Barrhaven South Urban Expansion Study Area Community Design Plan

FINAL Transportation Master Study

Ottawa, Ontario

Prepared for: Minto Communities

Prepared by: Stantec Consulting Ltd.

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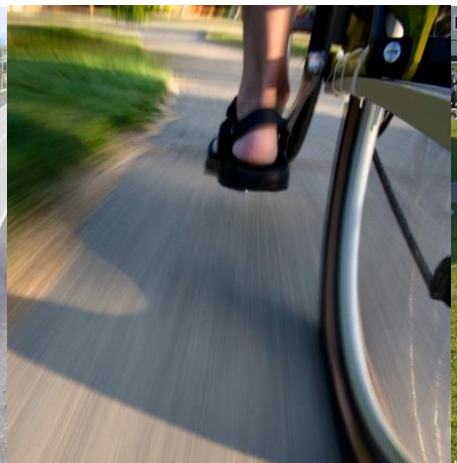

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1.0 INTRODUCTION

1.1 PURPOSE AND OBJECTIVES

This Transportation Master Study (TMS) was prepared in support of the Barrhaven South Urban Expansion Study Area Community Design Plan (the CDP) which was initiated by a landowner group comprised of Minto Communities and Mattamy Homes. The CDP provides guidelines for future development with regard to land use designations and density targets and identities infrastructure needs required to support it. The CDP provides an overall vision for the Barrhaven South Expansion Study Area as an extension of the existing Barrhaven South community.

As part of the Class Environmental Assessment process, an integrated approach is being undertaken in order to integrate the approvals under the province's *Environmental Assessment Act* and the *Planning Act*. The TMS is intended to support the CDP and provide direction regarding the transportation network within the study area.

1.2 APPROVED TERMS OF REFERENCE

The Class EA process recognizes the benefits of integrating approvals under the province's *Environmental Assessment Act* and the *Planning Act*. The Owners Group for the subject lands wishes to proceed with this integrated approach. The subject Transportation Master Study will fulfill the requirements of the Municipal Class Environmental Assessment process for Schedule A, A+, B and C projects.

Appendix A includes the Terms of Reference which was developed in conjunction with the City of Ottawa.

1.2.1 Study Area

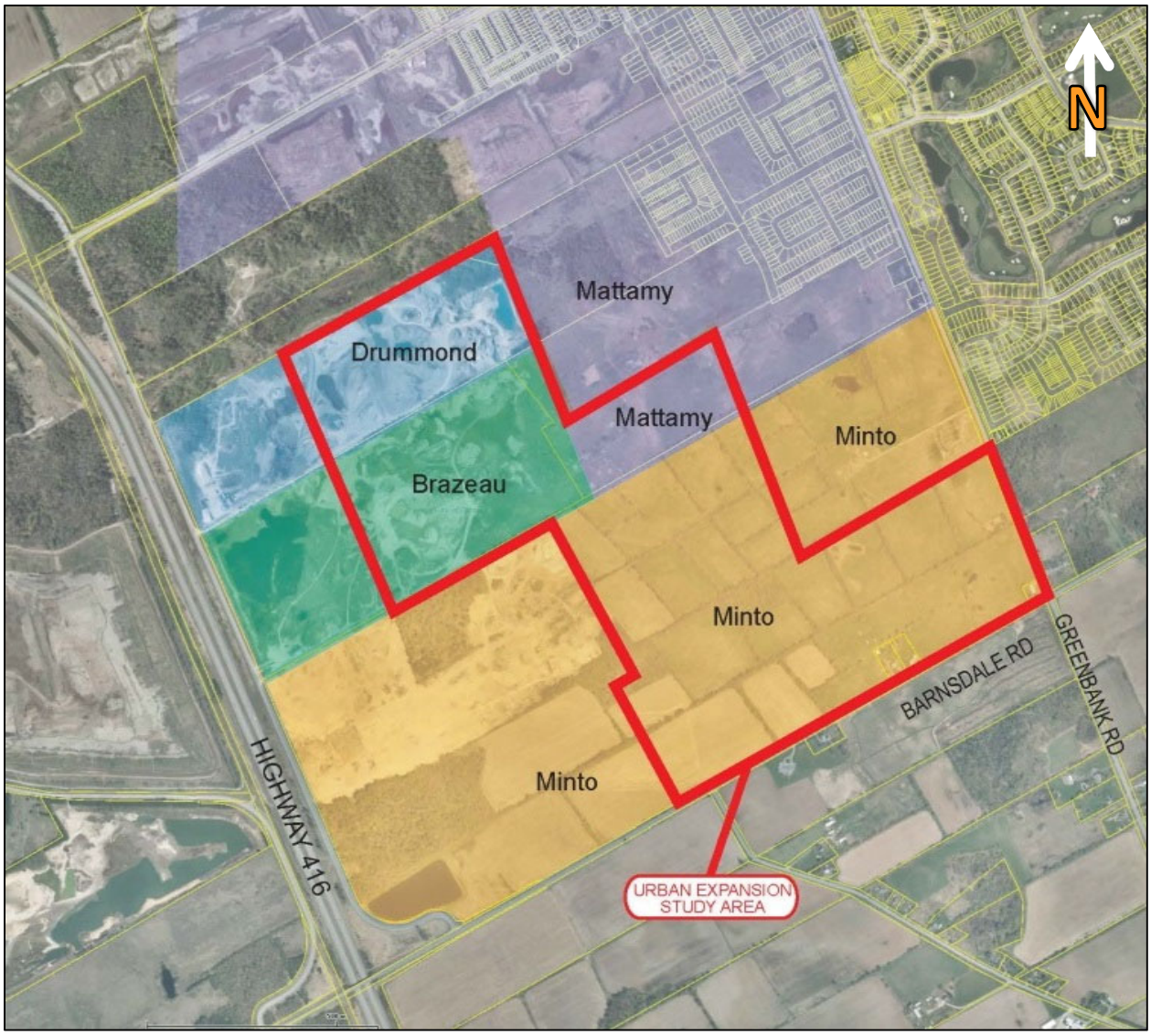
Figure 1 shows the CDP study area and landownership.

The study area is located 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 the existing Barrhaven South CDP area.

The 121 hectare Barrhaven South Urban Expansion Study Area, as identified in the City's Official Plan, is shown with a red border on **Figure 1**. Lands located adjacent to the Urban Expansion Study Area have also been included as part of the Transportation Master Study in order to ensure integration with adjacent lands.

The Urban Expansion Study Area includes two aggregate pits; the Brazeau and Drummond pits. These aggregate pits are included in the study area in order to plan for future development once the pits are no longer in operation.

Figure 1 Barrhaven South Expansion Area and Land Ownership



1.2.2 Study Area Intersections

As part of the subject TMS, the transportation analyses will include the key signalized and unsignalized intersections within close proximity to the CDP lands. The study area intersections include:

Signalized Intersections

- Prince of Wales Drive at Bankfield Road

Unsignalized Intersections

- Borrisokane Road at Cambrian Road;
- Existing Greenbank Road at Cambrian Road;
- Borrisokane Road at Barnsdale Road;
- Barnsdale Road at Viewbank Road;
- Existing Greenbank Road at Barnsdale Road;
- Prince of Wales Drive at Barnsdale Road; and
- Existing Greenbank Road at Prince of Wales Drive.

Site Access Points:

- Existing Greenbank Road at East – West Collector Road

2.0 POLICY AND REGULATORY FRAMEWORK

In preparation of this TMS several guiding documents were utilized to provide reference and direction on transportation policy and guidelines to be applied to the development of the CDP.

2.1 TRANSPORTATION MASTER PLAN

The City of Ottawa's *2013 Transportation Master Plan* (TMP) supports the policies outlined in the City's *Official Plan* while identifying transportation facilities that will meet the needs of the residents. The TMP focuses on integrating the concept of complete streets, establishing modal share targets, improving walking and cycling facilities, and supporting transit-oriented development.

The TMP is comprised of an affordable plan (i.e. projects scheduled to occur prior to 2031 and which can be afforded based on City budgeting parameters) and an overall network concept (i.e. projects that are required but cannot be afforded until beyond 2031).

2.2 OTTAWA PEDESTRIAN PLAN

The 2013 Ottawa Pedestrian Plan (OPP) provides direction on how the city can become more pedestrian-friendly through proposed upgrades to the pedestrian network, planning and design, safety and promotion, and maintenance and rehabilitation. According to the OPP, new roads should be designed and built to accommodate pedestrian activity, whether they are located in the urban core or suburban communities. Grid patterned roads are more pedestrian-friendly than curvilinear roads as they reduce the distance between origins and destinations for pedestrians.

Pedestrian facilities should connect to the surrounding network and be located such that they promote active travel to services and key destinations, such as public transit, schools, community centres, employment areas, and commercial areas.

2.3 OTTAWA CYCLING PLAN

The 2013 Ottawa Cycling Plan (OCP) is a planning document designed to help develop, strengthen, and support a cycling culture within the city. It stipulates that active modes of transportation should be taken into consideration when new suburban roads (local, collector, and arterial) are being developed. In addition, off-road multi-use paths within the right-of-way should be included during the planning stages of new subdivisions in order to establish cycling as a viable option for residents. Similar to pedestrian facilities, grid patterned roads are also favorable over curvilinear roads for cycling facilities.

The OCP outlines numerous planning guidelines to include when developing new subdivisions, such as:

- Multi-use pathways should be as continuous as possible, with the number of road crossings kept to a minimum.
- Multi-use pathway mid-block roadway crossings should include signage, road narrowings, and raised crossing areas on local roads.
- Arterials should be designed with appropriate cycling facilities.
- Schools and community centres should be located close to cycling facilities to encourage active transportation.

2.4 TRANSIT-ORIENTED DEVELOPMENT GUIDELINES

The City of Ottawa's Transit-Oriented Development Guidelines are used in the preparation of community design plans to promote and achieve appropriate Transit-Oriented Development (TOD) within the city. They are typically applied to areas within a 600m walking distance of a rapid transit stop or station. The Realigned Greenbank Road and Southwest Transitway Extension Planning and Environmental Assessment Study identifies a future park and ride lot and transit stations along Realigned Greenbank Road. Given that future Realigned Greenbank Road essentially bisects the study area, the majority of the CDP lands fall within 600m of a future rapid transit stop or station.

The TOD guidelines are generally outlined as follows:

- Land Use – locating combinations of land uses within the TOD areas will permit people to undertake multiple tasks at one location which will enhance efficiency of the transit system. Such uses include employment centres, commercial areas, and medium to high density residential dwellings. Providing transit supportive land uses within 600m walking distance of a rapid transit stop or station is an important factor when determining the land uses of a new community.
- Layout – layouts that reduce the need to travel great distances to transit stations or stops will allow more people to see the transit system as a viable alternative to auto travel.
- Built Form – creating 'good places' around transit stations will make for a more interesting and attractive public realm.
- Pedestrian and Cyclists – creating pedestrian and cycling facilities that are both convenient and positive will enhance the overall experience of using active modes to get to and from the transit stop or station.

- Vehicles and Parking – Minimizing conflicts between vehicular movement and pedestrians around transit stations is important to encourage active modes of transportation. Increased transit ridership and shared parking arrangements can reduce the demand for parking at transit stations.

- Streetscape and Environment – carefully designing the spaces that lead to and from transit stations is important to develop a positive environment for transit users.

2.5 BUILDING BETTER AND SMARTER SUBURBS

The City of Ottawa's approved Building Better and Smarter Suburbs (BBSS): Strategic Directions and Action Plan document is intended to accomplish the following:

- Increase land efficiencies by providing suitable and integrated subdivision design;

- Create complete communities, which includes facilities for drivers, cyclists, pedestrians, and transit users;

- Establish communities that are able to accommodate and provide safe and reliable transportation options; and

- Develop communities that have a balance between urban design and long-term maintenance and operational costs.

2.6 COMPLETE STREETS

A complete street provides amenity space for all road users, including pedestrians, cyclists, transit users, and motorists of all ages and abilities. Complete streets help to emphasize the importance of all road users, not only motorists, while providing safe and comfortable facilities for all users.

As outlined in the City of Ottawa's Complete Streets Implementation Framework, the following elements of complete streets should be considered for each type of user:

- Pedestrians – reducing traffic speeds with sidewalks on both sides of the street, frequent and accessible roadway crossings with treatments (raised crossings, curb extensions, and reduced curb radii), and buffers between the sidewalk and vehicular traffic.

- Cyclists – Reduced traffic speeds with shared or separate space, bikeway treatments at busy intersections, bicycle parking areas, and bike lane enhancements (buffered, protected, or segregated).

- Transit Users – accessible transit stops with street crossings and transit shelters and transit priority measures such as transit-only lanes or transit signal priority.

- Motorists – reduced number of travel lanes, parking / loading areas, and intersection design / traffic controls with traffic signal management.

- All Users – lighting, landscaping, traffic calming, and way-finding signage.

With the increasing non-auto mode targets that the City of Ottawa is striving for in the future, incorporating complete streets into new subdivisions will help achieve these targets.

2.7 BARRHAVEN SOUTH COMMUNITY TRANSPORTATION STUDY

The Barrhaven South Community Transportation Study was completed in 2010 to determine the future transportation requirements resulting from the development of Barrhaven South. The study found that by 2031 the Fallowfield, Strandherd, and Jock River screenlines are projected to operate over capacity. This resulted in a development cap being placed on Barrhaven South until the capacity constraints on the Jock River screenline were alleviated.

Since the study was completed, one major upgrade to Barrhaven South has been completed that increases the capacity of the Jock River screenline: the twinning of a section of the former Jockvale Road and bridge across the Jock River, which is now renamed Longfields Road.

2.8 REALIGNED GREENBANK ROAD AND SOUTHWEST TRANSITWAY EXTENSION PLANNING AND ENVIRONMENTAL ASSESSMENT

The Realigned Greenbank Road and Southwest Transitway Extension Planning and Environmental Assessment (EA) 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 in order 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.

2.9 CAMBRIAN ROAD ENVIRONMENTAL ASSESSMENT

The Cambrian Road Widening Environmental Assessment reviewed the existing 4-lane road design to ensure adequate arterial capacity for the primary east-west corridor within the Barrhaven South community. The technically preferred design includes a shared cycling, vehicle, and parking lane in the vicinity of Half Moon Bay Park, dedicated cycle lanes or cycle track, a multi-use pathway and sidewalks, a median and boulevard, an off-peak parking lane adjacent to Half Moon Bay Park, and various signalized intersections along Cambrian Road.

As the widening of Cambrian Road is not within the City of Ottawa's affordability plan, an interim 2-lane design was recommended.

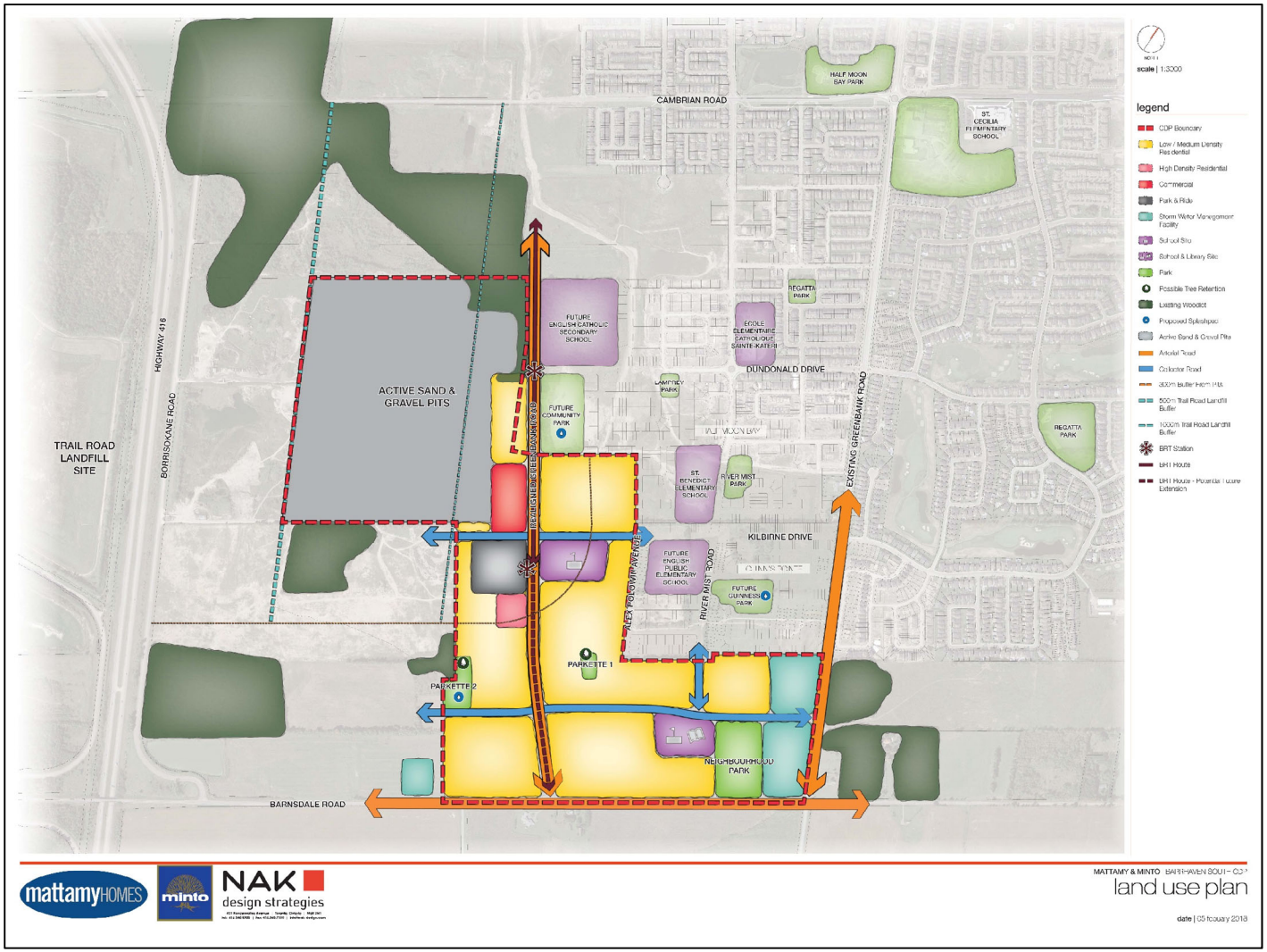
3.0 COMMUNITY DESIGN PLAN

The proposed development is approximately 121 hectares and includes approximately 1,500 residential units, two elementary schools, a small commercial component, a Park and Ride lot, a library, and several parks. Existing collector roads adjacent to the CDP area - River Mist Road and Kilbirnie Drive - are proposed to be continued through the CDP lands. A new East – West Collector is proposed to be located approximately 250m north of Barnsdale Road and will connect to Realigned Greenbank Road and Existing Greenbank Road.

The existing active Brazeau and Drummond sand and gravel pits are included in the subject CDP lands, however, the timing of the redevelopment of these lands is currently unknown. The conceptual planning overlay developed as part of the CDP allows for future transportation connections to be made to the Brazeau and Drummond lands via an extension of Dundonald Drive as well as local road connections to the remaining CDP lands. The subject Transportation Master Study, however, does not explicitly include traffic generated by these aggregate pits as the development timing and lot fabric are unknown. As the proponents of these lands proceed through the development approvals process, they will be required to undertake transportation impact assessments to determine the specific transportation improvements that will be required to support the redevelopment, including coordination between Brazeau and Drummond in terms of accessing Realigned Greenbank Road. The findings from subsequent transportation analysis may reveal that additional transportation improvements are required beyond what is being identified in the subject Transportation Master Study. Furthermore, some transportation improvements may be subject to cost-sharing between the various proponents / developers of the CDP.

Figure 2 below illustrates the proposed concept plan for the subject lands.

Figure 2 Proposed Concept Plan



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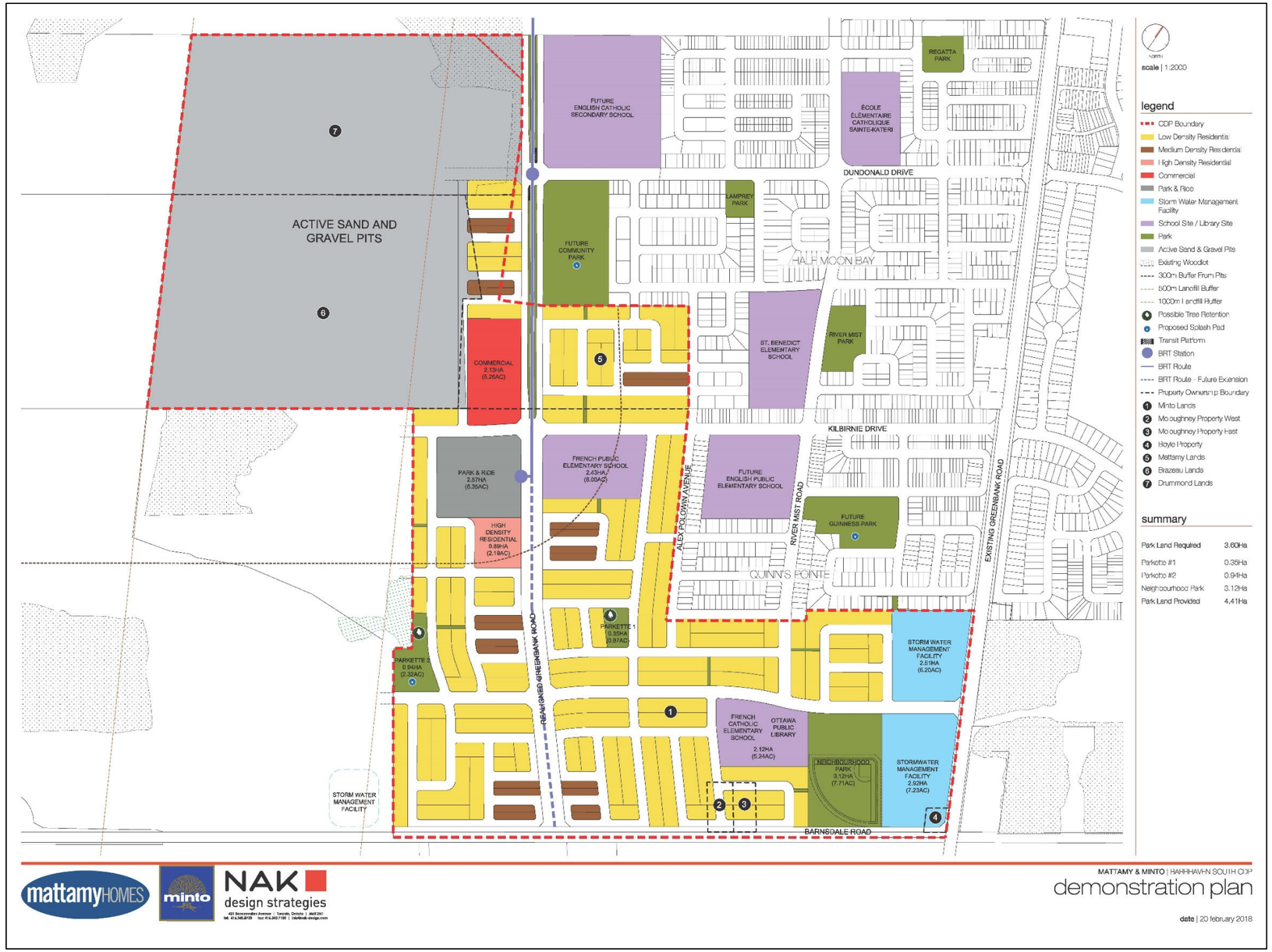
3.1 PREFERRED ALTERNATIVE

Through the CDP process, several CDP alternatives were developed for the subject lands. Each alternative was evaluated from a multi-disciplinary approach that included the natural environment, social environment, transportation network, servicing, and infrastructure costs. The Community Design Plan document contains the detailed evaluation of each alternative along with the selection process.

The Demonstration Plan in **Figure 3** below illustrates the preferred alternative.

Figure 3 CDP Demonstration Plan of Preferred Alternative



4.0 EXISTING TRANSPORTATION ENVIRONMENT

4.1 ROADS AND TRAFFIC CONTROL

The roadways under consideration in the study area are referenced from the City of Ottawa's Transportation Master Plan 2013 and are described as follows:

Existing Greenbank Road

Existing Greenbank Road is designated as a two-lane arterial north of Barnsdale Road and a two-lane collector south of Barnsdale Road. North of Kilbirnie Drive, Existing Greenbank Road has an urban cross-section with a posted speed of 60km/h and south of Kilbirnie Drive, it has a rural cross-section with a posted speed of 80 km/h.

Cambrian Road

Between Borrisokane Road and Seeley's Bay Street, Cambrian Road is a two-lane rural arterial road with a posted speed limit of 70km/h. 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. The intersection with Borrisokane Road is stop-controlled along Cambrian Road. The intersection with Existing Greenbank Road features a single-lane roundabout.

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. The intersection with Existing Greenbank Road is an all-way stop-controlled intersection. The intersection at Prince of Wales Drive is stop-controlled along the Barnsdale Road approach.

Bankfield Road

Bankfield Road is a two-lane arterial with a rural cross-section and a posted speed limit of 80 km/h. The intersection with Prince of Wales Drive is signalized.

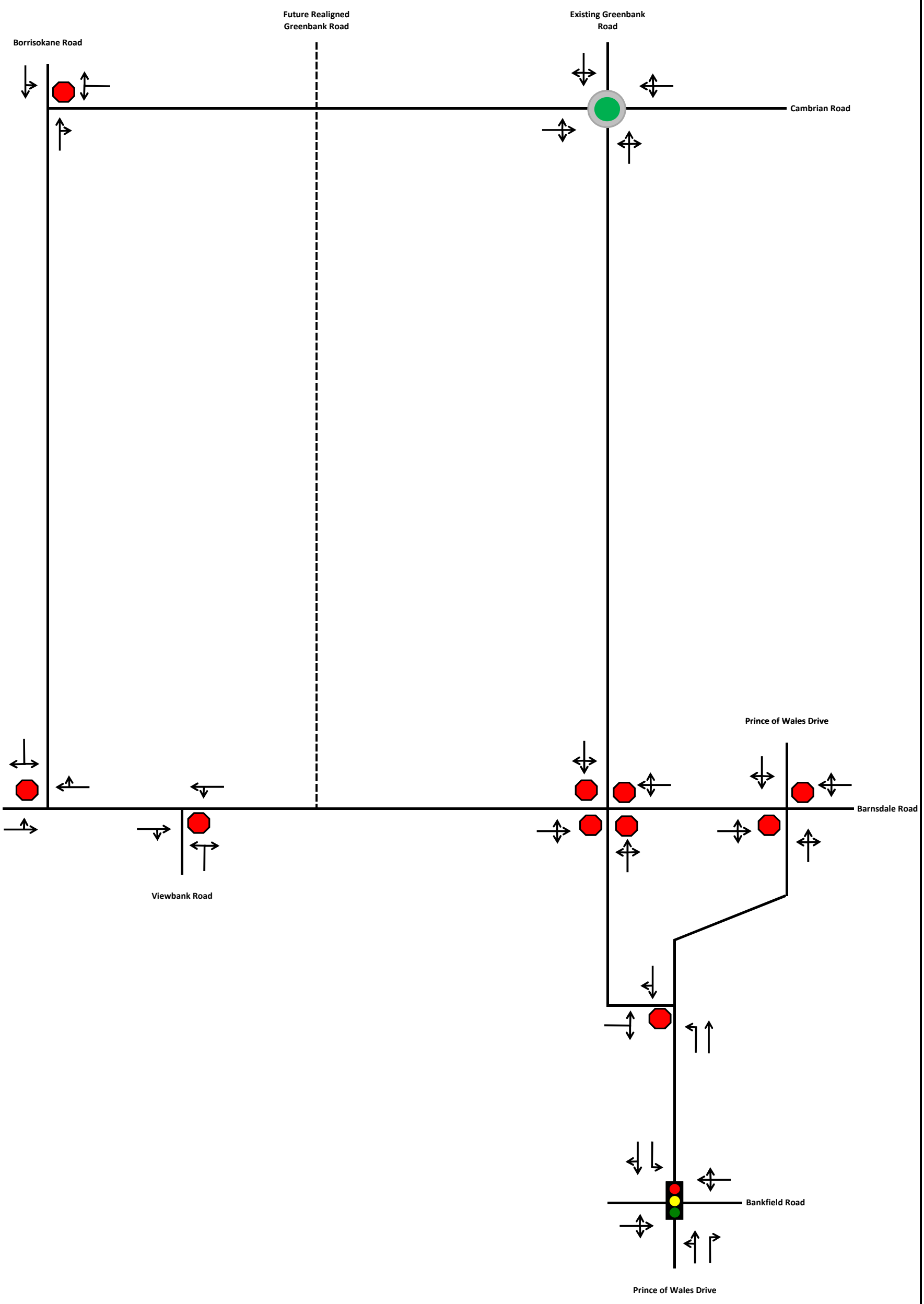
Prince of Wales Drive

Prince of Wales Drive is a two-lane arterial with a rural cross-section and a posted speed limit of 80 km/h. The intersection with Existing Greenbank Road is stop-controlled along the Existing Greenbank Road approach.

Viewbank Road

Viewbank Road is a two-lane local road with a rural cross-section and a posted speed limit of 50 km/h. The intersection with Barnsdale Road is stop-controlled along the Viewbank Road approach.

Figure 4 illustrates the existing intersection control and lane configuration for the study area intersections.



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Barrhaven South Urban Expansion Study Area CDP
Transportation Master Study
Figure 4 2016 Existing Intersection Control and Lane Configuration

4.2 TRANSIT

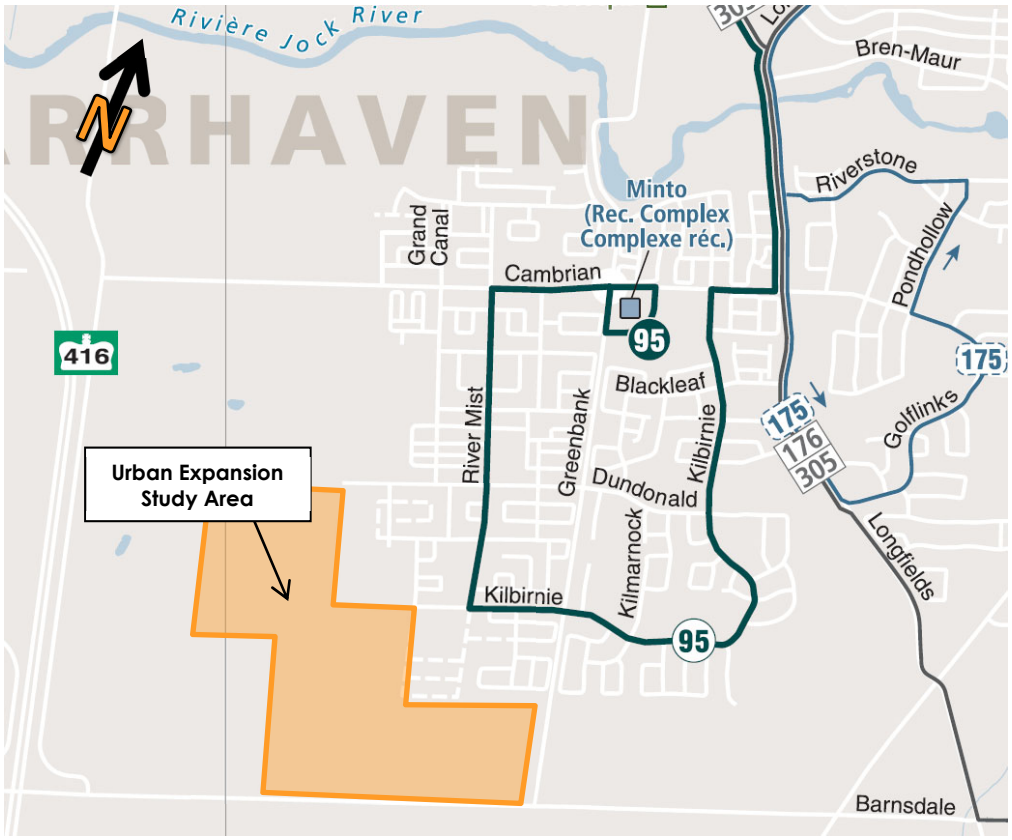
Transit service is provided to the Study Area via route 95. Route 95 is a regular bus route that runs from the Minto Centre Recreation Complex to Trim Road and operates on a 15-minute headway during the morning peak period northbound and during the afternoon peak period southbound.

Figure 5 illustrates existing study area transit routes.

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.

Figure 5 Existing Study Area Transit Service



(Source: OC Transpo, accessed January 2018)

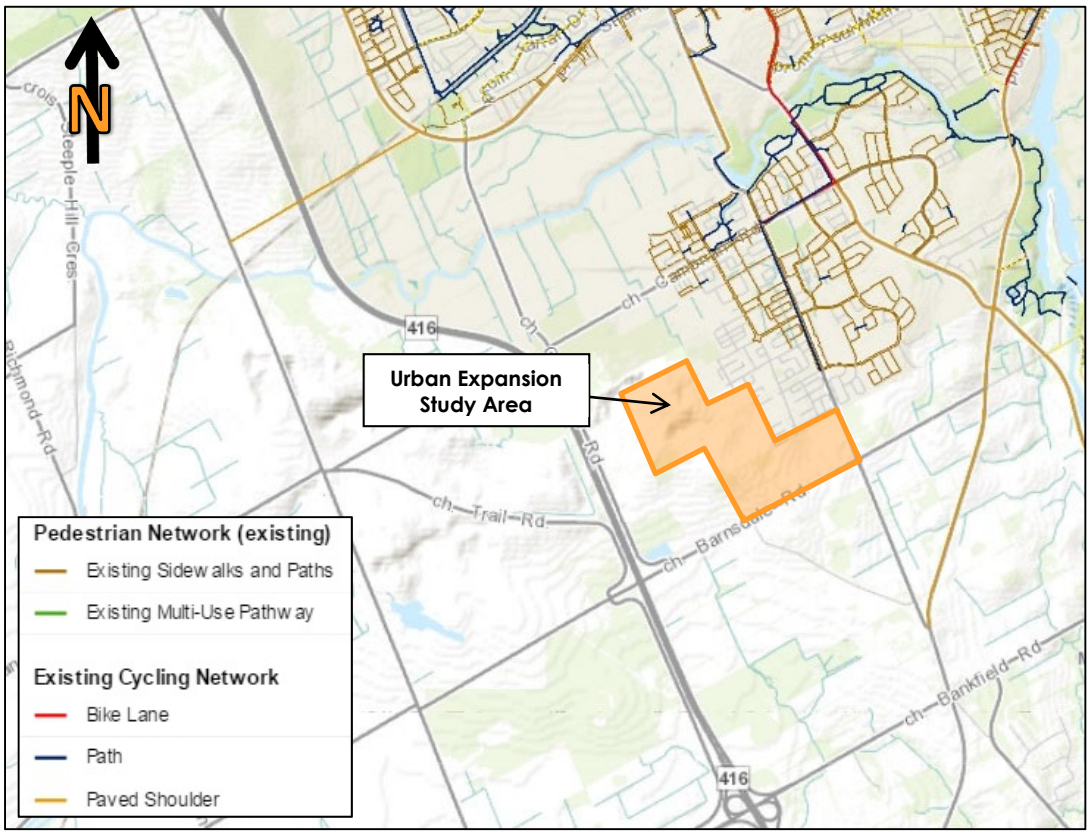
4.3 PEDESTRIAN AND CYCLING NETWORKS

Within the Barrhaven South community there are bicycle paths, paved shoulders, and sidewalks that connect the various neighbourhoods. There are numerous bicycle paths along the Jock River east of Existing Greenbank Road, within the Half Moon Bay North community, as well as along Existing Greenbank Road between Cambrian Road and Kilbirnie Drive and crossing the Jock River. Along Cambrian Road east of Existing Greenbank Road there is a bicycle lane that continues along Jockvale Road and Longfields Drive to Strandherd Drive. South of Cambrian Road, Jockvale Road has paved shoulders. Paved shoulders are also provided along Prince of Wales Drive.

In terms of pedestrian facilities, there are various sidewalks along the vast majority of the streets within the Half Moon Bay and Stonebridge communities, including Cambrian Road and Existing Greenbank Road. In addition, there are multi-use pathways along the Jock River, east of Existing Greenbank Road.

Figure 6 illustrates the existing pedestrian and cycling facilities within the study area.

Figure 6 Existing Pedestrian and Cycling Network



(Source: geoOttawa, accessed January 11th, 2015)

4.4 EXISTING TRAFFIC VOLUMES

Traffic counts were provided by the City of Ottawa at most study area intersections for the years 2013 and 2014. Where traffic counts were older than 2013, they were supplemented by counts undertaken by Stantec in July 2015.

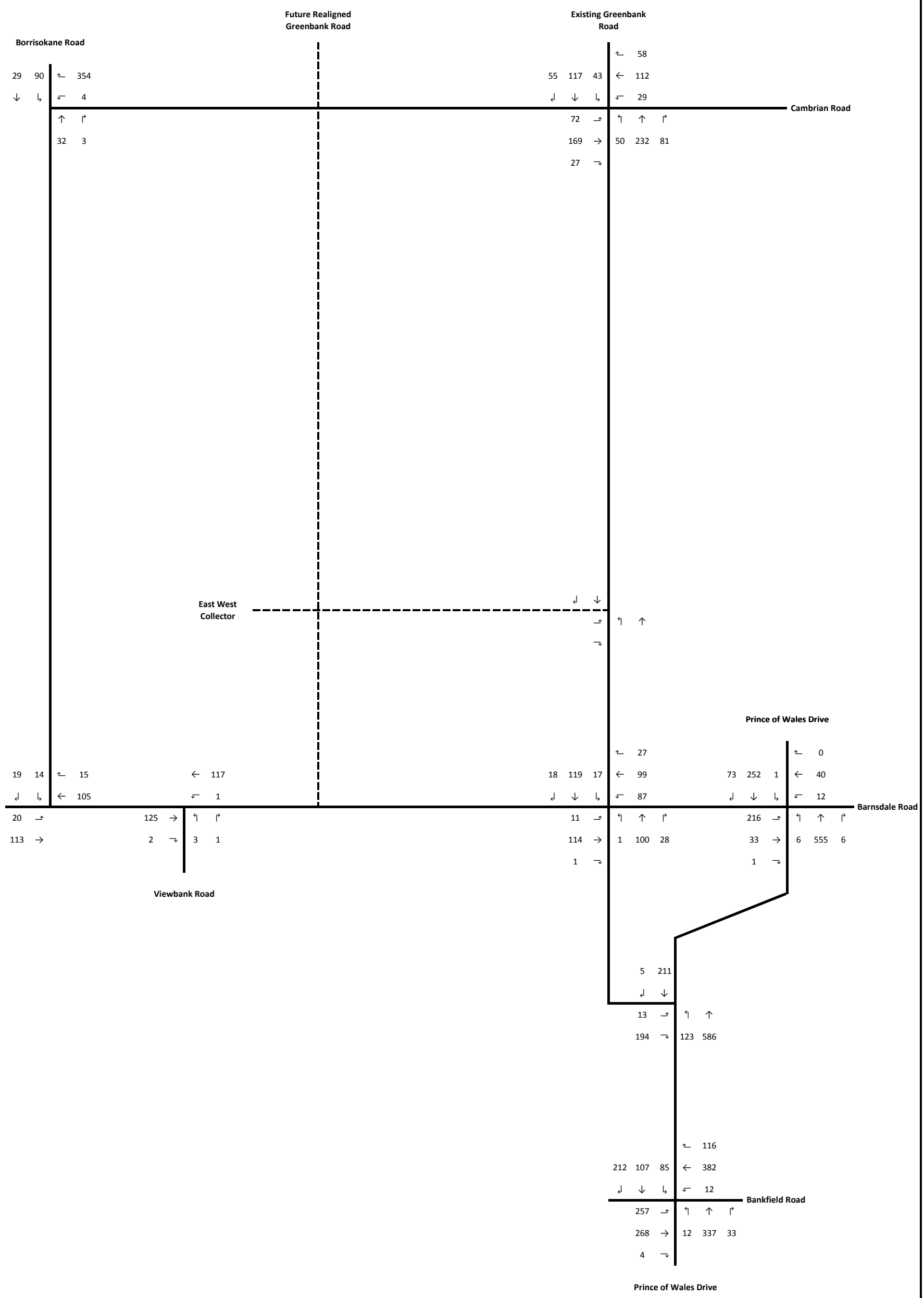
Using the TRANS regional transportation model data, growth rates were determined at three stations along the Jock River Screenline (Borrisokane Road, Existing Greenbank Road, and Jockvale Road). These growth rates were applied to the 2013 and 2014 traffic counts to bring them to 2016 volumes based on their location within the study area (i.e. traffic volumes traveling along Borrisokane Road were applied the growth percentage corresponding to the Borrisokane Road station growth at the Jock River Screenline).

For turning movements that were not directly associated with a screenline station, a nominal 2% annual rate of growth was applied. Traffic volumes were then balanced between intersections starting from the north and heading south towards Bankfield Road.

It should be noted that the City recently provided updated 2017 traffic volumes at the Barnsdale Road at Prince of Wales Drive intersection. As these volumes are the most up to date, they were used in the analysis of the existing conditions.

Figure 7 and **Figure 8** illustrate 2016 existing AM and PM peak hour traffic volumes at the study area intersections.

Appendix B contains the traffic data and is provided for reference.



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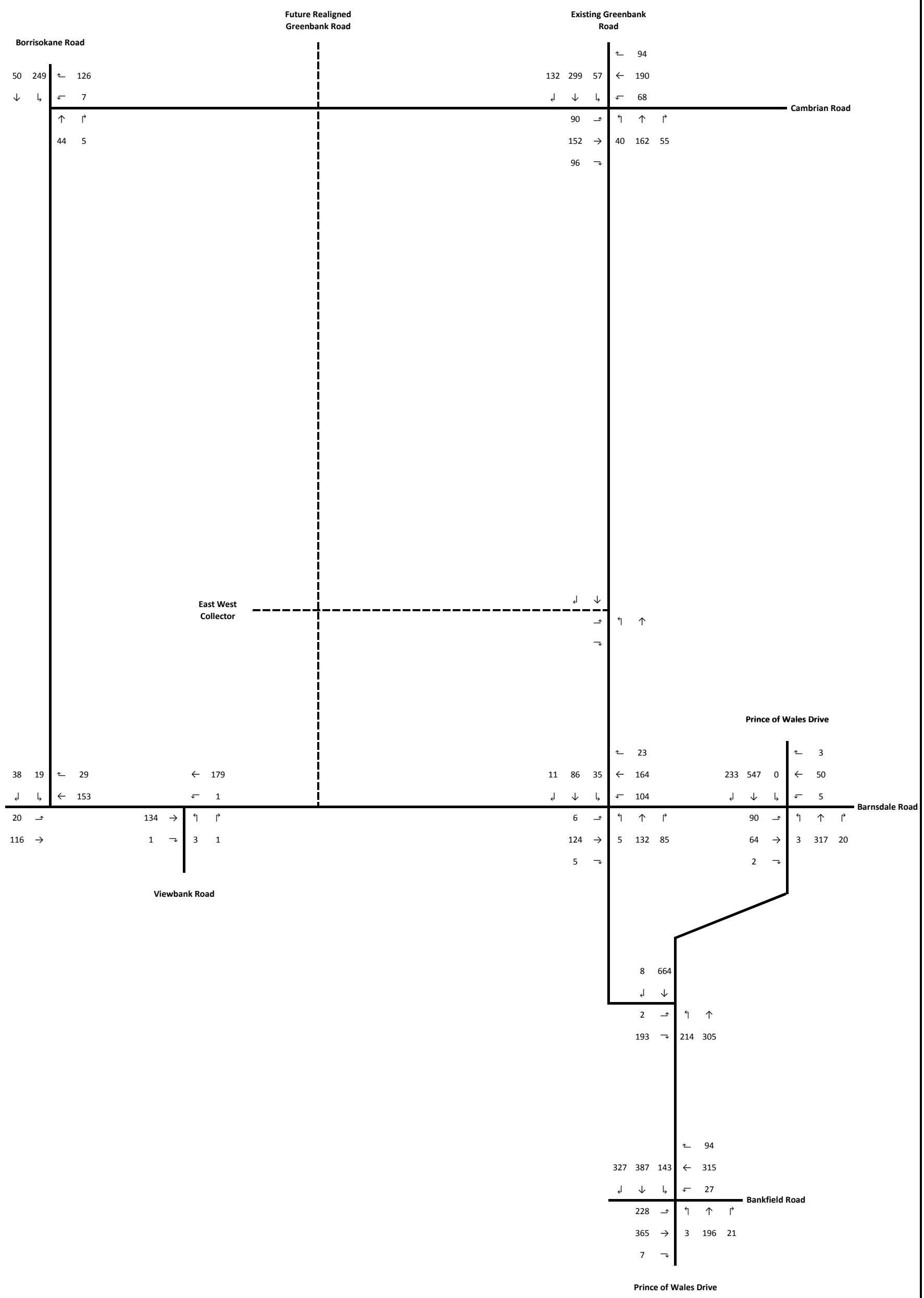
Barrhaven South Urban Expansion Study Area CDP
Transportation Master Study
Figure 7 2016 Existing Traffic Volumes - AM Peak Hour



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Barrhaven South Urban Expansion Study Area CDP
Transportation Master Study
Figure 8 2016 Existing Traffic Volumes - PM Peak Hour

5.0 TRAVEL DEMAND FORECASTING

5.1 FUTURE ROAD NETWORK IMPROVEMENTS

Several significant transportation improvements have been identified in the City of Ottawa's 2013 *Transportation Master Plan* (TMP) in the vicinity of the CDP area and are summarized in **Table 1** below.

Table 1 2013 Transportation Master Plan Scheduled Upgrades

PROJECT	DESCRIPTION	TMP PHASE
Realigned Greenbank Road	From Jockvale Road to Cambrian Road New four lane road including the Jock River Bridge	Phase 1 (2014 – 2019)
	From Cambrian Road towards the south New four lane road	Network Concept (i.e. beyond 2031)
Strandherd Drive Widening	Widen from two to four lanes between Fallowfield Road and Jockvale Road	Phase 2 (2020 – 2025)
Chapman Mills Drive	New four lane arterial road from Longfields Drive to Strandherd Drive, includes Bus Rapid Transit	Arterial Road: Phase 2 (2020 – 2025) Bus Rapid Transit: Network Concept (i.e. beyond 2031)
Cambrian Road Widening	Widen from two to four lanes from Realigned Greenbank Road to Jockvale Road	Network Concept (i.e. beyond 2031)
Southwest Transitway	From Barrhaven Centre to Cambrian Road Median Bus Rapid Transit	Network Concept (i.e. beyond 2031)

The TMP suggests that Realigned Greenbank Road, from Jockvale Road to Cambrian Road, will be constructed during Phase 1 (2014 – 2019). However, based on recent discussions with City of Ottawa staff, it has been confirmed that this segment of Realigned Greenbank Road will not be constructed as part of Phase 1. Instead, the funding that was earmarked for Realigned Greenbank Road was reallocated towards the widening of Strandherd Drive based on recent safety concerns regarding the VIA Rail crossings in the Barrhaven area. The next TMP update will determine the future timing of Realigned Greenbank Road.

5.2 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 in the vicinity of the subject site, as outlined in **Table 2** and as illustrated in **Figure 9** below.

Table 2 Background Developments

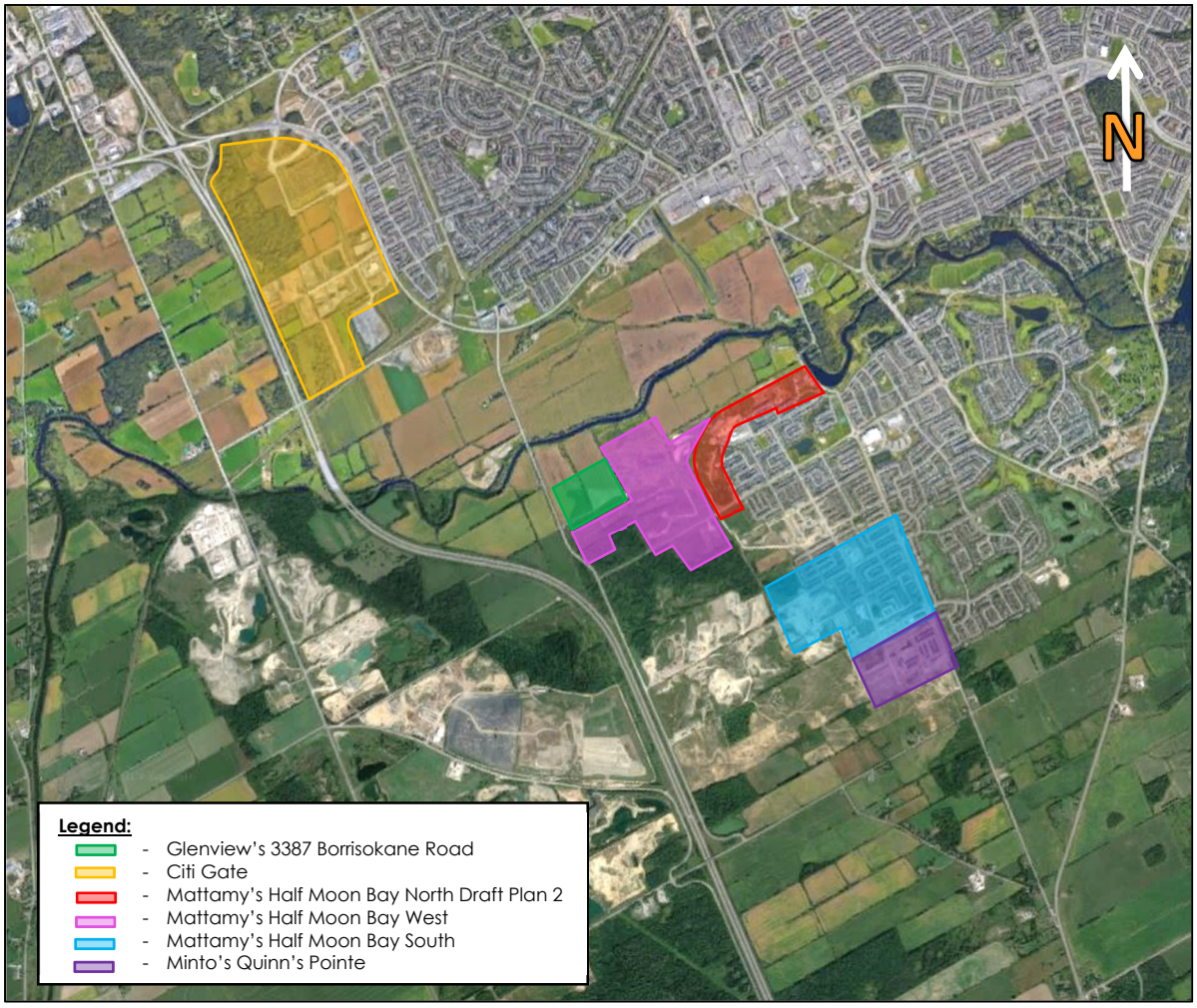
DEVELOPMENT	LOCATION	DEVELOPMENT SIZE	ASSUMED BUILD-OUT
Mattamy's Half Moon Bay South Phase 4	South of Half Moon Bay South Phase 3, between Realigned Greenbank and Existing Greenbank	265 Residential Units	2017
Minto's Quinn's Pointe	West of Existing Greenbank Road, South of Half Moon Bay South	475 Residential Units	2018
Mattamy's Half Moon Bay North Draft Plan 2	North of Cambrian Road, west of Greenbank Road	470 Residential Units	2019
Glenview's 3387 Borrisokane Road	North of Half Moon Bay West, east of Borrisokane Road, south of the Jock River	200 Residential Units	2022
Mattamy's Half Moon Bay West	North of Cambrian Road between Borrisokane Road and Realigned Greenbank Road	1,000 Residential Units	2024
Citi Gate Highway 416 Employment Lands	Between Highway 416 and Strandherd Drive, south of Fallowfield, north of the train tracks	350,000 ft^2 GFA 95 hectares of Business Park	Interim Phase: 2019 Ultimate Phase: 2029

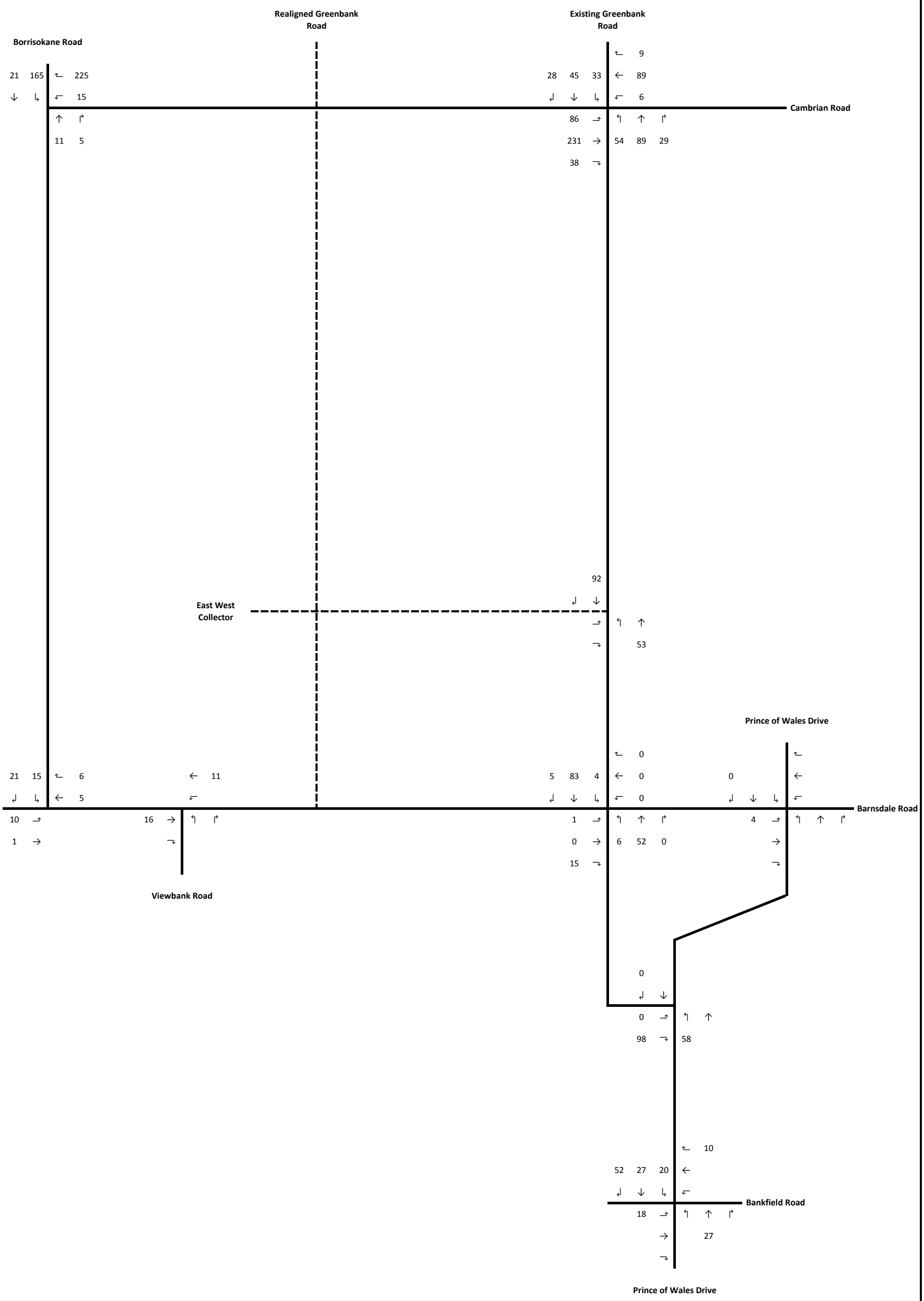
These background developments were explicitly accounted for and added to the roadway network as background traffic volumes. By 2025, the majority of the background developments will be built and occupied with the exception of the Ultimate Phase for the Citi Gate development, which will be built by the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

Figure 10 and **Figure 11** illustrate the background traffic forecasts from the aforementioned developments that are anticipated to be built by 2025.

Figure 12 and **Figure 13** illustrate the background traffic forecasts from the aforementioned developments that are anticipated to be built by 2031.

Figure 9 Background Developments





Barrhaven South Urban Expansion Study Area CDP
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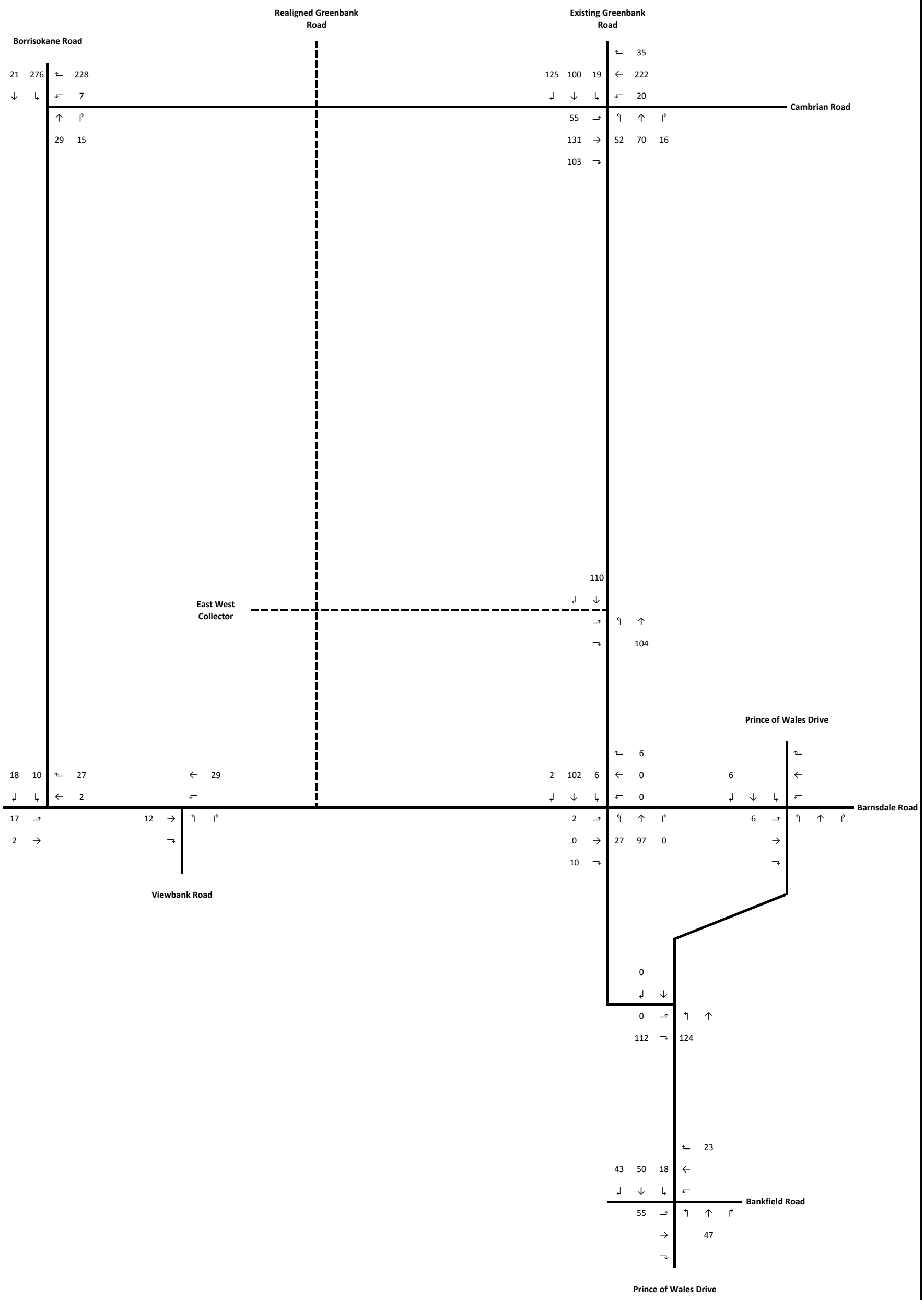
Figure 10 2025 Background Developments AM Peak Hour



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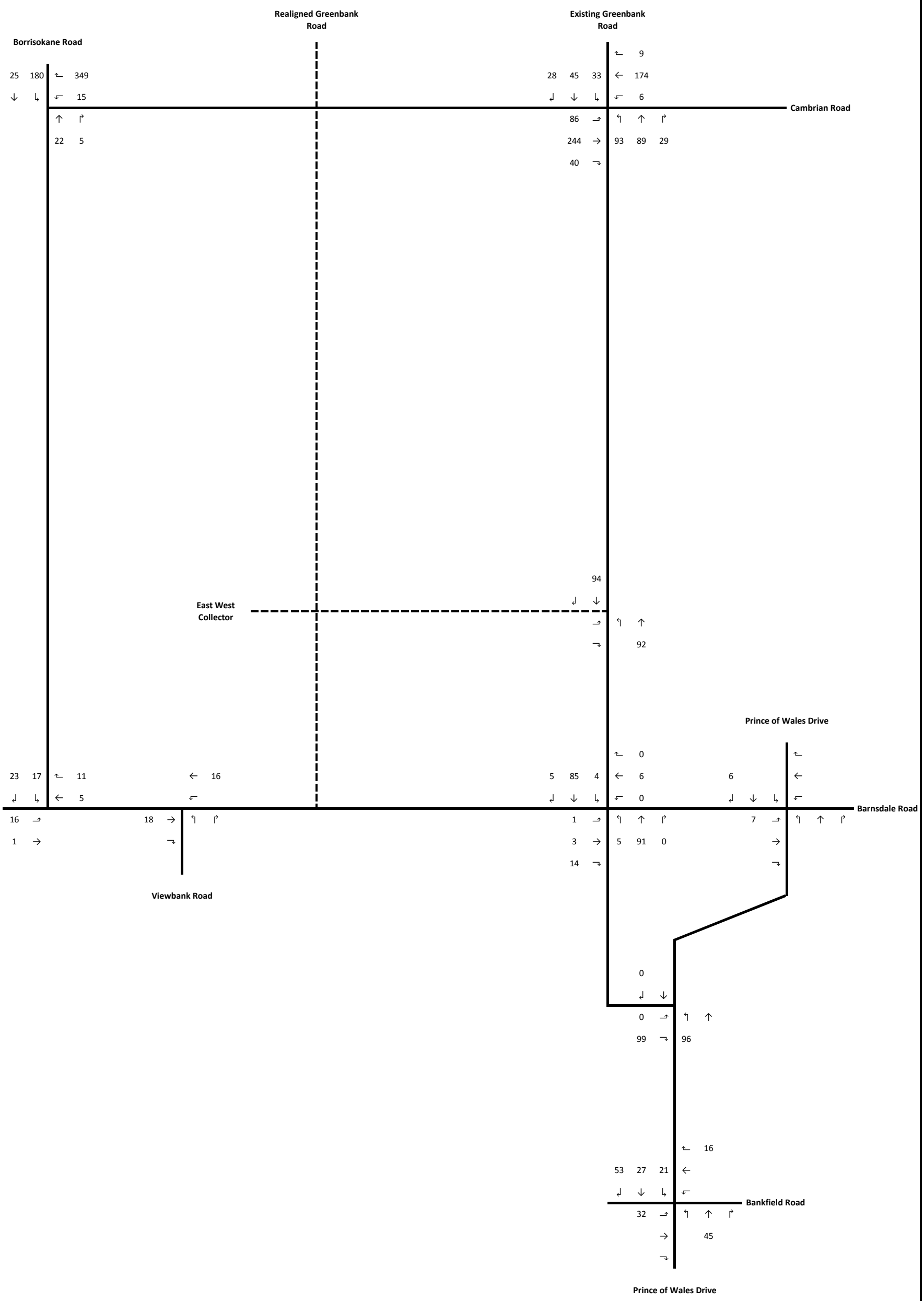
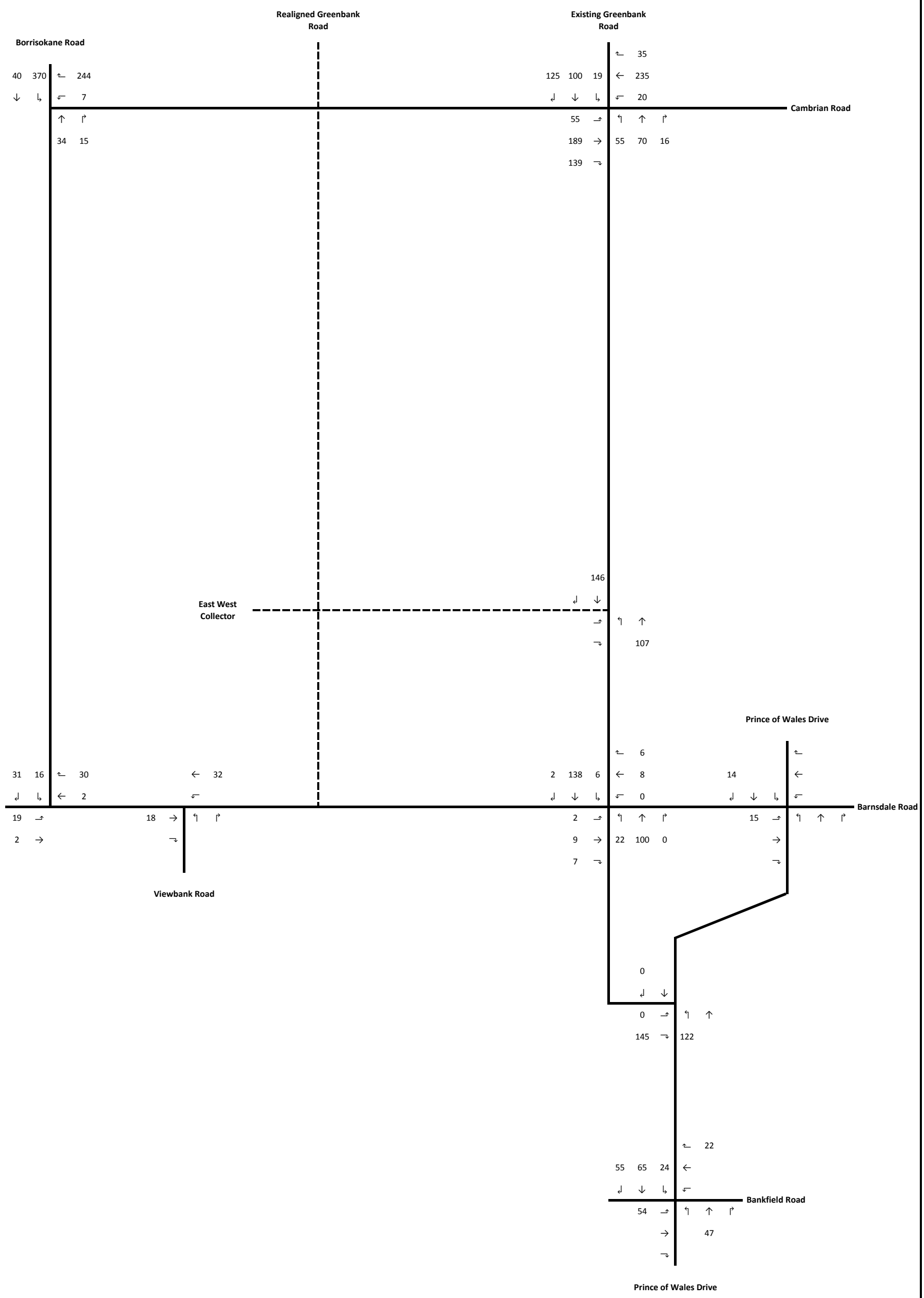
Transportation Master Study
Figure 11 2025 Background Developments PM Peak Hour



Barrhaven South Urban Expansion Study Area CDP
Transportation Master Study
Figure 12 2031 Background Developments AM Peak Hour



Barrhaven South Urban Expansion Study Area CDP
Transportation Master Study
Figure 13 2031 Background Developments PM Peak Hour

5.3 SITE TRAFFIC GENERATION

5.3.1 Land Use and Trip Generation Rates

The *Institute of Transportation Engineers (ITE) Trip Generation Manual (9th Edition)* was used to estimate traffic generated by the CDP development area. The ITE land use codes 210 – Single Detached Houses, 220 – Apartment, 230 – Residential Condo / Townhouse, 520 – Elementary School, and 826 – Specialty Retail were thought to be most representative of the proposed land uses.

Table 3 summarizes the trip rates obtained from the *ITE Trip Generation Manual* and the ensuing sections describe the methodology used to convert these trips to person trips across all modes.

Table 3 ITE Trip Generation Rates

ITE LAND USE	INDEPENDENT VARIABLE		MORNING PEAK HOUR			AFTERNOON PEAK HOUR		
			In	Out	Total	In	Out	Total
210 – Single Detached Houses	Units	786	0.18	0.53	0.71	0.64	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	584	0.06	0.30	0.36	0.29	0.14	0.44
520 – Elementary School	Gross Floor Area (1000 ft^2)	59	2.91	2.29	5.20	0.54	0.67	1.21
826 – Specialty Retail	Gross Floor Area (1000 ft^2)	69	0.00	0.00	0.00	1.19	1.52	2.71

5.3.2 Conversion of ITE Rates to Person Trips

The notion of quantifying the volume of "person" trips expected to be generated by a given development is becoming a commonly accepted practice. It is aimed at quantifying the expected demands across the primary modes of transportation.

In order to convert ITE rates to person trips, the rates obtained from the ITE Trip Generation Manual were adjusted to account for an inherent transit modal share and auto occupancy. An assumed transit share of 10% was thought to be inherent within the ITE rates and an auto occupancy rate of 1.1 persons per vehicle was also assumed to be inherent within the ITE rates.

The proposed development is anticipated to generate approximately 1360 and 1510 person trips during the AM and PM peak hours, respectively.

Table 4 outlines the conversion from auto trips to person trips.

Table 4 Conversion to Person Trips

ITE LAND USE	CONVERSION		MORNING PEAK HOUR			AFTERNOON PEAK HOUR		
			In	Out	Total	In	Out	Total
210 – Single Detached Houses	Trip Gen		140	420	560	423	249	672
	Transit Share	10%	14	42	56	42	25	67
	Auto Occupancy	1.1	14	42	56	42	25	67
	Total Person Trips		168	504	672	507	299	806
220 – Apartment	Trip Gen		11	42	53	47	25	72
	Transit Share	10%	1	4	5	5	3	8
	Auto Occupancy	1.1	1	4	5	5	3	8
	Total Person Trips		13	50	63	57	31	88
230 – Residential Condo / Townhouse	Trip Gen		36	176	212	171	84	255
	Transit Share	10%	4	18	22	17	8	25
	Auto Occupancy	1.1	4	18	22	17	8	25
	Total Person Trips		44	212	256	205	100	305
520 – Elementary School	Trip Gen		172	135	307	32	39	71
	Transit Share	10%	17	14	31	3	4	7
	Auto Occupancy	1.1	17	14	31	3	4	7
	Total Person Trips		206	163	369	38	47	85
826 – Specialty Retail	Trip Gen		0	0	0	82	104	186
	Transit Share	10%	0	0	0	8	10	18
	Auto Occupancy	1.1	0	0	0	8	10	18
	Total Person Trips		0	0	0	98	124	222
Total Development	**Trip Generation**		**359**	**773**	**1132**	**755**	**501**	**1256**
	Transit Share	**10%**	**36**	**77**	**113**	**76**	**50**	**126**
	Auto Occupancy	**1.1**	**36**	**77**	**113**	**76**	**50**	**126**
	Total Person Trips		**431**	**927**	**1358**	**907**	**601**	**1508**

5.3.3 Modal Share Adjustments

In order to convert the person trips to auto trips, the person trips were assigned to the four primary modal shares (i.e. auto, passenger, transit, and active moves) for each specific land use. Based on limited existing transit service and active modes facilities in the immediate study area, it was assumed that the auto modal share will be 90% with the remaining 10% encompassing passenger, transit, and active modes. The 90% auto modal share assumption ensures a conservative approach to generating site traffic for the CDP area.

In terms of vehicle trips, the CDP development area is anticipated to generate 1225 and 1355 auto trips (two-way) during the AM and PM peak hours, respectively.

Table 5 summarizes the expected person trips by modal share.

Table 5 Person Trips by Modal Share

ITE LAND USE	MODAL SHARE		MORNING PEAK HOUR			AFTERNOON PEAK HOUR		
			In	Out	Total	In	Out	Total
210 – Single Detached Houses	Auto	90%	151	454	605	456	269	725
	Passenger/Transit/Active Modes	10%	17	50	67	51	30	81
220 – Apartment	Auto	90%	12	45	57	51	28	79
	Passenger/Transit/Active Modes	10%	1	5	6	6	3	9
230 – Residential Condo / Townhouse	Auto	90%	40	191	231	185	90	275
	Passenger/Transit/Active Modes	10%	4	21	25	21	10	31
520 – Elementary School	Auto	90%	185	147	332	34	42	76
	Passenger/Transit/Active Modes	10%	20	16	36	4	4	8
826 – Specialty Retail	Auto	90%	0	0	0	88	112	200
	Passenger/Transit/Active Modes	10%	0	0	0	10	12	22
Total Development	**Auto**		**388**	**837**	**1225**	**814**	**541**	**1355**
	Passenger/ Transit / Active Modes		**42**	**92**	**134**	**92**	**59**	**151**

5.3.4 Pass-By and Internal Capture Trips

Pass-by trips are considered intermediate stops between an origin and a destination. They are site trips that are drawn from existing traffic volumes on the road network that are "passing-by" the site. While the total number of trips generated by a given development remains the same, the turning movements at intersections and site access require adjustments to reflect pass-by traffic. The rate of pass-by traffic is based on the specific land use and the rates were obtained from the ITE *Trip Generation Manual*.

When predicting trips that are associated with complementary land uses the interaction of traffic between those land use types must be accounted for by applying the principals of internal capture adjustments. Internal capture trips are trips which are shared between two or more uses on the same site. A portion of the site trips for a given land use is often drawn from an adjacent land uses, or, what is considered to be the primary "anchor" of a site. Internal capture adjustments were made to account for vehicle trips that visit more than one land use within a specific site (i.e. the commercial site the CDP) or within a specific area of study (i.e. an elementary school within a predominantly residential area). Since these trips are contained within the subject site, accounting for each trip individually on the roadway network would result in "double-counting". For this reason, land uses that may have associated internal capture trips between one another ultimately had their net new trips adjusted consistent with typical industry standards.

Table 6 below outlines the pass-by and internal capture percentages that were used for each land use in the subject development.

Table 6 Pass-By and Internal Capture Rates

LAND USE	PASS-BY		INTERNAL CAPTURE	
	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
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%
826 – Specialty Retail	N/A	34%	N/A	34%

Table 7 summarizes the expected pass-by and internal capture trips by modal share.

Table 7 Pass-By and Internal Capture

ITE LAND USE	PASS-BY / INTERNAL CAPTURE	MORNING PEAK HOUR			AFTERNOON PEAK HOUR		
		In	Out	Total	In	Out	Total
210 – Single Detached Houses	Auto Trips	151	454	605	456	269	725
	Pass-By	0	0	0	0	0	0
	Internal Capture	0	0	0	0	0	0
	Net New Auto Trips	151	454	605	456	269	725
220 – Apartment	Auto Trips	12	45	57	51	28	79
	Pass-By	0	0	0	0	0	0
	Internal Capture	0	0	0	0	0	0
	Net New Auto Trips	12	45	57	51	28	79
230 – Residential Condo / Townhouse	Auto Trips	40	191	231	185	90	275
	Pass-By	0	0	0	0	0	0
	Internal Capture	0	0	0	0	0	0
	Net New Auto Trips	40	191	231	185	90	275
520 – Elementary School	Auto Trips	185	147	332	34	42	76
	Pass-By	0	0	0	0	0	0
	Internal Capture	130	103	232	24	29	53
	Net New Auto Trips	56	44	100	10	13	23
826 – Specialty Retail	Auto Trips	0	0	0	88	112	200
	Pass-By	0	0	0	34	34	68
	Internal Capture	0	0	0	0	0	0
	Net New Auto Trips	0	0	0	54	78	132
Total Development	**Auto Trips**	**388**	**837**	**1225**	**814**	**541**	**1355**
	Pass-By	**0**	**0**	**0**	**34**	**34**	**68**
	Internal Capture	**130**	**103**	**233**	**24**	**29**	**53**
	Net New Auto Trips	**258**	**734**	**992**	**756**	**478**	**1234**

Following the application of the pass-by and internal capture rates, the development is expected to generate approximately 990 and 1235 net new auto trips (two-way) during the AM and PM peak hours, respectively.

5.4 SITE TRIP DISTRIBUTION AND ASSIGNMENT

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 provides a summary of the estimated distribution for the traffic generated by the proposed development.

Table 8 Traffic Distribution from the South Nepean District

CARDINAL DIRECTION	VIA (TO / FROM)
	% Distribution
North	25%
East	25%
South	5%
West	5%
Internal within the South Nepean District	40%
Total	**100%**

The anticipated site traffic generated by the CDP development area was assigned to the boundary road network using a logical pattern of primary roads (i.e. along arterials and collectors).

For the purposes of assigning site traffic to the boundary road network, Realigned Greenbank Road was assumed to not be in place prior to the ultimate 2031 horizon, which is consistent with the timelines outlined in the City's Transportation Master Plan. This enables the subject transportation assessment to determine if Realigned Greenbank Road – or portions of Realigned Greenbank Road - will in fact be required in order to enable the development to proceed and / or whether other intersection improvements will be required to support it.

The CDP lands to the east of Realigned Greenbank Road were assumed to be built and occupied by the interim 2025 future horizon while the remaining CDP lands west of Realigned Greenbank Road were assumed to be built and occupied by the ultimate 2031 horizon.

Figure 14 and **Figure 15** illustrate the 2025 interim site traffic volumes and **Figure 16** and **Figure 17** illustrate the 2031 ultimate site traffic volumes.

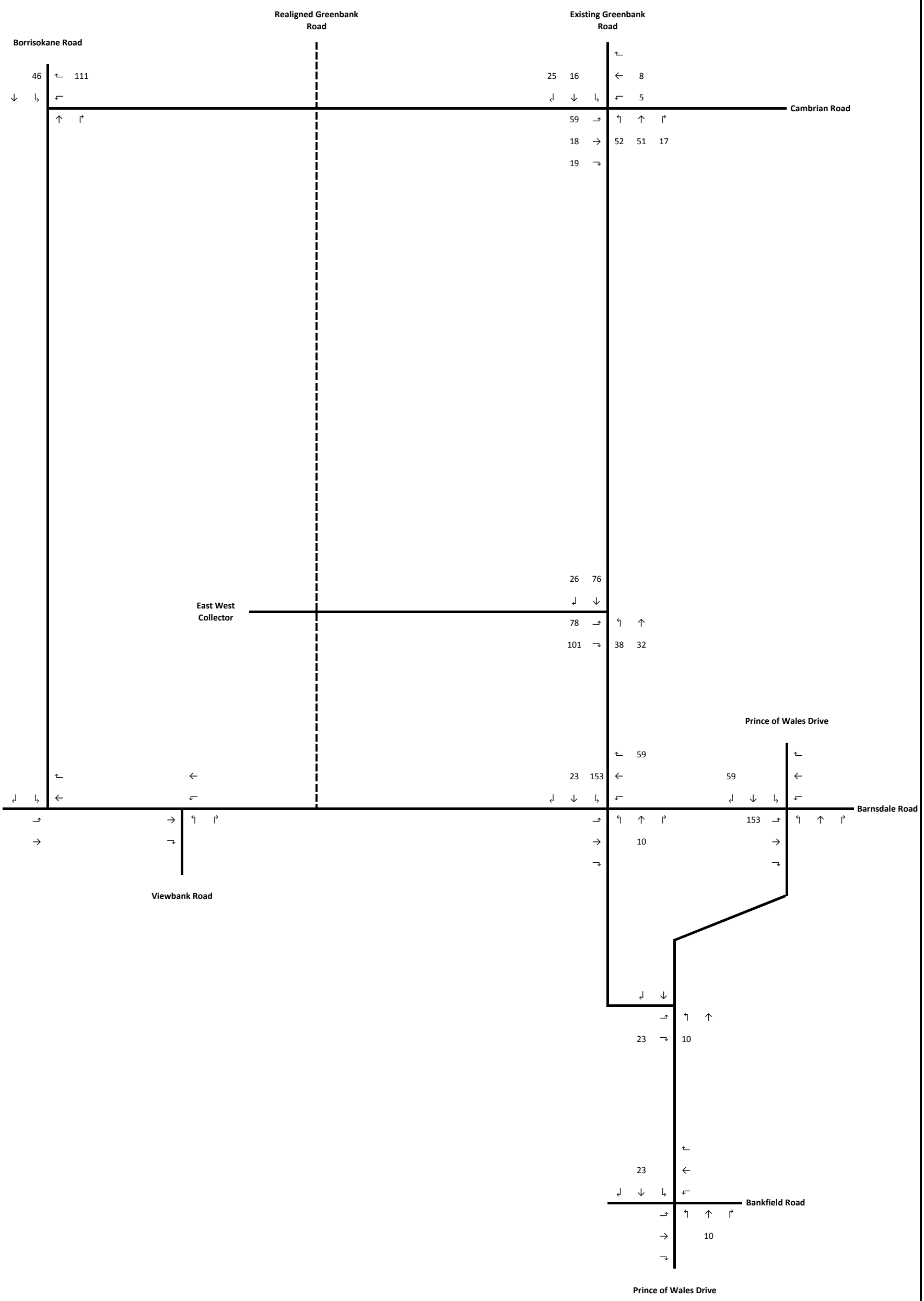


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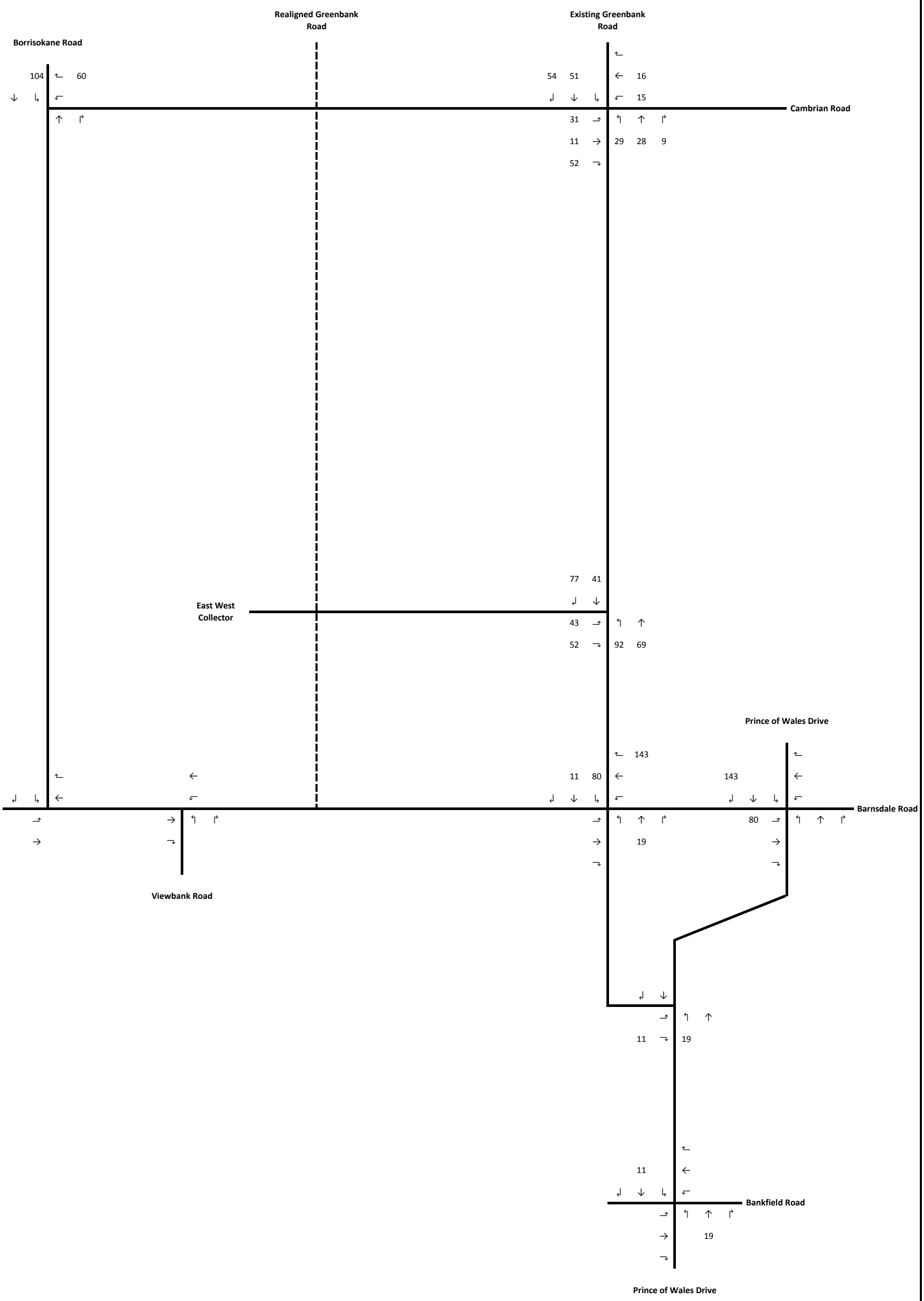
Figure 14 2025 Interim Site Traffic Volumes AM Peak Hour



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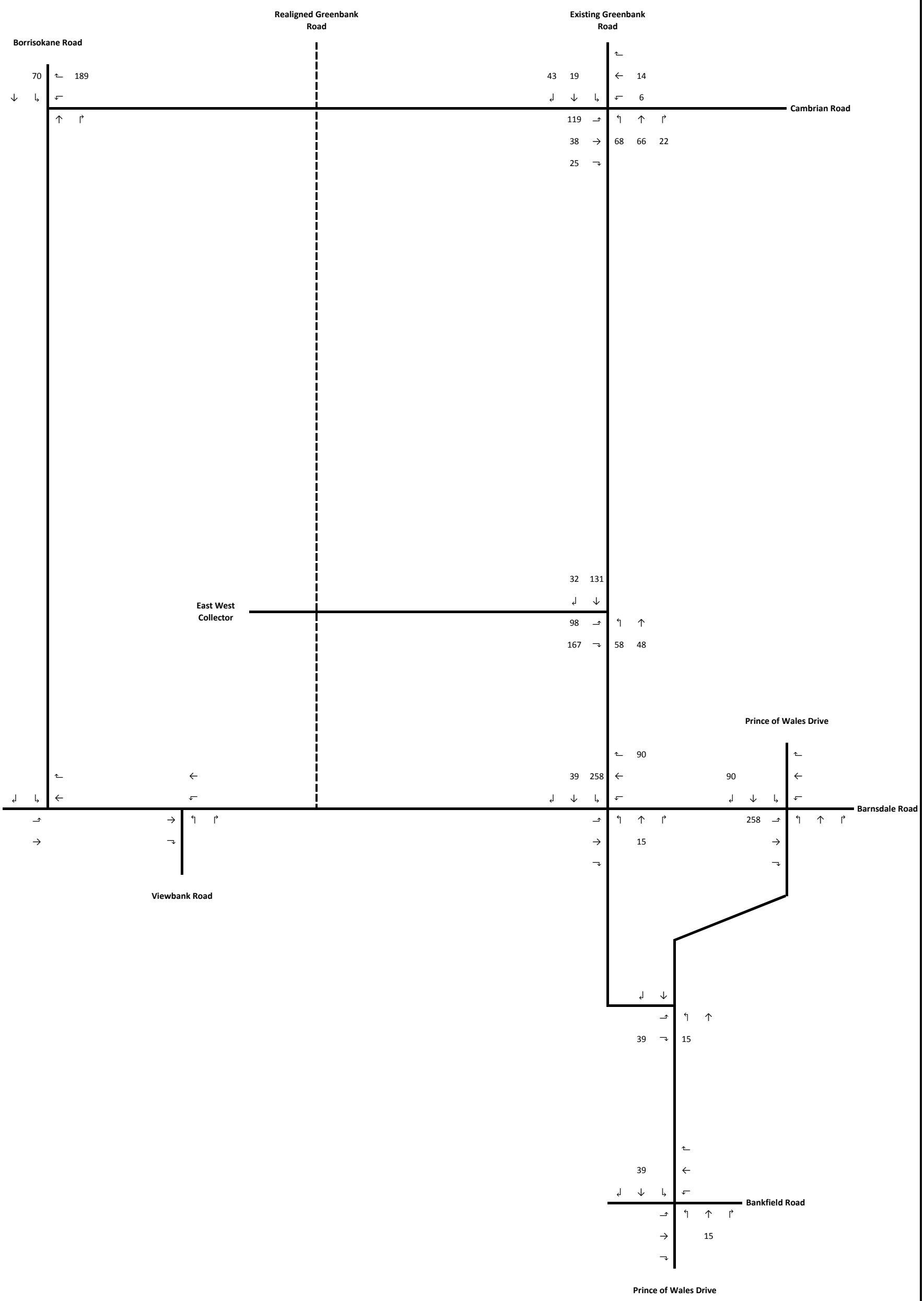
Transportation Master Study
Figure 15 2025 Interim Site Traffic Volumes PM Peak Hour



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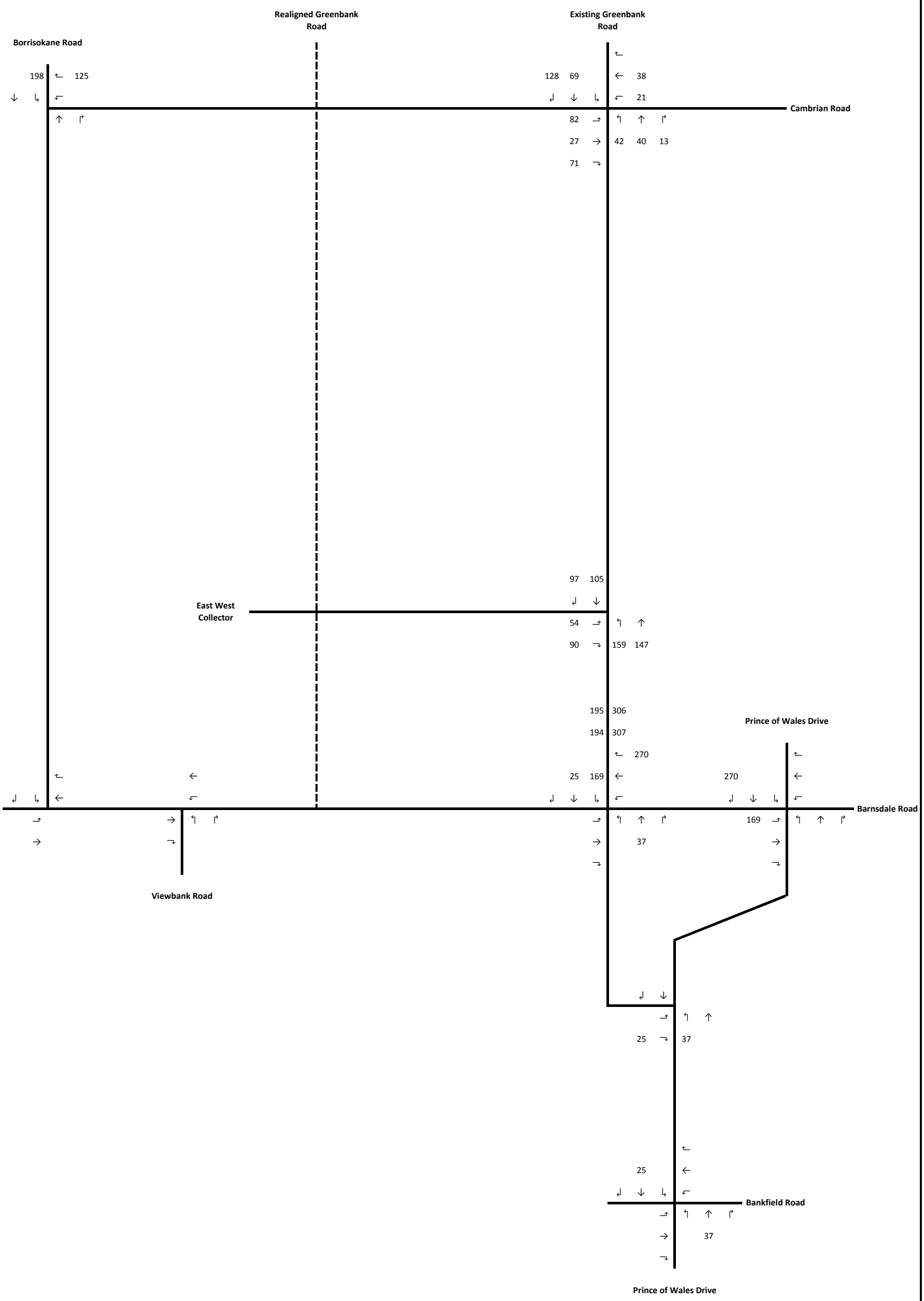
Barrhaven South Urban Expansion Study Area CDP
Transportation Master Study
Figure 16 2031 Ultimate Site Traffic Volumes AM Peak Hour



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Barrhaven South Urban Expansion Study Area CDP
Transportation Master Study
Figure 17 2031 Ultimate Site Traffic Volumes PM Peak Hour

6.0 TRANSPORTATION IMPACT ASSESSMENT

6.1 JOCK RIVER SCREENLINE GROWTH

A screenline is an imaginary line that is drawn along the boundary of an area of interest, in this case, the Jock River. System capacity across a screenline is determined by the number of roads and travel lanes which cross the screenline. Traffic demands are then compared to the available capacity to determine if there is a shortfall in system capacity.

Screenline data from the TRANS regional transportation model for the Jock River screenline (screenline 49) was obtained from the City of Ottawa's Transportation Modeling department for the years 2011 and 2031. The TRANS model and screenline data reflects the planned transportation network identified in the City of Ottawa's 2013 TMP (i.e. the affordable transportation plan). As outlined previously, the affordable transit network in the TMP does not include the Bus Rapid Transit component of Realigned Greenbank Road as occurring prior to 2031. As such, implicit within the screenline data is the fact that Realigned Greenbank Road will not include Bus Rapid Transit prior to 2031 which is reflected in **Table 9** below.

Annual growth rates were calculated for the entire screenline and at each station between Borrisokane Road and Prince of Wales Drive between 2011 and 2031 (assuming a straight-line growth assumption), which is outlined in **Table 9** below. The inbound movements represent vehicles traveling towards the urban core (i.e. leaving Barrhaven South by traveling north across the screenline) and outbound movements represent vehicles traveling away from the urban core (i.e. entering Barrhaven South by travelling south across the screenline). The inbound movement represents the predominant direction of travel during the AM peak and the outbound movement represents the predominant direction of travel during the PM peak.

As there are updated 2015 counts at the Borrisokane Road screenline station, these volumes replaced the 2011 volumes and were used in calculating the annual growth rate to 2031.

Total annual growth across the entire screenline is forecasted to be 7% during the AM peak (predominant direction being "inbound") and 6% during the PM peak (predominant direction being "outbound"). At individual stations the majority of the screenline growth is anticipated to occur at the Borrisokane Road and Existing Greenbank Road locations.

Table 9 Jock River Screenline Growth from 2011 to 2031

STATION	DIRECTION	2011 VOLUMES		2031 VOLUMES		ANNUAL GROWTH 2011 TO 2031	
		AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
Borrisokane	Inbound	346[1]	164[1]	694	165	6%	0%
	Outbound	104[1]	283[1]	67	637	-2%	8%
Greenbank	Inbound	414	137	1338	310	11%	6%
	Outbound	74	320	117	1012	3%	11%
Jockvale	Inbound	544	335	1411	381	8%	1%
	Outbound	194	562	175	1202	0%	6%
Prince of Wales	Inbound	931	507	1751	971	4%	5%
	Outbound	525	833	551	1736	0%	5%
Total	**Inbound**	2235	1143	5194	1827	7%	3%
	Outbound	897	1998	910	4587	0%	6%

Notes: 1. Taken from 2015 turning movement counts at Borrisokane / Cambrian

6.2 2016 EXISTING CONDITIONS

6.2.1 Jock River Screenline Performance

Using the annual growth rates from **Table 9**, the screenline data from 2011 (or 2015 for Borrisokane) was interpolated to the existing 2016 condition and can be seen in **Table 10** below.

Table 10 2016 Jock River Screenline Analysis

STATION	DIRECTION	2016 EXISTING CONDITIONS					
		AM Peak Hour	PM Peak Hour	Lanes	Capacity (Veh/hr)	AM Peak v/c[1]	PM Peak v/c[1]
Borrisokane	Inbound	386	170	1	1000	0.39	0.17
	Outbound	119	298	1	1000	0.12	0.30
Greenbank	Inbound	645	180	1	1000	0.65	0.18
	Outbound	85	493	1	1000	0.09	0.49
Jockvale	Inbound	761	347	2	2000	0.38	0.17
	Outbound	189	722	2	2000	0.09	0.36
Prince of Wales	Inbound	1136	623	2	2000	0.57	0.31
	Outbound	532	1059	2	2000	0.27	0.53
Total	**Inbound**	**2928**	**1320**	**6**	**6000**	**0.49**	**0.22**
	Outbound	**925**	**2572**	**6**	**6000**	**0.15**	**0.43**

Notes: 1. Volume to capacity ratio: compares roadway demand (vehicle volumes) with roadway supply (roadway carrying capacity).

As shown in **Table 10**, the volumes fall well below the capacities at all four stations along the Jock River screenline under 2016 existing conditions. In addition, the total volume across the entire

screenline is less than half of the existing available capacity which suggests that significant residual capacity exists across the screenline to accommodate future growth. During the AM peak, where predominant direction is inbound, the screenline currently operates at v/c 0.49. During the PM peak, where the predominant direction is outbound, the screenline currently operates at v/c 0.43.

6.2.2 Intersection Performance

An assessment of the study area intersections was undertaken to determine the operational characteristics of these intersections under existing 2016 conditions. The operational analysis was facilitated by Synchro 9.0™ software package for stop-controlled and signalized intersections and SIDRA 6.1 for roundabout intersections. Signal timings were obtained from the City of Ottawa and were used in the assessment of 2016 existing conditions.

Table 11 provides a summary of 2016 existing intersection operations.

Barnsdale Road at Prince of Wales Drive

Barnsdale Road at Prince of Wales Drive intersection currently operates at a level of service (LOS) F based on the excessive delay experienced by the eastbound and westbound approaches. The City of Ottawa is currently undertaking a functional design study of this intersection where it will be determined whether traffic signals or a roundabout will be required to address the operational constraints at this location. As such, recommendations to improve this intersection will not be made as part of the subject TMS study.

Bankfield Road at Prince of Wales Drive

The Bankfield Road at Prince of Wales Drive intersection currently operates at capacity during both the AM and PM peak hours. As outlined in the *Realigned Greenbank Road and South West Transitway Extension Environmental Assessment Study* (MMM 2014), this intersection is planned to be upgraded to a double lane roundabout. Intersection performance analysis, however, indicates that a single lane roundabout would be sufficient to address the existing intersection performance issues currently experienced at this intersection.

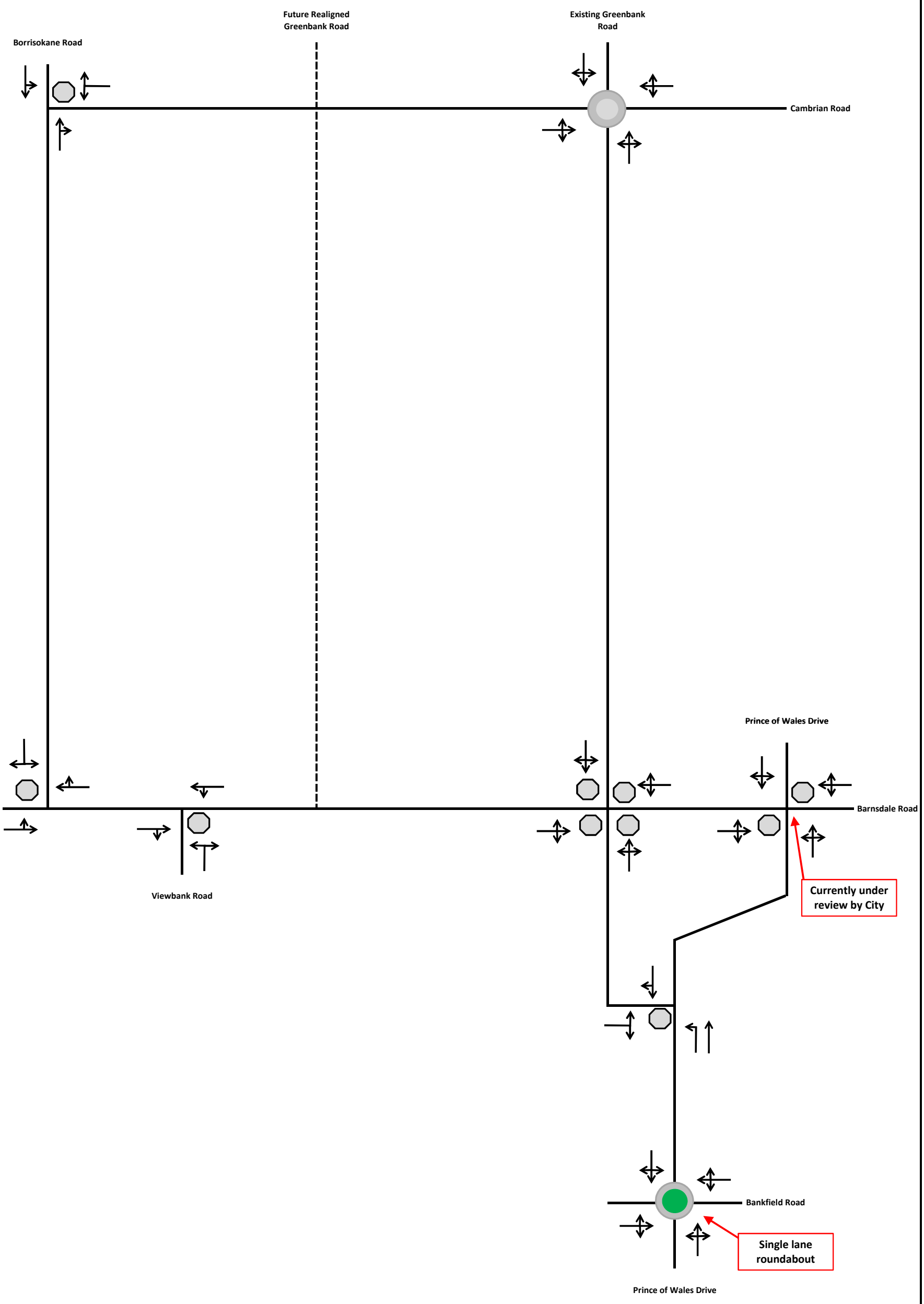
Figure 18 illustrates the required intersection control and lane configuration to accommodate the 2016 existing conditions.

Appendix C contains detailed intersection performance worksheets.

Table 11 2016 Existing Intersection Operations

INTERSECTION	TRAFFIC CONTROL	APPROACH / MOVEMENT		LOS	V/C[2]	DELAY (s)	Q[3] (m)
Cambrian Road at Borrisokane Road	Minor Stop Control	WB	Left / Right	B (A)	0.38 (0.16)	10.6 (9.6)	13.5 (4.2)
		NB	Through / Right	A (A)	0.02 (0.03)	0.0 (0.0)	0.0 (0.0)
		SB	Left / Through	A (A)	0.06 (0.17)	5.7 (6.7)	1.5 (6.7)
		Overall Intersection		***A (A)***	**-**	***8.7 (6.9)***	**-**
Existing Greenbank Road at Cambrian Road	Single Lane Roundabout	EB	Left / Through / Right	A (A)	0.23 (0.35)	1.8 (3.4)	9.2 (16.4)
		WB	Left / Through / Right	A (A)	0.19 (0.32)	2.3 (2.3)	7.9 (14.4)
		NB	Left / Through / Right	A(A)	0.33 (0.24)	2.1 (2.1)	14.7 (10.4)
		SB	Left / Through / Right	A (A)	0.18 (0.45)	1.6 (2.4)	7.3 (22.7)
		Overall Intersection		***A (A)***	***0.33 (0.45)***	***2.1 (22.7)***	**-**
Barnsdale Road at Borrisokane Road	Minor Stop Control	EB	Left / Through	A (A)	0.02 (0.02)	1.2 (1.3)	0.3 (0.4)
		WB	Through / Right	A (A)	0.08 (0.12)	0.0 (0.0)	0.0 (0.0)
		SB	Left / Right	A (B)	0.04 (0.08)	9.6 (10.1)	1.1 (2.0)
		Overall Intersection		***A (A)***	**-**	***1.7 (2.0)***	**-**
Barnsdale Road at Viewbank Road	Minor Stop Control	EB	Left / Through	A (A)	0.08 (0.09)	0.0 (0.0)	0.0 (0.0)
		WB	Through / Right	A (A)	0.00 (0.00)	0.1 (0.0)	0.0 (0.0)
		NB	Left / Right	A (B)	0.01 (0.01)	9.7 (10.2)	0.1 (0.1)
		Overall Intersection		***A (A)***	**-**	***0.2 (0.1)***	**-**
Barnsdale Road at Existing Greenbank Road	All-Way Stop Control	EB	Left / Through / Right	A (B)	0.19 (0.35)	9.2 (11.0)	0.7 (1.6)
		WB	Left / Through / Right	A (B)	0.19 (0.23)	9.3 (10.1)	0.7 (0.8)
		NB	Left / Through / Right	B (B)	0.32 (0.46)	10.2 (12.7)	1.3 (2.4)
		SB	Left / Through / Right	A (B)	0.23 (0.22)	9.6 (10.2)	0.9 (0.8)
		Overall Intersection		***A (B)***	**-**	***9.7 (11.3)***	**-**
Barnsdale Road at Prince of Wales Drive	Minor Stop Control	EB	Left / Through / Right	F (F)	1.34 (1.07)	225.3 (147.1)	117.0 (66.7)
		WB	Left / Through / Right	C (E)	0.25 (0.35)	24.45 (35.0)	7.2 (11.2)
		NB	Left / Through / Right	A (A)	0.01 (0.01)	0.2 (0.2)	0.1 (0.1)
		SB	Left / Through / Right	A (A)	0.01 (0.00)	0.2 (0.1)	0.2 (0.1)
		Overall Intersection		***E (C)***	**-**	***48.7 (19.1)***	**-**
Existing Greenbank Road at Prince of Wales Drive	Minor Stop Control	EB	Left / Right	B (C)	0.33 (0.52)	12.9 (22.7)	11.0 (21.8)
		NB	Left	A (B)	0.10 (0.27)	8.0 (10.6)	2.5 (8.2)
			Through	A (A)	0.37 (0.20)	0.0 (0.0)	0.0 (0.0)
		SB	Through / Right	A (A)	0.14 (0.43)	0.0 (0.0)	0.0 (0.0)
		Overall Intersection		***A (A)***	**-**	***3.2 (4.8)***	**-**
Bankfield Road at Prince of Wales Drive	Traffic Signals	EB	Left / Through / Right	F (F)	1.22 (1.10)	147.7 (98.4)	#252.6 (#268.6)
		WB	Left / Through / Right	B (A)	0.61 (0.53)	24.5 (21.5)	138.0 (113.3)
		NB	Left / Through	C (D)	0.76 (0.81)	50.3 (61.8)	#128.3 (#95.6)
			Right	A (A)	0.02 (0.01)	34.8 (37.2)	0.0 (0.0)
		SB	Left	A (A)	0.34 (0.39)	28.1 (27.5)	26.3 (41.2)
			Through / Right	A (F)	0.46 (1.12)	29.1 (111.5)	80.8 (#292.8)
		Overall Intersection		***F (F)***	***1.08 (1.25)***	***66.3 (78.1)***	**-**
	Single Lane Roundabout	***Improvement: Upgrade Traffic Control to Roundabout***					
		EB	Left / Through / Right	A (B)	0.44 (0.76)	2.7 (11.4)	24.1 (72.7)
		WB	Left / Through / Right	A (A)	0.62 (0.46)	7.5 (3.1)	43.9 (23.1)
		NB	Left / Through / Right	A (A)	0.47 (0.34)	4.9 (5.0)	25.0 (17.0)
		SB	Left / Through / Right	A (A)	0.43 (0.82)	3.4 (8.4)	22.6 (96.8)
		Overall Intersection		***A (A)***	***0.62 (0.82)***	***4.7 (7.8)***	**-**

Notes:
1. Table format: AM (PM)
2. v/c – represents the anticipated volume divided by the predicted capacity
3. 95th Percentile Queue (m)
4. # - 95th percentile volume exceeds capacity, queue may be longer



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Transportation Master Study
Figure 18 Intersection Control and Lane Configuration Required to Accommodate 2016 Existing Traffic Volumes

6.3 2025 FUTURE BACKGROUND CONDITIONS

Future background conditions for the 2025 horizon were assessed to determine transportation improvements that may be required to address growth in traffic exclusive from improvements that may be required to accommodate traffic generated by the subject lands.

Figure 19 and **Figure 20** illustrate the 2025 future background traffic volumes.

The improvements required to address the 2016 existing conditions were carried forward in the analysis of 2025 future background conditions.

Table 12 summarizes the operational characteristics of the study area intersections under 2025 future background conditions.

Existing Greenbank Road at Cambrian Road

The Existing Greenbank Road at Cambrian Road intersection is projected to experience significant delays in the southbound direction during the PM peak hour under 2025 future background conditions. As outlined in the *Cambrian Road Widening Environmental Assessment Study* (Stantec 2014), the Existing Greenbank Road and Cambrian Road intersection is recommended to be upgraded to a double-lane roundabout. The Cambrian Road EA assumed that Realigned Greenbank Road would be constructed as per the timelines set forth in the TMP, however, and the EA concluded that the north leg of the Existing Greenbank Road at Cambrian Road intersection could be maintained as a two-lane cross-section with one southbound lane entering the roundabout and one northbound lane exiting the intersection.

Through this CDP process, it was found that the timing of Realigned Greenbank Road will not follow the City's TMP and will be determined at the next TMP update. As part of the subject study, it was assumed that Realigned Greenbank Road will not be in place, and therefore, Existing Greenbank Road will be heavily relied on as a major route to / from the Barrhaven South community. As such, the volumes along Existing Greenbank Road will be significantly higher than the volumes projected in the Cambrian Road EA.

To accommodate the projected southbound volumes along Existing Greenbank Road, a southbound right turn lane is required at the Existing Greenbank Road at Cambrian Road roundabout intersection.

Barnsdale Road at Prince of Wales Drive

Consistent with the analysis of 2016 existing conditions, the Barnsdale Road at Prince of Wales Drive intersection is projected to operate with significant delays. The City of Ottawa is currently undertaking a functional design study of this intersection and as part of this study, it will be determined whether traffic signals or a roundabout will be required to address the operational

constraints at this location. As such, recommendations to improve this intersection will not be made as part of the subject study.

Existing Greenbank Road at Prince of Wales Drive

By 2025 the eastbound movement at the Existing Greenbank Road at Prince of Wales Drive intersection is projected to operate with significant delays during the PM peak hour. As outlined in the *Realigned Greenbank Road and South West Transitway Extension Environmental Assessment Study* (MMM 2014), this intersection is ultimately planned to be upgraded to include traffic signals, left and right turn auxiliary lanes, and dual northbound and southbound through lanes along Prince of Wales Drive.

To address the projected delays at this intersection under 2025 future background conditions, however, only traffic signals are required with left turn auxiliary lanes.

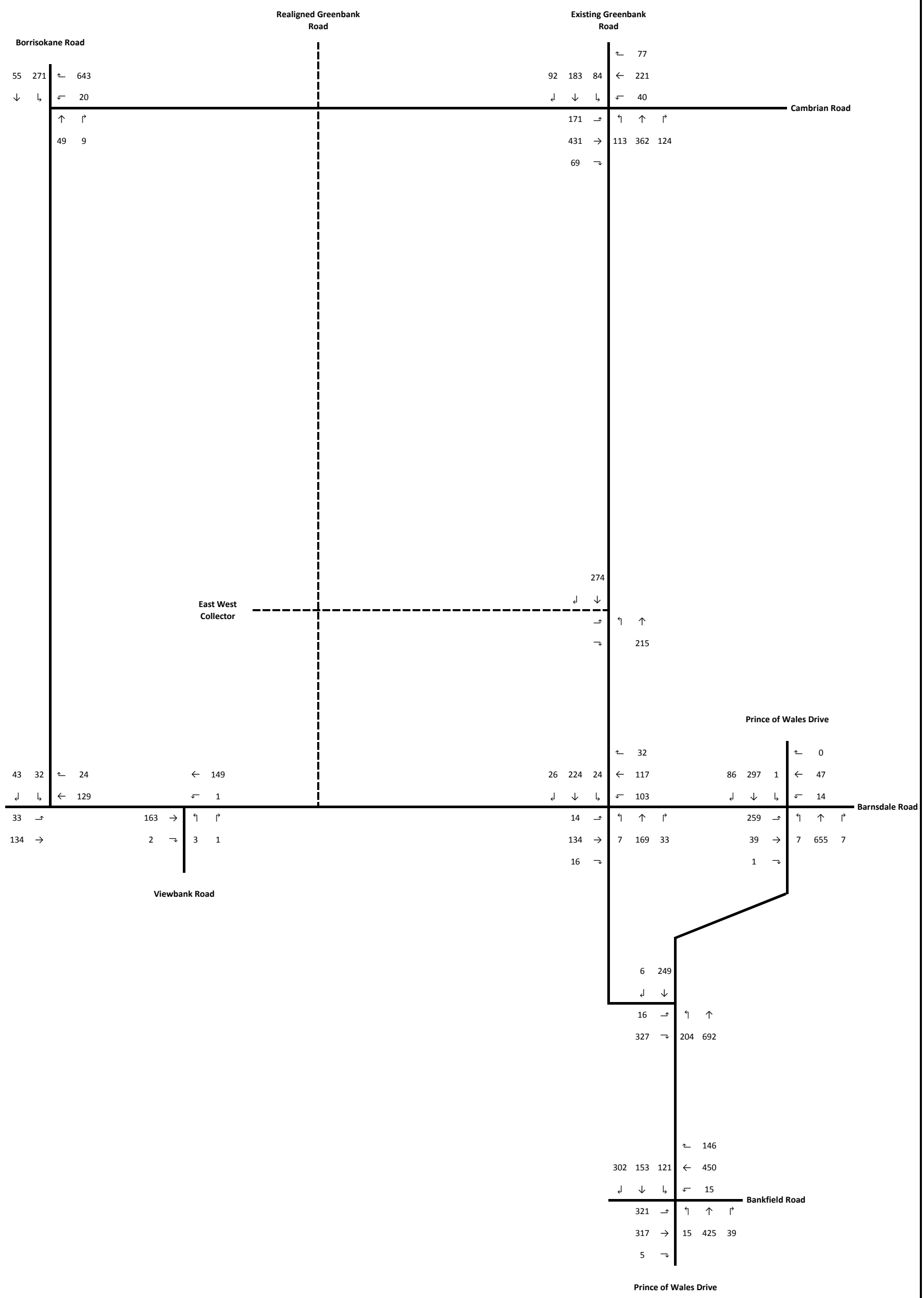
Bankfield Road at Prince of Wales Drive

The single lane roundabout configuration – which was recommended to accommodate existing conditions - is insufficient to handle the projected 2025 future background traffic volumes. As outlined in the *Realigned Greenbank Road and South West Transitway Extension Environmental Assessment Study* (MMM 2014), this intersection is ultimately planned to be upgraded to a double lane roundabout.

Incorporating aspects of the ultimate EA design, it was found that this intersection requires a southbound right turn lane and dual eastbound through lanes to operate acceptably with the projected 2025 future background traffic volumes.

Figure 21 illustrates the 2025 future background intersection control and lane configuration.

Appendix C contains detailed intersection performance worksheets.



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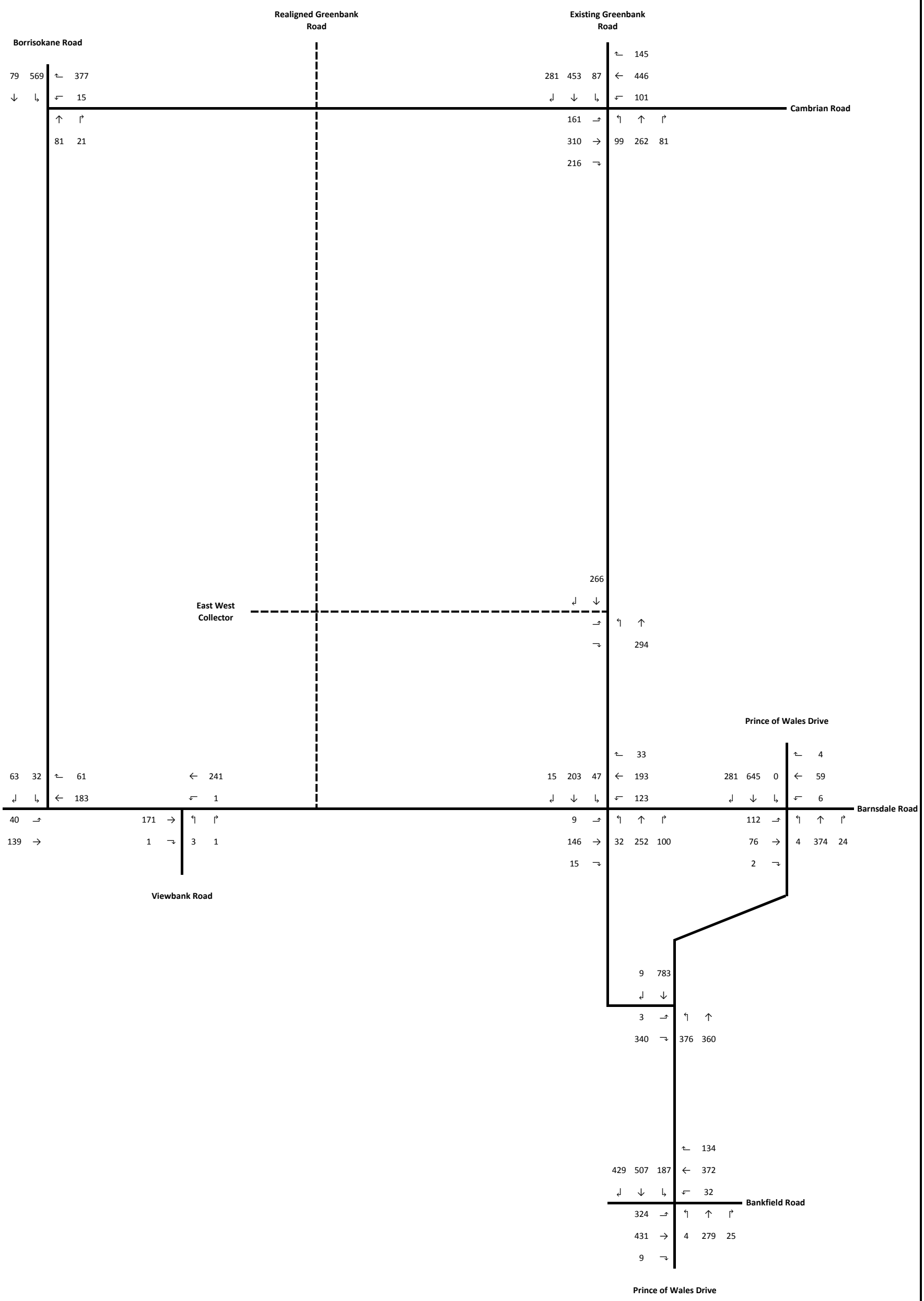
Transportation Master Study
Figure 19 2025 Future Background Traffic Volumes
AM Peak Hour



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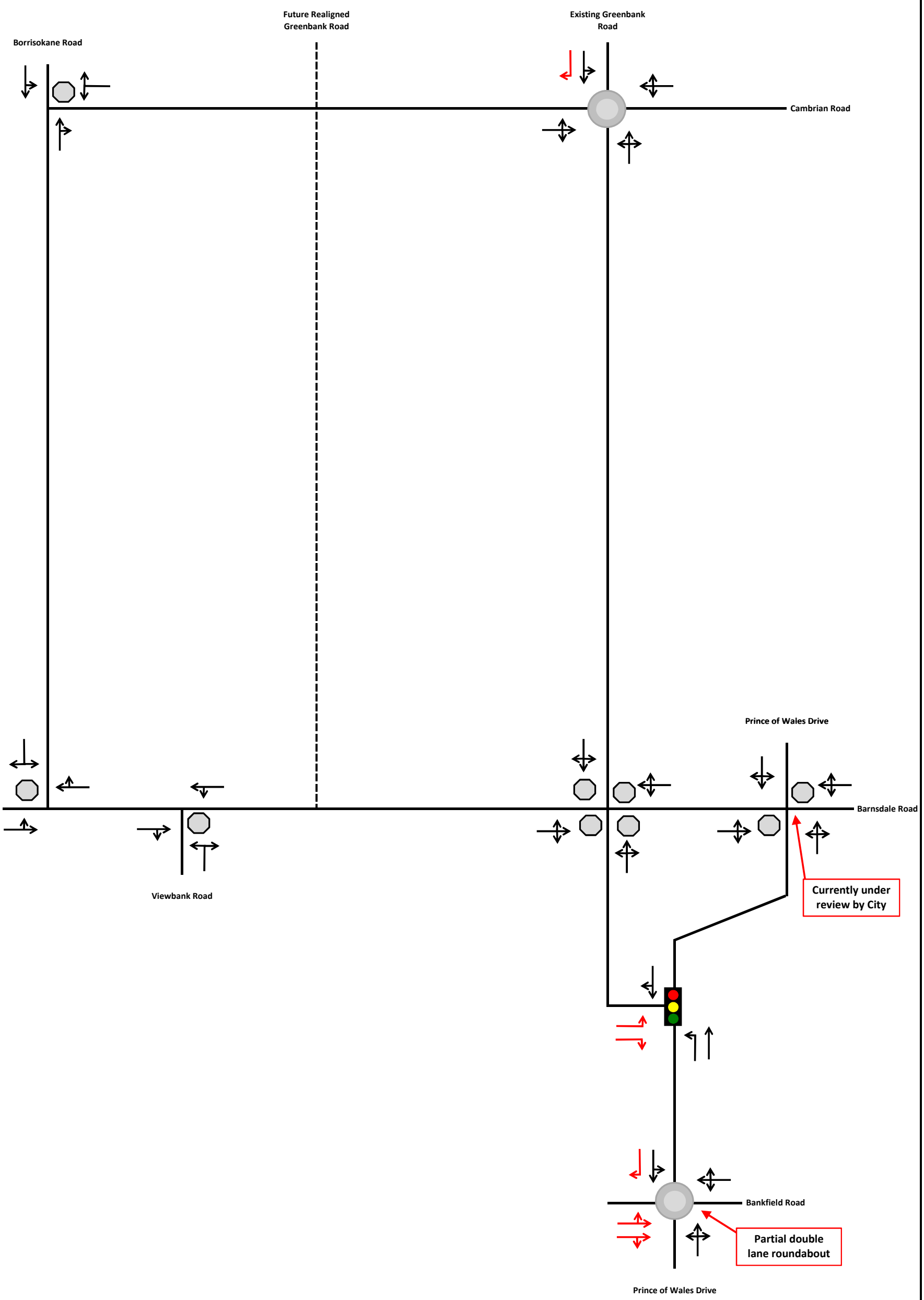
Barrhaven South Urban Expansion Study Area CDP
Transportation Master Study
Figure 20 2025 Future Background Traffic Volumes
PM Peak Hour

Table 12 2025 Future Background Intersection Operations

INTERSECTION	TRAFFIC CONTROL	APPROACH / MOVEMENT		LOS	V/C[2]	DELAY (s)	Q[3] (m)
Cambrian Road at Borrisokane Road	Minor Stop Control	WB	Left / Right	C (C)	0.69 (0.53)	17.0 (15.3)	48.7 (25.1)
		NB	Through / Right	A (A)	0.03 (0.06)	0.0 (0.0)	0.0 (0.0)
		SB	Left / Through	A (A)	0.18 (0.38)	6.7 (8.3)	4.8 (14.0)
		Overall Intersection		***B (A)***	**-**	***12.8 (9.9)***	**-**
Existing Greenbank Road at Cambrian Road	Single Lane Roundabout	EB	Left / Through / Right	A (C)	0.61 (0.87)	3.7 (19.3)	41.2 (120.8)
		WB	Left / Through / Right	A (B)	0.45 (0.79)	5.4 (11.5)	25.0 (84.3)
		NB	Left / Through / Right	B (A)	0.82 (0.55)	17.9 (5.8)	93.9 (34.7)
		SB	Left / Through / Right	A (F)	0.36 (1.13)	3.0 (256.2)	41.2 (985.3)
		Overall Intersection		***A (F)***	***0.82 (1.13)***	***8.2 (88.6)***	**-**
		Improvement: Implementation of a Southbound Right Turn Lane					
		EB	Left / Through / Right	A (C)	0.61 (0.93)	3.7 (32.4)	40.2 (171.6)
		WB	Left / Through / Right	A (B)	0.45 (0.79)	5.4 (11.5)	25.0 (84.5)
		NB	Left / Through / Right	B (A)	0.82 (0.55)	17.8 (6.0)	93.2 (35.2)
		SB	Left / Through	A (A)	0.22 (0.59)	2.5 (6.1)	10.0 (44.0)
			Right	A (A)	0.11 (0.40)	2.6 (5.0)	4.1 (20.7)
		Overall Intersection		***A (B)***	***0.82 (0.93)***	***8.1 (14.2)***	**-**
Barnsdale Road at Borrisokane Road	Minor Stop Control	EB	Left / Through	A (A)	0.02 (0.03)	1.7 (1.9)	0.5 (0.7)
		WB	Through / Right	A (A)	0.09 (0.14)	0.0 (0.0)	0.0 (0.0)
		SB	Left / Right	B (B)	0.10 (0.13)	10.2 (10.8)	2.5 (3.5)
		Overall Intersection		***A (A)***	**-**	***2.6 (2.7)***	**-**
Barnsdale Road at Viewbank Road	Minor Stop Control	EB	Left / Through	A (A)	0.10 (0.10)	0.0 (0.0)	0.0 (0.0)
		WB	Through / Right	A (A)	0.00 (0.00)	0.1 (0.0)	0.0 (0.0)
		NB	Left / Right	B (B)	0.01 (0.01)	10.0 (10.6)	0.1 (0.1)
		Overall Intersection		***A (A)***	**-**	***0.2 (0.1)***	**-**
Barnsdale Road at Existing Greenbank Road	All-Way Stop Control	EB	Left / Through / Right	B (B)	0.26 (0.32)	10.6 (13.2)	1.0 (1.4)
		WB	Left / Through / Right	B (C)	0.39 (0.62)	12.1 (20.0)	1.9 (4.7)
		NB	Left / Through / Right	B (C)	0.30 (0.65)	10.9 (20.7)	1.3 (5.4)
		SB	Left / Through / Right	B (C)	0.41 (0.48)	12.2 (15.6)	2.1 (2.7)
		Overall Intersection		***B (C)***	**-**	***11.6 (18.2)***	**-**
Barnsdale Road at Prince of Wales Drive	Minor Stop Control	EB	Left / Through / Right	F (F)	1.72 (1.48)	1365.2 (970.5)	530.7 (294.0)
		WB	Left / Through / Right	D (E)	0.30 (0.45)	28.8 (47.3)	9.8 (17.9)
		NB	Left / Through / Right	A (A)	0.01 (0.01)	0.2 (0.2)	0.2 (0.2)
		SB	Left / Through / Right	A (A)	0.01 (0.00)	0.2 (0.1)	0.2 (0.1)
		Overall Intersection		***F (F)***	**-**	***291.5 (119.5)***	**-**
Existing Greenbank Road at Prince of Wales Drive	Minor Stop Control	EB	Left / Right	C (F)	0.52 (0.94)	16.5 (101.5)	24.6 (136.2)
		NB	Left	A (B)	0.15 (0.45)	1.8 (12.9)	3.9 (18.7)
			Through	A (A)	0.41 (0.21)	0.0 (0.0)	0.0 (0.0)
		SB	Through / Right	A (A)	0.15 (0.47)	0.0 (0.0)	0.0 (0.0)
		Overall Intersection		***A (C)***	**-**	***4.9 (21.2)***	**-**
	Traffic Signals	***Improvement: Upgrade Traffic Control to Signals with Left Turn Auxiliary Lanes***					
		EB	Left	A (A)	0.09 (0.02)	34.4 (37.4)	8.8 (3.2)
			Right	A (A)	0.21 (0.21)	35.2 (38.8)	34.3 (37.6)
		NB	Left	A (C)	0.22 (0.77)	3.5 (29.0)	20.8 (#109.5)
			Through	A (A)	0.48 (0.25)	5.0 (3.2)	87.6 (36.5)
		SB	Through / Right	A(D)	0.18 (0.82)	3.1 (27.2)	23.9 (#256.7)
		Overall Intersection		***A (C)***	***0.45 (0.75)***	***11.5 (25.1)***	**-**
Bankfield Road at Prince of Wales Drive	Single Lane Roundabout	EB	Left / Through / Right	A (F)	0.59 (1.06)	3.9 (150.6)	39.3 (604.3)
		WB	Left / Through / Right	C (A)	0.89 (0.65)	30.3 (7.9)	137.7 (48.9)
		NB	Left / Through / Right	B (B)	0.71 (0.57)	13.2 (11.0)	60.7 (38.2)
		SB	Left / Through / Right	A (F)	0.67 (0.1.15)	7.1 (290.3)	53.8 (1487.7)
		Overall Intersection		***B (F)***	***0.89 (1.15)***	***13.6 (1487.7)***	**-**
	Partial Double Lane Roundabout	**Improvement: Implementation of an Exclusive Southbound Right Turn Lane and Dual Eastbound Through Lanes**					
		EB	Left / Through / Right	A (A)	0.28 (0.50)	2.8 (7.1)	13.1 (33.0)
		WB	Left / Through / Right	C (A)	0.87 (0.66)	25.3 (8.4)	119.6 (50.3)
		NB	Left / Through / Right	B (B)	0.64 (0.56)	10.7 (12.5)	48.0 (36.9)
		SB	Left / Through	A (A)	0.31 (0.60)	4.0 (3.8)	15.4 (43.0)
			Right	A (A)	0.28 0.47)	2.6 (3.3)	14.9 (25.1)
		Overall Intersection		***B (A)***	***0.87 (0.66)***	***10.5 (6.5)***	**-**

Notes:
1. Table format: AM (PM)
2. v/c – represents the anticipated volume divided by the predicted capacity
3. 95th Percentile Queue (m)
4. # - 95th percentile volume exceeds capacity, queue may be longer



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Transportation Master Study
Figure 21 2025 Future Background Intersection Control and Lane Configuration

6.4 2025 TOTAL FUTURE CONDITIONS

By 2025, the CDP lands to the east of Realigned Greenbank Road are assumed to be built and occupied.

6.4.1 Jock River Screenline Performance

Using the annual growth rates from **Table 9**, the screenline data was interpolated to the 2025 total future horizon and can be seen in **Table 13** below.

Table 13 2025 Total Future Jock River Screenline Assessment

STATION	DIRECTION	2025 TOTAL FUTURE					
		AM Peak Hour	PM Peak Hour	Lanes	Capacity (Veh / hr)	AM Peak v/c	PM Peak v/c
Borrisokane	Inbound	803	518	1	1000	0.80	0.52
	Outbound	373	753	1	1000	0.37	0.75
Greenbank	Inbound	1061	258	1	1000	1.06	0.26
	Outbound	104	804	1	1000	0.10	0.80
Jockvale	Inbound	1151	367	2	2000	0.58	0.18
	Outbound	181	1010	2	2000	0.09	0.51
Prince of Wales	Inbound	1505	832	2	2000	0.75	0.42
	Outbound	543	1465	2	2000	0.27	0.73
Total	**Inbound**	**4520**	**1975**	**6**	**6000**	**0.75**	**0.33**
	Outbound	**1201**	**4032**	**6**	**6000**	**0.20**	**0.67**

As shown in **Table 13**, the volumes fall well below the capacities at all stations with the exception of the Greenbank Road station. Despite this, the total volume across the entire screenline is significantly less than the available capacity which suggests that there is residual capacity along the screenline as a whole. As drivers start to experience delays at the Greenbank Road station, they will likely alter their driving patterns and find alternate north-south routes to mitigate these delays. As the remaining screenline stations are projected to have residual capacity, commuters will have viable alternatives to cross the Jock River at Borrisokane, Jockvale, or Prince of Wales Drive.

During the AM peak hour, where the predominant direction is inbound, the 2025 screenline is projected to operate at v/c 0.75. During the PM peak hour, where the predominant direction is outbound, the screenline is projected to operate at v/c 0.67.

6.4.2 Intersection Performance

The improvements required to address the 2025 future background conditions were carried forward in the analysis of 2025 total future conditions.

Figure 22 and **Figure 23** illustrate the 2025 total future traffic volumes.

Table 14 below outlines the operations characteristics of the study area intersections under 2025 total future conditions.

Existing Greenbank Road at Cambrian Road

The Existing Greenbank Road at Cambrian Road intersection is projected to experience significant delays in the northbound direction during the AM peak hour and in the eastbound direction during the PM peak hour under 2025 total future conditions. As outlined in the *Cambrian Road Widening Environmental Assessment Study* (Stantec 2014), the Existing Greenbank Road and Cambrian Road intersection is recommended to be upgraded to a double-lane roundabout.

To accommodate the projected 2025 total future traffic volumes at this intersection location, northbound and eastbound right turn lanes are required.

Existing Greenbank Road at Barnsdale Road

The Existing Greenbank Road at Barnsdale Road intersection is projected to operate with significant delays during the PM peak hour under 2025 total future conditions. As outlined in the *Realigned Greenbank Road and South West Transitway Extension Environmental Assessment Study* (MMM 2014), this intersection is planned to be upgraded to include traffic signals with left and right turn auxiliary lanes in most directions.

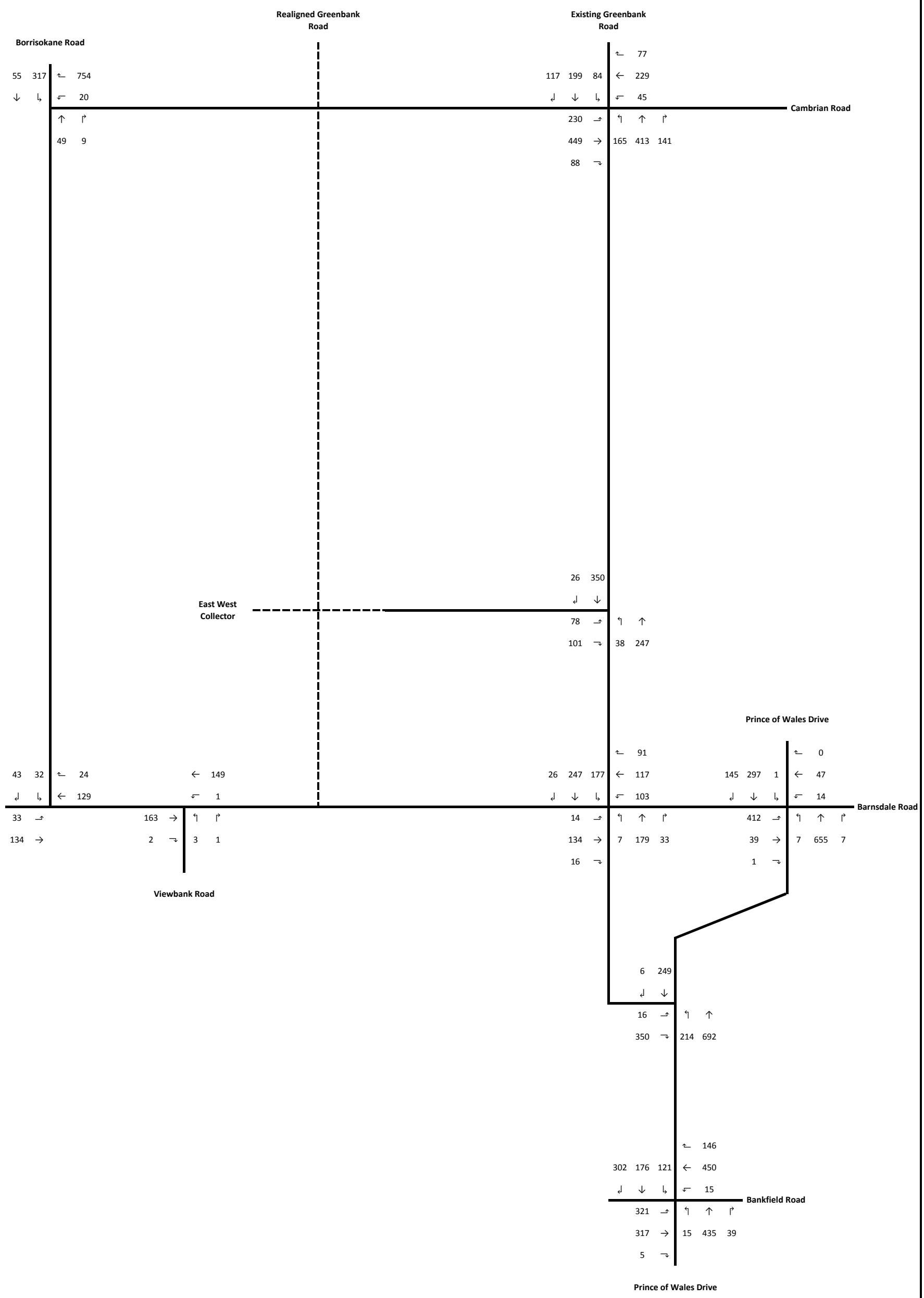
In order to address the operational constraints at this intersection, traffic signals are required with left turn auxiliary lanes in all directions to accommodate the projected 2025 total future traffic volumes.

Barnsdale Road at Prince of Wales Drive

The City of Ottawa is currently undertaking a functional design study of the Prince of Wales Drive at Barnsdale Road intersection. As part of this functional design study, it will be determined whether traffic signals or a roundabout will be required to address the capacity and safety issues that currently exist at this intersection. As such, recommendations to improve this intersection will not be made as part of the subject study.

Figure 24 illustrates the 2025 total future intersection control and lane configuration.

Appendix C contains detailed intersection performance worksheets.



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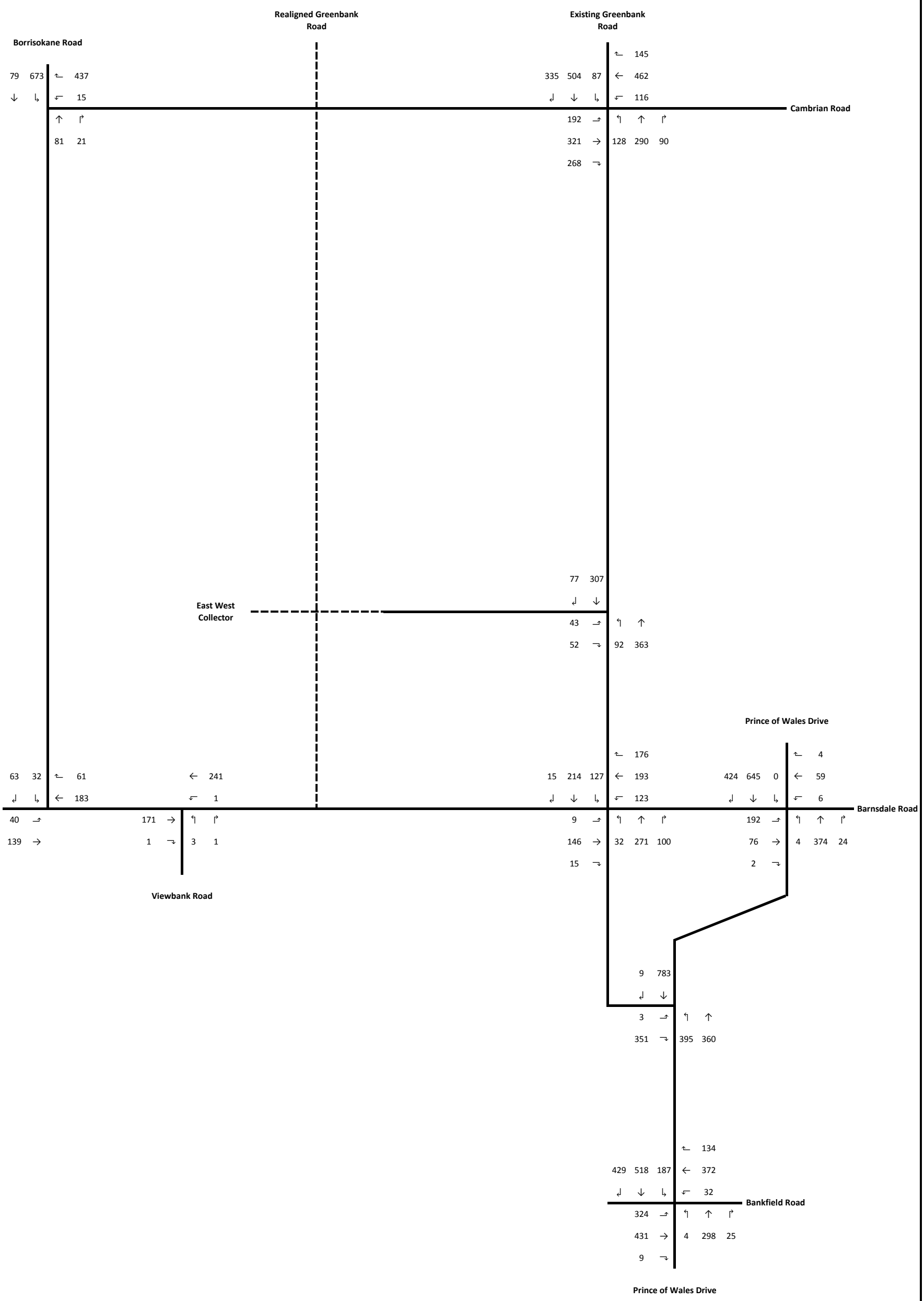
Barrhaven South Urban Expansion Study Area CDP
Transportation Master Study
Figure 22 2025 Total Future Traffic Volumes
AM Peak Hour

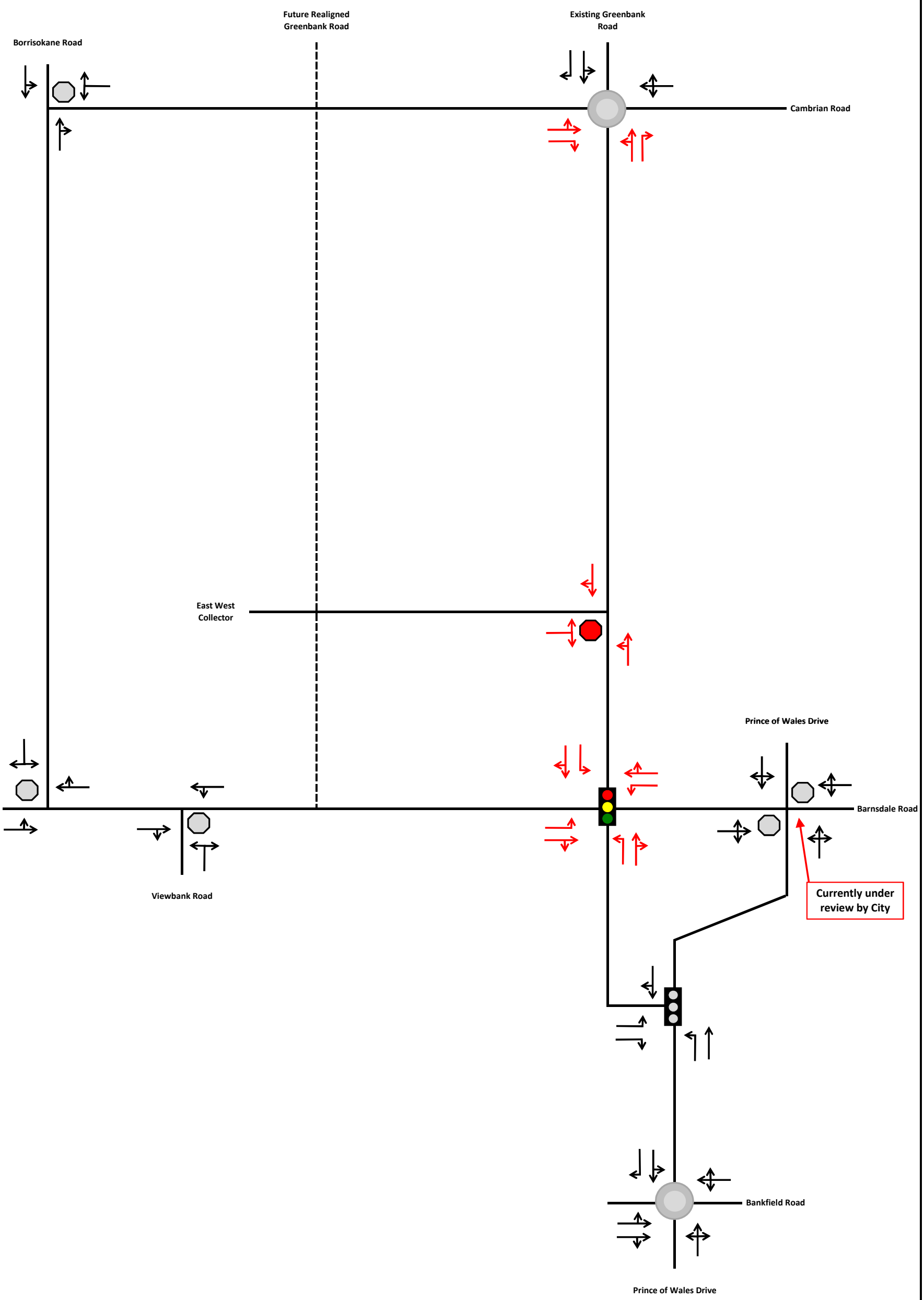


Barrhaven South Urban Expansion Study Area CDP
Transportation Master Study
Figure 23 2025 Total Future Traffic Volumes
PM Peak Hour

Table 14 2025 Total Future Intersection Operations

INTERSECTION	TRAFFIC CONTROL	APPROACH / MOVEMENT		LOS	V/C[2]	DELAY (s)	Q[3] (m)
Cambrian Road at Borrisokane Road	Minor Stop Control	WB	Left / Right	C (C)	0.81 (0.66)	24.1 (20.3)	48.7 (42.4)
		NB	Through / Right	A (A)	0.03 (0.06)	0.0 (0.0)	0.0 (0.0)
		SB	Left / Through	A (A)	0.21 (0.45)	7.0 (8.9)	4.8 (18.7)
		Overall Intersection		***C (A)***	**-**	***17.6 (12.2)***	**-**
Existing Greenbank Road at Cambrian Road	Single Lane Roundabout	EB	Left / Through / Right	A (F)	0.71 (1.16)	5.6 (306.9)	60.8 (1078.5)
		WB	Left / Through / Right	A (C)	0.53 (0.89)	8.1 (21.3)	32.9 (135.1)
		NB	Left / Through / Right	F (A)	1.11 (0.61)	234.4 (6.8)	801.1 (43.7)
		SB	Left / Through	A (A)	0.24 (0.68)	2.7 (9.2)	11.3 (61.6)
			Right	A (A)	0.13 (0.51)	2.9 (7.4)	5.4 (30.9)
		Overall Intersection		***E (F)***	***1.11 (1.16)***	***79.0 (90.7)***	**-**
		Improvement: Implementation of Eastbound and Northbound Right Turn Lanes					
		EB	Left / Through	A (A)	0.53 (0.60)	2.8 (7.8)	30.7 (46.0)
			Right	A (A)	0.11 (0.41)	2.6 (5.9)	3.9 (22.0)
		WB	Left / Through / Right	B (C)	0.57 (0.90)	10.0 (24.2)	38.2 (146.1)
		NB	Left / Through	B (A)	0.67 (0.43)	10.2 (4.1)	58.4 (25.0)
			Right	A (A)	0.25 (0.14)	6.4 (4.6)	11.0 (6.0)
		SB	Left / Through	A (A)	0.24 (0.68)	2.8 (9.2)	11.5 (61.6)
			Right	A (A)	0.14 (0.51)	3.0 (7.4)	5.5 (30.9)
		Overall Intersection		***A (B)***	***0.67 (0.90)***	***8.3 (11.2)***	**-**
Barnsdale Road at Borrisokane Road	Minor Stop Control	EB	Left / Through	A (A)	0.02 (0.03)	1.7 (1.9)	0.5 (0.7)
		WB	Through / Right	A (A)	0.09 (0.14)	0.0 (0.0)	0.0 (0.0)
		SB	Left / Right	B (B)	0.10 (0.13)	10.2 (10.8)	2.5 (3.5)
		Overall Intersection		***A (A)***	**-**	***2.6 (2.7)***	**-**
Barnsdale Road at Viewbank Road	Minor Stop Control	EB	Left / Through	A (A)	0.10 (0.10)	0.0 (0.0)	0.0 (0.0)
		WB	Through / Right	A (A)	0.00 (0.00)	0.1 (0.0)	0.0 (0.0)
		NB	Left / Right	B (B)	0.01 (0.01)	10.0 (10.6)	0.1 (0.1)
		Overall Intersection		***A (A)***	**-**	***0.2 (0.1)***	**-**
Barnsdale Road at Existing Greenbank Road	All-Way Stop Control	EB	Left / Through / Right	B (C)	0.31 (0.42)	12.6 (18.1)	1.3 (2.1)
		WB	Left / Through / Right	C (F)	0.54 (1.00)	16.5 (133.0)	3.4 (27.9)
		NB	Left / Through / Right	B (F)	0.36 (0.85)	13.0 (51.5)	1.7 (13.1)
		SB	Left / Through / Right	D (E)	0.74 (0.79)	25.9 (39.3)	7.9 (9.4)
		Overall Intersection		***C (F)***	**-**	***19.0 (72.7)***	**-**
	Traffic Signals	***Improvement: Upgrade to Traffic Signals with exclusive left turn lanes (all directions)***					
		EB	Left	A (A)	0.08 (0.06)	24.0 (19.9)	6.4 (4.4)
			Through / Right	A (A)	0.46 (0.33)	26.5 (21.7)	35.5 (34.1)
		WB	Left	A (A)	0.49 (0.39)	27.4 (22.4)	28.2 (29.8)
			Through / Right	A (C)	0.56 (0.73)	28.4 (29.9)	42.8 (74.4)
		NB	Left	A (A)	0.01 (0.05)	4.1 (6.7)	1.9 (7.2)
			Through / Right	A (A)	0.16 (0.35)	4.8 (8.8)	20.4 (57.0)
		SB	Left	A (A)	0.23 (0.23)	5.4 (8.2)	22.0 (23.7)
			Through / Right	A (A)	0.22 (0.23)	5.2 (7.7)	29.0 (34.7)
		Overall Intersection		***A (A)***	***0.30 (0.46)***	***14.5 (16.7)***	**-**
Barnsdale Road at Prince of Wales Drive	Minor Stop Control	EB	Left / Through / Right	F (F)	2.80 (2.71)	3297.1 (3174.8)	1147.9 (689.0)
		WB	Left / Through / Right	D (F)	0.33 (0.55)	31.3 (66.6)	10.8 (25.0)
		NB	Left / Through / Right	A (A)	0.01 (0.01)	0.2 (0.2)	0.1 (0.2)
		SB	Left / Through / Right	A (A)	0.01 (0.00)	0.2 (0.1)	0.1 (0.1)
		Overall Intersection		***F (F)***	**-**	***919.3 (478.9)***	**-**
Existing Greenbank Road at Prince of Wales Drive	Traffic Signals	EB	Left	A (A)	0.09 (0.02)	34.3 (32.5)	8.8 (3.0)
			Right	A (A)	0.22 (0.22)	35.3 (33.8)	36.1 (35.0)
		NB	Left	A (D)	0.23 (0.88)	3.6 (44.0)	22.8 (#126.7)
			Through	A (A)	0.49 (0.26)	5.1 (3.6)	89.9 (36.7)
		SB	Through / Right	A (D)	0.18 (0.89)	3.1 (34.0)	24.6 (#243.2)
		Overall Intersection		***A (D)***	***0.45 (0.83)***	***11.9 (30.3)***	**-**
Bankfield Road at Prince of Wales Drive	Partial Double Lane Roundabout	EB	Left / Through / Right	A (A)	0.29 (0.51)	2.9 (7.4)	13.5 (34.2)
		WB	Left / Through / Right	C (A)	0.88 (0.67)	27.8 (9.0)	128.1 (52.3)
		NB	Left / Through / Right	B (B)	0.66 (0.59)	11.2 (13.7)	50.8 (41.4)
		SB	Left / Through	A (A)	0.33 (0.61)	3.9 (3.9)	16.9 (44.7)
			Right	A (A)	0.28 (0.47)	2.6 (3.3)	14.9 (25.3)
		Overall Intersection		***B (A)***	***0.88 (0.67)***	***11.2 (6.9)***	**-**
Existing Greenbank Road at East – West Collector	Minor Stop Control	EB	Left / Right	C (C)	0.34 (0.22)	15.3 (15.9)	11.6 (6.5)
		NB	Left / Through	A (A)	0.03 (0.08)	1.4 (2.3)	0.8 (1.9)
		SB	Through / Right	A (A)	0.22 (0.23)	0.0 (0.0)	0.0 (0.0)
		Overall Intersection		***A (A)***	**-**	***3.8 (2.8)***	**-**

Notes:
1. Table format: AM (PM)
2. v/c – represents the anticipated volume divided by the predicted capacity
3. 95th Percentile Queue (m)
4. # - 95th percentile volume exceeds capacity, queue may be longer



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Barrhaven South Urban Expansion Study Area CDP
Transportation Master Study
Figure 24 2025 Total Future Intersection Control and Lane Configuration

6.5 2031 FUTURE BACKGROUND CONDITIONS

6.5.1 Intersection Performance

The 2031 future background horizon also includes the CDP lands to the east of Realigned Greenbank Road, which are assumed to be fully built by 2025. The improvements required to address the earlier horizons were carried forward in the analysis of 2031 future background conditions.

Figure 25 and **Figure 26** illustrate the 2031 future background traffic volumes.

Table 15 below outlines the operations characteristics of the study area intersections under 2031 future background conditions.

Cambrian Road at Borrisokane Road

The westbound movement at the Cambrian Road at Borrisokane Road intersection is projected to operate with significant delays during both peak hours under 2031 future background conditions. The implementation of traffic signals with left turn auxiliary lanes is required to address the operational constraints at this intersection location.

Existing Greenbank Road at Cambrian Road

The Existing Greenbank Road at Cambrian Road intersection is projected to experience significant delays during both peak hours under 2031 future background conditions. As outlined in the *Cambrian Road Widening Environmental Assessment Study* (Stantec 2014), the Existing Greenbank Road and Cambrian Road intersection is recommended to be upgraded to a double-lane roundabout.

To accommodate the projected 2031 future background traffic volumes at this intersection location, a westbound right turn lane and dual northbound and southbound through lanes (i.e. entry lanes) are required.

Barnsdale Road at Prince of Wales Drive

The City of Ottawa is currently undertaking a functional design study of the Prince of Wales Drive at Barnsdale Road intersection. As part of this functional design study, it will be determined whether traffic signals or a roundabout will be required to address the capacity and safety issues that currently exist at this intersection. As such, recommendations to improve this intersection will not be made as part of the subject study.

Existing Greenbank Road at Prince of Wales Drive

The southbound through and northbound left turn movements at the Existing Greenbank Road at Prince of Wales Drive intersection are projected to operate at or above capacity during the PM peak hour. As outlined in the *Realigned Greenbank Road and South West Transitway Extension Environmental Assessment Study* (MMM 2014), this intersection is planned to include left and right turn auxiliary lanes and dual northbound and southbound through lanes along Prince of Wales Drive.

To address the projected capacity constraints at this intersection, dual southbound through lanes are required at this intersection location to accommodate the projected 2031 future background traffic volumes.

Bankfield Road at Prince of Wales Drive

The Bankfield Road at Prince of Wales Drive intersection is projected to experience significant delays during both peak hours under 2031 future background conditions. As outlined in the *Realigned Greenbank Road and South West Transitway Extension Environmental Assessment Study* (MMM 2014), this intersection is planned to be upgraded to a double lane roundabout.

Incorporating aspects of the ultimate EA design, it was found that this intersection requires a westbound right turn lane and dual northbound and southbound through lanes to operate acceptably with the projected 2031 future background traffic volumes.

Figure 27 illustrates the 2031 future background intersection control and lane configuration.

Appendix C contains detailed intersection performance worksheets.

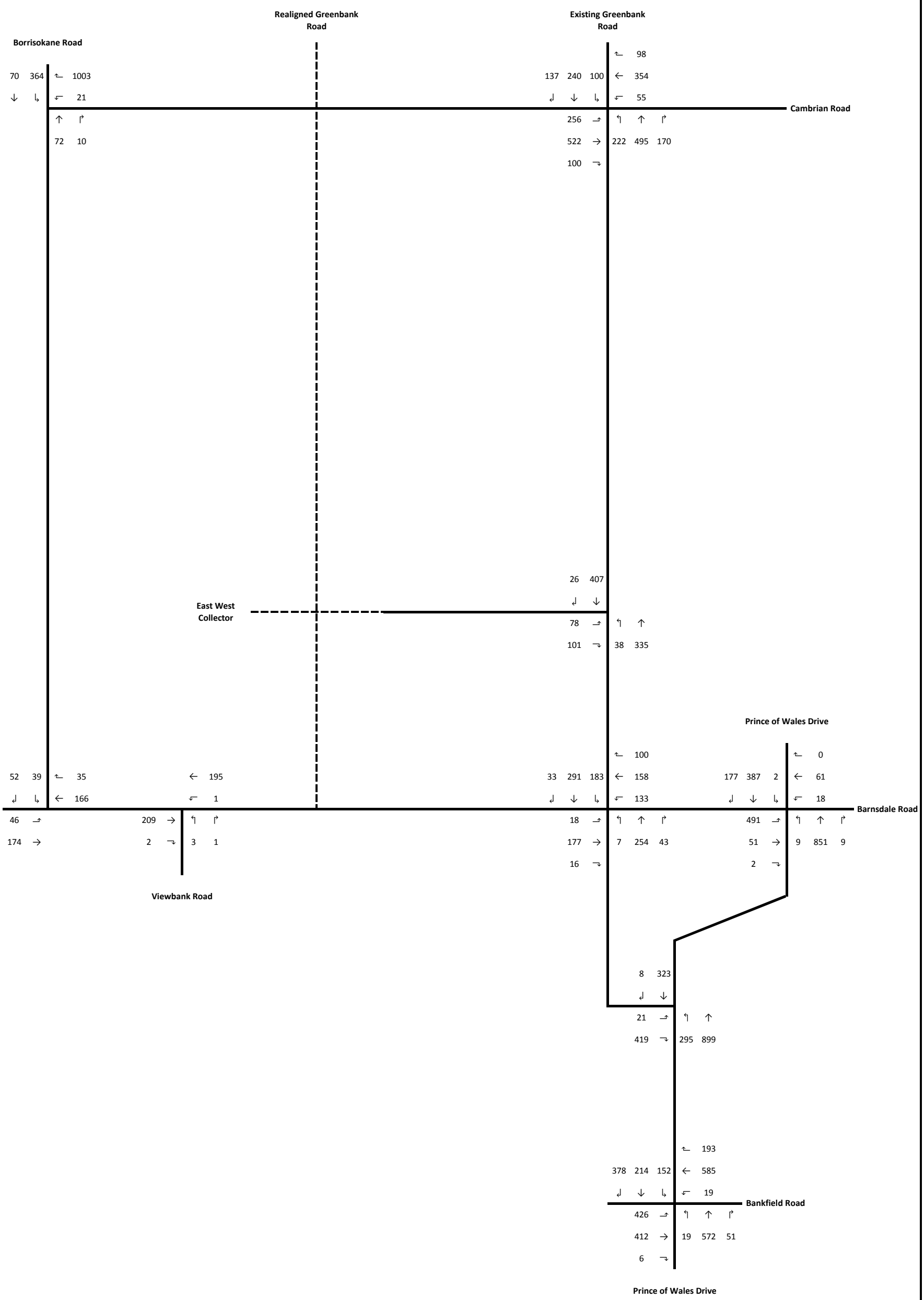

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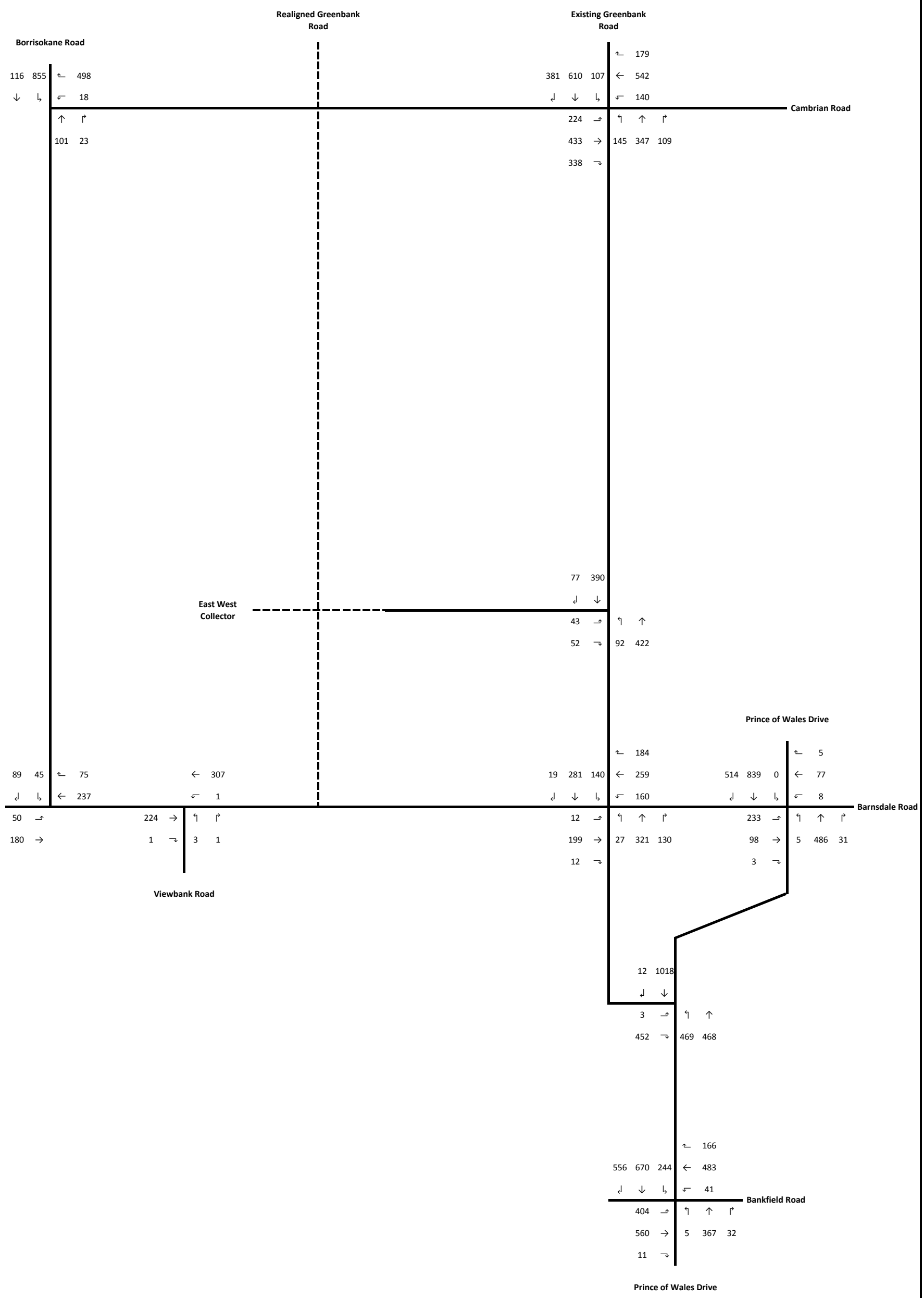
Figure 25 2031 Future Background Traffic Volumes
AM Peak Hour



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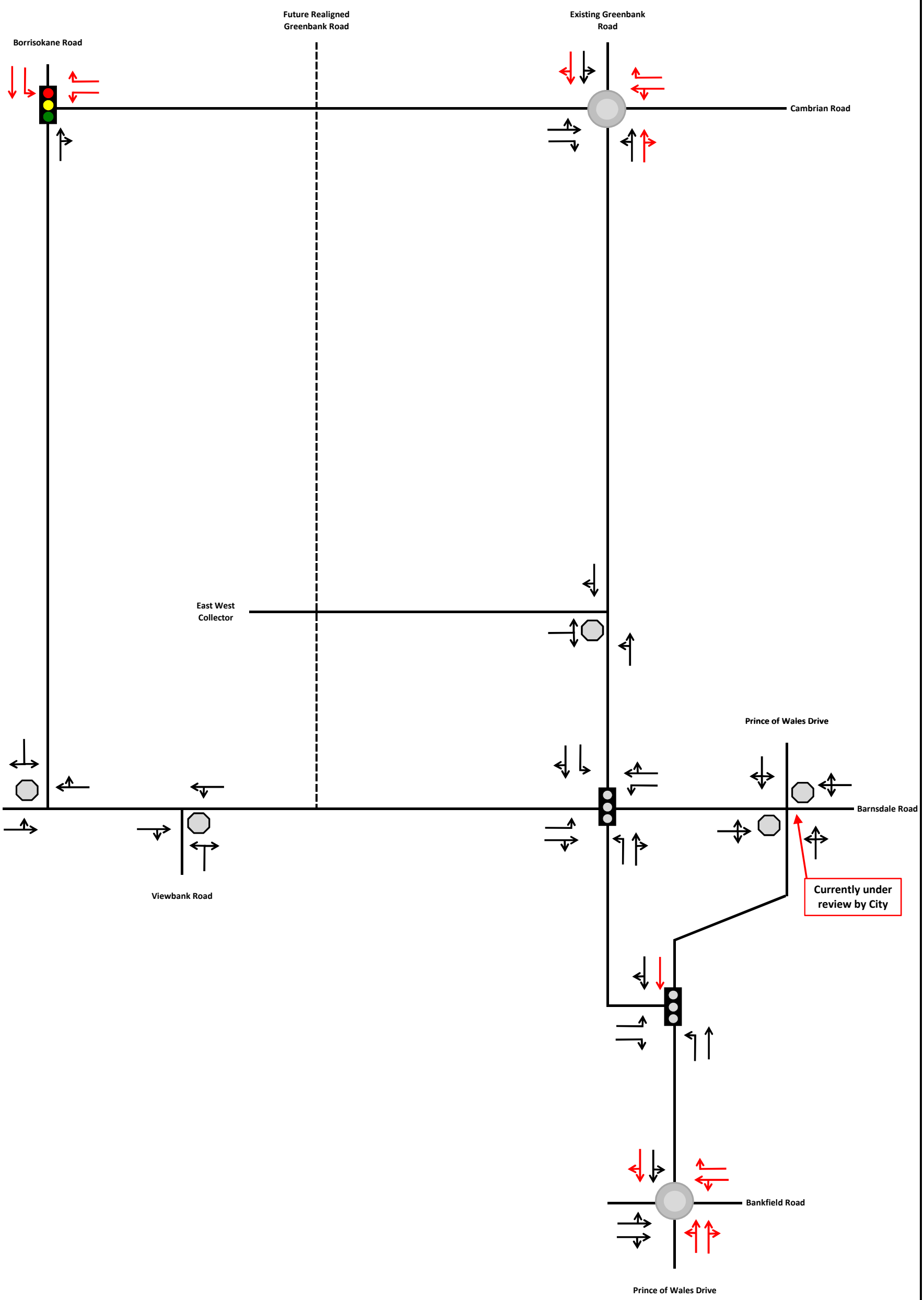
Barrhaven South Urban Expansion Study Area CDP
Transportation Master Study
Figure 26 2031 Future Background Traffic Volumes
PM Peak Hour

Table 15 2031 Future Background Intersection Operations

INTERSECTION	TRAFFIC CONTROL	APPROACH / MOVEMENT		LOS	V/C[2]	DELAY (s)	Q[3] (m)
Cambrian Road at Borrisokane Road	Minor Stop Control	WB	Left / Right	F (F)	1.11 (1.13)	233.8 (305.2)	537.4 (354.5)
		NB	Through / Right	A (A)	0.05 (0.07)	0.0 (0.0)	0.0 (0.0)
		SB	Left / Through	A (B)	0.24 (0.58)	7.1 (10.4)	7.2 (31.6)
		Overall Intersection		***F (F)***	**-**	***157.4 (104.0)***	**-**
	Traffic Signals	**Improvement: Upgrade to Traffic Signals with Southbound and Westbound Left Turn Lanes**					
		WB	Left	A (A)	0.04 (0.12)	16.5 (47.1)	6.1 (11.6)
			Right	D (A)	0.83 (0.31)	33.9 (48.8)	#180.1 (#71.7)
		NB	Through / Right	A (A)	0.08 (0.08)	8.7 (2.3)	19.4 (11.9)
		SB	Left	A (D)	0.54 (0.83)	14.3 (14.7)	#113.2 (#316.1)
			Through	A (A)	0.07 (0.08)	8.6 (2.3)	18.1 (12.7)
		Overall Intersection		***B (C)***	***0.65 (0.78)***	***26.5 (23.8)***	**-**
Existing Greenbank Road at Cambrian Road	Single Lane Roundabout	EB	Left / Through	A (C)	0.64 (0.90)	4.4 (34.0)	49.2 (158.5)
			Right	A (B)	0.13 (0.63)	3.1 (12.8)	5.0 (44.8)
		WB	Left / Through / Right	F (F)	1.04 (1.24)	153.1 (444.8)	389.4 (1579.1)
		NB	Left / Through	F (A)	0.99 (0.62)	81.8 (9.0)	336.8 (50.0)
			Right	A (A)	0.36 (0.21)	8.0 (6.2)	17.1 (9.6)
		SB	Left / Through	A (B)	0.34 (0.82)	4.0 (14.8)	18.2 (101.2)
			Right	A (A)	0.19 (0.57)	4.4 (5.4)	8.2 (38.1)
		Overall Intersection		***D (F)***	***1.04 (1.24)***	***52.1 (120.6)***	**-**
	Partial Double Lane Roundabout	**Improvement: Implementation of Westbound Right and 2nd Northbound and Southbound Through/Entry Lanes**					
		EB	Left / Through	A (C)	0.64 (0.85)	4.4 (25.2)	47.8 (122.7)
			Right	A (B)	0.13 (0.59)	3.1 (12.3)	4.9 (40.1)
		WB	Left / Through	B (B)	0.60 (0.73)	12.5 (11.3)	47.6 (74.0)
			Right	A (A)	0.21 (0.29)	8.9 (6.0)	9.8 (12.9)
		NB	Left / Through / Right	B (A)	0.69 (0.43)	15.1 (5.9)	64.2 (25.5)
		SB	Left / Through / Right	A (C)	0.27 (0.84)	4.2 (23.4)	14.0 (110.3)
		Overall Intersection		***A (B)***	***0.69 (0.85)***	***9.1 (16.5)***	**-**
Barnsdale Road at Borrisokane Road	Minor Stop Control	EB	Left / Through	A (A)	0.03 (0.04)	1.8 (2.0)	0.8 (1.0)
		WB	Through / Right	A (A)	0.12 (0.18)	0.0 (0.0)	0.0 (0.0)
		SB	Left / Right	B (B)	0.13 (0.21)	11.0 (12.2)	3.5 (6.1)
		Overall Intersection		***A (A)***	**-**	***2.7 (3.1)***	**-**
Barnsdale Road at Viewbank Road	Minor Stop Control	EB	Left / Through	A (A)	0.12 (0.13)	0.0 (0.0)	0.0 (0.0)
		WB	Through / Right	A (A)	0.00 (0.00)	0.0 (0.0)	0.0 (0.0)
		NB	Left / Right	B (B)	0.01 (0.01)	10.6 (11.5)	0.1 (0.2)
		Overall Intersection		***A (A)***	**-**	***0.1 (0.1)***	**-**
Barnsdale Road at Existing Greenbank Road	Traffic Signals	EB	Left	A (A)	0.11 (0.09)	23.7 (19.5)	7.7 (5.4)
			Through / Right	A (A)	0.51 (0.38)	26.7 (21.5)	45.4 (44.5)
		WB	Left	A (A)	0.60 (0.48)	30.4 (23.0)	36.8 (39.5)
			Through / Right	B (C)	0.64 (0.78)	30.3 (32.2)	56.3 (97.5)
		NB	Left	A (A)	0.01 (0.05)	4.8 (8.2)	2.1 (7.5)
			Through / Right	A (A)	0.25 (0.45)	6.2 (11.8)	36.0 (86.1)
		SB	Left	A (A)	0.27 (0.31)	6.7 (11.3)	27.0 (32.9)
			Through / Right	A (A)	0.27 (0.29)	6.4 (10.1)	40.2 (54.1)
		Overall Intersection		***A (A)***	***0.36 (0.56)***	***16.0 (18.9)***	**-**
Barnsdale Road at Prince of Wales Drive	Minor Stop Control	EB	Left / Through / Right	F (F)	7.08 (ERR)	ERR (ERR)	ERR (ERR)
		WB	Left / Through / Right	F (F)	0.70 (2.38)	96.3 (2745.8)	40.5 (232.1)
		NB	Left / Through / Right	A (A)	0.01 (0.01)	0.2 (0.3)	0.2 (0.2)
		SB	Left / Through / Right	A (A)	0.01 (0.00)	0.2 (0.2)	0.1 (0.1)
		Overall Intersection		***F (F)***	**-**	***2647.6 (ERR)***	**-**
Existing Greenbank Road at Prince of Wales Drive	Traffic Signals	EB	Left	A (A)	0.12 (0.02)	35.8 (30.6)	10.6 (4.0)
			Right	A (C)	0.26 (0.73)	36.9 (45.9)	42.7 (#92.0)
		NB	Left	A (F)	0.37 (1.20)	4.8 (422.2)	42.2 (#168.8)
			Through	B (A)	0.63 (0.35)	6.9 (5.7)	167.0 (55.7)
		SB	Through / Right	A (F)	0.23 (1.16)	3.4 (332.6)	35.4 (#348.0)
		Overall Intersection		***A (F)***	***0.58 (1.16)***	***12.7 (231.9)***	**-**
		Improvement: Implement Dual Southbound Through Lane					
		EB	Left	A (A)	0.12 (0.03)	35.8 (44.1)	10.6 (4.8)
			Right	A (A)	0.26 (0.28)	36.9 (46.1)	42.7 (52.7)
		NB	Left	A (C)	0.37 (0.76)	4.9 (23.1)	42.8 (110.7)
			Through	B (A)	0.63 (0.31)	6.9 (3.4)	167.0 (56.9)
		SB	Through / Right	A (A)	0.12 (0.57)	2.9 (19.5)	15.6 (#157.0)
		Overall Intersection		***A (C)***	***0.58 (0.74)***	***12.6 (22.1)***	**-**
Bankfield Road at Prince of Wales Drive	Partial Double Lane Roundabout	EB	Left / Through / Right	A (E)	0.38 (0.96)	3.5 (79.4)	20.1 (179.8)
		WB	Left / Through / Right	F (E)	1.45 (0.98)	791.8 (60.7)	2214.5 (267.4)
		NB	Left / Through / Right	F (F)	1.15 (1.11)	316.7 (292.8)	901.9 (522.1)
		SB	Left / Through	A (B)	0.39 (0.90)	3.8 (17.4)	20.6 (155.7)
			Right	A (A)	0.34 (0.70)	2.5 (8.5)	18.5 (58.8)
		Overall Intersection		***F (E)***	***1.43 (1.11)***	***277.4 (71.5)***	**-**
		Improvement: Implement Dual Northbound and Southbound Through Lanes and Westbound Right Turn Lane					
		EB	Left / Through / Right	A (C)	0.38 (0.83)	3.5 (30.3)	20.5 (109.9)
		WB	Left / Through	D (A)	0.89 (0.59)	42.2 (7.9)	157.6 (43.9)
			Right	B (A)	0.41 (0.27)	11.4 (6.3)	21.2 (11.9)

INTERSECTION	TRAFFIC CONTROL	APPROACH / MOVEMENT		LOS	V/C[2]	DELAY (s)	Q[3] (m)
		NB	Left / Through / Right	B (B)	0.51 (0.49)	11.1 (17.9)	35.1 (34.9)
		SB	Left / Through / Right	A (B)	0.45 (0.79)	4.7 (10.5)	27.1 (90.4)
		Overall Intersection		***B (B)***	***0.89 (0.83)***	***13.7 (16.2)***	**-**
Existing Greenbank Road at East – West Collector	Minor Stop Control	EB	Left / Right	C (C)	0.40 (0.27)	18.2 (18.9)	14.8 (8.3)
		NB	Left / Through	A (A)	0.03 (0.08)	1.2 (2.3)	0.8 (2.1)
		SB	Through / Right	A (A)	0.25 (0.27)	0.0 (0.0)	0.0 (0.0)
		Overall Intersection		***A (A)***	**-**	***3.8 (2.8)***	**-**

Notes:
1. Table format: AM (PM)
2. v/c – represents the anticipated volume divided by the predicted capacity
3. 95th Percentile Queue (m)
4. # - 95th percentile volume exceeds capacity, queue may be longer
5. ERR: Traffic volumes are too high to process



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Barrhaven South Urban Expansion Study Area CDP
Transportation Master Study
Figure 27 2031 Future Background Intersection Control and Lane Configuration

6.6 2031 ULTIMATE CONDITIONS

6.6.1 Jock River Screenline Performance

The Jock River screenline was assessed under 2031 ultimate conditions. As seen in **Table 16**, the overall Jock River screenline is anticipated to operate below capacity under 2031 ultimate conditions. During the AM peak hour, where the predominant direction is inbound, the 2031 screenline is projected to operate at v/c 0.94. During the PM peak hour, where the predominant direction is outbound, the screenline is projected to operate at v/c 0.84.

Notwithstanding the screenline performance as a whole, the individual stations at Greenbank Road and Borrisokane Road are projected to operate above capacity. As commuters start to experience congestion at the Greenbank Road and Borrisokane Road stations, they will have the option of altering their driving patterns to find alternate routes to mitigate these delays. As the remaining screenline stations are projected to have residual capacity, commuters may wish to cross the Jock River at Jockvale Road or Prince of Wales Drive.

Table 16 2031 Ultimate Jock River Screenline Assessment

STATION	DIRECTION	2031 ULTIMATE					
		AM Peak Hour	PM Peak Hour	Lanes	Capacity (Veh / hr)	AM Peak v/c	PM Peak v/c
Borrisokane	Inbound	1153	664	1	1000	1.15	0.66
	Outbound	458	1065	1	1000	0.46	1.07
Greenbank	Inbound	1338	310	1	1000	1.34	0.31
	Outbound	117	1012	1	1000	0.12	1.01
Jockvale	Inbound	1411	381	2	2000	0.71	0.19
	Outbound	175	1202	2	2000	0.09	0.60
Prince of Wales	Inbound	1751	971	2	2000	0.88	0.49
	Outbound	551	1736	2	2000	0.28	0.87
Total	**Inbound**	**5653**	**2326**	**6**	**6000**	**0.94**	**0.39**
	Outbound	**1301**	**5015**	**6**	**6000**	**0.22**	**0.84**

6.6.2 Intersection Performance

The improvements required to address the earlier horizons were carried forward in the analysis of 2031 ultimate conditions.

Figure 28 and **Figure 29** illustrates the 2031 ultimate traffic volumes.

Table 17 below outlines the operations characteristics of the study area intersections under 2031 ultimate conditions.

Existing Greenbank Road at Cambrian Road

The Existing Greenbank Road at Cambrian Road intersection is projected to experience high delays and capacity constraints during the PM peak hour under 2031 ultimate conditions. As outlined in the *Cambrian Road Widening Environmental Assessment Study* (Stantec 2014), the Existing Greenbank Road and Cambrian Road intersection is ultimately recommended to be upgraded to a double-lane roundabout.

To accommodate the projected 2031 ultimate traffic volumes at this intersection location, a double lane roundabout is required.

Figure 30 illustrates the 2031 ultimate intersection control and lane configuration.

Appendix C contains detailed intersection performance worksheets.

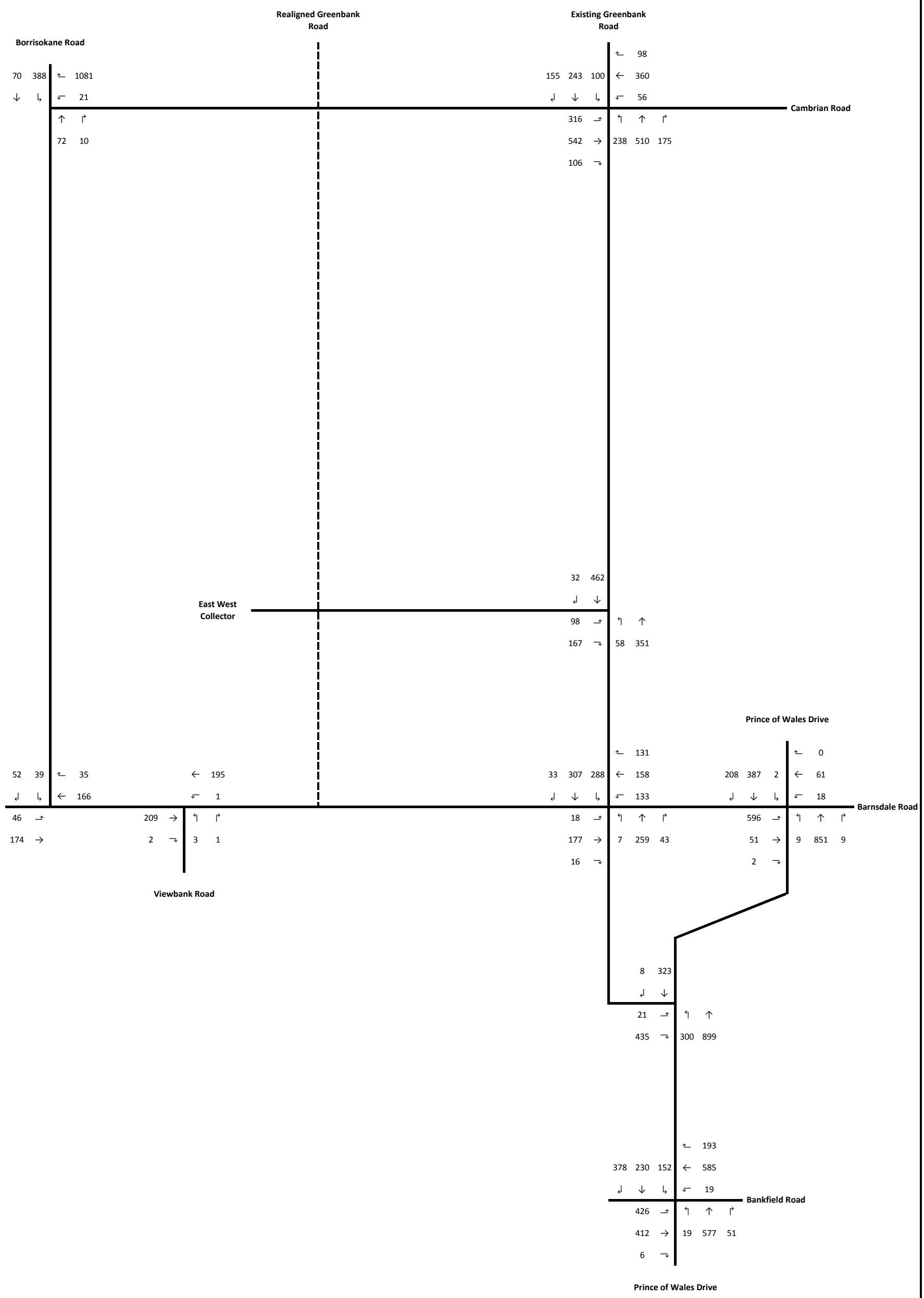

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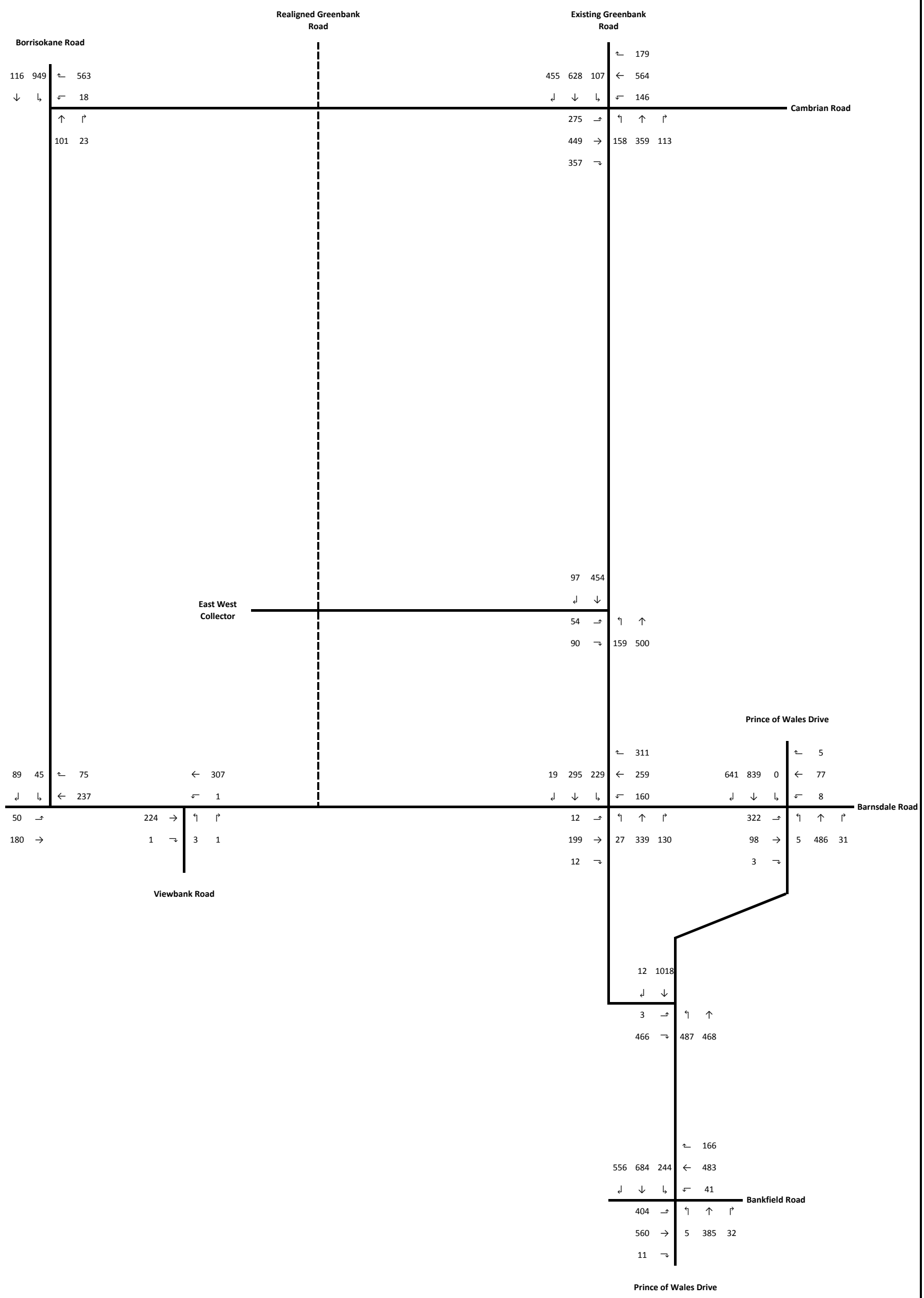
Figure 28 2031 Ultimate Traffic Volumes AM Peak Hour



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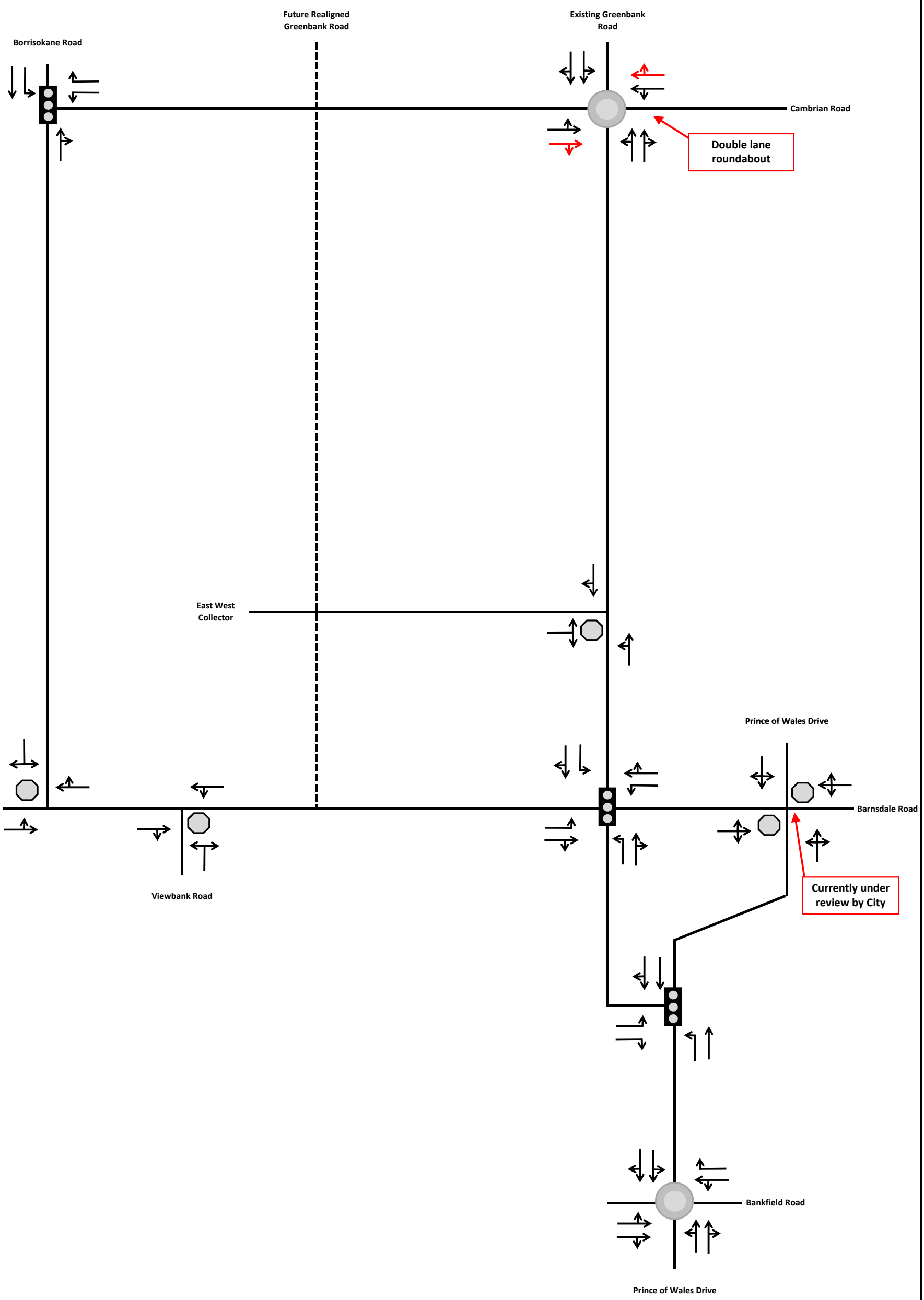
Barrhaven South Urban Expansion Study Area CDP
Transportation Master Study
Figure 29 2031 Ultimate Traffic Volumes PM Peak Hour

Table 17 2031 Ultimate Intersection Operations

INTERSECTION	TRAFFIC CONTROL	APPROACH / MOVEMENT		LOS	V/C[2]	DELAY (s)	Q[3] (m)
Cambrian Road at Borrisokane Road	Traffic Signals	WB	Left	A (A)	0.03 (0.12)	17.3 (47.5)	6.6 (11.7)
			Right	E (A)	0.91 (0.35)	47.5 (49.7)	#250.2 (#83.9)
		NB	Through / Right	A (A)	0.09 (0.08)	12.5 (2.3)	23.3 (11.4)
		SB	Left	A (E)	0.60 (0.92)	20.9 (26.5)	#145.9 (#367.0)
			Through	A (A)	0.08 (0.08)	12.4 (2.3)	21.5 (12.2)
		Overall Intersection		***C (D)***	***0.74 (0.87)***	***37.6 (30.8)***	**-**
Existing Greenbank Road at Cambrian Road	Partial Double Lane Roundabout	EB	Left / Through	A (E)	0.71 (0.96)	5.6 (60.7)	62.5 (266.1)
			Right	A (B)	0.14 (0.65)	3.2 (14.9)	5.2 (47.7)
		WB	Left / Through	B (B)	0.68 (0.83)	19.7 (18.9)	63.5 (109.6)
			Right	B (A)	0.23 (0.32)	10.5 (6.9)	11.1 (2.0)
		NB	Left / Through / Right	C (A)	0.83 (0.49)	30.1 (8.0)	106.3 (33.2)
		SB	Left / Through / Right	A (E)	0.29 (0.96)	5.3 (59.9)	62.5 (238.8)
		Overall Intersection		***B (D)***	***0.83 (0.96)***	***15.3 (37.0)***	**-**
	Double Lane Roundabout	**Improvement: Double Lane Roundabout**					
		EB	Left / Through / Right	A (C)	0.44 (0.81)	3.3 (23.8)	23.6 (103.8)
		WB	Left / Through / Right	B (A)	0.48 (0.58)	12.4 (9.1)	32.6 (42.7)
		NB	Left / Through / Right	B (A)	0.71 (0.45)	19.0 (7.3)	71.2 (27.6)
		SB	Left / Through / Right	A (C)	0.28 (0.87)	4.4 (29.7)	14.4 (136.0)
		Overall Intersection		***B (B)***	***0.71 (0.87)***	***10.1 (136.0)***	**-**
Barnsdale Road at Borrisokane Road	Minor Stop Control	EB	Left / Through	A (A)	0.03 (0.04)	1.8 (2.0)	0.8 (1.0)
		WB	Through / Right	A (A)	0.12 (0.18)	0.0 (0.0)	0.0 (0.0)
		SB	Left / Right	B (B)	0.13 (0.21)	11.0 (12.2)	3.5 (6.1)
		Overall Intersection		***A (A)***	**-**	***2.7 (3.1)***	**-**
Barnsdale Road at Viewbank Road	Minor Stop Control	EB	Left / Through	A (A)	0.12 (0.13)	0.0 (0.0)	0.0 (0.0)
		WB	Through / Right	A (A)	0.00 (0.00)	0.0 (0.0)	0.0 (0.0)
		NB	Left / Right	B (B)	0.01 (0.01)	10.6 (11.5)	0.1 (0.2)
		Overall Intersection		***A (A)***	***A (A)***	**-**	***0.1 (0.1)***
Barnsdale Road at Existing Greenbank Road	Traffic Signals	EB	Left	A (A)	0.13 (0.13)	25.8 (19.6)	8.2 (6.1)
			Through / Right	A (A)	0.49 (0.33)	28.5 (20.7)	48.6 (45.9)
		WB	Left	A (A)	0.60 (0.42)	32.5 (21.9)	39.6 (40.8)
			Through / Right	B (D)	0.70 (0.87)	34.8 (41.5)	67.3 (#157.9)
		NB	Left	A (A)	0.01 (0.05)	5.1 (10.4)	2.3 (7.6)
			Through / Right	A (A)	0.25 (0.49)	6.5 (15.1)	40.3 (93.0)
		SB	Left	A (A)	0.41 (0.59)	8.7 (21.1)	52.2 (#75.2)
			Through / Right	A (A)	0.28 (0.32)	6.8 (12.8)	46.6 (58.1)
		Overall Intersection		***A (C)***	***0.48 (0.71)***	***17.3 (24.1)***	**-**
Barnsdale Road at Prince of Wales Drive	Minor Stop Control	EB	Left / Through / Right	F (F)	8.97 (ERR)	ERR (ERR)	ERR (ERR)
		WB	Left / Through / Right	F (F)	0.72 (ERR)	107.4 (ERR)	44.0 (ERR)
		NB	Left / Through / Right	A (A)	0.01 (0.01)	0.2 (0.3)	0.2 (0.3)
		SB	Left / Through / Right	A (A)	0.01 (0.00)	0.2 (0.3)	0.1 (0.1)
		Overall Intersection		***F (F)***	**-**	***2960.9 (ERR)***	**-**
Existing Greenbank Road at Prince of Wales Drive	Traffic Signals	EB	Left	A (A)	0.11 (0.03)	35.3 (44.0)	10.4 (4.8)
			Right	A (A)	0.27 (0.29)	36.5 (46.1)	43.9 (53.9)
		NB	Left	A (C)	0.38 (0.78)	5.0 (25.6)	44.6 (#130.6)
			Through	B (A)	0.63 (0.31)	7.1 (3.4)	169.4 (58.1)
		SB	Through / Right	A (A)	0.12 (0.60)	2.9 (21.4)	15.9 (#170.4)
		Overall Intersection		***A (C)***	***0.59 (0.75)***	***12.8 (23.5)***	**-**
Bankfield Road at Prince of Wales Drive	Partial Double Lane Roundabout	EB	Left / Through / Right	A (C)	0.39 (0.84)	3.7 (33.8)	20.9 (118.8)
		WB	Left / Through	D (A)	0.89 (0.59)	44.6 (8.4)	164.2 (45.4)
			Right	B (A)	0.41 (0.27)	11.6 (6.5)	21.5 (12.1)
		NB	Left / Through / Right	B (B)	0.51 (0.51)	11.3 (19.0)	35.9 (37.6)
		SB	Left / Through / Right	A (B)	0.46 (0.80)	4.8 (10.8)	28.1 (93.7)
		Overall Intersection		***B (B)***	***0.89 (0.84)***	***14.2 (17.0)***	**-**
Existing Greenbank Road at East – West Collector	Minor Stop Control	EB	Left / Right	D (D)	0.64 (0.55)	28.9 (35.8)	38.1 (26.8)
		NB	Left / Through	A (A)	0.05 (0.16)	1.7 (3.8)	1.3 (4.2)
		SB	Through / Right	A (A)	0.29 (0.32)	0.0 (0.0)	0.0 (0.0)
		Overall Intersection		***A (A)***	**-**	***7.2 (5.6)***	**-**

Notes:
1. Table format: AM (PM)
2. v/c – represents the anticipated volume divided by the predicted capacity
3. 95th Percentile Queue (m)
4. # - 95th percentile volume exceeds capacity, queue may be longer
5. ERR: Traffic volumes are too high to process



Stantec

Barrhaven South Urban Expansion Study Area CDP
Transportation Master Study
Figure 30 2031 Ultimate Intersection Control and Lane Configuration

7.0 TRANSPORTATION IMPROVEMENTS AND DESIGN ELEMENTS

7.1 NETWORK MODIFICATIONS

A key finding of the transportation assessment is that the subject development can proceed without advancing the timelines of Realigned Greenbank Road as identified in the City's 2013 Transportation Master Plan. However, several intersection modifications are required at the study are intersections, as summarized in **Table 18** below.

With the exception of the Borrisokane Road at Cambrian Road intersection upgrades, all of the remaining recommended intersection improvements have been previously identified through various past planning documents such as the *Cambrian Road Widening Environmental Assessment Study* (Stantec 2014) and the *Realigned Greenbank Road and South West Transitway Extension Environmental Assessment Study* (MMM 2014).

The required intersection improvements at the Borrisokane Road at Cambrian Road intersection are not surprising given the recent shift in timelines of the implementation of Realigned Greenbank Road. While the overall Jock River Screenline is projected to operate acceptably without Realigned Greenbank Road in place, Borrisokane Road will be heavily relied on for commuters from Barrhaven South. This increase in traffic volumes along Borrisokane Road triggers the need to implement the traffic signals and turning lanes at the Borrisokane Road at Cambrian Road intersection.

Table 18 Required Transportation Improvements

INTERSECTION	EXISTING TRAFFIC CONTROL	2016 EXISTING	2025 FUTURE BACKGROUND	2025 TOTAL FUTURE	2031 FUTURE BACKGROUND	2031 ULTMATE
Borrisokane Road at Cambrian Road	Stop Control – Minor Approach	N/A	N/A	N/A	Traffic signals with left turn auxiliary lanes	N/A
Existing Greenbank Road at Cambrian Road	Single Lane Roundabout	N/A	Southbound right turn lane	Northbound and eastbound right turn lanes	Westbound right turn lane and dual northbound and southbound through lanes	Double lane roundabout
Barnsdale Road at Borrisokane Road	Stop Control – Minor Approach	N/A	N/A	N/A	N/A	N/A
Barnsdale Road at Viewbank Road	Stop Control – Minor Approach	N/A	N/A	N/A	N/A	N/A
Existing Greenbank Road at Barnsdale Road	All-Way Strop Control	N/A	N/A	Traffic signals with left turn auxiliary lanes	N/A	N/A
Prince of Wales Drive at Barnsdale Road[1]	Stop Control – Minor Approach	(refer to footnote [1])				
Existing Greenbank Road at Prince of Wales Drive	Stop Control – Minor Approach	N/A	Traffic signals with left turn auxiliary lanes	N/A	Dual southbound through lanes	N/A
Prince of Wales Drive at Bankfield Road	Traffic Signals	Single Lane Roundabout	Southbound right turn lane and dual eastbound through lanes	N/A	Westbound right turn lane and dual northbound and southbound through lanes	N/A

Notes:

1. The City is currently undertaking a functional design study of the Prince of Wales Drive at Barnsdale Road intersection. Through that study, it will be determined what the required upgrades are at this intersection. As such, intersection improvements were not considered at this location as part of the subject study.

7.2 RIGHT-OF-WAY REQUIREMENTS

Table 19 below summarizes the proposed right-of-way requirements and cross-sectional elements for the arterial, collector, and local roads within the subject CDP lands.

Table 19 Right-of-Way Requirements

ROAD CLASSIFICATION	ROADS	RIGHT-OF-WAY WIDTH	CROSS-SECTIONAL ELEMENTS
Arterial	Realigned Greenbank Road	41.5m	• Bus Rapid Transit • Auto Travel Lanes • Cycle Tracks • Sidewalks
Collector	River Mist Road	24.0m	*Same as existing section of River Mist. Includes:* • Auto Travel Lanes • Dedicated Parking Lanes <u>or</u> bicycle lanes but with no parking permitted • Sidewalks (both sides)
	Kilbirnie Drive	22.0m	*Same as existing section of Kilbirnie. Includes:* • Auto Travel Lanes – Shared Use with Bicycles • No on-street parking • Sidewalks (both sides)
	East – West Collector	24.0m	• Auto Travel Lanes • Transit Shelter and Bus Pad / Dedicated Parking Lane (alternates) • Multi-Use Pathway (MUP) along south side • Sidewalk along north side
Local	-	18.0m	• Auto Travel Lanes – Shared Use with Bicycles • Sidewalk Options: o No Sidewalks o Sidewalk on One Side o Sidewalk on Both Sides

Figure 31 illustrates the proposed cross-section for Realigned Greenbank Road, as per the *Realigned Greenbank Road and South West Transitway Extension Environmental Assessment Study* (MMM 2014).

Figure 32 illustrates the proposed cross-section for River Mist Road. The proposed River Mist Road cross-section is consistent with the existing cross-section for River Mist.

Figure 33 illustrates the proposed cross-section for Kilbirnie Drive. The proposed Kilbirnie Drive cross-section is consistent with Kilbirnie Drive's existing cross-section.

Figure 34 and **Figure 35** illustrate two proposed cross-sections for the East – West Collector. Figure 34 shows the cross-section at transit stop locations while Figure 35 shows the cross-section at a mid-block location with parking provided along one side of the road.

Figure 36 and **Figure 37** illustrate two proposed cross-sections for local roads, both with and without sidewalks.

Figure 31 Realigned Greenbank Road Proposed Cross-Section

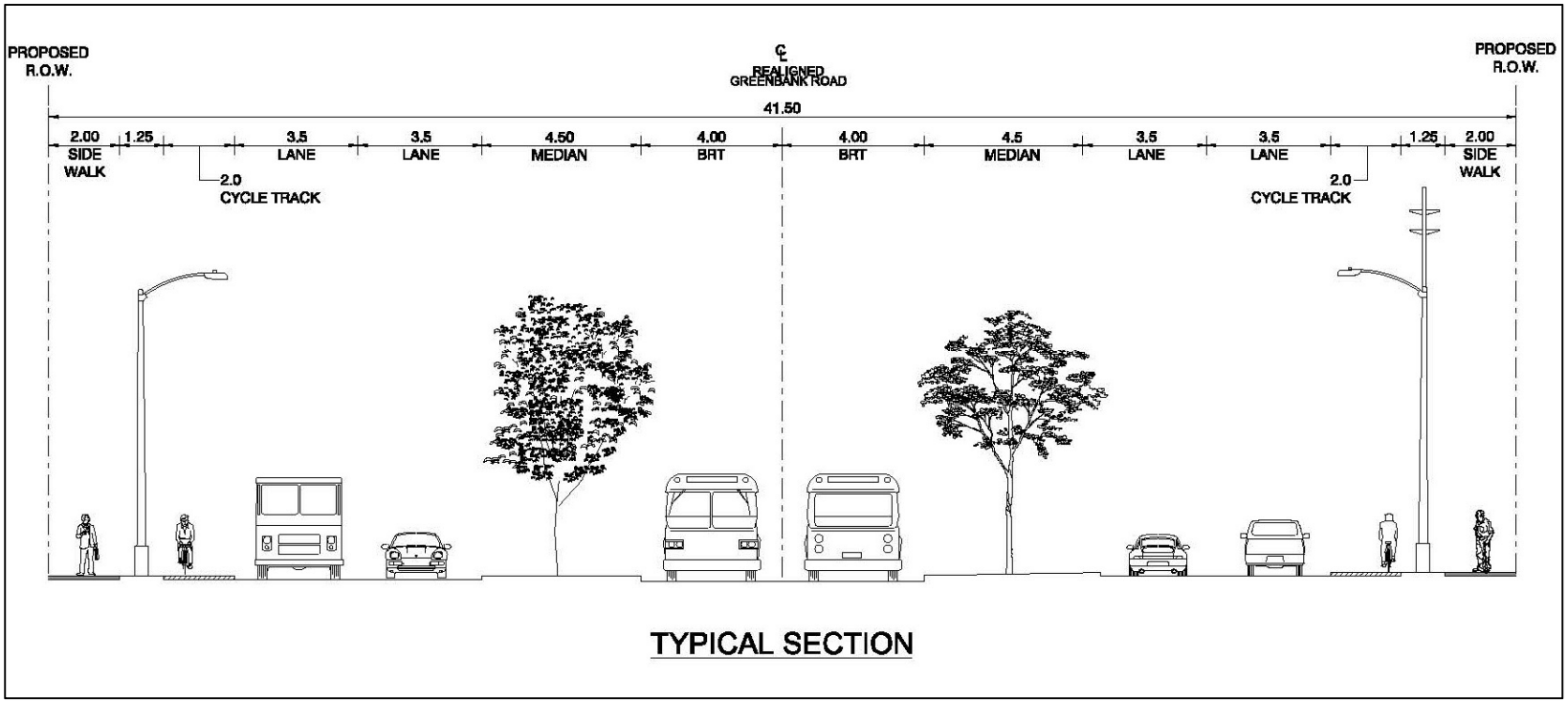
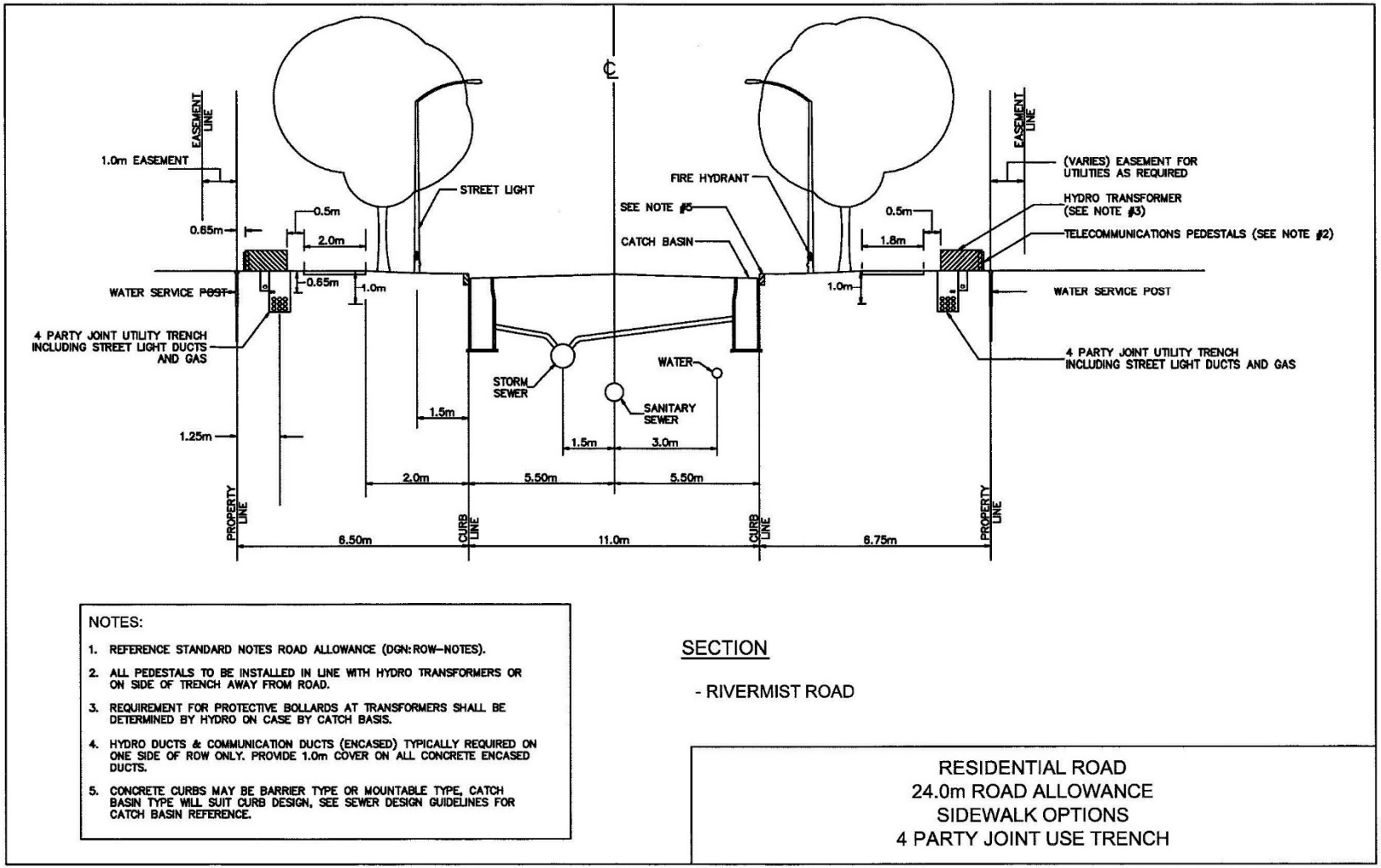


Figure 32 River Mist Road Proposed Cross-Section



NOTES:

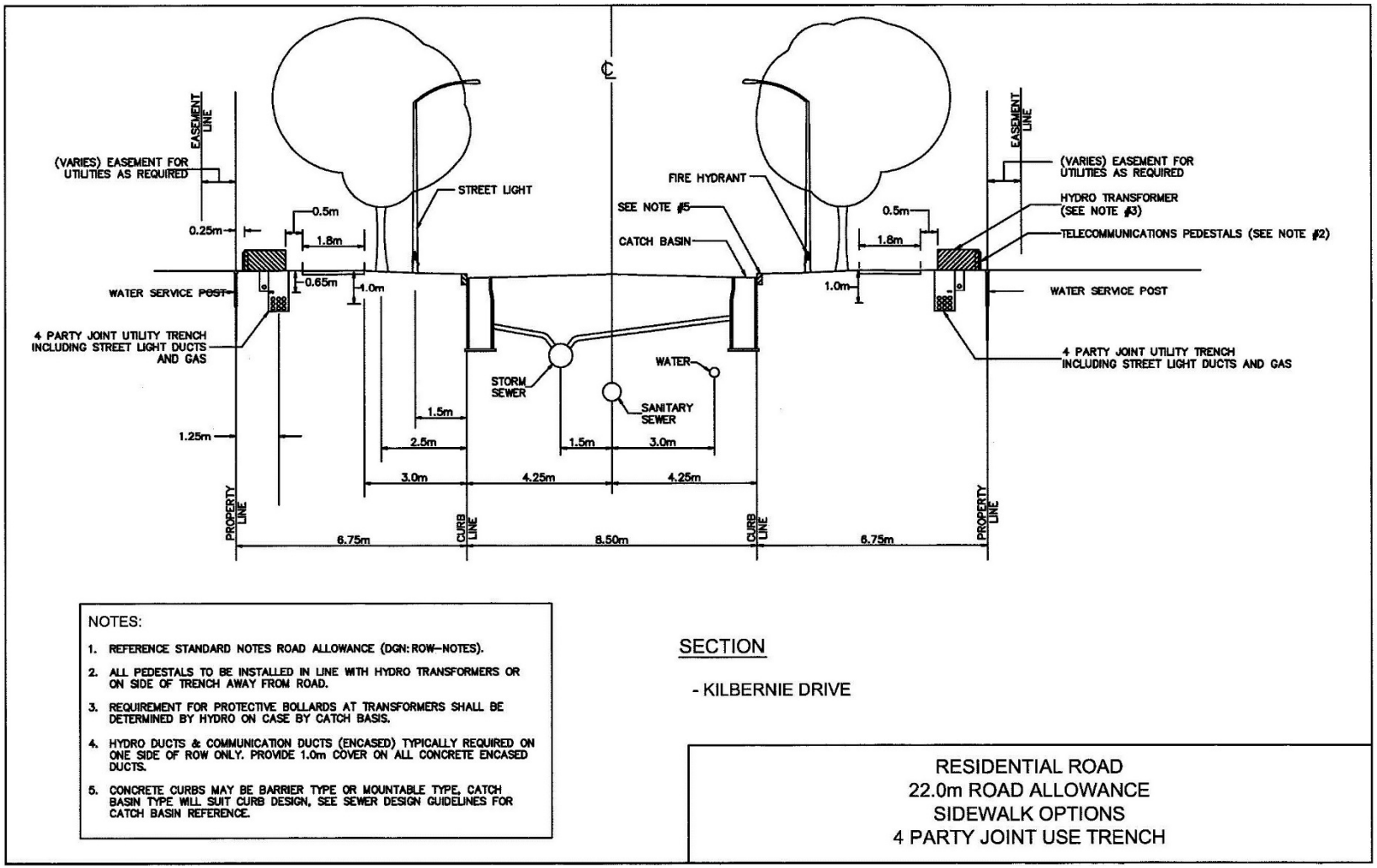
1. REFERENCE STANDARD NOTES ROAD ALLOWANCE (DGN: ROW–NOTES).
2. ALL PEDESTALS TO BE INSTALLED IN LINE WITH HYDRO TRANSFORMERS OR ON SIDE OF TRENCH AWAY FROM ROAD.
3. REQUIREMENT FOR PROTECTIVE BOLLARDS AT TRANSFORMERS SHALL BE DETERMINED BY HYDRO ON CASE BY CATCH BASIS.
4. HYDRO DUCTS & COMMUNICATION DUCTS (ENCASED) TYPICALLY REQUIRED ON ONE SIDE OF ROW ONLY. PROVIDE 1.0m COVER ON ALL CONCRETE ENCASED DUCTS.
5. CONCRETE CURBS MAY BE BARRIER TYPE OR MOUNTABLE TYPE, CATCH BASIN TYPE WILL SUIT CURB DESIGN, SEE SEWER DESIGN GUIDELINES FOR CATCH BASIN REFERENCE.

SECTION

- RIVERMIST ROAD

RESIDENTIAL ROAD
24.0m ROAD ALLOWANCE
SIDEWALK OPTIONS
4 PARTY JOINT USE TRENCH

Figure 33 Kilbirnie Drive Proposed Cross-Section



NOTES:

1. REFERENCE STANDARD NOTES ROAD ALLOWANCE (DGN: ROW–NOTES).
2. ALL PEDESTALS TO BE INSTALLED IN LINE WITH HYDRO TRANSFORMERS OR ON SIDE OF TRENCH AWAY FROM ROAD.
3. REQUIREMENT FOR PROTECTIVE BOLLARDS AT TRANSFORMERS SHALL BE DETERMINED BY HYDRO ON CASE BY CATCH BASIS.
4. HYDRO DUCTS & COMMUNICATION DUCTS (ENCASED) TYPICALLY REQUIRED ON ONE SIDE OF ROW ONLY. PROVIDE 1.0m COVER ON ALL CONCRETE ENCASED DUCTS.
5. CONCRETE CURBS MAY BE BARRIER TYPE OR MOUNTABLE TYPE, CATCH BASIN TYPE WILL SUIT CURB DESIGN, SEE SEWER DESIGN GUIDELINES FOR CATCH BASIN REFERENCE.

SECTION

- KILBERNIE DRIVE

RESIDENTIAL ROAD
22.0m ROAD ALLOWANCE
SIDEWALK OPTIONS
4 PARTY JOINT USE TRENCH

Figure 34 East - West Collector Proposed Cross-Section (at Transit stops)

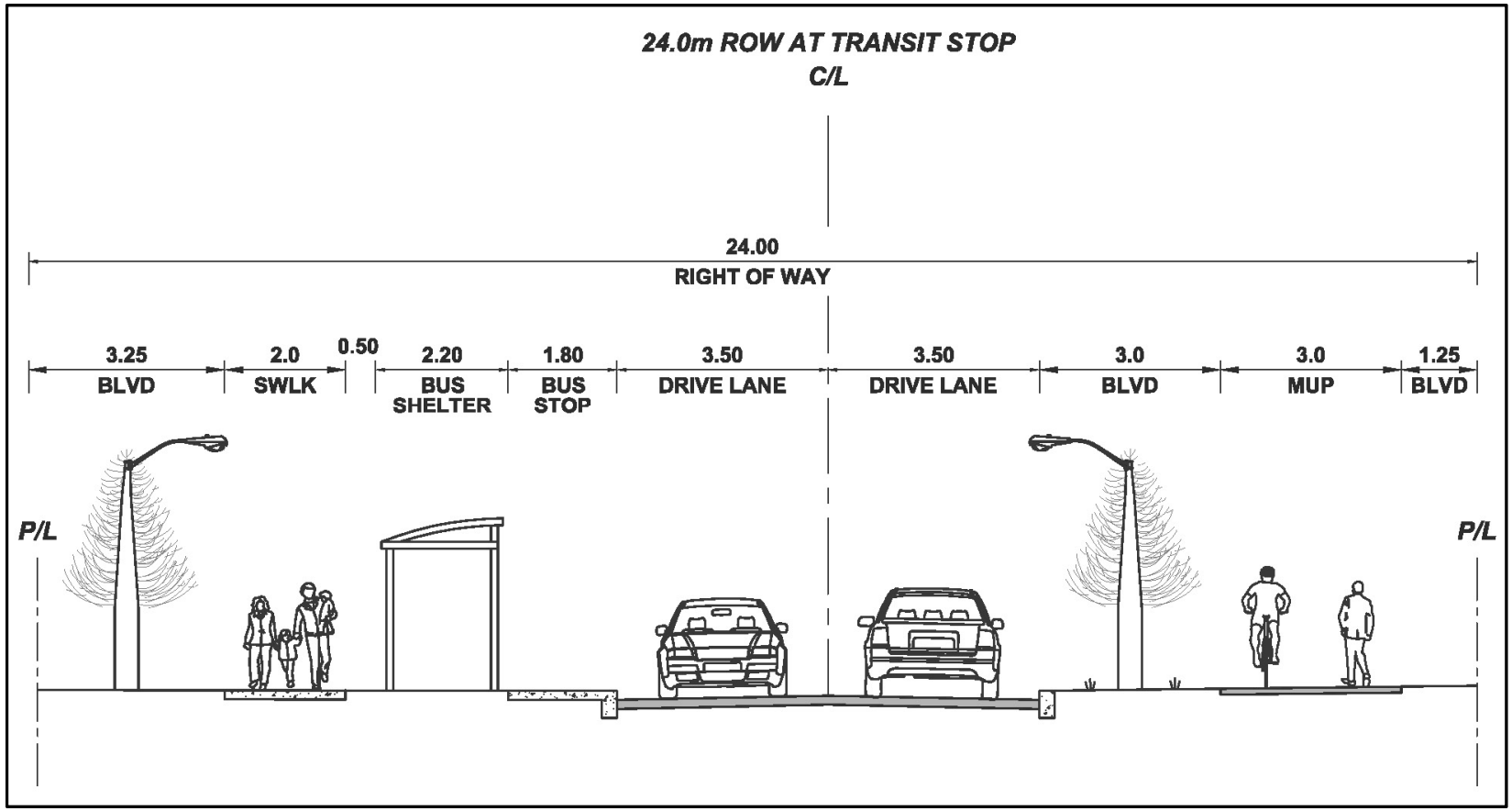


Figure 35 East - West Collector Proposed Cross-Section (mid-block with Parking on one side)

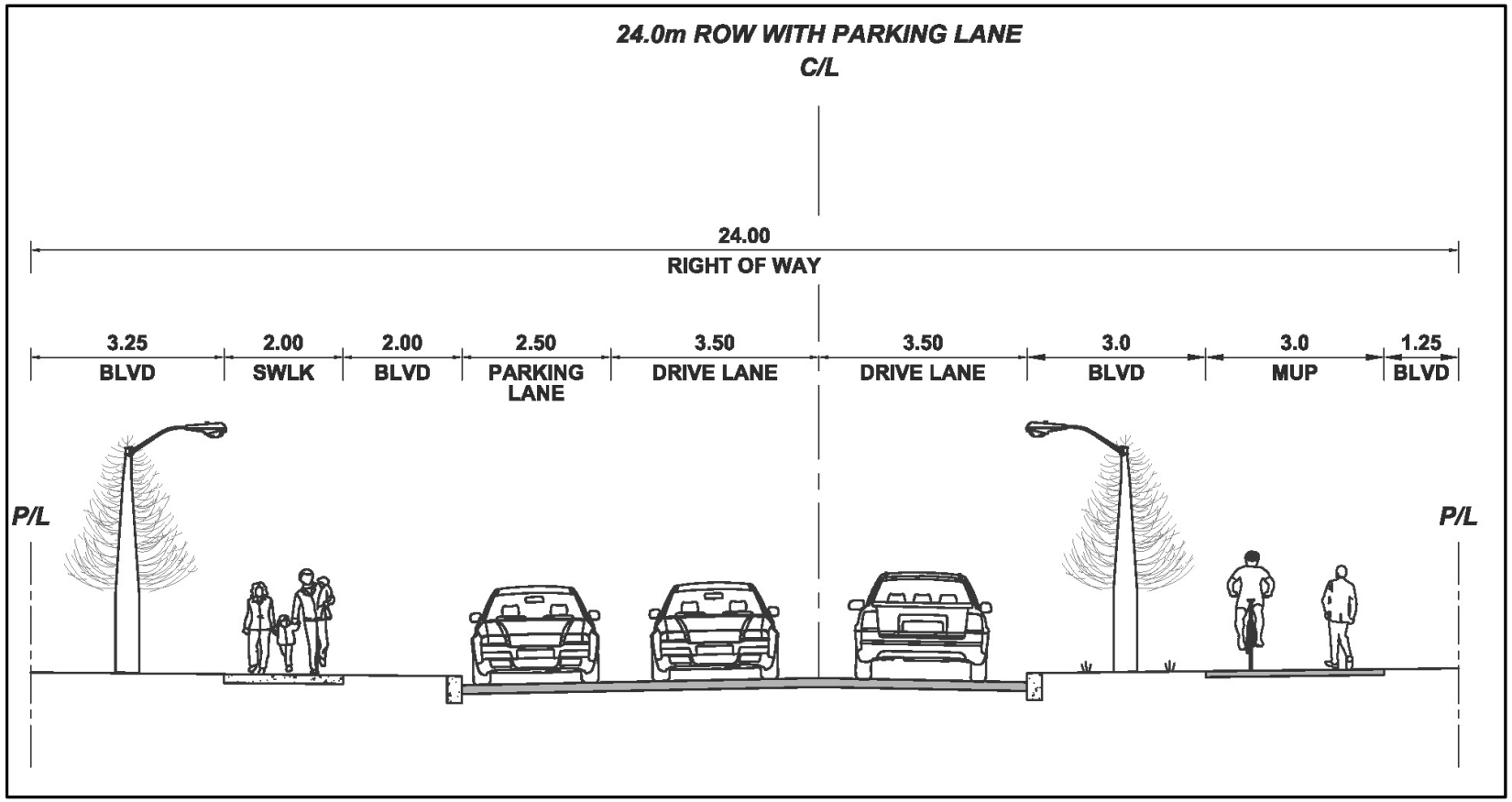


Figure 36 Local Road Proposed Cross-Section – Sidewalks on One (or both) Sides

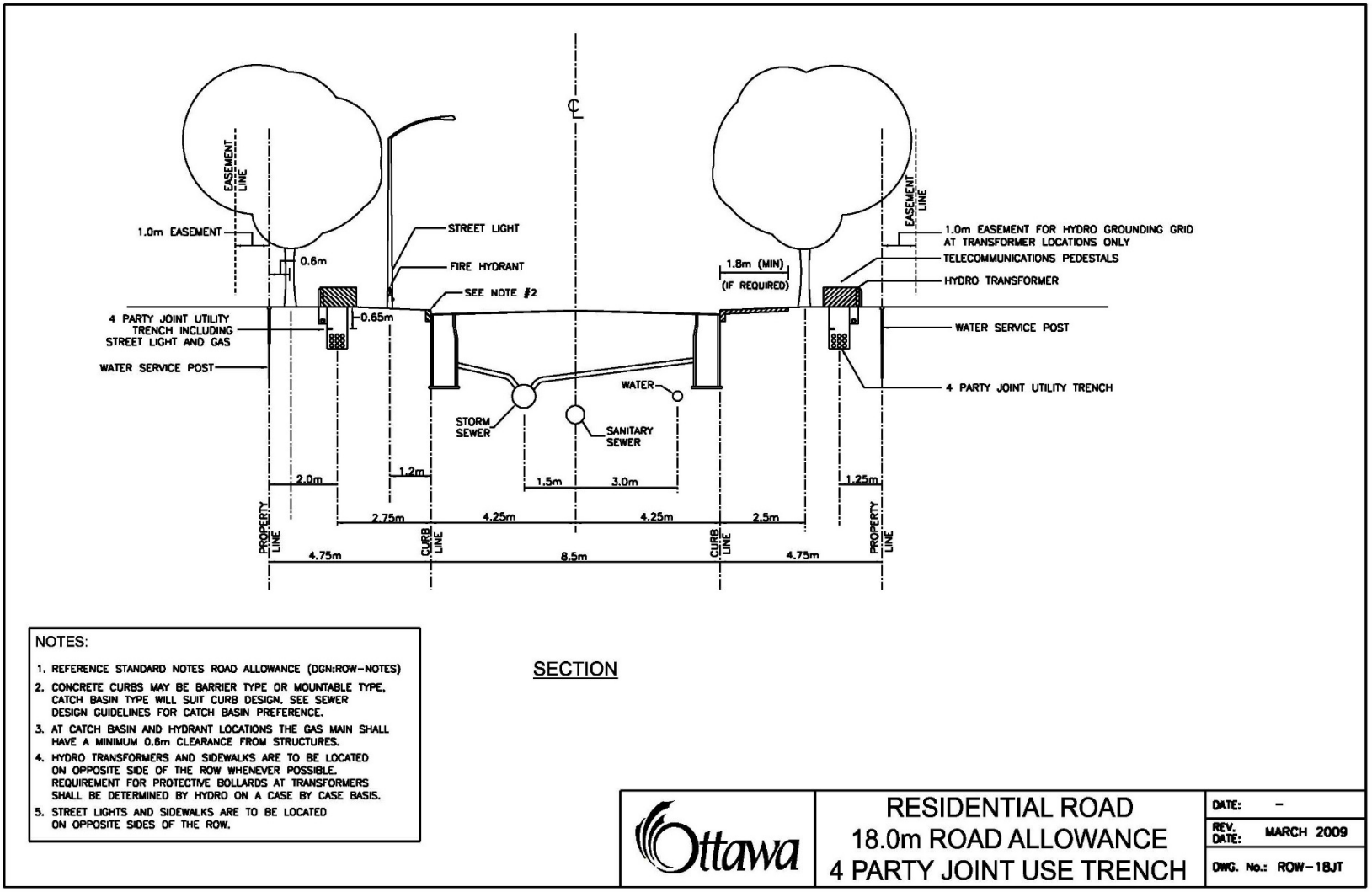
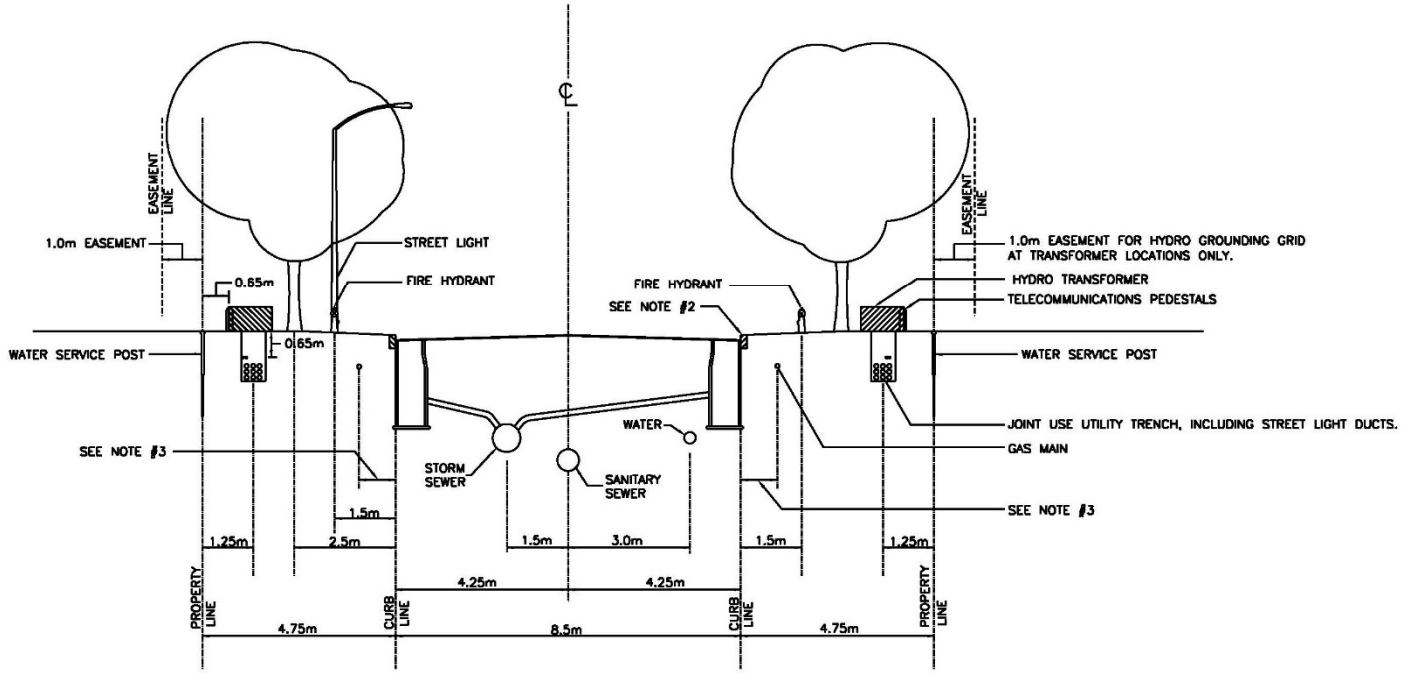


Figure 37 Local Road Proposed Cross-Section - No Sidewalks



NOTES:

1. REFERENCE STANDARD NOTES ROAD ALLOWANCE (DGN:ROW-NOTES)
2. CONCRETE CURBS MAY BE BARRIER TYPE OR MOUNTABLE TYPE. CATCH BASIN TYPE WILL SUIT CURB DESIGN. SEE SEWER DESIGN GUIDELINES FOR CATCH BASIN PREFERENCE.
3. AT CATCH BASIN AND HYDRANT LOCATIONS THE GAS MAIN SHALL HAVE A MINIMUM 0.6m CLEARANCE FROM STRUCTURE.
4. STREET LIGHTS CAN BE LOCATED ON EITHER SIDE OF R.O.W.
5. FOR SINGLE LOADED ROAD, BOULEVARD ON SIDE WITH NO HOUSING MAY BE REDUCED TO A MINIMUM OF 1.5m

SECTION

Ottawa

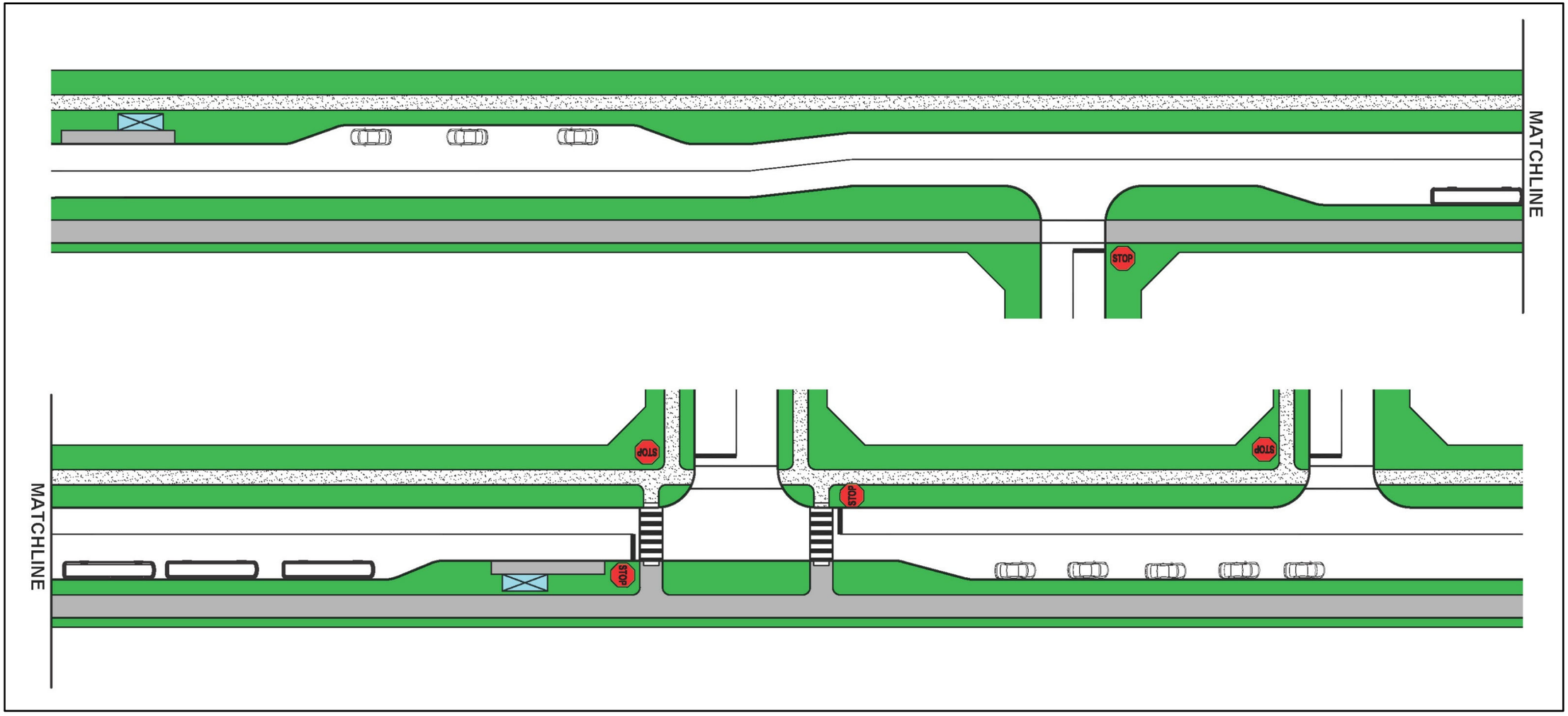
RESIDENTIAL ROAD
18.0m ROAD ALLOWANCE

DATE: -
REV. DATE: MARCH 2009
DWG. No.: ROW-18

7.2.1 East-West Collector Roadway

The proposed east-west collector road is planned to include a 24.0m right-of-way. The cross-section of this road, as outlined previously, will include a sidewalk along the north side, a multi-use pathway along the south side, and transit stops / on-street parking along one side of the roadway (note that between intersections, the transit stops / on-street parking alternates between the north and south sides of the roadway). A concept was developed to demonstrate how the aforementioned cross-sectional elements could be incorporated within the right-of-way (**Figure 38**).

Figure 38 East-West Collector Road Conceptual Layout



7.2.2 Community Arterial

As a means of addressing common concerns regarding traditional arterial roadways (i.e. high operating speeds, uncomfortable for pedestrians, high traffic noise, no minor driveway access), the City of Ottawa is exploring the notion of a "Community Arterial" concept. The Community Arterial concept features two very distinct areas of travel within the right-of-way: the centre lanes facilitate travel at higher speeds while the outside lanes facilitate travel at reduced speeds, areas for on-street parking, and access to driveways and side streets.

Community Arterials are more comfortable for pedestrians, they facilitate driveway and side street access, they encourage appropriate speeds along the outside lanes, and they are thought to reduce traffic noise by means of landscaped buffers.

Figure 39 illustrates a typical community arterial that has a 30m ROW and **Figure 40** illustrates one with a 36.6m ROW. It should be noted that these cross-sections are incomplete conceptual designs and are for discussion purposes only.

Figure 39 Community Arterial Concept - 30m ROW

(source: Community Arterials Mixed-Use Avenue presentation. City of Ottawa. August 2017)

Figure 40 Community Arterial Concept - 36.6m ROW

(source: Community Arterials Mixed-Use Avenue presentation. City of Ottawa. August 2017)

The notion of incorporating a Community Arterial concept into the subject development area was discussed as part of the CDP process. Two potential candidate locations were identified as Barndale Road and Realigned Greenbank Road (south of the Park and Ride lot). Given that the Community Arterial concept has not yet been fully vetted by internal City departments, incorporating this type of facility within the Barrhaven South Urban Expansion Area CDP was thought to be premature. The right-of-way requirements identified for both Realigned Greenbank Road and Barnsdale Road, however, would accommodate the Community Arterial concept should the need arise in the future.

8.0 MOBILITY AND CIRCULATION

8.1 ROAD NETWORK

The subject CDP lands will feature arterial, collector, and local roads with varying right-of-way widths as described in **Table 19** above. The City's Transportation Master Plan (TMP) defines the road types as follows:

Arterial Roads:	assist with travel throughout the city in conjunction with other roads and provide access to adjacent lands
Collector Roads:	assist with neighbourhood travel between major collector or arterial roads and provide direct access to adjacent lands
Local Roads:	provides direct access to adjacent lands and serve as neighbourhood travel to and from collector roads

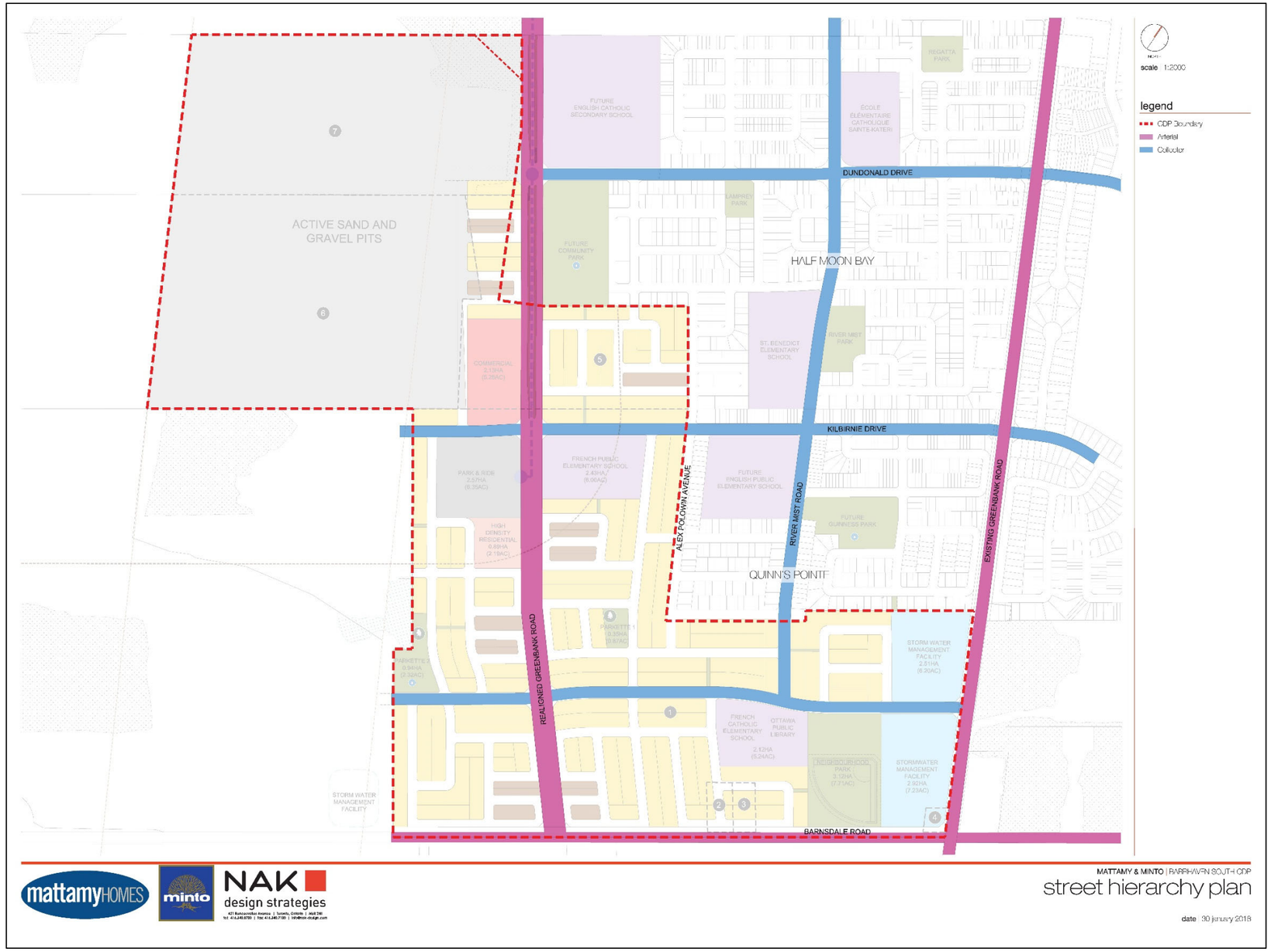
Realigned Greenbank Road, Existing Greenbank Road, and Barnsdale Road are all classified as arterial roads in the City's TMP and Official Plan.

Dundonald Drive, Kilbirnie Drive, and River Mist Road are existing collector roads with predetermined right-of-way widths. The extension of these three collector roads into the subject CDP lands will maintain consistency with the functionality and right-of-way widths of the existing facilities.

The new East – West Collector connects Realigned Greenbank Road and Existing Greenbank Road and facilitates access to parks and schools. As such, the functionality of this road will follow that of a collector road, and the cross-section elements are reflective of its intended use.

Figure 41 illustrates the proposed road hierarchy within the project area.

Figure 41 Road Hierarchy



8.2 ACTIVE MODES

The City of Ottawa has numerous guidelines for creating effective and efficient pedestrian and cycling networks within new developments with the main goals being:

- Building continuous, well connected pedestrian networks by placing sidewalks:
    - Along both sides of arterial and collector roads;
    - On both sides of all roads that carry transit service;
    - On local roads that lead directly to transit stations, schools, public parks, recreation centres, retail, or employment centres; and
    - Within and between neighbourhoods to create permeable walkable communities.
- Building a quality cycling network by placing cycling facilities:
    - Where there are gaps in the existing cycling network;
    - In developing suburban areas; and
    - Around transit stations.

Figure 42 illustrates the proposed pedestrian facilities within the subject CDP lands.

As outlined in the City's 2013 Cycling Plan, Realigned Greenbank Road and Existing Greenbank Road are planned to function as cycling spine routes. Borrisokane Road, Barnsdale Road, Cambrian Road, and River Mist Road are planned to function as local cycling routes.

The City of Ottawa's 2013 Cycling Plan includes a cycling facility pre-selection nomograph that assists with determining the appropriate type of cycling facility to select. Using this nomograph, it was found that along the collector roads, on-street cycling lanes would be appropriate. In addition to this, as Kilbirnie Drive and River Mist Road are existing collector roads, it would be appropriate to create a continuous road cross-section along these collectors through the subject CDP lands.

Along the East – West Collector active modes are accommodated via a sidewalk along the north side and via a multi-use pathway along the south side.

Figure 43 illustrates the proposed cycling facilities.

Figure 42 Proposed Pedestrian Facilities

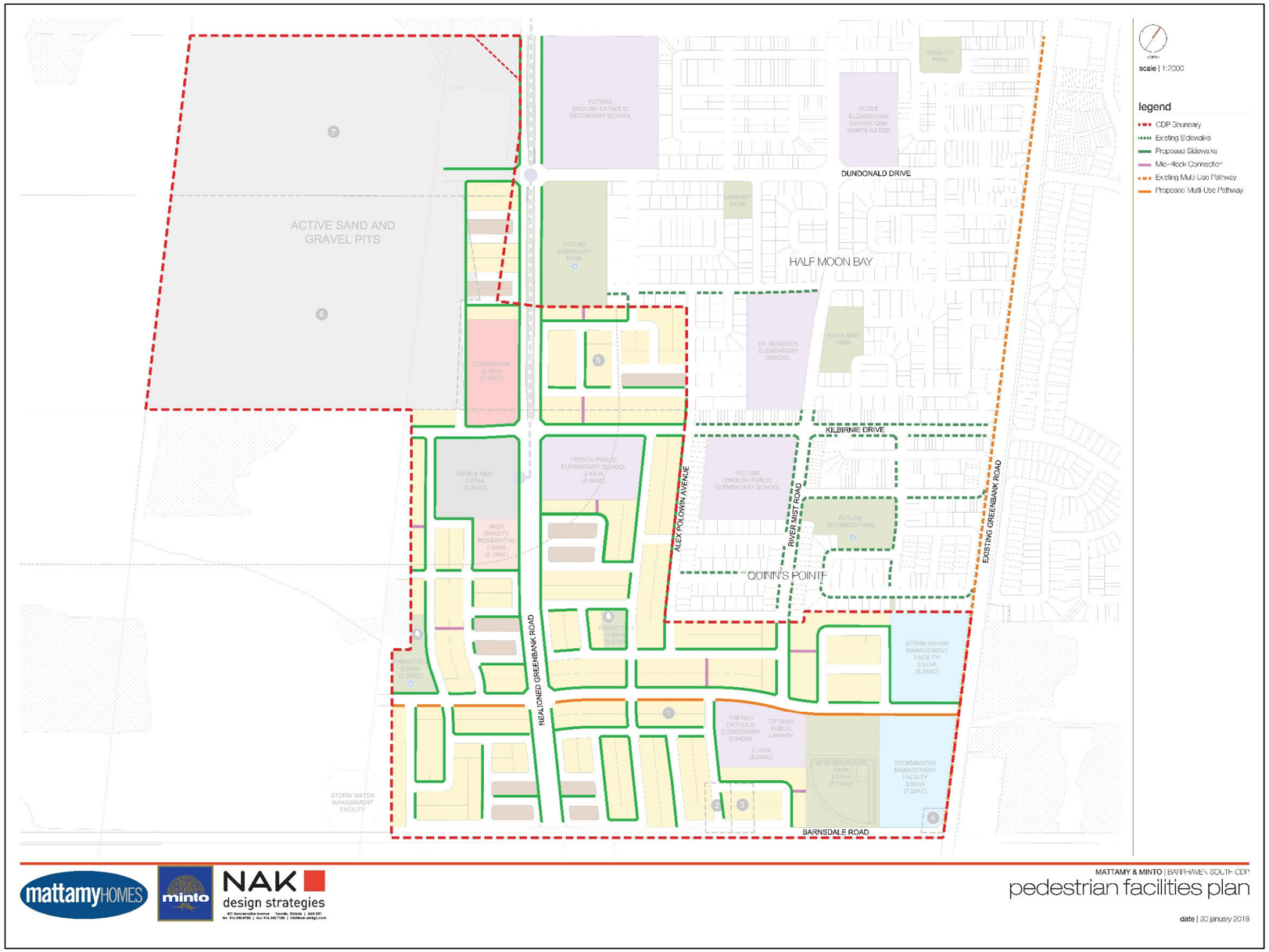
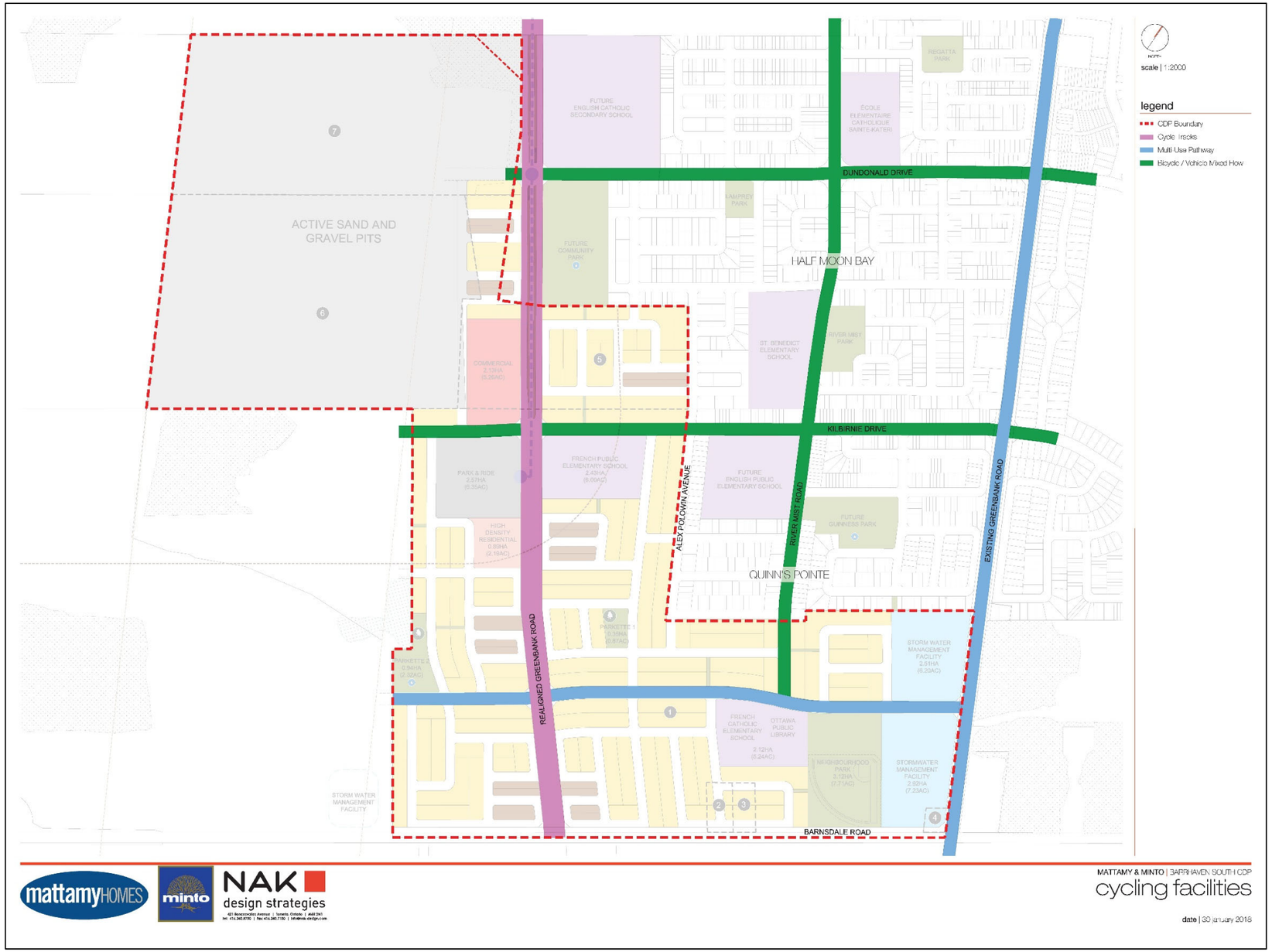


Figure 43 Proposed Cycling Facilities



8.3 TRANSIT

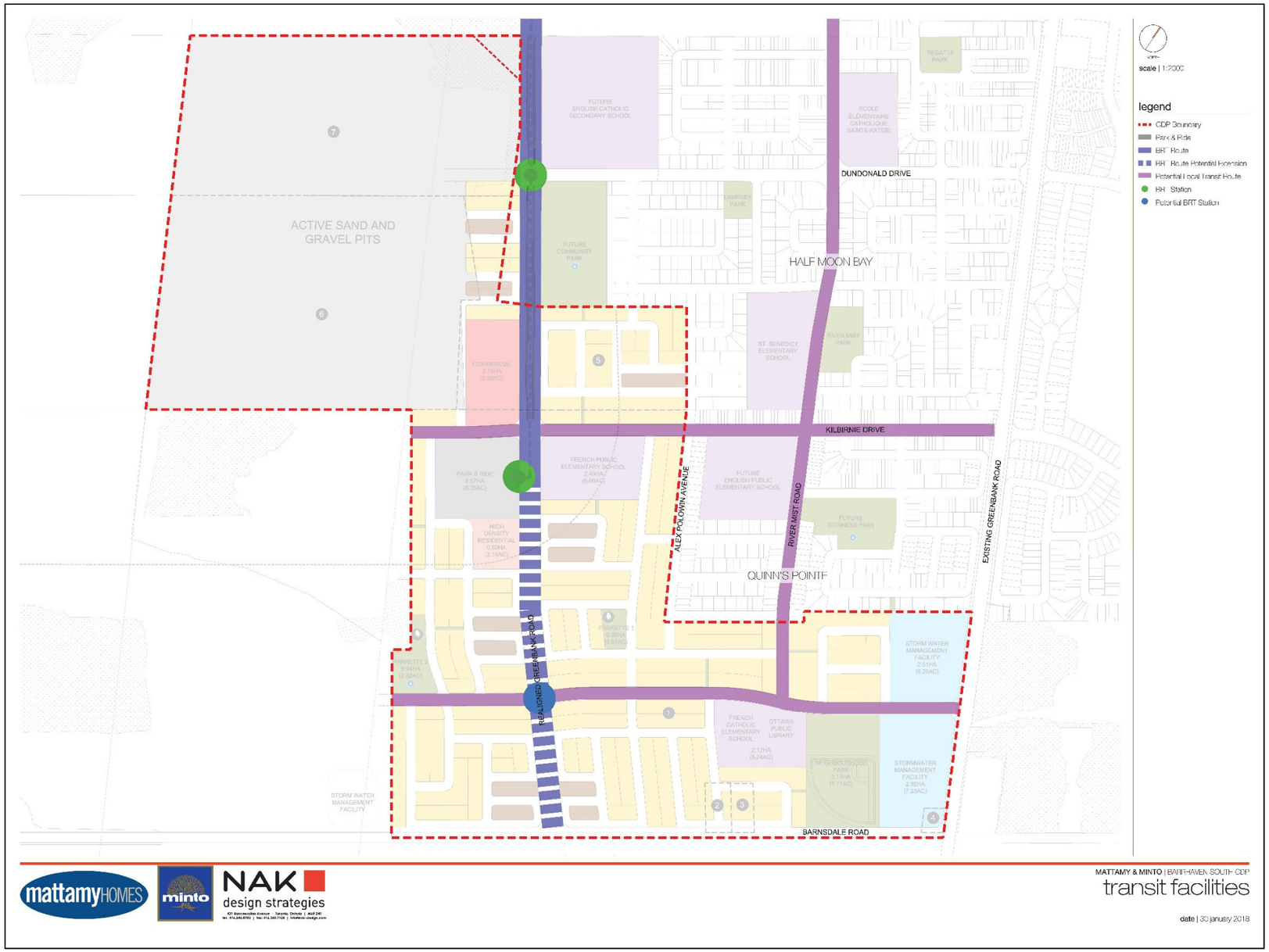
The *Realigned Greenbank Road and Southwest Transitway Extension Planning and Environmental Assessment Study* (MMM 2014) identifies Bus Rapid Transit along Realigned Greenbank Road, terminating at the proposed Park and Ride lot. The EA also outlines that there will be transit stations along Realigned Greenbank Road at Cambrian Road, Dundonald Drive, and the Park and Ride lot.

Through this CDP process, the location of the Park and Ride lot was established to be roughly 650m north of Barnsdale Road, on the southwestern quadrant of the Realigned Greenbank Road at Kilbirnie Drive intersection. The majority of the subject CDP lands are located with a 5-minute walking distance of the proposed Park and Ride with the remaining lands located within a 10-minute walking distance.

As the Bus Rapid Transit will terminate at the Park and Ride, a local transit route throughout the subject CDP lands should be considered to provide an increased level of transit service. One potential local transit route could commence at the Park and Ride lot, travel south along Realigned Greenbank Road, east along the East – West Collector Road, and then head north along River Mist Road towards Cambrian Road. OC Transpo will provide additional input on the proposed transit routes, transit stop locations, service frequency, etc. as the development approvals process progresses.

Figure 44 illustrates the proposed transit facilities within the project area.

Figure 44 Proposed Transit Facilities



8.4 BUILDING BETTER AND SMARTER SUBURBS

As outlined in **Section 2.5**, the City of Ottawa's Building Better and Smarter Suburbs (BBSS) initiative includes guidelines and recommendations for building complete communities with reliable transportation options and integrated subdivision design. The following **Table 20** includes the transportation-related BBSS objectives and directions and how they have been achieved in the Barrhaven South Urban Expansion Study Area (BSUESA).

Table 20 Building Better and Smart Suburbs Transportation Objectives and Directions

BBSS OBJECTIVE	BSUESA
1. Street Network and Land Use	
Implement a network of street typologies that complements the land uses, densities, and built form within a community.	Plan incorporates a range of street types, including arterial (Realigned Greenbank Road), collector and local roads.
Create a highly-connected street and block pattern with short blocks to support efficient routing of transit, short distances to transit stops and stations, and intuitive wayfinding.	Street network is designed as a modified grid, enhancing connectivity and generally facilitating access to each level of the road hierarchy.
Design the street network to respond to and respect natural cultural features.	Street network is designed to preserve portions of existing woodlots.
Design the street network to enhance access to public facilities and services; prioritize pedestrian and cycling access for short trips, and walking / cycling connections to transit stations and Park and Ride lots for longer-distance trips.	Schools, library, parks, and Park and Ride lot have frontage on multiple roads to enhance access. The Park and Ride lot is located a maximum 10-minute walking from all points within the planning area.
Integrate the street network with the park and open space system.	The street network is designed around the blocks reserved for stormwater management facilities, woodlots, and parks.
Design the street network and block lengths to include a diversity of routes for vehicular and active transportation in order to minimize bottleneck locations.	The modified grid design ensures that vehicles and active transportation modes have alternate routes throughout the community.
Provide opportunities for small local retail or commercial spaces in new neighbourhoods, where appropriate.	A limited amount of land is envisioned for small-scale commercial uses adjacent to the Park and Ride lot along Realigned Greenbank Road.
Reduce vehicle operating speeds, particularly on local streets, in order to improve safety by reducing vehicular and pedestrian / cyclist conflicts.	Local streets will be designed to generally have an effective operating speed of 30 km/h. Consideration will be given for the provision of safe crossing points (where necessary) and sidewalks will be provided along select local streets connecting residential areas and other land uses.
Create a street system that promotes passive traffic calming and includes traffic calming features built into the initial designs for local and collector roads.	The modified grid local road network avoids cut through traffic and encourages reduced vehicular speeds. Traffic calming features such as parking lanes protected by bulb-outs and intersection narrowings will be incorporated.
6. Road Right-of-Way	
Balance the needs of all elements within the street right-of-way.	Pedestrian and cycling facilities are provided in appropriate streets throughout the subdivision.
Ensure a range of street cross-sections that are appropriate for the application, area, and community design context.	Street cross-sections are designed to be appropriate for each context.
Create complete streets that accommodate all modes of transportation.	Realigned Greenbank Road and the internal streets are designed as complete streets by accommodating

BBSS OBJECTIVE	BSUESA
	facilities for all modes. Pedestrian and cycling facilities are provided along appropriate streets throughout the subdivision.
Create street environments that enhance safety and livability.	Street cross-sections are designed to be appropriate for each context. Right-of-way widths for internal streets accommodate a range of cross-sections which will be finalized during the Plan of Subdivision process.
Create beautiful tree-lined streets as a key component of the public realm.	Street plantings to be determined through detailed design.
Accommodate stormwater management strategies in the right-of-way.	Appropriate stormwater management strategies to be determined through Plan of Subdivision and detailed design.
BBSS STRATEGIC DIRECTION	**BSUESA**
1. Street Network and Land Use	
Design the street network as an integral part and extension of the municipal grid, taking into consideration its future adjustments and evolution.	Proposed street network integrates into existing road network, particularly collector roads. The streets terminate to allow for future connections.
Design the street network based on a modified or offset grid to maximize choices of travel routes and opportunities for utility connections.	The plan includes a modified grid street pattern.
Design the street network in conjunction with the land use and open space system to ensure direct pedestrian and cycling connectivity to key destinations in the community (schools, shops, bus stops, and stations, etc.).	Modified grid pattern designed to optimize connectivity for all modes to major destinations throughout the community.
Examine opportunities to design the street network with more closely-spaced arterial roads in order to minimize the need for very wide ROWs that can be perceived as community dividers and barriers to active transportation.	The community is designed around the proposed Realigned Greenbank Road right-of-way, which was established through an Environmental Assessment process.
Ensure that a range of appropriate-sized roadways complements the character and functional needs of each community area.	Street right-of-way and cross-sections are designed to respect planned context.
Implement traffic calming measures at the outset of road design for local and collector streets.	Local road design reduces cut-through traffic and encourages traffic calming. Additional measures will be determined at the detailed design stage.
Use roundabouts that prioritize pedestrian and cyclist safety in appropriate functional locations.	No roundabouts are proposed within the CDP area.
Implement prescribed facilities from the 2013 Ottawa Pedestrian Plan (OPP) and 2013 Ottawa Cycling Plan (OCP) within development.	Realigned Greenbank Road is planned to be a spine route in the OCP. As per the Environmental Assessment, this road will include cycle tracks. River Mist Road is identified as a local cycling route as per the OCP. The proposed River Mist cross-section includes cycle tracks.
Avoid reverse frontage lots (rear yards abutting public streets) within a community.	Plan incorporates window streets and avoids rear lotting.
Encourage representation from OC Transpo at pre-consultation meetings for plans of subdivision in order to incorporate transit planning into initial subdivision design.	OC Transpo has been involved during the CDP process through the Technical Advisory Committee (TAC).
Provide flexibility in zoning to accommodate a mix of land uses within a community, such as areas that allow live-work units or local commercial land uses.	Specific zoning provisions to be determined through the Zoning By-Law Amendment process.

BBSS OBJECTIVE	BSUESA
To support housing affordability, encourage developers to "rough-in" utilities in basements in order to facilitate their future conversion to second dwelling units in single, semi-detached, and townhouse units.	House design is outside of the scope of the CDP
6. Road Right-of-Way	
Add a series of new ROW cross-sections that respond to built form context, better accommodate street trees, and address items below.	A range of street cross-sections have been designed to respond to local context.
Consider adding an extra narrow ROW for a one-way street design.	All streets to be two-way to facilitate circulation and connectivity.
ROW cross-sections, roadway widths, and design speeds should respond to built form and land use context.	A range of street cross-sections have been designed to respond to local context.
Ensure new cross-sections consider offset geometry and differences between ROW width versus paved road width.	A range of street cross-sections have been designed to respond to local context.
Reduce width of vehicle travel lanes in new ROW cross-sections.	A range of street cross-sections have been designed to respond to local context.
Accommodate public transit and related amenities in the design of streets with existing or anticipated transit service.	Realigned Greenbank Road features designated transit lanes and the proposed East-West Collector is envisioned to accommodate public transit routes / stops. Other transit facilities to be determined at the Plan of Subdivision stage.
Implement traffic calming measures (such as those in the Canadian Guide to Neighbourhood Traffic Calming) at the outset of road design for local and collector streets.	Traffic calming measures to be determined at the Plan of Subdivision stage.
Allow for increased storage of stormwater volumes within the ROW, taking into consideration opportunities to use bioswales for tree hydration.	Water volumes anticipated to be low due to natural infiltration patterns and soil conditions.
Determine preferred sizes and location for combined mail boxes in the right-of-way that support active transportation and safety, and reduce the creation of short vehicular trips.	Mailbox design is outside the scope of the CDP.
Ensure components of a "complete street" are provided in the ROW, such as: - Pedestrian facilities - Cycling facilities - On-street parking - Traffic calming features - Trees on both sides of the street, including canopy trees - Utility placement and operational consideration that do not interfere with the attributes of complete streets	Street cross-sections designed to accommodate pedestrian and cycling infrastructure where appropriate. Traffic calming measures and street trees to be determined at the detailed design stage.

9.0 MULTI-MODAL LEVEL OF SERVICE ASSESSMENT

Multi-modal level of service (MMLOS) attempts to quantify the convenience and comfort that all roadway users will experience at intersections and along roadway segments. Roadway users include auto drivers, pedestrians, cyclists, truck drivers, and transit riders.

A multi-modal level of service (MMLOS) assessment was undertaken to:

- Determine the appropriate intersections and road segments in which to analyze the MMLOS;
- Assess the pedestrian level of service (PLOS);
- Assess the bicycle level of service (BLOS);
- Assess the truck level of service (TkLOS); and
- Assess the transit level of service (TLOS).

The pedestrian level of service (PLOS) evaluates pedestrians comfort, safety, and convenience. The PLOS is determined by two different measures: the Pedestrian Exposure to Traffic at Signalized Intersections (PETSI) and the average delay pedestrians experience at the intersections. The measure that produces the worst PLOS governs.

The bicycle level of service (BLOS) evaluates the level of traffic stress (LTS) that cyclists will experience. The higher the level of traffic stress, the worse the BLOS will be. Typically, a high LTS results in only very confident and experienced cyclists using the road corridor, while a low LTS allows cyclists of all ages and skill level to use the corridor.

The truck level of service (TkLOS) considers the physical space available for trucks to navigate roadway corridors and intersections. Trucks can negotiate wider roads and more generous turning radii easier, resulting in safer operations. However, as there are no designated truck routes within the study area, the TkLOS was not assessed as part of the subject study.

The transit level of service (TLOS) looks at the transit travel time and the transit priority given to transit vehicles based on the different facility types and conditions. The longer the transit travel time, the lower the TLOS will be. TLOS is intended to be determined along roads with rapid transit or transit priority measures.

9.1 INTERSECTIONS AND ROAD SEGMENT SELECTION

9.1.1 Intersections

The MMLOS assessment is only applied to signalized intersections. As there are no signalized intersections within the project area, intersection MMLOS does not apply.

9.1.2 Road Segments

The road segments that were include in the MMLOS assessment include the collector and arterial roads, as follows:

- Realigned Greenbank Road (41.5m ROW)
    - Dundonald Drive to Kilbirnie Drive
    - Kilbirnie Drive to Barnsdale Road
- Kilbirnie Drive (22.0m ROW)
- East – West Collector (24.0m ROW)
- River Mist Road (24.0m ROW)

Table 21 below provides the MMLOS assessment along with the targets. The targets are based on the road segments being within 600m of a Rapid Transit Station.

Table 21 Segment MMLOS Summary

ROAD SEGMENT	PEDESTRIAN		CYCLIST		TRANSIT		AUTO	
	Target	Actual	Target	Actual	Target	Actual	Target	Actual
Realigned Greenbank Road: Dundonald Drive to Kilbirnie Drive	A	D	C	A	A	A	E	N/A
Realigned Greenbank Road: Kilbirnie Drive to Barnsdale Road	A	D	C	A	A	D	E	N/A
Kilbirnie Drive	A	B	B	A	N/A	N/A[1]	E	D
East – West Collector	A	B	B	A	N/A	F	E	A
River Mist Road	A	B	B	A	N/A	F	E	F

Notes:
1. It was assumed that there will be no transit service along Kilbirnie Drive

Appendix D contains the detailed MMLOS assessment.

10.0 SUMMARY AND CONCLUSIONS

Community Design Plan

The Barrhaven South Expansion Study Area encompasses roughly 121 hectares of land. The lands are located east of Borrisokane Road, north of Barnsdale Road, west of Existing Greenbank Road, and south of the existing Barrhaven South CDP area. The preferred alternative for the CDP lands includes roughly 1,500 residential units, two elementary schools, a small commercial component, a Park and Ride lot, a library, and several parks.

The existing active Brazeau and Drummond sand and gravel pits are included in the subject CDP lands, however, the timing of the redevelopment of these lands is currently unknown. The conceptual planning overlay developed as part of the CDP allows for future transportation connections to be made to the Brazeau and Drummond lands via an extension of Dundonald Drive as well as local road connections to the remaining CDP lands. The subject Transportation Master Study, however, does not explicitly include traffic generated by these aggregate pits as the development timing and lot fabric are unknown. As the proponents of these lands proceed through the development approvals process, they will be required to undertake transportation impact assessments to determine the specific transportation improvements that will be required to support the redevelopment, including coordination between Brazeau and Drummond in terms of accessing Realigned Greenbank Road. The findings from subsequent transportation analysis may reveal that additional transportation improvements are required beyond what is being identified in the subject Transportation Master Study. Furthermore, some transportation improvements may be subject to cost-sharing between the various proponents / developers of the CDP.

Transit and Active Transportation Facilities

The CDP lands will be well serviced in the future by rapid transit service on Realigned Greenbank Road and park and ride at Realigned Greenbank Road and Kilbirnie Drive. The proposed pedestrian facilities will provide direct and convenient access to transit facilities, schools, and recreational areas. The proposed cycling facilities will provide direct and convenient access to arterial and collector roadways and to the rest of Barrhaven.

Road Network Improvements

A key finding of the transportation assessment is that the subject development can proceed without advancing the timelines of Realigned Greenbank Road as identified in the City's 2013 Transportation Master Plan. However, several intersection modifications are required at the study area intersections, as described in **Table 22** below.

Table 22 Required Transportation Improvements

INTERSECTION	EXISTING TRAFFIC CONTROL	2016 EXISTING	2025 FUTURE BACKGROUND	2025 TOTAL FUTURE	2031 FUTURE BACKGROUND	2031 ULTMATE
Borrisokane Road at Cambrian Road	Stop Control – Minor Approach	N/A	N/A	N/A	Traffic signals with left turn auxiliary lanes	N/A
Existing Greenbank Road at Cambrian Road	Single Lane Roundabout	N/A	Southbound right turn lane	Northbound and eastbound right turn lanes	Westbound right turn lane and dual northbound and southbound through lanes	Double lane roundabout
Barnsdale Road at Borrisokane Road	Stop Control – Minor Approach	N/A	N/A	N/A	N/A	N/A
Barnsdale Road at Viewbank Road	Stop Control – Minor Approach	N/A	N/A	N/A	N/A	N/A
Existing Greenbank Road at Barnsdale Road	All-Way Strop Control	N/A	N/A	Traffic signals with left turn auxiliary lanes	N/A	N/A
Prince of Wales Drive at Barnsdale Road[1]	Stop Control – Minor Approach	-	-	-	-	-
Existing Greenbank Road at Prince of Wales Drive	Stop Control – Minor Approach	N/A	Traffic signals with left turn auxiliary lanes	N/A	Dual southbound through lanes	N/A
Prince of Wales Drive at Bankfield Road	Traffic Signals	Single Lane Roundabout	Southbound right turn lane and dual eastbound through lanes	N/A	Westbound right turn lane and dual northbound and southbound through lanes	N/A

Notes:

1. The City is currently undertaking a functional design study of the Prince of Wales Drive at Barnsdale Road intersection. Through that study, it will be determined what the required upgrades are at this intersection. As such, intersection improvements were not considered at this location as part of the subject study.

With the exception of the recommended improvements at the Borrisokane Road at Cambrian Road intersection, the remaining recommended intersection improvements have been previously identified through various planning documents such as the Cambrian Road Widening Environmental Assessment Study (Stantec 2014) and the Realigned Greenbank Road and South West Transitway Extension Environmental Assessment Study (MMM 2014).

The required intersection improvements at the Borrisokane Road at Cambrian Road intersection are not surprising given the recent change in the implementation timelines of Realigned Greenbank Road. While the overall Jock River Screenline is projected to operate acceptably without Realigned Greenbank Road, Borrisokane Road will be heavily relied on for commuters from Barrhaven South. The projected increase in traffic volume along Borrisokane Road triggers the need to implement traffic signals and turning lanes at the Borrisokane Road at Cambrian Road intersection.

It is noted that subsequent transportation impact assessments will be required for each phase of development as part of the development approvals process. Based on the findings of this Transportation Master Study, approval of the Barrhaven South Urban Expansion Study Area Community Design Plan is recommended from a transportation perspective.

Prepared by (Original signed)
(signature)
Lauren O'Grady, P.Eng., Transportation Engineer

Reviewed by (Original signed)
(signature)
Robert Vastag, RPP, Senior Transportation Planner

Appendix A TRANSPORTATION MASTER STUDY TERMS OF REFERENCE

TRANSPORTATION MASTER STUDY TERMS OF REFERENCE (VERSION 5)

Introduction

In early 2015 Stantec prepared a DRAFT Terms of Reference for a Transportation Assessment to support the Barrhaven South Urban Expansion Study Area Community Design Plan (CDP). At that time it was thought that the Transportation Assessment would proceed in the form of a Community Transportation Study (CTS).

The Class EA process, however, recognizes the benefits of integrating approvals under the province's *Environmental Assessment Act* and the *Planning Act*. The Owners Group for the subject lands wishes to proceed with this integrated approach and have retained a Consulting Team to prepare a series of deliverables in support of the CDP. The deliverables will include an Existing Conditions Report (ECR), and Environmental Management Plan (EMP), a Transportation Master Study, and a Master Servicing Study (MSS).

Stantec has been retained to prepare the Transportation Master Study, which will address the DRAFT Terms of Reference previously outlined in the form of a CTS, and will also fulfill the requirements of the Municipal Class Environmental Assessment process for Schedule B and C projects.

The following Terms of Reference have been updated to reflect specific comments / additions requested by the City based on their review of the initial draft.

The tasks outlined below are linked to the relevant tasks referenced in the parent document produced by FoTenn.

Task 3 – Existing Conditions Report

- Summary of current policy and regulatory framework:
    - Transportation Master Plan (TMP);
    - Ottawa Pedestrian Plan (OPP);
    - Ottawa Cycling Plan (OCP);
    - Transit-Oriented Development Guidelines;
    - Emerging policy direction related to Building Better and Smarter Suburbs (BBSS);
    - Policies related to Complete Streets;
    - Barrhaven South Community Transportation Study (BSCTS) dated October 29, 2010;

  - Realigned Greenbank Road and Southwest Transitway Extension Planning and Environmental Assessment Study;
  - Cambrian Road Environmental Assessment Study; and
- Summarize / assess performance (i.e. Level of Service) for the existing road network in the Study Area, including the following intersections:
  - Cambrian at Cedarview
  - Cambrian at Greenbank (existing)
  - Barnsdale at Cedarview
  - Barnsdale at Viewbank
  - Barnsdale at Greenbank (existing)
  - Barnsdale at Prince of Wales
  - Greenbank at Prince of Wales
  - Bankfield at Prince of Wales
- Peak periods for assessment:
  - Weekday AM roadway peak
  - Weekday PM roadway peak
- Summarize / assess the existing capacity of the Jock River Screenline (partial SL49 from Cedarview Road to Prince of Wales Drive).
- Overview of current transit service, including existing ridership and modal share, as well as any transit priority measures in the area, where appropriate.
- Overview of existing pedestrian and cycling networks and linkages to adjacent communities.

Deliverable – Preliminary Existing Conditions Report on Transportation

Task 4 – Vision, Objectives, Targets

- Establish appropriate Vision, Objectives and Targets for the transportation system consistent with guiding documents (i.e. TMP), through community input, and in keeping with BBSS policy directions.

Deliverable – Transportation Vision, Objectives, Targets

Task 5 – Preliminary Concept Plans (Transportation Forecasts and Assessment of Background Conditions)

- Establish future background conditions based on growth forecasts and known transportation improvements that area expected to occur within the study horizons. Future horizons include:
    - 2031 conditions (TMP Affordable Network);
    - One interim horizon (year to be determined).
- Identify gaps (i.e. capacity, level of service, critical connections, etc.) in the transportation system and identify potential transportation solutions to address the background conditions. The following future intersections, in addition to those outlined in Task 3, will be assessed:
    - Cambrian at Realigned Greenbank
    - Barnsdale at Realigned Greenbank
    - Realigned Greenbank at PNR/Collector Street #1
    - Realigned Greenbank at Collector Street #2
    - Barnsdale at Collector Street #3
    - Greenbank (existing) at Collector Street #4
- Summarize / assess the future background capacity of the Jock River Screenline (partial SL49 from Cedarview to Prince of Wales). This will also include a review of the traffic analysis undertaken as part of the Greenbank Road and Southwest Transitway Extension EA. Screenline forecasts for the 2031 horizon year from the Trans Committee will be acquired. Potential improvements to transportation system capacity will be identified including the potential need for a new Highway 416 interchange at Barnsdale Road as a means of addressing screenline capacity constraints. However, a detailed assessment of the potential future interchange will not be undertaken as part of this scope as that project is identified to be constructed post-2031.
- Provide transportation input into the Concept Plan development including the development of the Plan's transportation network. Identify key road linkages / connections, review intersection spacing, establish roadway hierarchy, transit connections, pathways, traffic calming measures, and typical cross-sections.

Deliverable – Future Background Transportation Conditions Report

Task 6 – Preferred Concept Plan, Demonstration Plan & Design Guidelines

- Develop transportation forecasts for the Preferred Concept Plan (i.e. traffic generation in terms of 'person trips' for each mode, including developing a modal split for the CDP area and a Multi Modal Level of Service (MMLOS) assessment.
- Examine the location of a future park and ride along Realigned Greenbank / Southwest Transitway extension at the terminus of the future Transitway. The preferred location will consider both land use planning and transportation considerations.
- Identify potential transit demand and any required service improvements / changes to accommodate the demand.
- Undertake refinements to the transportation network of the Preferred Concept Plan.
- Develop typical road cross-sections for the various road types supporting the Preferred Concept Plan. These typical cross-sections will illustrate the relationships between the various users of all modes, having regard for BBSS policy direction and Complete Street principles. For example, typical roadway cross-sections will be developed with adjacent land use context in mind (i.e. collector road cross-sections adjacent to schools may accommodate school bus lay-bys and/or passenger pick-up and drop-off areas and may be different than cross-sections applied to segments where schools are not present) and will be developed using a multi-modal approach.
- Identify intersections / corridors which are integral to the movement of children to and from school, and show how safety is addressed through cross-section elements and where traffic calming solutions may be required. Such items may become conditions of draft subdivision, and where needed, conditions of Site Plan Control approval.
- Identify transportation improvements required to accommodate the traffic generated by the Preferred Concept Plan.
- Identify transit strategies and potential transit routes.
- Illustrate the Plan's active modes network (i.e. cycling and pedestrian facilities).

Deliverable – Draft Transportation Master Study

Task 7 – The Barrhaven South Expansion Area Community Design Plan / Transportation Master Study

Finalize the Barrhaven South Expansion Area TMS to include:

- Summary of Existing Conditions
- Summary of Future Background Conditions
- Concept Plan of the Transportation Network

- Transportation infrastructure required to support the CDP, for all modes of transportation – cyclists, pedestrians, transit users, vehicles, and carpooling.
- Transit strategy and goals
- Ultimate screenline conditions and implications on the timing of a potential Highway 416 interchange at Barnsdale Road (Note: this does not include detailed operational assessment of the interchange ramps or interchange configuration).
- Implementation Plan, including phasing and costing. Phasing to be based on the assessment of one interim horizon.
- EA implications of infrastructure improvements
- The final TMS will incorporate any comments received by staff from the review of the Draft TMS

Deliverable – Transportation Master Study final report

Consultation and Meetings

Based on a 12-month project schedule and at a meeting frequency of roughly one meeting every six to eight weeks, a total of seven (7) project team meetings have been assumed and three (3) additional meetings with City staff have been accounted for.

Attendance / participation at two (2) Workshops and two (2) Open Houses have been included within our work plan. Our commitments will be further detailed in the "Consultation Strategy" which we understand will become part of the over-arching Terms of Reference.

Appendix B TRAFFIC DATA

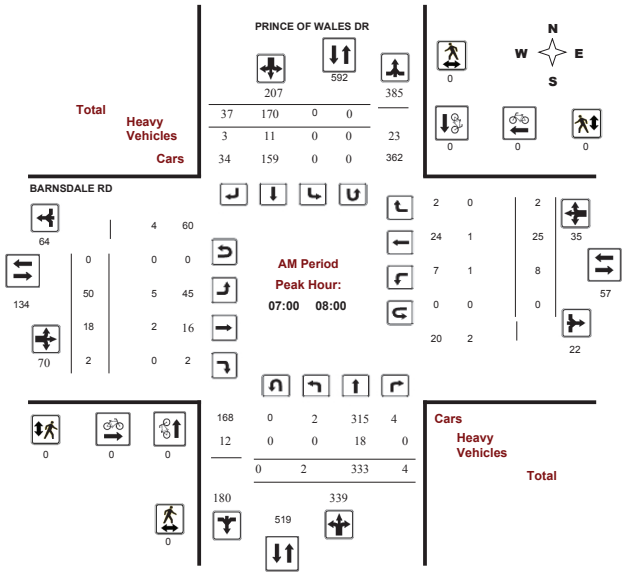
Public Works - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram

BARNSDALE RD @ PRINCE OF WALES DR

Survey Date: Friday, July 26, 2013 **WO No:** 31417

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



Comments

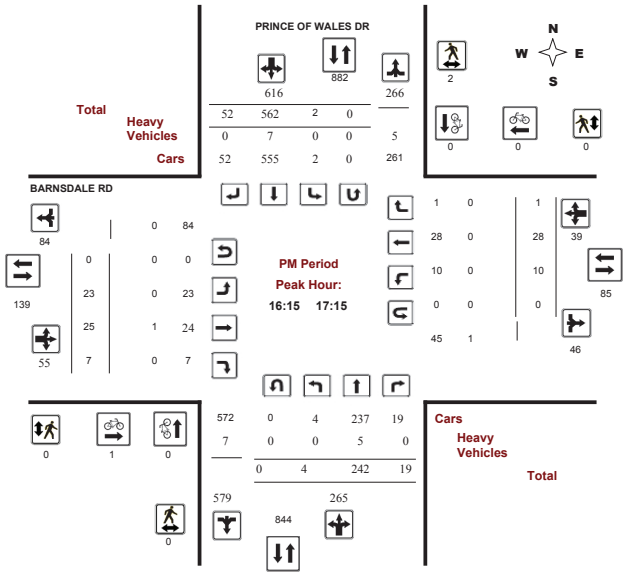
Public Works - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram

BARNSDALE RD @ PRINCE OF WALES DR

Survey Date: Friday, July 26, 2013 **WO No:** 31417

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



Comments

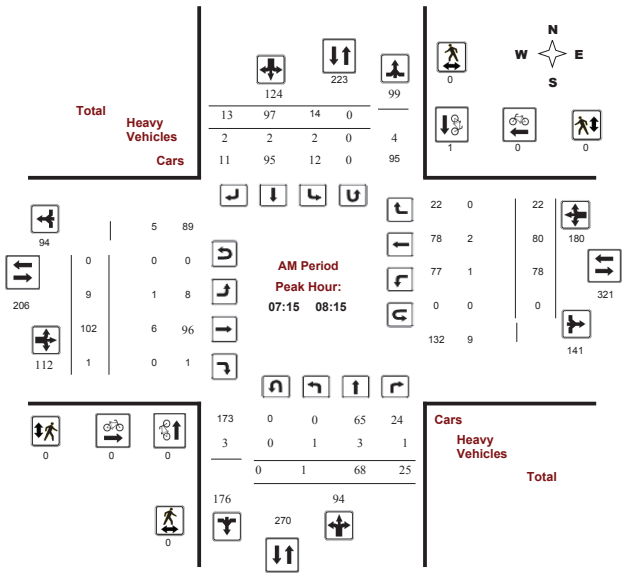
Public Works - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram

BARNSDALE RD @ GREENBANK RD

Survey Date: Tuesday, September 30, 2014 **WO No:** 29891

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



Comments

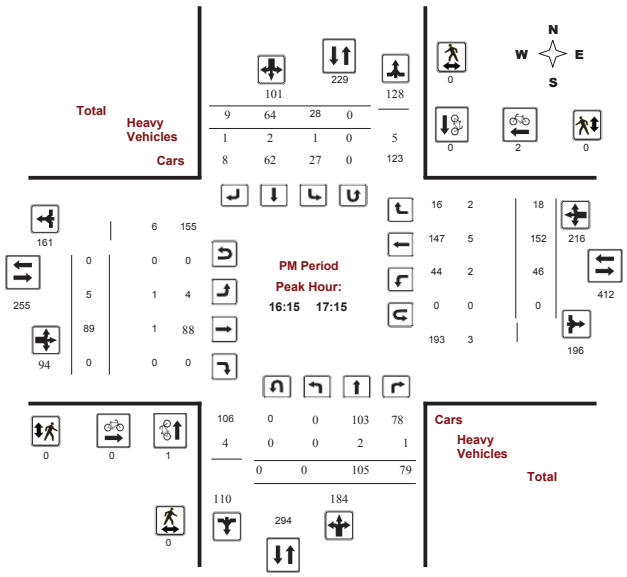
Public Works - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram

BARNSDALE RD @ GREENBANK RD

Survey Date: Tuesday, September 30, 2014 **WO No:** 29891

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



Comments

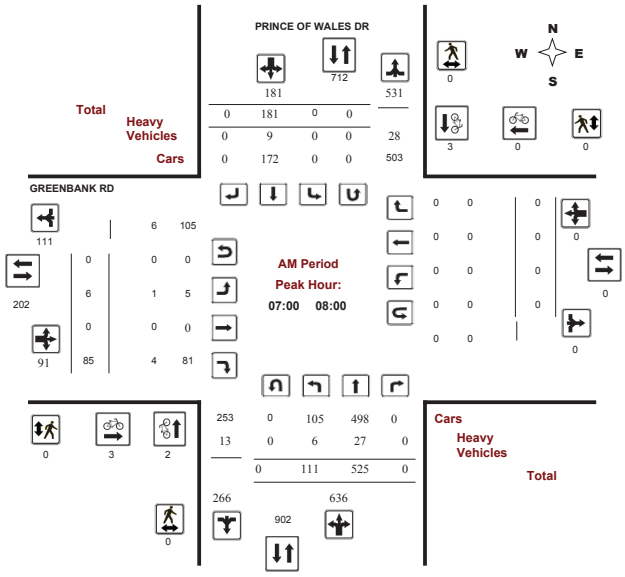
Public Works - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram

GREENBANK RD @ PRINCE OF WALES DR

Survey Date: Wednesday, October 29, 2014 **WO No:** 29890

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



2015-Jul-02 Page 1 of 3

Public Works - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram

GREENBANK RD @ PRINCE OF WALES DR

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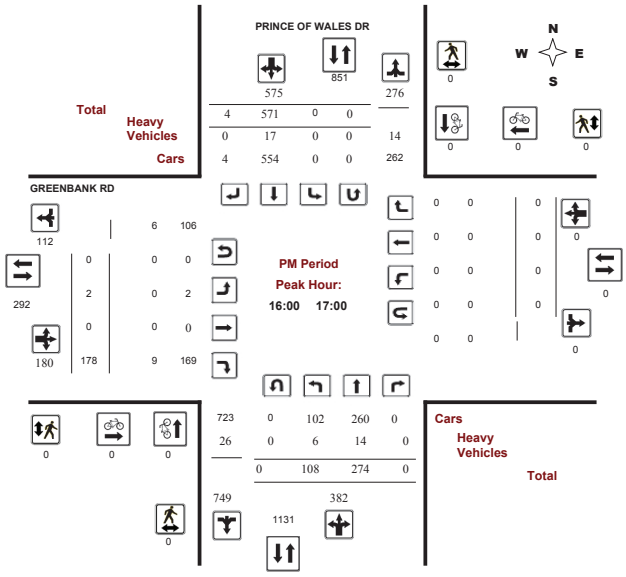
Start Time: 07:00 **Device:** Miovision



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Public Works - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram

BANKFIELD RD @ PRINCE OF WALES DR

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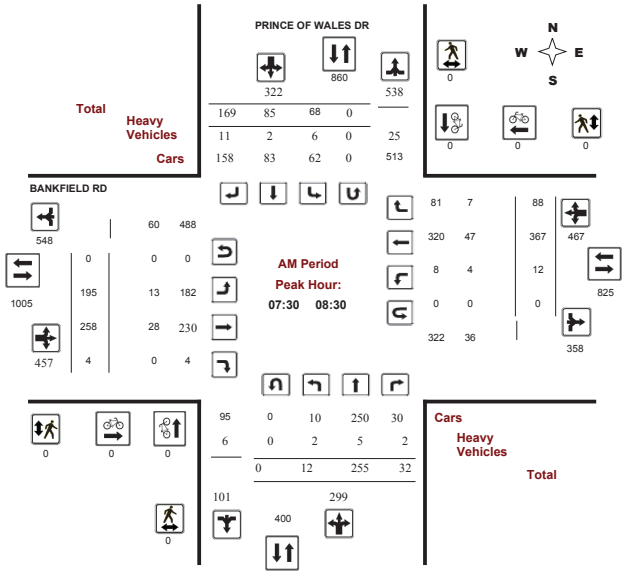
Start Time: 07:00 **Device:** Miovision



2015-Jul-02 Page 1 of 3

Public Works - Traffic Services

Turning Movement Count - Full Study Peak Hour Diagram

BANKFIELD RD @ PRINCE OF WALES DR

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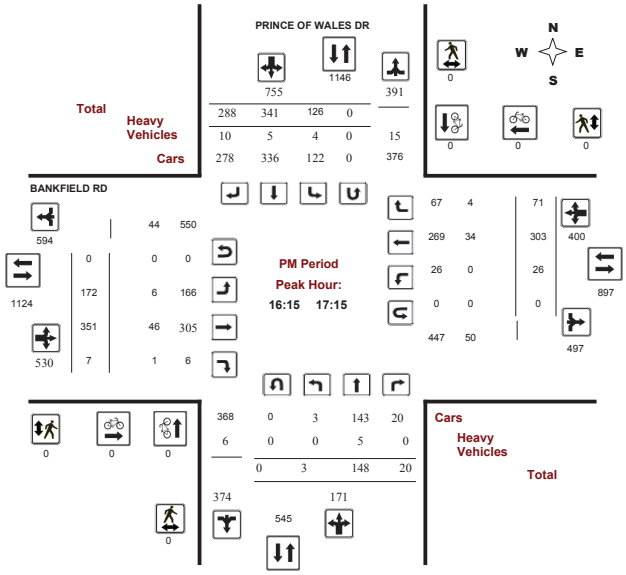
Start Time: 07:00 **Device:** Miovision



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Intersection: Barnsdale at Viewbank
Date: 7-Jul-15

	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR	Total	Hour
7:45 - 8:00	1	0	0	0	0	0	0	16	0	0	14	0	31	
8:00 - 8:15	1	0	0	0	0	0	0	16	1	1	18	0	37	
8:15 - 8:30	0	0	0	0	0	0	0	25	0	0	23	0	48	
8:30 - 8:45	0	0	1	0	0	0	0	27	1	0	25	0	54	170
8:45 - 9:00	2	0	0	0	0	0	0	19	0	0	14	0	35	174
9:00 - 9:15	0	0	0	0	0	0	0	15	0	0	14	0	29	166
Peak Hour	**3**	**0**	**1**	**0**	**0**	**0**	**0**	**87**	**2**	**1**	**80**	**0**		

	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR	Total	Hour
4:00 - 4:15	1	0	0	0	0	0	0	23	0	0	28	0	52	
4:15 - 4:30	1	0	0	0	0	0	0	33	0	1	42	0	77	
4: 30 - 4:45	1	0	0	0	0	0	0	30	0	0	25	0	56	
4: 45 - 5:00	1	0	0	0	0	0	0	26	0	0	27	0	54	239
5:00 - 5:15	0	0	0	0	0	0	0	30	1	0	28	0	59	246
5:15 - 5:30	0	0	0	0	0	0	0	31	0	0	19	0	50	219
Peak Hour	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**119**	**1**	**1**	**122**	**0**		

Intersection: Cambrian at Borrisokane
Date: 21-Jul-15

	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR	Total	Hour
7:15 - 7:30	0	5	0	19	4	0	0	0	0	1	0	83	112	
7:30 -7:45	0	7	1	21	3	0	0	0	0	1	0	83	116	
7:45 - 8:00	0	7	0	18	10	0	0	0	0	0	0	82	117	
8:00 - 8:15	0	5	2	24	5	0	0	0	0	2	0	74	112	457
8:15 - 8:30	0	14	1	20	5	0	0	0	0	1	0	69	110	455
8:30 - 8:45	0	9	0	20	8	0	0	0	0	1	0	71	109	448
Peak Hour	**0**	**24**	**3**	**82**	**22**	**0**	**0**	**0**	**0**	**4**	**0**	**322**		

	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR	Total	Hour
3:30 - 3:45	0	10	1	48	9	0	0	0	0	1	0	31	100	
3:45 - 4:00	0	12	1	53	11	0	0	0	0	2	0	33	112	
4:00 - 4:15	0	9	2	56	14	0	0	0	0	2	0	34	117	
4:15 - 4:30	0	19	1	67	11	0	0	0	0	1	0	22	121	450
4:30 - 4:45	0	4	1	60	11	0	0	0	0	2	0	31	109	459
4:45 - 5:00	0	3	1	57	5	0	0	0	0	3	0	28	97	444
Peak Hour	**0**	**44**	**5**	**236**	**47**	**0**	**0**	**0**	**0**	**7**	**0**	**120**		

Intersection: Greenbank at Cambrian
Date: 22-Jul-15

	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR	Total	Hour
7:15 - 7:30	9	57	12	3	29	19	16	38	4	6	21	9	223	
7:30 - 7:45	14	50	13	7	23	16	40	58	9	8	23	4	265	
7:45 - 8:00	0	1	4	0	3	1	2	5	0	0	1	0	17	
8:00 - 8:15	16	60	17	6	21	5	22	55	7	9	29	13	260	765
8:15 - 8:30	14	53	18	5	23	15	19	41	5	5	26	11	235	777
8:30 - 8:45	9	55	21	16	21	17	15	37	4	8	30	11	244	756
8:45 - 9:00	10	40	23	12	40	12	9	33	10	6	25	17	237	976
Peak Hour	**49**	**208**	**79**	**39**	**105**	**49**	**65**	**166**	**26**	**28**	**110**	**52**		

	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR	Total	Hour
4:00 - 4:15	4	29	15	13	46	29	15	19	15	9	28	11	233	
4:15 - 4:30	7	39	9	13	65	29	19	33	17	17	33	12	293	
4: 30 - 4:45	10	49	17	8	74	22	21	29	27	12	47	17	333	
4: 45 - 5:00	10	36	15	14	75	28	16	37	38	21	46	19	355	1214
5:00 - 5:15	9	30	13	15	69	35	28	44	16	17	53	23	352	1333
5:15 - 5:30	10	29	9	14	66	32	15	39	13	17	40	24	308	1348
Peak Hour	**39**	**144**	**54**	**51**	**284**	**117**	**80**	**149**	**94**	**67**	**186**	**83**		

Intersection: Borrisokane at Barnsdale
Date: 23-Jul-15

	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR	Total	Hour
7:15 - 7:30	0	0	0	2	0	3	4	26	0	0	27	2	64	
7:30 - 7:45	0	0	0	6	0	6	4	23	0	0	26	4	69	
7:45 - 8:00	0	0	0	3	0	4	4	20	0	0	25	3	59	
8:00 - 8 :15	0	0	0	2	0	4	6	25	0	0	23	5	65	257
8:15 - 8:30	0	0	0	2	0	5	2	19	0	0	18	2	48	241
8:30 - 8:45	0	0	0	4	0	3	4	16	0	0	19	1	47	219
Peak Hour	**0**	**0**	**0**	**13**	**0**	**17**	**18**	**94**	**0**	**0**	**101**	**14**		

	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR	Total	Hour
3:45 - 4:00	0	0	0	5	0	6	3	29	0	0	19	4	66	
4:00 - 4:15	0	0	0	2	0	7	3	26	0	0	21	4	63	
4:15 - 4:30	0	0	0	4	0	8	1	29	0	0	31	5	78	
4:30 - 4:45	0	0	0	4	0	3	7	23	0	0	27	4	68	275
4:45 - 5:00	0	0	0	3	0	5	4	20	0	0	28	8	68	277
5:00 - 5:15	0	0	0		0	6	5	17	7	0	26	4	65	279
Peak Hour	**0**	**0**	**0**	**11**	**0**	**22**	**17**	**89**	**7**	**0**	**112**	**21**		

Appendix C INTERSECTION PERFORMANCE WORKSHEETS

C.1 2016 EXISTING CONDITIONS

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	4	354	32	3	90	29
Future Volume (Veh/h)	4	354	32	3	90	29
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	4	385	35	3	98	32
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	264	36			38	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	264	36			38	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	99	63			94	
cM capacity (veh/h)	679	1036			1572	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	389	38	130
Volume Left	4	0	98
Volume Right	385	3	0
cSH	1030	1700	1572
Volume to Capacity	0.38	0.02	0.06
Queue Length 95th (m)	13.5	0.0	1.5
Control Delay (s)	10.6	0.0	5.7
Lane LOS	B		A
Approach Delay (s)	10.6	0.0	5.7
Approach LOS	B		

Intersection Summary			
Average Delay		8.7	
Intersection Capacity Utilization		42.0%	ICU Level of Service A
Analysis Period (min)		15	

LANE SUMMARY

Site: 2016 Existing AM

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Greenbank Road South													
Lane 1[d]	363	0.0	1100	0.330	100	2.1	LOS A	2.1	14.7	Full	500	0.0	0.0
Approach	363	0.0		0.330		2.1	LOS A	2.1	14.7				
East: Cambrian Road East													
Lane 1[d]	199	0.0	1029	0.193	100	2.3	LOS A	1.1	7.9	Full	500	0.0	0.0
Approach	199	0.0		0.193		2.3	LOS A	1.1	7.9				
North: Greenbank Road North													
Lane 1[d]	215	0.0	1178	0.183	100	1.6	LOS A	1.0	7.3	Full	500	0.0	0.0
Approach	215	0.0		0.183		1.6	LOS A	1.0	7.3				
West: Cambrian Road West													
Lane 1[d]	268	0.0	1194	0.225	100	1.8	LOS A	1.3	9.2	Full	500	0.0	0.0
Approach	268	0.0		0.225		1.8	LOS A	1.3	9.2				
Intersection	1045	0.0		0.330		2.0	LOS A	2.1	14.7				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

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Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	20	113	105	15	14	19
Future Volume (Veh/h)	20	113	105	15	14	19
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	123	114	16	15	21
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	130				289	122
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	130				289	122
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	98				98	98
cM capacity (veh/h)	1455				691	929

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	145	130	36
Volume Left	22	0	15
Volume Right	0	16	21
cSH	1455	1700	812
Volume to Capacity	0.02	0.08	0.04
Queue Length 95th (m)	0.3	0.0	1.1
Control Delay (s)	1.2	0.0	9.6
Lane LOS	A		A
Approach Delay (s)	1.2	0.0	9.6
Approach LOS			A

Intersection Summary			
Average Delay		1.7	
Intersection Capacity Utilization		23.7%	ICU Level of Service A
Analysis Period (min)		15	

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	125	2	1	117	3	1
Future Volume (Veh/h)	125	2	1	117	3	1
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	136	2	1	127	3	1
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			138		266	137
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			138		266	137
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			1446		723	911

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	138	128	4
Volume Left	0	1	3
Volume Right	2	0	1
cSH	1700	1446	762
Volume to Capacity	0.08	0.00	0.01
Queue Length 95th (m)	0.0	0.0	0.1
Control Delay (s)	0.0	0.1	9.7
Lane LOS		A	A
Approach Delay (s)	0.0	0.1	9.7
Approach LOS			A

Intersection Summary			
Average Delay		0.2	
Intersection Capacity Utilization		17.0%	ICU Level of Service A
Analysis Period (min)		15	

Intersection	
Intersection Delay, s/veh	9.7
Intersection LOS	A

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Lane Configurations												
Traffic Vol, veh/h	0	11	114	1	0	87	99	27	0	1	100	28
Future Vol, veh/h	0	11	114	1	0	87	99	27	0	1	100	28
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	12	124	1	0	95	108	29	0	1	109	30
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	9.3	10.2	9.2
HCM LOS	A	B	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	1%	9%	41%	11%
Vol Thru, %	78%	90%	46%	77%
Vol Right, %	22%	1%	13%	12%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	129	126	213	154
LT Vol	1	11	87	17
Through Vol	100	114	99	119
RT Vol	28	1	27	18
Lane Flow Rate	140	137	232	167
Geometry Grp	1	1	1	1
Degree of Util (X)	0.192	0.19	0.313	0.231
Departure Headway (Hd)	4.93	5	4.871	4.971
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	721	711	732	716
Service Time	3.005	3.077	2.94	3.044
HCM Lane V/C Ratio	0.194	0.193	0.317	0.233
HCM Control Delay	9.2	9.3	10.2	9.6
HCM Lane LOS	A	A	B	A
HCM 95th-tile Q	0.7	0.7	1.3	0.9

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Lane Configurations				
Traffic Vol, veh/h	0	17	119	18
Future Vol, veh/h	0	17	119	18
Peak Hour Factor	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2
Mvmt Flow	0	18	129	20
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	9.6
HCM LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	216	33	5	12	40	5	6	555	6	5	252	73
Future Volume (Veh/h)	216	33	5	12	40	5	6	555	6	5	252	73
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	235	36	5	13	43	5	7	603	7	5	274	79
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	970	948	314	967	984	606	353			610		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	970	948	314	967	984	606	353			610		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	86	99	94	83	99	99			99		
cM capacity (veh/h)	198	258	727	206	246	497	1206			969		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	276	61	617	358
Volume Left	235	13	7	5
Volume Right	5	5	7	79
cSH	207	246	1206	969
Volume to Capacity	1.34	0.25	0.01	0.01
Queue Length 95th (m)	117.0	7.2	0.1	0.1
Control Delay (s)	225.3	24.4	0.2	0.2
Lane LOS	F	C	A	A
Approach Delay (s)	225.3	24.4	0.2	0.2
Approach LOS	F	C		

Intersection Summary				
Average Delay		48.7		
Intersection Capacity Utilization		60.2%	ICU Level of Service	B
Analysis Period (min)		15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	13	194	123	586	211	5
Future Volume (Veh/h)	13	194	123	586	211	5
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	14	211	134	637	229	5
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1136	232	234			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1136	232	234			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	93	74	90			
cM capacity (veh/h)	201	808	1333			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	225	134	637	234
Volume Left	14	134	0	0
Volume Right	211	0	0	5
cSH	680	1333	1700	1700
Volume to Capacity	0.33	0.10	0.37	0.14
Queue Length 95th (m)	11.0	2.5	0.0	0.0
Control Delay (s)	12.9	8.0	0.0	0.0
Lane LOS	B	A		
Approach Delay (s)	12.9	1.4		0.0
Approach LOS	B			

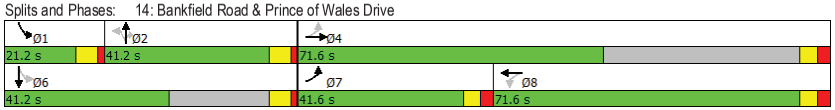
Intersection Summary				
Average Delay		3.2		
Intersection Capacity Utilization		50.2%	ICU Level of Service	A
Analysis Period (min)		15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	257	268	4	12	382	116	12	337	33	85	107	212
Future Volume (vph)	257	268	4	12	382	116	12	337	33	85	107	212
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	0.0		0.0	0.0		100.0	90.0		0.0
Storage Lanes	0		0	0		0	0		1	1		0
Taper Length (m)	30.0			30.0			30.0			30.0		
Lane Util. 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
Frt		0.999			0.969				0.850		0.900	
Flt Protected		0.976			0.999			0.998		0.950		
Satd. Flow (prot)	0	1836	0	0	1823	0	0	1880	1601	1789	1695	0
Flt Permitted		0.501			0.983			0.981		0.208		
Satd. Flow (perm)	0	943	0	0	1794	0	0	1848	1601	392	1695	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					10				102		60	
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		390.8			302.0			341.8			604.9	
Travel Time (s)		28.1			21.7			24.6			43.6	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	279	291	4	13	415	126	13	366	36	92	116	230
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	574	0	0	554	0	0	379	36	92	346	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	1		1	1		1	0	0	1	0	
Detector Template	Left			Left			Left	Thru	Right		Thru	
Leading Detector (m)	6.1	0.0		6.1	0.0		6.1	0.0	0.0	0.0	0.0	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Position(m)	0.0	1.0		0.0	3.0		0.0	0.0	0.0	1.0	0.0	
Detector 1 Size(m)	6.1	10.0		6.1	10.0		6.1	1.8	6.1	15.0	1.8	
Detector 1 Type	Cl+Ex	Call		Cl+Ex	Call		Cl+Ex	Cl+Ex	Cl+Ex	Call	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Turn Type	pm+pt	NA		Perm	NA		Perm	NA	Perm	pm+pt	NA	
Protected Phases	7	4			8			2		1	6	
Permitted Phases	4			8			2		2	6		
Detector Phase	7	4		8	8		2	2	2	1	6	
Switch Phase												
Minimum Initial (s)	10.0	8.0		10.0	10.0		25.0	25.0	25.0	10.0	25.0	
Minimum Split (s)	16.6	31.6		31.6	31.6		31.6	31.6	31.6	16.2	31.2	
Total Split (s)	41.6	71.6		71.6	71.6		41.2	41.2	41.2	21.2	41.2	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Split (%)	23.7%	40.8%		40.8%	40.8%		23.5%	23.5%	23.5%	12.1%	23.5%	
Maximum Green (s)	35.0	65.0		65.0	65.0		35.0	35.0	35.0	15.0	35.0	
Yellow Time (s)	3.7	3.7		3.7	3.7		4.6	4.6	4.6	4.6	4.6	
All-Red Time (s)	2.9	2.9		2.9	2.9		1.6	1.6	1.6	1.6	1.6	
Lost Time Adjust (s)		0.0			0.0			0.0	0.0	0.0	0.0	
Total Lost Time (s)		6.6			6.6			6.2	6.2	6.2	6.2	
Lead/Lag	Lead			Lag	Lag		Lag	Lag	Lag	Lead		
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None		None	None		Min	Min	Min	None	Min	
Walk Time (s)		7.0		7.0	7.0		7.0	7.0	7.0		7.0	
Flash Dont Walk (s)		10.0		10.0	10.0		10.0	10.0	10.0		10.0	
Pedestrian Calls (#/hr)		0		0	0		0	0	0		0	
Act Effct Green (s)		65.0			65.0			35.0	35.0	51.9	51.9	
Actuated g/C Ratio		0.50			0.50			0.27	0.27	0.40	0.40	
v/c Ratio		1.21			0.61			0.76	0.07	0.34	0.49	
Control Delay		145.4			26.6			54.8	0.3	28.2	26.2	
Queue Delay		0.0			0.0			0.0	0.0	0.0	0.0	
Total Delay		145.4			26.6			54.8	0.3	28.2	26.2	
LOS		F			C			D	A	C	C	
Approach Delay		145.4			26.6			50.1			26.6	
Approach LOS		F			C			D			C	

Intersection Summary	
Area Type: Other	
Cycle Length: 175.6	
Actuated Cycle Length: 129.7	
Natural Cycle: 130	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 1.21	
Intersection Signal Delay: 65.9	Intersection LOS: E
Intersection Capacity Utilization 119.4%	ICU Level of Service H
Analysis Period (min) 15	

Splits and Phases: 14: Bankfield Road & Prince of Wales Drive



Lane Group	EBT	WBT	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	574	554	379	36	92	346
v/c Ratio	1.21	0.61	0.76	0.07	0.34	0.49
Control Delay	145.4	26.6	54.8	0.3	28.2	26.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	145.4	26.6	54.8	0.3	28.2	26.2
Queue Length 50th (m)	~177.6	96.3	88.6	0.0	14.7	53.5
Queue Length 95th (m)	#252.6	138.0	#128.3	0.0	26.3	80.8
Internal Link Dist (m)	366.8	278.0	317.8			580.9
Turn Bay Length (m)				100.0	90.0	
Base Capacity (vph)	775	904	498	506	318	768
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.74	0.61	0.76	0.07	0.29	0.45

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	257	268	4	12	382	116	12	337	33	85	107	212
Future Volume (vph)	257	268	4	12	382	116	12	337	33	85	107	212
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.6			6.6			6.2	6.2	6.2	6.2	
Lane Util. Factor		1.00			1.00			1.00	1.00	1.00	1.00	
Frt		1.00			0.97			1.00	0.85	1.00	0.90	
Flt Protected		0.98			1.00			1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1837			1823			1880	1601	1789	1696	
Flt Permitted		0.50			0.98			0.98	1.00	0.21	1.00	
Satd. Flow (perm)		943			1794			1848	1601	391	1696	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	279	291	4	13	415	126	13	366	36	92	116	230
RTOR Reduction (vph)	0	0	0	0	5	0	0	0	26	0	36	0
Lane Group Flow (vph)	0	574	0	0	549	0	0	379	10	92	310	0
Turn Type	pm+pt	NA		Perm	NA		Perm	NA	Perm	pm+pt	NA	
Protected Phases	7	4			8			2		1	6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)		65.0			65.0			35.0	35.0	51.9	51.9	
Effective Green, g (s)		65.0			65.0			35.0	35.0	51.9	51.9	
Actuated g/C Ratio		0.50			0.50			0.27	0.27	0.40	0.40	
Clearance Time (s)		6.6			6.6			6.2	6.2	6.2	6.2	
Vehicle Extension (s)		3.0			3.0			3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		472			899			498	432	271	678	
v/s Ratio Prot										0.03	c0.18	
v/s Ratio Perm		c0.61			0.31			c0.21	0.01	0.11		
v/c Ratio		1.22			0.61			0.76	0.02	0.34	0.46	
Uniform Delay, d1		32.3			23.3			43.5	34.8	27.3	28.6	
Progression Factor		1.00			1.00			1.00	1.00	1.00	1.00	
Incremental Delay, d2		115.3			1.2			6.8	0.0	0.7	0.5	
Delay (s)		147.7			24.5			50.3	34.8	28.1	29.1	
Level of Service		F			C			D	C	C	C	
Approach Delay (s)		147.7			24.5			48.9			28.8	
Approach LOS		F			C			D			C	

Intersection Summary

HCM 2000 Control Delay	66.3	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.08		
Actuated Cycle Length (s)	129.7	Sum of lost time (s)	25.6
Intersection Capacity Utilization	119.4%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	7	126	44	5	249	50
Future Volume (Veh/h)	7	126	44	5	249	50
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	8	137	48	5	271	54
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	646	50			53	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	646	50			53	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	98	87			83	
cM capacity (veh/h)	360	1018			1553	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	145	53	325
Volume Left	8	0	271
Volume Right	137	5	0
cSH	924	1700	1553
Volume to Capacity	0.16	0.03	0.17
Queue Length 95th (m)	4.2	0.0	4.8
Control Delay (s)	9.6	0.0	6.7
Lane LOS	A		A
Approach Delay (s)	9.6	0.0	6.7
Approach LOS	A		

Intersection Summary			
Average Delay		6.9	
Intersection Capacity Utilization		37.9%	ICU Level of Service A
Analysis Period (min)		15	

LANE SUMMARY

Site: 2016 Existing PM

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Greenbank Road South													
Lane 1[d]	257	0.0	1067	0.241	100	2.1	LOS A	1.5	10.4	Full	500	0.0	0.0
Approach	257	0.0		0.241		2.1	LOS A	1.5	10.4				
East: Cambrian Road East													
Lane 1[d]	352	0.0	1089	0.323	100	2.3	LOS A	2.1	14.4	Full	500	0.0	0.0
Approach	352	0.0		0.323		2.3	LOS A	2.1	14.4				
North: Greenbank Road North													
Lane 1[d]	488	0.0	1091	0.447	100	2.4	LOS A	3.2	22.7	Full	500	0.0	0.0
Approach	488	0.0		0.447		2.4	LOS A	3.2	22.7				
West: Cambrian Road West													
Lane 1[d]	338	0.0	962	0.351	100	3.4	LOS A	2.3	16.4	Full	500	0.0	0.0
Approach	338	0.0		0.351		3.4	LOS A	2.3	16.4				
Intersection	1435	0.0		0.447		2.6	LOS A	3.2	22.7				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

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Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	20	116	153	29	19	38
Future Volume (Veh/h)	20	116	153	29	19	38
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	126	166	32	21	41
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	198				352	182
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	198				352	182
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	98				97	95
cM capacity (veh/h)	1375				635	861

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	148	198	62
Volume Left	22	0	21
Volume Right	0	32	41
cSH	1375	1700	768
Volume to Capacity	0.02	0.12	0.08
Queue Length 95th (m)	0.4	0.0	2.0
Control Delay (s)	1.3	0.0	10.1
Lane LOS	A		B
Approach Delay (s)	1.3	0.0	10.1
Approach LOS			B

Intersection Summary			
Average Delay		2.0	
Intersection Capacity Utilization		30.4%	ICU Level of Service A
Analysis Period (min)		15	

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	134	1	1	179	3	1
Future Volume (Veh/h)	134	1	1	179	3	1
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	146	1	1	195	3	1
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			147		344	146
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			147		344	146
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			1435		652	901

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	147	196	4
Volume Left	0	1	3
Volume Right	1	0	1
cSH	1700	1435	701
Volume to Capacity	0.09	0.00	0.01
Queue Length 95th (m)	0.0	0.0	0.1
Control Delay (s)	0.0	0.0	10.2
Lane LOS		A	B
Approach Delay (s)	0.0	0.0	10.2
Approach LOS			B

Intersection Summary			
Average Delay		0.1	
Intersection Capacity Utilization		20.2%	ICU Level of Service A
Analysis Period (min)		15	

Intersection	
Intersection Delay, s/veh	11.3
Intersection LOS	B

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Lane Configurations												
Traffic Vol, veh/h	0	6	124	5	0	104	164	23	0	5	132	85
Future Vol, veh/h	0	6	124	5	0	104	164	23	0	5	132	85
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	7	135	5	0	113	178	25	0	5	143	92
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	10.1	12.7	11
HCM LOS	B	B	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	2%	4%	36%	27%
Vol Thru, %	59%	92%	56%	65%
Vol Right, %	38%	4%	8%	8%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	222	135	291	132
LT Vol	5	6	104	35
Through Vol	132	124	164	86
RT Vol	85	5	23	11
Lane Flow Rate	241	147	316	143
Geometry Grp	1	1	1	1
Degree of Util (X)	0.349	0.223	0.461	0.223
Departure Headway (Hd)	5.214	5.481	5.251	5.597
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	690	654	686	641
Service Time	3.25	3.522	3.284	3.636
HCM Lane V/C Ratio	0.349	0.225	0.461	0.223
HCM Control Delay	11	10.1	12.7	10.2
HCM Lane LOS	B	B	B	B
HCM 95th-tile Q	1.6	0.8	2.4	0.8

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Lane Configurations				
Traffic Vol, veh/h	0	35	86	11
Future Vol, veh/h	0	35	86	11
Peak Hour Factor	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2
Mvmt Flow	0	38	93	12
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	10.2
HCM LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	90	64	5	5	50	5	5	317	20	5	547	233
Future Volume (Veh/h)	90	64	5	5	50	5	5	317	20	5	547	233
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	98	70	5	5	54	5	5	345	22	5	595	253
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1130	1108	722	1138	1224	356	848			367		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1130	1108	722	1138	1224	356	848			367		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	28	66	99	96	70	99	99			100		
cM capacity (veh/h)	136	208	427	129	177	688	790			1192		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	173	64	372	853
Volume Left	98	5	5	5
Volume Right	5	5	22	253
cSH	162	182	790	1192
Volume to Capacity	1.07	0.35	0.01	0.00
Queue Length 95th (m)	66.7	11.2	0.1	0.1
Control Delay (s)	147.1	35.0	0.2	0.1
Lane LOS	F	E	A	A
Approach Delay (s)	147.1	35.0	0.2	0.1
Approach LOS	F	E		

Intersection Summary				
Average Delay		19.1		
Intersection Capacity Utilization		67.9%	ICU Level of Service	C
Analysis Period (min)		15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	2	193	214	305	664	8
Future Volume (Veh/h)	2	193	214	305	664	8
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	210	233	332	722	9
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1524	726	731			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1524	726	731			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	50	73			
cM capacity (veh/h)	95	424	873			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	212	233	332	731
Volume Left	2	233	0	0
Volume Right	210	0	0	9
cSH	411	873	1700	1700
Volume to Capacity	0.52	0.27	0.20	0.43
Queue Length 95th (m)	21.8	8.2	0.0	0.0
Control Delay (s)	22.7	10.6	0.0	0.0
Lane LOS	C	B		
Approach Delay (s)	22.7	4.4		0.0
Approach LOS	C			

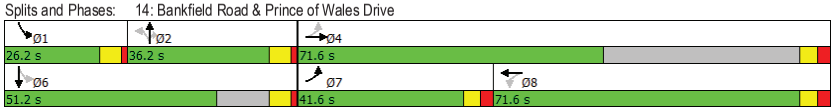
Intersection Summary				
Average Delay		4.8		
Intersection Capacity Utilization		69.3%	ICU Level of Service	C
Analysis Period (min)		15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	228	365	7	27	315	94	3	196	21	143	387	327
Future Volume (vph)	228	365	7	27	315	94	3	196	21	143	387	327
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	0.0		0.0	0.0		100.0	90.0		0.0
Storage Lanes	0		0	0		0	0		1	1		0
Taper Length (m)	30.0			30.0			30.0			30.0		
Lane Util. 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
Frt		0.998			0.971				0.850		0.931	
Flt Protected		0.981			0.997			0.999		0.950		
Satd. Flow (prot)	0	1844	0	0	1823	0	0	1882	1601	1789	1753	0
Flt Permitted		0.617			0.936			0.604		0.395		
Satd. Flow (perm)	0	1160	0	0	1712	0	0	1138	1601	744	1753	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			9				102		25	
Link Speed (k/h)		50			50			50			50	
Link Distance (m)		390.8			302.0			341.8			604.9	
Travel Time (s)		28.1			21.7			24.6			43.6	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	248	397	8	29	342	102	3	213	23	155	421	355
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	653	0	0	473	0	0	216	23	155	776	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Number of Detectors	1	1		1	1		1	0	0	1	0	
Detector Template	Left			Left			Left	Thru	Right		Thru	
Leading Detector (m)	6.1	0.0		6.1	0.0		6.1	0.0	0.0	0.0	0.0	
Trailing Detector (m)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Position(m)	0.0	1.0		0.0	3.0		0.0	0.0	0.0	1.0	0.0	
Detector 1 Size(m)	6.1	10.0		6.1	2.0		6.1	1.8	6.1	15.0	1.8	
Detector 1 Type	Cl+Ex	Call		Cl+Ex	Call		Cl+Ex	Cl+Ex	Cl+Ex	Call	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Turn Type	pm+pt	NA		Perm	NA		Perm	NA	Perm	pm+pt	NA	
Protected Phases	7	4			8			2		1	6	
Permitted Phases	4			8			2		2	6		
Detector Phase	7	4		8	8		2	2	2	1	6	
Switch Phase												
Minimum Initial (s)	10.0	8.0		10.0	10.0		25.0	25.0	25.0	10.0	25.0	
Minimum Split (s)	16.6	31.6		31.6	31.6		31.6	31.6	31.6	16.2	31.2	
Total Split (s)	41.6	71.6		71.6	71.6		36.2	36.2	36.2	26.2	51.2	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Split (%)	23.7%	40.8%		40.8%	40.8%		20.6%	20.6%	20.6%	14.9%	29.2%	
Maximum Green (s)	35.0	65.0		65.0	65.0		30.0	30.0	30.0	20.0	45.0	
Yellow Time (s)	3.7	3.7		3.7	3.7		4.6	4.6	4.6	4.6	4.6	
All-Red Time (s)	2.9	2.9		2.9	2.9		1.6	1.6	1.6	1.6	1.6	
Lost Time Adjust (s)		0.0			0.0			0.0	0.0	0.0	0.0	
Total Lost Time (s)		6.6			6.6			6.2	6.2	6.2	6.2	
Lead/Lag	Lead			Lag	Lag		Lag	Lag	Lag	Lead		
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None		None	None		Min	Min	Min	None	Min	
Walk Time (s)		7.0		7.0	7.0		7.0	7.0	7.0		7.0	
Flash Dont Walk (s)		10.0		10.0	10.0		10.0	10.0	10.0		10.0	
Pedestrian Calls (#/hr)		0		0	0		0	0	0		0	
Act Effct Green (s)		65.0			65.0			30.0	30.0	49.2	49.2	
Actuated g/C Ratio		0.51			0.51			0.24	0.24	0.39	0.39	
v/c Ratio		1.10			0.54			0.81	0.05	0.39	1.12	
Control Delay		98.2			23.6			69.2	0.2	29.2	107.1	
Queue Delay		0.0			0.0			0.0	0.0	0.0	0.0	
Total Delay		98.2			23.6			69.2	0.2	29.2	107.1	
LOS		F			C			E	A	C	F	
Approach Delay		98.2			23.6			62.6			94.1	
Approach LOS		F			C			E			F	

Intersection Summary	
Area Type: Other	
Cycle Length: 175.6	
Actuated Cycle Length: 127.1	
Natural Cycle: 120	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 1.12	
Intersection Signal Delay: 77.5	Intersection LOS: E
Intersection Capacity Utilization 138.6%	ICU Level of Service H
Analysis Period (min) 15	

Splits and Phases: 14: Bankfield Road & Prince of Wales Drive



Lane Group	EBT	WBT	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	653	473	216	23	155	776
v/c Ratio	1.10	0.54	0.81	0.05	0.39	1.12
Control Delay	98.2	23.6	69.2	0.2	29.2	107.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	98.2	23.6	69.2	0.2	29.2	107.1
Queue Length 50th (m)	~184.7	75.4	51.1	0.0	25.7	~219.4
Queue Length 95th (m)	#268.6	113.3	#95.6	0.0	41.2	#292.8
Internal Link Dist (m)	366.8	278.0	317.8			580.9
Turn Bay Length (m)				100.0	90.0	
Base Capacity (vph)	973	880	268	455	452	789
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.67	0.54	0.81	0.05	0.34	0.98

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	228	365	7	27	315	94	3	196	21	143	387	327
Future Volume (vph)	228	365	7	27	315	94	3	196	21	143	387	327
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.6			6.6			6.2	6.2	6.2	6.2	
Lane Util. Factor		1.00			1.00			1.00	1.00	1.00	1.00	
Frt		1.00			0.97			1.00	0.85	1.00	0.93	
Flt Protected		0.98			1.00			1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1845			1823			1882	1601	1789	1754	
Flt Permitted		0.62			0.94			0.60	1.00	0.40	1.00	
Satd. Flow (perm)		1160			1712			1138	1601	745	1754	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	248	397	8	29	342	102	3	213	23	155	421	355
RTOR Reduction (vph)	0	0	0	0	4	0	0	0	18	0	15	0
Lane Group Flow (vph)	0	653	0	0	469	0	0	216	5	155	761	0
Turn Type	pm+pt	NA		Perm	NA		Perm	NA	Perm	pm+pt	NA	
Protected Phases	7	4			8			2		1	6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)		65.0			65.0			30.0	30.0	49.2	49.2	
Effective Green, g (s)		65.0			65.0			30.0	30.0	49.2	49.2	
Actuated g/C Ratio		0.51			0.51			0.24	0.24	0.39	0.39	
Clearance Time (s)		6.6			6.6			6.2	6.2	6.2	6.2	
Vehicle Extension (s)		3.0			3.0			3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		593			876			268	378	395	679	
v/s Ratio Prot										0.04	c0.43	
v/s Ratio Perm		c0.56			0.27			0.19	0.00	0.11		
v/c Ratio		1.10			0.53			0.81	0.01	0.39	1.12	
Uniform Delay, d1		31.0			20.8			45.8	37.2	26.9	38.9	
Progression Factor		1.00			1.00			1.00	1.00	1.00	1.00	
Incremental Delay, d2		67.4			0.6			16.0	0.0	0.6	72.6	
Delay (s)		98.4			21.5			61.8	37.2	27.5	111.5	
Level of Service		F			C			E	D	C	F	
Approach Delay (s)		98.4			21.5			59.4			97.5	
Approach LOS		F			C			E			F	

Intersection Summary

HCM 2000 Control Delay	78.1	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.25		
Actuated Cycle Length (s)	127.0	Sum of lost time (s)	25.6
Intersection Capacity Utilization	138.6%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

C.2 2016 EXISTING CONDITIONS – WITH IMPROVEMENTS

LANE SUMMARY

Site: 2016 Existing AM

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Prince of Wales Drive South													
Lane 1[d]	382	0.0	821	0.465	100	4.9	LOS A	3.6	25.0	Full	500	0.0	0.0
Approach	382	0.0		0.465		4.9	LOS A	3.6	25.0				
East: Bankfield Road East													
Lane 1[d]	510	0.0	824	0.619	100	7.5	LOS A	6.3	43.9	Full	500	0.0	0.0
Approach	510	0.0		0.619		7.5	LOS A	6.3	43.9				
North: Prince of Wales Drive North													
Lane 1[d]	404	0.0	939	0.430	100	3.4	LOS A	3.2	22.6	Full	500	0.0	0.0
Approach	404	0.0		0.430		3.4	LOS A	3.2	22.6				
West: Bankfield Road West													
Lane 1[d]	529	0.0	1196	0.442	100	2.7	LOS A	3.4	24.1	Full	500	0.0	0.0
Approach	529	0.0		0.442		2.7	LOS A	3.4	24.1				
Intersection	1825	0.0		0.619		4.7	LOS A	6.3	43.9				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 2016 Existing PM

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Prince of Wales Drive South													
Lane 1[d]	220	0.0	657	0.335	100	5.0	LOS A	2.4	17.0	Full	500	0.0	0.0
Approach	220	0.0		0.335		5.0	LOS A	2.4	17.0				
East: Bankfield Road East													
Lane 1[d]	436	0.0	957	0.456	100	3.1	LOS A	3.3	23.1	Full	500	0.0	0.0
Approach	436	0.0		0.456		3.1	LOS A	3.3	23.1				
North: Prince of Wales Drive North													
Lane 1[d]	857	0.0	1050	0.816	100	8.4	LOS A	13.8	96.8	Full	500	0.0	0.0
Approach	857	0.0		0.816		8.4	LOS A	13.8	96.8				
West: Bankfield Road West													
Lane 1[d]	600	0.0	793	0.756	100	11.4	LOS B	10.4	72.7	Full	500	0.0	0.0
Approach	600	0.0		0.756		11.4	LOS B	10.4	72.7				
Intersection	2113	0.0		0.816		7.8	LOS A	13.8	96.8				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

C.3 2025 FUTURE BACKGROUND

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	20	643	49	9	271	55
Future Volume (Veh/h)	20	643	49	9	271	55
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	20	643	49	9	271	55
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	650	54			58	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	650	54			58	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	94	37			82	
cM capacity (veh/h)	357	1014			1546	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	663	58	326
Volume Left	20	0	271
Volume Right	643	9	0
cSH	961	1700	1546
Volume to Capacity	0.69	0.03	0.18
Queue Length 95th (m)	48.7	0.0	4.8
Control Delay (s)	17.0	0.0	6.7
Lane LOS	C		A
Approach Delay (s)	17.0	0.0	6.7
Approach LOS	C		

Intersection Summary			
Average Delay		12.8	
Intersection Capacity Utilization		72.1%	ICU Level of Service C
Analysis Period (min)		60	

LANE SUMMARY

Site: 2025 FBG AM

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Greenbank Road South													
Lane 1[d]	599	0.0	729	0.821	100	17.9	LOS B	13.4	93.9	Full	500	0.0	0.0
Approach	599	0.0		0.821		17.9	LOS B	13.4	93.9				
East: Cambrian Road East													
Lane 1[d]	338	0.0	747	0.453	100	5.4	LOS A	3.6	25.0	Full	500	0.0	0.0
Approach	338	0.0		0.453		5.4	LOS A	3.6	25.0				
North: Greenbank Road North													
Lane 1[d]	359	0.0	995	0.361	100	3.0	LOS A	2.5	17.2	Full	500	0.0	0.0
Approach	359	0.0		0.361		3.0	LOS A	2.5	17.2				
West: Cambrian Road West													
Lane 1[d]	671	0.0	1092	0.614	100	3.7	LOS A	5.9	41.2	Full	500	0.0	0.0
Approach	671	0.0		0.614		3.7	LOS A	5.9	41.2				
Intersection	1967	0.0		0.821		8.2	LOS A	13.4	93.9				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

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Project: W:\active\163601009\planning\traffic\analysis\synchro & sidra\Greenbank at Cambrian.sip6

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	33	134	129	24	32	43
Future Volume (Veh/h)	33	134	129	24	32	43
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	33	134	129	24	32	43
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	153				341	141
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	153				341	141
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	98				95	95
cM capacity (veh/h)	1428				640	907

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	167	153	75
Volume Left	33	0	32
Volume Right	0	24	43
cSH	1428	1700	770
Volume to Capacity	0.02	0.09	0.10
Queue Length 95th (m)	0.5	0.0	2.5
Control Delay (s)	1.7	0.0	10.2
Lane LOS	A		B
Approach Delay (s)	1.7	0.0	10.2
Approach LOS			B

Intersection Summary			
Average Delay		2.6	
Intersection Capacity Utilization		31.5%	ICU Level of Service A
Analysis Period (min)		60	

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	163	2	1	149	3	1
Future Volume (Veh/h)	163	2	1	149	3	1
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	163	2	1	149	3	1
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			165		315	164
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			165		315	164
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			1413		677	881

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	165	150	4
Volume Left	0	1	3
Volume Right	2	0	1
cSH	1700	1413	719
Volume to Capacity	0.10	0.00	0.01
Queue Length 95th (m)	0.0	0.0	0.1
Control Delay (s)	0.0	0.1	10.0
Lane LOS		A	B
Approach Delay (s)	0.0	0.1	10.0
Approach LOS			B

Intersection Summary			
Average Delay		0.2	
Intersection Capacity Utilization		18.7%	ICU Level of Service A
Analysis Period (min)		60	

Intersection	
Intersection Delay, s/veh	11.6
Intersection LOS	B

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Lane Configurations												
Traffic Vol, veh/h	0	14	134	16	0	103	117	32	0	7	155	33
Future Vol, veh/h	0	14	134	16	0	103	117	32	0	7	155	33
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	0	14	134	16	0	103	117	32	0	7	155	33
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	10.6	12.1	10.9
HCM LOS	B	B	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	4%	9%	41%	9%
Vol Thru, %	79%	82%	46%	82%
Vol Right, %	17%	10%	13%	9%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	195	164	252	274
LT Vol	7	14	103	24
Through Vol	155	134	117	224
RT Vol	33	16	32	26
Lane Flow Rate	195	164	252	274
Geometry Grp	1	1	1	1
Degree of Util (X)	0.297	0.256	0.386	0.411
Departure Headway (Hd)	5.475	5.628	5.519	5.397
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	655	636	650	666
Service Time	3.525	3.682	3.566	3.443
HCM Lane V/C Ratio	0.298	0.258	0.388	0.411
HCM Control Delay	10.9	10.6	12.1	12.2
HCM Lane LOS	B	B	B	B
HCM 95th-tile Q	1.3	1	1.9	2.1

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Lane Configurations				
Traffic Vol, veh/h	0	24	224	26
Future Vol, veh/h	0	24	224	26
Peak Hour Factor	100	100	100	100
Heavy Vehicles, %	2	2	2	2
Mvmt Flow	0	24	224	26
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	12.2
HCM LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	259	39	5	14	47	5	7	655	7	5	297	86
Future Volume (Veh/h)	259	39	5	14	47	5	7	655	7	5	297	86
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
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
Hourly flow rate (vph)	259	39	5	14	47	5	7	655	7	5	297	86
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1051	1026	340	1047	1066	658	383			662		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1051	1026	340	1047	1066	658	383			662		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	83	99	92	79	99	99			99		
cM capacity (veh/h)	168	232	702	177	220	464	1175			927		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	303	66	669	388
Volume Left	259	14	7	5
Volume Right	5	5	7	86
cSH	176	217	1175	927
Volume to Capacity	1.72	0.30	0.01	0.01
Queue Length 95th (m)	530.7	9.8	0.1	0.1
Control Delay (s)	1365.2	28.8	0.2	0.2
Lane LOS	F	D	A	A
Approach Delay (s)	1365.2	28.8	0.2	0.2
Approach LOS	F	D		

Intersection Summary				
Average Delay	291.5			
Intersection Capacity Utilization	69.0%	ICU Level of Service	C	
Analysis Period (min)	60			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	16	327	190	692	249	6
Future Volume (Veh/h)	16	327	190	692	249	6
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	16	327	190	692	249	6
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1324	252	255			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1324	252	255			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	89	58	85			
cM capacity (veh/h)	147	787	1310			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	343	190	692	255
Volume Left	16	190	0	0
Volume Right	327	0	0	6
cSH	654	1310	1700	1700
Volume to Capacity	0.52	0.15	0.41	0.15
Queue Length 95th (m)	24.6	3.9	0.0	0.0
Control Delay (s)	16.5	8.2	0.0	0.0
Lane LOS	C	A		
Approach Delay (s)	16.5	1.8		0.0
Approach LOS	C			

Intersection Summary				
Average Delay	4.9			
Intersection Capacity Utilization	64.2%	ICU Level of Service	C	
Analysis Period (min)	60			

LANE SUMMARY

Site: 2025 FBG AM

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Prince of Wales Drive South													
Lane 1[d]	479	0.0	675	0.710	100	13.2	LOS B	8.7	60.7	Full	500	0.0	0.0
Approach	479	0.0		0.710		13.2	LOS B	8.7	60.7				
East: Bankfield Road East													
Lane 1[d]	611	0.0	683	0.894	100	30.3	LOS C	19.7	137.7	Full	500	0.0	0.0
Approach	611	0.0		0.894		30.3	LOS C	19.7	137.7				
North: Prince of Wales Drive North													
Lane 1[d]	576	0.0	860	0.670	100	7.1	LOS A	7.7	53.8	Full	500	0.0	0.0
Approach	576	0.0		0.670		7.1	LOS A	7.7	53.8				
West: Bankfield Road West													
Lane 1[d]	643	0.0	1083	0.594	100	3.9	LOS A	5.6	39.3	Full	500	0.0	0.0
Approach	643	0.0		0.594		3.9	LOS A	5.6	39.3				
Intersection	2309	0.0		0.894		13.6	LOS B	19.7	137.7				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

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Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	15	377	81	21	569	79
Future Volume (Veh/h)	15	377	81	21	569	79
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	15	377	81	21	569	79
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1308	92			102	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1308	92			102	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	86	61			62	
cM capacity (veh/h)	109	966			1490	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	392	102	648
Volume Left	15	0	569
Volume Right	377	21	0
cSH	742	1700	1490
Volume to Capacity	0.53	0.06	0.38
Queue Length 95th (m)	25.1	0.0	14.0
Control Delay (s)	15.3	0.0	8.3
Lane LOS	C		A
Approach Delay (s)	15.3	0.0	8.3
Approach LOS	C		

Intersection Summary			
Average Delay	9.9		
Intersection Capacity Utilization	73.2%	ICU Level of Service	D
Analysis Period (min)	60		

LANE SUMMARY

Site: 2025 FBG PM

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Greenbank Road South													
Lane 1[d]	442	0.0	812	0.545	100	5.8	LOS A	5.0	34.7	Full	500	0.0	0.0
Approach	442	0.0		0.545		5.8	LOS A	5.0	34.7				
East: Cambrian Road East													
Lane 1[d]	692	0.0	874	0.792	100	11.5	LOS B	12.0	84.3	Full	500	0.0	0.0
Approach	692	0.0		0.792		11.5	LOS B	12.0	84.3				
North: Greenbank Road North													
Lane 1[d]	821	0.0	728	1.127	100	256.2	LOS F	140.8	985.3	Full	500	0.0	31.5
Approach	821	0.0		1.127		256.2	LOS F	140.8	985.3				
West: Cambrian Road West													
Lane 1[d]	687	0.0	788	0.871	100	19.3	LOS B	17.3	120.8	Full	500	0.0	0.0
Approach	687	0.0		0.871		19.3	LOS B	17.3	120.8				
Intersection	2642	0.0		1.127		88.6	LOS F	140.8	985.3				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

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Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	40	139	183	61	32	63
Future Volume (Veh/h)	40	139	183	61	32	63
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	40	139	183	61	32	63
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	244				432	214
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	244				432	214
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	97				94	92
cM capacity (veh/h)	1322				563	827

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	179	244	95
Volume Left	40	0	32
Volume Right	0	61	63
cSH	1322	1700	714
Volume to Capacity	0.03	0.14	0.13
Queue Length 95th (m)	0.7	0.0	3.5
Control Delay (s)	1.9	0.0	10.8
Lane LOS	A		B
Approach Delay (s)	1.9	0.0	10.8
Approach LOS			B

Intersection Summary			
Average Delay	2.7		
Intersection Capacity Utilization	38.5%	ICU Level of Service	A
Analysis Period (min)	60		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	171	1	1	241	3	1
Future Volume (Veh/h)	171	1	1	241	3	1
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	171	1	1	241	3	1
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			172		414	172
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			172		414	172
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	100
cM capacity (veh/h)			1405		594	872

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	172	242	4
Volume Left	0	1	3
Volume Right	1	0	1
cSH	1700	1405	645
Volume to Capacity	0.10	0.00	0.01
Queue Length 95th (m)	0.0	0.0	0.1
Control Delay (s)	0.0	0.0	10.6
Lane LOS		A	B
Approach Delay (s)	0.0	0.0	10.6
Approach LOS			B

Intersection Summary			
Average Delay		0.1	
Intersection Capacity Utilization		23.5%	ICU Level of Service A
Analysis Period (min)		60	

Intersection	
Intersection Delay, s/veh	18.2
Intersection LOS	C

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Lane Configurations												
Traffic Vol, veh/h	0	9	146	15	0	123	193	33	0	32	252	100
Future Vol, veh/h	0	9	146	15	0	123	193	33	0	32	252	100
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	0	9	146	15	0	123	193	33	0	32	252	100
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	13.2	20	20.7
HCM LOS	B	C	C

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	8%	5%	35%	18%
Vol Thru, %	66%	86%	55%	77%
Vol Right, %	26%	9%	9%	6%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	384	170	349	265
LT Vol	32	9	123	47
Through Vol	252	146	193	203
RT Vol	100	15	33	15
Lane Flow Rate	384	170	349	265
Geometry Grp	1	1	1	1
Degree of Util (X)	0.654	0.322	0.622	0.48
Departure Headway (Hd)	6.131	6.829	6.415	6.518
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	588	524	562	551
Service Time	4.194	4.91	4.479	4.588
HCM Lane V/C Ratio	0.653	0.324	0.621	0.481
HCM Control Delay	20.7	13.2	20	15.6
HCM Lane LOS	C	B	C	C
HCM 95th-tile Q	5.4	1.4	4.7	2.7

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Lane Configurations				
Traffic Vol, veh/h	0	47	203	15
Future Vol, veh/h	0	47	203	15
Peak Hour Factor	100	100	100	100
Heavy Vehicles, %	2	2	2	2
Mvmt Flow	0	47	203	15
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	15.6
HCM LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	112	76	5	6	59	5	5	374	24	5	645	281
Future Volume (Veh/h)	112	76	5	6	59	5	5	374	24	5	645	281
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
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
Hourly flow rate (vph)	112	76	5	6	59	5	5	374	24	5	645	281
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1226	1204	786	1234	1332	386	926			398		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1226	1204	786	1234	1332	386	926			398		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	58	99	94	61	99	99			100		
cM capacity (veh/h)	107	182	392	101	153	662	738			1161		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	193	70	403	931
Volume Left	112	6	5	5
Volume Right	5	5	24	281
cSH	131	154	738	1161
Volume to Capacity	1.48	0.45	0.01	0.00
Queue Length 95th (m)	294.0	17.9	0.2	0.1
Control Delay (s)	970.5	47.3	0.2	0.1
Lane LOS	F	E	A	A
Approach Delay (s)	970.5	47.3	0.2	0.1
Approach LOS	F	E		

Intersection Summary			
Average Delay	119.5		
Intersection Capacity Utilization	77.9%	ICU Level of Service	D
Analysis Period (min)	60		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	3	340	376	360	783	9
Future Volume (Veh/h)	3	340	376	360	783	9
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	3	340	376	360	783	9
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1900	788	792			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1900	788	792			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	93	13	55			
cM capacity (veh/h)	42	391	829			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	343	376	360	792
Volume Left	3	376	0	0
Volume Right	340	0	0	9
cSH	365	829	1700	1700
Volume to Capacity	0.94	0.45	0.21	0.47
Queue Length 95th (m)	136.2	18.7	0.0	0.0
Control Delay (s)	101.5	12.9	0.0	0.0
Lane LOS	F	B		
Approach Delay (s)	101.5	6.6		0.0
Approach LOS	F			

Intersection Summary			
Average Delay		21.2	
Intersection Capacity Utilization		93.8%	ICU Level of Service F
Analysis Period (min)		60	

LANE SUMMARY

Site: 2025 FBG PM

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Prince of Wales Drive South													
Lane 1 [d]	308	0.0	544	0.566	100	11.0	LOS B	5.5	38.2	Full	500	0.0	0.0
Approach	308	0.0		0.566		11.0	LOS B	5.5	38.2				
East: Bankfield Road East													
Lane 1 [d]	538	0.0	830	0.648	100	7.9	LOS A	7.0	48.9	Full	500	0.0	0.0
Approach	538	0.0		0.648		7.9	LOS A	7.0	48.9				
North: Prince of Wales Drive North													
Lane 1 [d]	1123	0.0	974	1.153	100	290.3	LOS F	212.5	1487.7	Full	500	0.0	100.0
Approach	1123	0.0		1.153		290.3	LOS F	212.5	1487.7				
West: Bankfield Road West													
Lane 1 [d]	764	0.0	720	1.061	100	150.6	LOS F	86.3	604.3	Full	500	0.0	10.9
Approach	764	0.0		1.061		150.6	LOS F	86.3	604.3				
Intersection	2733	0.0		1.153		164.2	LOS F	212.5	1487.7				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

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C.4 2025 FUTURE BACKGROUND – WITH IMPROVEMENTS

LANE SUMMARY

Site: 2025 FBG AM - Mods

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Greenbank Road South													
Lane 1[d]	599	0.0	731	0.819	100	17.8	LOS B	13.3	93.2	Full	500	0.0	0.0
Approach	599	0.0		0.819		17.8	LOS B	13.3	93.2				
East: Cambrian Road East													
Lane 1[d]	338	0.0	747	0.453	100	5.4	LOS A	3.6	25.0	Full	500	0.0	0.0
Approach	338	0.0		0.453		5.4	LOS A	3.6	25.0				
North: Greenbank Road North													
Lane 1[d]	267	0.0	1224	0.218	100	2.5	LOS A	1.4	10.0	Full	500	0.0	0.0
Lane 2	92	0.0	875	0.105	100	2.6	LOS A	0.6	4.1	Full	80	0.0	0.0
Approach	359	0.0		0.218		2.5	LOS A	1.4	10.0				
West: Cambrian Road West													
Lane 1[d]	671	0.0	1098	0.611	100	3.7	LOS A	5.7	40.2	Full	500	0.0	0.0
Approach	671	0.0		0.611		3.7	LOS A	5.7	40.2				
Intersection	1967	0.0		0.819		8.1	LOS A	13.3	93.2				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

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Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	16	327	190	692	255
v/c Ratio	0.09	0.73	0.22	0.48	0.18
Control Delay	34.2	14.9	4.2	5.7	3.6
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	34.2	14.9	4.2	5.7	3.6
Queue Length 50th (m)	2.4	0.0	5.9	28.1	7.5
Queue Length 95th (m)	8.8	34.3	20.8	87.6	23.9
Internal Link Dist (m)	48.5			580.9	293.8
Turn Bay Length (m)	37.5		180.0		
Base Capacity (vph)	538	710	858	1427	1424
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	0.03	0.46	0.22	0.48	0.18

Intersection Summary

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	16	327	190	692	249	6
Future Volume (vph)	16	327	190	692	249	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	1.00	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1789	1601	1789	1883	1877	
Flt Permitted	0.95	1.00	0.60	1.00	1.00	
Satd. Flow (perm)	1789	1601	1132	1883	1877	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	16	327	190	692	249	6
RTOR Reduction (vph)	0	295	0	0	0	0
Lane Group Flow (vph)	16	32	190	692	255	0
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	8.1	8.1	63.1	63.1	63.1	
Effective Green, g (s)	8.1	8.1	63.1	63.1	63.1	
Actuated g/C Ratio	0.10	0.10	0.76	0.76	0.76	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	174	155	858	1428	1423	
v/s Ratio Prot	0.01			c0.37	0.14	
v/s Ratio Perm		c0.02	0.17			
v/c Ratio	0.09	0.21	0.22	0.48	0.18	
Uniform Delay, d1	34.2	34.6	2.9	3.8	2.8	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.2	0.7	0.6	1.2	0.3	
Delay (s)	34.4	35.2	3.5	5.0	3.1	
Level of Service	C	D	A	A	A	
Approach Delay (s)	35.2			4.7	3.1	
Approach LOS	D			A	A	

Intersection Summary			
HCM 2000 Control Delay	11.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	83.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	50.6%	ICU Level of Service	A
Analysis Period (min)	60		

c Critical Lane Group

LANE SUMMARY

Site: 2025 FBG AM - Mods

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Prince of Wales Drive South													
Lane 1[d]	473	0.0	739	0.640	100	10.7	LOS B	6.9	48.0	Full	500	0.0	0.0
Approach	473	0.0		0.640		10.7	LOS B	6.9	48.0				
East: Bankfield Road East													
Lane 1[d]	608	0.0	700	0.869	100	25.3	LOS C	17.1	119.6	Full	500	0.0	0.0
Approach	608	0.0		0.869		25.3	LOS C	17.1	119.6				
North: Prince of Wales Drive North													
Lane 1	274	0.0	888	0.308	100	4.0	LOS A	2.2	15.4	Full	500	0.0	0.0
Lane 2[d]	302	0.0	1069	0.283	100	2.6	LOS A	2.1	14.9	Full	80	0.0	0.0
Approach	576	0.0		0.308		3.3	LOS A	2.2	15.4				
West: Bankfield Road West													
Lane 1	316	0.0	1122	0.282	100	4.4	LOS A	1.9	13.1	Full	500	0.0	0.0
Lane 2[d]	322	0.0	1294	0.249	88[5]	1.2	LOS A	1.7	11.7	Full	80	0.0	0.0
Approach	638	0.0		0.282		2.8	LOS A	1.9	13.1				
Intersection	2295	0.0		0.869		10.5	LOS B	17.1	119.6				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

5 Lane under-utilisation found by the program
d Dominant lane on roundabout approach

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LANE SUMMARY

Site: 2025 FBG PM - Mods

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Greenbank Road South													
Lane 1[d]	442	0.0	805	0.549	100	6.0	LOS A	5.0	35.2	Full	500	0.0	0.0
Approach	442	0.0		0.549		6.0	LOS A	5.0	35.2				
East: Cambrian Road East													
Lane 1[d]	692	0.0	874	0.792	100	11.5	LOS B	12.1	84.5	Full	500	0.0	0.0
Approach	692	0.0		0.792		11.5	LOS B	12.1	84.5				
North: Greenbank Road North													
Lane 1[d]	540	0.0	919	0.587	100	6.1	LOS A	6.3	44.0	Full	500	0.0	0.0
Lane 2	281	0.0	696	0.404	100	5.0	LOS A	3.0	20.7	Full	80	0.0	0.0
Approach	821	0.0		0.587		5.7	LOS A	6.3	44.0				
West: Cambrian Road West													
Lane 1[d]	687	0.0	741	0.927	100	32.4	LOS C	24.5	171.6	Full	500	0.0	0.0
Approach	687	0.0		0.927		32.4	LOS C	24.5	171.6				
Intersection	2642	0.0		0.927		14.2	LOS B	24.5	171.6				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

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Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	3	340	376	360	792
v/c Ratio	0.02	0.75	0.77	0.25	0.82
Control Delay	36.0	16.0	28.7	3.7	29.6
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	36.0	16.0	28.7	3.7	29.6
Queue Length 50th (m)	0.5	0.0	31.3	10.9	105.7
Queue Length 95th (m)	3.2	37.6	#109.5	36.5	#256.7
Internal Link Dist (m)	48.5			580.9	293.8
Turn Bay Length (m)	37.5		180.0		
Base Capacity (vph)	356	591	507	1460	961
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	0.01	0.58	0.74	0.25	0.82

Intersection Summary

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

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	3	340	376	360	783	9
Future Volume (vph)	3	340	376	360	783	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	1.00	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1789	1601	1789	1883	1881	
Flt Permitted	0.95	1.00	0.12	1.00	1.00	
Satd. Flow (perm)	1789	1601	231	1883	1881	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	3	340	376	360	783	9
RTOR Reduction (vph)	0	309	0	0	0	0
Lane Group Flow (vph)	3	31	376	360	792	0
Turn Type	Prot	Perm	pm+pt	NA	NA	
Protected Phases	4		5	2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	8.3	8.3	70.1	70.1	46.2	
Effective Green, g (s)	8.3	8.3	70.1	70.1	46.2	
Actuated g/C Ratio	0.09	0.09	0.78	0.78	0.51	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	164	146	487	1460	961	
v/s Ratio Prot	0.00		c0.15	0.19	c0.42	
v/s Ratio Perm		c0.02	0.45			
v/c Ratio	0.02	0.21	0.77	0.25	0.82	
Uniform Delay, d1	37.3	38.0	21.2	2.8	18.7	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.0	0.7	7.8	0.4	8.5	
Delay (s)	37.4	38.8	29.0	3.2	27.2	
Level of Service	D	D	C	A	C	
Approach Delay (s)	38.8			16.4	27.2	
Approach LOS	D			B	C	

Intersection Summary			
HCM 2000 Control Delay	25.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	90.4	Sum of lost time (s)	18.0
Intersection Capacity Utilization	81.8%	ICU Level of Service	D
Analysis Period (min)	60		

c Critical Lane Group

LANE SUMMARY

Site: 2025 FBG PM - Mods

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Prince of Wales Drive South													
Lane 1[d]	308	0.0	555	0.555	100	12.5	LOS B	5.3	36.9	Full	500	0.0	0.0
Approach	308	0.0		0.555		12.5	LOS B	5.3	36.9				
East: Bankfield Road East													
Lane 1[d]	538	0.0	819	0.657	100	8.4	LOS A	7.2	50.3	Full	500	0.0	0.0
Approach	538	0.0		0.657		8.4	LOS A	7.2	50.3				
North: Prince of Wales Drive North													
Lane 1[d]	694	0.0	1159	0.599	100	3.8	LOS A	6.1	43.0	Full	500	0.0	0.0
Lane 2	429	0.0	923	0.465	100	3.3	LOS A	3.6	25.1	Full	80	0.0	0.0
Approach	1123	0.0		0.599		3.6	LOS A	6.1	43.0				
West: Bankfield Road West													
Lane 1	336	0.0	671	0.501	100	9.6	LOS A	4.4	30.5	Full	500	0.0	0.0
Lane 2[d]	428	0.0	854	0.501	100	5.2	LOS A	4.7	33.0	Full	80	0.0	0.0
Approach	764	0.0		0.501		7.1	LOS A	4.7	33.0				
Intersection	2733	0.0		0.657		6.5	LOS A	7.2	50.3				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

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C.5 2025 TOTAL FUTURE

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	20	754	49	9	317	55
Future Volume (Veh/h)	20	754	49	9	317	55
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	20	754	49	9	317	55
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	742	54			58	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	742	54			58	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	93	26			79	
cM capacity (veh/h)	304	1014			1546	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	774	58	372
Volume Left	20	0	317
Volume Right	754	9	0
cSH	956	1700	1546
Volume to Capacity	0.81	0.03	0.21
Queue Length 95th (m)	86.1	0.0	5.9
Control Delay (s)	24.1	0.0	7.0
Lane LOS	C		A
Approach Delay (s)	24.1	0.0	7.0
Approach LOS	C		

Intersection Summary			
Average Delay		17.6	
Intersection Capacity Utilization		81.6%	ICU Level of Service D
Analysis Period (min)		60	

LANE SUMMARY

Site: 2025 Total AM

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Greenbank Road South													
Lane 1[d]	719	0.0	648	1.110	100	234.4	LOS F	114.4	801.1	Full	500	0.0	21.3
Approach	719	0.0		1.110		234.4	LOS F	114.4	801.1				
East: Cambrian Road East													
Lane 1[d]	351	0.0	668	0.526	100	8.1	LOS A	4.7	32.9	Full	500	0.0	0.0
Approach	351	0.0		0.526		8.1	LOS A	4.7	32.9				
North: Greenbank Road North													
Lane 1[d]	283	0.0	1179	0.240	100	2.7	LOS A	1.6	11.3	Full	500	0.0	0.0
Lane 2	117	0.0	876	0.134	100	2.9	LOS A	0.8	5.4	Full	80	0.0	0.0
Approach	400	0.0		0.240		2.7	LOS A	1.6	11.3				
West: Cambrian Road West													
Lane 1[d]	767	0.0	1080	0.710	100	5.6	LOS A	8.7	60.8	Full	500	0.0	0.0
Approach	767	0.0		0.710		5.6	LOS A	8.7	60.8				
Intersection	2237	0.0		1.110		79.0	LOS E	114.4	801.1				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

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Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	33	134	129	24	32	43
Future Volume (Veh/h)	33	134	129	24	32	43
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	33	134	129	24	32	43
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	153				341	141
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	153				341	141
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	98				95	95
cM capacity (veh/h)	1428				640	907

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	167	153	75
Volume Left	33	0	32
Volume Right	0	24	43
cSH	1428	1700	770
Volume to Capacity	0.02	0.09	0.10
Queue Length 95th (m)	0.5	0.0	2.5
Control Delay (s)	1.7	0.0	10.2
Lane LOS	A		B
Approach Delay (s)	1.7	0.0	10.2
Approach LOS			B

Intersection Summary			
Average Delay		2.6	
Intersection Capacity Utilization		31.5%	ICU Level of Service A
Analysis Period (min)		60	

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	163	2	1	149	3	1
Future Volume (Veh/h)	163	2	1	149	3	1
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	163	2	1	149	3	1
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			165		315	164
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			165		315	164
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			1413		677	881

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	165	150	4
Volume Left	0	1	3
Volume Right	2	0	1
cSH	1700	1413	719
Volume to Capacity	0.10	0.00	0.01
Queue Length 95th (m)	0.0	0.0	0.1
Control Delay (s)	0.0	0.1	10.0
Lane LOS		A	B
Approach Delay (s)	0.0	0.1	10.0
Approach LOS			B

Intersection Summary			
Average Delay		0.2	
Intersection Capacity Utilization		18.7%	ICU Level of Service A
Analysis Period (min)		60	

Intersection	
Intersection Delay, s/veh	19
Intersection LOS	C

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Lane Configurations												
Traffic Vol, veh/h	0	14	134	16	0	103	117	91	0	7	165	33
Future Vol, veh/h	0	14	134	16	0	103	117	91	0	7	165	33
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	0	14	134	16	0	103	117	91	0	7	165	33
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	12.6	16.5	13
HCM LOS	B	C	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	3%	9%	33%	39%
Vol Thru, %	80%	82%	38%	55%
Vol Right, %	16%	10%	29%	6%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	205	164	311	450
LT Vol	7	14	103	177
Through Vol	165	134	117	247
RT Vol	33	16	91	26
Lane Flow Rate	205	164	311	450
Geometry Grp	1	1	1	1
Degree of Util (X)	0.361	0.303	0.538	0.745
Departure Headway (Hd)	6.335	6.661	6.233	5.962
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	566	538	578	608
Service Time	4.389	4.721	4.282	4.005
HCM Lane V/C Ratio	0.362	0.305	0.538	0.74
HCM Control Delay	13	12.6	16.5	25.9
HCM Lane LOS	B	B	C	D
HCM 95th-tile Q	1.7	1.3	3.4	7.9

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Lane Configurations				
Traffic Vol, veh/h	0	177	247	26
Future Vol, veh/h	0	177	247	26
Peak Hour Factor	100	100	100	100
Heavy Vehicles, %	2	2	2	2
Mvmt Flow	0	177	247	26
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	25.9
HCM LOS	D

HCM Unsignalized Intersection Capacity Analysis
12: Prince of Wales Drive & Barnsdale Road

Barrhaven South CDP
2025 Total AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	412	39	5	14	47	5	7	655	7	5	297	145
Future Volume (Veh/h)	412	39	5	14	47	5	7	655	7	5	297	145
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
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
Hourly flow rate (vph)	412	39	5	14	47	5	7	655	7	5	297	145
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1080	1056	370	1076	1124	658	442			662		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1080	1056	370	1076	1124	658	442			662		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	82	99	92	77	99	99			99		
cM capacity (veh/h)	158	223	676	168	203	464	1118			927		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	456	66	669	447
Volume Left	412	14	7	5
Volume Right	5	5	7	145
cSH	163	202	1118	927
Volume to Capacity	2.80	0.33	0.01	0.01
Queue Length 95th (m)	1147.9	10.8	0.1	0.1
Control Delay (s)	3297.1	31.3	0.2	0.2
Lane LOS	F	D	A	A
Approach Delay (s)	3297.1	31.3	0.2	0.2
Approach LOS	F	D		

Intersection Summary				
Average Delay		919.3		
Intersection Capacity Utilization		77.6%	ICU Level of Service	D
Analysis Period (min)		60		

Queues
13: Prince of Wales Drive & Existing Greenbank Road

Barrhaven South CDP
2025 Total AM

Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	16	350	200	692	255
v/c Ratio	0.09	0.74	0.23	0.49	0.18
Control Delay	34.1	14.9	4.3	5.8	3.6
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	34.1	14.9	4.3	5.8	3.6
Queue Length 50th (m)	2.4	0.0	6.2	28.1	7.5
Queue Length 95th (m)	8.8	36.1	22.8	89.9	24.6
Internal Link Dist (m)	48.5			580.9	293.8
Turn Bay Length (m)	37.5		180.0		
Base Capacity (vph)	537	725	856	1425	1421
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	0.03	0.48	0.23	0.49	0.18

Intersection Summary

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	16	350	200	692	249	6
Future Volume (vph)	16	350	200	692	249	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	1.00	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1789	1601	1789	1883	1877	
Flt Permitted	0.95	1.00	0.60	1.00	1.00	
Satd. Flow (perm)	1789	1601	1132	1883	1877	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	16	350	200	692	249	6
RTOR Reduction (vph)	0	315	0	0	0	0
Lane Group Flow (vph)	16	35	200	692	255	0
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	8.3	8.3	63.1	63.1	63.1	
Effective Green, g (s)	8.3	8.3	63.1	63.1	63.1	
Actuated g/C Ratio	0.10	0.10	0.76	0.76	0.76	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	178	159	856	1424	1420	
v/s Ratio Prot	0.01			c0.37	0.14	
v/s Ratio Perm		c0.02	0.18			
v/c Ratio	0.09	0.22	0.23	0.49	0.18	
Uniform Delay, d1	34.1	34.6	3.0	3.9	2.9	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.2	0.7	0.6	1.2	0.3	
Delay (s)	34.3	35.3	3.6	5.1	3.1	
Level of Service	C	D	A	A	A	
Approach Delay (s)	35.2			4.8	3.1	
Approach LOS	D			A	A	

Intersection Summary			
HCM 2000 Control Delay	11.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	83.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	50.6%	ICU Level of Service	A
Analysis Period (min)	60		

c Critical Lane Group

LANE SUMMARY

Site: 2025 Total AM

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Prince of Wales Drive South													
Lane 1[d]	483	0.0	736	0.656	100	11.2	LOS B	7.3	50.8	Full	500	0.0	0.0
Approach	483	0.0		0.656		11.2	LOS B	7.3	50.8				
East: Bankfield Road East													
Lane 1[d]	608	0.0	690	0.881	100	27.8	LOS C	18.3	128.1	Full	500	0.0	0.0
Approach	608	0.0		0.881		27.8	LOS C	18.3	128.1				
North: Prince of Wales Drive North													
Lane 1	297	0.0	895	0.332	100	3.9	LOS A	2.4	16.9	Full	500	0.0	0.0
Lane 2[d]	302	0.0	1069	0.283	100	2.6	LOS A	2.1	14.9	Full	80	0.0	0.0
Approach	599	0.0		0.332		3.3	LOS A	2.4	16.9				
West: Bankfield Road West													
Lane 1	316	0.0	1097	0.288	100	4.6	LOS A	1.9	13.5	Full	500	0.0	0.0
Lane 2[d]	322	0.0	1271	0.253	88[5]	1.3	LOS A	1.7	12.0	Full	80	0.0	0.0
Approach	638	0.0		0.288		2.9	LOS A	1.9	13.5				
Intersection	2328	0.0		0.881		11.2	LOS B	18.3	128.1				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

5 Lane under-utilisation found by the program
d Dominant lane on roundabout approach

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Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	78	101	38	233	350	26
Future Volume (Veh/h)	78	101	38	233	350	26
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	78	101	38	233	350	26
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	672	363	376			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	672	363	376			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	81	85	97			
cM capacity (veh/h)	408	682	1182			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	179	271	376
Volume Left	78	38	0
Volume Right	101	0	26
cSH	527	1182	1700
Volume to Capacity	0.34	0.03	0.22
Queue Length 95th (m)	11.6	0.8	0.0
Control Delay (s)	15.3	1.4	0.0
Lane LOS	C	A	
Approach Delay (s)	15.3	1.4	0.0
Approach LOS	C		

Intersection Summary			
Average Delay		3.8	
Intersection Capacity Utilization		54.9%	ICU Level of Service A
Analysis Period (min)		60	

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	15	437	81	21	673	79
Future Volume (Veh/h)	15	437	81	21	673	79
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	15	437	81	21	673	79
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1516	92			102	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1516	92			102	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	79	55			55	
cM capacity (veh/h)	72	966			1490	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	452	102	752
Volume Left	15	0	673
Volume Right	437	21	0
cSH	684	1700	1490
Volume to Capacity	0.66	0.06	0.45
Queue Length 95th (m)	42.4	0.0	18.7
Control Delay (s)	20.3	0.0	8.9
Lane LOS	C		A
Approach Delay (s)	20.3	0.0	8.9
Approach LOS	C		

Intersection Summary			
Average Delay		12.2	
Intersection Capacity Utilization		82.6%	ICU Level of Service E
Analysis Period (min)		60	

LANE SUMMARY

Site: 2025 Total PM

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Greenbank Road South													
Lane 1[d]	508	0.0	830	0.612	100	6.8	LOS A	6.2	43.7	Full	500	0.0	0.0
Approach	508	0.0		0.612		6.8	LOS A	6.2	43.7				
East: Cambrian Road East													
Lane 1[d]	723	0.0	814	0.888	100	21.3	LOS C	19.3	135.1	Full	500	0.0	0.0
Approach	723	0.0		0.888		21.3	LOS C	19.3	135.1				
North: Greenbank Road North													
Lane 1[d]	591	0.0	864	0.684	100	9.2	LOS A	8.8	61.6	Full	500	0.0	0.0
Lane 2	335	0.0	658	0.509	100	7.4	LOS A	4.4	30.9	Full	80	0.0	0.0
Approach	926	0.0		0.684		8.5	LOS A	8.8	61.6				
West: Cambrian Road West													
Lane 1[d]	781	0.0	676	1.155	100	306.9	LOS F	154.1	1078.5	Full	500	0.0	37.2
Approach	781	0.0		1.155		306.9	LOS F	154.1	1078.5				
Intersection	2938	0.0		1.155		90.7	LOS F	154.1	1078.5				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

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Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	40	139	183	61	32	63
Future Volume (Veh/h)	40	139	183	61	32	63
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	40	139	183	61	32	63
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	244				432	214
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	244				432	214
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	97				94	92
cM capacity (veh/h)	1322				563	827

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	179	244	95
Volume Left	40	0	32
Volume Right	0	61	63
cSH	1322	1700	714
Volume to Capacity	0.03	0.14	0.13
Queue Length 95th (m)	0.7	0.0	3.5
Control Delay (s)	1.9	0.0	10.8
Lane LOS	A		B
Approach Delay (s)	1.9	0.0	10.8
Approach LOS			B

Intersection Summary			
Average Delay	2.7		
Intersection Capacity Utilization	38.5%	ICU Level of Service	A
Analysis Period (min)	60		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	171	1	1	241	3	1
Future Volume (Veh/h)	171	1	1	241	3	1
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	171	1	1	241	3	1
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			172		414	172
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			172		414	172
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	100
cM capacity (veh/h)			1405		594	872

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	172	242	4
Volume Left	0	1	3
Volume Right	1	0	1
cSH	1700	1405	645
Volume to Capacity	0.10	0.00	0.01
Queue Length 95th (m)	0.0	0.0	0.1
Control Delay (s)	0.0	0.0	10.6
Lane LOS		A	B
Approach Delay (s)	0.0	0.0	10.6
Approach LOS			B

Intersection Summary			
Average Delay		0.1	
Intersection Capacity Utilization		23.5%	ICU Level of Service A
Analysis Period (min)		60	

Intersection	
Intersection Delay, s/veh	72.7
Intersection LOS	F

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Lane Configurations												
Traffic Vol, veh/h	0	9	146	15	0	123	193	176	0	32	271	100
Future Vol, veh/h	0	9	146	15	0	123	193	176	0	32	271	100
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	0	9	146	15	0	123	193	176	0	32	271	100
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	18.1	133	51.5
HCM LOS	C	F	F

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	8%	5%	25%	36%
Vol Thru, %	67%	86%	39%	60%
Vol Right, %	25%	9%	36%	4%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	403	170	492	356
LT Vol	32	9	123	127
Through Vol	271	146	193	214
RT Vol	100	15	176	15
Lane Flow Rate	403	170	492	356
Geometry Grp	1	1	1	1
Degree of Util (X)	0.859	0.414	1.007	0.79
Departure Headway (Hd)	7.676	8.872	7.37	7.988
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	472	408	492	452
Service Time	5.758	6.872	5.44	6.071
HCM Lane V/C Ratio	0.854	0.417	1	0.788
HCM Control Delay	51.5	18.1	133	39.3
HCM Lane LOS	F	C	F	E
HCM 95th-tile Q	13.1	2.1	27.9	9.4

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Lane Configurations				
Traffic Vol, veh/h	0	127	214	15
Future Vol, veh/h	0	127	214	15
Peak Hour Factor	100	100	100	100
Heavy Vehicles, %	2	2	2	2
Mvmt Flow	0	127	214	15
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	39.3
HCM LOS	E

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	192	76	5	6	59	5	5	374	24	5	645	424
Future Volume (Veh/h)	192	76	5	6	59	5	5	374	24	5	645	424
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
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
Hourly flow rate (vph)	192	76	5	6	59	5	5	374	24	5	645	424
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1298	1275	857	1306	1475	386	1069			398		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1298	1275	857	1306	1475	386	1069			398		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	54	99	93	53	99	99			100		
cM capacity (veh/h)	86	165	357	85	125	662	652			1161		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	273	70	403	1074
Volume Left	192	6	5	5
Volume Right	5	5	24	424
cSH	101	127	652	1161
Volume to Capacity	2.71	0.55	0.01	0.00
Queue Length 95th (m)	689.0	25.0	0.2	0.1
Control Delay (s)	3174.8	66.6	0.2	0.1
Lane LOS	F	F	A	A
Approach Delay (s)	3174.8	66.6	0.2	0.1
Approach LOS	F	F		

Intersection Summary			
Average Delay	478.9		
Intersection Capacity Utilization	91.2%	ICU Level of Service	F
Analysis Period (min)	60		

Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	3	351	395	360	792
v/c Ratio	0.02	0.74	0.88	0.26	0.89
Control Delay	31.0	14.5	47.5	4.2	36.5
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	31.0	14.5	47.5	4.2	36.5
Queue Length 50th (m)	0.4	0.0	39.1	10.9	97.0
Queue Length 95th (m)	3.0	35.0	#126.7	36.7	#243.2
Internal Link Dist (m)	48.5			580.9	293.8
Turn Bay Length (m)	37.5		180.0		
Base Capacity (vph)	401	631	450	1409	892
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	0.01	0.56	0.88	0.26	0.89

Intersection Summary

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

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	3	351	395	360	783	9
Future Volume (vph)	3	351	395	360	783	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	1.00	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1789	1601	1789	1883	1881	
Flt Permitted	0.95	1.00	0.09	1.00	1.00	
Satd. Flow (perm)	1789	1601	171	1883	1881	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	3	351	395	360	783	9
RTOR Reduction (vph)	0	315	0	0	1	0
Lane Group Flow (vph)	3	36	395	360	791	0
Turn Type	Prot	Perm	pm+pt	NA	NA	
Protected Phases	4		5	2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	8.2	8.2	60.1	60.1	38.1	
Effective Green, g (s)	8.2	8.2	60.1	60.1	38.1	
Actuated g/C Ratio	0.10	0.10	0.75	0.75	0.47	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	182	163	450	1409	892	
v/s Ratio Prot	0.00		c0.17	0.19	0.42	
v/s Ratio Perm		c0.02	c0.48			
v/c Ratio	0.02	0.22	0.88	0.26	0.89	
Uniform Delay, d1	32.4	33.1	23.2	3.1	19.2	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.0	0.7	20.8	0.4	14.8	
Delay (s)	32.5	33.8	44.0	3.6	34.0	
Level of Service	C	C	D	A	C	
Approach Delay (s)	33.8			24.7	34.0	
Approach LOS	C			C	C	

Intersection Summary

HCM 2000 Control Delay	30.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	80.3	Sum of lost time (s)	18.0
Intersection Capacity Utilization	82.8%	ICU Level of Service	E
Analysis Period (min)	60		

c Critical Lane Group

LANE SUMMARY

Site: 2025 Total PM

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Prince of Wales Drive South													
Lane 1[d]	327	0.0	553	0.591	100	13.7	LOS B	5.9	41.4	Full	500	0.0	0.0
Approach	327	0.0		0.591		13.7	LOS B	5.9	41.4				
East: Bankfield Road East													
Lane 1[d]	538	0.0	806	0.667	100	9.0	LOS A	7.5	52.3	Full	500	0.0	0.0
Approach	538	0.0		0.667		9.0	LOS A	7.5	52.3				
North: Prince of Wales Drive North													
Lane 1[d]	705	0.0	1157	0.609	100	3.9	LOS A	6.4	44.7	Full	500	0.0	0.0
Lane 2	429	0.0	920	0.466	100	3.3	LOS A	3.6	25.3	Full	80	0.0	0.0
Approach	1134	0.0		0.609		3.7	LOS A	6.4	44.7				
West: Bankfield Road West													
Lane 1	336	0.0	659	0.510	100	9.9	LOS A	4.5	31.4	Full	500	0.0	0.0
Lane 2[d]	428	0.0	840	0.510	100	5.5	LOS A	4.9	34.2	Full	80	0.0	0.0
Approach	764	0.0		0.510		7.4	LOS A	4.9	34.2				
Intersection	2763	0.0		0.667		6.9	LOS A	7.5	52.3				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

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Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	43	52	92	363	307	77
Future Volume (Veh/h)	43	52	92	363	307	77
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	43	52	92	363	307	77
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	892	346	384			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	892	346	384			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	85	93	92			
cM capacity (veh/h)	288	697	1174			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	95	455	384
Volume Left	43	92	0
Volume Right	52	0	77
cSH	424	1174	1700
Volume to Capacity	0.22	0.08	0.23
Queue Length 95th (m)	6.5	1.9	0.0
Control Delay (s)	15.9	2.3	0.0
Lane LOS	C	A	
Approach Delay (s)	15.9	2.3	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	2.8		
Intersection Capacity Utilization	60.6%	ICU Level of Service	B
Analysis Period (min)	60		

C.6 2025 TOTAL FUTURE – WITH IMPROVEMENTS

LANE SUMMARY

Site: 2025 Total AM - Mods

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Greenbank Road South													
Lane 1[d]	578	0.0	867	0.666	100	10.2	LOS B	8.3	58.4	Full	500	0.0	0.0
Lane 2	141	0.0	568	0.248	100	6.4	LOS A	1.6	11.0	Full	80	0.0	0.0
Approach	719	0.0		0.666		9.5	LOS A	8.3	58.4				
East: Cambrian Road East													
Lane 1[d]	351	0.0	618	0.568	100	10.0	LOS B	5.5	38.2	Full	500	0.0	0.0
Approach	351	0.0		0.568		10.0	LOS B	5.5	38.2				
North: Greenbank Road North													
Lane 1[d]	283	0.0	1164	0.243	100	2.8	LOS A	1.6	11.5	Full	500	0.0	0.0
Lane 2	117	0.0	863	0.136	100	3.0	LOS A	0.8	5.5	Full	80	0.0	0.0
Approach	400	0.0		0.243		2.8	LOS A	1.6	11.5				
West: Cambrian Road West													
Lane 1[d]	679	0.0	1290	0.527	100	2.8	LOS A	4.4	30.7	Full	500	0.0	0.0
Lane 2	88	0.0	830	0.106	100	2.6	LOS A	0.6	3.9	Full	80	0.0	0.0
Approach	767	0.0		0.527		2.8	LOS A	4.4	30.7				
Intersection	2237	0.0		0.666		6.1	LOS A	8.3	58.4				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

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Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	14	150	103	208	7	198	177	273
v/c Ratio	0.08	0.47	0.49	0.62	0.01	0.16	0.23	0.22
Control Delay	23.9	28.7	33.6	27.9	5.3	5.2	6.4	5.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.9	28.7	33.6	27.9	5.3	5.2	6.4	5.8
Queue Length 50th (m)	1.5	16.2	11.9	18.3	0.3	7.4	7.7	11.4
Queue Length 95th (m)	6.4	35.5	28.2	42.8	1.9	20.4	22.0	29.0
Internal Link Dist (m)		1027.2		1181.4		1460.0		218.0
Turn Bay Length (m)								
Base Capacity (vph)	520	931	624	906	728	1206	779	1218
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	0.03	0.16	0.17	0.23	0.01	0.16	0.23	0.22

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	14	134	16	103	117	91	7	165	33	177	247	26
Future Volume (vph)	14	134	16	103	117	91	7	165	33	177	247	26
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.93		1.00	0.97		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1853		1789	1760		1789	1836		1789	1857	
Flt Permitted	0.55	1.00		0.66	1.00		0.59	1.00		0.63	1.00	
Satd. Flow (perm)	1040	1853		1246	1760		1114	1836		1193	1857	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	14	134	16	103	117	91	7	165	33	177	247	26
RTOR Reduction (vph)	0	7	0	0	42	0	0	6	0	0	3	0
Lane Group Flow (vph)	14	143	0	103	166	0	7	192	0	177	270	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	11.5	11.5		11.5	11.5		44.5	44.5		44.5	44.5	
Effective Green, g (s)	11.5	11.5		11.5	11.5		44.5	44.5		44.5	44.5	
Actuated g/C Ratio	0.17	0.17		0.17	0.17		0.65	0.65		0.65	0.65	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	175	313		210	297		729	1201		780	1215	
v/s Ratio Prot		0.08			c0.09			0.10			0.15	
v/s Ratio Perm	0.01			0.08			0.01			c0.15		
v/c Ratio	0.08	0.46		0.49	0.56		0.01	0.16		0.23	0.22	
Uniform Delay, d1	23.8	25.4		25.6	25.9		4.1	4.5		4.8	4.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.2	1.1		1.8	2.4		0.0	0.3		0.7	0.4	
Delay (s)	24.0	26.5		27.4	28.4		4.1	4.8		5.4	5.2	
Level of Service	C	C		C	C		A	A		A	A	
Approach Delay (s)		26.3			28.0			4.8			5.3	
Approach LOS		C			C			A			A	

Intersection Summary			
HCM 2000 Control Delay	14.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.30		
Actuated Cycle Length (s)	68.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	56.4%	ICU Level of Service	B
Analysis Period (min)	60		

c Critical Lane Group

LANE SUMMARY

Site: 2025 Total PM - Mods

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Greenbank Road South													
Lane 1[d]	418	0.0	968	0.432	100	4.1	LOS A	3.6	25.0	Full	500	0.0	0.0
Lane 2	90	0.0	628	0.143	100	4.6	LOS A	0.9	6.0	Full	80	0.0	0.0
Approach	508	0.0		0.432		4.2	LOS A	3.6	25.0				
East: Cambrian Road East													
Lane 1[d]	723	0.0	804	0.900	100	24.2	LOS C	20.9	146.1	Full	500	0.0	0.0
Approach	723	0.0		0.900		24.2	LOS C	20.9	146.1				
North: Greenbank Road North													
Lane 1[d]	591	0.0	864	0.684	100	9.2	LOS A	8.8	61.6	Full	500	0.0	0.0
Lane 2	335	0.0	658	0.509	100	7.4	LOS A	4.4	30.9	Full	80	0.0	0.0
Approach	926	0.0		0.684		8.5	LOS A	8.8	61.6				
West: Cambrian Road West													
Lane 1[d]	513	0.0	859	0.597	100	7.8	LOS A	6.6	46.0	Full	500	0.0	0.0
Lane 2	268	0.0	647	0.414	100	5.9	LOS A	3.1	22.0	Full	80	0.0	0.0
Approach	781	0.0		0.597		7.1	LOS A	6.6	46.0				
Intersection	2938	0.0		0.900		11.2	LOS B	20.9	146.1				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

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Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	9	161	123	369	32	371	127	229
v/c Ratio	0.06	0.34	0.39	0.75	0.05	0.35	0.23	0.21
Control Delay	19.4	21.7	25.0	30.5	8.7	9.6	10.3	8.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.4	21.7	25.0	30.5	8.7	9.6	10.3	8.9
Queue Length 50th (m)	0.9	16.3	13.3	36.7	1.6	21.1	7.3	12.7
Queue Length 95th (m)	4.4	34.1	29.8	74.4	7.2	57.0	23.7	34.7
Internal Link Dist (m)		1027.2		1181.4		1460.0		217.6
Turn Bay Length (m)								
Base Capacity (vph)	323	1015	672	981	665	1048	558	1072
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	0.03	0.16	0.18	0.38	0.05	0.35	0.23	0.21

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	9	146	15	123	193	176	32	271	100	127	214	15
Future Volume (vph)	9	146	15	123	193	176	32	271	100	127	214	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.93		1.00	0.96		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1857		1789	1749		1789	1807		1789	1865	
Flt Permitted	0.31	1.00		0.66	1.00		0.62	1.00		0.52	1.00	
Satd. Flow (perm)	593	1857		1234	1749		1160	1807		974	1865	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	9	146	15	123	193	176	32	271	100	127	214	15
RTOR Reduction (vph)	0	5	0	0	47	0	0	11	0	0	2	0
Lane Group Flow (vph)	9	156	0	123	322	0	32	360	0	127	227	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	17.8	17.8		17.8	17.8		40.2	40.2		40.2	40.2	
Effective Green, g (s)	17.8	17.8		17.8	17.8		40.2	40.2		40.2	40.2	
Actuated g/C Ratio	0.25	0.25		0.25	0.25		0.57	0.57		0.57	0.57	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	150	472		313	444		666	1037		559	1071	
v/s Ratio Prot		0.08			c0.18			c0.20			0.12	
v/s Ratio Perm	0.02			0.10			0.03			0.13		
v/c Ratio	0.06	0.33		0.39	0.73		0.05	0.35		0.23	0.21	
Uniform Delay, d1	19.8	21.2		21.6	23.9		6.5	7.9		7.3	7.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.2	0.4		0.8	6.0		0.1	0.9		0.9	0.5	
Delay (s)	19.9	21.7		22.4	29.9		6.7	8.8		8.2	7.7	
Level of Service	B	C		C	C		A	A		A	A	
Approach Delay (s)		21.6			28.0			8.7			7.9	
Approach LOS		C			C			A			A	

Intersection Summary

HCM 2000 Control Delay	16.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	72.5%	ICU Level of Service	C
Analysis Period (min)	60		

c Critical Lane Group

C.7 2031 FUTURE BACKGROUND

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	21	1003	72	10	364	70
Future Volume (Veh/h)	21	1003	72	10	364	70
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	21	1003	72	10	364	70
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	875	77			82	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	875	77			82	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	91	0			76	
cM capacity (veh/h)	243	984			1515	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	1024	82	434
Volume Left	21	0	364
Volume Right	1003	10	0
cSH	926	1700	1515
Volume to Capacity	1.11	0.05	0.24
Queue Length 95th (m)	537.4	0.0	7.2
Control Delay (s)	233.8	0.0	7.1
Lane LOS	F		A
Approach Delay (s)	233.8	0.0	7.1
Approach LOS	F		

Intersection Summary			
Average Delay		157.4	
Intersection Capacity Utilization		100.4%	ICU Level of Service G
Analysis Period (min)		60	

LANE SUMMARY

Site: 2031 FBG AM

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Greenbank Road South													
Lane 1[d]	717	0.0	723	0.991	100	81.8	LOS F	48.1	336.8	Full	500	0.0	0.0
Lane 2	170	0.0	479	0.355	100	8.0	LOS A	2.4	17.1	Full	80	0.0	0.0
Approach	887	0.0		0.991		67.7	LOS E	48.1	336.8				
East: Cambrian Road East													
Lane 1[d]	507	0.0	488	1.040	100	153.1	LOS F	55.6	389.4	Full	500	0.0	0.0
Approach	507	0.0		1.040		153.1	LOS F	55.6	389.4				
North: Greenbank Road North													
Lane 1[d]	340	0.0	994	0.342	100	4.0	LOS A	2.6	18.2	Full	500	0.0	0.0
Lane 2	137	0.0	723	0.190	100	4.4	LOS A	1.2	8.2	Full	80	0.0	0.0
Approach	477	0.0		0.342		4.1	LOS A	2.6	18.2				
West: Cambrian Road West													
Lane 1[d]	778	0.0	1208	0.644	100	4.4	LOS A	7.0	49.2	Full	500	0.0	0.0
Lane 2	100	0.0	777	0.129	100	3.1	LOS A	0.7	5.0	Full	80	0.0	0.0
Approach	878	0.0		0.644		4.3	LOS A	7.0	49.2				
Intersection	2749	0.0		1.040		52.1	LOS D	55.6	389.4				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

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Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	46	174	166	35	39	52
Future Volume (Veh/h)	46	174	166	35	39	52
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	46	174	166	35	39	52
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	201				450	184
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	201				450	184
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	97				93	94
cM capacity (veh/h)	1371				548	859

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	220	201	91
Volume Left	46	0	39
Volume Right	0	35	52
cSH	1371	1700	691
Volume to Capacity	0.03	0.12	0.13
Queue Length 95th (m)	0.8	0.0	3.5
Control Delay (s)	1.8	0.0	11.0
Lane LOS	A		B
Approach Delay (s)	1.8	0.0	11.0
Approach LOS			B

Intersection Summary			
Average Delay		2.7	
Intersection Capacity Utilization		37.9%	ICU Level of Service A
Analysis Period (min)		60	

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	209	2	1	195	3	1
Future Volume (Veh/h)	209	2	1	195	3	1
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	209	2	1	195	3	1
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			211		407	210
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			211		407	210
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	100
cM capacity (veh/h)			1360		600	830

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	211	196	4
Volume Left	0	1	3
Volume Right	2	0	1
cSH	1700	1360	644
Volume to Capacity	0.12	0.00	0.01
Queue Length 95th (m)	0.0	0.0	0.1
Control Delay (s)	0.0	0.0	10.6
Lane LOS		A	B
Approach Delay (s)	0.0	0.0	10.6
Approach LOS			B

Intersection Summary			
Average Delay		0.1	
Intersection Capacity Utilization		21.1%	ICU Level of Service A
Analysis Period (min)		60	

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	18	193	133	258	7	297	183	324
v/c Ratio	0.11	0.52	0.60	0.68	0.01	0.25	0.26	0.27
Control Delay	24.1	29.7	38.1	31.8	6.3	6.8	7.9	7.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.1	29.7	38.1	31.8	6.3	6.8	7.9	7.1
Queue Length 50th (m)	2.0	22.4	16.3	26.9	0.3	14.1	9.3	16.1
Queue Length 95th (m)	7.7	45.4	36.8	56.3	2.1	36.0	27.0	40.2
Internal Link Dist (m)		1027.2		1181.4		1460.0		218.0
Turn Bay Length (m)	37.5		37.5		37.5		37.5	
Base Capacity (vph)	392	868	523	845	673	1172	691	1179
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	0.05	0.22	0.25	0.31	0.01	0.25	0.26	0.27

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	18	177	16	133	158	100	7	254	43	183	291	33
Future Volume (vph)	18	177	16	133	158	100	7	254	43	183	291	33
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.94		1.00	0.98		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1860		1789	1774		1789	1843		1789	1855	
Flt Permitted	0.45	1.00		0.60	1.00		0.56	1.00		0.58	1.00	
Satd. Flow (perm)	845	1860		1125	1774		1063	1843		1090	1855	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	18	177	16	133	158	100	7	254	43	183	291	33
RTOR Reduction (vph)	0	5	0	0	32	0	0	5	0	0	3	0
Lane Group Flow (vph)	18	188	0	133	226	0	7	292	0	183	321	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	14.1	14.1		14.1	14.1		45.1	45.1		45.1	45.1	
Effective Green, g (s)	14.1	14.1		14.1	14.1		45.1	45.1		45.1	45.1	
Actuated g/C Ratio	0.20	0.20		0.20	0.20		0.63	0.63		0.63	0.63	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	167	368		222	351		673	1167		690	1175	
v/s Ratio Prot		0.10			c0.13			0.16			c0.17	
v/s Ratio Perm	0.02			0.12			0.01			0.17		
v/c Ratio	0.11	0.51		0.60	0.64		0.01	0.25		0.27	0.27	
Uniform Delay, d1	23.4	25.5		26.0	26.2		4.8	5.7		5.7	5.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.3	1.2		4.4	4.1		0.0	0.5		0.9	0.6	
Delay (s)	23.7	26.7		30.4	30.3		4.8	6.2		6.7	6.4	
Level of Service	C	C		C	C		A	A		A	A	
Approach Delay (s)		26.4			30.3			6.2			6.5	
Approach LOS		C			C			A			A	

Intersection Summary			
HCM 2000 Control Delay	16.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.36		
Actuated Cycle Length (s)	71.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	64.7%	ICU Level of Service	C
Analysis Period (min)	60		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	491	51	5	18	61	5	9	851	9	5	387	177
Future Volume (Veh/h)	491	51	5	18	61	5	9	851	9	5	387	177
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
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
Hourly flow rate (vph)	491	51	5	18	61	5	9	851	9	5	387	177
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1394	1364	476	1390	1448	856	564			860		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1394	1364	476	1390	1448	856	564			860		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	65	99	79	53	99	99			99		
cM capacity (veh/h)	73	145	589	85	129	358	1008			781		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	547	84	869	569
Volume Left	491	18	9	5
Volume Right	5	5	9	177
cSH	77	121	1008	781
Volume to Capacity	7.08	0.70	0.01	0.01
Queue Length 95th (m)	Err	40.5	0.2	0.1
Control Delay (s)	Err	96.3	0.2	0.2
Lane LOS	F	F	A	A
Approach Delay (s)	Err	96.3	0.2	0.2
Approach LOS	F	F		

Intersection Summary				
Average Delay		2647.6		
Intersection Capacity Utilization		94.6%	ICU Level of Service	F
Analysis Period (min)		60		

Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	21	419	295	899	331
v/c Ratio	0.12	0.78	0.37	0.63	0.23
Control Delay	35.6	15.4	5.8	8.2	4.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	35.6	15.4	5.8	8.2	4.0
Queue Length 50th (m)	3.2	0.0	10.7	45.3	10.4
Queue Length 95th (m)	10.6	42.7	42.2	167.0	35.4
Internal Link Dist (m)	48.5			580.9	293.8
Turn Bay Length (m)	37.5		180.0		
Base Capacity (vph)	452	718	802	1430	1427
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	0.05	0.58	0.37	0.63	0.23

Intersection Summary

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	21	419	295	899	323	8
Future Volume (vph)	21	419	295	899	323	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	1.00	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1789	1601	1789	1883	1877	
Flt Permitted	0.95	1.00	0.56	1.00	1.00	
Satd. Flow (perm)	1789	1601	1056	1883	1877	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	21	419	295	899	323	8
RTOR Reduction (vph)	0	376	0	0	1	0
Lane Group Flow (vph)	21	43	295	899	330	0
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	8.9	8.9	66.2	66.2	66.2	
Effective Green, g (s)	8.9	8.9	66.2	66.2	66.2	
Actuated g/C Ratio	0.10	0.10	0.76	0.76	0.76	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	182	163	802	1431	1426	
v/s Ratio Prot	0.01			c0.48	0.18	
v/s Ratio Perm		c0.03	0.28			
v/c Ratio	0.12	0.26	0.37	0.63	0.23	
Uniform Delay, d1	35.5	36.1	3.5	4.8	3.0	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.3	0.9	1.3	2.1	0.4	
Delay (s)	35.8	36.9	4.8	6.9	3.4	
Level of Service	D	D	A	A	A	
Approach Delay (s)	36.9			6.4	3.4	
Approach LOS	D			A	A	

Intersection Summary			
HCM 2000 Control Delay	12.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	87.1	Sum of lost time (s)	12.0
Intersection Capacity Utilization	61.5%	ICU Level of Service	B
Analysis Period (min)	60		

c Critical Lane Group

LANE SUMMARY

Site: 2031 FBG AM

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Prince of Wales Drive South													
Lane 1[d]	642	0.0	558	1.150	100	316.7	LOS F	128.8	901.9	Full	500	0.0	26.8
Approach	642	0.0		1.150		316.7	LOS F	128.8	901.9				
East: Bankfield Road East													
Lane 1[d]	797	0.0	559	1.426	100	791.8	LOS F	316.4	2214.5	Full	500	0.0	100.0
Approach	797	0.0		1.426		791.8	LOS F	316.4	2214.5				
North: Prince of Wales Drive North													
Lane 1	366	0.0	937	0.391	100	3.8	LOS A	2.9	20.6	Full	500	0.0	0.0
Lane 2[d]	378	0.0	1112	0.340	100	2.5	LOS A	2.6	18.5	Full	80	0.0	0.0
Approach	744	0.0		0.391		3.2	LOS A	2.9	20.6				
West: Bankfield Road West													
Lane 1[d]	459	0.0	1206	0.381	100	4.5	LOS A	2.9	20.1	Full	500	0.0	0.0
Lane 2	385	0.0	1011	0.381	100	2.3	LOS A	2.7	19.0	Full	80	0.0	0.0
Approach	844	0.0		0.381		3.5	LOS A	2.9	20.1				
Intersection	3027	0.0		1.426		277.4	LOS F	316.4	2214.5				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

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Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	78	101	38	335	407	26
Future Volume (Veh/h)	78	101	38	335	407	26
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	78	101	38	335	407	26
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)				242		
pX, platoon unblocked						
vC, conflicting volume	831	420	433			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	831	420	433			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	76	84	97			
cM capacity (veh/h)	328	633	1127			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	179	373	433
Volume Left	78	38	0
Volume Right	101	0	26
cSH	451	1127	1700
Volume to Capacity	0.40	0.03	0.25
Queue Length 95th (m)	14.8	0.8	0.0
Control Delay (s)	18.2	1.2	0.0
Lane LOS	C	A	
Approach Delay (s)	18.2	1.2	0.0
Approach LOS	C		

Intersection Summary			
Average Delay		3.8	
Intersection Capacity Utilization		63.3%	ICU Level of Service B
Analysis Period (min)		60	

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	18	498	101	23	855	116
Future Volume (Veh/h)	18	498	101	23	855	116
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	18	498	101	23	855	116
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1938	112			124	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1938	112			124	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	40	47			42	
cM capacity (veh/h)	30	940			1463	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	516	124	971
Volume Left	18	0	855
Volume Right	498	23	0
cSH	456	1700	1463
Volume to Capacity	1.13	0.07	0.58
Queue Length 95th (m)	354.5	0.0	31.6
Control Delay (s)	305.2	0.0	10.4
Lane LOS	F		B
Approach Delay (s)	305.2	0.0	10.4
Approach LOS	F		

Intersection Summary			
Average Delay		104.0	
Intersection Capacity Utilization		102.0%	ICU Level of Service G
Analysis Period (min)		60	

LANE SUMMARY

Site: 2031 FBG PM

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Greenbank Road South													
Lane 1[d]	492	0.0	795	0.619	100	9.0	LOS A	7.1	50.0	Full	500	0.0	0.0
Lane 2	109	0.0	520	0.209	100	6.2	LOS A	1.4	9.6	Full	80	0.0	0.0
Approach	601	0.0		0.619		8.5	LOS A	7.1	50.0				
East: Cambrian Road East													
Lane 1[d]	861	0.0	697	1.235	100	444.8	LOS F	225.6	1579.1	Full	500	0.0	100.0
Approach	861	0.0		1.235		444.8	LOS F	225.6	1579.1				
North: Greenbank Road North													
Lane 1[d]	717	0.0	879	0.815	100	14.8	LOS B	14.5	101.2	Full	500	0.0	0.0
Lane 2	381	0.0	664	0.574	100	8.6	LOS A	5.4	38.1	Full	80	0.0	0.0
Approach	1098	0.0		0.815		12.7	LOS B	14.5	101.2				
West: Cambrian Road West													
Lane 1[d]	657	0.0	727	0.904	100	34.0	LOS C	22.6	158.5	Full	500	0.0	0.0
Lane 2	338	0.0	540	0.626	100	12.8	LOS B	6.4	44.8	Full	80	0.0	0.0
Approach	995	0.0		0.904		26.8	LOS C	22.6	158.5				
Intersection	3555	0.0		1.235		120.6	LOS F	225.6	1579.1				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

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Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	50	180	237	75	45	89
Future Volume (Veh/h)	50	180	237	75	45	89
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	50	180	237	75	45	89
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	312				554	274
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	312				554	274
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	96				90	88
cM capacity (veh/h)	1248				473	764

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	230	312	134
Volume Left	50	0	45
Volume Right	0	75	89
cSH	1248	1700	633
Volume to Capacity	0.04	0.18	0.21
Queue Length 95th (m)	1.0	0.0	6.1
Control Delay (s)	2.0	0.0	12.2
Lane LOS	A		B
Approach Delay (s)	2.0	0.0	12.2
Approach LOS			B

Intersection Summary			
Average Delay	3.1		
Intersection Capacity Utilization	47.2%	ICU Level of Service	A
Analysis Period (min)	60		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	224	1	1	307	3	1
Future Volume (Veh/h)	224	1	1	307	3	1
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	224	1	1	307	3	1
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			225		534	224
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			225		534	224
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	100
cM capacity (veh/h)			1344		507	815

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	225	308	4
Volume Left	0	1	3
Volume Right	1	0	1
cSH	1700	1344	560
Volume to Capacity	0.13	0.00	0.01
Queue Length 95th (m)	0.0	0.0	0.2
Control Delay (s)	0.0	0.0	11.5
Lane LOS		A	B
Approach Delay (s)	0.0	0.0	11.5
Approach LOS			B

Intersection Summary			
Average Delay		0.1	
Intersection Capacity Utilization		27.0%	ICU Level of Service A
Analysis Period (min)		60	

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	12	211	160	443	27	451	140	300
v/c Ratio	0.09	0.38	0.48	0.79	0.05	0.45	0.31	0.30
Control Delay	19.4	22.1	26.5	33.5	10.9	13.0	14.1	11.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.4	22.1	26.5	33.5	10.9	13.0	14.1	11.7
Queue Length 50th (m)	1.2	23.1	18.5	51.5	1.6	32.7	10.0	20.8
Queue Length 95th (m)	5.4	44.5	39.5	97.5	7.5	86.1	32.9	54.1
Internal Link Dist (m)		1027.2		1181.4		1460.0		217.6
Turn Bay Length (m)	37.5		37.5		37.5		37.5	
Base Capacity (vph)	231	918	551	892	577	993	445	1016
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	0.05	0.23	0.29	0.50	0.05	0.45	0.31	0.30

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	12	199	12	160	259	184	27	321	130	140	281	19
Future Volume (vph)	12	199	12	160	259	184	27	321	130	140	281	19
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.94		1.00	0.96		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1867		1789	1766		1789	1802		1789	1866	
Flt Permitted	0.25	1.00		0.60	1.00		0.56	1.00		0.44	1.00	
Satd. Flow (perm)	470	1867		1122	1766		1063	1802		819	1866	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	12	199	12	160	259	184	27	321	130	140	281	19
RTOR Reduction (vph)	0	3	0	0	34	0	0	14	0	0	2	0
Lane Group Flow (vph)	12	208	0	160	409	0	27	437	0	140	298	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	22.5	22.5		22.5	22.5		41.3	41.3		41.3	41.3	
Effective Green, g (s)	22.5	22.5		22.5	22.5		41.3	41.3		41.3	41.3	
Actuated g/C Ratio	0.30	0.30		0.30	0.30		0.54	0.54		0.54	0.54	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	139	554		333	524		579	981		446	1016	
v/s Ratio Prot		0.11			c0.23			c0.24			0.16	
v/s Ratio Perm	0.03			0.14			0.03			0.17		
v/c Ratio	0.09	0.38		0.48	0.78		0.05	0.45		0.31	0.29	
Uniform Delay, d1	19.2	21.1		21.9	24.4		8.1	10.4		9.5	9.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.3	0.4		1.1	7.8		0.2	1.5		1.8	0.7	
Delay (s)	19.5	21.5		23.0	32.2		8.2	11.8		11.3	10.1	
Level of Service	B	C		C	C		A	B		B	B	
Approach Delay (s)		21.4			29.8			11.6			10.5	
Approach LOS		C			C			B			B	

Intersection Summary				
HCM 2000 Control Delay	18.9	HCM 2000 Level of Service	B	
HCM 2000 Volume to Capacity ratio	0.56			
Actuated Cycle Length (s)	75.8	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	81.6%	ICU Level of Service	D	
Analysis Period (min)	60			

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	233	98	5	8	77	5	5	486	31	5	839	514
Future Volume (Veh/h)	233	98	5	8	77	5	5	486	31	5	839	514
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
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
Hourly flow rate (vph)	233	98	5	8	77	5	5	486	31	5	839	514
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1661	1633	1096	1672	1874	502	1353			517		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1661	1633	1096	1672	1874	502	1353			517		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	2	98	0	0	99	99			100		
cM capacity (veh/h)	0	100	259	6	71	570	509			1049		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	336	90	522	1358
Volume Left	233	8	5	5
Volume Right	5	5	31	514
cSH	0	38	509	1049
Volume to Capacity	Err	2.38	0.01	0.00
Queue Length 95th (m)	Err	232.1	0.2	0.1
Control Delay (s)	Err	2745.8	0.3	0.2
Lane LOS	F	F	A	A
Approach Delay (s)	Err	2745.8	0.3	0.2
Approach LOS	F	F		

Intersection Summary			
Average Delay	Err		
Intersection Capacity Utilization	110.5%	ICU Level of Service	H
Analysis Period (min)	60		

Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	5	452	459	468	1030
v/c Ratio	0.02	0.87	1.20	0.35	1.17
Control Delay	29.4	33.0	413.3	6.5	339.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	29.4	33.0	413.3	6.5	339.0
Queue Length 50th (m)	0.7	20.1	~79.9	27.5	~210.4
Queue Length 95th (m)	4.0	#92.0	#168.8	55.7	#348.0
Internal Link Dist (m)	48.5			580.9	293.8
Turn Bay Length (m)	37.5		180.0		
Base Capacity (vph)	377	590	382	1326	883
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	0.01	0.77	1.20	0.35	1.17

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

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

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	5	452	459	468	1018	12
Future Volume (vph)	5	452	459	468	1018	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	1.00	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1789	1601	1789	1883	1880	
Flt Permitted	0.95	1.00	0.09	1.00	1.00	
Satd. Flow (perm)	1789	1601	163	1883	1880	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	5	452	459	468	1018	12
RTOR Reduction (vph)	0	271	0	0	1	0
Lane Group Flow (vph)	5	181	459	468	1029	0
Turn Type	Prot	Perm	pm+pt	NA	NA	
Protected Phases	4		5	2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	13.2	13.2	60.2	60.2	40.2	
Effective Green, g (s)	13.2	13.2	60.2	60.2	40.2	
Actuated g/C Ratio	0.15	0.15	0.70	0.70	0.47	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	276	247	381	1327	884	
v/s Ratio Prot	0.00		c0.20	0.25	0.55	
v/s Ratio Perm		c0.11	c0.65			
v/c Ratio	0.02	0.73	1.20	0.35	1.16	
Uniform Delay, d1	30.6	34.4	27.8	4.9	22.6	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.0	11.5	394.5	0.7	310.0	
Delay (s)	30.6	45.9	422.2	5.7	332.6	
Level of Service	C	D	F	A	F	
Approach Delay (s)	45.7			211.9	332.6	
Approach LOS	D			F	F	

Intersection Summary

HCM 2000 Control Delay	231.9	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.16		
Actuated Cycle Length (s)	85.4	Sum of lost time (s)	18.0
Intersection Capacity Utilization	98.9%	ICU Level of Service	F
Analysis Period (min)	60		

c Critical Lane Group

LANE SUMMARY

Site: 2031 FBG PM

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Prince of Wales Drive South													
Lane 1[d]	404	0.0	363	1.112	100	292.8	LOS F	74.6	522.1	Full	500	0.0	6.3
Approach	404	0.0		1.112		292.8	LOS F	74.6	522.1				
East: Bankfield Road East													
Lane 1[d]	690	0.0	707	0.976	100	60.7	LOS E	38.2	267.4	Full	500	0.0	0.0
Approach	690	0.0		0.976		60.7	LOS E	38.2	267.4				
North: Prince of Wales Drive North													
Lane 1[d]	914	0.0	1017	0.899	100	17.4	LOS B	22.2	155.7	Full	500	0.0	0.0
Lane 2	556	0.0	797	0.698	100	8.5	LOS A	8.4	58.8	Full	80	0.0	0.0
Approach	1470	0.0		0.899		14.0	LOS B	22.2	155.7				
West: Bankfield Road West													
Lane 1	420	0.0	437	0.960	100	79.4	LOS E	25.7	179.8	Full	500	0.0	0.0
Lane 2[d]	555	0.0	579	0.960	100	69.9	LOS E	31.9	223.6	Full	80	0.0	71.3
Approach	975	0.0		0.960		74.0	LOS E	31.9	223.6				
Intersection	3539	0.0		1.112		71.5	LOS E	74.6	522.1				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

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Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	43	52	92	422	390	77
Future Volume (Veh/h)	43	52	92	422	390	77
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	43	52	92	422	390	77
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)				242		
pX, platoon unblocked	0.95					
vC, conflicting volume	1034	428	467			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1011	428	467			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	81	92	92			
cM capacity (veh/h)	231	626	1094			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	95	514	467
Volume Left	43	92	0
Volume Right	52	0	77
cSH	353	1094	1700
Volume to Capacity	0.27	0.08	0.27
Queue Length 95th (m)	8.3	2.1	0.0
Control Delay (s)	18.9	2.3	0.0
Lane LOS	C	A	
Approach Delay (s)	18.9	2.3	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	2.8		
Intersection Capacity Utilization	68.1%	ICU Level of Service	C
Analysis Period (min)	60		

C.8 2031 FUTURE BACKGROUND – WITH IMPROVEMENTS

Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	21	1003	82	364	70
v/c Ratio	0.04	0.92	0.09	0.54	0.07
Control Delay	13.5	21.4	12.9	20.1	14.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	13.5	21.4	12.9	20.1	14.0
Queue Length 50th (m)	1.8	13.7	4.3	28.5	4.1
Queue Length 95th (m)	6.1	#180.1	19.4	#113.2	18.1
Internal Link Dist (m)	634.3		2077.3		243.8
Turn Bay Length (m)	37.5			37.5	
Base Capacity (vph)	1179	1347	948	675	959
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	0.02	0.74	0.09	0.54	0.07

Intersection Summary

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

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	21	1003	72	10	364	70
Future Volume (vph)	21	1003	72	10	364	70
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	0.85	0.98		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1789	1601	1852		1789	1883
Flt Permitted	0.95	1.00	1.00		0.70	1.00
Satd. Flow (perm)	1789	1601	1852		1325	1883
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	21	1003	72	10	364	70
RTOR Reduction (vph)	0	588	4	0	0	0
Lane Group Flow (vph)	21	415	78	0	364	70
Turn Type	Prot	Perm	NA		Perm	NA
Protected Phases	8		2			6
Permitted Phases		8			6	
Actuated Green, G (s)	21.6	21.6	35.4		35.4	35.4
Effective Green, g (s)	21.6	21.6	35.4		35.4	35.4
Actuated g/C Ratio	0.31	0.31	0.51		0.51	0.51
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	560	501	950		679	966
v/s Ratio Prot	0.01		0.04			0.04
v/s Ratio Perm		c0.26			c0.27	
v/c Ratio	0.04	0.83	0.08		0.54	0.07
Uniform Delay, d1	16.5	22.0	8.5		11.3	8.5
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.0	11.9	0.2		3.1	0.1
Delay (s)	16.5	33.9	8.7		14.3	8.6
Level of Service	B	C	A		B	A
Approach Delay (s)	33.5		8.7			13.4
Approach LOS	C		A			B

Intersection Summary

HCM 2000 Control Delay	26.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	69.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	76.5%	ICU Level of Service	D
Analysis Period (min)	60		

c Critical Lane Group

LANE SUMMARY

Site: 2031 FBG AM - Mods

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Greenbank Road South													
Lane 1	385	0.0	557	0.690	100	17.6	LOS B	8.0	55.9	Full	500	0.0	0.0
Lane 2[d]	502	0.0	728	0.690	100	13.3	LOS B	9.2	64.2	Full	80	0.0	0.0
Approach	887	0.0		0.690		15.1	LOS B	9.2	64.2				
East: Cambrian Road East													
Lane 1[d]	409	0.0	687	0.595	100	12.5	LOS B	6.8	47.6	Full	500	0.0	0.0
Lane 2	98	0.0	461	0.213	100	8.9	LOS A	1.4	9.8	Full	80	0.0	0.0
Approach	507	0.0		0.595		11.8	LOS B	6.8	47.6				
North: Greenbank Road North													
Lane 1	212	0.0	781	0.271	100	5.2	LOS A	1.8	12.8	Full	500	0.0	0.0
Lane 2[d]	265	0.0	977	0.271	100	3.3	LOS A	2.0	14.0	Full	80	0.0	0.0
Approach	477	0.0		0.271		4.2	LOS A	2.0	14.0				
West: Cambrian Road West													
Lane 1[d]	778	0.0	1217	0.639	100	4.4	LOS A	6.8	47.8	Full	500	0.0	0.0
Lane 2	100	0.0	782	0.128	100	3.1	LOS A	0.7	4.9	Full	80	0.0	0.0
Approach	878	0.0		0.639		4.2	LOS A	6.8	47.8				
Intersection	2749	0.0		0.690		9.1	LOS A	9.2	64.2				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

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Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	21	419	295	899	331
v/c Ratio	0.12	0.78	0.37	0.63	0.12
Control Delay	35.6	15.4	5.9	8.2	3.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	35.6	15.4	5.9	8.2	3.3
Queue Length 50th (m)	3.2	0.0	10.8	45.3	4.9
Queue Length 95th (m)	10.6	42.7	42.8	167.0	15.6
Internal Link Dist (m)	48.5			580.9	293.8
Turn Bay Length (m)	37.5		180.0		
Base Capacity (vph)	452	718	790	1430	2708
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	0.05	0.58	0.37	0.63	0.12

Intersection Summary

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	21	419	295	899	323	8
Future Volume (vph)	21	419	295	899	323	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95	
Frt	1.00	0.85	1.00	1.00	1.00	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1789	1601	1789	1883	3566	
Flt Permitted	0.95	1.00	0.55	1.00	1.00	
Satd. Flow (perm)	1789	1601	1040	1883	3566	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	21	419	295	899	323	8
RTOR Reduction (vph)	0	376	0	0	1	0
Lane Group Flow (vph)	21	43	295	899	330	0
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	8.9	8.9	66.2	66.2	66.2	
Effective Green, g (s)	8.9	8.9	66.2	66.2	66.2	
Actuated g/C Ratio	0.10	0.10	0.76	0.76	0.76	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	182	163	790	1431	2710	
v/s Ratio Prot	0.01			c0.48	0.09	
v/s Ratio Perm		c0.03	0.28			
v/c Ratio	0.12	0.26	0.37	0.63	0.12	
Uniform Delay, d1	35.5	36.1	3.5	4.8	2.8	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.3	0.9	1.4	2.1	0.1	
Delay (s)	35.8	36.9	4.9	6.9	2.9	
Level of Service	D	D	A	A	A	
Approach Delay (s)	36.9			6.4	2.9	
Approach LOS	D			A	A	

Intersection Summary			
HCM 2000 Control Delay	12.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	87.1	Sum of lost time (s)	12.0
Intersection Capacity Utilization	61.5%	ICU Level of Service	B
Analysis Period (min)	60		

c Critical Lane Group

LANE SUMMARY

Site: 2031 FBG AM - Mods

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Prince of Wales Drive South													
Lane 1	275	0.0	542	0.508	100	12.7	LOS B	4.5	31.2	Full	500	0.0	0.0
Lane 2[d]	367	0.0	722	0.508	100	9.9	LOS A	5.0	35.1	Full	500	0.0	0.0
Approach	642	0.0		0.508		11.1	LOS B	5.0	35.1				
East: Bankfield Road East													
Lane 1[d]	604	0.0	683	0.885	100	42.2	LOS D	22.5	157.6	Full	500	0.0	0.0
Lane 2	193	0.0	476	0.405	100	11.4	LOS B	3.0	21.2	Full	80	0.0	0.0
Approach	797	0.0		0.885		34.8	LOS C	22.5	157.6				
North: Prince of Wales Drive North													
Lane 1	331	0.0	734	0.451	100	5.9	LOS A	3.6	25.5	Full	500	0.0	0.0
Lane 2[d]	413	0.0	917	0.451	100	3.8	LOS A	3.9	27.1	Full	80	0.0	0.0
Approach	744	0.0		0.451		4.7	LOS A	3.9	27.1				
West: Bankfield Road West													
Lane 1[d]	459	0.0	1195	0.384	100	4.6	LOS A	2.9	20.5	Full	500	0.0	0.0
Lane 2	385	0.0	1001	0.384	100	2.3	LOS A	2.8	19.3	Full	80	0.0	0.0
Approach	844	0.0		0.384		3.5	LOS A	2.9	20.5				
Intersection	3027	0.0		0.885		13.7	LOS B	22.5	157.6				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

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Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	18	498	124	855	116
v/c Ratio	0.12	0.84	0.08	0.83	0.08
Control Delay	46.9	19.7	2.5	17.7	2.9
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	46.9	19.7	2.5	17.7	2.9
Queue Length 50th (m)	3.7	0.0	2.8	68.7	3.3
Queue Length 95th (m)	11.6	#71.7	11.9	#316.1	12.7
Internal Link Dist (m)	634.3		2077.3		243.8
Turn Bay Length (m)	37.5			37.5	
Base Capacity (vph)	307	687	1483	1026	1516
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	0.06	0.72	0.08	0.83	0.08

Intersection Summary

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

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	18	498	101	23	855	116
Future Volume (vph)	18	498	101	23	855	116
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	0.85	0.97		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1789	1601	1836		1789	1883
Flt Permitted	0.95	1.00	1.00		0.68	1.00
Satd. Flow (perm)	1789	1601	1836		1276	1883
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	18	498	101	23	855	116
RTOR Reduction (vph)	0	455	4	0	0	0
Lane Group Flow (vph)	18	43	120	0	855	116
Turn Type	Prot	Perm	NA		Perm	NA
Protected Phases	8		2			6
Permitted Phases		8			6	
Actuated Green, G (s)	9.5	9.5	89.2		89.2	89.2
Effective Green, g (s)	9.5	9.5	89.2		89.2	89.2
Actuated g/C Ratio	0.09	0.09	0.81		0.81	0.81
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	153	137	1479		1028	1517
v/s Ratio Prot	0.01		0.07			0.06
v/s Ratio Perm		c0.03			c0.67	
v/c Ratio	0.12	0.31	0.08		0.83	0.08
Uniform Delay, d1	46.7	47.5	2.2		6.3	2.2
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.3	1.3	0.1		8.4	0.1
Delay (s)	47.1	48.8	2.3		14.7	2.3
Level of Service	D	D	A		B	A
Approach Delay (s)	48.8		2.3			13.3
Approach LOS	D		A			B

Intersection Summary

HCM 2000 Control Delay	23.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	110.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	73.2%	ICU Level of Service	D
Analysis Period (min)	60		

c Critical Lane Group

LANE SUMMARY

Site: 2031 FBG PM - Mods

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Greenbank Road South													
Lane 1	264	0.0	621	0.425	100	7.5	LOS A	3.4	23.5	Full	500	0.0	0.0
Lane 2[d]	337	0.0	795	0.425	100	4.6	LOS A	3.6	25.5	Full	80	0.0	0.0
Approach	601	0.0		0.425		5.9	LOS A	3.6	25.5				
East: Cambrian Road East													
Lane 1[d]	682	0.0	929	0.734	100	11.3	LOS B	10.6	74.0	Full	500	0.0	0.0
Lane 2	179	0.0	614	0.292	100	6.0	LOS A	1.8	12.9	Full	80	0.0	0.0
Approach	861	0.0		0.734		10.2	LOS B	10.6	74.0				
North: Greenbank Road North													
Lane 1	478	0.0	573	0.836	100	25.7	LOS C	13.6	94.9	Full	500	0.0	0.0
Lane 2[d]	620	0.0	741	0.836	100	21.6	LOS C	15.8	110.3	Full	80	0.0	15.5
Approach	1098	0.0		0.836		23.4	LOS C	15.8	110.3				
West: Cambrian Road West													
Lane 1[d]	657	0.0	773	0.850	100	25.2	LOS C	17.5	122.7	Full	500	0.0	0.0
Lane 2	338	0.0	573	0.590	100	12.3	LOS B	5.7	40.1	Full	80	0.0	0.0
Approach	995	0.0		0.850		20.8	LOS C	17.5	122.7				
Intersection	3555	0.0		0.850		16.5	LOS B	17.5	122.7				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

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Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	5	452	459	468	1030
v/c Ratio	0.03	0.82	0.76	0.31	0.57
Control Delay	42.2	18.4	22.7	4.1	22.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	42.2	18.4	22.7	4.1	22.3
Queue Length 50th (m)	1.0	0.0	37.8	15.4	67.6
Queue Length 95th (m)	4.8	52.7	110.7	56.9	#157.0
Internal Link Dist (m)	48.5			580.9	293.8
Turn Bay Length (m)	37.5		180.0		
Base Capacity (vph)	408	713	746	1502	1803
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	0.01	0.63	0.62	0.31	0.57

Intersection Summary

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

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	5	452	459	468	1018	12
Future Volume (vph)	5	452	459	468	1018	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95	
Frt	1.00	0.85	1.00	1.00	1.00	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1789	1601	1789	1883	3572	
Flt Permitted	0.95	1.00	0.17	1.00	1.00	
Satd. Flow (perm)	1789	1601	325	1883	3572	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	5	452	459	468	1018	12
RTOR Reduction (vph)	0	412	0	0	0	0
Lane Group Flow (vph)	5	40	459	468	1030	0
Turn Type	Prot	Perm	pm+pt	NA	NA	
Protected Phases	4		5	2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	9.3	9.3	84.2	84.2	53.3	
Effective Green, g (s)	9.3	9.3	84.2	84.2	53.3	
Actuated g/C Ratio	0.09	0.09	0.80	0.80	0.51	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	157	141	604	1502	1804	
v/s Ratio Prot	0.00		c0.18	0.25	0.29	
v/s Ratio Perm		c0.02	c0.43			
v/c Ratio	0.03	0.28	0.76	0.31	0.57	
Uniform Delay, d1	44.0	45.0	17.4	2.9	18.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1	1.1	5.7	0.5	1.3	
Delay (s)	44.1	46.1	23.1	3.4	19.5	
Level of Service	D	D	C	A	B	
Approach Delay (s)	46.1			13.2	19.5	
Approach LOS	D			B	B	

Intersection Summary			
HCM 2000 Control Delay	22.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	105.5	Sum of lost time (s)	18.0
Intersection Capacity Utilization	73.1%	ICU Level of Service	D
Analysis Period (min)	60		

c Critical Lane Group

LANE SUMMARY

Site: 2031 FBG PM - Mods

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Prince of Wales Drive South													
Lane 1	170	0.0	347	0.489	100	20.3	LOS C	4.3	29.9	Full	500	0.0	0.0
Lane 2[d]	234	0.0	479	0.489	100	16.0	LOS B	5.0	34.9	Full	500	0.0	0.0
Approach	404	0.0		0.489		17.9	LOS B	5.0	34.9				
East: Bankfield Road East													
Lane 1[d]	524	0.0	894	0.586	100	7.9	LOS A	6.3	43.9	Full	500	0.0	0.0
Lane 2	166	0.0	617	0.269	100	6.3	LOS A	1.7	11.9	Full	80	0.0	0.0
Approach	690	0.0		0.586		7.5	LOS A	6.3	43.9				
North: Prince of Wales Drive North													
Lane 1	660	0.0	834	0.791	100	12.0	LOS B	12.0	84.1	Full	500	0.0	0.0
Lane 2[d]	810	0.0	1024	0.791	100	9.2	LOS A	12.9	90.4	Full	80	0.0	8.7
Approach	1470	0.0		0.791		10.5	LOS B	12.9	90.4				
West: Bankfield Road West													
Lane 1	420	0.0	507	0.828	100	34.4	LOS C	13.1	91.8	Full	500	0.0	0.0
Lane 2[d]	555	0.0	671	0.828	100	27.1	LOS C	15.7	109.9	Full	80	0.0	15.3
Approach	975	0.0		0.828		30.3	LOS C	15.7	109.9				
Intersection	3539	0.0		0.828		16.2	LOS B	15.7	109.9				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

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C.9 2031 ULTIMATE

Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	21	1081	82	388	70
v/c Ratio	0.03	0.95	0.09	0.61	0.08
Control Delay	13.9	30.1	18.2	28.3	19.4
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	13.9	30.1	18.2	28.3	19.4
Queue Length 50th (m)	2.1	36.3	6.9	48.7	6.5
Queue Length 95th (m)	6.6	#250.2	23.3	#145.9	21.5
Internal Link Dist (m)	634.3		2077.3		243.8
Turn Bay Length (m)	37.5			37.5	
Base Capacity (vph)	1197	1354	895	638	906
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	0.02	0.80	0.09	0.61	0.08

Intersection Summary

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

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	21	1081	72	10	388	70
Future Volume (vph)	21	1081	72	10	388	70
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	0.85	0.98		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1789	1601	1852		1789	1883
Flt Permitted	0.95	1.00	1.00		0.70	1.00
Satd. Flow (perm)	1789	1601	1852		1325	1883
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	21	1081	72	10	388	70
RTOR Reduction (vph)	0	530	4	0	0	0
Lane Group Flow (vph)	21	551	78	0	388	70
Turn Type	Prot	Perm	NA		Perm	NA
Protected Phases	8		2			6
Permitted Phases		8			6	
Actuated Green, G (s)	33.7	33.7	43.0		43.0	43.0
Effective Green, g (s)	33.7	33.7	43.0		43.0	43.0
Actuated g/C Ratio	0.38	0.38	0.48		0.48	0.48
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	679	608	897		642	912
v/s Ratio Prot	0.01		0.04			0.04
v/s Ratio Perm		c0.34			c0.29	
v/c Ratio	0.03	0.91	0.09		0.60	0.08
Uniform Delay, d1	17.3	26.0	12.3		16.7	12.2
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.0	21.5	0.2		4.3	0.2
Delay (s)	17.3	47.5	12.5		20.9	12.4
Level of Service	B	D	B		C	B
Approach Delay (s)	46.9		12.5			19.6
Approach LOS	D		B			B

Intersection Summary

HCM 2000 Control Delay	37.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	88.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	81.3%	ICU Level of Service	D
Analysis Period (min)	60		

c Critical Lane Group

LANE SUMMARY

Site: 2031 Ultimate AM

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Greenbank Road South													
Lane 1	397	0.0	481	0.826	100	33.5	LOS C	12.7	88.8	Full	500	0.0	0.0
Lane 2[d]	526	0.0	637	0.826	100	27.5	LOS C	15.2	106.3	Full	80	0.0	14.1
Approach	923	0.0		0.826		30.1	LOS C	15.2	106.3				
East: Cambrian Road East													
Lane 1[d]	416	0.0	616	0.676	100	19.7	LOS B	9.1	63.5	Full	500	0.0	0.0
Lane 2	98	0.0	418	0.234	100	10.5	LOS B	1.6	11.1	Full	80	0.0	0.0
Approach	514	0.0		0.676		18.0	LOS B	9.1	63.5				
North: Greenbank Road North													
Lane 1	221	0.0	763	0.289	100	5.4	LOS A	2.0	13.8	Full	500	0.0	0.0
Lane 2[d]	277	0.0	958	0.289	100	3.5	LOS A	2.2	15.1	Full	80	0.0	0.0
Approach	498	0.0		0.289		4.4	LOS A	2.2	15.1				
West: Cambrian Road West													
Lane 1[d]	858	0.0	1214	0.707	100	5.6	LOS A	8.9	62.5	Full	500	0.0	0.0
Lane 2	106	0.0	779	0.136	100	3.2	LOS A	0.7	5.2	Full	80	0.0	0.0
Approach	964	0.0		0.707		5.3	LOS A	8.9	62.5				
Intersection	2899	0.0		0.826		15.3	LOS B	15.2	106.3				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

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Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	46	174	166	35	39	52
Future Volume (Veh/h)	46	174	166	35	39	52
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	46	174	166	35	39	52
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	201				450	184
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	201				450	184
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	97				93	94
cM capacity (veh/h)	1371				548	859

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	220	201	91
Volume Left	46	0	39
Volume Right	0	35	52
cSH	1371	1700	691
Volume to Capacity	0.03	0.12	0.13
Queue Length 95th (m)	0.8	0.0	3.5
Control Delay (s)	1.8	0.0	11.0
Lane LOS	A		B
Approach Delay (s)	1.8	0.0	11.0
Approach LOS			B

Intersection Summary			
Average Delay	2.7		
Intersection Capacity Utilization	37.9%	ICU Level of Service	A
Analysis Period (min)	60		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	209	2	1	195	3	1
Future Volume (Veh/h)	209	2	1	195	3	1
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	209	2	1	195	3	1
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			211		407	210
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			211		407	210
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	100
cM capacity (veh/h)			1360		600	830

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	211	196	4
Volume Left	0	1	3
Volume Right	2	0	1
cSH	1700	1360	644
Volume to Capacity	0.12	0.00	0.01
Queue Length 95th (m)	0.0	0.0	0.1
Control Delay (s)	0.0	0.0	10.6
Lane LOS		A	B
Approach Delay (s)	0.0	0.0	10.6
Approach LOS			B

Intersection Summary			
Average Delay		0.1	
Intersection Capacity Utilization		21.1%	ICU Level of Service A
Analysis Period (min)		60	

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	18	193	133	289	7	302	288	340
v/c Ratio	0.13	0.50	0.59	0.72	0.01	0.25	0.41	0.29
Control Delay	26.4	31.1	39.7	35.5	6.9	7.2	10.3	7.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	26.4	31.1	39.7	35.5	6.9	7.2	10.3	7.6
Queue Length 50th (m)	2.2	24.7	17.9	33.4	0.3	15.9	18.3	18.8
Queue Length 95th (m)	8.2	48.6	39.6	67.3	2.3	40.3	52.2	46.6
Internal Link Dist (m)		1027.2		1181.4		1460.0		218.0
Turn Bay Length (m)	37.5		37.5		37.5		37.5	
Base Capacity (vph)	249	670	390	660	663	1186	694	1191
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	0.07	0.29	0.34	0.44	0.01	0.25	0.41	0.29

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	18	177	16	133	158	131	7	259	43	288	307	33
Future Volume (vph)	18	177	16	133	158	131	7	259	43	288	307	33
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.93		1.00	0.98		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1860		1789	1755		1789	1843		1789	1856	
Flt Permitted	0.37	1.00		0.58	1.00		0.55	1.00		0.58	1.00	
Satd. Flow (perm)	696	1860		1089	1755		1036	1843		1085	1856	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	18	177	16	133	158	131	7	259	43	288	307	33
RTOR Reduction (vph)	0	4	0	0	38	0	0	5	0	0	4	0
Lane Group Flow (vph)	18	189	0	133	251	0	7	297	0	288	336	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	16.1	16.1		16.1	16.1		50.2	50.2		50.2	50.2	
Effective Green, g (s)	16.1	16.1		16.1	16.1		50.2	50.2		50.2	50.2	
Actuated g/C Ratio	0.21	0.21		0.21	0.21		0.64	0.64		0.64	0.64	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	143	382		223	360		664	1181		695	1189	
v/s Ratio Prot		0.10			c0.14			0.16			0.18	
v/s Ratio Perm	0.03			0.12			0.01			c0.27		
v/c Ratio	0.13	0.49		0.60	0.70		0.01	0.25		0.41	0.28	
Uniform Delay, d1	25.4	27.5		28.2	28.8		5.1	6.0		6.9	6.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.4	1.0		4.3	6.0		0.0	0.5		1.8	0.6	
Delay (s)	25.8	28.5		32.5	34.8		5.1	6.5		8.7	6.8	
Level of Service	C	C		C	C		A	A		A	A	
Approach Delay (s)		28.3			34.1			6.5			7.6	
Approach LOS		C			C			A			A	

Intersection Summary				
HCM 2000 Control Delay	17.3	HCM 2000 Level of Service	B	
HCM 2000 Volume to Capacity ratio	0.48			
Actuated Cycle Length (s)	78.3	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	72.7%	ICU Level of Service	C	
Analysis Period (min)	60			

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	596	51	5	18	61	5	9	851	9	5	387	208
Future Volume (Veh/h)	596	51	5	18	61	5	9	851	9	5	387	208
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
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
Hourly flow rate (vph)	596	51	5	18	61	5	9	851	9	5	387	208
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1410	1379	491	1405	1478	856	595			860		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1410	1379	491	1405	1478	856	595			860		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	64	99	78	51	99	99			99		
cM capacity (veh/h)	69	142	578	83	124	358	981			781		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	652	84	869	600
Volume Left	596	18	9	5
Volume Right	5	5	9	208
cSH	73	116	981	781
Volume to Capacity	8.97	0.72	0.01	0.01
Queue Length 95th (m)	Err	44.0	0.2	0.1
Control Delay (s)	Err	107.4	0.2	0.2
Lane LOS	F	F	A	A
Approach Delay (s)	Err	107.4	0.2	0.2
Approach LOS	F	F		

Intersection Summary				
Average Delay	2960.9			
Intersection Capacity Utilization	100.4%	ICU Level of Service	G	
Analysis Period (min)	60			

Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	21	435	300	899	331
v/c Ratio	0.11	0.78	0.38	0.63	0.12
Control Delay	35.0	15.3	6.1	8.3	3.4
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	35.0	15.3	6.1	8.3	3.4
Queue Length 50th (m)	3.2	0.0	11.1	45.3	4.9
Queue Length 95th (m)	10.4	43.9	44.6	169.4	15.9
Internal Link Dist (m)	48.5			580.9	293.8
Turn Bay Length (m)	37.5		180.0		
Base Capacity (vph)	478	746	786	1424	2696
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	0.04	0.58	0.38	0.63	0.12

Intersection Summary

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	21	435	300	899	323	8
Future Volume (vph)	21	435	300	899	323	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95	
Frt	1.00	0.85	1.00	1.00	1.00	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1789	1601	1789	1883	3566	
Flt Permitted	0.95	1.00	0.55	1.00	1.00	
Satd. Flow (perm)	1789	1601	1040	1883	3566	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	21	435	300	899	323	8
RTOR Reduction (vph)	0	390	0	0	1	0
Lane Group Flow (vph)	21	45	300	899	330	0
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	9.0	9.0	65.2	65.2	65.2	
Effective Green, g (s)	9.0	9.0	65.2	65.2	65.2	
Actuated g/C Ratio	0.10	0.10	0.76	0.76	0.76	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	186	167	786	1424	2697	
v/s Ratio Prot	0.01			c0.48	0.09	
v/s Ratio Perm		c0.03	0.29			
v/c Ratio	0.11	0.27	0.38	0.63	0.12	
Uniform Delay, d1	35.0	35.6	3.6	4.9	2.8	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.3	0.9	1.4	2.2	0.1	
Delay (s)	35.3	36.5	5.0	7.1	2.9	
Level of Service	D	D	A	A	A	
Approach Delay (s)	36.4			6.5	2.9	
Approach LOS	D			A	A	

Intersection Summary

HCM 2000 Control Delay	12.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	86.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	61.5%	ICU Level of Service	B
Analysis Period (min)	60		

c Critical Lane Group

LANE SUMMARY

Site: 2031 Ultimate AM

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Prince of Wales Drive South													
Lane 1	278	0.0	540	0.514	100	12.9	LOS B	4.6	31.9	Full	500	0.0	0.0
Lane 2[d]	369	0.0	719	0.514	100	10.1	LOS B	5.1	35.9	Full	500	0.0	0.0
Approach	647	0.0		0.514		11.3	LOS B	5.1	35.9				
East: Bankfield Road East													
Lane 1[d]	604	0.0	678	0.891	100	44.6	LOS D	23.5	164.2	Full	500	0.0	0.0
Lane 2	193	0.0	473	0.408	100	11.6	LOS B	3.1	21.5	Full	80	0.0	0.0
Approach	797	0.0		0.891		36.6	LOS D	23.5	164.2				
North: Prince of Wales Drive North													
Lane 1	338	0.0	734	0.460	100	6.0	LOS A	3.8	26.4	Full	500	0.0	0.0
Lane 2[d]	422	0.0	917	0.460	100	3.9	LOS A	4.0	28.1	Full	80	0.0	0.0
Approach	760	0.0		0.460		4.8	LOS A	4.0	28.1				
West: Bankfield Road West													
Lane 1[d]	460	0.0	1180	0.390	100	4.7	LOS A	3.0	20.9	Full	500	0.0	0.0
Lane 2	384	0.0	986	0.390	100	2.5	LOS A	2.8	19.7	Full	80	0.0	0.0
Approach	844	0.0		0.390		3.7	LOS A	3.0	20.9				
Intersection	3048	0.0		0.891		14.2	LOS B	23.5	164.2				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

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Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	98	167	58	351	462	32
Future Volume (Veh/h)	98	167	58	351	462	32
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	98	167	58	351	462	32
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)				242		
pX, platoon unblocked						
vC, conflicting volume	945	478	494			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	945	478	494			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	64	72	95			
cM capacity (veh/h)	275	587	1070			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	265	409	494
Volume Left	98	58	0
Volume Right	167	0	32
cSH	414	1070	1700
Volume to Capacity	0.64	0.05	0.29
Queue Length 95th (m)	38.1	1.3	0.0
Control Delay (s)	28.9	1.7	0.0
Lane LOS	D	A	
Approach Delay (s)	28.9	1.7	0.0
Approach LOS	D		

Intersection Summary			
Average Delay	7.2		
Intersection Capacity Utilization	73.6%	ICU Level of Service	D
Analysis Period (min)	60		

Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	18	563	124	949	116
v/c Ratio	0.12	0.86	0.08	0.92	0.08
Control Delay	47.4	20.7	2.5	30.0	2.9
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	47.4	20.7	2.5	30.0	2.9
Queue Length 50th (m)	3.7	0.0	2.8	98.3	3.3
Queue Length 95th (m)	11.7	#83.9	11.4	#367.0	12.2
Internal Link Dist (m)	634.3		2077.3		243.8
Turn Bay Length (m)	37.5			37.5	
Base Capacity (vph)	288	730	1484	1028	1518
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	0.06	0.77	0.08	0.92	0.08

Intersection Summary

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

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	18	563	101	23	949	116
Future Volume (vph)	18	563	101	23	949	116
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	0.85	0.97		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1789	1601	1836		1789	1883
Flt Permitted	0.95	1.00	1.00		0.68	1.00
Satd. Flow (perm)	1789	1601	1836		1276	1883
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	18	563	101	23	949	116
RTOR Reduction (vph)	0	515	4	0	0	0
Lane Group Flow (vph)	18	48	120	0	949	116
Turn Type	Prot	Perm	NA		Perm	NA
Protected Phases	8		2			6
Permitted Phases		8			6	
Actuated Green, G (s)	9.6	9.6	90.2		90.2	90.2
Effective Green, g (s)	9.6	9.6	90.2		90.2	90.2
Actuated g/C Ratio	0.09	0.09	0.81		0.81	0.81
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	153	137	1481		1029	1519
v/s Ratio Prot	0.01		0.07			0.06
v/s Ratio Perm		c0.03			c0.74	
v/c Ratio	0.12	0.35	0.08		0.92	0.08
Uniform Delay, d1	47.2	48.2	2.2		8.2	2.2
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.3	1.6	0.1		18.3	0.1
Delay (s)	47.5	49.7	2.3		26.5	2.3
Level of Service	D	D	A		C	A
Approach Delay (s)	49.7		2.3			23.9
Approach LOS	D		A			C

Intersection Summary

HCM 2000 Control Delay	30.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	111.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	78.5%	ICU Level of Service	D
Analysis Period (min)	60		

c Critical Lane Group

LANE SUMMARY

Site: 2031 Ultimate PM

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Greenbank Road South													
Lane 1	274	0.0	559	0.491	100	10.0	LOS A	4.3	29.9	Full	500	0.0	0.0
Lane 2[d]	356	0.0	724	0.491	100	6.5	LOS A	4.7	33.2	Full	80	0.0	0.0
Approach	630	0.0		0.491		8.0	LOS A	4.7	33.2				
East: Cambrian Road East													
Lane 1[d]	710	0.0	861	0.825	100	18.9	LOS B	15.7	109.6	Full	500	0.0	0.0
Lane 2	179	0.0	566	0.316	100	6.9	LOS A	2.0	14.3	Full	80	0.0	0.0
Approach	889	0.0		0.825		16.5	LOS B	15.7	109.6				
North: Greenbank Road North													
Lane 1	517	0.0	540	0.957	100	63.8	LOS E	28.1	196.7	Full	500	0.0	0.0
Lane 2[d]	673	0.0	703	0.957	100	56.9	LOS E	34.1	238.8	Full	80	0.0	100.0
Approach	1190	0.0		0.957		59.9	LOS E	34.1	238.8				
West: Cambrian Road West													
Lane 1[d]	724	0.0	752	0.962	100	60.7	LOS E	38.0	266.1	Full	500	0.0	0.0
Lane 2	357	0.0	553	0.645	100	14.9	LOS B	6.8	47.7	Full	80	0.0	0.0
Approach	1081	0.0		0.962		45.6	LOS D	38.0	266.1				
Intersection	3790	0.0		0.962		37.0	LOS D	38.0	266.1				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

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Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	50	180	237	75	45	89
Future Volume (Veh/h)	50	180	237	75	45	89
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	50	180	237	75	45	89
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	312				554	274
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	312				554	274
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	96				90	88
cM capacity (veh/h)	1248				473	764

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	230	312	134
Volume Left	50	0	45
Volume Right	0	75	89
cSH	1248	1700	633
Volume to Capacity	0.04	0.18	0.21
Queue Length 95th (m)	1.0	0.0	6.1
Control Delay (s)	2.0	0.0	12.2
Lane LOS	A		B
Approach Delay (s)	2.0	0.0	12.2
Approach LOS			B

Intersection Summary			
Average Delay		3.1	
Intersection Capacity Utilization		47.2%	ICU Level of Service A
Analysis Period (min)		60	

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	224	1	1	307	3	1
Future Volume (Veh/h)	224	1	1	307	3	1
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	224	1	1	307	3	1
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			225		534	224
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			225		534	224
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		99	100
cM capacity (veh/h)			1344		507	815

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	225	308	4
Volume Left	0	1	3
Volume Right	1	0	1
cSH	1700	1344	560
Volume to Capacity	0.13	0.00	0.01
Queue Length 95th (m)	0.0	0.0	0.2
Control Delay (s)	0.0	0.0	11.5
Lane LOS		A	B
Approach Delay (s)	0.0	0.0	11.5
Approach LOS			B

Intersection Summary			
Average Delay		0.1	
Intersection Capacity Utilization		27.0%	ICU Level of Service A
Analysis Period (min)		60	

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	12	211	160	570	27	469	229	314
v/c Ratio	0.13	0.33	0.42	0.89	0.05	0.50	0.59	0.33
Control Delay	21.9	21.1	24.4	42.3	12.7	16.0	24.4	14.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	21.9	21.1	24.4	42.3	12.7	16.0	24.4	14.2
Queue Length 50th (m)	1.3	24.1	19.3	74.4	2.2	46.9	26.3	29.5
Queue Length 95th (m)	6.1	45.9	40.8	#157.9	7.6	93.0	#75.2	58.1
Internal Link Dist (m)		1027.2		1181.4		1460.0		217.6
Turn Bay Length (m)	37.5		37.5		37.5		37.5	
Base Capacity (vph)	113	782	470	769	517	941	385	961
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	0.11	0.27	0.34	0.74	0.05	0.50	0.59	0.33

Intersection Summary

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

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	12	199	12	160	259	311	27	339	130	229	295	19
Future Volume (vph)	12	199	12	160	259	311	27	339	130	229	295	19
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	0.92		1.00	0.96		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1867		1789	1729		1789	1805		1789	1866	
Flt Permitted	0.14	1.00		0.60	1.00		0.53	1.00		0.40	1.00	
Satd. Flow (perm)	272	1867		1124	1729		1007	1805		750	1866	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	12	199	12	160	259	311	27	339	130	229	295	19
RTOR Reduction (vph)	0	3	0	0	52	0	0	14	0	0	2	0
Lane Group Flow (vph)	12	208	0	160	518	0	27	455	0	229	312	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	28.9	28.9		28.9	28.9		43.3	43.3		43.3	43.3	
Effective Green, g (s)	28.9	28.9		28.9	28.9		43.3	43.3		43.3	43.3	
Actuated g/C Ratio	0.34	0.34		0.34	0.34		0.51	0.51		0.51	0.51	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	93	640		385	593		517	928		385	959	
v/s Ratio Prot		0.11			c0.30			0.25			0.17	
v/s Ratio Perm	0.04			0.14			0.03			c0.31		
v/c Ratio	0.13	0.33		0.42	0.87		0.05	0.49		0.59	0.32	
Uniform Delay, d1	19.0	20.4		21.2	25.9		10.2	13.3		14.3	11.9	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.6	0.3		0.7	15.6		0.2	1.9		6.8	0.9	
Delay (s)	19.6	20.7		21.9	41.5		10.4	15.1		21.1	12.8	
Level of Service	B	C		C	D		B	B		C	B	
Approach Delay (s)		20.7			37.2			14.9			16.3	
Approach LOS		C			D			B			B	

Intersection Summary				
HCM 2000 Control Delay	24.1	HCM 2000 Level of Service	C	
HCM 2000 Volume to Capacity ratio	0.71			
Actuated Cycle Length (s)	84.2	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	95.3%	ICU Level of Service	F	
Analysis Period (min)	60			

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	322	98	5	8	77	5	5	486	31	5	839	641
Future Volume (Veh/h)	322	98	5	8	77	5	5	486	31	5	839	641
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
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
Hourly flow rate (vph)	322	98	5	8	77	5	5	486	31	5	839	641
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1724	1696	1160	1735	2002	502	1480			517		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1724	1696	1160	1735	2002	502	1480			517		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	0	98	0	0	99	99			100		
cM capacity (veh/h)	0	91	238	0	59	570	455			1049		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	425	90	522	1485
Volume Left	322	8	5	5
Volume Right	5	5	31	641
cSH	0	0	455	1049
Volume to Capacity	Err	Err	0.01	0.00
Queue Length 95th (m)	Err	Err	0.3	0.1
Control Delay (s)	Err	Err	0.3	0.3
Lane LOS	F	F	A	A
Approach Delay (s)	Err	Err	0.3	0.3
Approach LOS	F	F		

Intersection Summary			
Average Delay	Err		
Intersection Capacity Utilization	123.2%	ICU Level of Service	H
Analysis Period (min)	60		

Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	5	466	487	468	1030
v/c Ratio	0.03	0.82	0.78	0.31	0.60
Control Delay	42.2	18.4	25.5	4.1	24.2
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	42.2	18.4	25.5	4.1	24.2
Queue Length 50th (m)	1.0	0.0	46.5	15.4	71.4
Queue Length 95th (m)	4.8	53.9	#130.6	58.1	#170.4
Internal Link Dist (m)	48.5			580.9	293.8
Turn Bay Length (m)	37.5		180.0		
Base Capacity (vph)	407	724	750	1500	1723
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	0.01	0.64	0.65	0.31	0.60

Intersection Summary

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

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	5	466	487	468	1018	12
Future Volume (vph)	5	466	487	468	1018	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95	
Frt	1.00	0.85	1.00	1.00	1.00	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1789	1601	1789	1883	3572	
Flt Permitted	0.95	1.00	0.16	1.00	1.00	
Satd. Flow (perm)	1789	1601	308	1883	3572	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	5	466	487	468	1018	12
RTOR Reduction (vph)	0	425	0	0	1	0
Lane Group Flow (vph)	5	41	487	468	1029	0
Turn Type	Prot	Perm	pm+pt	NA	NA	
Protected Phases	4		5	2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	9.4	9.4	84.2	84.2	51.0	
Effective Green, g (s)	9.4	9.4	84.2	84.2	51.0	
Actuated g/C Ratio	0.09	0.09	0.80	0.80	0.48	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	159	142	627	1501	1725	
v/s Ratio Prot	0.00		c0.20	0.25	0.29	
v/s Ratio Perm		c0.03	c0.42			
v/c Ratio	0.03	0.29	0.78	0.31	0.60	
Uniform Delay, d1	43.9	45.0	19.3	2.9	19.8	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1	1.1	6.3	0.5	1.5	
Delay (s)	44.0	46.1	25.6	3.4	21.4	
Level of Service	D	D	C	A	C	
Approach Delay (s)	46.1			14.7	21.4	
Approach LOS	D			B	C	

Intersection Summary

HCM 2000 Control Delay	23.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	105.6	Sum of lost time (s)	18.0
Intersection Capacity Utilization	74.7%	ICU Level of Service	D
Analysis Period (min)	60		

c Critical Lane Group

LANE SUMMARY

Site: 2031 Ultimate PM

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Prince of Wales Drive South													
Lane 1	177	0.0	347	0.511	100	21.5	LOS C	4.6	32.0	Full	500	0.0	0.0
Lane 2[d]	245	0.0	479	0.511	100	17.2	LOS B	5.4	37.6	Full	500	0.0	0.0
Approach	422	0.0		0.511		19.0	LOS B	5.4	37.6				
East: Bankfield Road East													
Lane 1[d]	524	0.0	882	0.594	100	8.4	LOS A	6.5	45.4	Full	500	0.0	0.0
Lane 2	166	0.0	609	0.272	100	6.5	LOS A	1.7	12.1	Full	80	0.0	0.0
Approach	690	0.0		0.594		7.9	LOS A	6.5	45.4				
North: Prince of Wales Drive North													
Lane 1	666	0.0	833	0.800	100	12.4	LOS B	12.4	87.1	Full	500	0.0	0.0
Lane 2[d]	818	0.0	1023	0.800	100	9.6	LOS A	13.4	93.7	Full	80	0.0	9.9
Approach	1484	0.0		0.800		10.8	LOS B	13.4	93.7				
West: Bankfield Road West													
Lane 1	419	0.0	496	0.844	100	38.1	LOS D	14.1	98.6	Full	500	0.0	0.0
Lane 2[d]	556	0.0	658	0.844	100	30.5	LOS C	17.0	118.8	Full	80	0.0	18.2
Approach	975	0.0		0.844		33.8	LOS C	17.0	118.8				
Intersection	3571	0.0		0.844		17.5	LOS B	17.0	118.8				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

SIDRA INTERSECTION 6.1 | Copyright © 2000-2015 Akcelik and Associates Pty Ltd | sidrasolutions.com
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Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	54	90	159	500	454	97
Future Volume (Veh/h)	54	90	159	500	454	97
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	54	90	159	500	454	97
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)				242		
pX, platoon unblocked	0.91					
vC, conflicting volume	1320	502	551			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1303	502	551			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	60	84	84			
cM capacity (veh/h)	136	569	1019			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	144	659	551
Volume Left	54	159	0
Volume Right	90	0	97
cSH	260	1019	1700
Volume to Capacity	0.55	0.16	0.32
Queue Length 95th (m)	26.8	4.2	0.0
Control Delay (s)	35.8	3.8	0.0
Lane LOS	E	A	
Approach Delay (s)	35.8	3.8	0.0
Approach LOS	E		

Intersection Summary			
Average Delay	5.6		
Intersection Capacity Utilization	83.4%	ICU Level of Service	E
Analysis Period (min)	60		

C.10 2031 ULTIMATE – WITH IMPROVEMENTS

LANE SUMMARY

Site: 2031 Ultimate AM - Mods

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Greenbank Road South													
Lane 1	397	0.0	559	0.710	100	21.7	LOS C	8.7	61.0	Full	500	0.0	0.0
Lane 2[d]	526	0.0	741	0.710	100	16.9	LOS B	10.2	71.2	Full	80	0.0	1.7
Approach	923	0.0		0.710		19.0	LOS B	10.2	71.2				
East: Cambrian Road East													
Lane 1	219	0.0	457	0.479	100	14.5	LOS B	4.1	28.7	Full	500	0.0	0.0
Lane 2[d]	295	0.0	616	0.479	100	10.9	LOS B	4.7	32.6	Full	80	0.0	0.0
Approach	514	0.0		0.479		12.4	LOS B	4.7	32.6				
North: Greenbank Road North													
Lane 1	221	0.0	782	0.282	100	5.4	LOS A	1.9	13.1	Full	500	0.0	0.0
Lane 2[d]	277	0.0	982	0.282	100	3.5	LOS A	2.1	14.4	Full	80	0.0	0.0
Approach	498	0.0		0.282		4.4	LOS A	2.1	14.4				
West: Cambrian Road West													
Lane 1	439	0.0	1005	0.437	100	4.7	LOS A	3.2	22.3	Full	500	0.0	0.0
Lane 2[d]	525	0.0	1203	0.437	100	2.2	LOS A	3.4	23.6	Full	80	0.0	0.0
Approach	964	0.0		0.437		3.3	LOS A	3.4	23.6				
Intersection	2899	0.0		0.710		10.1	LOS B	10.2	71.2				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

LANE SUMMARY

Site: 2031 Ultimate PM - Mods

Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Greenbank Road South													
Lane 1	274	0.0	611	0.449	100	9.2	LOS A	3.6	25.3	Full	500	0.0	0.0
Lane 2[d]	356	0.0	792	0.449	100	5.8	LOS A	3.9	27.6	Full	80	0.0	0.0
Approach	630	0.0		0.449		7.3	LOS A	3.9	27.6				
East: Cambrian Road East													
Lane 1	389	0.0	675	0.576	100	10.7	LOS B	5.5	38.7	Full	500	0.0	0.0
Lane 2[d]	500	0.0	868	0.576	100	7.8	LOS A	6.1	42.7	Full	80	0.0	0.0
Approach	889	0.0		0.576		9.1	LOS A	6.1	42.7				
North: Greenbank Road North													
Lane 1	517	0.0	596	0.867	100	32.4	LOS C	16.5	115.4	Full	500	0.0	0.0
Lane 2[d]	673	0.0	777	0.867	100	27.6	LOS C	19.4	136.0	Full	500	0.0	0.0
Approach	1190	0.0		0.867		29.7	LOS C	19.4	136.0				
West: Cambrian Road West													
Lane 1	469	0.0	576	0.814	100	26.8	LOS C	12.7	88.6	Full	500	0.0	0.0
Lane 2[d]	612	0.0	752	0.814	100	21.6	LOS C	14.8	103.8	Full	80	0.0	13.3
Approach	1081	0.0		0.814		23.8	LOS C	14.8	103.8				
Intersection	3790	0.0		0.867		19.5	LOS B	19.4	136.0				

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

Appendix D MULTI-MODAL LEVEL OF SERVICE ASSESSMENT

Road Segment Multi-Modal Level of Service Evaluation Table

SEGMENT		REALIGNED GREENBANK		KILBIRNIE	EAST - WEST COLLECTOR	RIVER MIST
		DUNDONALD TO KILBIRNIE	KILBIRNIE TO BARNSDALE			
Pedestrian	Sidewalk Width	2	2	1.8	1.8	1.8
	Boulevard Width	> 2.0	> 2.0	>2	>2	>2
	AADT	>3000	>3000	>3000	>3000	>3000
	On-Street Parking	no	no	yes	yes	yes
	Operating Speeds	> 60	> 60	30 - 50	30 - 50	30 - 50
	Level of Service	**D**	**D**	**B**	**B**	**B**
Cyclist	Type of Bikeway	Separated	Separated	Separated	Separated	Separated
	Level of Service	**A**	**A**	**A**	**A**	**A**
Transit	Facility Type	Segregated ROW	Mixed Traffic	N/A	Mixed Traffic	Mixed Traffic
	Parking / Driveways	N/A	Limited	N/A	Frequent	Frequent
	Level of Service	**A**	**D**	**N/A**	**F**	**F**
Auto	Capacity (AADT)			8000	8000	8000
	Volumes (AADT)			6500	4000	8000
	v/c			0.81	0.50	1.00
	Level of Service	**N/A**	**N/A**	**D**	**A**	**F**