	337	416	786	341	416	856	1320			1396			
Mov Cap-2 Maneuver	337	416	700	341	416	030	1320			1370			
Stage 1	686	649		726	674								
Stage 2	587	674		565	649								
Stage 2	307	0/4		303	047								
Approach	EB			WB			NB			SB			
HCM Control Delay, s	15.4			13.1			1.4			0.7			
HCM LOS	13.4 C			13.1 B			1.4			U.1			
HCM EUS	C			D									
Minor Lane/Major Mvn	nt	NBL	NBT	NDD	EDI n1	EDI n2	WBLn1V	VDI n2	SBL	SBT	SBR		
	п	1320	IVDI	MON	337		341		1396	JDI	JOK		
Capacity (veh/h)						747		810					
HCM Cantrol Doloy (c)		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	١	A		-	1.2	В	C	В	A				
HCM 95th %tile Q(veh)	0.1			1.2	0.5	0.7	0.5	0.1	-			

Intersection Delay, s/veh	7.6											
Intersection LOS	A											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SB
Lane Configurations		4			4			4			4	
Traffic Vol, veh/h	38	70	4	15	38	26	2	13	32	39	5	- 1
Future Vol, veh/h	38	70	4	15	38	26	2	13	32	39	5	1
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	1.0
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	
Mvmt Flow	38	70	4	15	38	26	2	13	32	39	5	- 1
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	
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	Α			Α			Α			Α		
Lane		NBLn1		WBLn1	SBLn1							
Vol Left, %		4% 28%	34%	19%	67%							
Vol Thru, %			62%	48%	9%							
Vol Right, %		68%	4%	33%	24%							
Vol Right, % Sign Control		68% Stop	4% Stop	33% Stop	24% Stop							
Vol Right, % Sign Control Traffic Vol by Lane		68% Stop 47	4% Stop 112	33% Stop 79	24% Stop 58							
Vol Right, % Sign Control Traffic Vol by Lane LT Vol		68% Stop 47	4% Stop 112 38	33% Stop 79 15	24% Stop 58 39							
Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol		68% Stop 47 2 13	4% Stop 112 38 70	33% Stop 79 15 38	24% Stop 58 39 5							
Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol		68% Stop 47 2 13	4% Stop 112 38 70 4	33% Stop 79 15 38 26	24% Stop 58 39 5							
Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate		68% Stop 47 2 13 32 47	4% Stop 112 38 70 4 112	33% Stop 79 15 38 26 79	24% Stop 58 39 5 14 58							
Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp		68% Stop 47 2 13 32 47	4% Stop 112 38 70 4 112	33% Stop 79 15 38 26 79	24% Stop 58 39 5 14 58							
Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X)		68% Stop 47 2 13 32 47 1 0.052	4% Stop 112 38 70 4 112 1 0.131	33% Stop 79 15 38 26 79 1 0.089	24% Stop 58 39 5 14 58 1 0.071							
Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd)		68% Stop 47 2 13 32 47 1 0.052 4.02	4% Stop 112 38 70 4 112 1 0.131 4.225	33% Stop 79 15 38 26 79 1 0.089 4.044	24% Stop 58 39 5 14 58 1 0.071 4.395							
Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, YIN		68% Stop 47 2 13 32 47 1 0.052 4.02 Yes	4% Stop 112 38 70 4 112 1 0.131 4.225 Yes	33% Stop 79 15 38 26 79 1 0.089 4.044 Yes	24% Stop 58 39 5 14 58 1 0.071 4.395 Yes							
Vol Righti, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, Y/N Cap		68% Stop 47 2 13 32 47 1 0.052 4.02 Yes 896	4% Stop 112 38 70 4 112 1 0.131 4.225 Yes 839	33% Stop 79 15 38 26 79 1 0.089 4.044 Yes 873	24% Stop 58 39 5 14 58 1 0.071 4.395 Yes 820							
Vol Right, % Sisjing Control Traffic Vol by Lane LT Vol Traffic Vol by Vol RT Vol Lane Flow Rate Geometry Crp Degree of Util (X) Convergence, Y/N Cap Service Time		68% Stop 47 2 13 32 47 1 0.052 4.02 Yes 896 2.022	4% Stop 112 38 70 4 112 1 0.131 4.225 Yes 839 2.298	33% Stop 79 15 38 26 79 1 0.089 4.044 Yes 873 2.129	24% Stop 58 39 5 14 58 1 0.071 4.395 Yes 820 2.396							
Vol Right, % Sign Centrol Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Uili (X) Departure Headway (Hd) Convergence, Y/N Cap Service Time HotM Lane WC Ratio		68% Stop 47 2 13 32 47 1 0.052 4.02 Yes 896 2.022 0.052	4% Stop 112 38 70 4 112 1 0.131 4.225 Yes 839 2.298 0.133	33% Stop 79 15 38 26 79 1 0.089 4.044 Yes 873 2.129 0.09	24% Stop 58 39 5 14 58 1 0.071 4.395 Yes 820 2.396 0.071							
Vol Right, % Sisjin Control Traffic Vol by Lane LT Vol Trrough Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, Y/N Cap Service Time HGM Lane VIC Ratio		68% Stop 47 2 13 32 47 1 0.052 4.02 Yes 896 2.022 0.052 7.2	4% Stop 112 38 70 4 112 1 0.131 4.225 Yes 839 2.298 0.133 7.9	33% Stop 79 15 38 26 79 1 0.089 4.044 Yes 873 2.129 0.09 7.5	24% Stop 58 39 5 14 58 1 0.071 4.395 Yes 820 2.396 0.071 7.7							
Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp		68% Stop 47 2 13 32 47 1 0.052 4.02 Yes 896 2.022 0.052	4% Stop 112 38 70 4 112 1 0.131 4.225 Yes 839 2.298 0.133	33% Stop 79 15 38 26 79 1 0.089 4.044 Yes 873 2.129 0.09	24% Stop 58 39 5 14 58 1 0.071 4.395 Yes 820 2.396 0.071							

Intersection						
Int Delay, s/veh	2.9					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	LDL	4	1	TIDIN	JDL W	JON
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	102	5	5	5
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	riee	None			Stop -	
				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	Mojor1		Anior?		Minor2	
	Major1		Major2			400
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. %					000	
Mov Cap-1 Maneuver	1344		-	- 1	595	841
	1344				595	
Mov Cap-2 Maneuver						
Stage 1		-			840	
Stage 2		-			808	
Approach	EB		WB		SB	
HCM Control Delay, s	2		0		10.6	
HCM LOS			0		10.0 B	
TIOW EOS					ь	
Minor Lane/Major Mvn	nt	EBL	EBT	WBT	WBR:	SBLn1
Capacity (veh/h)		1344			-	737
HCM Lane V/C Ratio		0.029				0.132
		7.8	0			10.6
						B
HCM Control Delay (s) HCM Lane LOS						
HCM Control Delay (s) HCM Lane LOS HCM 95th %tile Q(veh	١	0.1	A			0.5

05/25/2018 Synchro 9 Report 05/25/2018 Synchro 9 Report

HCM 2010 TWSC 3: Existing Greenbank Road & Kilbirnie Drive

HCM 2010 TWSC

1: Barnsdale Road & Borrisokane Road

2025 FBG Conditions

PM Peak Hour

Int Delay, s/veh	5.1												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations	ሻ	₽		Ť	î,		ሻ	†	7	ሻ	↑	7	
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	e,# -	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	
Mymt Flow	62	2	50	23	5	61	109	276	66	89	260	104	
Major/Minor I	Minor2			Minor1			Major1			Major2			
Conflicting Flow All	975	942	270	968	942	286	265	0	0	281	0	0	
Stage 1	443	443	2.70	499	499	200		-		201		-	
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	0.22	6.12	5.52	0.22	4.12			4.12			
Critical Hdwy Stg 2	6.12	5.52		6.12	5.52								
Follow-up Hdwy			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	707	554	544	755	12//			1202			
Stage 2	531	544		575	576								
Platoon blocked, %	001	011		070	0,0								
Mov Cap-1 Maneuver	183	222	762	190	222	746	1293			1276			
Mov Cap-2 Maneuver	183	222	702	190	222	, 10	1270			1270			
Stage 1	541	533		505	496								
Stage 2	440	496		496	533								
Olugo 2	110	170		170	000								
Approach	EB			WB			NB			SB			
HCM Control Delay, s	23.5			15.2			1.9			1.6			
HCM LOS	23.3 C			13.2 C			1.7			1.0			
HOW EOS	C			C									
Minor Lane/Major Mvm	nt	NBL	NBT	NRR	FRI n1	FRI n2	NBLn1\	NRI n2	SBL	SBT	SBR		
Capacity (veh/h)	*	1293	IVDI	NUN	183	697	190	633	1276	001	JUIN		
HCM Lane V/C Ratio		0.084	- :			0.075		0.104	0.07		- :		
HCM Control Delay (s)	1	0.004			34.4	10.6	26.5	11.3	0.07				
HCM Lane LOS		A	- :		34.4 D	10.0 B	20.0 D	11.3 B	A				
HCM 95th %tile Q(veh	٨	0.3		-	1.4	0.2	0.4	0.3	0.2	- 1	- :		
HOW FOR WILL	,	0.3			1.4	0.2	0.4	0.3	U.Z				

Intersection Delay, s/veh	15.3											
Intersection LOS	С											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SE
Lane Configurations		4			4			4			4	
Traffic Vol, veh/h	43	91	10	0	138	261	36	167	0	85	216	
Future Vol, veh/h	43	91	10	0	138	261	36	167	0	85	216	
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	1.0
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	
Mvmt Flow	43	91	10	0	138	261	36	167	0	85	216	
Number of Lanes	0	1	0	0	1	0	0	1	0	0	- 1	
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	В				С		В			С		
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							
Сар		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							
		12.8	11.7	17	16.4							
HCM Control Delay												
HCM Control Delay HCM Lane LOS		В	В	C 4.2	C 3.5							

HCM 2010 AWSC 2025 FBG Conditions

4: River Mist Road	& Kilbi	rnie D	rive								PM Pea	ak Hou
Intersection												
Intersection Delay, s/veh	7.7											
Intersection LOS	Α											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SB
Lane Configurations	LDL	4	LDIC	WDL	4	WDIC	HUL	4	HER	ODL	4	- 05
Traffic Vol. veh/h	21	39	1	26	71	45	5	10	12	30	14	3
Future Vol. veh/h	21	39	1	26	71	45	5	10	12	30	14	3
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	1.0
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	
Mvmt Flow	21	39	- 1	26	71	45	5	10	12	30	14	3
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	
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	Α			Α			Α			Α		
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							
I T Vol		5	21	26	30							

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	

Appendix C Intersection Performance Worksheets May 25, 2018

C.3 2025 TOTAL FUTURE CONDITIONS



Lane Group
Lane Configurations
Traffic Volume (vph)
Future Volume (vph)
Satd. Flow (prot)
FIT Permitted
Satd Flow (norm)

Seach now (good)
Satd. Flow (RTOR)
Satd. Flow (RTOR)
Lane Group Flow (vph)
Turn Type
Protected Phases
Detector Phase
Switch Phase
Minimum Initial (s)
Minimum Spiti (s)
Total Spiti (s)
Total Spiti (s)
Total Spiti (s)
Stillow Addust (s)
All-Red Time (s)
Lost Time Addust (s)

Lost Time Adjust (s)
Total Lost Time (s)

Lead/Lag Detimize?
Recall Mode
Act Effct Green (s)
Actuated g/C Ratio

v/c Ratio
Control Delay
Queue Delay
Total Delay
LOS
Approach Delay
Approach LOS

Intersection Summ

↓ Ø6

05/25/2018

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 Capacity Utilization 75.8%
Analysis Period (min) 15

EBT

38 90 38 90 1658 1701 0.490

848 1701

10.0 10.0 23.6 23.6 28.0 28.0 31.1% 31.1% 4.6 4.6 1.0 1.0

None None 13.2 13.2 0.16 0.16

0.28 0.37 34.6 31.0

0.0 0.0 34.6 31.0

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

\$\int_{\text{g}_1}\$

\$\displays{g}_1\$

31.9

0.0 5.6 0.0 5.6

38 Perm

3 87 3 87 1658 1567 0.689

10.0 10.0 23.6 23.6 28.0 28.0 31.1% 31.1% 4.6 4.6 1.0 1.0

None None 13.2 13.2 0.16 0.16

0.02 0.65 27.3 30.3

0.0 0.0 27.3 30.3

Intersection LOS: B
ICU Level of Service D

0.0 5.6 0.0 5.6

202 NA 8

0 1189 1567

3

0 357 0 357 0 1658 169 169 1682

1003 1682

5.0 10.0 11.0 23.6 31.0 62.0 34.4% 68.9% 4.0 4.6 2.0 1.0

0.0 0.0 5.6

None 56.1 0.69 Max 56.5 0.70

0.45 7.3 0.18

Synchro 9 Report

357

211 NA 6

NBR

115 19 133 115 19 133 0 1658 1745 0.626

0 1082 1745

19

10.0 23.6 31.0 34.4% 10.0 23.6 31.0 34.4%

4.6 1.0

0.0 0.0

Lag Yes Lag Yes Max 37.8 0.47

Max 37.8 0.47

0.04 15.7 0.16 15.5

0.0 0.0

-204

√ øs

133 NA 2

uture	Conditions	
	AM Peak Hour	

4

SBR

0

0

Intersection						
Int Delay, s/veh	2.9					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	EDL	<u>EDI</u>	T _P	NON	SDL W	SDR
	27			27		46
Traffic Vol, veh/h Future Vol. veh/h	37	113 113	123	27	34	46
	37					
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
Mymt Flow	37	113	123	27	34	46
	Najor1		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. %					041	
	1410			- :	637	892
Mov Cap-1 Maneuver	1418	-				
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	1.7		U		10.3 B	
HCW LU3					ь	
Minor Lane/Major Mvmt	t	EBL	EBT	WBT	WBR:	SBLn1
Capacity (veh/h)		1418	-	-	-	762
HCM Lane V/C Ratio		0.026	-	-	-	0.105
		7.6	0	-		10.3
		Α.	A			B
HCM Control Delay (s)						
HCM Control Delay (s) HCM Lane LOS						0.4
CM Control Delay (s)		0.1	-		-	0.4

05/25/2018 Synchro 9 Report

2: Existing Greenbank Road & Barnsdale Road

2025 Total Future Conditions AM Peak Hour

AM Peak Hour

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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									

HCM 2010 TWSC 2025 Total Future Conditions AM Peak Hour 3: Existing Greenbank Road & Kilbirnie Drive

8.4 EBL											
EBL											
	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
7	ĥ		Ť	ĥ		Ť	†	ř	ሻ	†	ř
129	6	138	66	6	107	62	248	- 11	29	263	56
129	6	138	66	6	107	62	248	11	29	263	56
5	0	5	5	0	5	5	0	5	5	0	5
Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
-	-	None			None			None	-		None
200			200			500		375	500		375
.# -	0	-		0			0		-	0	
	0	-		0			0		-	0	
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		/59			114	1290			1306		
						-				-	
						-					
485	584	-	495	031		-	-			-	-
EB			WB			NB			SB		
21.1			16.4			1.5			0.7		
С			С								
t	MRI	MRT	MRD	FRI n1	FRI n2l	VRI n1V	VRI n2	SRI	SRT	SRD	
		IVDI	NDIX						JUI	JUIK	
										- 1	
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	200 ,# - 100 2 129 760 326 434 7.12 6.12 6.12 3.518 323 687 600 258 651 485 EB	200	200 - None 200 None 200	200 - 200 201 202 - 202 100 100 100 100 2 2 2 2 2 129 6 138 66 203 26 - 377 326 326 326 - 377 326 326 326 - 377 326 326 62 7.12 6.12 5.52 - 6.12 6.12 5.52 - 6.12 6.12 5.52 - 6.12 6.12 5.52 - 6.12 6.12 5.52 - 6.12 6.12 5.52 - 6.12 6.12 5.52 - 6.12 6.12 5.52 - 6.12 6.12 5.52 - 6.12 6.12 5.52 - 6.12 6.12 5.52 - 6.12 6.12 5.52 - 6.12 6.12 5.52 - 6.12 6.12 5.52 - 6.12 6.12 5.52 - 6.12 6.12 5.52 - 6.12 6.12 5.52 - 6.12 6.12 5.52 - 6.12 6.12 5.52 - 6.12 6.13 5.58 - 6.12 6.14 6.4 6.4 6.58 - 648 - 644 6.68 - 648 6.64 - 648 6.64 - 648 6.75 - 648 6.75 - 648 6.87 - 648 6.8	200 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0	200 None - None 200 200 100 0 0 100 100 100 100 100 2 2 2 2 2 2 2 2 2 129 2 2 2 2 2 2 2 2 2 3 2 2 3 2 3 775 703 258 326 326 - 377 377 73 258 326 326 - 377 377 73 258 326 326 - 377 377 73 258 326 326 - 377 377 5 703 258 326 326 - 375 5 703 258 326 326 - 375 377 377 5 703 258 326 326 - 377 377 5 703 258 326 326 - 377 377 5 703 258 327 652 612 552 612 552 612 552 612 552 612 552 612 552 612 552 612 552 612 552 612 552 612 552 612 552 612 552 612 552 612 552 612 552 612 552 612 552 612 552 613 536 4018 3.318 3318 4018 3.318 323 323 324 764 4616 6 628 648 648 648 648 648 648 648 648 648 64	200 None None 500 201 200 500 202 200 0 500 203 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -	200	200 - 200 - 500 - 375	None None	None

AM Peak Hour

Intersection												
Intersection Delay, s/veh	14.5											
ntersection LOS	В											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBF
Lane Configurations	ች	î,		ች	1		ች	.	17		†	į
Traffic Vol, veh/h	129	6	138	66	6	107	62	248	11	29	263	5
Future Vol, veh/h	129	6	138	66	6	107	62	248	11	29	263	5
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	1.0
Heavy Vehicles, %	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	
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	В			В			С			С		
Lane		AUDI 4	NIDI O	AUDI O								
		NBLn1	NBLn2	NBLn3	EBLn1	EBLn2	WBLn1	WBLn2	SBLn1	SBLn2	SBLn3	
Vol Left, %		100%	NBLn2	NBLn3	100%	EBLn2 0%	WBLn1 100%	WBLn2 0%	SBLn1 100%	SBLn2 0%	SBLn3 0%	
		100% 0%			100% 0%		100% 0%		100% 0%			
Vol Left, %		100%	0%	0%	100%	0%	100%	0%	100%	0%	0%	
Vol Left, % Vol Thru, % Vol Right, %		100% 0%	0% 100%	0% 0%	100% 0%	0% 4%	100% 0%	0% 5%	100% 0%	0% 100%	0% 0%	
Vol Left, % Vol Thru, %		100% 0% 0%	0% 100% 0%	0% 0% 100%	100% 0% 0%	0% 4% 96%	100% 0% 0%	0% 5% 95%	100% 0% 0%	0% 100% 0%	0% 0% 100%	
Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane		100% 0% 0% Stop	0% 100% 0% Stop	0% 0% 100% Stop	100% 0% 0% Stop	0% 4% 96% Stop	100% 0% 0% Stop	0% 5% 95% Stop	100% 0% 0% Stop	0% 100% 0% Stop	0% 0% 100% Stop	
Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol		100% 0% 0% Stop 62	0% 100% 0% Stop 248	0% 0% 100% Stop 11	100% 0% 0% Stop 129	0% 4% 96% Stop 144	100% 0% 0% Stop 66	0% 5% 95% Stop 113	100% 0% 0% Stop 29	0% 100% 0% Stop 263	0% 0% 100% Stop 56	
Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane TV Vol Through Vol		100% 0% 0% Stop 62 62	0% 100% 0% Stop 248 0	0% 0% 100% Stop 11 0	100% 0% 0% Stop 129 129	0% 4% 96% Stop 144 0	100% 0% 0% Stop 66 66	0% 5% 95% Stop 113	100% 0% 0% Stop 29	0% 100% 0% Stop 263 0	0% 0% 100% Stop 56 0	
Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane IT Vol Tr Vol Tr Vol		100% 0% 0% Stop 62 62 0 0	0% 100% 0% Stop 248 0 248 0	0% 0% 100% Stop 11 0 0	100% 0% 0% Stop 129 129 0 0	0% 4% 96% Stop 144 0 6 138	100% 0% 0% Stop 66 66 0	0% 5% 95% Stop 113 0	100% 0% 0% Stop 29 29 0 0	0% 100% 0% Stop 263 0 263 0	0% 0% 100% Stop 56 0 0 56	
Vol Left, % Vol Thru, % Vol Right, % Sign Control		100% 0% 0% Stop 62 62 0	0% 100% 0% Stop 248 0 248	0% 0% 100% Stop 11 0 0	100% 0% 0% Stop 129 129 0	0% 4% 96% Stop 144 0 6	100% 0% 0% Stop 66 66 0	0% 5% 95% Stop 113 0 6	100% 0% 0% Stop 29 29 0	0% 100% 0% Stop 263 0 263	0% 0% 100% Stop 56 0 0	
Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol RT Vol RT Vol Lane Flow Rate		100% 0% 0% Stop 62 62 0 0	0% 100% 0% Stop 248 0 248 0	0% 0% 100% Stop 11 0 0	100% 0% 0% Stop 129 129 0 0	0% 4% 96% Stop 144 0 6 138	100% 0% 0% Stop 66 66 0	0% 5% 95% Stop 113 0 6 107	100% 0% 0% Stop 29 29 0 0	0% 100% 0% Stop 263 0 263 0	0% 0% 100% Stop 56 0 0 56	
Jol Left, % Jol Thru, % Jol Right, % Sign Control Traffic Vol by Lane _T Vol Through Vol RT Vol _ane Flow Rate Seemetry Grp Degree of Util (X)		100% 0% 0% Stop 62 62 0 0	0% 100% 0% Stop 248 0 248 0 248	0% 0% 100% Stop 11 0 0 11 11	100% 0% 0% Stop 129 129 0 0	0% 4% 96% Stop 144 0 6 138 144	100% 0% 0% Stop 66 66 0 0	0% 5% 95% Stop 113 0 6 107 113	100% 0% 0% Stop 29 29 0 0 29	0% 100% 0% Stop 263 0 263 0 263	0% 0% 100% Stop 56 0 0 56 56	
Jol Left, % Jol Thru, % Jol Right, % Sign Control Traffic Vol by Lane		100% 0% Stop 62 0 0 0 62 8 0.134	0% 100% 0% Stop 248 0 248 0 248 8 0.5	0% 0% 100% Stop 11 0 0 11 11 11 8	100% 0% 0% Stop 129 129 0 0 129 8 0.282	0% 4% 96% Stop 144 0 6 138 144 8 0.268	100% 0% 0% Stop 66 66 0 0 66 8	0% 5% 95% Stop 113 0 6 107 113 8 0.219	100% 0% 0% Stop 29 29 0 0 29	0% 100% 0% Stop 263 0 263 0 263 8 0.526	0% 0% 100% Stop 56 0 0 56 56 8 0.101	
Vol Left, % Vol Thru, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane _T Vol Through Vol ST Vol ane Flow Rate Seemetry Grp Degree of Util (X) Departure Headway (Hd) Conwergence, YN		100% 0% 0% Stop 62 62 0 0 62 8 0.134 7.763	0% 100% 0% Stop 248 0 248 0 248 8 0.5 7.252	0% 0% 100% Stop 11 0 0 11 11 8 0.02 6.538	100% 0% 0% Stop 129 0 0 129 8 0.282 7.88	0% 4% 96% Stop 144 0 6 138 144 8 0.268 6.701	100% 0% 0% Stop 66 66 0 0 66 8 0.149 8.147	0% 5% 95% Stop 113 0 6 107 113 8 0.219 6.974	100% 0% 0% Stop 29 0 0 29 8 0.062 7.713	0% 100% 0% Stop 263 0 263 0 263 8 0.526 7.203	0% 0% 100% Stop 56 0 0 56 56 56 8 0.101 6.489	
Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp		100% 0% 0% Stop 62 62 0 0 62 8 0.134 7.763 Yes	0% 100% 0% Stop 248 0 248 0 248 8 0.5 7.252 Yes	0% 0% 100% Stop 11 0 0 11 11 8 0.02 6.538 Yes	100% 0% 0% Stop 129 0 0 129 8 0.282 7.88 Yes	0% 4% 96% Stop 144 0 6 138 144 8 0.268 6.701 Yes	100% 0% 0% Stop 66 66 0 0 66 8 0.149 8.147 Yes	0% 5% 95% Stop 113 0 6 107 113 8 0.219 6.974 Yes	100% 0% 0% Stop 29 0 0 29 8 0.062 7.713 Yes	0% 100% 0% Stop 263 0 263 0 263 8 0.526 7.203 Yes	0% 0% 100% Stop 56 0 0 56 56 8 0.101 6.489 Yes	
Vol Left, % Vol Thru, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by LaneT Vol Through Vol EXT Vol a.ne Flow Rate Seemetry Grp Degree of Util (X) Convergence, YM Zap Service Time		100% 0% 0% Stop 62 62 0 0 62 8 0.134 7.763 Yes 462	0% 100% 0% Stop 248 0 248 0 248 8 0.5 7.252 Yes	0% 0% 100% Stop 11 0 0 11 11 8 0.02 6.538 Yes 547	100% 0% 0% Stop 129 0 0 129 8 0.282 7.88 Yes 455	0% 4% 96% Stop 144 0 6 138 144 8 0.268 6.701 Yes 536	100% 0% 0% Stop 66 66 0 0 66 8 0.149 8.147 Yes 440	0% 5% 95% Stop 113 0 6 107 113 8 0.219 6.974 Yes 514	100% 0% 0% Stop 29 0 0 29 8 0.062 7.713 Yes 464	0% 100% 0% Stop 263 0 263 8 0.526 7.203 Yes 500	0% 0% 100% Stop 56 0 0 56 56 56 8 0.101 6.489 Yes 552	
Vol Left, % //ol Thru, % /ol Ripht, % Sign Control Traffic Vol by LaneT Vol Through Vol RT Volane Flow Rate Geometry Grp Legree of Util (X) Legrature Headway (Hd) Convergence, Y/N Zap		100% 0% 0% Stop 62 0 0 62 8 0.134 7.763 Yes 462 5.508	0% 100% 0% Stop 248 0 248 8 0.5 7.252 Yes 496	0% 0% 100% Stop 11 0 0 11 11 8 0.02 6.538 Yes 547 4.282	100% 0% 0% Stop 129 0 0 129 0 0.282 7.88 Yes 455 5.63	0% 4% 96% Stop 144 0 6 138 144 8 0.268 6.701 Yes 536 4.451	100% 0% 0% Stop 66 66 0 0 66 8 0.149 8.147 Yes 440 5.9	0% 5% 95% Stop 113 0 6 107 113 8 0.219 6.974 Yes 514 4.726	100% 0% 0% Stop 29 0 0 29 8 0.062 7.713 Yes 464 5.46	0% 100% 0% Stop 263 0 263 8 0.526 7.203 Yes 500 4.95	0% 0% 100% Stop 56 0 0 56 56 8 0.101 6.489 Yes 552 4.235	
Vol Left, % Vol Thru, % Vol Thru, % Vol Ripht, % Sign Control i Traffic Vol by LaneT Vol Through Vol RT Vol Same Flow Rate Seemerly Grp Degreed Vull (X) Departure Headway (Hd) Convergence, YM Zap Service Time CRM Lane W/C Ratio		100% 0% 0% Stop 62 62 0 0 62 8 0.134 7.763 Yes 462 5.508 0.134	0% 100% 0% Stop 248 0 248 8 0.5 7.252 Yes 496 4.997 0.5	0% 0% 100% Stop 11 0 0 11 11 8 0.02 6.538 Yes 547 4.282	100% 0% 0% Stop 129 0 0 129 8 0.282 7.88 Yes 455 5.63 0.284	0% 4% 96% Stop 144 0 6 138 144 8 0.268 6.701 Yes 536 4.451 0.269	100% 0% 0% Stop 66 66 0 66 8 0.149 Yes 440 5.9 0.15	0% 5% 95% Stop 113 0 6 107 113 8 0.219 6.974 Yes 514 4.726	100% 0% 0% Stop 29 0 0 29 8 0.062 7.713 Yes 464 5.46 0.063	0% 100% 0% Stop 263 0 263 8 0.526 7.203 Yes 500 4.95	0% 0% 100% Stop 56 0 0 56 56 8 0.101 6.489 Yes 552 4.235 0.101	

05/25/2018 Synchro 9 Report

HCM 2010 TWSC 5: Existing Greenbank Road & New E-W Collector 2025 Total Future Conditions AM Peak Hour

Intersection						
Int Delay, s/veh	3.2					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	٦	ř		ર્ન	ĥ	
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	M	ajor2	
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	-	-	-	-	-
-						
			ND		on.	
Approach	EB		NB		SB	
HCM Control Delay, s	14.9		1.1		0	
HCM LOS	В					

Minor Lane/Major Mymt	NBI	NRT	FRI n1	FBI n2	SBT	SBR
					OD!	ODIC
Capacity (veh/h)	1094		017	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	Α	С	В		-
HCM 95th %tile O(veh)	0.1		0.9	0.6		

Intersection
Intersection Delay, s/veh
Intersection LOS Movement Lane Configurations Traffic Vol, veh/h Future Vol, veh/h
 44
 112
 4
 25
 63
 26
 2
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 Peak Hour Factor Heavy Vehicles, % Mvmt Flow Number of Lanes Approach Approach
Opposing Approach
Opposing Lanes
Conflicting Approach Left
Conflicting Lanes Left
Conflicting Approach Right
Conflicting Lanes Right
HCM Control Delay
HCM LOS WB SB

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

05/25/2018 Synchro 9 Report

HCM 2010 AWSC 6: New E-W Collector & River Mist Road 2025 Total Future Conditions AM Peak Hour

Intersection Intersection Delay, s/veh	7.7											
Intersection LOS	Α.											
IIICI SCCIIOII EOS	A											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		4			4			4			4	
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	Α			Α				Α		Α		
Lane		NBLn1	EBLn1	WBLn1	SBLn1							
Vol Left, %		0%	18%	24%	66%							
Vol Thru. %		43%	82%	47%	22%							

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
Сар	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	Α	Α	Α
HCM 95th-tile Q	0.1	0.5	0.2	0.2

EBL EBT WBT WBR SBL SBR

39	112	152	62	33	64
39	112	152	62	33	64
5	0	0	5	5	5
Free	Free	Free	Stop	Stop	
None	None	None	None		

195 -6.42 6.22

5.42 -5.42 -3.518 3.318 620 849 844 -838 -

737 0.132

10.6

EBT WBT WBR SBLn1

1344 0.029

7.8 A

0.1

Major1

4.12

Intersection Int Delay, s/veh

Movement

Lane Configurations
Traffic Vol, veh/h
Future Vol, veh/h
Conflicting Peds, #/hr
Sign Control
RT Channelized

Major/Minor
Conflicting Flow All
Stage 1
Stage 2
Critical Hdwy

Critical Hdwy Stg 1
Critical Hdwy Stg 2
Follow-up Hdwy 2.218
Pot Cap-1 Maneuver 35age 1
Stage 2
Plateon blecked %

Stage 2 - Platoon blocked, %
Mov Cap-1 Maneuver 1344
Mov Cap-2 Maneuver - Stage 1 - Stage 2 -

Approach HCM Control Delay, s HCM LOS

Minor Lane/Major Mvmt Capacity (veh/h) HCM Lane V/C Ratio HCM Control Delay (s) HCM Lane LOS HCM 95th %tile Q(veh)

	٠	\rightarrow	*	1	←	•	4	†	-	>	↓
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations	ሻ	4		ሻ	4		ሻ	4		٦	1>
Traffic Volume (vph)	43	91	10	0	138	376	36	183	0	150	225
Future Volume (vph)	43	91	10	0	138	376	36	183	0	150	225
Satd. Flow (prot)	1658	1713	0	1745	1516	0	1658	1745	0	1658	1699
Flt Permitted	0.253						0.597			0.642	
Satd. Flow (perm)	439	1713	0	1745	1516	0	1034	1745	0	1110	1699
Satd. Flow (RTOR)		10			276						9
Lane Group Flow (vph)	43	101	0	0	514	0	36	183	0	150	263
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	N/
Protected Phases		4			8			2			
Permitted Phases	4			8	3		2	-		6	
Detector Phase	4	4		8	8		2	2		6	
Switch Phase	4	4		0	J		2	2		0	
Minimum Initial (s)	10.0	10.0		10.0	10.0		10.0	10.0		10.0	10
Minimum Split (s)	23.6	23.6		23.6	23.6		23.6	23.6		23.6	23
Total Split (s)	60.0	60.0		60.0	60.0		30.0	30.0		30.0	30
					66.7%			33.3%	_		33.3
Total Split (%)	66.7%	66.7%		66.7%			33.3%				33.
Yellow Time (s)	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	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	
I Lost Time (s)	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	
Act Effct Green (s)	15.8	15.8			15.8		24.7	24.7		24.7	
Actuated g/C Ratio	0.31	0.31			0.31		0.48	0.48		0.48	
c Ratio	0.32	0.19			0.79		0.07	0.22		0.28	
Control Delay	20.0	12.2			16.6		10.4	10.6		12.1	
Queue Delay	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	
LOS	В	В			В		В	В		В	
Approach Delay		14.5			16.6			10.6			1
Approach LOS		В			В			В			
Intersection Summary											
Cycle Length: 90											
Actuated Cycle Length:	1.8										
Natural Cycle: 50											
Control Type: Semi Act-	Incoord										
Maximum v/c Ratio: 0.79											
Intersection Signal Delay				Ir	tersection	LOS: B					
Intersection Capacity Uti		,		10	CU Level o	f Service	e D				
Analysis Period (min) 15											
Splits and Phases: 2:	Evictina Croo	nhank Da	ad 8. Dan	edalo De	ad						
	Existing Gree			isdale Ro	ıdü						
↑ ¶ø2			~ 94								

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05/25/2018 Synchro 9 Report 05/25/2018 Synchro 9 Report

2: Existing Greenbank Road & Barnsdale Road

2025 Total Future Conditions PM Peak Hour

	۶	→	←	4	†	-	↓
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							

HCM 2010 AWSC 2025 Total Future Conditions PM Peak Hour 3: Existing Greenbank Road & Kilbirnie Drive

Intersection												
Intersection Delay, s/veh	16.4											
Intersection LOS	С											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ሻ	1		ሻ	4		ሻ	†	7*	ሻ	†	ř
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	В			В			С			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				3.993	6.288	5.096	6.525	5.365	5.176	4.668	3.958	
		5.21										
		5.21 0.303	4.703 0.614				0.056	0.14	0.184	0.649	0.227	
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 Lane V/C Ratio HCM Control Delay							0.056 12 B	0.14 11.6 B	0.184 11.9 B	0.649 21.7 C	0.227 10.8 B	
HCM Lane V/C Ratio		0.303 13.4	0.614 20.2	0.115 9.8	0.183 13.2	0.152 11.4	12	11.6	11.9	21.7	10.8	

16.4											
C											
EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
*	ĥ		*	12		*	4	7	*	*	7
77	2	72	23	5	61	146	318	66	89	338	131
				5							131
											1.00
											1.00
				-			-	-	-		121
	_			5		140	318	00			131
1	1	0	1	1	0	1	1	1	1	1	1
EB			WB			NB			SB		
SB			NB			EB			WB		
3			3			2			2		
NB			SB			WB			EB		
3			3			2			2		
						17			17.6		
			В			C					
NF	3I n1	VBI n2	NBI n3	FBI n1	FBI n2	WBI n1	WBI n2	SBI n1	SBI n2	SBI n3	
			66								
	0	318	0	0	2	0	5	0	338	0	
				0	72	0	61	0	0	131	
	0	0	66	U						131	
	146	318	66	77	74	23	66	89	338	131	
					74 8	23 8	66 8	89 8	338	131	
0	146	318	66	77							
	146 8 0.303	318 8 0.615	66 8 0.115	77 8 0.183	8 0.151	8 0.056	8 0.14	8 0.184	8 0.651	0.226	
7	146 8 0.303 1.471	318 8 0.615 6.964	66 8 0.115 6.254	77 8 0.183 8.538	8 0.151 7.347	8 0.056 8.772	8 0.14 7.612	8 0.184 7.436	8 0.651 6.929	8 0.226 6.219	
7	146 8 0.303 7.471 Yes	318 8 0.615 6.964 Yes	66 8 0.115 6.254 Yes	77 8 0.183 8.538 Yes	8 0.151 7.347 Yes	8 0.056 8.772 Yes	8 0.14 7.612 Yes	8 0.184 7.436 Yes	8 0.651 6.929 Yes	8 0.226 6.219 Yes	
7	146 8 0.303 7.471 Yes 482	318 8 0.615 6.964 Yes 518	66 8 0.115 6.254 Yes 573	77 8 0.183 8.538 Yes 420	8 0.151 7.347 Yes 488	8 0.056 8.772 Yes 408	8 0.14 7.612 Yes 471	8 0.184 7.436 Yes 483	8 0.651 6.929 Yes 521	8 0.226 6.219 Yes 578	
7	146 8 0.303 9.471 Yes 482 5.21	318 8 0.615 6.964 Yes 518 4.703	66 8 0.115 6.254 Yes 573 3.993	77 8 0.183 8.538 Yes 420 6.288	8 0.151 7.347 Yes 488 5.096	8 0.056 8.772 Yes 408 6.525	8 0.14 7.612 Yes 471 5.365	8 0.184 7.436 Yes 483 5.176	8 0.651 6.929 Yes 521 4.668	8 0.226 6.219 Yes 578 3.958	
7	146 8 0.303 7.471 Yes 482 5.21 0.303	318 8 0.615 6.964 Yes 518 4.703 0.614	66 8 0.115 6.254 Yes 573 3.993 0.115	77 8 0.183 8.538 Yes 420 6.288 0.183	8 0.151 7.347 Yes 488 5.096 0.152	8 0.056 8.772 Yes 408 6.525 0.056	8 0.14 7.612 Yes 471 5.365 0.14	8 0.184 7.436 Yes 483 5.176 0.184	8 0.651 6.929 Yes 521 4.668 0.649	8 0.226 6.219 Yes 578 3.958 0.227	
7	146 8 1.303 1.471 Yes 482 5.21 1.303 13.4	318 8 0.615 6.964 Yes 518 4.703	66 8 0.115 6.254 Yes 573 3.993	77 8 0.183 8.538 Yes 420 6.288 0.183 13.2	8 0.151 7.347 Yes 488 5.096 0.152 11.4	8 0.056 8.772 Yes 408 6.525 0.056	8 0.14 7.612 Yes 471 5.365 0.14 11.6	8 0.184 7.436 Yes 483 5.176 0.184 11.9	8 0.651 6.929 Yes 521 4.668 0.649 21.7	8 0.226 6.219 Yes 578 3.958 0.227 10.8	
7	146 8 0.303 1.471 Yes 482 5.21 0.303 13.4 B	318 8 0.615 6.964 Yes 518 4.703 0.614 20.2 C	66 8 0.115 6.254 Yes 573 3.993 0.115 9.8 A	77 8 0.183 8.538 Yes 420 6.288 0.183 13.2 B	8 0.151 7.347 Yes 488 5.096 0.152 11.4 B	8 0.056 8.772 Yes 408 6.525 0.056 12 B	8 0.14 7.612 Yes 471 5.365 0.14 11.6 B	8 0.184 7.436 Yes 483 5.176 0.184 11.9 B	8 0.651 6.929 Yes 521 4.668 0.649 21.7 C	8 0.226 6.219 Yes 578 3.958 0.227 10.8 B	
7	146 8 1.303 1.471 Yes 482 5.21 1.303 13.4	318 8 0.615 6.964 Yes 518 4.703 0.614	66 8 0.115 6.254 Yes 573 3.993 0.115	77 8 0.183 8.538 Yes 420 6.288 0.183 13.2	8 0.151 7.347 Yes 488 5.096 0.152 11.4	8 0.056 8.772 Yes 408 6.525 0.056	8 0.14 7.612 Yes 471 5.365 0.14 11.6	8 0.184 7.436 Yes 483 5.176 0.184 11.9	8 0.651 6.929 Yes 521 4.668 0.649 21.7	8 0.226 6.219 Yes 578 3.958 0.227 10.8	
7	146 8 0.303 1.471 Yes 482 5.21 0.303 13.4 B	318 8 0.615 6.964 Yes 518 4.703 0.614 20.2 C	66 8 0.115 6.254 Yes 573 3.993 0.115 9.8 A	77 8 0.183 8.538 Yes 420 6.288 0.183 13.2 B	8 0.151 7.347 Yes 488 5.096 0.152 11.4 B	8 0.056 8.772 Yes 408 6.525 0.056 12 B	8 0.14 7.612 Yes 471 5.365 0.14 11.6 B	8 0.184 7.436 Yes 483 5.176 0.184 11.9 B	8 0.651 6.929 Yes 521 4.668 0.649 21.7 C	8 0.226 6.219 Yes 578 3.958 0.227 10.8 B	
	C EBL 77 77 77 1.00 2 2 77 1 1.00 2 5 8 3 NB 2 12.3 B	EBL EBT 77 2 77 2 1.00 1.00 2 2 2 77 2 1 1 EB WB 2 SB 3 NB NB 12.3 B NBLn1 100% 0% 0% 0% Slopp 146 0	C EBL EBR EBR T T T T T T T T T	Tebl. EBI EBR WBL The property The prop	Tebl. EBT EBR WBL WBT	Tebl. EBI EBR WBL WBI WBR	Tebl. EBT EBR WBL WBT WBR NBL NBL WBT WBR NBL NB	Tebl	FEBL	Fig. Fig.	FEBL

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

2025 Total Future Conditions
PM Peak Hour

2025 Total Future Conditions with Improvements
PM Peak Hour

HCM 2010 AWSC 6: New E-W Collector & River Mist Road

2025 Total Future Conditions
PM Peak Hour

Interception						
Intersection	2.3					
Int Delay, s/veh						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	, A			ર્ન	î,	
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	-
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 I	Minor2		Major1	1	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					
Ü						
Approach	FB		NB		SB	
HCM Control Delay, s	19.9		1.3		0	
HCM LOS	19.9 C		1.3		U	
HCW LU3	C					
Minor Lane/Major Mvm	ıt	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		Α	Α	С		-
HCM 95th %tile Q(veh))	0.3		1.1		

Intersection Delay, s/veh	7.6											
Intersection LOS	Α											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SB
Lane Configurations		4			4			4			4	
Traffic Vol, veh/h	13	58	0	3	106	35	0	2	4	27	2	2
Future Vol, veh/h	13	58	0	3	106	35	0	2	4	27	2	2
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	1.0
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	
Mvmt Flow	13	58	0	3	106	35	0	2	4	27	2	2
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	
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				Α		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							
Сар		889	850	903	852							
Service Time		2.052	2.24	1.996	2.232							
		0.007	0.084	0.159	0.062							
			7.6	7.7	7.5							
HCM Control Delay		7.1										
HCM Lane V/C Ratio HCM Control Delay HCM Lane LOS HCM 95th-tile Q		7.1 A	7.6 A 0.3	7.7 A 0.6	A 0.2							

Appendix C Intersection Performance Worksheets May 25, 2018

C.4 2031 FUTURE BACKGROUND CONDITIONS



Major1 Major2 177 0 -

1392 0.033

7.7 A

0.1

4.12

0 382 165 - 160 -- 222 -- 6.42 6.22

5.42 -5.42 -5.42 -3.518 3.318 620 879 869 -815 -

723 0.124

10.7

- 0.4

EBL EBT WBT WBR SBLn1

Intersection Int Delay, s/veh

Major/Minor
Conflicting Flow All
Stage 1
Stage 2
Critical Hdwy

Critical Hdwy Stg 1
Critical Hdwy Stg 2
Follow-up Hdwy 2.218
Pol Cap-1 Maneuver 1399
Stage 1
Stage 2
Platon blocked %

Stage 2 - Platoon blocked, %
Mov Cap-1 Maneuver 1392
Mov Cap-2 Maneuver - Stage 1 - Stage 2 -

Approach EB HCM Control Delay, s 2.1 HCM LOS

Minor Lane/Major Mvmt Capacity (veh/h) HCM Lane V/C Ratio HCM Control Delay (s) HCM Lane LOS HCM 95th %tile Q(veh)

05/25/2018

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Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBI
Lane Configurations	ሻ	1>		ሻ	4		ሻ	1		ሻ	7-	
Traffic Volume (vph)	42	104	14	4	102	126	20	182	0	399	175	4
Future Volume (vph)	42	104	14	4	102	126	20	182	0	399	175	4
Satd. Flow (prot)	1658	1707	0	1658	1572	0	1658	1745	0	1658	1678	
Flt Permitted	0.437			0.681			0.620			0.558		
Satd. Flow (perm)	756	1707	0	1176	1572	0	1072	1745	0	966	1678	
Satd. Flow (RTOR)		7			66						29	
Lane Group Flow (vph)	42	118	0	4	228	0	20	182	0	399	222	
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		4			8			2		1	6	
Permitted Phases	4			8	U		2	-		6	Ū	
Detector Phase	4	4		8	8		2	2		1	6	
Switch Phase					Ü		-	-			Ū	
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	0.0	0.0		0.0	0.0		Lag	Lag		Lead	0.0	
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	
//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	С		C	С		В	В		A	A	
Approach Delay		32.5			33.2			18.0			7.3	
Approach LOS		С			С			В			A	
Intersection Summary												
Cycle Length: 90												
Actuated Cycle Length: 82.	3											
Natural Cycle: 60												
Control Type: Semi Act-Und	coord											
Maximum v/c Ratio: 0.69												
ntersection Signal Delay: 1	7.3			li li	ntersection	LOS: B						
Intersection Capacity Utiliza	ition 79.6%			10	CU Level o	f Service	D					
Analysis Period (min) 15												
Splits and Phases: 2: Exi	ictina Croo	nhank Dos	nd 9. Dan	nedalo Di	had							
ø1	suriy Gree	ilualik KUa	d & Ball	isualt Ri	Jau							
-W1			1 1 02					-04				
32 s			30 s					28 s				

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2: Existing Greenbank Road & Barnsdale Road

2031 FBG Conditions AM Peak Hour

2031 FBG Conditions

AM Peak Hour

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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								

2031 FBG Conditions AM Peak Hour HCM 2010 AWSC 3: Existing Greenbank Road & Kilbirnie Drive

Intersection Delay, s/veh Intersection LOS												
Intersection LOS	17.3											
	С											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ሻ	1>		ሻ	4		ሻ	†	7	ሻ	†	۴
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	В			В			С			С		
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	
		68					66	113	29	287	58	
Lane Flow Rate		00	302	11	135	165	00	113	27			
Lane Flow Rate Geometry Grp		8	302 8	11	135	165	8	8	8	8	8	
Geometry Grp		8	8	8	8	8	8	8	8	8	8	
Geometry Grp Degree of Util (X)		8 0.152	8 0.634 7.553 Yes	0.021 6.836 Yes	8 0.311 8.284 Yes	8 0.325	8 0.158	8 0.234 7.468 Yes	0.065	8 0.605 7.591 Yes	0.111 6.874 Yes	
Geometry Grp Degree of Util (X) Departure Headway (Hd)		8 0.152 8.065	8 0.634 7.553	8 0.021 6.836 Yes 522	8 0.311 8.284	8 0.325 7.099	8 0.158 8.645	8 0.234 7.468	8 0.065 8.103	0.605 7.591	8 0.111 6.874	
Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, Y/N		8 0.152 8.065 Yes	8 0.634 7.553 Yes	0.021 6.836 Yes	8 0.311 8.284 Yes	8 0.325 7.099 Yes	8 0.158 8.645 Yes	8 0.234 7.468 Yes	8 0.065 8.103 Yes	8 0.605 7.591 Yes	0.111 6.874 Yes	
Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, Y/N Cap		8 0.152 8.065 Yes 444	8 0.634 7.553 Yes 477	8 0.021 6.836 Yes 522	8 0.311 8.284 Yes 433	8 0.325 7.099 Yes 505	8 0.158 8.645 Yes 414	8 0.234 7.468 Yes 479	8 0.065 8.103 Yes 441	8 0.605 7.591 Yes 474	8 0.111 6.874 Yes 520	
Geometry Grp Degree of Utill (X) Departure Headway (Hd) Convergence, Y/N Cap Service Time		8 0.152 8.065 Yes 444 5.83	8 0.634 7.553 Yes 477 5.318	8 0.021 6.836 Yes 522 4.601	8 0.311 8.284 Yes 433 6.053	8 0.325 7.099 Yes 505 4.867	8 0.158 8.645 Yes 414 6.424	8 0.234 7.468 Yes 479 5.245	8 0.065 8.103 Yes 441 5.871	8 0.605 7.591 Yes 474 5.359	8 0.111 6.874 Yes 520 4.642	
Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, Y/N Cap Service Time HCM Lane V/C Ratio		8 0.152 8.065 Yes 444 5.83 0.153	8 0.634 7.553 Yes 477 5.318 0.633	8 0.021 6.836 Yes 522 4.601 0.021	8 0.311 8.284 Yes 433 6.053 0.312	8 0.325 7.099 Yes 505 4.867 0.327	8 0.158 8.645 Yes 414 6.424 0.159	8 0.234 7.468 Yes 479 5.245 0.236	8 0.065 8.103 Yes 441 5.871 0.066	8 0.605 7.591 Yes 474 5.359 0.605	8 0.111 6.874 Yes 520 4.642 0.112	

	•	\rightarrow	1	-	4	†	1	-	Ų.	4	
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	

Protected Phases Permitted Phases Detector Phase Switch Phase Minimum Initial (s) Minimum Split (s) Total Split (s)	135 135 1658 0.449 777 135 pm+pt 7	EBT 6 6 6 1449 1449 159 165	159 159 0	WBL 66 66 1658 0.653	WBT 6 6 1455	107 107	NBL *1 68 68	NBT ↑ 302	NBR 7" 11	SBL *1 29	SBT ↑ 287	SBR 7 58
Traffic Volume (pyh) Traffic Volume (pyh) Sald. Flow (prot) Fill Fill Fill Fill Fill Fill Fill Fil	135 135 1658 0.449 777 135 pm+pt 7	6 6 1449 1449 159	159 0	66 66 1658	6		68	302	11			
Future Volume (rph) Sald. Flow (prot) It Permitted Sald. Flow (perm) Sald. Flow (perm) Sald. Flow (perm) Sald. Flow (perm) Lame Group Flow (pth) Lame Group Flow (pth) Lame Group Flow (pth) Lame Group Flow (pth) Leane Group Flow (pth) Leane Sald. Flow (135 1658 0.449 777 135 pm+pt 7	6 1449 1449 159	159 0	66 1658	6					29	287	
Sald. Flow (prot) Fill Permitted Sald. Flow (perm) Sald. Flow (PTOR) Sald. Flow (PTOR) Sald. Flow (PTOR) Sald. Flow (PTOR) Flo	1658 0.449 777 135 pm+pt 7	1449 1449 159	0	1658		107	68	000				20
Ell Permitted Sald, Flow (perm) Sald, Flow (RTOR) Lane Group Flow Oph) Lane Group Flow Oph) Lane Torpu Flow Oph Lane The Protected Phases Permitted Phases Delector Phase Which Phase Minimum Split (s) Total Split (s) Total Split (s) Total Split (s) Hall Red Time (s)	0.449 777 135 pm+pt 7	1449 159			1455			302	11	29	287	58
Said. Flow (perm) Said. Flow (perm) Lane Group Flow (yth) Lurn Type Protected Phases Permitted Phases Detector Phase Switch Phase Minimum Initial (s) Minimum Split (s) Total Split (s) Total Split (s) Total Split (s)	777 135 pm+pt 7	159	0	0.653		0	1658	1745	1483	1658	1745	1483
Sald Flow (RTOR) Lane Group Flow (vph) Turn Type Protected Phases Permitted Phases Detector Phase which Phase Minimum Initial (s) Minimum Split (s) Total Split (s) Total Split (s) Volat Split (s) Volat Split (s) Volat Split (s) Volat Split (s) Volat Split (s) Volat Split (s) Volat Split (s) Volat Split (s) Volat Split (s)	135 pm+pt 7	159	0				0.558			0.545		
Lane Group Flow (vph) Turn Type Protected Phases Permitted Phases Detector Phase Switch Phase Minimum Initial (s) Minimum Split (s) Total Split (s) Total Split (s) Vellow Time (s)	pm+pt 7			1130	1455	0	967	1745	1435	945	1745	1435
Turn Type Protected Phases Permitted Phases Detector Phase Switch Phase Minimum Initial (s) Minimum Split (s) Total Split (s) Total Split (s) Total Split (s) All-Red Time (s)	pm+pt 7	1/5			107				75			75
Turn Type Protected Phases Permitted Phases Detector Phase Switch Phase Minimum Initial (s) Minimum Split (s) Total Split (s) Total Split (s) Total Split (s) All-Red Time (s)	7	105	0	66	113	0	68	302	11	29	287	58
Protected Phases Permitted Phases Detector Phase Switch Phase Switch Phase Minimum Initial (s) Minimum Spiti (s) Total Spiti (s) Total Spiti (%) Yellow Time (s)	7	NA		Perm	NA		Perm	NA	Perm	Perm	NA	Perm
Detector Phase Switch Phase Minimum Initial (s) Minimum Spilt (s) Total Spilt (s) Total Spilt (%) Yellow Time (s) All-Red Time (s)		4			8			2			6	
Switch Phase Minimum Initial (s) Minimum Split (s) Total Split (s) Total Split (%) Yellow Time (s) All-Red Time (s)	4			8			2		2	6		6
Minimum Initial (s) Minimum Split (s) Total Split (s) Total Split (%) Yellow Time (s) All-Red Time (s)	7	4		8	8		2	2	2	6	6	6
Minimum Split (s) Total Split (s) Total Split (%) Yellow Time (s) All-Red Time (s)												
Total Split (s) Total Split (%) Yellow Time (s) All-Red Time (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Total Split (s) Total Split (%) Yellow Time (s) All-Red Time (s)	9.6	26.6		26.6	26.6		22.7	22.7	22.7	22.7	22.7	22.7
Total Split (%) Yellow Time (s) All-Red Time (s)	22.0	51.0		29.0	29.0		39.0	39.0	39.0	39.0	39.0	39.0
Yellow Time (s) All-Red Time (s)	24.4%	56.7%		32.2%	32.2%		43.3%	43.3%	43.3%	43.3%	43.3%	43.3%
All-Red Time (s)	3.3	3.3		3.3	3.3		3.7	3.7	3.7	3.7	3.7	3.7
	1.3	1.3		1.3	1.3		1.0	1.0	1.0	1.0	1.0	1.0
	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	Α.5		D	В		Α.	Α.	Α.	12.3 B	12.0 B	2.0 A
Approach Delay		13.3			23.1			5.3			11.1	^
Approach LOS		В			C			Α.			В	
Intersection Summary												
Cycle Length: 90												
Actuated Cycle Length: 90												
Offset: 13 (14%), Referenced t	to phase	2:NBTL a	and 6:SB	TL. Start	of Green							
Natural Cycle: 60												
Control Type: Actuated-Coordi	inated											
Maximum v/c Ratio: 0.44												
Intersection Signal Delay: 11.6	5											
Intersection Capacity Utilization				Ir	ntersection	LOS: B						
Analysis Period (min) 15					ntersection		e A					

05/25/2018 Synchro 9 Report

HCM 2010 AWSC

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

2031 FBG Conditions

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

05/25/2018

05/25/2018

2031 FBG Conditions AM Peak Hour

Synchro 9 Report

Intersection												
Intersection Delay, s/veh	9.3											
Intersection LOS	Α.											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBF
Lane Configurations		4			4			4			4	
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	- 1
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	(
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	В			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							
Сар		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		Α	В	Α	Α							
HCM 95th-tile Q		0.7	1.4	0.6	0.5							

Intersection						
Int Delay, s/veh	3.2					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
	EBL	EBK	INBL	MRI	281	SBK
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	08	0	39	313	520	28
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	Stop	None	Free	None	Free	None
Storage Length	200	0		None.		None -
Veh in Median Storage		-		0	0	
Grade, %	2,# 0			0	0	
Peak Hour Factor	100	100	100	100	100	100
	2	2	2	2	2	2
Heavy Vehicles, % Mymt Flow	80	101	39	313	520	28
MVIIIL FIOW	80	101	39	313	520	28
Major/Minor	Minor2	- 1	Major1	- 1	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, %	000					
Mov Cap-1 Maneuver	285	546	1021			
Mov Cap-1 Maneuver	285	340	1021			
	588					
Stano 1						
Stage 1						
Stage 1 Stage 2	652		-			
	652 EB		NB		SB	
Stage 2	652 EB	-			SB 0	
Stage 2 Approach	652 EB	-	NB			
Stage 2 Approach HCM Control Delay, s	652 EB 17.3		NB			
Stage 2 Approach HCM Control Delay, s HCM LOS	652 EB 17.3 C		NB 1	EDI n1 I	0	CDT
Stage 2 Approach HCM Control Delay, s HCM LOS Minor Lane/Major Mvn	652 EB 17.3 C	NBL	NB 1	EBLn1	0 EBLn2	SBT
Stage 2 Approach HCM Control Delay, s HCM LOS Minor Lane/Major Mvm Capacity (veh/h)	652 EB 17.3 C	NBL 1021	NB 1 NBT	285	0 EBLn2 546	-
Stage 2 Approach HCM Control Delay, s HCM LOS Minor Lane/Major Mvn Capacity (velvh) HCM Lane V/C Ratio	652 EB 17.3 C	NBL 1021 0.038	NB 1	285 0.281	0 EBLn2 546 0.185	-
Slage 2 Approach HCM Control Delay, s HCM LOS Minor Lane/Major Mvn Capacity (veh/h) HCM Lane V/C Ratio HCM Control Delay (s)	652 EB 17.3 C	NBL 1021 0.038 8.7	NB 1 NBT	285 0.281 22.5	0 EBLn2 546 0.185 13.1	:
Stage 2 Approach HCM Control Delay, s HCM LOS Minor Lane/Major Mvn Capacity (velvh) HCM Lane V/C Ratio	652 EB 17.3 C	NBL 1021 0.038	NB 1	285 0.281	0 EBLn2 546 0.185	-

5: Existing Greenb	ariik rkoc	u u 14	O V L V	AM Peak Hou		
	•	•	4	1	ţ	
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 percer	-471			-	_	

	•	•	4	1	↓	4
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	ሻ	7"	ሻ	†	4	
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	В	Α	Α	Α	
Approach Delay	24.8			2.7	3.3	
Approach LOS	С			Α	Α	
Intersection Summary						
Cycle Length: 90						
Actuated Cycle Length: 90						

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

Splits and Phases: 5: Existing Greenbank Road & New E-W Collector Ø2 (R)

05/25/2018 Synchro 9 Report

Synchro 9 Report 05/25/2018

HCM 2010 AWSC

2031 FBG Conditions

HCM 2010 TWSC 1: Barnsdale Road & Borrisokane Road

2031 FBG Conditions PM Peak Hour

Intersection												
Intersection Delay, s/veh	7.7											
Intersection LOS	Α											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBF
Lane Configurations		4			4			4			4	
Traffic Vol. veh/h	24	107	0	16	32	20	0	9	12	33	11	
Future Vol. veh/h	24	107	0	16	32	20	0	9	12	33	11	
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	1.0
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	
Mymt Flow	24	107	0	16	32	20	0	9	12	33	11	
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	-
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				Α		Α		
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		Α	Α	Α	A							
HCM 95th-tile Q		0.1	0.5	0.2	0.2							

3.2					
EBL	EBT	WBT	WBR	SBL	SBR
	ન	ĥ		¥	
43			69	41	83
43			69	41	83
5	0	0	5	5	5
Free	Free	Free	Free	Stop	Stop
-		-	None		None
	-			0	
,# -	0	0		0	
	0	0	-	0	-
100	100	100	100	100	100
2	2	2	2	2	2
43	126	171	69	41	83
		-	0		216
		-	-		-
				2.17	
			-		6.22
-	-	-	-		
-	-	-	-		-
	-	-	-		
	-	-	-		824
	-				
-	-			819	
	-				
	-				816
	-				
-	-		-		-
-	-	-	-	787	
EB		WB		SB	
2		0		11.2	
				В	
lt				WBR:	
					708
	0.033				0.175
	7.8	0		-	11.2
)	A 0.1	A	-		0.6
	433 43 5 Free	EBL EBT 4 43 126 43 126 5 0 Free Free - None - 2, # − 0 100 100 2 2 43 126 - 1245 0 1245 0 125 1315	BEL BRT WBT	BEL BET WBT WBR WBT WBR WBT STATE STAT	

	•	\rightarrow	—	4	1	-	↓	
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	,,,,							

	۶	→	*	€	←	4	4	†	~	-	↓	1
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ሻ	ħ		ሻ	4		٦	1		7	1>	
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	С	В			В		В	В		В	В	
Approach Delay		14.7			19.6			14.0			16.2	
Approach LOS		В			В			В			В	
Intersection Summary												
Cycle Length: 90												
Actuated Cycle Length: 56.7												
Natural Cycle: 50												
Control Type: Semi Act-Unco	oord											
Maximum v/c Ratio: 0.84												
Internation Class I Delev. 17	. 0			1.0		- LOC D						

Intersection Signal Delay: 17.0 Intersection Capacity Utilization 82.9% Analysis Period (min) 15 Intersection LOS: B
ICU Level of Service E

Splits and Phases: 2: Existing Greenbank Road & Barnsdale Road ↓ ø6

05/25/2018 Synchro 9 Report 05/25/2018 Synchro 9 Report

2031 FBG Conditions with Improvements PM Peak Hour

HCM 2010 AWSC 3: Existing Greenbank Road & Kilbirnie Drive

22.8

Intersection Intersection Delay, s/veh Intersection LOS

Movement

2031 FBG Conditions PM Peak Hour

8: 89 1.00 2

395 1.00 143

395 143

66

	۶	-	•	•	←	*	4	†	1	>		∢
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	7	1		7	7-		Ť	†	ř	Ť	†	ř
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	В		С	В		Α	Α	A	A	A	A
Approach Delay		24.8			17.3			4.2			4.1	
Approach LOS		С			В			Α			Α	
Intersection Summary												

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

05/25/2018

Lanes, Volumes, Timings

3: Existing Greenbank Road & Kilbirnie Drive

Splits and i hases. S. Existing Greenbank Road & Ribinic Dive	
1 Ø2 (R)	≜ ø4
58 s	32 s
∮ Ø6 (R)	₩ Ø8
58 s	32 s

23

116

61

1.00

1.00 1.00 Lane Group
Lane Group Flow (vph)
vic Ratio
Control Delay
Queue Delay
Total Delay
Queue Length 50th (m)
Queue Length 50th (m)
Gueue Length 50th (m)
Turn Bay Length (m)
Base Capacity (vph)
Starvation Cap Reducth
Spillback Cap Reducth
Spillback Cap Reducth

Storage Cap Reductn Reduced v/c Ratio

Intersection Summary

•	-	•	←	4	†	-	1	↓	4	
EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR	
89	118		66	189	347	66	89	395	143	
0.51	0.39		0.25	0.28	0.26	0.06	0.12	0.30	0.13	
44.1	10.1	32.7 0.0	11.9	5.1	4.2	1.8	4.6	5.0	1.2 0.0	
0.0 44.1	0.0 10.1		0.0 11.9	0.0 5.1	0.0 4.2	0.0 1.8	0.0 4.6	5.0	1.2	
14.6	0.3		0.8	3.8	6.9	0.0	3.1	16.3	0.0	
25.5	12.9		10.4	20.3	32.9	2.9	10.9	42.1	5.6	
	360.1		212.9		511.5			369.2		
37.5		37.5		50.0		37.5	50.0		37.5	
375	520	336	487	676	1316	1099	717	1316	1118	
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	0.13	
0.24	0.23	0.07	0.14	0.28	0.26	0.06	0.12	0.30	0.13	

05/25/2018 Synchro 9 Report 05/25/2018 Synchro 9 Report

HCM 2010 TWSC 5: Existing Greenbank Road & New E-W Collector 2031 FBG Conditions PM Peak Hour

Intersection Int Delay, s/veh 2.2 | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | Second | S Heavy Vehicles, % Mvmt Flow 42 52 95 598 470 78

Major/Minor I	Minor2		Major1	Ma	jor2	
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			1.2		0	
HCM LOS	23.1		1.2		J	

TICINI ECO	0							
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	Α	Ε	В		-		
HCM 95th %tile Q(veh)	0.3	-	- 1	0.3	-	-		

Lanes, Volumes, Timings

2031 FBG Conditions with Improvements

	•	•	4	†	↓	1	
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	
Lane Configurations	ሻ	7	*	†	12		
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	1100	0.445	1710	1712	•	
Satd. Flow (perm)	1658	1483	777	1745	1712	0	
Satd. Flow (RTOR)	1000	52		1710	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	7	7	2	2	0		
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		
	4.3	4.3	0.0	0.0	3.0		
Lead/Lag							
Lead-Lag Optimize? Recall Mode	None	None	C-Max	C-Max	C-Max		
	9.3	9.3	73.9	73.9	73.9		
Act Effct Green (s)	0.10	0.10	0.82	0.82	0.82		
Actuated g/C Ratio							
//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	В	A	A	A		
Approach Delay	24.4			2.7	3.7		
Approach LOS	С			Α	Α		
Intersection Summary							
Cycle Length: 90							
Actuated Cycle Length: 90							
Offset: 0 (0%), Referenced	to phase 2	:NBTL an	d 6:SBT,	Start of 0	Green		
Natural Cycle: 60							
Control Type: Actuated-Cor	ordinated						
Maximum v/c Ratio: 0.42							
ntersection Signal Delay: 4	.7			- II	ntersection	LOS: A	
ntersection Capacity Utiliza	ation 52 7%			16	CILL aval o	f Service A	

2031 FBG Conditions with Improvements
PM Peak Hour

HCM 2010 AWSC 6: New E-W Collector & River Mist Road 2031 FBG Conditions PM Peak Hour

 S: Existing Greenbank Road & New E-W Collector
 PM Peak Hour

 Lane Group
 EBI
 EBR
 NBL
 NBT
 SBT

 Lane Group Flow (vph)
 42
 52
 95
 598
 548

 Vie Ratio
 0.25
 0.26
 0.15
 0.42
 0.39

 Control Delay
 38.4
 13.1
 2.2
 2.8
 3.7

 Oueue Delay
 38.4
 13.1
 2.2
 2.8
 3.7

 Oueue Length 50th (m)
 7.0
 0.0
 1.5
 10.9
 17.8

 Oueue Length 95th (m)
 14.5
 9.0
 m5.1
 41.2
 43.1

 Internal Link Dist (m)
 34.5
 181.0
 28.7

 Turn Bay Length (m)
 37.5
 37.5

 Base Capacity (vph)
 43.6
 428
 638
 143.2
 1408

 Stanvation Cap Reductn
 0
 0
 0
 0
 0
 Sitrage Cap Reductn
 0
 0
 0
 0
 0
 Sitrage Capacity Reductn
 0
 0
 0
 0
 0
 0<

Intersection												
Intersection Delay, s/veh	7.6											
Intersection LOS	Α											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBF
Lane Configurations		4			4			4			4	
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	(
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	Α			Α				Α		Α		
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							
Сар		889	850	903	852							
			2.24	1.996	2.232							
Service Time		2.052										
HCM Lane V/C Ratio		0.007	0.084	0.159	0.062							
HCM Lane V/C Ratio HCM Control Delay		0.007 7.1	0.084 7.6	0.159 7.7	7.5							
HCM Lane V/C Ratio		0.007	0.084	0.159								

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Appendix C Intersection Performance Worksheets May 25, 2018

C.5 2031 TOTAL FUTURE CONDITIONS



222 -6.42 6.22

5.42 6.22 5.42 -5.42 -3.518 3.318 620 879 869 -815 -

592 871 592 -

723 0.124

10.7

- 0.4

EBT WBT WBR SBLn1

EBL EBT WBT WBR SBL SBR

1392 0.033

7.7 A

0.1

4.12

Intersection Int Delay, s/veh

Movement

Major/Minor
Conflicting Flow All
Stage 1
Stage 2
Critical Hdwy

Platoon blocked. % Mov Cap-1 Maneuver 1392
Mov Cap-2 Maneuver Stage 1 Stage 2 -

Critical Hdwy Stg 1
Critical Hdwy Stg 2
Critical Hdwy Stg 2
Follow-up Hdwy 2.218
Pot Cap-1 Maneuver 389
Stage 1
Stage 2
Platen blocked %

Approach EB HCM Control Delay, s 2.1 HCM LOS

Minor Lane/Major Mvmt Capacity (veh/h) HCM Lane V/C Ratio HCM Control Delay (s) HCM Lane LOS HCM 95th %tile Q(veh)

2: Existing Greenba	ank Ro	ad & Ba	arnsda	ale Ro	ad						AM Pea	k Hou
	۶	\rightarrow	•	•	←	•	4	1	-	1	↓	4
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SB
Lane Configurations	ሻ	1		ሻ	4		ሻ	7		ሻ	1	
Traffic Volume (vph)	42	104	14	4	102	145	20	185	0	468	185	4
Future Volume (vph)	42	104	14	4	102	145	20	185	0	468	185	4
Satd. Flow (prot)	1658	1707	0	1658	1561	0	1658	1745	0	1658	1682	
FIt Permitted	0.368			0.681			0.614			0.562		
Satd. Flow (perm)	637	1707	0	1176	1561	0	1062	1745	0	973	1682	
Satd. Flow (RTOR)		7			76						27	
Lane Group Flow (vph)	42	118	0	4	247	0	20	185	0	468	232	
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	5.0	5.0		5.0	5.0		Lag	Lag		Lead	3.0	
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	
//c Ratio	0.10	0.39		0.02	0.73		0.43	0.43		0.70	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	40.8 D	33.1 C		27.5 C	D		20.4 C	17.7 B		7.5 A	2.0 A	
Approach Delay	D	35.1		C	36.4		C	19.9		^	5.9	
Approach LOS		33.1 D			D			17.7 B			J.7	
**		D			D			ь			^	
Intersection Summary												
Cycle Length: 90												
Actuated Cycle Length: 90												
Offset: 40 (44%), Reference	ed to phase	2:NBTL a	and 6:SB	TL, Start	of Green							
Natural Cycle: 65												
Control Type: Actuated-Coo	ordinated											
Maximum v/c Ratio: 0.73												
ntersection Signal Delay: 1					ntersection							
ntersection Capacity Utiliza	ition 84.7%	,		10	CU Level o	of Service	Ε					
Analysis Period (min) 15												
Splits and Phases: 2: Exi	isting Gree	nbank Roa	nd & Ban	nsdale Rr	oad							
	. ,							1 4				
L			- ≪T	COL				- Com.				
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2031 Total Future Conditions AM Peak Hour 2: Existing Greenbank Road & Barnsdale Road

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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									

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

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2031 Total Future Conditions AM Peak Hour

Synchro 9 Report

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Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ሻ	1>		٦	4		٦	†	7	Ť	†	ř
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	С	A		D	В		Α	Α	Α	В	В	A
Approach Delay		12.8			23.3			5.7			11.4	
Approach LOS		В			С			Α			В	
Intersection Summary												

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

Splits and Phases: 3: Existing Greenbank Road & Kilbirnie Drive 51 S → 07 ∳ Ø6 (R)

2031 Total Future Conditions AM Peak Hour HCM 2010 AWSC 4: River Mist Road & Kilbirnie Drive 2031 Total Future Conditions AM Peak Hour

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Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR	I	Intersection	Intersection	Intersection	Intersection	Intersection	Intersection	Intersection	Intersection	Intersection	Intersection	Intersection	Intersection
Lane Group Flow (vph)	142	188	66	113	74	319	11	29	292	60		Intersection Delay, s/veh											
v/c Ratio	0.39	0.33	0.45	0.40	0.13	0.31	0.01	0.05	0.28	0.07		Intersection LOS											
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		Management	Manager	Manager EDI EDI	Manager EDI EDI EDI	Manager EDI EDI EDI INDI	Manager EDI EDI EDD WIDT WIDT	Manager EDI EDI EDI MIDI MIDI MEDI	Married FDI FDT FDD WDI WDT WDD NDI	TOU FOR FOR WOL WOT WOD NOT	TOU FOT FOO WAY WITH WITH A POT AND	Management FDI FDT FDD WDI WDT WDD NDI NDT NDD CDI	Married FDI FDI FDD MIN MDI MDD NDI NDI NDD CDI CDI
Total Delay	23.8	4.4	43.5	11.4	5.3	6.0	0.2	12.9	13.0	3.0		Movement											
Queue Length 50th (m)	18.2	0.7	10.9	0.9	4.2	19.0	0.0	2.0	23.5	0.0		Lane Configurations											
Queue Length 95th (m)	23.9	10.8	20.3	13.3	8.4	29.9	0.2	8.3	55.1	5.3		Traffic Vol, veh/h											
Internal Link Dist (m)		360.1		212.9		511.5			369.2			Future Vol, veh/h											
Turn Bay Length (m)	20.0		20.0		50.0		37.5	50.0		37.5		Peak Hour Factor											
Base Capacity (vph)	423	835	299	472	567	1033	880	544	1033	880		Heavy Vehicles, %											
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0		Mvmt Flow											
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0		Number of Lanes	Number of Lanes 0	Number of Lanes 0 1	Number of Lanes 0 1 0	Number of Lanes 0 1 0 0	Number of Lanes 0 1 0 0 1	Number of Lanes 0 1 0 0 1 0	Number of Lanes 0 1 0 0 1 0 0	Number of Lanes 0 1 0 0 1 0 0 1	Number of Lanes 0 1 0 0 1 0 0 1 0	Number of Lanes 0 1 0 0 1 0 0 1 0 0	Number of Lanes 0 1 0 0 1 0 0 1 0 0 1
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0		Approach	Approach EB	Approach EB	Approach EB	Approach EB WB	Approach EB WB	Approach EB WB	Approach EB WB NB	Approach EB WB NB	Approach EB WB NB	Approach EB WB NB SB	Approach EB WB NB SB
Reduced v/c Ratio	0.34	0.23	0.22	0.24	0.13	0.31	0.01	0.05	0.28	0.07		Opposing Approach											
Intersection Summary												Opposing Lanes											
incisection Summary												Conflicting Approach Left											
												Conflicting Lanes Left											
												Conflicting Approach Right											
												Conflicting Lanes Right											
												HCM Control Delay											
												HCM LOS											

Lane Vol Left, % Vol Thru, % 1% 42% 19% 28% 70% 57% 61% 36% Vol Thru, %
Vol Right, %
Sigin Control
Traffic Vol by Lane
LT Vol
Through Vol
RT Vol
Lane Flow Rate
Geometry Grp
Degree of Util (X)
Departure Headway (Hd)
Cap
Service Time
HCM Lane WC Ratio
HCM Control Delay
HCM Lane LOS
HCM 95ih-lile Q
 70%
 37%
 31%
 30%

 29%
 1%
 20%
 36%

 Stop
 Stop
 Stop
 Stop

 211
 297
 130
 140

 2
 125
 25
 39

 147
 168
 79
 50

 62
 4
 26
 51

 211
 297
 130
 140

 1
 1
 1
 1
 211 297 130 140
1 1 1 1
0.3 0.426 0.189 0.204
5.115 5.167 5.237 5.238
Yes Yes Yes Yes
703 701 685 685
3.148 3.167 3.271 3.273
0.3 0.424 0.119 0.204
10.3 11.9 9.5 9.6
B B A A
1.3 2.1 0.7 0.8

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2031 Total Future Conditions

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

	•	*	4	1	ţ	4	
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	
Lane Configurations	ሻ	7	7	†	4		
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	В	Α	Α	A		
Approach Delay	23.3			4.2	4.0		
Approach LOS	С			Α	Α		
Intersection Summary							

Intersection Summary		
Cycle Length: 90		
Actuated Cycle Length: 90		
Offset: 2 (2%), Referenced to phase 2:NBTL and 6:5	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 ↓ Ø6 (R)

2031 Total Future Conditions AM Peak Hour Queues 5: Existing Greenbank Road & New E-W Collector

	٠	•	4	†	ļ
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 percei	ntile queue is	s meterei	d by upsti	ream sign	al.

Intersection												
Intersection Delay, s/yeh	8.7											
Intersection LOS	A											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		4			4			4			4	
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
Mymt 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	1	0
				-		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		
				1				- 1		1		
Conflicting Lanes Right	1											
Conflicting Lanes Right HCM Control Delay				7.8								
HCM Control Delay	9.3			7.8 A				7.6		8.1 A		
										8.1		
HCM Control Delay HCM LOS	9.3 A			A				7.6		8.1		
HCM Control Delay	9.3 A	NBLn1	EBLn1	A WBLn1	SBLn1			7.6		8.1		
HCM Control Delay HCM LOS	9.3 A	NBLn1 0%	EBLn1 '	A	SBLn1 49%			7.6		8.1		
HCM Control Delay HCM LOS	9.3 A			A WBLn1				7.6		8.1		
HCM Control Delay HCM LOS Lane Vol Left, % Vol Thru, %	9.3 A	0%	33% 67%	A WBLn1 18% 59%	49% 16%			7.6		8.1		
HCM Control Delay HCM LOS Lane Vol Left, % Vol Thru, % Vol Right, %	9.3 A	0% 43% 57%	33% 67% 0%	A WBLn1 18% 59% 23%	49% 16% 35%			7.6		8.1		
HCM Control Delay HCM LOS Lane Vol Left, % Vol Triru, % Vol Right, % Sign Control	9.3 A	0% 43% 57% Stop	33% 67% 0% Stop	A WBLn1 18% 59% 23% Stop	49% 16% 35% Stop			7.6		8.1		
HCM Control Delay HCM LOS Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane	9.3 A	0% 43% 57% Stop 21	33% 67% 0% Stop 269	MBLn1 18% 59% 23% Stop 88	49% 16% 35% Stop 68			7.6		8.1		
HCM Control Delay HCM LOS Lane Vol Left, % Vol Trivu, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol	9.3 A	0% 43% 57% Stop 21 0	33% 67% 0% Stop 269 90	WBLn1 18% 59% 23% Stop 88 16	49% 16% 35% Stop 68 33			7.6		8.1		
HCM Control Delay HCM LOS Lane Vol Left, % Vol Rhru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol	9.3 A	0% 43% 57% Stop 21 0	33% 67% 0% Stop 269 90 179	WBLn1 18% 59% 23% Stop 88 16 52	49% 16% 35% Stop 68 33 11			7.6		8.1		
HCM Control Delay HCM LOS Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RY Vol	9.3 A	0% 43% 57% Stop 21 0 9	33% 67% 0% Stop 269 90 179 0	MBLn1 18% 59% 23% Stop 88 16 52 20	49% 16% 35% Stop 68 33 11 24			7.6		8.1		
HCM Control Delay HCM LOS Lane Vol Left, % Vol Riytt, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol LT Vol LT LOS LT Vol LT LOS LT Vol LT LOS LT LO	9.3 A	0% 43% 57% Stop 21 0	33% 67% 0% Stop 269 90 179	WBLn1 18% 59% 23% Stop 88 16 52	49% 16% 35% Stop 68 33 11			7.6		8.1		
HCM Control Delay HCM LOS Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp	9.3 A	0% 43% 57% Stop 21 0 9 12 21	33% 67% 0% Stop 269 90 179 0 269	A WBLn1 18% 59% 23% Stop 88 16 52 20 88 1	49% 16% 35% Stop 68 33 11 24 68			7.6		8.1		
HCM Control Delay HCM LOS Lane Vol Left, % Vol Ryth, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X)	9.3 A	0% 43% 57% Stop 21 0 9 12 21 1 0.026	33% 67% 0% Stop 269 90 179 0 269 1	A WBLn1 18% 59% 23% Stop 88 16 52 20 88 1 0.106	49% 16% 35% Stop 68 33 11 24 68 1 0.088			7.6		8.1		
HCM Control Delay HCM LOS Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Uili (X) Degarture Headway (Hd)	9.3 A	0% 43% 57% Stop 21 0 9 12 21 1 0.026 4.475	33% 67% 0% Stop 269 90 179 0 269 1 0.316 4.223	MBLn1 18% 59% 23% Stop 88 16 52 20 88 1 0.106 4.325	49% 16% 35% Stop 68 33 11 24 68 1 0.088 4.644			7.6		8.1		
HCM Control Delay HCM LOS Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, YN	9.3 A	0% 43% 57% Stop 21 0 9 12 21 1 0.026 4.475 Yes	33% 67% 0% Stop 269 90 179 0 269 1 0.316 4.223 Yes	MBLn1 18% 59% 23% Stop 88 16 52 20 88 1 0.106 4.325 Yes	49% 16% 35% Stop 68 33 11 24 68 1 0.088 4.644 Yes			7.6		8.1		
HCM Control Delay HCM LOS Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, Y/N Cap	9.3 A	0% 43% 57% Stop 21 0 9 12 21 1 0.026 4.475 Yes 803	33% 67% 0% Stop 269 90 179 0 269 1 0.316 4.223 Yes 839	MBLn1 18% 59% 23% Stop 88 16 52 20 88 1 0.106 4.325 Yes 832	49% 16% 35% Stop 68 33 11 24 68 1 0.088 4.644 Yes 775			7.6		8.1		
HCM Confrol Delay HCM LOS Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, Y/N Cap Service Time	9.3 A	0% 43% 57% Stop 21 0 9 12 21 1 0.026 4.475 Yes 803 2.485	33% 67% 0% Stop 269 90 179 0 269 1 0.316 4.223 Yes 839 2.317	A WBLn1 18% 59% 23% Stop 88 16 52 20 88 1 0.106 4.325 Yes 832 2.335	49% 16% 35% Stop 68 33 11 24 68 1 0.088 4.644 Yes 775 2.65			7.6		8.1		
HCM Control Delay HCM LOS Lane Vol Left, % Vol Riyt, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Degree of Util (X) Degarture Headway (Hd) Convergence, YN Cap Service Time HCM Lane VIC Ratio	9.3 A	0% 43% 57% Stop 21 0 9 12 21 1 0.026 4.475 Yes 803 2.485 0.026	33% 67% 0% Stop 269 90 179 0 269 1 0.316 4.223 Yes 839 2.317 0.321	A WBLn1 18% 59% 23% Stop 88 16 52 20 88 1 0.106 4.325 Yes 832 2.335 0.106	49% 16% 35% Stop 68 33 11 24 68 1 0.088 4.644 Yes 775 2.65 0.088			7.6		8.1		
HCM Control Delay HCM Control Delay HCM LOS Lane Vol Left, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, YN Cap Service Time HCM Lane V/C Ratio HCM Control Delay	9.3 A	0% 43% 57% Stop 21 0 9 12 21 1 0.026 4.475 Yes 803 2.485 0.026 7.6	33% 67% 0% Stop 269 90 179 0 269 1 0.316 4.223 Yes 839 2.317 0.321 9.3	MBLn1 18% 59% 23% Stop 88 16 52 20 88 1 0.106 4.325 Yes 832 2.335 0.106 7.8	49% 16% 35% Stop 68 33 11 24 68 1 0.088 4.644 Yes 775 2.65 0.088 8.1			7.6		8.1		
HCM Control Delay HCM LOS Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, Y/N Cap Service Time HCM Lane V/C Ratio HCM Lane V/C Ratio HCM Control Delay HCM Lane LOS	9.3 A	0% 43% 57% Stop 21 0 9 12 21 1 0.026 4.475 Yes 803 2.485 0.026 7.6 A	33% 67% 0% Stop 269 90 179 0 269 1 0.316 4.223 Yes 839 2.317 0.321 9.3	MBLn1 18% 59% 23% Stop 88 16 52 20 88 1 0.106 4.325 Yes 832 2.335 0.106 7.8 A	49% 16% 35% Stop 68 33 11 24 68 1 0.088 4.644 Yes 775 2.65 0.088 8.1			7.6		8.1		
HCM Control Delay HCM Control Delay HCM LOS Lane Vol Left, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, YN Cap Service Time HCM Lane V/C Ratio HCM Control Delay	9.3 A	0% 43% 57% Stop 21 0 9 12 21 1 0.026 4.475 Yes 803 2.485 0.026 7.6	33% 67% 0% Stop 269 90 179 0 269 1 0.316 4.223 Yes 839 2.317 0.321 9.3	MBLn1 18% 59% 23% Stop 88 16 52 20 88 1 0.106 4.325 Yes 832 2.335 0.106 7.8	49% 16% 35% Stop 68 33 11 24 68 1 0.088 4.644 Yes 775 2.65 0.088 8.1			7.6		8.1		
HCM Control Delay HCM LOS Lane Vol Left, % Vol Thru, % Vol Right, % Sign Control Traffic Vol by Lane LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, Y/N Cap Service Time HCM Lane V/C Ratio HCM Lane V/C Ratio HCM Control Delay HCM Lane LOS	9.3 A	0% 43% 57% Stop 21 0 9 12 21 1 0.026 4.475 Yes 803 2.485 0.026 7.6 A	33% 67% 0% Stop 269 90 179 0 269 1 0.316 4.223 Yes 839 2.317 0.321 9.3	MBLn1 18% 59% 23% Stop 88 16 52 20 88 1 0.106 4.325 Yes 832 2.335 0.106 7.8 A	49% 16% 35% Stop 68 33 11 24 68 1 0.088 4.644 Yes 775 2.65 0.088 8.1			7.6		8.1		

05/25/2018 Synchro 9 Report 05/25/2018 Synchro 9 Report

Lanes, Volumes, Timings

2031 Total Future

2: Existing Greenb	ank Ro	ad & Ba	arnsda	ale Ro	ad						PM Peak Hour		
	٠	-	*	•	←	*	4	†	~	-	↓	4	
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations	Ť	ĥ		Ť	î		ሻ	₽		ሻ	4		
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	В			С		В	В		С	В		
Approach Delay		24.7			22.2			19.3			18.3		
Approach LOS		С			С			В			В		
Intersection Summary													
Cyclo Longth: 00													

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

Ø2 (R)	→ Ø4
30 s	60 s
₩ Ø6 (R)	₹ ø8
30 s	60 s

2031 Total Future PM Peak Hour Queues 2: Existing Greenbank Road & Barnsdale Road

	•	\rightarrow	←	4	†	-	↓	
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								
# 05th percentile volume of	en shoony	nacity or	iolio may	he longe	r			

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

Synchro 9 Report 05/25/2018 05/25/2018 Synchro 9 Report

2031 Total Future PM Peak Hou

2031 Total Future

Queues

2031 Total Future PM Peak Hour

3: Existing Greenbank Road & Kilbirnie Drive ⅉ ļ Lane Group
Lane Group Flow (vph)
w/c Railo
Control Delay
Queue Delay
Total Delay
Queue Length 50th (m)
Queue Length 95th (m)
Internal Link (bist (m)
Turn Bay Length (m)
Base Capacity (vph)
Starvation Cap Reducth
Spilliack Cap Reducth EBT 23 0.16 33.0 0.0 33.0 132 0.42 10.0 0.0 10.0 213 0.32 0.53 44.6 0.0 44.6 1.2 0.0 1.2 5.4 0.0 4.2 0.0 5.2 17.6 15.3 26.5 0.0 8.2 32.6 0.3 3.6 9.2 0.8 5.1 0.1 3.2 11.0 23.3 360.1 212.9 511.5 369.2 37.5 375 37.5 50.0 37.5 529 313 487 660 1313 1096 50.0 707 37.5 1313 1117 Storage Cap Reductn 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 Summar

	۶	→	•	•	←	•	4	†	~	/	↓	- ✓
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	ሻ	1		ሻ	4		ሻ	†	7	ሻ	↑	7
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	В		С	В		Α	A	A	A	A	A
Approach Delay		24.3			17.2			4.3			4.2	
Approach LOS		С			В			Α			Α	
Intersection Summary												
Cycle Length: 90												
Actuated 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 v6: Ratio: 0.53
Intersection Signal Delay 7. 8
Intersection Signal Delay 7. 8
Intersection (Spangly Utilization 65.6%
Analysis Period (min) 15 Intersection LOS: A ICU Level of Service C

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

05/25/2018 Synchro 9 Report 05/25/2018 Synchro 9 Report

HCM 2010 AWSC 4: River Mist Road & Kilbirnie Drive

PM Peak Hour

Intersection												
Intersection Delay, s/veh	12.5											
Intersection LOS	В											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBF
Lane Configurations		4			4			4			4	
Traffic Vol, veh/h	105	133	- 1	56	190	45	0	82	29	30	144	14
Future Vol, veh/h	105	133	- 1	56	190	45	0	82	29	30	144	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	1.0
Heavy Vehicles, %	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	(
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	В			В				В		В		
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							
Сар		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		В	В	В	В							
HCM 95th-tile Q		0.7	1.8	2.3	2.6							

Lanes, Volumes, Timings

2031 Total Future

	•	•	4	†	↓	4	
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	
Lane Configurations	*	7	*	†	1>		
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	В	A	A	A		
Approach Delay	22.5			3.3	4.0		
Approach LOS	C			A	A		
Intersection Summary							

Cycle Length: 90
Offsel: 6 (7%), Referenced to phase 2:NBTL and 6:SBT, Start of Green
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum vic Ratio: 0.44
Intersection Signal Delay: 5.3
Intersection Signal Delay: 5.1
Intersection Capacity Utilization 59.0%
Intersection Capacity Utilization 59.0%
ICU Lev
Analysis Period (min) 15 Intersection LOS: A ICU Level of Service B

Splits and Phases: 5: Existing Greenbank Road & New E-W Collector ↓ Ø6 (R)

2031 Total Future PM Peak Hour HCM 2010 AWSC 6: New E-W Collector & River Mist Road 2031 Total Future PM Peak Hour

	۶	•	1	†	↓						
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											
Volume for 95th percentile queue is metered by upstream signal.											

Intersection												
Intersection Delay, s/veh	8.6											
Intersection LOS	Α											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SE
Lane Configurations		4			4			4			4	
Traffic Vol. veh/h	51	99	0	3	179	35	0	2	4	27	2	
Future Vol, veh/h	51	99	0	3	179	35	0	2	4	27	2	
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	1.0
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	
Mvmt Flow	51	99	0	3	179	35	0	2	4	27	2	
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	
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	Α			A				Α		A		
Lane		NBLn1	EBLn1		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							
					4.348							
		4.5	4.514	4.289								
Convergence, Y/N		Yes	Yes	Yes	Yes							
Convergence, Y/N Cap		Yes 795	Yes 795	Yes 838	Yes 825							
Convergence, Y/N Cap Service Time		Yes 795 2.53	Yes 795 2.537	Yes 838 2.31	Yes 825 2.371							
Convergence, Y/N Cap Service Time HCM Lane V/C Ratio		Yes 795 2.53 0.008	Yes 795 2.537 0.189	Yes 838 2.31 0.259	Yes 825 2.371 0.147							
Convergence, Y/N Cap Service Time HCM Lane V/C Ratio HCM Control Delay		Yes 795 2.53 0.008 7.6	Yes 795 2.537 0.189 8.6	Yes 838 2.31 0.259 8.8	Yes 825 2.371 0.147 8.1							
Departure Headway (Hd) Convergence, Y/N Cap Service Time HCM Lane V/C Ratio HCM Control Delay HCM Lane LOS HCM 95th-tile Q		Yes 795 2.53 0.008	Yes 795 2.537 0.189	Yes 838 2.31 0.259	Yes 825 2.371 0.147							

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Appendix C Intersection Performance Worksheets May 25, 2018

C.6 2036 ULTIMATE CONDITIONS



- None

6.42 6.22

5.42

800

EBT WBT WBR SBLn1

566 855

701 0.136

10.9

EBL EBT WBT WBR SBL SBR

49 137 151 37 41 49 137 151 37 41 5 0 0 5 5 Free Free Free Stop

None - None

100 100 100 100 100 100

2 2 2 2 2 2 49 137 151 37 41 54

| Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity | Vicinity

4.12

0.036

7.7

0.1

Intersection Int Delay, s/veh

Lane Configurations
Traffic Vol, veh/h
Future Vol, veh/h
Conflicting Peds, #/hr

RT Channelized

Heavy Vehicles, % Mvmt Flow

Major/Minor
Conflicting Flow All
Stage 1

Platoon blocked, %

Approach HCM Control Delay, s

Capacity (veh/h) HCM Lane V/C Ratio

HCM Control Delay (s)
HCM Lane LOS
HCM 95th %tile Q(veh)

HCM LOS Minor Lane/Major Mvmt

Critical Hdwy Stg 1
Critical Hdwy Stg 2
Follow-up Hdwy 2.218
Pot Cap-1 Maneuver Stage 1
Stage 2
Plateon blocked %

Mov Cap-1 Maneuver 1374
Mov Cap-2 Maneuver Stage 1 Stage 2 -

Stage 2 Critical Hdwy

Movement

2036 Ultimate

AM Peak Hour

Intersection Summ 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 wic Ratio: 0.76
Intersection Signal Delay 18.7
Intersection Signal Delay 18.7
Intersection (Intersection Capacity Utilization 87.0%
Analysis Period (min) 15 Intersection LOS: B ICU Level of Service E

Splits and Phases: 2: Existing Greenbank Road & Barnsdale Road A04 Ø6 (R)

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2036 Ultimate 2: Existing Greenbank Road & Barnsdale Road AM Peak Hour

	٠	→	*	—	4	†	>	ţ	
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									

Lanes, Volumes, Timings 3: Existing Greenbank Road & Kilbirnie Drive 2036 Ultimate AM Peak Hour

	•	→	•	•	←	•	4	†	-	-	ļ	4
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBF
Lane Configurations	*	7-		ሻ	7-		*	†	7	*	†	
Traffic Volume (vph)	142	6	182	66	6	107	74	333	11	29	312	6
Future Volume (vph)	142	6	182	66	6	107	74	333	11	29	312	6
Satd. Flow (prot)	1658	1449	0	1658	1455	0	1658	1745	1483	1658	1745	148
Flt Permitted	0.449			0.639			0.536			0.519		
Satd. Flow (perm)	777	1449	0	1106	1455	0	929	1745	1435	900	1745	143
Satd. Flow (RTOR)		182			107				75			7
Lane Group Flow (vph)	142	188	0	66	113	0	74	333	11	29	312	6
Turn Type	pm+pt	NA		Perm	NA		Perm	NA	Perm	Perm	NA	Pen
Protected Phases	7	4			8			2			6	
Permitted Phases	4			8			2		2	6		
Detector Phase	7	4		8	8		2	2	2	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
Minimum Split (s)	9.6	26.6		26.6	26.6		22.7	22.7	22.7	22.7	22.7	22
Total Split (s)	22.0	51.0		29.0	29.0		39.0	39.0	39.0	39.0	39.0	39
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.
All-Red Time (s)	1.3	1.3		1.3	1.3		1.0	1.0	1.0	1.0	1.0	1.
Lost Time Adjust (s)	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
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-Ma
Act Effct Green (s)	27.4	27.4		11.9	11.9		53.3	53.3	53.3	53.3	53.3	53
Actuated q/C Ratio	0.30	0.30		0.13	0.13		0.59	0.59	0.59	0.59	0.59	0.5
v/c Ratio	0.39	0.33		0.45	0.40		0.13	0.32	0.01	0.05	0.30	0.0
Control Delay	23.8	4.4		43.5	11.4		5.1	5.9	0.1	12.9	13.2	3
Queue Delay	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
LOS	C	A		D	В		A	A	A	В	В	
Approach Delay		12.8			23.3			5.6			11.6	
Approach LOS		В			С			A			В	

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

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

05/25/2018

√Îø2 (R)	- Ø4		
39 s	51 s		
₩ Ø6 (R)	≯ Ø7	₹ Ø8	
39 s	22 s	29 s	

05/25/2018

Synchro 9 Report

125

WB 1 SB 1 NB

1 11.9 B

1% 42% 19% 28% 70% 57% 61% 36%

 70%
 37%
 31%
 30%

 29%
 1%
 20%
 36%

 Stop
 Stop
 Stop
 Stop

 211
 297
 130
 140

 2
 125
 25
 39

 147
 168
 79
 50

 62
 4
 26
 51

 211
 297
 130
 140

 1
 1
 1
 1

211 297 130 140
1 1 1 1
0.3 0.426 0.189 0.204
5.115 5.167 5.237 5.238
Yes Yes Yes Yes
703 701 685 685
3.148 3.167 3.271 3.273
0.3 0.424 0.119 0.204
10.3 11.9 9.5 9.6
B B A A
1.3 2.1 0.7 0.8

Intersection
Intersection Delay, s/veh
Intersection LOS

Movement
Lane Configurations
Traffic Vol, veh/h
Future Vol, veh/h
Peak Hour Factor
Heavy Vehicles, %
Mvmt Flow
Number of Lanes

Approach
Opposing Approach
Opposing Lanes
Conflicting Approach Left
Conflicting Lanes Left
Conflicting Approach Right
Conflicting Lanes Right
HCM Control Delay
HCM LOS

Vol Thru, %
Vol Right, %
Sigin Control
Traffic Vol by Lane
LT Vol
Through Vol
RT Vol
Lane Flow Rate
Geometry Grp
Degree of Util (X)
Departure Headway (Hd)
Cap
Service Time
HCM Lane WC Ratio
HCM Control Delay
HCM Lane LOS
HCM 95ih-lile Q

Approach

Lane Vol Left, % Vol Thru, %

51

Synchro 9 Report

| Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | Column | C

SB

EB

10.3

147

	•	-	1	←	4	†	-	-	↓	4	
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											

05/25/2018

Lanes, Volumes, T 5: Existing Greenb		A & N	lew F-	W Coll	ector		2036 Ultimate AM Peak Hour
J. Existing Greens	Je Je Je Je Je Je Je Je Je Je Je Je Je J	*	₹\	†	ţ	4	7WT CUX TOUR
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	
Lane Configurations	ሻ	7	*	*	1		
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 q/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	В	A	A	A		
Approach Delay	23.3			4.5	4.3		
Approach LOS	С			Α	Α		
Intersection Summary							
Cycle Length: 90							
Actuated Cycle Length: 90							
Offset: 89 (99%), Reference	ed to phase	2:NBTL	and 6:SB	T, Start o	of Green		
Natural Cycle: 60	- '						
Control Type: Actuated-Co	ordinated						
Maximum v/c Ratio: 0.49							
Intersection Signal Delay: 8	3.2			li li	ntersection	LOS: A	
Intersection Capacity Utiliza				10	CU Level	of Service B	
Analysis Period (min) 15							

Splits and Phases:	5: Existing Greenbank Road & New E-W Collector	
¶ Ø2 (R)	•	₹ Ø4
64 s		26 s
Ø6 (R)		
64 s		

Queues 5: Existing Greenba	ank Roa	d & N	ew E-\	N Colle	ector	2036 Ultimate AM Peak Hot
-	۶	•	4	†		
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						

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179

NBLn1 EBLn1 WBLn1 SBLn 0% 33% 43% 67%

21 269 88 68 1 1 1 0.026 0.316 0.106 0.088 4.475 4.223 4.325 4.644 Yes Yes Yes Yes 803 839 832 75 2.485 2.317 2.335 2.65 0.026 0.321 0.106 0.088 7.6 9.3 7.8 8.1 A A A A 0.1 1.4 0.4 0.3

18% 59%

WB

Intersection Delay, s/veh Intersection LOS

Movement
Lane Configurations
Traffic Vol, veh/h
Future Vol, veh/h

Peak Hour Factor Heavy Vehicles, % Mvmt Flow Number of Lanes

Approach
Opposing Approach
Opposing Lanes
Conflicting Approach Left
Conflicting Lanes Left
Conflicting Approach Right
Conflicting Lanes Right
HCM Control Delay
HCM LOS

Vol Thru, %
Vol Right, %
Sign Control
Traffic Vol by Lane
LT Vol
Through Vol
RT Vol
Lane Flow Rate
Geometry Grp
Degree of Util (X)
Departure Headway (Hd)
Cap
Service Time
HCM Lane WC Ratio
HCM Control Delay
HCM Lane LOS
HCM 95in-Ilie Q

05/25/2018

Lane Vol Left, % Vol Thru, %

Intersection						
Int Delay, s/veh	3.3					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		4	1>		*y*	
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	e,# -	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	1	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	-		Ū		В	
Mineral and Males Marin		EDI	EDT	WDT	WDD	CDI -1
Minor Lane/Major Mvn	11	1292	EBT	WBT	WBR	SBLn1
Capacity (veh/h)						682
HCM Cantrol Doloy (c)		0.036 7.9	0			0.194
HCM Control Delay (s)			U			
		Λ	Α.			
HCM Lane LOS HCM 95th %tile Q(veh	`	0.1	A	-	-	0.7

05/25/2018 Synchro 9 Report

Lanes, Volumes, Timings roadala Daad 2036 Ultimate

Synchro 9 Report

2036 Ultimate

AM Peak Hour

24

2: Existing Greenb	ank Ro	ad & Ba	arnsda	ale Ro	ad						PM Pea	ık Hour
	٠	-	*	•	←	4	4	†	1	/	↓	1
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	Ť	î,		ሻ	4		ሻ	4		٦	4	
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	В			С		С	С		С	В	
Approach Delay		21.5			22.4			21.8			22.2	
Approach LOS		С			С			С			С	
Intersection Summary												

Intersection Summary
Cycle Length: 90
Olfset: 41 (46%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycles: 0
Control Type: Actuated-Coordinated
Maximum vic Ratio: 0.86
Intersection Signal Delay 22.1
Intersection Intersection (annex) University 150
Analysis Perfod (min) 15

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

Ø2 (R)	→ Ø4
30 s	60 s
₩ Ø6 (R)	₹ Ø8
30 s	60 s

2: Existing Greenbank Road & Barnsdale Road

2036 Ultimate PM Peak Hour

					_		
	٠	→	←	4	†	-	ļ
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.

05/25/2018 Synchro 9 Report 05/25/2018 Synchro 9 Report 2036 Ultimate PM Peak Hour Queues
3: Existing Greenhank Road & Kilbirnia Drive

2036 Ultimate PM Peak Hour

3. Existing Greenba	IIIK INU	au & Ni	IDITTIE	Dilve							FINI F Cak HU
	۶	→	•	←	4	†	1	-	↓	4	
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											

4 ļ Lane Group
Lane Configurations
Traffic Volume (vph)
Future Volume (vph)
Satd. Flow (prot)
FIT Permitted
State Flow (porm) EBT EBR SBR 93 2 93 2 1658 1443 0.714 61 213 61 213 0 1658 0.494 379 66 89 431 150 379 66 89 431 150 1745 1483 1658 1745 1483 0.527 130 23 5 0 1658 1461 0.595 Fit Permitted
Satd. Flow (perm)
Satd. Flow (RTOR)
Lane Group Flow (vph)
Turn Type
Protected Phases
Permitted Phases
Detector Phase
Switch Phases 0.494 0.527 0 857 1745 1435 914 1745 1435 66 150 1234 1443 0 1030 1461 132 NA 4 431 NA 6 93 Perm 0 23 Perm 0 213 Perm 89 Perm 4 Detector Phase
Switch Phase
Minimum Initial (s)
Minimum Split (s)
Total Split (s)
Total Split (s)
Yellow Time (s)
All-Red Time (s)
Lost Time Adjust (s)
Total Lost Time (s)
Leadli ac 5.0 5.0 26.6 26.6 32.0 32.0 35.6% 35.6% 3.3 3.3 1.3 1.3
 5.0
 5.0
 5.0
 5.0

 22.7
 22.7
 22.7
 22.7

 58.0
 58.0
 58.0
 58.0

 64.4%
 64.4%
 64.4%
 64.4%
 64.4%
 5.0 5.0 26.6 26.6 32.0 32.0 35.6% 35.6% 3.3 3.3 1.3 1.3 3.7 3.7 1.0 1.0 3.7 3.7 1.0 1.0 0.0 4.6 0.0 4.6 0.0 4.6 0.0 4.6 0.0 4.7 0.0 4.7 0.0 4.7 0.0 4.7 0.0 4.7 0.0 4.7 Lead/Lag Lead-Lag Optimize? Recall Mode Act Effct Green (s) Actuated g/C Ratio
 C-Max
 C-Max
 C-Max
 C-Max
 C-Max
 C-Max

 67.7
 67.7
 67.7
 67.7
 67.7
 67.7

 0.75
 0.75
 0.75
 0.75
 0.75
 0.75
 None None 13.0 13.0 0.14 0.14 None None 13.0 13.0 0.14 0.14 v/c Ratio
Control Delay
Queue Delay
Total Delay
LOS
Approach Delay
Approach LOS 0.53 0.42 44.6 10.0 0.16 0.25 33.0 11.8 0.29 0.06 0.0 0.0 44.6 10.0 D B 0.0 0.0 33.0 11.8 17.2 Intersection Summar

Intersection Summary
Cycle Length: 90
Actuated Cycle Length: 90
Olfset: 11 (12%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 0
Statural Cycle: 0
Intersection Signal Delay 7. 7
Intersection Signal Delay 7. 7
Intersection Signal Cycle: 0
Analysis Period (min) 15

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

Spiris and Fridaics. S. Existing Greenbank Road & Ribinie Drive	
∮Ø2 (R)	^ Ø4
58 s	32 s
\$\psi \pi \pi \pi \pi \pi \pi \pi \pi \pi \p	∜ Ø8
58 s	32 s

05/25/2018 Synchro 9 Report

05/25/2018 Synchro 9 Report

HCM 2010 AWSC 4: River Mist Road & Kilbirnie Drive 2036 Ultimate PM Peak Hour

Intersection												
Intersection Delay, s/veh	12.5											
Intersection LOS	В											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		4			4			4			4	
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	В			В				В		В		
Lane		NRI n1	FRI n1	WRI n1	SRI n1							

I ICIVI EUS	ь		ь		ь	ь
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	В	В	В	В		
HCM 95th-tile Q	0.7	1.8	2.3	2.6		

Lanes, Volumes, Timings 5: Existing Greenbank Road & New E-W Collector 2036 Ultimate PM Peak Hour

Lane Group EBL EBR NBL NBT SBT SBR	
Traffic Volume (yph) 51 85 152 664 509 95 Future Volume (yph) 51 85 152 664 509 95 Sald Flow (prot) 1658 1483 1658 1745 1708 0 FIT Permitted 0.950 0.414 Sald Flow (prot) 1658 1483 722 1745 1708 0 Sald Flow (prot) 1558 185 152 664 604 0 Sald Flow (prot) 151 85 152 664 604 0 Turn Type Prot Perm Perm NA NA Protected Phases 4 2 6 Permitted Phases 4 2 2 6 Permitted Phases 4 2 2 6 Permitted Phases 4 2 2 6 Permitted Phases 4 2 2 6 Permitted Phases 4 2 2 6 Permitted Phases 4 2 2 6 Permitted Phases 4 2 2 6 Permitted Phases 4 2 2 6 Permitted Phases 4 4 2 2 2 6 Permitted Phases 4 4 2 2 2 6 Permitted Phases 4 4 6 2 2 6 Permitted Phases 4 6 8 2 8 0 8 0 8 0 8 0 8 0 8 0 8 0 8 0 8 0	
Future Volume (vph)	
Sald, Flow (pord)	
Fil Permitted	
Sald. Flow (perm) 1658 1483 722 1745 1708 0 Sald. Flow (PTOR) 85 20 Lane Group Flow (vph) 51 85 152 664 604 0 Furn Type Prot Perm Perm NA NA Proflected Phases 4 2 6 Permitted Phases 4 4 2 2 Permitted Phases 4 4 2 2 6 6 Switch Phase 4 4 2 2 6 6 Switch Phase 4 4 2 2 2 6 Switch Phase 4 4 2 2 2 6 Switch Phase 4 4 2 2 2 6 Switch Phase 6 2 2 8 0 28 0 28 0 28 0 28 0 28 0 28 0	
Satid Flow (RTOR) Lane Group Flow (vph) 51 85 152 664 604 0 Furn Type Profite Ledd Phases 4 2 6 Permitted Phases 4 2 Defector Phase 4 4 2 Defector Phase With Pha	
Lane Group Flow (ph)	
Turn Type Profected Phases 4 2 2 6 Permitted Phases 4 4 2 2 6 Permitted Phases 4 4 2 2 6 Permitted Phases 4 4 2 2 6 Which Phase Which Phas	
Protected Phases 4 2 2 6 Permitted Phases 4 4 2 2 Detector Phase 4 4 2 2 2 6 Switch Phase 6 Which Phase 1 White Ph	
Permitted Phases	
Delector Phase Minimum Initial (s) 50 50 50 50 50 50 50 50 50 5	
Switch Phase Minimum Initial (s)	
Milinium Initial (s) 5.0 5.0 5.0 5.0 5.0 5.0 5.0 Milinium Initial (s) 28.0 28.0 28.0 28.0 28.0 28.0 28.0 7.0 Total Split (s) 28.0 28.0 28.0 62.0 62.0 62.0 62.0 Total Split (s) 31.1% 31.1% 68.9% 68.9% 69.9% Total Split (s) 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 Total Lost Time (s) 4.3 4.3 5.6 5.6 5.6 Lead-Lag Optimize? Recall Mode	
Minimum Spilt (s) 28.0	
Total Split (s)	
Total Split (\$) 28.0 28.0 62.0 62.0 62.0 62.0 Total Split (\$) 31.9 31.9 68.9 68.9 68.9 68.9 59. Yellow Time (\$) 3.3 3.3 3.4 6 4.6 4.6 4.6 All-Red Time (\$) 1.0 1.0 1.0 1.0 1.0 1.0 1.0 Incost Time Aghust (\$) 0.0 0.0 0.0 0.0 0.0 Total Lost Time (\$) 4.3 4.3 5.6 5.6 5.6 Lead-Lag Optimize? Recall Mode	
Total Spili (%) 31.1% 31.1% 68.9% 69	
Vellow Time (s)	
All-Red Time (s)	
Lost Time (Adjust (s)	
Total Lost Time (s)	
LeadLag Oplimize? Recall Mode None Rome C-Max C-Max C-Max Act Effict Green (s) 9.6 9.6 73.6 73.6 73.6 Act Effict Green (s) 9.6 9.6 73.6 73.6 73.6 Act Effict Green (s) 9.6 9.6 73.6 73.6 73.6 Act Effict Green (s) 9.6 9.6 73.6 73.6 73.6 Act Effict Green (s) 9.6 9.6 73.6 73.6 73.6 Control Delay 0.2 0.2 0.2 0.2 0.2 Control Delay 39.2 12.4 3.2 3.7 4.1 Cueue Delay 0.0 0.0 0.0 0.0 0.0 0.0 Total Delay 39.2 12.4 3.2 3.7 4.1 LOS 0 B B A A A A A A A A A A A A A A A A A	
Lead-Lag Oplimize? Recall Mode None None C-Max C-Max C-Max Act Effct Green (s) 9.6 9.6 73.6 73.6 73.6 73.6 Act Lated gic Ratio 0.11 0.11 0.82 0.82 0.82 0.82 0.82 0.82 0.82 0.82	
Recall Mode None None C-Max C-Max C-Max C-Max ACLETIC Green (S) 9.6 9.6 73.6 73.6 73.6 73.6 73.6 Recall Mode None Recall Mode None Recall Mode Not Not Not Not Not Not Not Not Not Not	
Act Effect 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 0.82 0.82 0.82 0.82 0.82	
Actuated gC Ratio 0.11 0.11 0.82 0.82 0.82 0.82 0.02 0.02 0.29 0.36 0.26 0.26 0.47 0.43 0.00 0.29 0.36 0.26 0.47 0.43 0.00 0.00 0.0 0.0 0.0 0.0 0.0 0.0 0.0	
\(\text{Nc Ratio} \) 0.29 \ 0.36 \ 0.26 \ 0.47 \ 0.43 \) \(\text{Control Delay} \) 39.2 \ 12.4 \ 3.2 \ 3.7 \ 4.1 \) \(\text{Ducue Delay} \) 0.0 \ 0.0 \ 0.0 \ 0.0 \ 0.0 \) \(\text{Total Delay} \) 39.2 \ 12.4 \ 3.2 \ 3.7 \ 4.1 \) \(\text{LOS} \) D \(\text{B} \) A \(\text{A} \) A \(\text{Approach Delay} \) 22.5 \(\text{B} \) 3.6 \(\text{A} \) 1.4 \(\text{Approach Delay} \) 22.5 \(\text{A} \) 3.6 \(\text{A} \) 1.4 \(\text{Approach Delay} \) 22.5 \(\text{A} \) 3.6 \(\text{A} \) 1.4 \(\text{Approach Delay} \) 20.5 \(\text{C} \) A \(\text{A} \) A \(\text{Intersection Summary} \) \(\text{Cycle Length: 90} \) \(\text{Offiset B (9%)}, Referenced to phase 2:NBTL and 6:SBT, Start of Green \) \(\text{Natural Cycle: 60} \) \(\text{Control Type: Actualed-Coordinated Maximum vic Ratio: 0.47 \) \(\text{Maximum vic Ratio: 0.47 \) \(\text{Intersection Signal Delay: 5.5 \) \(\text{Intersection LOS: A} \)	
Control Delay 39.2 12.4 3.2 3.7 4.1 Dueue Delay 0.0 0.0 0.0 0.0 0.0 0.0 Intersection Summary Cycle Length: 90 Control Type: Actuated-Coordinated Maximum Vic Ratio. 47 Maximar Cycle St. St. St. St. St. St. St. St. St. St.	
Dueue Delay 0.0 0.0 0.0 0.0 0.0 0.0 1.0 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 Dost C A A A Approach Delay 22.5 3.6 4.1 Approach Delay 22.5 1.6 1.2 C B A A A A A A A A A A A A A A	
LOS D B A A A A A A A A A A A A A A A A A A	
Approach Delay 22.5 3.6 4.1 Approach LOS C A A A Intersection Summary Cycle Length: 90 Actualed Cycle Length: 90 Offset: 8 (9%), Referenced to phase 2:NBTL and 6:SBT, Start of Green Natural Cycle: 60 Control Type: Actualed-Coordinated Maximum Vic Ratio: 0.47 Intersection Signal Delay: 5.5 Intersection LOS: A	
Approach LOS C A A Intersection Summary Cycle Length: 90 Actuated Cycle Length: 90 Actuated Cycle Length: 90 Offset 8 (9%), Referenced to phase 2:NBTL and 6:SBT, Start of Green Natural Cycle: 00 Control Type: Actuated-Coordinated Maximum Vic Ratio: 0.47 Intersection Signal Delay: 5.5 Intersection LOS: A	
Cycle Length: 90 Actualed Cycle Length: 90 Offset: 8 (%), Referenced to phase 2:NBTL and 6:SBT, Start of Green Valurad Cycle: 40 Control Type: Actualed-Coordinated Maximum Vic Ratio: 0.47 Intersection Signal Delay: 5.5 Intersection LOS: A	
Acfualed Cycle Length: 90 Offiset 8 (9%), Referenced to phase 2:NBTL and 6:SBT, Start of Green Natural Cycle: 60 Control Type: Actualed-Coordinated Maximum vic Ratio: 0.47 Intersection Signal Delay: 5.5 Intersection LOS: A	
Acfualed Cycle Length: 90 Offiset 8 (9%), Referenced to phase 2:NBTL and 6:SBT, Start of Green Natural Cycle: 60 Control Type: Actualed-Coordinated Maximum vic Ratio: 0.47 Intersection Signal Delay: 5.5 Intersection LOS: A	
Offiset 8 (9%), Referenced to phase 2:NBTL and 6:SBT, Start of Green Natural Cycle: 60 Control Type: Actuated-Coordinated Maximum Vic Ratio: 0.47 Intersection Signal Delay: 5.5 Intersection LOS: A	
Natural Cycle: 60 Control Type: Actualed-Coordinated Maximum viR Ratio: 0.47 ntersection Signal Delay: 5.5 Intersection LOS: A	
Control Type: Actuated-Coordinated Maximum vic Ratio: 0.47 flersection Signal Delay: 5.5 Intersection LOS: A	
Maximum v/c Ratio: 0.47 Intersection Signal Delay: 5.5 Intersection LOS: A	
Intersection Signal Delay: 5.5 Intersection LOS: A	
ICU Level of Service B	
Analysis Period (min) 15	

	۶	•	4	†	↓
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 percent	ile aueue i:	s metere	d by upst	ream sign	al.
			, ,	- 3	

Intersection Intersection Delay, s/veh	8.6											
Intersection LOS	Α.											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SB
Lane Configurations		4			4			4			4	
Traffic Vol, veh/h	51	99	0	3	179	35	0	2	4	27	2	9
Future Vol, veh/h	51	99	0	3	179	35	0	2	4	27	2	9
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	1.0
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	
Mvmt Flow	51	99	0	3	179	35	0	2	4	27	2	9
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	
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	Α			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							
raπic Vol by Lane		6	150	217	121							
Traffic Vol by Lane LT Vol		6		3								
LT Vol		0	150 51 99	3 179	121 27 2							
LT Vol Through Vol RT Vol		0	150 51 99 0	3 179 35	121 27 2 92							
LT Vol Through Vol RT Vol Lane Flow Rate		0 2 4 6	150 51 99 0 150	3 179 35 217	121 27 2 92 121							
LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp		0 2 4 6	150 51 99 0 150	3 179 35 217	121 27 2 92 121							
LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X)		0 2 4 6	150 51 99 0 150 1 0.188	3 179 35 217 1 0.259	121 27 2 92 121 1 0.146							
LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X)		0 2 4 6	150 51 99 0 150	3 179 35 217	121 27 2 92 121							
LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, Y/N		0 2 4 6 1 0.008 4.5 Yes	150 51 99 0 150 1 0.188 4.514 Yes	3 179 35 217 1 0.259 4.289 Yes	121 27 2 92 121 1 0.146 4.348 Yes							
LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, Y/N Cap		0 2 4 6 1 0.008 4.5 Yes 795	150 51 99 0 150 1 0.188 4.514 Yes 795	3 179 35 217 1 0.259 4.289 Yes 838	121 27 2 92 121 1 0.146 4.348 Yes 825							
LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, Y/N Cap		0 2 4 6 1 0.008 4.5 Yes 795 2.53	150 51 99 0 150 1 0.188 4.514 Yes 795 2.537	3 179 35 217 1 0.259 4.289 Yes 838 2.31	121 27 2 92 121 1 0.146 4.348 Yes							
LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, Y/N Cap Service Time		0 2 4 6 1 0.008 4.5 Yes 795	150 51 99 0 150 1 0.188 4.514 Yes 795	3 179 35 217 1 0.259 4.289 Yes 838 2.31 0.259	121 27 2 92 121 1 0.146 4.348 Yes 825							
LT Vol Through Vol RT Vol Lane Flow Rate Geometry Grp Degree of Util (X) Departure Headway (Hd) Convergence, Y/N Cap Service Time HCM Lane V/C Ratio		0 2 4 6 1 0.008 4.5 Yes 795 2.53	150 51 99 0 150 1 0.188 4.514 Yes 795 2.537	3 179 35 217 1 0.259 4.289 Yes 838 2.31	121 27 2 92 121 1 0.146 4.348 Yes 825 2.371							
		0 2 4 6 1 0.008 4.5 Yes 795 2.53 0.008	150 51 99 0 150 1 0.188 4.514 Yes 795 2.537 0.189	3 179 35 217 1 0.259 4.289 Yes 838 2.31 0.259	121 27 2 92 121 1 0.146 4.348 Yes 825 2.371 0.147							

05/25/2018 Synchro 9 Report 05/25/2018 Synchro 9 Report

Appendix D Intersection Control Warrants May 25, 2018

APPENDIX D INTERSECTION CONTROL WARRANTS



Appendix D Intersection Control Warrants May 25, 2018

D.1 MULTIWAY STOP-CONTROL WARRANT ANALYSIS



Multi-Way Stop Control Warrant Analysis Urban Arterial

INTERSECTION:

Existing Greenbank Road at Kilbirnie Drive - 2025 FBG

DAT	E OF COUNT USED: 9-Nov	-17	LENGTH OF S	STUDY IN hou	rs:	8
	NUMBER OF LEGS: 4					
Criteria:	<u></u>					
Volume:	Total vehicle volume for all a over heaviest 8-hour period (Total minor street volume (in exceeds 200 each hour over OR	between 7am and 6 cluding pedestrians same 8-hr period	om) crossing the m	ajor)	AND	
Collision:	Where an avg of 3 or more of (I.e. right angle) has occurred OR		preventable by	y all-way stop c	ontrols	
Visibility:	Where the sight distance from 55m to the left 60m from the right	m a point 2.7m from	the edge of the	e major street is	s less than	
	Total Vol	Veh Vol	Ped Vol	Total Minor		
all	approaches	from Minor	Xing Major	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%	ļ
Hour 6	1218 100%	260		260	100%]
Hour 7	1285 100%	260		260	100%	ļ
Hour 8	1328 100%	240		240	100%	
Total Volume	Warrant 100.0%	Minor Approac	ch Warrant:	100.0%		
	Volume Criteria M	let :		YES		
	Percent Volume C			100.0%		
Directional Split:	(Four-Legged 65/35) (Three-Legged 75/25)	Criteria Met: (Y Criteria Met: (Y 1083.25	•	27%	No N/A	
Collision Data:						
Total number	er of preventable collisions in p	oast 3 years		1	No	
Visibility:						
Is visibility re	estricted at this intersection? (yes/no)		I	N	l
Comments:						

Appendix D Intersection Control Warrants May 25, 2018

D.2 TRAFFIC SIGNAL WARRANT ANALYSIS



What are the intersecting roadw What is the direction of the Main Justification 1 - 4: Volum a Number of lanes on the Main b Number of lanes on the Min c How many approaches?								
Justification 1 - 4: Volur a Number of lanes on the Mai b Number of lanes on the Min c How many approaches?								
a Number of lanes on the Maib Number of lanes on the Minc How many approaches?								
b Number of lanes on the Min c How many approaches?								
b Number of lanes on the Min								
c How many approaches?								
-l AMIt is the semanation and in-								
d What is the operating environment?								
NATI (1. 41 - 1.14)								
e What is the eight hour vehic								
Main Northbo								
Hour Ending LT T								
8:00 60 3								
8:00 60 3 9:00 68 3								
9:00 68 3 10:00 63 3								
9:00 68 3 10:00 63 3 12:30 43 3								
9:00 68 3 10:00 63 3 12:30 43 3 13:30 61 1								
9:00 68 3 10:00 63 3 12:30 43 3 13:30 61 1 16:00 153 2								
9:00 68 3 10:00 63 3 12:30 43 3 13:30 61 1 16:00 153 2								

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.

	Zor	Zone 1		ne 2	Zone 3 (i	f needed)	Zone 4 (i	f needed)	Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Total
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Factored 8 hour pedestrian volume	()	0		0		0		
% Assigned to crossing rate	10	0%	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.

	Zor	Zone 1		ne 2	Zone 3 (i	f needed)	Zone 4 (i	if needed)	Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	TOtal
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		
% Assigned to Crossing Rate	100	0%	50%		0%		0%		
Net 8 Hour Volume of Total Pedestrians									0
Net 8 Hour Volume of Delayed Pedestrians								0	

Justification 1: Minimum Vehicle Volumes

Restricted Flow Urban Conditions

Justification	Gu	ıidance Ap	proach Lane	es		Percentage Warrant							Total	Section
bustineation	1 La	nes	2 or Mor	e Lanes	Hour Ending							Across	Percent	
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		
I IA	COMPLIANCE %			100	100	100	100	100	100	100	100	800	100	
48	120	170	120	170	466	479	291	241	201	328	334	296		
1B		COMPL	IANCE %		100	100	100	100	100	100	100	100	800	100
	Restricted Flow Signal Justification 1:													

Justification 2: Delay to Cross Traffic

Restricted Flow Urban Conditions

Justification	Gu	uidance Ap	proach Lan	es		Percentage Warrant							Total	Section
Justinication	1 lanes 2 or More lanes			re lanes		Hour Ending						Across	Percent	
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		
ZA	COMPLIANCE %			95	84	76	82	78	100	100	100	716	89	
2B	50	75	50	75	191	207	126	114	86	125	111	117		
26	COMPLIANCE %			100	100	100	100	100	100	100	100	800	100	
Restricted Flow Signal Justification 2:				_					▽					

Justification 3: Combination

Combination Justification 1 and 2

	Justification Satisfied 80% or Mo		ifications 0% or More		
Justification 1	Minimum Vehicle Volume	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) X	Heaviest Minor Approach Y (actual)	Required Value Y (warrant threshold)	Average % Compliance	Overall % Compliance
	8:00	859	307	250	100 %	
Justification 4	16:00	1,089	249	166	100 %	100.9/
Justification 4	17:00	1,156	252	148	100 %	100 %
	18:00	1,229	207	131	100 %	

Justification 5: Collision Experience

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

Justification 6: Pedestrian Volume

Pedestrian Volume Analysis

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

Pedestrian Delay Analysis

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

Results	Sheet	<u>Input Sheet</u> Analy	rsis Sheet	Propo	osed Collision GO TO Justification:				
Intersection: Existing Greenbank Road and Kilbirnie Drive 2031 - FCount Date: Predicted									
Summary Results									
	Justification	Compliance	Signal .	Justified?					
·		Compilation	YES	NO					
1. Minimum Vehicular	A Total Volume	100 %							
Volume	B Crossing Volume	100 %							
2. Delay to Cross	A Main Road	89 %		V					
Traffic	B Crossing Road	100 %		-					
3. Combination	A Justificaton 1	100 %							
	B Justification 2	89 %							
4. 4-Hr Volume		100 %	~						
5. Collision Expe	erience	7 %		V					

~

Justification not met

6. Pedestrians

A Volume

B Delay

Input Dat	ta She	et		Analysis	Sheet	Results	Sheet	Proposed	d Collision		O Justificati	ion:	
What are the in	tersecting i	roadways?	Ex	ietinėtinė en	eembankdR	and valend page	we Gollectorz	ō3W-2D3tái+i	Total Futur	е			_
What is the dire	ection of the	e Main Road	d street?	Nor	th-South	•	When was t	he data colle	ected?	Predicted	Predicted		
Justification	า 1 - 4: V	olume W	arrants										
a Number of	lanes on th	e Main Road	d?	1	•								
b Number of	lanes on th	e Minor Roa	ad?	1	-								
	annraachae	s? 3	•										
c How many	approacries	·											
c How many d What is the		,	 t?	Urban	•	Popula	tion >= 10,000	AND	Speed < 70	km/hr			
d What is the	operating	environmen						AND	Speed < 70	km/hr			
d What is the	operating eight hour	environmen	ıme at the i	ntersection?		ll in table be	elow)	AND uthbound Ap			estbound A	\pproach	Pedestrians
d What is the	operating eight hour	environment	ıme at the i	ntersection?	(Please fi	ll in table be	elow)				estbound A	Approach RT	Pedestrians Crossing Main Road
d What is the	operating of eight hour Main No	environment vehicle volu	ume at the i	ntersection? Minor Ea	(Please fi astbound A TH	ll in table be	elow) Main Sou	uthbound Ap	proach RT	Minor W	<u>.</u>		Crossing Main
d What is the e What is the Hour Ending	operating of eight hour	environment vehicle volu orthbound A	ume at the i	ntersection?	(Please fi	ll in table be pproach RT	elow) Main Sou LT	uthbound Ap	pproach	Minor W	TH	RT	Crossing Main Road
d What is the e What is the Hour Ending 8:00	operating of eight hour Main No LT 35	environment vehicle volu orthbound A TH 409	pproach RT	Minor Ea	(Please fi astbound A TH	Il in table be pproach RT 116	Main Sou LT 0	uthbound Ap TH 603	proach RT 18	Minor W	TH 0	RT 0	Crossing Main Road
d What is the Hour Ending 8:00 9:00	eight hour Main No LT 35 39	environment vehicle volu orthbound A TH 409 313	pproach RT 0 0	Minor Ea LT 71 80	(Please fi astbound A TH 0	pproach RT 116 101	Main Sou LT 0 0	uthbound Ap TH 603 520	pproach RT 18 28	Minor W LT 0 0	TH 0 0	RT 0 0	Crossing Main Road 0
d What is the Hour Ending 8:00 9:00 10:00	operating eight hour Main No LT 35 39 36	environment vehicle volu orthbound A TH 409 313 354	pproach RT 0 0 0	Minor Ea LT 71 80 60	(Please fi astbound A TH 0 0	pproach RT 116 101 81	Main Sou LT 0 0	thbound Ap TH 603 520 384	oproach RT 18 28 17	Minor W LT 0 0 0	TH 0 0 0 0	RT 0 0 0	Crossing Main Road 0 0 0
d What is the Hour Ending 8:00 9:00 10:00 12:30	operating of eight hour Main No LT 35 39 36 25	environment vehicle volu orthbound A TH 409 313 354 398	pproach RT 0 0 0 0	Minor Ea LT 71 80 60 54	(Please fi astbound A TH 0 0 0	pproach RT 116 101 81 55	Main Sou LT 0 0 0	uthbound Ap TH 603 520 384 425	pproach RT 18 28 17 16	Minor W LT 0 0 0 0	TH 0 0 0 0 0 0	RT 0 0 0 0 0	Crossing Main Road 0 0 0 0
d What is the e What is the Hour Ending 8:00 9:00 10:00 12:30 13:30	eight hour Main No LT 35 39 36 25 31	environment vehicle volu orthbound A TH 409 313 354 398 301	pproach RT 0 0 0 0 0	Minor Ea LT 71 80 60 54 31	(Please fi	pproach RT 116 101 81 55 33	Main Sou LT 0 0 0 0	uthbound Ap TH 603 520 384 425 401	pproach RT 18 28 17 16 42	Minor W LT 0 0 0 0 0	TH 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	RT 0 0 0 0 0 0 0 0	Crossing Main Road 0 0 0 0 0
d What is the e What is the Hour Ending 8:00 9:00 10:00 12:30 13:30 16:00	eight hour Main No LT 35 39 36 25 31 77	environment vehicle volu prthbound A TH 409 313 354 398 301 492	pproach RT 0 0 0 0 0 0 0	Minor Ea LT 71 80 60 54 31 42	(Please find astbound A TH 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	pproach RT 116 101 81 55 33 67	Main Sou LT 0 0 0 0	Jthbound Ap TH 603 520 384 425 401 521	proach RT 18 28 17 16 42 56	Minor W LT 0 0 0 0 0 0 0	TH 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	RT 0 0 0 0 0 0 0 0	Crossing Main Road 0 0 0 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.

	Zor	ne 1	Zo	ne 2	Zone 3 (i	f needed)	Zone 4 (i	f needed)	Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	lotai
Total 8 hour pedestrian volume	0	0	0	0	0	0	0	0	
Factored 8 hour pedestrian volume	()		0	()		0	
% Assigned to crossing rate	10	0%	50	0%	0	%	0	%	
Net 8 Hour Pedestrian Volume at Cros	sing			-					0
Net 8 Hour Vehicular Volume on Stree	t Being Cros	sed							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.

	Zor	ne 1	Zo	ne 2	Zone 3 (i	f needed)	Zone 4 (i	if needed)	Total
	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	Assisted	Unassisted	TOTAL
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	
Factored volume of delayed pedestrians	()		0		0		0	
% Assigned to Crossing Rate	100	0%	50	0%	0	%	С)%	
Net 8 Hour Volume of Total Pedestrian	s								0
Net 8 Hour Volume of Delayed Pedestr	ians								0

Justification 1: Minimum Vehicle Volumes

Restricted Flow Urban Conditions

Justification	Gu	idance Ap	proach Lane	es				Percentage	Warrant				Total	Section
Justinication	1 La	nes	2 or Mor	e Lanes				Hour Er	ding				Across	Percent
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		
		COMPL	IANCE %		100	100	100	100	100	100	100	100	800	100
1B	180	255	180	255	187	181	141	109	64	109	114	94		
16		COMPL	IANCE %		73	71	55	43	25	43	45	37	392	49
		icted Flo			Both 1A and 1 Lesser of 1A o				urs	Yes Yes		No No	>	

Justification 2: Delay to Cross Traffic

Restricted Flow Urban Conditions

Justification	Gu	ıidance Ap	proach Lan	es				Percentage	Warrant				Total	Section
Justinication	1 la	nes	2 or Mo	re lanes				Hour Er	ding				Across	Percent
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		
ZA		COMPL	IANCE %		100	100	100	100	100	100	100	100	800	100
2B	50	75	50	75	71	80	60	54	31	42	39	42		
26		COMPL	IANCE %		95	100	80	72	41	56	52	56	552	69
		icted Flo			Both 2A and 2B Lesser of 2A o				urs				ママ	

Justification 3: Combination

Combination Justification 1 and 2

	Justification Satisfied 80% or Mo	re			ifications 0% 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) X	Heaviest Minor Approach Y (actual)	Required Value Y (warrant threshold)	Average % Compliance	Overall % Compliance
	8:00	1,065	187	90	100 %	
Justification 4	16:00	1,146	109	78	100 %	100.9/
Justification 4	17:00	1,236	114	80	100 %	100 %
	18:00	1,241	94	80	100 %	

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

Justification 5: Collision Experience

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

Justification 6: Pedestrian Volume

Pedestrian Volume Analysis

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

Pedestrian Delay Analysis

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

Results	Sheet	<u>Input Sheet</u> Analysis	Sheet	Propo
Intersection: E	Existing Greenbank Road a	nd New Collector E-W 20 Count Date	: Predicted	
Summary F	Results			
	Justification	Compliance	Signal J	ustified?
			YES	NO
1. Minimum Vehicular	A Total Volume	100 %		~
Volume	B Crossing Volume	49 %		
2. Delay to Cross	A Main Road	100 %	П	~
Traffic	B Crossing Road	69 %		
3. Combination	A Justificaton 1	49 %		~
	B Justification 2	69 %		1*
4. 4-Hr Volume		100 %	~	
5. Collision Expo	erience	7 %		V

~

Justification not met

Justification not met

6. Pedestrians

A Volume

B Delay