

SAPPERTON & MASSEY VICTORY HEIGHTS TRANSPORTATION PLAN

JUNE 2018

FINAL REPORT

NEW WESTMINSTER

McElhanney

Acknowledgements

- City of New Westminster Mayor and Council
- City of New Westminster Advisory Committees
    - Neighbourhood Traffic Advisory Committee
    - Advisory Committee for Transit, Bicycles and Pedestrians
    - Access Ability Advisory Committee
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- McElhanney Consulting Services Ltd.
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- BC Trucking Association
- BC Ambulance Service
- Fraser Health Authority staff
- Community Working Group Members
- Local residents and business owners

PROJECT DELIVERABLE

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Executive Summary

The City's Master Transportation Plan (MTP) provides a framework to guide transportation policies, priorities and investments over the next 25 years in the following areas:

- Walkability;
- Cycling;
- Transit;
- Local and regional travel through the City, including regional goods movement;
- Great streets;
- Neighbourhood liveability; and
- Programs and policies that encourage walking, cycling, and transit, and reduce reliance on the automobile.

In line with the MTP, one of the main goals of this Sapperton/ Massey-Victory Heights Transportation Plan (the Plan) is to enhance the multimodal transportation system throughout the study area, thereby providing better travel mode choices and improvements that can be sustained for years to come. Traffic calming and improved safety are equally important goals, with the objective being "to keep the right traffic on the right roads". Traffic analysis revealed that the current network is already congested, with some problem intersections that cannot be addressed with typical capacity improvement upgrades alone. Given the extent of ongoing and future development in the area, in particular the expansion of the Royal Columbia Hospital (RCH) which will attract even more regional traffic to the area, the analysis of future traffic shows the situation will only get worse, emphasising the need for multimodal solutions, as well as parking strategies to help reduce the impact of this development growth on the local community.

To help achieve these goals, evaluation criteria were developed against which proposed improvements could be measured, and which criteria also addressed the comments and concerns of the City and residents of the study neighbourhoods heard during the consultation events. While it is evident that improvements are necessary to improve the transportation system, there was also an awareness that "restrictions beget restrictions" – in other words, movement restrictions need to be implemented with caution as they might only relocate the problem trying to be addressed, thereby forcing additional restrictions, and so on. This scenario does not serve the local community who tend to then become limited in their own flexibility of movement. The improvements however do need to be measurable to evaluate their success (or failure). *Table 7-2*, in *Section 7* presents each improvement or intervention proposed in the Plan and which evaluation criteria each satisfies, noting that Cost Efficiency applies to all measures. In the table, improvement themes are prioritized as follows, based on the community's feedback during the engagement process:

1. Traffic Calming Improvements
2. Intersection and Roadway Improvements
3. Improved Parking Management
4. Bicycle and Pedestrian Improvements
5. Transit Improvements

There are several multimodal network improvement measures identified in this Plan that will benefit the community in the short-term. Some of these quick-win measures are within the City's sole jurisdiction and can be implemented once funding is available. Other measures will require further community and stakeholder engagement and a funding strategy, possibly partnering with agencies such as TransLink and the Insurance Corporation of BC (ICBC). In addition, developers are also a source of funding based on their developments' contributions to growth in traffic and local intersection improvements adjacent to particular developments. From an overall network perspective, development funding is also required to help achieve the desired shift out of Single Occupant Vehicles to lessen the growth in vehicle traffic by contributing to the multimodal network improvements.

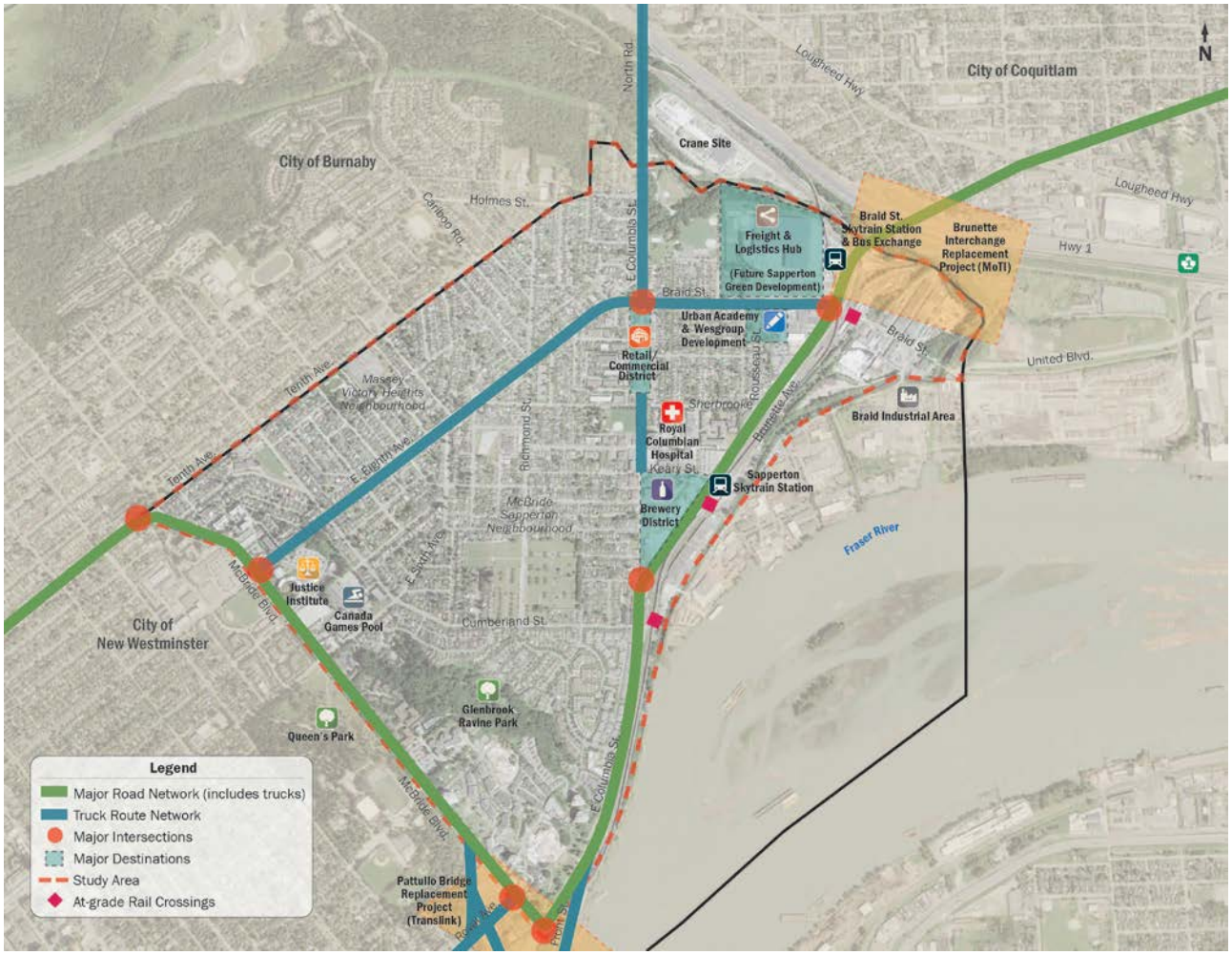
Table 8-1 in *Section 8* details the improvement measures identified in this Plan with possible timing, and also indicates those measures which require further engagement with either other agencies or the community, or both, prior to moving forward. The timing is influenced to some degree by the developments expected to be completed in the area, which timing is also shown in the table. Given the study area's already congested transportation network, these developments do not necessarily serve as 'triggers' for many of these proposed improvement measures, however where they do, this has also been shown.

Importantly, the study findings indicate that the Sapperton area requires a regional solution to address its current and future traffic congestion challenges. The scale of new development and the expansion of RCH are too vast for their traffic impacts to be managed simply by shifting travellers from private vehicles to other modes such as walking, cycling and transit. While these alternative modes will provide some relief, a regional network solution to reduce the amount of through traffic will likely provide the ultimate solution for the local community. Such a solution is beyond the jurisdiction or responsibility of the City and will require regional partners such as the Ministry of Transportation and Infrastructure (MoTI), TransLink, and the Port of Vancouver, as well as neighbouring municipalities. These regional agencies' interests will primarily be driven by the need to improve the efficiency of goods movement through the Sapperton area, given its geographic proximity to major regional infrastructure, namely the Brunette Interchange at Highway 1, the Pattullo Bridge and the Queensborough Bridge / Highway 91A. Such a regional solution is also in line with the Memorandum of Understanding (MOU) signed between the Fraser Health Authority, MoTI and the City.

1. Study Context

The City of New Westminster (the City) is located in the heart of the Metro Vancouver region and is the historical capital of British Columbia. It is constrained geographically by the Fraser River to the south and east, with heavy rail and trucking corridors following the river bank. This Plan will focus on two of the neighbourhoods within the City, notably Sapperton and Massey-Victory Heights. *Figure 1-1* shows the study area and its proximity to key regional infrastructure, as well as the area's primary road network, major intersections and development nodes.

Figure 1-1 The City of New Westminster and Study Area



1.1. Purpose and Content

The City's Master Transportation Plan (MTP) provides a framework to guide transportation policies, priorities and investments over the next 25 years, including:

- Walkability,
- Cycling,
- Transit,
- Local and regional travel through the City, including regional goods movement,
- Great streets,
- Neighbourhood liveability, and
- Programs and policies that encourage walking, cycling, and transit, and reduce reliance on the automobile.

Sapperton was identified in the Master Transportation Plan as a key neighbourhood for advancing policies related to walking, cycling, transit, Great Streets and neighbourhood liveability. As such, the goal of the Sapperton/ Massey-Victory Heights Transportation Plan (the Plan) is to establish a sustainable transportation plan (including a traffic calming plan), consistent with the City's MTP and Official Community Plan (OCP), with a focus on the safety and liveability of the community. For the purposes of the Plan, "Sapperton" includes the communities located within Sapperton, Massey-Victory Heights, and Victoria Hill.

A key driver of the need for this Plan is the substantial amount of property development taking place and planned to take place in the area. The most significant of these include:

- Royal Columbian Hospital expansion,
- Sapperton Green,
- Brewery District, and
- 100 Braid Street (Urban Academy)

Anchored by the Royal Columbian Hospital (RCH) expansion, the City has been working on an initiative to develop an IDEA Centre (formerly known as the Economic Health Care Cluster or EHCC) since January 2015. The Centre builds upon the strengths of a major health care anchor with a wide variety of advanced specialties, leading health education institutions and related research and development activities to create the highest quality health care environment and promote economic development in the City.

In addition, the area is severely impacted by regional through traffic, influenced by the Pattullo Bridge to the south, Brunette Interchange at Highway 1 to the north-east and the Highway 91A / Queensborough Bridge to the west. These traffic confluence points cause significant peak period congestion in the study area, negatively impacting local residents' liveability and hampering both local and regional transportation efficiency. Combining a growing economy with the planned future land development, Pattullo Bridge replacement, and Brunette Interchange replacement, it is important for the City to get ahead of these growing impacts and proactively understand and manage these where possible. This will also help the City respond to regional partners leading some of the broader initiatives affecting the City.

The key qualities of a successfully planned neighbourhood include: designated and efficient routes for regional traffic that maintains flows and discourages through cutting; transit oriented, traffic calmed local neighbourhoods where walking, cycling and transit are viable, attractive and safe, and where driving is a last resort; good multimodal connectivity to other parts of the City. The key elements of this Plan therefore include the following:

Traffic Volumes

- Efficient regional connections
- Through traffic on designated routes
- Intersection / signal timing improvements
- Objective to remove 8th Ave & E. Columbia St. from truck route network

Vehicle Speeds

- Integrated neighbourhood traffic calming plan
- Designate emergency routes
- Safe speed limits

Transit

- Improved bus service and frequency in evening/ off peak
- Improved bus facilities
- Better SkyTrain station accessibility

Walking & Cycling

- More / improved crosswalks
- Wider sidewalks and curb extensions
- Centre medians and pedestrian refuges
- Better greenway and Riverfront connectivity
- Bike routes that avoid the steepest grades

TRANSPORTATION DEMAND MANAGEMENT

- Reduced car ownership
- Reduced motor vehicle use
- Fraser Health to increase and promote TDM amongst RCH employees
- City to promote TDM measures in the community

Development

- Embrace opportunities for public art
- Manage impact of development on the transportation network
- Manage impacts of development on parking

Enforcement

- Speed enforcement
- Increased enforcement by Commercial Vehicle Unit (truck routes)
- Parking Bylaw enforcement

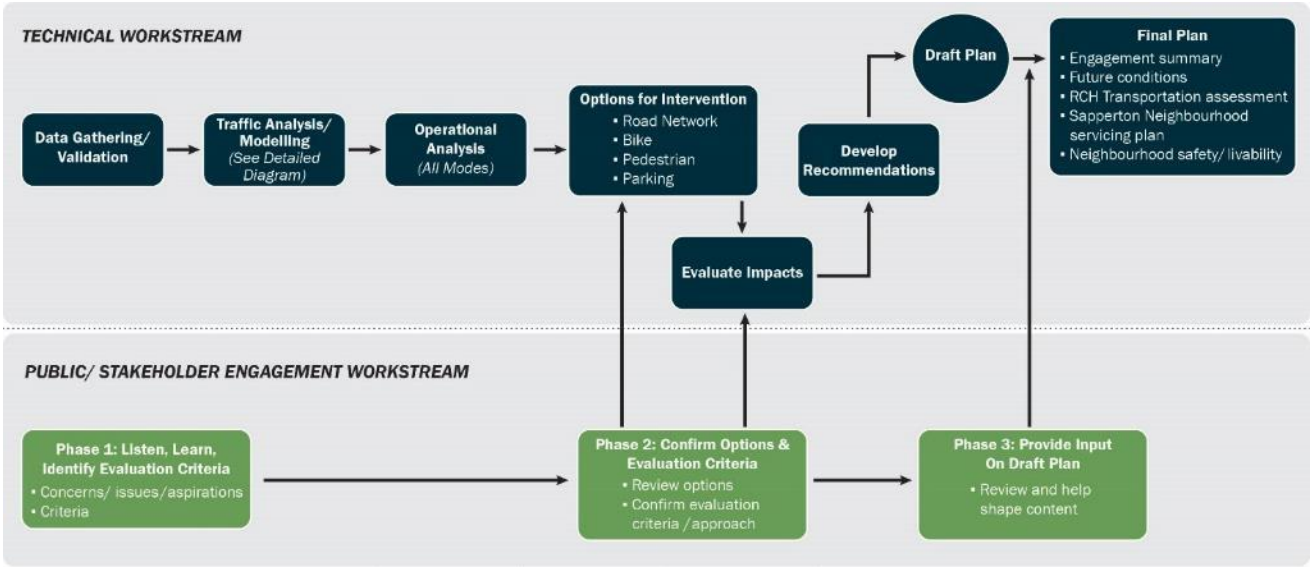
Parking

- RCH staff, patient, visitor, and service provider parking to be accommodated on site
- Manage parking as a system
- Balance between residential, institutional, and commercial needs

1.2. Study Process

Recognizing that the affected community is characterized by high levels of engagement with clear views and opinions and a desire to be involved, the Plan's preparation included two parallel work streams, as set out in *Figure 1-2*: a Technical Work stream and a Public Stakeholder Engagement Work stream. As shown, interfaces between these parallel work streams occurred at key project stages.

Figure 1-2 Interface between Technical and Engagement Work streams



1.3. Community Engagement

In addition to the technical data gathering, analysis and traffic modelling which underpins the Plan, the project also included a significant stakeholder and community engagement component. Public engagement was undertaken in three phases:

- Phase 1 – Listen and Learn and Development of Evaluation Criteria
- Phase 2 – Confirmation of Evaluation Criteria and Presentation of Options
- Phase 3 – Input on the Draft Plan

During the Phase 1 community workshop (held on October 16, 2016) the study team heard about peoples' transportation concerns and what participants value most about the area. Building on that and based on further technical analysis, the project team developed a set of evaluation criteria and identified potential intervention options. As part of the Phase 2 engagement, feedback was sought on these options via a community workshop (held on April 8, 2017) and by means of an online community survey hosted on the City's project website. Based on inputs received and further technical analysis a draft Plan was prepared which was the subject of two Open House sessions held on June 8, 2017 with a second session held in September geared toward Massey-Victory Heights neighbourhood.

The outcomes from each of the three phases of consultation are contained in three reports provided in *Appendix A*. These community inputs guided decision-making in selecting from alternative options developed to address community and City issues and concerns in the area, and underpinned the recommendations contained in this Plan.

In the survey undertaken as part of the Phase 3 consultation, when the draft plan was presented to the public, respondents ranked the Plan elements in the following order of priority:

1. Traffic Calming Improvements
2. Intersection and Roadway Improvements
3. Improved Parking Management
4. Bicycle and Pedestrian Improvements
5. Transit Improvements

1.4. Evaluation Criteria

One of the main goals of this Plan is to enhance the multimodal transportation system throughout the study area, and provide improvements that can be sustained for years to come. To this end, evaluation criteria were developed that specifically addressed the comments and concerns of the residents and the City. Additionally, improvements need to be measurable to evaluate the success (or failure) of the improvements. *Table 1-1* presents the evaluation criteria, the primary measure used to evaluate the alignment between proposed interventions and the evaluation criteria, and key considerations. Key considerations reflect issues raised during discussions with the community and which provide a view on the types of interventions being considered. These criteria were developed and approved by residents and the City early in the project process.

Table 1-1 Evaluation Criteria

Evaluation Criteria		Evaluation Measure [1]	Key Considerations
1	Improved safety and perception of safety	**Vehicle speeds** o Vehicle speeds at or below posted limits o Number, frequency, and severity of vehicle collisions	Perceived vehicle speed is as important as actual speed especially if walking and cycling is to be promoted. Requires interventions that make people feel safe (e.g. traffic calming, separation between modes).
2	Enhanced liveability	**Traffic volumes by type** o Noise and emissions [2] from traffic o Mix of compatible land uses	Need also to consider appropriate commercial loading routes, areas and times for businesses, including RCH deliveries.
3	Reduced reliance on private vehicles	**Mode share** (compared to OCP Transit usage goals) o Access to alternative mobility options (bus, SkyTrain, cycling and walking) across the community o Car share	Requires implementation of Travel Demand Management (TDM) strategies for RCH and other major employers, e.g. transit passes, showers, secure bike parking, rideshare, car share parking on-site, other incentives.
4	Balance between on-street parking supply and demand	**Parking stall occupancy rates ~ 85%** o Availability of on-street parking for residents and businesses	Designated parking areas for appropriate users. Appropriate pricing for all users (meters, on-site lots, resident permits). Reduced impact of employee parking on-street by businesses and institutions actively managing their parking needs, either by providing sufficient on-site parking or by adopting TDM measures.

Evaluation Criteria		Evaluation Measure [1]	Key Considerations
5	Superior walkability	**Safe, comfortable and convenient pedestrian connections between key destinations (transit, retail, local amenities etc.)** o "Popsicle" Test: proportion of households who would permit a Grade 5 child to walk from home to the local store to purchase a "popsicle", or walk to/from school.	Provision of sidewalks/paths, separation of vehicle and pedestrians, safe pedestrian crossings, lighting, flat grades (where possible) in the design concepts.
6	Bike access for all ages and abilities (AAA)	**Safe, comfortable and convenient cycling corridors between key destinations (transit, retail, local amenities etc.)**	Integration of local routes into the regional network. End of trip facilities for cycling, including secure parking (covered and uncovered). Grades of <10%.
7	A match between traffic type and road classification	**Proportion of through traffic on local streets**	The goal in the MTP is less than 1,000 vehicles on local streets. Road classification should include consideration of the appropriate types of traffic permitted (e.g. through traffic, trucks, vehicles, transit, bikes, pedestrians). Requires integrated approach to implementation of traffic calming measures.
8	Reduced delay at key intersections and along key corridors	**Improved travel time reliability, levels of service, a reduction in delay per vehicle, and lower volume to capacity ratios on key corridors and at key intersections**	Improvements to corridors and intersections resulting in improved flexibility and maneuverability along key corridors. There will be no net increase in City-wide capacity.
9	Strengthening and respecting the identity and history of the Sapperton neighbourhood	**Interventions acknowledge the importance of the history of the Sapperton neighbourhood and are scaled to respect the character and liveability of the area**	Scale of interventions is important
10	Cost efficiency	**Number / quality of benefits accrued relative to investment required**	Focus on maximizing benefits from investment
11	Fair distribution of benefits	**Project prioritization to ensure that benefits are distributed throughout the study area**	Individual neighbourhoods should also not benefit at the expense of others

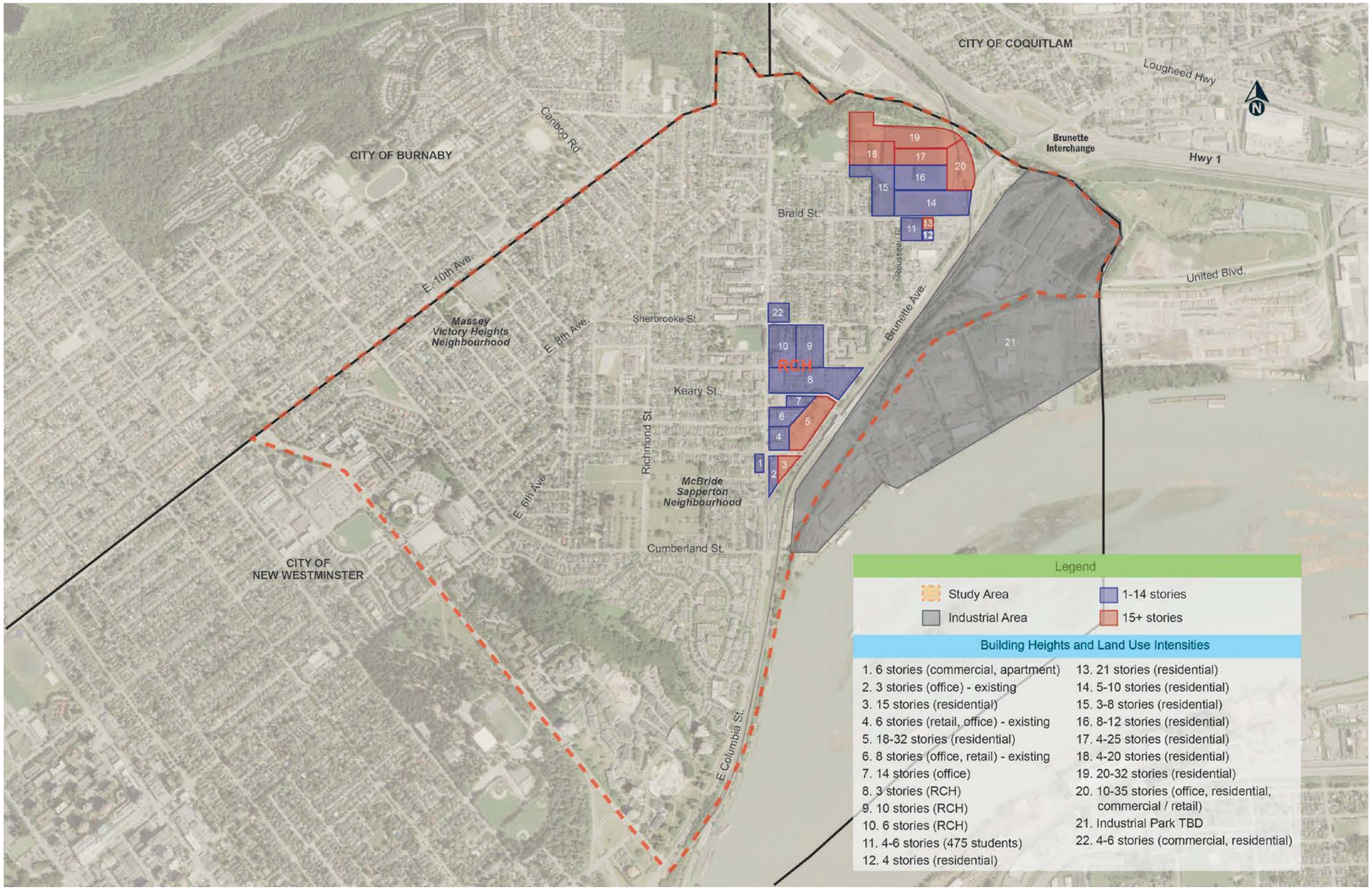
Notes:

1. The measures identified in **bold** are the primary measures which were used to evaluate the alignment between proposed interventions and the evaluation criteria during plan preparation.
2. Volumes (including heavy vehicles) may be used as proxy for emissions and noise in planning stage

1.5. Sapperton Development Areas

The Sapperton area is expected to experience significant growth in employment, services, and population over the next 25 years. The location and proposed building heights of each current and future development is presented in *Figure 1-3* and each development is briefly described below.

Figure 1-3 Location of Current and Future Developments



1.5.1. Royal Columbian Hospital Redevelopment

Figure 1-4 Proposed RCH Development



Source: Fraser Health Authority

The Fraser Health Authority (FHA) is undergoing a $1.3 billion-dollar redevelopment of the Royal Columbian Hospital (RCH) (*see* Figure 1-4). The Royal Columbian Hospital is increasing its capacity to support the significant increase in patient volumes, as well as the by-products of this growth seen in recent years and expected by 2025 as our aging population grows. In order to achieve this expansion, the City, FHA, and Ministry of Transportation and Infrastructure (MOTI) have signed a Memorandum of Understanding (MOU) to seek ways to address traffic congestion on Brunette Avenue and to provide better emergency and regional access to the facility. Phase 1 construction began in 2017 and will continue through 2019, including a utility corridor that will surround the entire hospital. Rezoning for the hospital is planned to occur in early 2019 after engaging with the community on a variety of transportation and other issues. Phase two is set to get underway from 2020-2024, and phase three from 2023-2026 following City Council approval of the Rezoning Application (*Figure 1-5)*.

Figure 1-5 Proposed RCH Development Phases - Renderings



Source: Fraser Health Authority

The redevelopment of Royal Columbian Hospital will spur the need for additional medical and office related uses close to the hospital. In response to this, the City embarked on the development of the IDEA Centre Strategy.

1.5.2. Brewery District

Figure 1-6 Proposed Brewery District Redevelopment - Renderings



Source: WesGroup Properties

The Brewery District is a nine acre, master-planned, transit-oriented development, previously home to the Labatt's Brewery. The development is adjacent to the Sapperton SkyTrain Station and the RCH. The site offers 1.4 million square feet of buildable area within eight planned buildings (six have been completed or are under construction). The Brewery District consists of four major uses:

- Office – over 600,000 sq.ft.
- Retail – 140,000 sq.ft.
- Residential – 650-750 units
- Health – 65,000 sq.ft. (health practitioners, health education and health services)

The three completed buildings are:

- Building One (completed 2013)
  - 29,000 sq.ft. of ground floor retail with 236,000 sq.ft. of office space above
  - Tenants include: TransLink, Transit Police, Shoppers Drug Mart, Brown's Social House, Starbucks, Kids & Company
- Building Two (completed 2010)
  - 48,000 sq.ft. of ground floor retail and 60,000 sq.ft. of strata office above
  - Tenants include: Save On Foods, TD Canada Trust, Take 5 Café, Freshii, BC Biomedical Laboratories, and Metro West Insurance
- Building Three (completed 2014)
  - 28,000 sq.ft. for Health Sciences Association
- Building Four (completed 2017)
  - 99,336 sq.ft.; 15-storey residential tower

Additionally, at the time of writing, buildings five (123,933 sq. ft; 18 storey), and six (206,345 sq. ft; 25 storey) were under construction, with two more buildings (Seven and Eight) yet to be developed.

1.5.3. East Columbia Street Developments

In addition to RCH and the Brewery District, several other developments are planned along East Columbia Street. As one of New Westminster's Great Streets, East Columbia Street is a diverse corridor that is well connected to local and regional transit, contains a diverse range of uses and is poised to be an important employment and residential hub for the city.

Figure 1-7 406-412 E Columbia Development



Source: I4 Property Group

One such development located at 406-412 E. Columbia Street went to Public Hearing in April 2018, consisting of 10,000 square feet of ground floor retail, 16,000 square feet of second floor office, and 4-storeys of market rental apartments (72 units). The development comes complete with end-of-trip cycling facilities, electric vehicle charging stations and is located within 400m walking distance from Sapperton SkyTrain Station.

1.5.4. 100 Braid Street (Urban Academy and WesGroup Development)

Figure 1-8 WesGroup Properties and Urban Academy Development



Source: WesGroup Properties & Urban Academy

The recently approved 100 Braid Street development that is now under construction involved demolishing the existing uses on the site and construct a K-12 private school (for 476 students). The existing Urban Academy schools on 3rd Street (junior campus) and 8th Avenue (senior campus) in the City would both relocate to the new location.

The development also proposes to construct a new residential tower consisting of approximately 225 strata units.

1.5.5. Sapperton Green

Sapperton Green is a sustainable and transit-oriented master-planned community that is located on a 38-acre site adjacent to the Highway 1 / Brunette Interchange, Hume Park, the Brunette River, and the Braid SkyTrain station. It is planned as a mixed-use development which includes 150,000 sq. ft. of retail commercial, 750,000 to 1.5 million sq. ft. of office space, and 3.4 million sq. ft. of residential floor space. The site location and proposed layout plan are shown on Figure 1-9. This is a unique site in the region due to its size and proximity to a variety of transportation infrastructure. It is also near to natural, ecological and recreation amenities, including Hume Park, regional greenways, and the Brunette River. The Sapperton Green website provides information on the consultation that has been undertaken to date. This site is run by the applicant's planning consultants, Brook Pooni.

Figure 1-9 Sapperton Redevelopment



Source: QuadReal Property Group

1.5.6. New West Aquatics & Community Centre

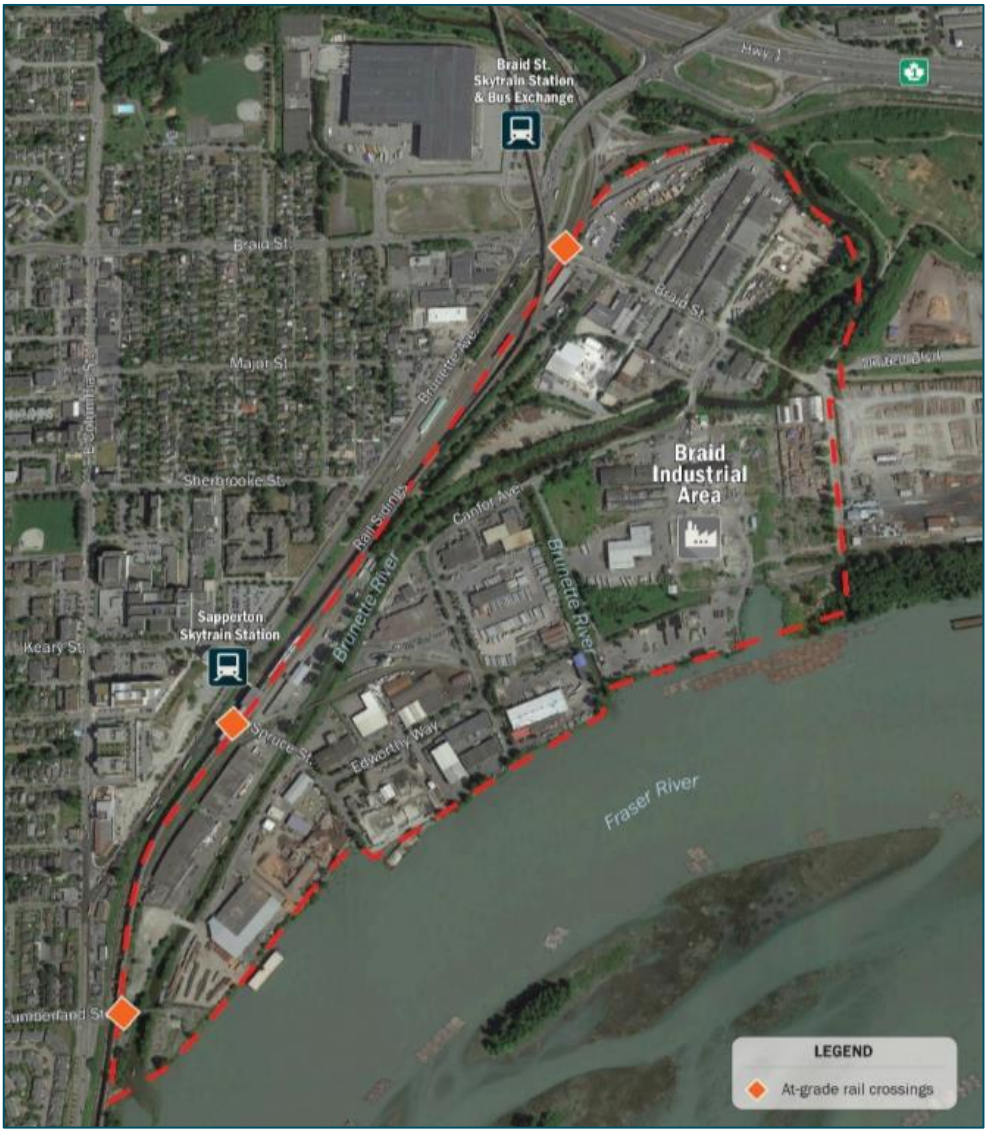
The Canada Games Pool is a community pool and fitness facility owned and operated by the City. It was constructed in 1972 and has undergone a series of changes and partial upgrades over time. However, many of the building systems are approaching the end of their expected service life and, in 2016 the City asked the community and stakeholders to weigh-in about the future of the Pool and Centennial Community Centre. As a result, a feasibility study was commissioned in 2017 to assess the budget and programming priorities. As this work was not underway or completed in time to inform the Plan, some assumptions were made to account for future growth on the site. The preferred layout for the site based upon the feasibility study is illustrated in figure 1-10 below.

Figure 1-10 New West Aquatics Centre Concept



1.5.7. Braid Industrial Area

Figure 1-11 Braid Industrial Area



Source: City of New Westminster & HCMA Architecture + Design

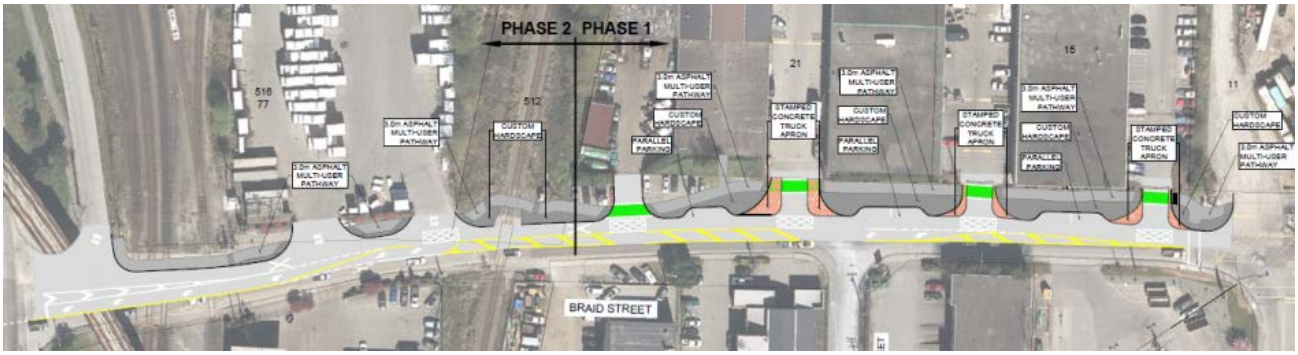
The Braid Industrial Area (BIA) is an area located on the east side of New Westminster, bordered by Brunette Avenue, the rail corridor, and the Brunette River to the west; the Fraser River and City of Coquitlam to the east; and Highway 1 to the north. This piece of land is particularly significant given the shortage of industrial land in Metro Vancouver, as well as its substantial industrial water frontage onto the Fraser River, thereby offering Port related opportunities. The Port of Vancouver has indicated a desire to better utilize these lands to further grow the region's economy. Current land uses include both heavy and light industry; however, the area is characterized by limited road access, with access restricted to Braid Street and United Boulevard to the north and Spruce Street to the southwest, as shown on *Figure 1-11.* Both Spruce Street and the west of Braid Street have at-grade rail crossings, with there being five sets of tracks on Braid Street. Due to the train repositioning that occurs at the Braid Street crossings, traffic delays can be several minutes, causing traffic congestion on Braid Street and especially on Brunette Avenue. Although the Braid Street SkyTrain station is in close proximity to the industrial area, poor pedestrian connectivity to the station and utilization by the industrial area has traditionally been relatively low.

1.5.8. Other Projects/ Areas of Significance

1.5.8.1. Braid Street Section of the Brunette Fraser Regional Greenway

During 2017, the City began constructing Phase 1 of the Braid Street section of the Brunette Fraser Regional Greenway as part of the Canada 150 Program. The Multi-Use Path between Brunette Avenue and Canfor Avenue fills a significant gap in the regional Greenway network, providing a safe, comfortable and convenient path along this section of Braid Street. Phase 1 was completed in early 2018, with phase 2 beginning later in 2018.

Figure 1-12 Braid Street Section of Brunette Fraser Regional Greenway



Source: City of New Westminster & ISL Engineering

1.5.8.2. Victoria Hill

The Victoria Hill Mixed Use Neighbourhood provides a mix of housing forms, as well as commercial, employment, institutional and park spaces. As it nears full buildout, new residents & businesses have raised their concerns about the supply of on-street parking in the community.

In response to the concerns raised, the City will be assessing parking supply and demand in the community. The information gathered through community engagement and technical analysis in 2018 will be used to develop options to address on-street parking in the community.

1.5.8.3. Pattullo Bridge Replacement Project

TransLink led the Pattullo Bridge Replacement Project through its conceptual development and planning phases. In 2018, the Province took over the project and will fund and build the replacement bridge. Upon completion, the Province will own and operate the new Pattullo Bridge. The Pattullo Bridge is a key connection between the communities of Surrey and New Westminster. The new four-lane Pattullo Bridge will provide important improvements for everyone utilising the bridge, including people who are driving, cycling or walking, as well as communities on either side of the bridge, including:

- A safer crossing for all bridge users with modern, wider lanes, separated by a centre median barrier
- Dedicated walking and cycling lanes, separated from traffic by a median on both sides of the bridge
- Better connections to, from and near the bridge

Construction is targeted to begin in the summer of 2019 and the new bridge will open in 2023. Once the new bridge is open, the existing bridge will be removed, with a complete cost estimate of $1.377 billion and be delivered, funded and owned by the Province of B.C.

Figure 1-13 Pattullo Bridge Redevelopment

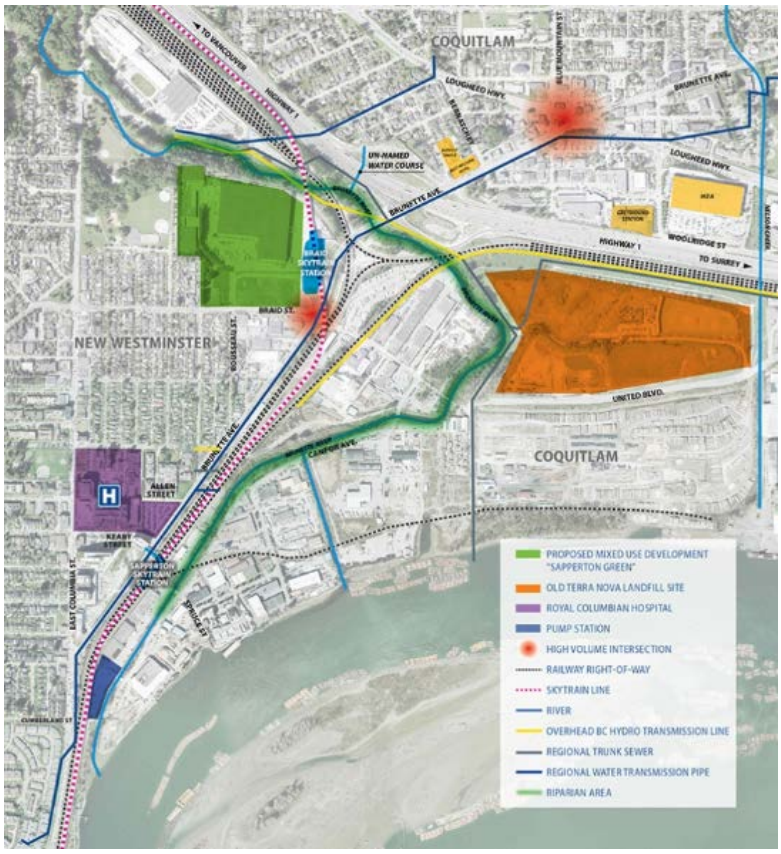


Source: TransLink

1.5.8.4. Brunette Interchange Project

Located on Highway 1, the Brunette Avenue interchange is heavily used by highway traffic headed for Coquitlam and New Westminster. It also serves as a key local connection between these municipalities. The interchange also serves cyclists and pedestrians along Brunette Avenue, especially those accessing the Braid Street SkyTrain Station. Finally, it is the primary interchange for commercial vehicles travelling between Highway 1 and Lougheed Highway in Coquitlam and Brunette Avenue in New Westminster.

Figure 1-14 Brunette Interchange Project



Source: Ministry of Transportation & Infrastructure

Improving the Brunette overpass is critical for moving people and goods in this area and for private and emergency vehicles accessing Royal Columbian Hospital. Currently, this interchange is often a bottleneck on the Highway 1 corridor, especially at peak times. The BC Government is looking at options to clear the bottleneck and keep people and goods moving efficiently again.

In November and December 2016, there was an online survey and 4 open houses held to gather public feedback on the proposed options. Since this time, there have been no further developments on the project.

In response to the work being undertaken by the Ministry of Transportation & Infrastructure (MOTI), the City has prepared a Position Paper in November 2016 that sets out the City's perspective on the planning that has been conducted to date and the options being offered for public comment. The paper is available on the City's website.

2. Existing Transportation Network

Table 2-1 presents the general roadway characteristics in the study area, while *Figure 2-1* to *Figure 2-3* present the existing intersection signal or stop control and lane geometry of each of the study intersections.

Table 2-1 Functional Classification of Roadways

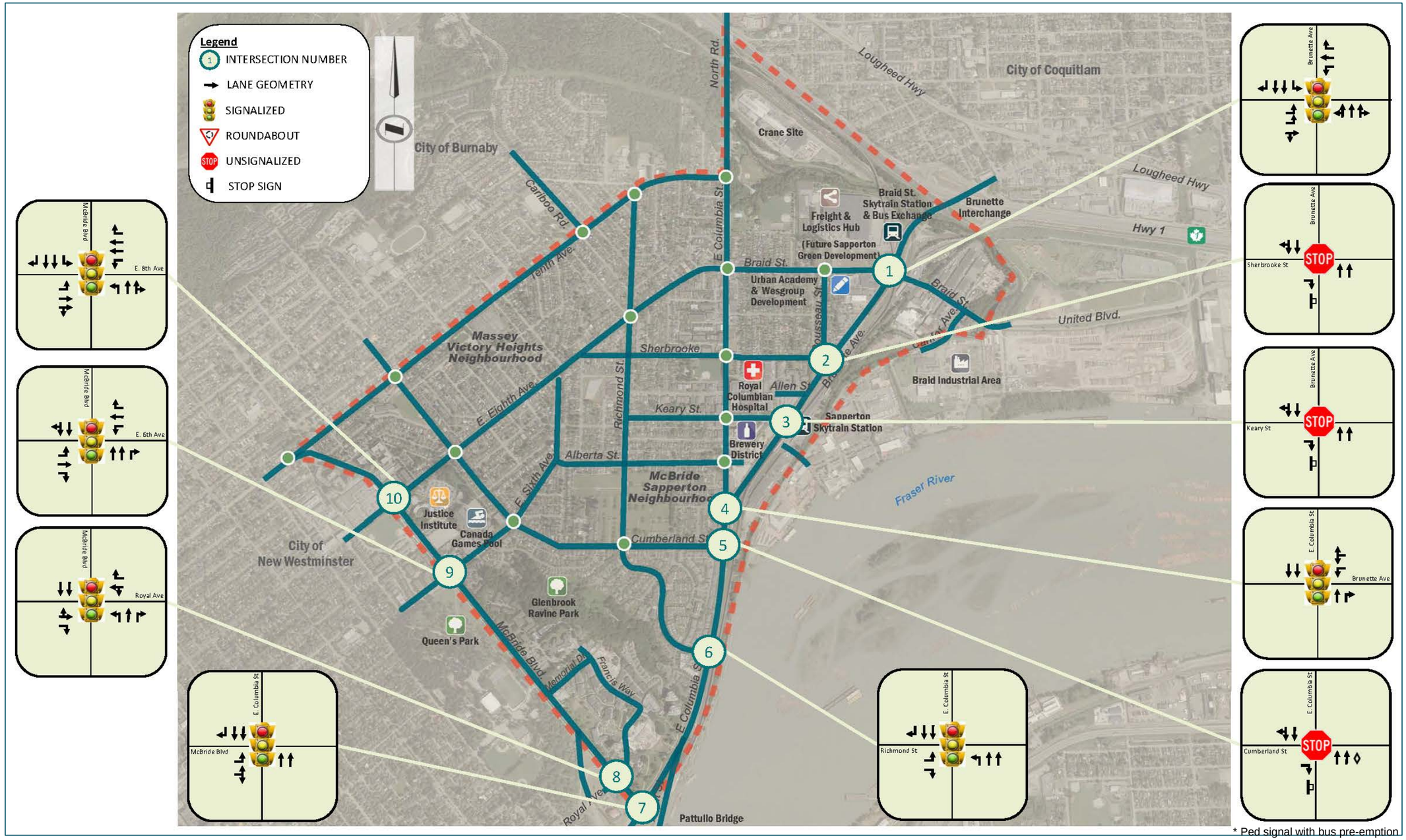
Roadway	Classification [1]	Number of Lanes (both directions)
Brunette Avenue	Major Road Network (Truck Route)	3 to 4
McBride Boulevard	Major Road Network (Truck Route)	4
Royal Avenue	Major Road Network (Truck Route)	4
Front Street	Arterial (Truck Route)	2
North Road	City Collector/ Arterial [2] (Truck Route)	4
E. Columbia Street	Major Road Network (Brunette to McBride Blvd.); City Collector (partial Truck Route)	2 to 4
E. Sixth Avenue	City Collector	2
E. Eighth Avenue	City Collector (time restricted Truck Route)	2 to 4
Tenth Avenue	City Collector	2 to 4
Braid Street	City Collector; Local (partial Truck Route)	2 to 4
Holmes Street	Neighbourhood Collector / Collector [2]	2
Cariboo Road	Collector [2]	2
Cumberland Street	Local (except between Richmond St and E. Sixth Ave where it is a City Collector)	2
Richmond Street	Local (except between Cumberland St and E. Columbia St where it is a City Collector)	2

Notes:

1. Based on the City of New Westminster MTP
2. Based on City of Burnaby Transportation Plan

The City's Master Transportation Plan outlines the City's desire to remove the Truck Route Designation from both E. Columbia Street (Brunette to Braid Street) and E. Eighth Avenue in the future, however since these are currently part of the regional truck route network and require TransLink approval. The Pattullo Bridge Replacement could be the trigger for the re-evaluation of the truck route designation on these corridors.

Figure 2-1 Study Intersections (# 1 to # 10) - Intersection Control and Lane Geometry



* Ped signal with bus pre-emption

Figure 2-2 Study Intersections (# 11 to # 20) - Intersection Control and Lane Geometry

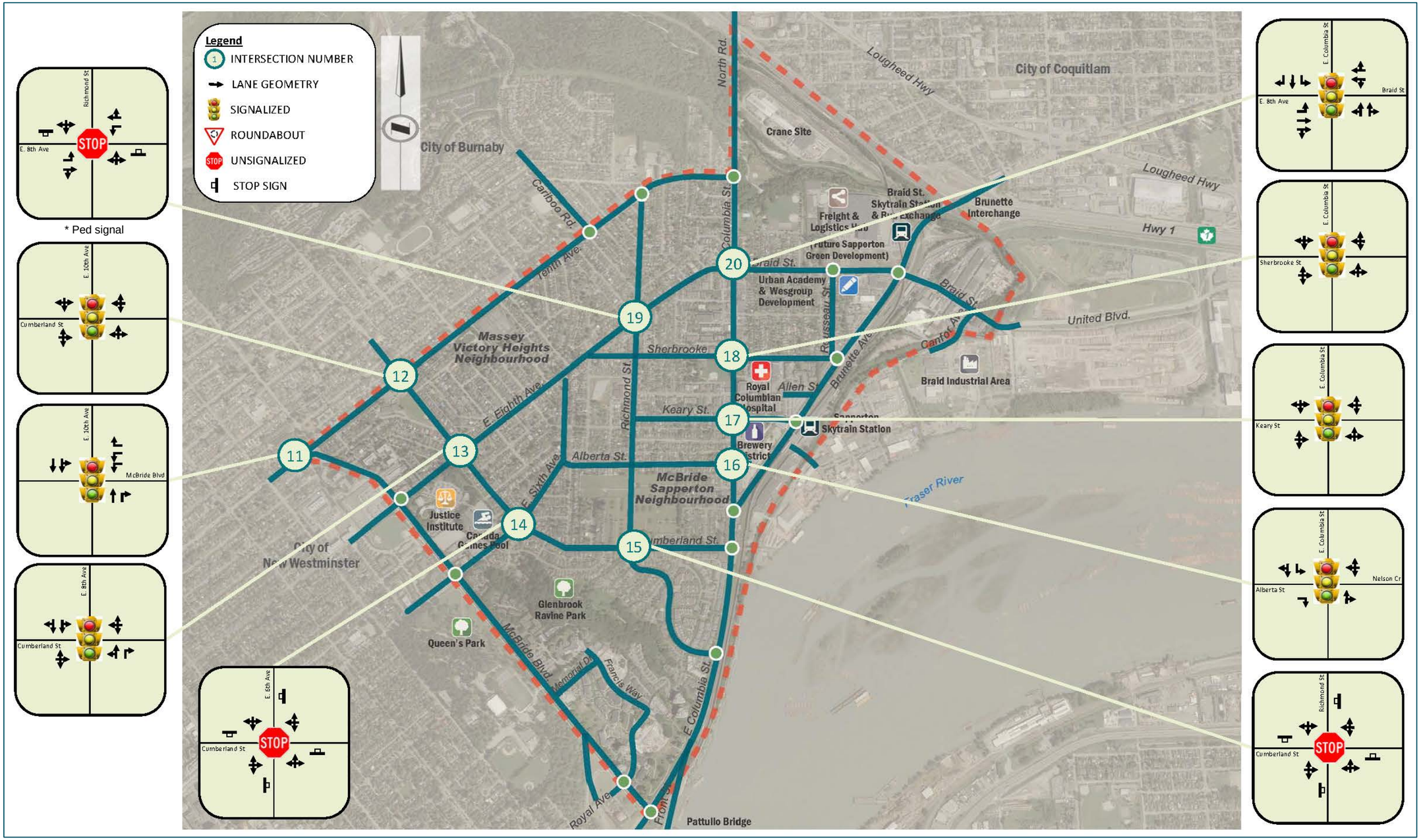
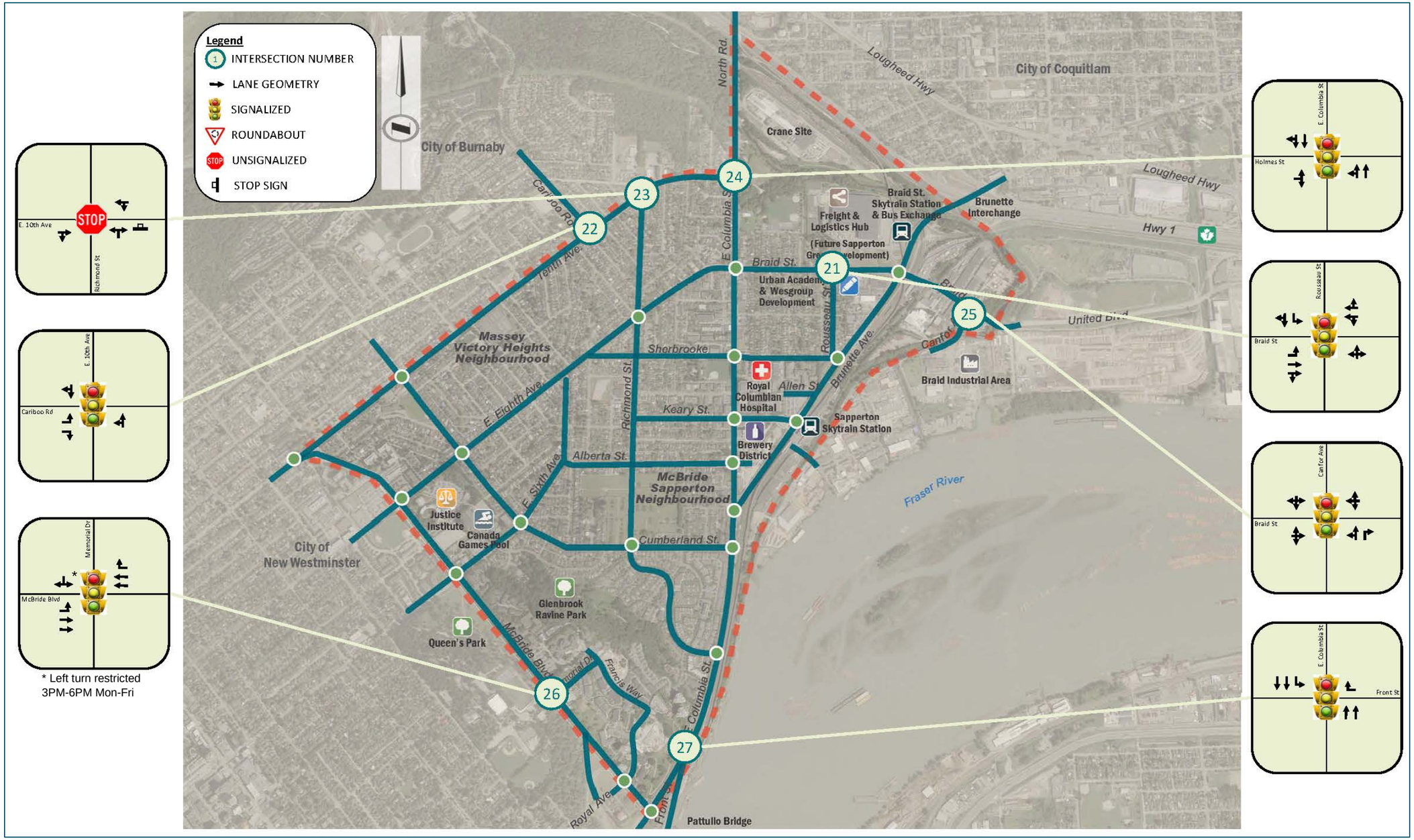


Figure 2-3 Study Intersections (# 21 to # 27) - Intersection Control and Lane Geometry



3. Traffic Volumes

3.1. Existing 2016 Traffic Volumes

A significant data collection effort was undertaken to develop roadway and intersection volumes for the study area. The AM and PM weekday peak hour traffic volumes (which include heavy vehicles) were provided by the City and the City of Burnaby. *Table 3-1* provides a list of all the intersection count locations, the type of intersection control (i.e. signal, side-street stop, all-way stop, roundabout, etc.), and the intersection count date.

Table 3-1 Intersection Count Locations

Intersection ID	Intersection Name	Count Date	Control
1	Brunette Ave / Braid St	Oct 2013	Signal
2	Brunette Ave / Sherbrooke St	Nov 2013	Side-street stop
3	Brunette Ave / Spruce St / Keary St	Nov 2013	Side-street stop
4	E. Columbia St / Brunette Ave / Debeck St	Jun 2013	Signal
5	E. Columbia St / Cumberland St	Feb 2017	Side-street stop
6	E. Columbia St / Richmond St	Feb 2017	Signal
7	E. Columbia St / McBride Blvd	May 2013	Signal
8	Royal Ave / McBride Blvd	Oct 2016	Signal
9	E. Sixth Ave / McBride Blvd	Feb 2017	Signal
10	E. Eighth Ave / McBride Blvd	Feb 2017	Signal
11	E. Tenth Ave / McBride Blvd	Feb 2017	Signal
12	E. Tenth Ave / Cumberland St	Jun 2015	Signal
13	E. Eighth Ave / Cumberland St	Oct 2008	Signal
14	E. Sixth Ave / Cumberland St	Nov 2016	All-way stop
15	Richmond St / Cumberland St	Feb 2017	All-way stop
16	E. Columbia St / Alberta St	Dec 2016	Signal
17	E. Columbia St / Keary St	Nov 2013	Signal
18	E. Columbia St / Sherbrooke St	Nov 2013	Signal
19	Richmond St / E. Eighth Ave	Feb 2017	Side-street stop
20	E. Columbia St / Braid St / E. Eighth Ave	Jun 2013	Signal
21	Rousseau St / Braid St	Nov 2013	Signal
22	E. Tenth Ave / Cariboo Rd	Jun 2015	Signal
23	Richmond St / E. Tenth Ave	Feb 2017	Side-street stop
24	E Columbia St / Holmes St	Feb 2017	Signal
25	Canfor Ave / Braid St	Feb 2017	Signal
26	Memorial Drive / McBride Blvd	Nov 2014	Signal
27	E Columbia St / Front St	Jun 2013	Signal

For traffic analysis consistency, an existing condition month and year was established. For purposes of this analysis October 2016 was chosen as the existing condition as it represents a "typical" month during the year (i.e. school is in session, holidays are minimal, vacation time is small, there is not an influx of people entering the area for vacation, etc.).

It should be noted that the data available, and assessment undertaken was undertaken under the premise of the tolls still in place on a number of river crossings (prior to Provincial election and toll removal in 2017).

As shown in *Table 3-1*, counts were collected in different years and during different months. To convert volumes to the existing condition (i.e. October 2016), factors (yearly and monthly) were developed based on data from permanent count stations at the three major bridges surrounding New Westminster (Queensborough, Pattullo, and Port Mann).

To develop the annual growth rate, the last two to three years of traffic volume data from the Queensborough and Pattullo Bridges was utilized. On average, these locations experienced a growth rate of 2.0% per year. Typically, the last five years or longer of traffic data is used to develop a trend. However, longer historical data was not available at either bridge. Additionally, the Port Mann Bridge was not included as it did not represent the volume growth patterns expected in the region. There was significant year to year changes due to construction, rerouting, introduction of a toll and the traffic ramp up as vehicles returned to the facility over time, and post construction. Therefore, for counts prior to 2016, the intersection volumes were increased by 2.0% per year compounded annually.

Monthly Average Daily Traffic (MADT) factors were computed from the three bridge locations and a blended average was calculated to determine the monthly factors. These factors were then normalized to October, as shown in *Table 3-2*. These normalized monthly factors were used to convert all intersection counts to the equivalent October volume by dividing the traffic count by the factor corresponding to the month the traffic count data was collected. As shown, during summer months, when volumes are typically higher than the annual average, the monthly factor is greater than one (1) and will result in a reduction of the count volume. Conversely, during winter months, when volumes are typically lower, the monthly factor is less than one (1) and result in an increase of the count volume.

Table 3-2 Normalized Monthly Factors

Month	Factor
January	0.92
February	0.95
March	0.96
April	0.99
May	1.00
June	1.02
July	1.02
August	1.01
September	1.01
October	1.00
November	0.98
December	0.96

Volume balancing was performed throughout the study area, where necessary, to adjust locations with unexplained significant increases or decreases. Existing Conditions 2016 AM and PM peak hour traffic volumes at the key intersections are summarized on *Figure 3-1* to *Figure 3-3*. A summary of both the raw traffic count volumes and the final adjusted volumes can be found in *Appendix B*. It should be noted that the raw volumes for the peak hour are for the study area and not the peak hour of each intersection. The peak hour of the study area for the morning peak was determined to be 7:30 to 8:30 AM and for the evening peak 4:00 to 5:00 PM.

Figure 3-1 Existing (Year 2016) Traffic Volumes

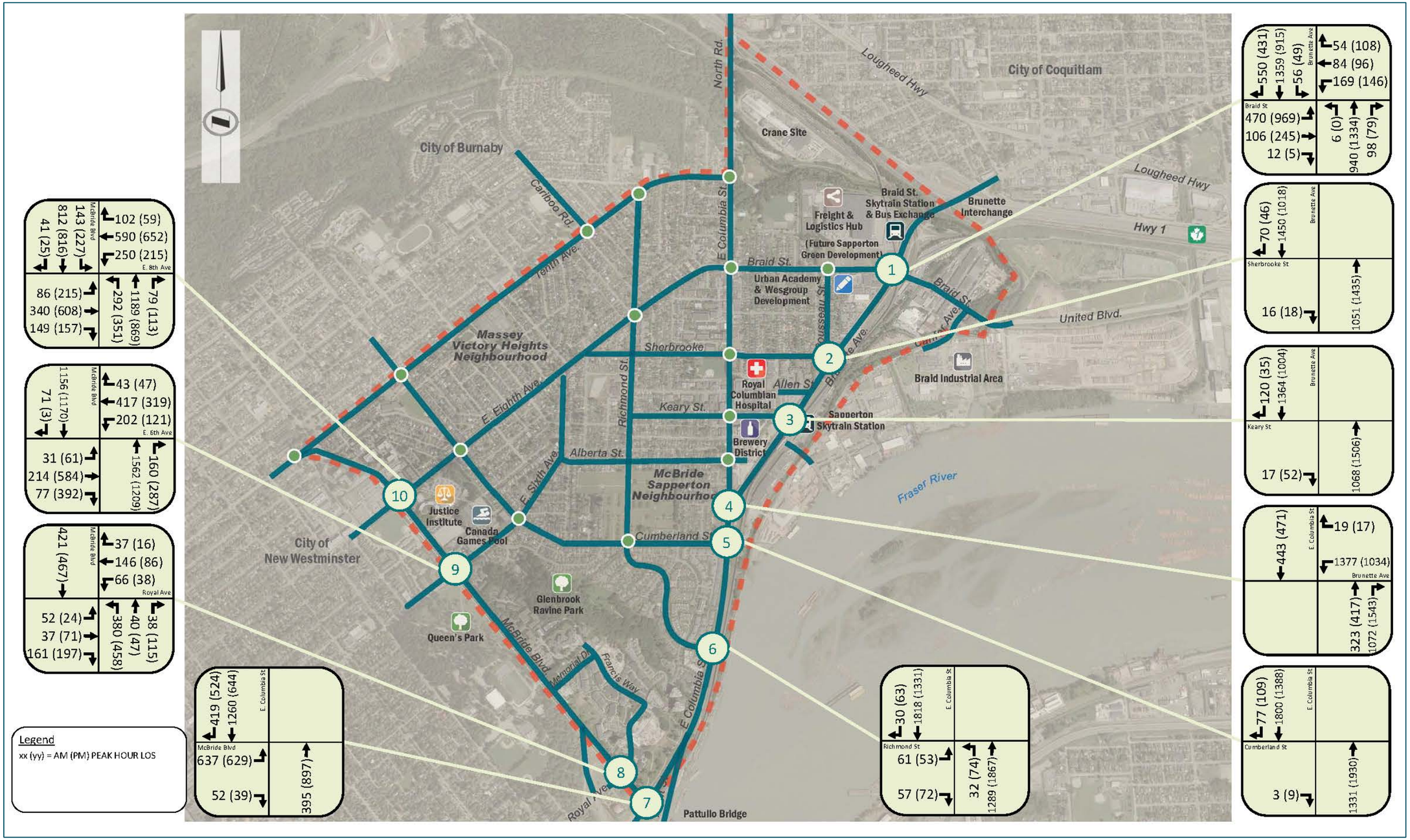


Figure 3-2 Existing (Year 2016) Traffic Volumes

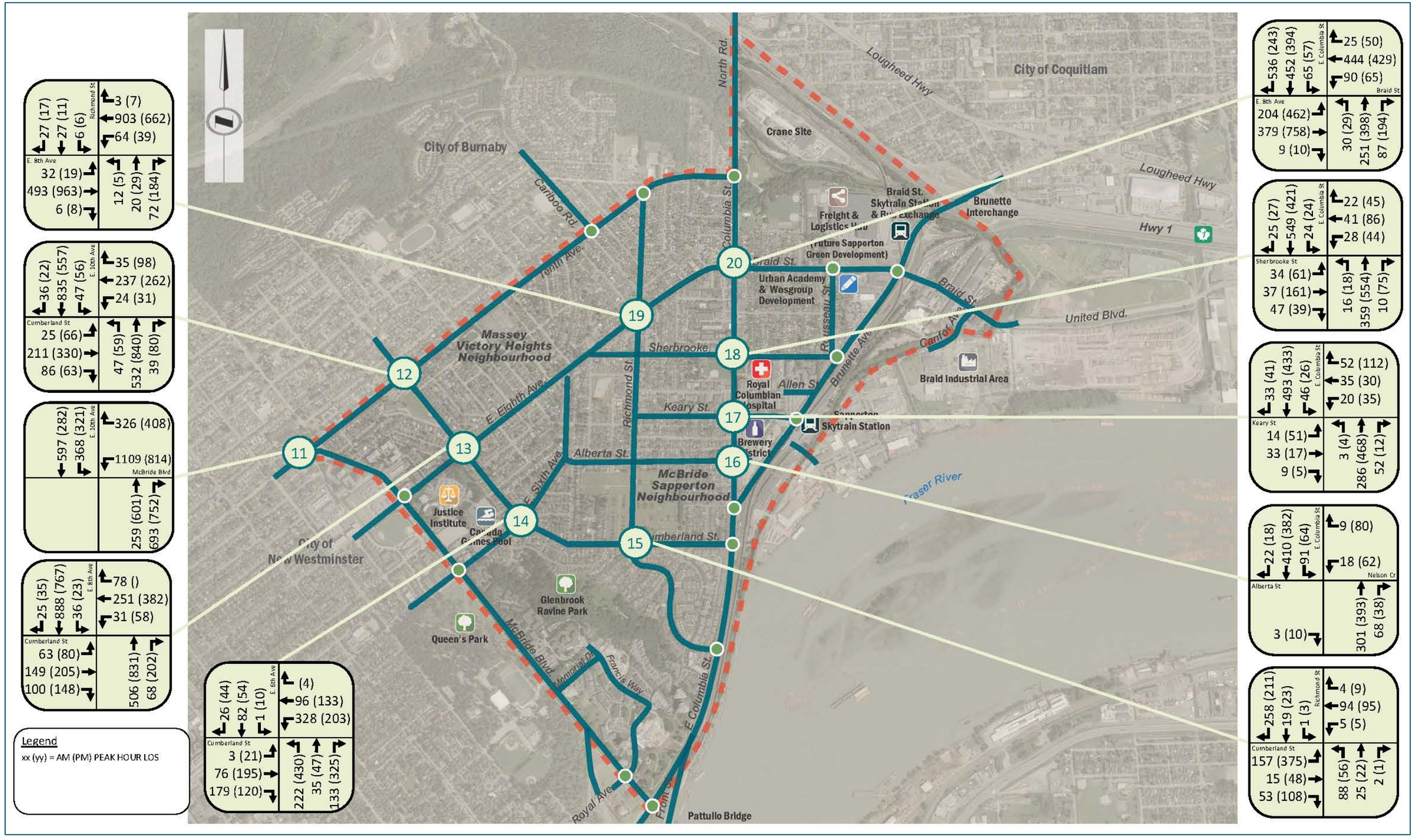


Figure 3-3 Existing (Year 2016) Traffic Volumes



3.2. Future Traffic Volumes (Year 2042)

To develop traffic volumes 25 years into the future (2042), and when full build-out of land development is anticipated, the recently validated demand sub-area model (EMME) developed as part of the Braid Industrial Area Corridor (BIAC) regional network study was used to first validate existing base traffic volumes. This model has undergone extensive validation in terms of vehicle volumes and travel times along key corridors for prior evaluations and assignments in and around the study area. The model was further validated for the Sapperton study area using existing traffic counts at key intersections.

The future base EMME network from the sub-area model was used and updated for the future development build out. Additional network changes were only related to the Pattullo Bridge replacement and reconfiguration of the ramps to access to the new bridge. Since the ultimate design of the Brunette Avenue interchange was unknown (and still has not been decided) at the time of the modelling effort, it remained in its current configuration.

The future land use from the Regional Growth Strategy (RGS) was presented to the City for review, which included future population and employment totals for all zones in New Westminster. This gave the City the opportunity to ensure the land use associated with their vision and Official Community Plan (OCP) was incorporated into the model. The updated totals provided by the City were input into the EMME model and a series of model runs were completed to calculate growth for network links and turning movements in the study area.

To determine the future traffic volumes at each of the study intersections, an extensive process was undertaken that took the existing counts and applied the growth from the EMME model (between existing and build-out). Future Year 2042 AM and PM peak hour traffic volumes at the key intersections are summarized on *Figure 3-4* to *Figure 3-6*. A model validation report is provided in *Appendix C* that demonstrates the model's representation of existing conditions, thereby giving greater confidence in the future forecasted outputs.

Figure 3-4 Future (Year 2042) Full Build-Out Traffic Volumes

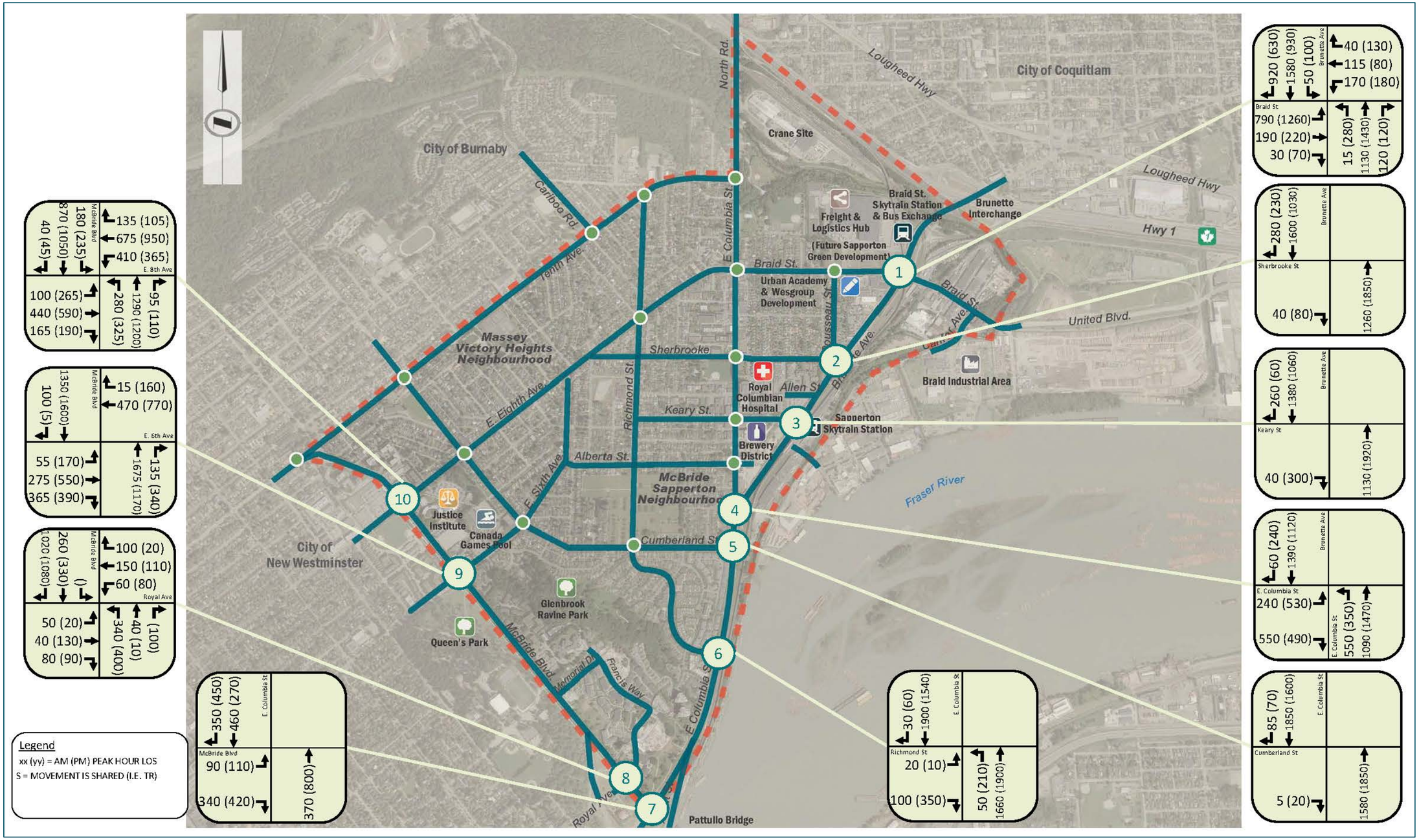


Figure 3-5 Future (Year 2042) Full Build-Out Traffic Volumes



Figure 3-6 Future (Year 2042) Full Build-Out Traffic Volumes



3.3. Development Contribution to Traffic Growth

As stated above, future year traffic volumes were developed based on future employment and population forecasts in the EMME model traffic zones (including all proposed development within the Study Area). While this gives a general volume trend on a macroscopic roadway (link) level, it is not appropriate when trying to determine the volume at a microscopic intersection (turning movement) level. Since the proposed land use is known for each development (i.e. square footage and number of units), to determine the development generated traffic volume at the intersection level, a trip generation / distribution analysis was undertaken to determine how many trips could be expected at each intersection. In turn, this analysis will inform the degree to which each development contributes to the additional traffic at each intersection.

3.3.1. Trip Generation

Land Use Types and Densities

Land use types and densities for subject developments are based on information provided by the City in 2016. Updates or modifications to these statistics may have occurred between when the data was supplied and the final report being prepared, however they are not accounted for in this analysis given the technical need to fix a point in time. The location of each development is shown on *Figure 1-3*, while the land use types and densities are summarized in *Table 3-3*. In the table, the development number refers to the number on *Figure 1-3*.

Table 3-3 Land Use Types and Densities Summary

Development	Size (DU = Dwelling Unit, SF = Square Feet)	ITE Land Use Code and Classification	Anticipated Horizon
Royal Columbian Hospital (RCH) (8, 9, 10)	348 *NEW* beds and associated facilities 75,500 SF out-patient and support facilities	610: Hospital 720: Medical -Dental Office	**10 Year Horizon:** Phase 1 – Mental Health Centre Phase 2 – New Acute Tower Phase 3 – potential for 50 overflow beds; expanded out-patient services
Brewery District (2 to 7)	Building 4 – Residential Strata: 114 DU	232: High-Rise Condominium / Townhouse 222: High Rise Apartment (for Building 5 rental units) 710: General Office Building	**10 Year Horizon:** Buildings 4-6 **Full Build-out:** Buildings 7-8
	Building 5 – Residential Strata: 90 DU Rental: 90 DU		
	Building 6 – Residential Strata: 232 DU		
	Building 7 – Residential Strata: 285 DU		
	Building 8 – Office: 300,000 SF		
408-412 East Columbia Street (22)	Retail: 7,000 SF	826: Specialty Retail 230: Condominium / Townhouse 710: General Office Building	**10 Year Horizon:** Complete development
	Residential: 60 DU		
	Office: 11,520 SF		
145-201 East Columbia Street (1)	Retail: 8,809 SF	826: Specialty Retail 220: Apartment	**10 Year Horizon:** Complete development
	Residential: 71 DU		

Development	Size (DU = Dwelling Unit, SF = Square Feet)	ITE Land Use Code and Classification	Anticipated Horizon
100 Braid Street: Urban Academy & WesGroup Residential Development (11, 12, 13)	Private School K-12: **476 Students** *Previous studies were based on 450 students; however, the UA program identifies: - JK: 16 students - K and 1: 16 students, 2 classes (32 students per grade) - 2 through 12: 18 students, 2 classes (36 students per grade)	536: Private School (K-12) 232: High-Rise Condominium / Townhouse	**10 Year Horizon:** Urban Academy **Full Build-out:** WesGroup Residential Development
	Residential Strata: 225 DU		
Sapperton Green (14 to 20)	Office:794 KSF	710: General Office Building 820: Shopping Center 222: High Rise Apartment (rental) 230: Condominium / Townhouse	**10 Year Horizon:** 10% of residential and 25% of office **Full Build-out:** 75% of residential, 100% of office, and 100% of retail
	Commercial: 75.9 KSF		
	High-Rise Apartment: 1,850 DU		
	High-Rise Condominium / Townhouse: 1,850 DU		
Canada Games Pool Redevelopment (not yet confirmed)	Condominium / Townhouse: 25 DU	230: Condominium / Townhouse 220: Apartment	**10 Year Horizon:** Complete development
	Mid to high-rise apartments: 100 DU		
Industrial Area	N/A	N/A	N/A

Trip Generation Rates

Project trip generation refers to the process of estimating the amount of vehicular traffic a project would add to the surrounding roadway system. The total amount of traffic entering and exiting project driveways is calculated for an average weekday, then separate estimates are created for the peak one-hour period during the morning and evening commute (AM and PM peak hour) when traffic volumes on the surrounding streets are highest. Project traffic includes both new traffic generated by the project and traffic that would already be on the adjacent roadways, where the driver decides to stop at the site (referred to as “pass-by” trips). It should be noted that trip rates developed by ITE are based on typical isolated locations in a suburban environment. They generally do not include the effects of mixed use or near-by complimentary land uses, or a high percentage of transit, walk, or bike modes (i.e. mostly vehicle trips). Therefore, an extensive procedure was applied (as detailed below) to account for internalization of trips, transit, and walk / bike trips.

Peak hour trip generation estimates for the development were calculated using the Trip Generation Handbook, 9th Edition, 2012, Institute of Transportation Engineers (ITE). *Table 3-4* below summarizes the ITE trip generation rates used for each land use.

Table 3-4 ITE Trip Generation Rates

Land Use Description	ITE Land Use Code (unit)	Peak Time Period	In/Out % Distribution	Average Rate
Apartment	220: Apartment (DU)	Daily	50/50	6.65
		AM	20/80	0.51
		PM	65/35	0.62
High-Rise Residential	222: High-Rise Apartment (DU)	Daily	50/50	4.20
		AM	25/75	0.30
		PM	61/39	0.35
Townhouse	230: Residential Condominium / Townhouse (DU)	Daily	50/50	5.81
		AM	17/83	0.44
		PM	67/33	0.52
High-Rise Residential	232: High-Rise Residential Condominium / Townhouse (DU)	Daily	50/50	4.18
		AM	19/81	0.34
		PM	62/38	0.38
Private School	536: Private School (K-12) (students)	Daily	50/50	2.48
		AM	61/39	0.81
		PM	43/57	0.17
Hospital	610: Hospital (beds)	Daily	50/50	12.94
		AM	72/28	1.32
		PM	33/67	1.42
Office	710: General Office Building (KSF)	Daily	50/50	11.03
		AM	88/12	1.56
		PM	17/83	1.49
Hospital out-patient and support facilities	720: Medical -Dental Office Building (KSF)	Daily	50/50	36.13
		AM	79/21	2.39
		PM	28/72	3.57
Retail	820: Shopping Center (KSF)	Daily	50/50	42.70
		AM	62/38	0.96
		PM	48/52	3.71
Retail	826: Specialty Retail Center (KSF)	Daily	50/50	44.32
		AM (1)	62/38	0.96
		PM	44/56	2.71

Notes:

DU = Dwelling Unit; KSF = 1,000 square feet

1. No AM Rate available for Specialty retail because assumed that these stores are not open until after 9 AM; however, using shopping centre AM rate to account for possible employees' arrival before 9 AM.

Trip Generation Reductions

There are three types of trip reductions assumed for the Sapperton area: internal trip capture, pass-by trips, and transit and active transportation mode choice (i.e. walk and bike).

Internal Trip Reductions

Internal trip capture for a development (site or area) is the percentage of total trips that are made internally to the development without using external roads. For mixed-use development (MXD) projects, Chapter 7 of the *Trip Generation Handbook, 2nd Edition, ITE, 2004*, outlines a procedure for estimating the proportion of trips that are internal to the development. While this procedure is typically applied to a MXD with an internal roadway system, it was applied to the Sapperton area as the mix of land uses is complimentary and in close proximity. However, it was only applied to groupings of proposed sites (e.g. RCH and the Brewery District have complementary uses in workers and retail / restaurant), rather than to all uses. The following is a summary of the procedure to determine internal trips.

ITE trip generation rates are applied to each land use to obtain an initial estimate of the number of vehicle trips generated by the site. This estimate is what the site would generate if there were no interactions among each land use.

The different land use types within the development are separated into six land use types: residential, commercial, office, hotel, restaurant, and entertainment / cinema.

The trips generated by the five land use categories are then reduced by a percentage to account for internal capture within the MXD (based on look-up tables in the Trip Generation Handbook).

For each pair of land uses (e.g. residential – office), productions and attractions are reconciled so the number of internal trips produced by one equals the number attracted by the other. The lesser of the two estimates is chosen as the number of internal trips (i.e. one land use type cannot generate or attract more than the other).

The MXD methodology does not specifically account for institutional internal capture. For the Urban Academy & WesGroup Residential Development and Sapperton Green sites, since there is a proposed private school and a significant number of residents in close proximity to the school, it is likely that some of the school trips would come from within the developments. Therefore, it was assumed that 10% of the school specific trips would be internal to the developments. Additionally, the school has proposed before / after school care. Based on current school operations, it was assumed that 5% of the AM school trips would arrive prior to the peak hour. There is no reduction for the PM, as most of the students would be picked up prior to the PM peak hour.

Pass-By Trips

Pass-by trips are additional stops on the way from an origin to a final destination without diverting from the original route and are not considered new traffic added to the system. Pass-by trips are trips that are attracted from traffic traveling on an adjacent roadway to the development when a driver chooses to stop and visit one of the land uses. Since direct access to the development site is provided from the adjacent street, pass-by trips are not diverted from another roadway.

Pass-by trips are most commonly made to retail-type developments (e.g. shopping centers, discount stores, restaurants, banks, service stations and convenience stores) located adjacent to busy streets that attract motorists traveling on the roadway. Because there will be a relatively large commercial portion to the development, pass-by trips were incorporated in the trip generation analysis. The pass-by reduction is applied only to the specific retail land use and not to the total number of trips.

However, this traffic is considered new traffic at the site driveways. Upon exiting, pass-by trips would continue travelling in the same direction they were traveling in before stopping at the site. It should be noted that,

depending on the layout of the site, the exiting trip may not leave via the same driveway that it entered, nor the same street it entered from.

The *Trip Generation Handbook 2nd Edition (Chapter 5)* provides information on pass-by trips, including the pass-by trip percentage. In the Handbook, most land uses surveyed were only for the PM peak period, as the majority of land uses are not open during the AM peak period (i.e. most retail stores do not open until after 9:00 AM). Since the specific land use occupants for the retail / commercial portion (e.g. whether Best Buy, a dry cleaner, etc.) of the site is not known, the pass-by trip percentage for Shopping Center (land use code 820) was used as a basis. The justification for pass-by trip reduction for commercial land use is presented (bold values are estimated).

- AM = **10%**; since the specific land use occupants are unknown, and the majority of retail land use does not open until after the AM peak period, a small percentage was used to account for the possibility that some uses would be open during the AM peak period (i.e. coffee shops, such as Tim Horton's or Starbucks).
- PM = **34%**; pass-by trip percentages range from 10% to 90% with an average of 34%.
- Daily = **17%**; since Daily pass-by is not available, assumed 50% of the PM peak.

Transit and Alternative Mode Choice

There are two SkyTrain stations in the Sapperton area, Braid Street and Sapperton Stations. Sapperton Green, 100 Braid Street, RCH, and Brewery District are both within the walkable catchment (400m) of a SkyTrain station. Additionally, Sapperton is serviced by five bus routes along several of the main corridors (E. Columbia Street, Braid Street / E. Eighth Avenue, Cumberland Street, Richmond Street, McBride Boulevard, etc.).

For each development, a percentage reduction in generated trips was applied based on the service type and frequency. Research for transit proximity indicates that in a suburban / urban environment, a typical trip reduction for a development adjacent to frequent transit (SkyTrain station in this instance) is 15% to 20%, within 400m of a frequent transit corridor (Skytrain) are typically 5% to 10%, and within walking distance of a bus stop are typically 5%.

Except for the area surrounding the Canada Games Pool Redevelopment, the majority of the assessed developments are located within close proximity of a SkyTrain station. For those developments located near the Sapperton station a 15% transit trip reduction was applied. For the developments located near the Braid station, a 20% trip reduction was applied, as the station is more centrally located within Sapperton Green. There are bus routes adjacent to the Canada Games Pool, all running at approximately 30 min headways. For this reason, only a 5% transit trip reduction was assumed for the Canada Games Pool redevelopment, also noting the future redevelopment has not been thoroughly planned or designed at the time of this analysis.

Most of the internal trips between the developments would be walking and / or biking. It is also anticipated that there would be additional walking or bike trips to / from the surrounding neighbourhoods. Based on the *2011 Metro Vancouver Regional Trip Diary Survey – Analysis Report, TransLink (2013)*, approximately 10% of the mode share for the Burnaby / New Westminster area was a walking or biking trip. However, the MTP states that approximately 16% of trips are walk or bike trips. Therefore, a 15% walk / bike mode share was assumed for the proposed developments. For Sapperton Green, a 20% walk / bike mode share was assumed as one of the goals of the development is to create a more walkable and alternative-mode friendly environment.

Estimated Trip Generation

Each of the developments shown in *Table 3-3* was consolidated for purposes of trip generation based on their proximity to each other, which resulted in three major areas:

1) Braid Street – includes Sapperton Green, Urban Academy & WesGroup developments
2) E. Columbia Street – includes Royal Columbian Hospital, Brewery District, 408-412 East Columbia Street, and 145-201 East Columbia Street
3) McBride Boulevard – Canada Games Pool Redevelopment

The estimated trips generated by the proposed developments are shown in *Table 3-5*.

Table 3-5 Trip Generation Summary

	Development	AM Peak Hour			PM Peak Hour			Daily
		In	Out	Total	In	Out	Total	
Total Trips before Reduction	Braid St	1,662	1,482	3,144	1,465	1,777	3,242	32,636
	E. Columbia St	977	498	1,475	576	1,075	1,651	15,582
	McBride Blvd	12	50	62	49	26	75	812
	Total Trips	2,651	2,030	4,681	2,090	2,878	4,968	49,030
Total Internal Reduction	Braid St	93	80	173	114	115	229	3,248
	E. Columbia St	145	145	290	208	208	416	5,842
	McBride Blvd	0	0	0	0	0	0	0
	Internal Trips	238	225	463	322	323	645	9,090
Pass-By Trips (1)	Braid St	2	2	4	37	37	74	360
	E. Columbia St	0	0	0	0	0	0	0
	McBride Blvd	0	0	0	0	0	0	0
	Pass-By Trips	2	2	4	37	37	74	360
Transit	Braid St	313	280	593	263	325	588	5,806
	E. Columbia St	125	53	178	55	130	185	1,462
	McBride Blvd	1	3	4	2	1	3	40
	Transit Trips	439	336	775	320	456	776	7,308
Active Modes	Braid St	251	224	475	210	260	470	4,644
	E. Columbia St	106	45	151	47	111	158	1,242
	McBride Blvd	2	7	9	7	4	11	116
	Active Mode Trips	359	276	635	264	375	639	6,002
Net New Trips	Braid St	1,003	896	1,899	841	1,040	1,881	18,578
	E. Columbia St	601	255	856	266	626	892	7,036
	McBride Blvd	9	40	49	40	21	61	656
	Net New Trips	1,613	1,191	2,804	1,147	1,687	2,834	26,270
	Total % Reduced	40%			43%			46%

Notes:

1. E. Columbia Street does not include pass-by trips as the majority of the proposed new development is residential and office (i.e. minimal new retail), which typically doesn't induce pass-by trips. The portion that is new retail would be negligible.

As shown in the table, after applying trip reductions for internalization, pass-by, transit, and active mode, the new developments are projected to generate approximately 2,800 AM and PM peak hour trips and 26,300 daily trips, which equates to a 40% to 45% reduction in the estimated ITE trips generated.

3.3.2. Trip Distribution

The trip distribution proposed for this analysis was derived from select link outputs of the base EMME model. *Table 3-6* shows the percentage of traffic, inbound, outbound, and combined, between study developments and the key routes into and out of the City, as determined by the EMME model.

Table 3-6 Trip Distribution Percentages between Study Developments and Key Routes, from EMME

Gate	Canada Games			Braid Industrial			RCH / Brewery District			Sapperton Green			Urban Academy		
	I	O	C	I	O	C	I	O	C	I	O	C	I	O	C
Pattullo Bridge	25	20	25	15	15	15	15	10	15	10	10	10	10	10	10
Front St	0	0	0	5	5	5	0	5	0	0	0	0	0	0	0
E Columbia St	0	0	0	0	0	0	0	5	0	0	0	0	0	5	5
Royal Ave	0	5	0	0	10	0	0	0	0	0	0	0	0	0	0
E Sixth Ave	25	20	25	5	0	5	10	5	10	0	0	0	5	5	5
E Eighth Ave	0	5	0	0	0	0	0	5	0	10	10	10	10	10	10
E Tenth Ave	0	10	0	5	0	5	5	5	5	5	5	5	5	5	5
Cumberland St	5	10	5	0	0	0	0	5	5	0	0	0	5	5	5
Cariboo Rd	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0
North Rd	5	5	5	5	5	5	5	10	5	10	15	10	15	15	15
Hwy 1 (West)	10	5	10	30	35	30	35	30	35	35	35	35	30	30	30
Brunette Ave (East of Hwy 1)	5	5	5	0	5	5	10	5	5	10	10	10	5	5	5
Hwy 1 (East)	10	5	10	5	10	5	10	10	10	10	10	10	5	5	5
United Blvd	10	5	10	30	15	25	10	5	10	10	5	10	10	5	5
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Notes: I = Inbound, O = Outbound, C = Combined

Based on the EMME outputs and adjusted for consistency with previously completed projects, the trip distribution percentages recommended for both the AM and PM peak hour analysis are shown in *Table 3-7*. It should be noted that the model zone for Canada Games Pool (CGP) also contains the Justice Institute. Since the Justice Institute creates more of a regional draw than CGP, it skewed the distribution toward the Pattullo Bridge and Sixth Avenue. The distribution for CGP has been modified to reflect a more local draw from the neighbourhoods surrounding the site, which is assumed to be reasonable for the peak period.

Table 3-7 Recommended Trip Distribution Percentages

Gate	Canada Games	Braid Industrial	RCH / Brewery District	Sapperton Green	Urban Academy
Pattullo Bridge	10	15	15	10	10
Front Street	0	5	0	0	0
E Columbia Street	0	0	0	10	5
Royal Avenue	0	0	0	0	0
E Sixth Avenue	15	5	10	0	5
E Eighth Avenue	0	0	0	10	15
E Tenth Avenue	10	5	5	5	5
Cumberland Street	15	0	5	0	5
Cariboo Road	10	0	0	0	5
North Road	5	5	5	10	15
Highway 1 (West)	10	30	35	25	15
Brunette Avenue (East of Hwy 1)	5	5	5	10	10
Highway 1 (East)	10	5	10	15	10
United Boulevard	10	25	10	5	0
Total	**100%**	**100%**	**100%**	**100%**	**100%**

Notes:

15 = Denotes locations that were adjusted for consistency with previously completed projects and/or to better reflect an individual land use within a larger model (EMME) zone.

While distribution percentages are shown for the Braid Industrial Area, no planned development is identified for this area. Therefore, for analysis, all trips traveling to and from this area were assumed to be existing traffic or part of future, background growth.

3.3.3. Development Contributions to Traffic Growth

To determine the number of trips per intersection associated with each development, the Vistro modelling software was utilized. Having determined the roadway network within the Sapperton area, gateways (i.e. locations where trips would enter / exit the study area) and zones (i.e. location of development) were created. The trip distribution (from *Section 3.3.2*) to each gateway was entered as well as the trip generation information for each development. Finally, paths to / from the zones to / from the gateways were coded.

The resulting volume and percent development contribution results for the AM and PM peak hours for full build-out is presented in *Table 3-8*.

Table 3-8 Traffic Contribution Per Development

Location	Royal Columbian Hospital	Sapperton Green	Brewery District	Canada Games	Urban Academy	408-412 E. Columbia Street	145-201 E. Columbia Street
Brunette Avenue / Braid Street	478 (14%)	2,134 (64%)	500 (15%)	41 (1%)	131 (4%)	40 (1%)	36 (1%)
E. Columbia Street / Brunette Avenue	272 (15%)	762 (42%)	646 (35%)	19 (1%)	79 (4%)	16 (1%)	43 (2%)
E. Sixth Avenue / McBride Boulevard	79 (35%)	0 (0%)	83 (37%)	30 (13%)	19 (9%)	7 (3%)	7 (3%)
E. Eighth Avenue / McBride Boulevard	0 (0%)	486 (85%)	0 (0%)	9 (2%)	72 (13%)	0 (0%)	0 (0%)
E. Tenth Avenue / McBride Boulevard	39 (13%)	172 (60%)	41 (14%)	11 (4%)	19 (7%)	4 (1%)	3 (1%)
E. Tenth Avenue / Cumberland Street	78 (30%)	27 (11%)	82 (32%)	36 (14%)	22 (9%)	8 (3%)	6 (2%)
E. Eighth Avenue / Cumberland Street	78 (9%)	513 (60%)	82 (10%)	65 (7%)	103 (12%)	8 (1%)	6 (1%)
E. Columbia Street / Keary Street	286 (27%)	505 (48%)	199 (19%)	0 (0%)	43 (4%)	9 (1%)	8 (1%)
Richmond Street / E. Eighth Avenue	0 (0%)	433 (79%)	0 (0%)	23 (4%)	90 (17%)	0 (0%)	0 (0%)
E. Columbia Street / Braid Street	161 (9%)	1,279 (74%)	41 (2%)	23 (1%)	208 (12%)	23 (1%)	8 (1%)
Rousseau Street / Braid Street	122 (3%)	3,413 (87%)	0 (0%)	20 (1%)	339 (9%)	19 (0%)	5 (0%)
E. Tenth Avenue / Cariboo Road	0 (0%)	0 (0%)	0 (0%)	11 (50%)	11 (50%)	0 (0%)	0 (0%)
E. Columbia Street / Holmes Street	39 (7%)	341 (67%)	41 (8%)	3 (1%)	75 (15%)	4 (1%)	3 (1%)

4. Traffic Operations Analysis

Traffic operations analysis was conducted for two (2) scenarios:

- Existing Conditions (2016)
- Assumed Full Build-Out (Year 2042)

All scenarios were analyzed for two (2) time periods:

- AM weekday peak hour
- PM weekday peak hour

4.1. Analysis Software

Synchro software, version 9.0, was used to report the Level of Service (LOS) and average delay at each of the study intersections. Synchro is a traffic simulation model used to determine traffic conditions based on volumes, laning, type of traffic control, percent heavy vehicle (many intersection locations within the City are on a truck route and therefore have higher than typical truck percentages), and grade (as there are many locations throughout the City that have significant grades, it is important to include this factor to account for the longer acceleration time, especially where the heavy truck percentage is high). The model calculates the average delays and queue lengths for each movement at an intersection. Average delays are translated into a LOS. Synchro incorporates the *Highway Capacity Manual* (HCM) methodologies. It should be noted that Synchro results are calculated and typically conservative compared to observed traffic flow that is affected by driver behaviour. Detailed Synchro analysis reports are included in *Appendix D*.

4.2. Intersection Level of Service Criteria

Operations of roadway facilities are described in terms of Level of Service (LOS). LOS is a qualitative description of traffic flow based on factors such as speed, travel time, delay, and freedom to manoeuvre. Six service levels are defined, ranging from LOS A, the best operating conditions, to LOS F, the worst or failing operating conditions. LOS E corresponds to "at or near capacity" operations. When volumes exceed capacity, stop-and-go conditions result and operations are designated LOS F. The delay thresholds and corresponding LOS are presented in *Table 4-1*. The typical industry-accepted criterion for acceptable operation is LOS D. Therefore, any movement or intersection operating at LOS E or worse may be in need of improvement.

Table 4-1 Intersection Level of Service Definitions

Level of Service	Delay Criteria (sec / veh) [1]		Description
	Signalized Intersections	Unsignalized Intersections	
A	≤ 10	<10	Represents free flow. Individual users are virtually unaffected by others in the traffic stream. Usually no conflicting traffic
B	> 10 to 20	>10 and <15	Stable flow, but the presence of other users in the traffic stream begins to be noticeable. Occasionally some delay due to conflicting traffic
C	> 20 to 35	>15 and <25	Stable flow, but the operation of individual users becomes significantly affected by interactions with others in the traffic

			stream. Delay is noticeable, but not inconveniencing.
D	> 35 to 55	>25 and <35	Represents high-density, but stable flow. Delay is noticeable and irritating; increased likelihood of risk taking.
E	> 55 to 80	>35 and <50	Represents operating conditions at or near the capacity level. Delay approaching tolerance levels; risk taking behaviour is likely.
F	> 80	>50	Represents forced or breakdown flow. Delay exceeds tolerance level; high likelihood of risk taking.

Notes:

1. HCM 2000, Chapters 16 and 17

Signalized Intersections

Signalized operations were analyzed using the methodology contained in Chapter 16 of the *Highway Capacity Manual (HCM) 2000* (Transportation Research Board, 2000). This methodology determines the LOS by comparing the average control delay for all vehicles approaching the intersection to the delay thresholds shown in *Table 4-1*.

Unsignalized Intersections

For unsignalized (all-way and side-street stop-controlled) intersections, the LOS calculations were conducted using the method in Chapter 17 of the *Highway Capacity Manual 2000*. The LOS rating is based on the average control delay expressed in seconds per vehicle. For controlled approaches composed of a single lane, the control delay is computed as the average of all movements in that lane. *Table 4-1* also presents the thresholds for unsignalized intersections.

It should be noted that for side-street stop-controlled intersections, the overall intersection LOS is typically not reported, as the major street through volume typically has higher volumes and little to no delay, thus skewing the average delay per vehicle.

95th Percentile Queue Length

Synchro was used to report the queue lengths at each of the study intersections. It should be noted, however, that Synchro only reports the 95th % queue for unsignalized intersections (as opposed to average). However, the 95th % queue is typically used for design purposes. It should also be noted that the 95th % queue length in Synchro is calculated, and not necessarily observed. Also, when a volume exceeds the capacity for a movement, Synchro does not calculate the 95th % queue for the entire hour. Rather, Synchro reports the maximum queue after only two cycles. Therefore, the queue may be longer than presented.

4.3. Level of Service Results

4.3.1. Existing Conditions 2016

Existing conditions analysis was conducted using the existing signal timing for each of the signalized intersections, as provided by the City and City of Burnaby. A summary of the Existing Conditions (2016) intersection LOS results can be found in *Table 4-2* while *Figure 4-1* to *Figure 4-3* present the overall and individual movement LOS results.

Table 4-2 Existing Conditions (2016) Intersection Level of Service Results

	Intersection Name	AM		PM	
		LOS	Average Delay (1)	LOS	Average Delay (1)
1	Brunette Ave / Braid St	D	38	**E**	**62**
2	Brunette Ave / Sherbrooke St	EBR – C	16	EBR – B	14
3	Brunette Ave / Spruce St / Keary St	EBR – C	16	EBR – B	12
4	E. Columbia St / Brunette Ave / Debeck St	B	19	C	32
5	E. Columbia St / Cumberland St	EBR – C	16	EBR – B	14
6	E. Columbia St / Richmond St	B	14	B	12
7	E. Columbia St / McBride Blvd	C	23	C / D	35
8	Royal Ave / McBride Blvd	B	19	B	16
9	E. Sixth Ave / McBride Blvd	C	28	C	29
10	E. Eighth Ave / McBride Blvd	D	48	**E**	**74**
11	E. Tenth Ave / McBride Blvd	C	20	C	26
12	E. Tenth Ave / Cumberland St	D	48	**F**	**93**
13	E. Eighth Ave / Cumberland St	C	23	D	36
14	E. Sixth Ave / Cumberland St	C	24	**F**	**185**
15	Richmond St / Cumberland St	B	11	C	18
16	E. Columbia St / Alberta St	A	3	A	6
17	E. Columbia St / Keary St	A	7	A	9
18	E. Columbia St / Sherbrooke St	A	6	B	10
19	Richmond St / E. Eighth Ave	**NB/SB – F**	See note 2	**NB/SB – F**	See note 2
20	E. Columbia St / Braid St / E. Eighth Ave	C	25	D	46
21	Rousseau St / Braid St	A	9	A	8
22	E. Tenth Ave / Cariboo Rd	D	53	D	41
23	Richmond St / E. Tenth Ave	NB – B	11	NB – B	11
24	E. Columbia St / Holmes St	B	12	C	23
25	Canfor Ave / Braid St	B	10	B	10
26	Memorial Drive / McBride Blvd	A / B	10	A	2
27	E. Columbia St / Front St /	B	12	B	18

Notes:
Bold indicates unacceptable operation.
1. Average delay = seconds per vehicle.
2. Delay is not reported, as once side-street LOS reaches LOS F, it is likely improvements are required.

As can be seen in *Table 4-1*, all intersections are currently operating at LOS D or better for all time periods, except the following intersections and corresponding peak hours:

- Brunette Avenue / Braid Street (PM)
- E. Eighth Avenue / McBride Boulevard (PM)
- E. Tenth Avenue / Cumberland Street (PM)
- E. Sixth Avenue / Cumberland Street (PM)
- Richmond Street / E. Eighth Avenue (AM and PM)

Additionally, as shown on *Figure 4-1* to *Figure 4-3*, there are many individual movements operating at LOS E or LOS F.

Figure 4-1 Existing (Year 2016) Intersection Operational Performance

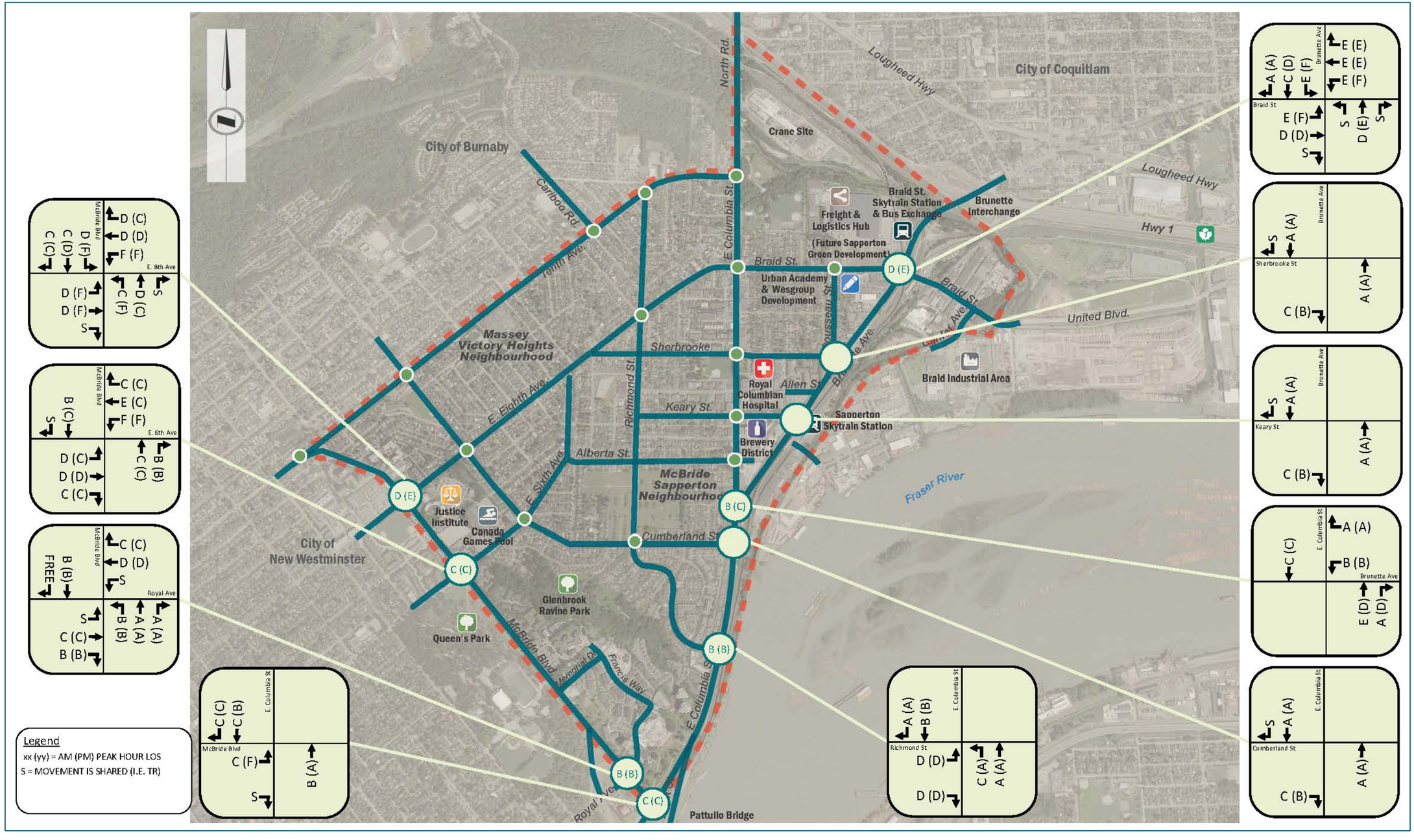


Figure 4-2 Existing (Year 2016) Intersection Operational Performance

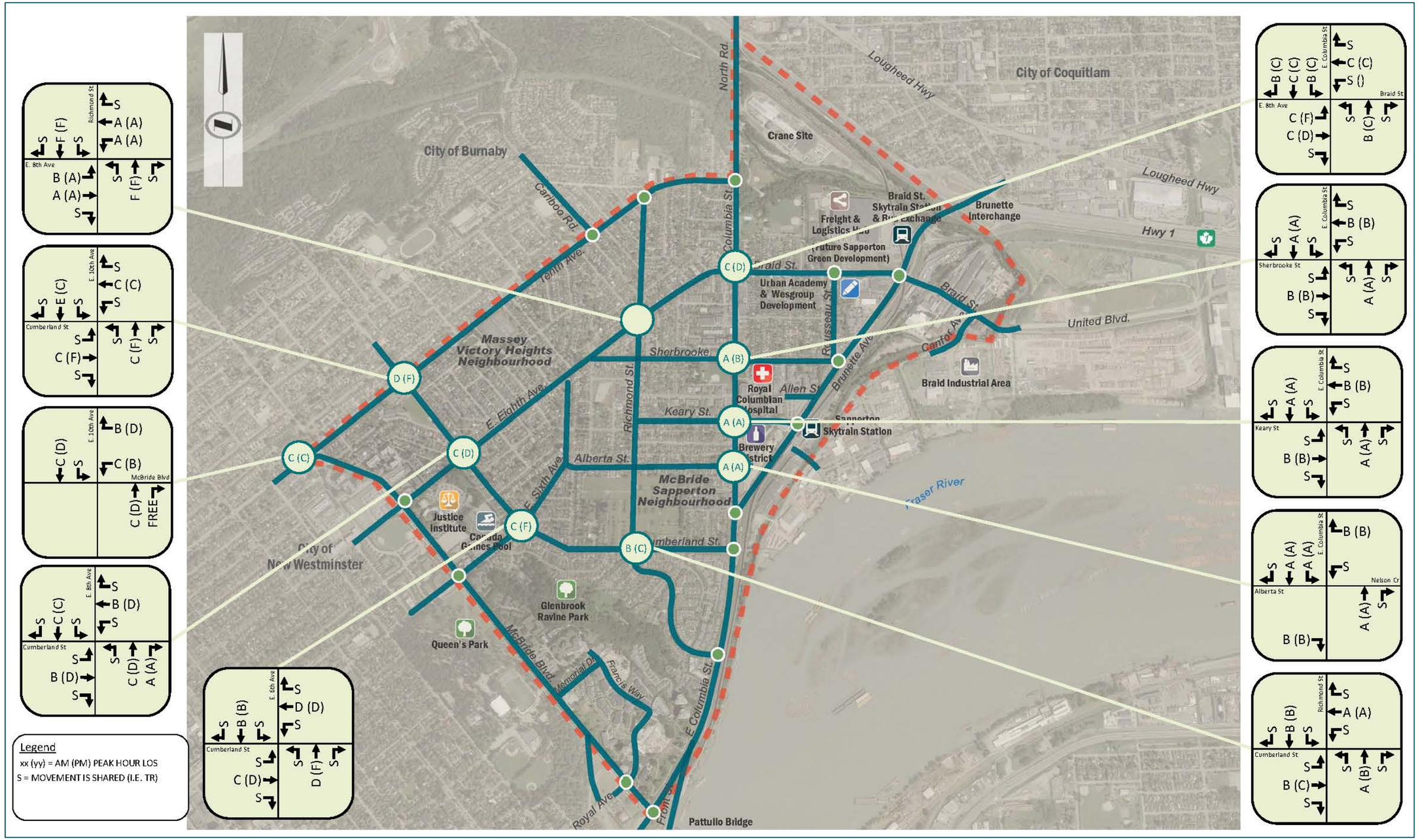
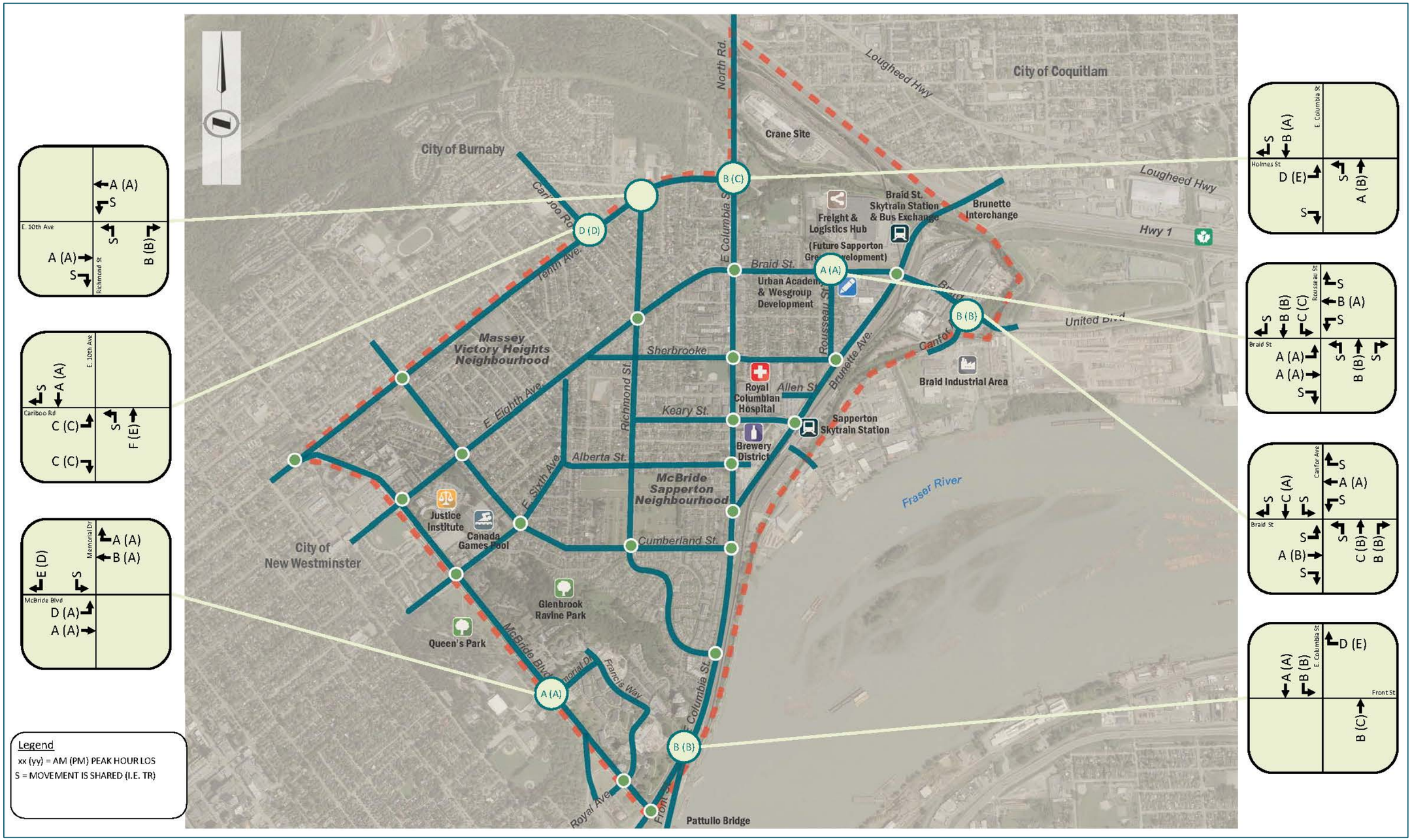


Figure 4-3 Existing (Year 2016) Intersection Operational Performance



4.3.2. Full Build-Out (Year 2042)

As part of the Full Build-Out road network assumptions outside the study area, the only major improvement assumed was the Pattullo Bridge replacement. The Brunette Interchange project was not included as there is no certainty as to whether it will actually evolve within the scope of this assessment.

Within the study area, an initial assessment of intersection operation for Year 2042 was performed for the AM and PM peak hours assuming no improvements (i.e. existing laning) with the exception of optimization of signal timings (cycle, offset and splits). This assessment, using traffic modelling software (EMME), indicated which locations would operate poorly in the future. As shown on *Figure 4-4* several corridors (E. Eighth Avenue, Brunette Avenue, E. Columbia Street, McBride Boulevard) experience long delays and queues in the future, and will typically have a traffic demand that exceeds the available capacity, usually resulting in drivers attempting to find alternative routes (short-cutting) to bypass congestion.

Mitigation measures aimed at improving network performance as well as traffic calming measures aimed at encouraging vehicles to stay on the right roads and are not short-cutting through neighbourhoods are proposed in later sections. These interventions also take into account neighbourhood liveability, improvements in cycling and pedestrian facilities, transit service improvements, and other related elements.

The net impact of the recommended measures was then analysed to determine their effectiveness on improving congestion on the network. These findings are presented in *Section 7.*

Figure 4-4 Locations That Operate Poorly in Future



5. Safety and Liveability

With the City's policy of *"no net increase in roadway capacity"* for general purpose traffic and its highly built-up neighbourhoods, simply building new or wider roads to address congestion concerns is not an option. The liveability and safety of the community must be retained or, preferably, improved. Enabling residents to make better use of alternative modes versus their cars is essential (i.e. make it easier to drive less).

The City's Master Transportation Plan (MTP) identifies a vision, goals and targets for all modes of transportation. These include goals for a walkable city, comfortable cycling facilities, an attractive and convenient transit service, livable neighbourhoods and "great streets" that are vibrant destinations, such as E. Columbia Street through Sapperton. Actions to achieve these goals include new and improved facilities for pedestrians and cyclists of all ages and abilities (AAA), persons with disabilities, transit users and other priority modes of transportation, and to calm traffic on neighbourhood streets.

The Sapperton/ Massey Victory Heights Transportation Plan include three key components:

- A transit plan to improve reliability of service and enhance the users experience
- An active transportation plan to improve pedestrian facilities and bicycle routes, and encourage residents, employees and visitors to Sapperton to walk, cycle and use transit
- A traffic calming plan that seeks to mitigate or eliminate the impacts of unwanted traffic on residential streets in Sapperton, and encourage the right traffic to stay on the right roads

In addition to this, street lighting plays a key role in enhancing the safety of a community. A study undertaken by DMD & Associates in 2009 documents locations in the study area that have street lighting below recommended levels. Given that a large portion of the study area, including designated Major Road Network and truck route corridors are not sufficiently illuminated, it is recommended that sufficient capital funding be set aside and grant funding sought so that this key safety enhancement within the community can be made.

5.1. Transit

The Sapperton neighbourhood is currently served by five bus routes (#128, #155, #C3, #C4, and #C9, with headways ranging from 10 to 30 minutes depending on time of day and route) and two SkyTrain stations (Braid and Sapperton) as shown in *Figure 5-1*. Since the area is generally well served, no additional transit routes are recommended.

Over the course of each year, TransLink makes regular quarterly and seasonal bus service changes, both to bring more service to where customers need it most and to reflect temporary changes in demand. As part of Phase One of the 10-Year Vision for Metro Vancouver Transit and Transportation, TransLink has committed to:

- *C3 Victoria Hill/ Quayside*
  - Increased service at bus times throughout the week to reduce overcrowding in April 2018. Buses now run every 10- minutes between 6a.m. – 9a.m. and 3p.m. – 7p.m.
- *Bus #128*
  - Add more frequency during weekday midday
  - Frequency to every 20 minutes (previously 30 minutes)
- *Bus C3 & C4*
  - Extend bus later into the evening – every half hour from 9pm-12am

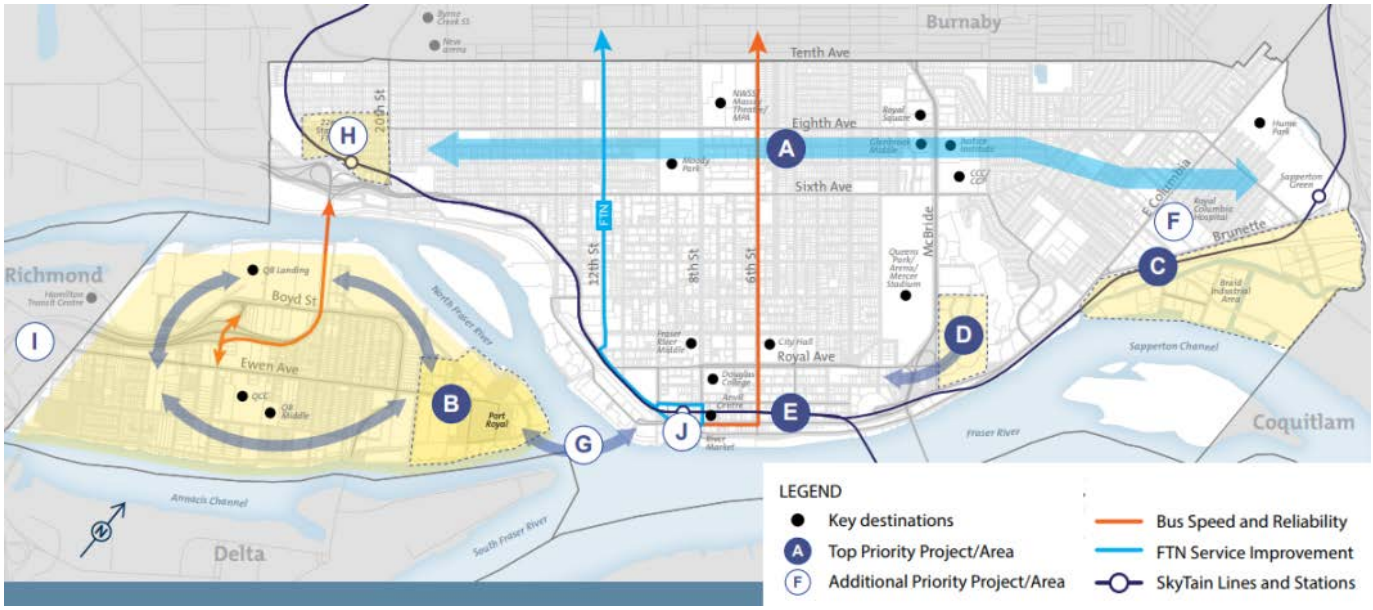
In May 2018, Council endorsed the New Westminster Transit Priorities Reference Document, which summarizes the City's transit priorities so that the city can provide feedback through TransLink's and Mayors'

Council processes, identify opportunities for cost-sharing funding programs and partnerships with senior levels of government.

The projects highlighted in the document, were drawn from directions in the Master Transportation Plan and updated with feedback from the public through recent consultation processes including the Official Community Plan and neighbourhood transportation planning programs. The selected projects represent the top priorities for transit-related initiatives that require partnerships, advocacy, or additional coordination to fully achieve. The document can be found at www.newwestcity.ca/transit. Some of the projects identified that have an impact on the communities in the study area are:

- A: East-West Frequent Transit Service/ Route
- C: Sapperton Station Elevator
- D: Service to Victoria Hill
- F: Royal Columbia Hospital - innovative travel demand management solutions

Figure 5-1 Proposed Transit Improvements



Source: City of New Westminster

The following transit improvements are proposed and shown on *Figure 5-1* (it should be noted that some improvements will require further discussion with and support from TransLink through future phases of the 10-Year Vision for Metro Vancouver Transit and Transportation):

- Increased frequency, especially in the off-peak periods
- Additional bus stops on Route # C9
- Erect shelters at the hospital on E. Columbia Street and on Jamieson Crescent outside Royal City Manor
- Place benches at bus stops – the majority of bus stops in the area do not have benches and in order to encourage the use of transit through an improved user experience, benches should be considered as a minimum
- To improve reliability of service for Route #128 along E. Eighth Avenue, peak period bus lanes (with parking restrictions) are proposed between Cumberland Street and E. Columbia Street
- Where achievable, transit signal priority should be considered at key / congested locations to improve transit service reliability along those corridors

Figure 5-2 Transit Routes and Facilities

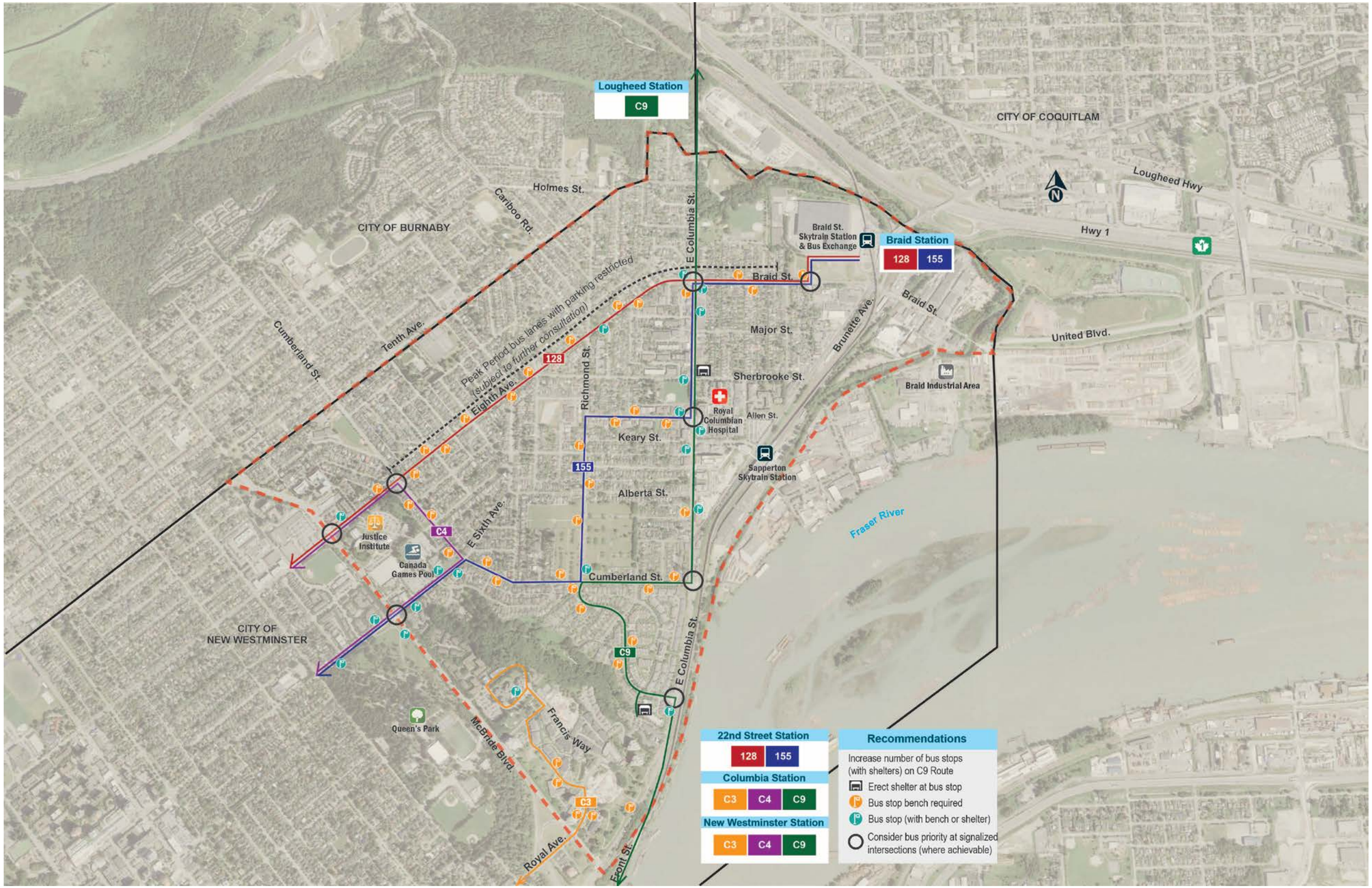
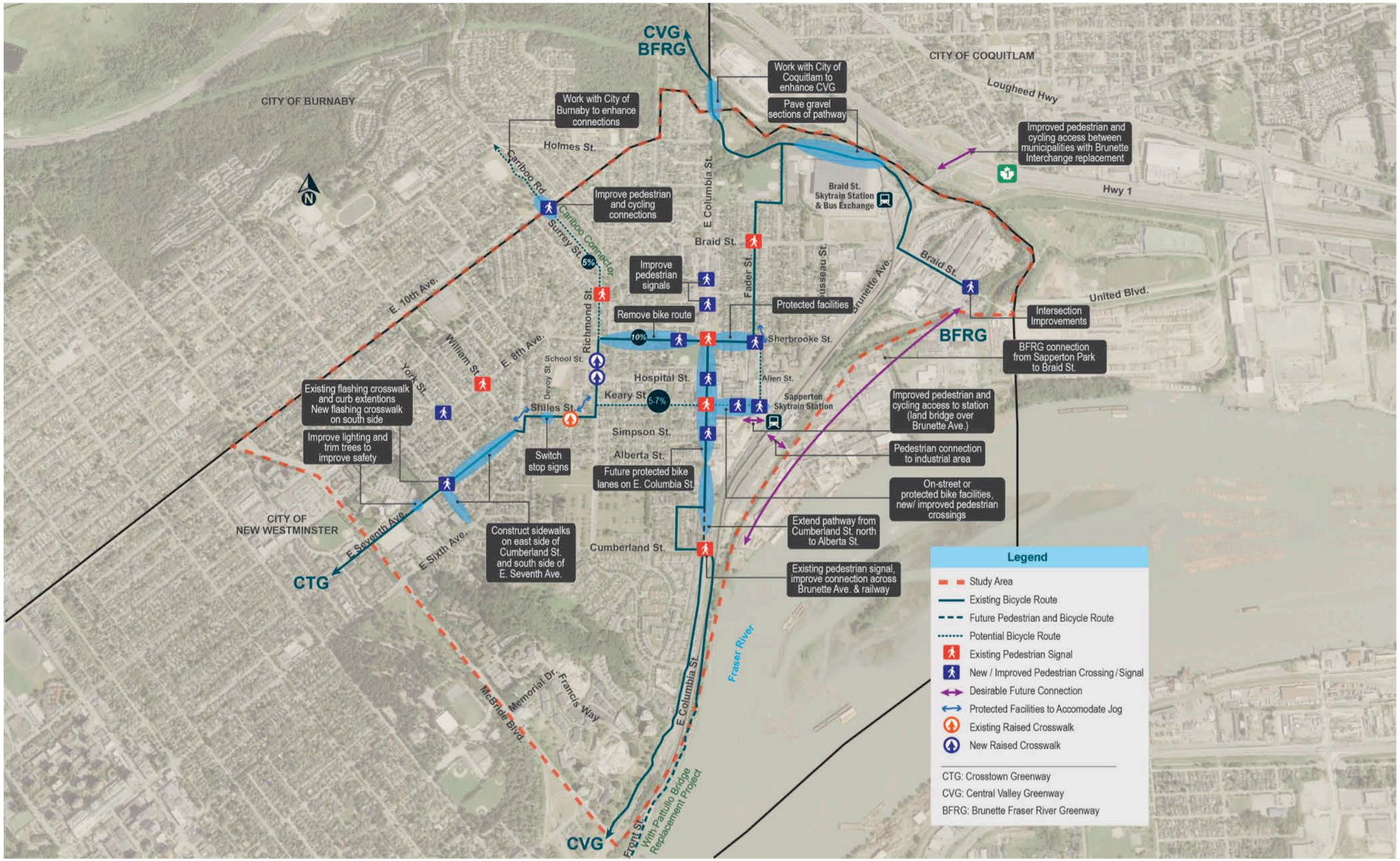


Figure 5-3 Bicycle Routes and Pedestrian Facilities



5.2. Active Transportation

The City's Master Transportation Plan identifies a vision, goals and targets for active transportation intended to create a more walkable city and more comfortable cycling facilities. This section presents an active transportation plan for Sapperton to improve pedestrian facilities and bicycle routes, and encourage residents, employees and visitors to Sapperton to walk, cycle and use transit. The existing and proposed new and improved active transportation facilities in Sapperton are presented on *Figure 5-2*.

5.3. Pedestrian Facilities

Figure 5-3 identifies a number of improvements to pedestrian facilities. These and more improvements are described below. Warrants for proposed pedestrian crossings were not done as part of this study. However, warrants should be used with caution as they tend to focus on minimizing the delay to motor vehicle traffic and not necessarily to improve pedestrian safety. Transportation Association of Canada's (TAC) 2012 pedestrian crossing guidelines have abandoned the warrant approach. It is therefore recommended that at the time of implementation, the City apply TAC guidelines to confirm the appropriate types of crossings.

Locations where pedestrian crossings should be improved include:

- **E. Columbia Street at Simpson Street**
  Although there is currently not a pedestrian crossing at this intersection, pedestrians frequently cross E. Columbia Street at this location. With additional development on the west side of E. Columbia Street, even more pedestrians can be expected to cross at Simpson Street. To safely accommodate pedestrian crossing E. Columbia Street, a new pedestrian crossing should be implemented at Simpson Street with pedestrian-activated flashing beacons, lights and overhead illuminated pedestrian crossing signs.
- **E. Columbia Street at Hospital Street**
  The existing pedestrian crossing is equipped with flashing beacons. This intersection had some minor improvements made in 2017, however feedback from the community tells us that motorists often disregard the flashing lights and fail to stop for pedestrians. Two options for upgrading this crossing include:
  - The crossing could be enhanced with flashing RRFB lights that have been shown to have higher motorist compliance rates than conventional flashing amber lights, as well as overhead illuminated pedestrian crossing signs.
  - Alternatively, as Hospital Street is a transit route, the intersection could be converted to a pedestrian signal/ Transit Priority signal with bus and emergency vehicle actuation to assist buses turning left from Hospital Street to E. Columbia Street and emergency vehicles accessing the hospital. In this case, a second crosswalk would be added on the south side of the intersection. Given the "great street" objective for E. Columbia Street, this option is preferred.
- **E. Columbia Street at Cedar Street and south of Ward Street**
  The two existing crosswalks are simple marked crosswalks with overhead illuminated pedestrian crossing signs. To increase the visibility of pedestrians and the crosswalks, and help to ensure that motorists stop for pedestrians in the crosswalk, these two crossings could be enhanced with pedestrian-activated flashing RRFB beacons, overhead illumination, enlarging the overhead pedestrian crossing signs, and changing the overhead signs to 'black on white' symbols.
- **Richmond Street at School Street and Hospital Street (north leg)**
  These crossings are on key routes to Richard McBride Elementary School. Raised crosswalks would be added to improve pedestrian safety and discourage speeding on Richmond Street in the 30 km/h school zone. A raised crosswalk would not be appropriate at the south leg of Hospital Street, nor at Keary Street, as this section of Richmond Street is a bus route and primary emergency response route.

Further conversation may be required with Fraser Health and the BC Ambulance Service to establish whether this corridor would continue to be used after the Emergency Department has been relocated as part of the redevelopment of the Royal Columbian Hospital. Additionally, any future enhancements should be done with the redevelopment of the Sir Richard McBride School in mind.

- **Cumberland Street at E. Seventh Avenue**
  The existing crosswalk on the north side of the intersection is equipped with flashing beacons. The crossing should be improved by adding a second crosswalk on the south side of the intersection to connect to new sidewalks (described below). The second crosswalk would also be equipped with flashing beacons, or both crosswalks could be converted to flashing RRFBs. These enhancements should align with the redevelopment of the Canada Games Pool.
- **E. Eighth Avenue at York Street**
  There are bus stops in both directions on E. Eighth Avenue at York Street, and to assist transit passengers and other pedestrians in crossing E. Eighth Avenue a new pedestrian crossing should be implemented, optionally with curb extensions (bus priority lane dependent), pedestrian-activated flashing beacons and overhead illuminated pedestrian crossing signs (black-on-white).
- **Sherbrooke Street adjacent to Sapperton Park**
  A new pedestrian crossing that could potentially be integrated with a traffic calming measure. It would help to connect people to the Sapperton Park and playground.
- **Sherbrooke Street at Fader Street**
  There is no existing crosswalk at this location. Given the plan intends to provide an official connection for pedestrians and bicycles through the lane connecting to Keary Street, a crosswalk should be provided at this location that connects to the existing Greenway along Fader Street. The layout for this should be established through the RCH Rezoning process.
- **Keary Street at RCH Lane**
  There is no existing crosswalk at this location. Given the plan intends to provide an official connection for pedestrians and bicycles through the lane connecting to Sherbrooke Street, a crosswalk should be provided at this location that connects to the existing Greenway along Fader Street. The layout for this should be established through the RCH Rezoning process.
- **Keary Street mid-block adjacent to RCH**
  There is an existing crosswalk at this location. As part of the redevelopment of the Royal Columbian Hospital, this crossing should be realigned to connect with a suitable entry point to the Hospital for all users (including accessible needs).

Key locations where there is no sidewalk on one side of a road are identified below. These locations are on or connect to the Crosstown Greenway and, consequently, new sidewalks in these locations are considered a priority and are recommended to be constructed by the City rather than funded by adjacent property owners:

- E. Seventh Avenue between Cumberland Street and E. Sixth Avenue, south side
- E. Seventh Avenue west of Cumberland Street, south side
- Cumberland Street between E. Sixth and E. Seventh Avenues, east side

Locations where pedestrian access across the railway tracks could be improved include:

- A pedestrian connection from the Sapperton SkyTrain station east across the railway tracks would improve pedestrian access to the industrial area along the Brunette River, and to the Brunette Fraser Regional Greenway. This connection could incorporate stairs, a ramp or an elevator from the station to ground level. Further communication with TransLink, the rail companies and adjacent property owners would be required to facilitate the future connection.
- The existing pedestrian signal on E. Columbia Street at Cumberland Street provides access for pedestrians and cyclists from the Central Valley Greenway east across the railway tracks. This connection incorporates stairs and a ramp with constrained geometry, and crosses an “off-ramp” from E. Columbia Street. The connection could be improved by adding curb ramps for persons with disabilities, widening the sidewalk along E. Columbia Street, adding more signage, pavement markings and illumination. Additionally, the City is working with rail companies to achieve whistle cessation at this

railway crossing, which might require additional pedestrian safety enhancements such as fencing and removal of any vegetation obstructing sight lines.

5.3.1. Crosstown Greenway

The Crosstown Greenway extends west-east across New Westminster, connecting 22nd Street SkyTrain station in the west (where it connects with the BC Parkway) to Hume Park in the east (where it connects with the Central Valley Greenway and Brunette Fraser Regional Greenway). Through Sapperton, the Crosstown Greenway follows E. Seventh Avenue across McBride Boulevard, and then jogs along several local streets to Hume Park. As shown on *Figure 5-3* a key recommendation is to reroute the Crosstown Greenway via Keary Street instead of the existing route on Sherbrooke Street between Richmond Street and East Columbia Street. The new route would also make use of the planned pathway through the lane as part of the Royal Columbian Hospital redevelopment. This change offers several benefits for cyclists and pedestrians:

- Keary Street between E. Columbia and Richmond Streets is a constant grade of 5% to 7%, as compared to the varying grades on Sherbrooke Street that are up to 10%
- The new route is a more direct connection to the Sapperton SkyTrain station
- The City's policy of 30km/h speed limits on designated bike routes and greenways allows the City to sign and design the new route to ensure vehicles are traveling at an acceptable speed, and potentially reduce the desire to use Keary Street as a through-street
- Creates a more comfortable pedestrian environment along the corridor as well as opportunities for increased landscaping.

As described in *Section 5.4*, speed humps and a pinch point are proposed to be installed on Keary Street to discourage speeding and improve safety. Speed humps are compatible with bicycle routes and do not negatively impact cyclists.

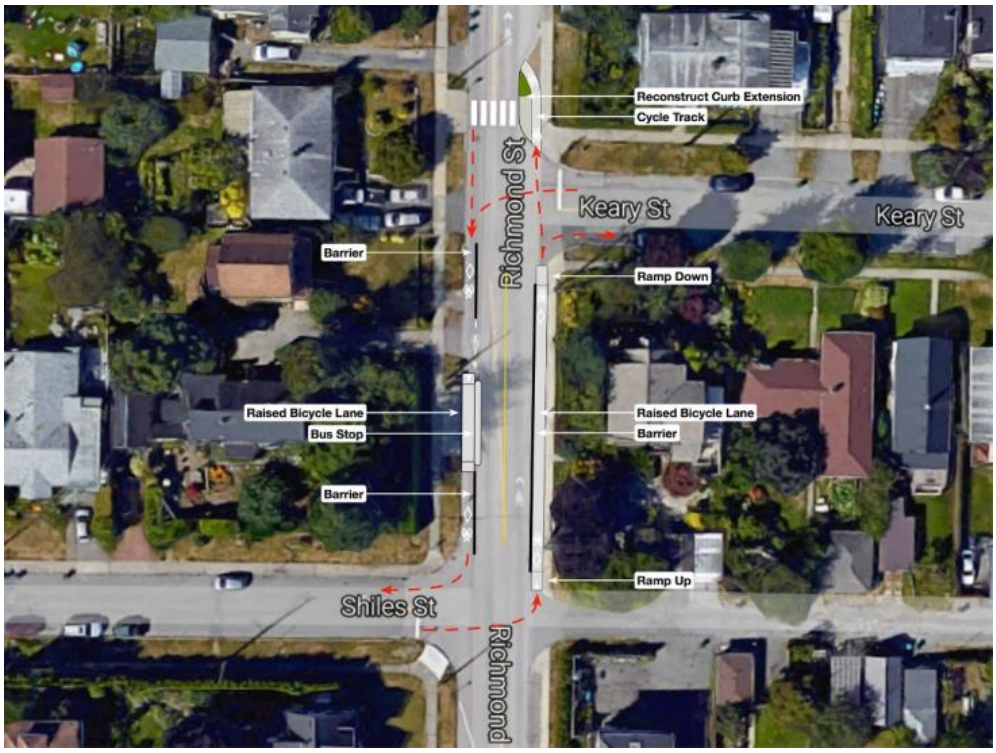
The section of Keary Street east of E. Columbia Street could be either an on-street bicycle route (as on Keary Street west of E. Columbia Street), or could incorporate protected bicycle facilities. The configuration of this section of Keary Street and the preferred bicycle facility would be determined through consultation with Fraser Health and other stakeholders, and depends on plans for the redevelopment and expansion of the hospital as well as the extent to which it is desirable to retain on-street parking.

For the short section of the Crosstown Greenway on Richmond Street between Shiles and Keary Streets, protected bicycle lanes could be constructed as illustrated on *Figure 5-4* to accommodate cyclists of all ages and abilities who might not be comfortable riding on Richmond Street where traffic volumes are much higher than on the other neighbourhood streets that the Greenway follows:

- The southbound protected bicycle lane on the west side of Richmond Street would be compatible with the existing bus stop, and would be raised through the bus stop to maintain access for transit passengers and indicate that pedestrians have priority in this section of the bicycle lane.
- On the east side of Richmond Street, the northbound protected bicycle lane could be implemented by converting the 1.5 m wide paved boulevard between the sidewalk and the road to a bicycle lane by adding ramps at each end and a barrier.
- To accommodate cyclists continuing northbound on Richmond Street, it will be necessary to reconstruct the existing curb extension on the east side of the crosswalk on the north side of Keary Street to incorporate a short "cycle track" that runs across the curb extension, as shown in the figure. This will prevent cyclists travelling northbound from having to abruptly swerve to the left at the crosswalk.

With the Crosstown Greenway rerouted to Keary Street, the section of Sherbrooke Street between Richmond and E. Columbia Streets would no longer be part of the Greenway and would not be signed as a bicycle route.

Figure 5-4 Conceptual Option – Protected bicycle lanes on Richmond Street at Keary / Shiles Streets



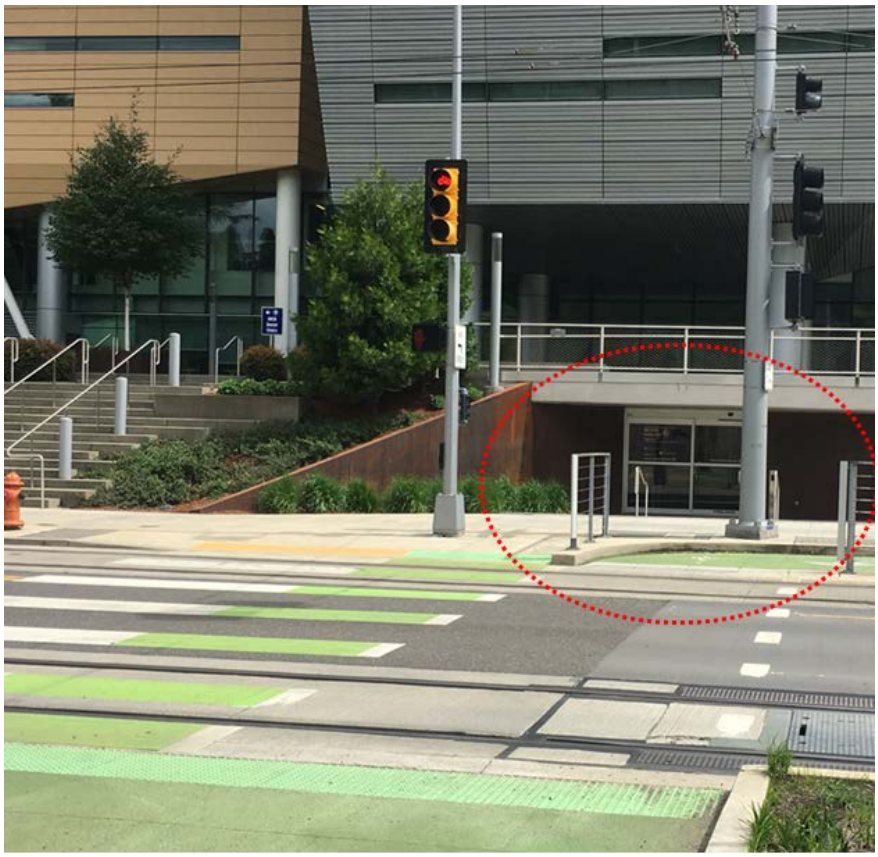
Other improvements on the Crosstown Greenway through the study area include:

- A median island, curb extension and pavement markings, including signs on the island of an appropriate size and height, could be implemented on E. Sixth Avenue to facilitate the jog between E. Seventh Avenue and Shiles Street, as illustrated on *Figure 5-4*. These improvements also incorporate a reconfigured intersection at E. Seventh Avenue closer to 90 degrees to improve intersection safety for cyclists, pedestrians and motorists.
- Stop signs on Shiles Street at Devoy Street could be switched to be oriented north-south, to accommodate cyclists on Shiles Street and improve safety.
- A sidewalk on the south side of E. Seventh Avenue from west of Cumberland Street to E. Sixth Avenue, as described in *Section 5.3* above.
- Improvements to the connection through the Canada Games Pool and Justice Institute sites between Cumberland Street and McBride Boulevard. Currently, this connection is comprised of an asphalt pathway, a concrete sidewalk, a parking lot and a service lane. An improved connection should better delineate the Crosstown Greenway route, provide a wider facility with adequate geometry and clearances, improve illumination, increase the visibility of users to reduce personal security concerns (including trimming of vegetation), reducing the conflicts / exposure of users to vehicular traffic on the site, and remove any blind corners around buildings. Achieving this will involve discussions with the operators of the pool and other stakeholders, and may be best achieved through the Canada Games Pool redevelopment. See *Figure 5-5.*
- Protected bicycle facilities on Sherbrooke Street at Fader Street to facilitate the jog between Fader Street and the lane on the east side of the hospital, as illustrated in *Figure 5-7* and described in the discussion of the Central Valley Greenway in *Section 5.3.2.*
- Additional signs and pavement markings to improve wayfinding and identify bicycle facilities.
- A direct entrance for cyclists to enter the Royal Columbian Hospital cycle room from the Greenway could be integrated with the future phases of redevelopment as shown in *Figure 5-6.*

Figure 5-5 Conceptual Option – Intersection reconfiguration on E. Sixth Street at E. Seventh Avenue



Figure 5-6 Royal Columbian Hospital Bike Room Entrance



Source: City of New Westminster

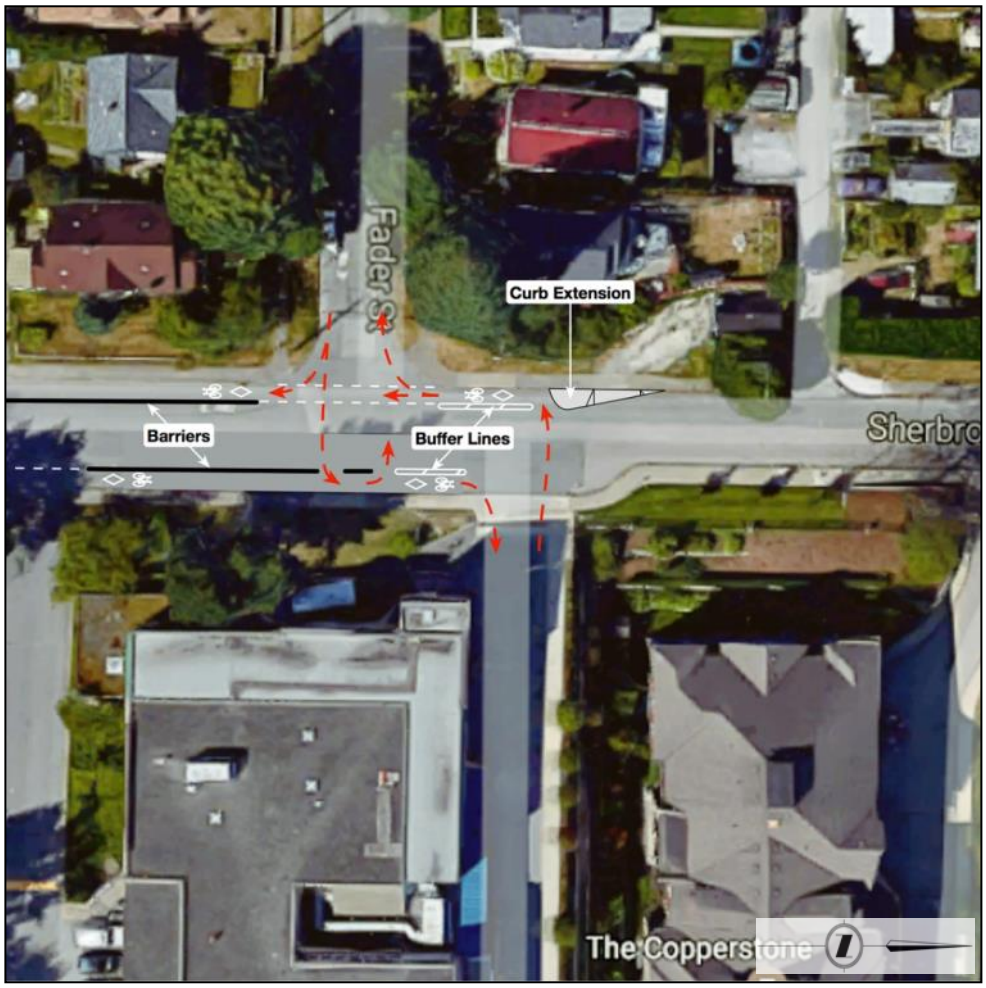
5.3.2. Central Valley Greenway

The Central Valley Greenway extends along E. Columbia Street from Begbie Street in downtown New Westminster (where it connects with the BC Parkway) to Sherbrooke Street in Sapperton, where it then jogs along neighbourhood streets to Hume Park (following the same alignment as the Crosstown Greenway, and connecting with the Brunette Fraser Greenway).

The only recommended change to the alignment of the Central Valley Greenway would be to eliminate the existing jog in the route between Cumberland and Debeck Streets by continuing the 3m-wide (minimum) pathway on the west side of E. Columbia Street northbound from Cumberland Street. This new pathway would be a continuation of the pathway south of Cumberland Street, and could be constructed as part of the project to reconfigure the E. Columbia Street–Brunette Avenue intersection and with new development.

Figure 5-7 illustrates how the protected bicycle lanes could terminate at Fader Street and the lane on the east side of the hospital, allowing for all cyclist movements between connecting routes. Buffer lines instead of barriers at the east ends of the bicycle lanes would accommodate large trucks turning into and out of the hospital loading area. Further analysis may be required as part of the RCH Redevelopment which may result in this concept being modified.

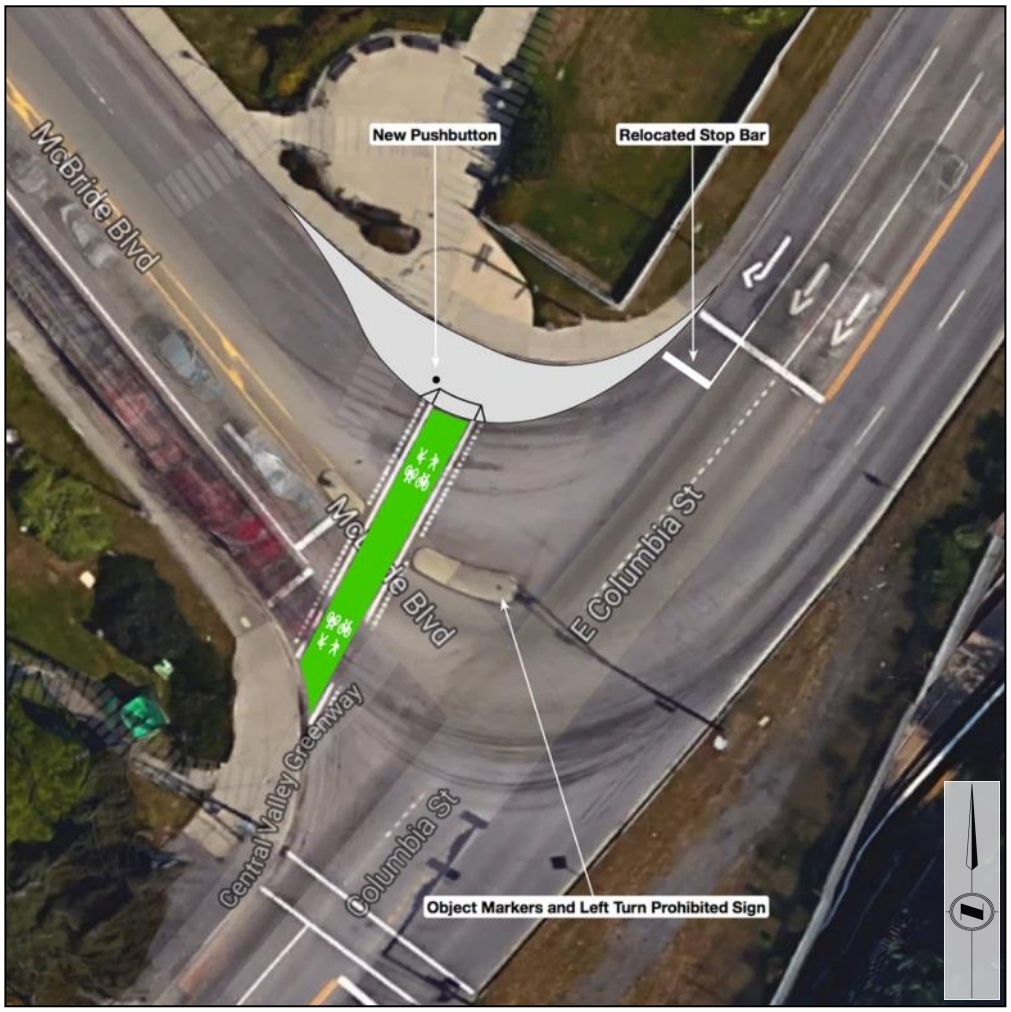
Figure 5-7 Conceptual Option – Protected bicycle lanes on Sherbrooke Street at Fader Street



Another improvement on the Central Valley Greenway is at the crossing of McBride Boulevard at E. Columbia Street. Due to the Heritage retaining wall at this intersection, motorists turning right from eastbound E. Columbia Street to northbound McBride Boulevard often do not yield to pedestrians and cyclists in the crossing, and disregard signage that indicates that right turns are permitted on a green signal only. Improvements at this crossing, all of which must allow for truck (WB-20) turning movements, are illustrated on *Figure 5-6*, and include:

- A curb extension on the northwest corner to position pedestrians and cyclists where they would be more visible to right-turning motorists, and to reduce the crossing distance
- A relocated stop bar for right-turning motorists placed further forward to provide motorists with a better view of pedestrians and cyclists approaching the crossing
- Green pavement colouring and pavement markings to increase the visibility of the crossing and highlight for pedestrians, cyclists and motorists that it is a potential crossing zone
- Standard RB-17R “Right Turn on Red Prohibited” signs to replace the existing and confusing right turn restriction signs
- Object markers to increase the visibility of the median island to motorists, with a “Left Turn Prohibited” sign facing north/eastbound motorists

Figure 5-8 Conceptual Option – Crossing improvements on McBride Boulevard at E. Columbia Street



Other improvements on the Central Valley Greenway through Sapperton include:

- Gravel sections of the Central Valley Greenway (shared with the Brunette Fraser Regional Greenway) should be paved with asphalt west of the Braid Street SkyTrain station and at Hume Park
- Additional signs and pavement markings to improve wayfinding and identify bicycle facilities
- Other measures could be implemented in response to the City's 30km/h speed limit on designated bike routes policy after a monitoring period

5.3.3. Cariboo Connector Bicycle Route

Figure 5-3 illustrates a new bicycle route that continues north from the Crosstown Greenway via Richmond and Surrey Streets to connect with bicycle routes in Burnaby through Massey-Victory Heights (it is worth noting that Surrey Street is already shown on Burnaby's bicycle map as a bike route into New Westminster from Cariboo Road). It provides a suitable bicycle connection between Sapperton and Massey-Victory Heights that utilizes some existing and proposed road and intersection improvements to support a safe connection across 8th Avenue.

Although it involves a climb up to E. Tenth Avenue, this new route would be attractive to cyclists as Richmond Street is relatively flat north of Sherbrooke Street, and Surrey Street is a constant grade of approximately 5%, before connecting to the existing pathway in Cariboo Park.

The new Cariboo Connector route incorporates an improved crossing for cyclists across E. Tenth Avenue at Richmond Street. A benefit of the crossing improvements is restrictions on motorists turning right from Surrey Street to E. Tenth Avenue and then left into Cariboo Road, which, as discussed in *Section 5.4.4*, would reduce short-cutting via Surrey Street and prevent motorists from making unsafe manoeuvres through the Cariboo Road intersection.

The proposed Surrey Street / E. Tenth Avenue intersection is illustrated in *Figure 5-9*.

Two-way traffic and parking is maintained on both sides of Surrey Street, and would accommodate cyclists travelling in both directions. The existing right turn to E. Tenth Avenue would be maintained, but a new barrier on E. Tenth Avenue would constrain motorists turning from Surrey Street to continue eastbound along E. Tenth Avenue, preventing them from turning left to Cariboo Road. This would reduce short-cutting traffic on Surrey Street and improve intersection safety without altering the traffic and parking configuration on Surrey Street. As a result, Surrey Street could function as a two-way local street bicycle route with no need for bicycle-specific infrastructure, similar to bicycle routes on other local streets in Sapperton unless additional measures are warranted.

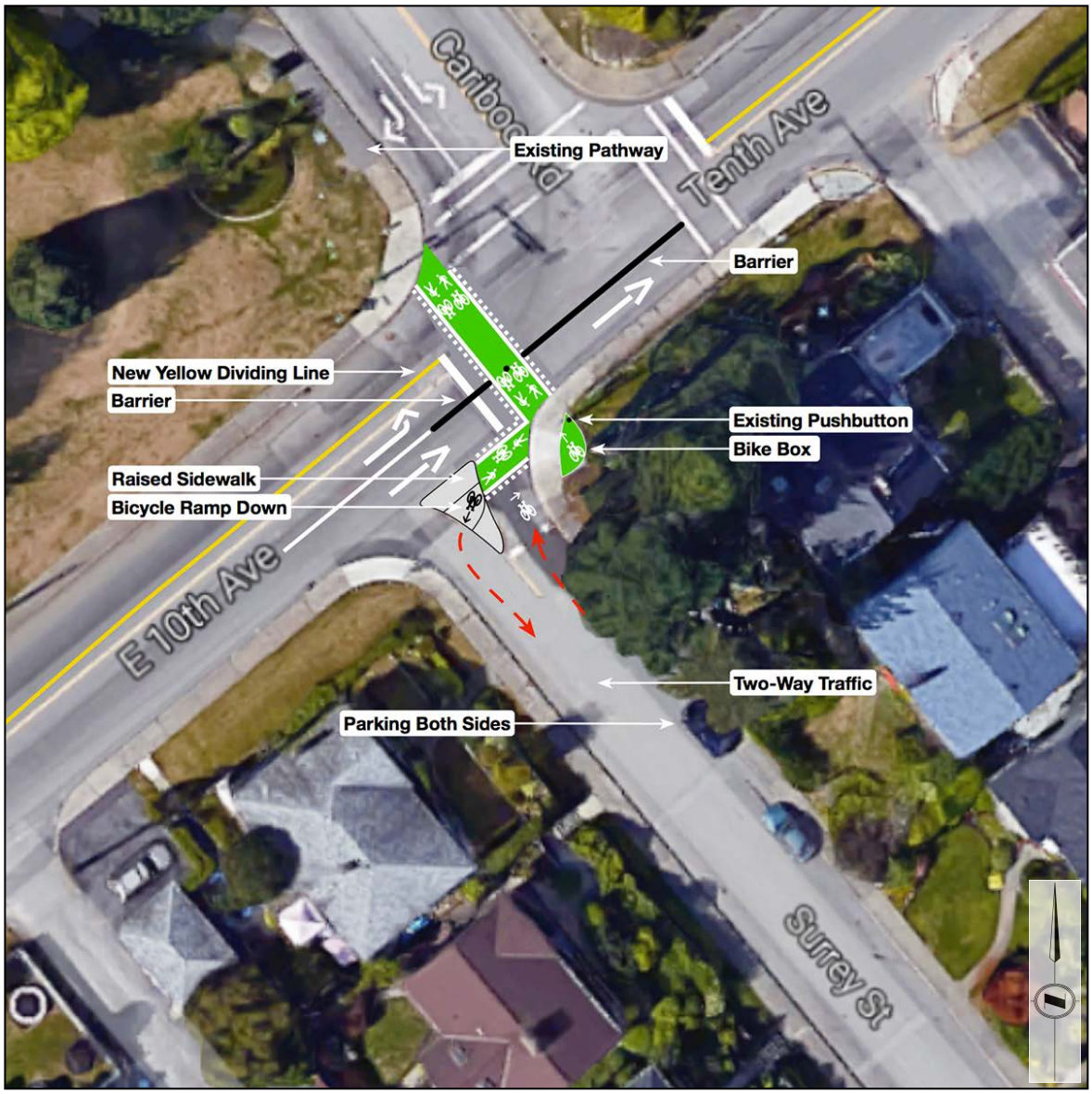
The 10.7 m width of E. Tenth Avenue at Cariboo Road could be reconfigured with a 3.6 m westbound lane, a 3.3m eastbound left turn lane, a 0.3 m barrier and a 3.5 m eastbound through lane, as illustrated on *Figure 5-9*. Eastbound motorists already arrange themselves into two lanes at the Cariboo intersection (one for left turns and one for through traffic), and this option would simply formalize that behaviour, as well as adding a barrier to prevent access to Cariboo Road from Surrey Street. The barrier would only need to be approximately 150 mm high, enough to prevent motorists from Surrey Street from driving over it.

For cyclists, this option converts the existing pedestrian crossing across E. Tenth Avenue to a multi-use crossing complete with green markings and elephants' feet. A bike staging area can be added in the existing hard surface area where northbound cyclists can press the pushbutton and wait for the signals to change. For pedestrians, the existing barrier on the back of the sidewalk should be relocated to the curb, so that the sidewalk is behind the barrier. The sidewalk would need to be widened to maintain accessibility for people using wheelchairs and other pedestrians.

It should be noted that these improvements are subject to support from the City of Burnaby, as they are responsible for E. Tenth Avenue corridor operations.

> Another option considered for Surrey Street converted Surrey Street into a one-way southbound with parking restrictions on the east side to allow for a two-way cycling facility. This option received significant opposition by local residents and therefore was not advanced any further.

Figure 5-9 Conceptual Option – Surrey Street 2-way traffic with barrier on E. Tenth Avenue



5.4. Traffic Calming

This section presents traffic calming plans and measures throughout Sapperton and Massey Victory Heights intended to mitigate or eliminate the impacts of unwanted traffic on neighbourhood streets. For the purposes of traffic calming, the study area has been divided into four areas, described in *Section 5.4.1* through *5.4.4*.

The primary challenge in developing a traffic calming plan is to find an appropriate level of access restriction. The issue is the extent to which residents and businesses in an area will accept restrictions to motor vehicle access in order to keep unwanted traffic off neighbourhood streets, recognizing that such restrictions also affect access for residents, visitors and customers of businesses in the area. In considering access restrictions it is also important to anticipate how traffic might shift to other streets, and avoid creating or exacerbating traffic impacts elsewhere in the neighbourhood.

Restricting access is not the only way to calm traffic, however. It is also possible to mitigate speeding, poor driver behaviour and other negative impacts of traffic with traffic calming measures that do not restrict motor vehicle access. In many cases such an approach can mitigate traffic impacts sufficiently to satisfy the majority of residents and businesses in a neighbourhood without access restrictions.

Recognizing this trade-off between access restrictions and traffic impacts, two traffic calming options were presented for the Sapperton and Lower Sapperton areas as these areas were seen to be the most problematic communities in the study area from community feedback. In both cases, the preferred plan does not restrict access, instead incorporating measures to help ensure that any motorists who do drive through the neighbourhood do so at appropriate speeds and in a safe manner. The alternative plans incorporate access restrictions, and are included primarily to contrast the benefits and impacts of the two approaches to traffic calming.

5.4.1. Lower Sapperton Traffic Calming Plan

The Lower Sapperton area is bounded by E. Columbia, Sherbrooke, Braid and Rousseau Streets. The key issue in this area is short-cutting and speeding traffic that predominantly travels through the neighbourhood in a southwest-to-northeast direction during the afternoon, but also in the reverse northeast-to-southwest direction during the morning, primarily trying to bypass the traffic congestion on Braid Street and/ or E. Columbia Street. Key findings from traffic data collected in November 2016 include:

- Traffic volumes on Sherbrooke Street between Kelly and Fader Streets are as high as 2,478 vehicles per day, and during the weekday afternoon peak hour over 200 vehicles travel eastbound on Sherbrooke Street.
- Traffic volumes on Rousseau Street between Major and Braid Streets are as high as 1,570 vehicles per day. 40% of northbound vehicles exceed the 50 km/h speed limit, with some vehicles recorded travelling faster than 70 km/h.
- The existing speed humps on most blocks and traffic circles along Major Street appear to be discouraging speeding. Average daily 85th percentile speeds on Kelly and Fader Streets range from 31.5 km/h to 37.8 km/h.

Two different approaches to resolving traffic and safety issues in Lower Sapperton were presented to the community, with the majority of residents expressing support for the traffic calming measures illustrated on *Figure 5-10*. The differences between the two alternative plans and the disadvantages of the second plan are discussed in the following paragraphs.

Figure 5-10 Lower Sapperton Traffic Calming Measures

Lower Sapperton Traffic Calming:

- Maintain existing measures
- Mitigate effects of short-cutting traffic without overly obstructing access

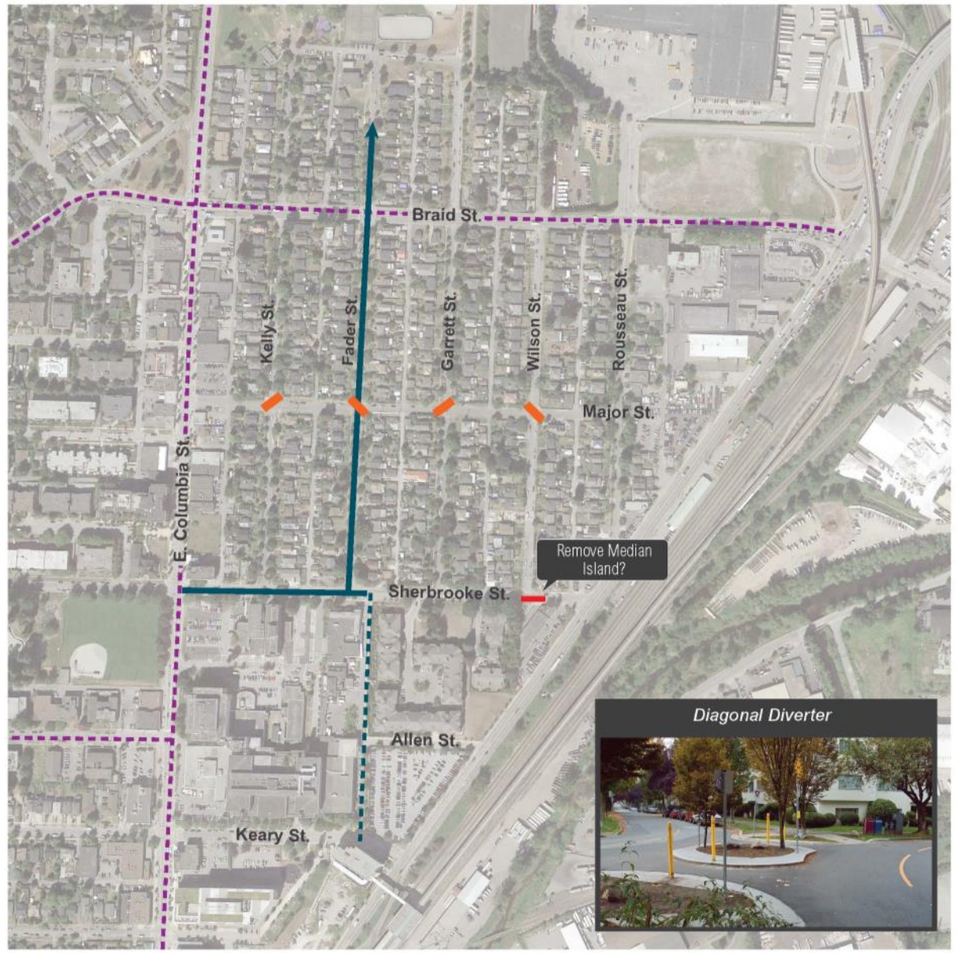
Proposed



Sapperton Traffic Calming:

- Obstruct through access (residents can use adjacent parallel lanes for local access)

Alternative Option Considered



LEGEND

Traffic Circle | Speed Hump | Bus and Ambulance Routes | Existing Bicycle Route | Proposed Bicycle Route (Fraser Health property) | Diverter (Remove existing traffic circles) Existing speed humps to be removed over time

The preferred traffic calming plan is a continuation of the existing traffic calming measures in the area, and seeks to mitigate the impacts of short-cutting traffic without obstructing access for residents. Key features of the preferred traffic calming plan include:

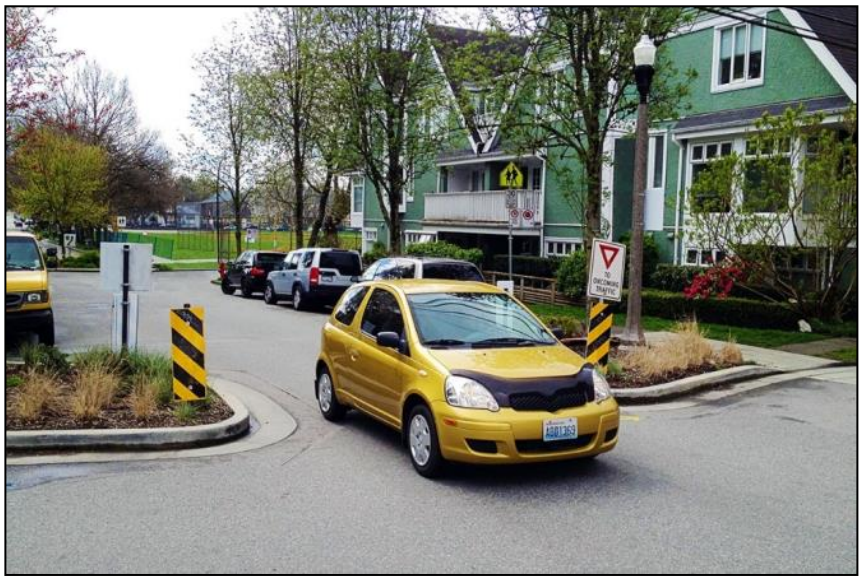
- Existing speed humps and traffic circles would be retained, as would the median island on Sherbrooke Street at Wilson Street.
- A traffic circle would be added at the Kelly Street–Major Street intersection to discourage commercial traffic from using Kelly Street.
- One speed hump would be added on Garrett Street, and two speed humps each would be added on Wilson and Rousseau Streets, so that there are two speed humps on each north-south street in the area. Adding any more speed humps over penalizes the local residents on these streets, however the situation should be monitored post implementation.
- Pinch points would be implemented on Cedar and Ward Streets west of E. Columbia Street. As shown on *Figure 5-11*, a pinch point is only wide enough for a vehicle to pass though in one direction at a time, requiring motorists to yield to oncoming traffic and discouraging short-cutting. The pinch points would separate the commercial section of each street from the residential section to the west, discouraging motorists travelling to and from businesses on E. Columbia Street from driving on residential streets.

The alternative traffic calming plan for Lower Sapperton follows the approach of obstructing short-cutting traffic, but in doing so also restricts access for residents. The plan incorporates four diagonal diverters on Major Street at Kelly, Fader, Garrett and Wilson Streets, replacing the existing traffic circles. Diagonal diverters are the only effective way to block short-cutting and speeding traffic that travels in both directions through the neighbourhood. Other measures such as right-in/right-out diverters and directional closures would only obstruct short-cutting traffic in one direction on any particular street, and as a result would shift traffic from one Neighbourhood Street to other streets or even lanes behind homes, and could also encourage unsafe manoeuvres on Sherbrooke Street to circumvent restrictions.

Neither plan includes a traffic circle or diagonal diverter at the Rousseau Street–Major Street intersection due to commercial uses on Rousseau Street that generate truck traffic. In the future, when existing commercial uses are redeveloped to residential uses, a traffic circle could be constructed at this intersection. In the interim, the all-way stop control is not recommended. All-way stop controls are often not complied with, and at this intersection the predominant short-cutting movement from eastbound Major Street to northbound Rousseau Street would likely be facilitated by this all-way stop control due to the “T” configuration of the intersection and the imbalance between traffic volumes on Rousseau and Major Streets. This also has associated safety concerns.

The preferred traffic calming plan maintains traffic circles at intersections on Major Street. It has been suggested that the traffic circle at Fader Street could be replaced by a diagonal diverter to discourage through traffic on Fader Street, which is one of the City’s Greenways. While this would benefit cyclists, it is not recommended as it would shift local and short-cutting traffic to other neighbourhood streets, particularly Garrett Street, and could create new traffic and safety issues and exacerbate existing problems.

Figure 5-11 Pinch point (Vancouver)



5.4.2. Central Sapperton Traffic Calming Plan

The Central Sapperton area is bounded by E. Columbia and Richmond Streets. East-west streets in the area are often used by short-cutting traffic, particularly Alberta and Keary Streets (a temporary right-in/right-out diverter was installed on Alberta Street at E. Columbia Street in spring 2015 in an effort to discourage short-cutting traffic). There is also a considerable amount of traffic on Richmond and Sherbrooke Streets, even though both are classified as local streets. Traffic data collected in November 2016 indicates that:

- Maximum weekday traffic volumes on east-west streets between Richmond and E. Columbia Streets are 603, 1,776 and 2,898 vehicles per day (vpd) on Simpson Street, 1,776 vpd on Keary Street, 2,898 vpd on Sherbrooke Streets, and 1,113 vpd on Hospital Street.
- Weekday traffic volumes in the lane between Simpson and Keary Streets (which connects directly to Shiles Street at Richmond Street) are as high as 171 vehicles per day, as compared with less than half that volume on the weekend.
- Before the diverter was installed on Alberta Street at E. Columbia Street, the weekday traffic volume on Alberta Street was 1,164 vehicles per day. After the diverter was installed, weekday traffic volumes range from 392 to 651 vehicles per day.
- Weekday traffic volumes on Strand Street are as high as 377 vehicles per day. Residents of Strand Street and Keary Street have reported that traffic volumes have increased substantially since the right-in/right-out diverter was installed on Alberta Street.
- Average daily 85th percentile traffic speeds on east-west streets between Richmond and E. Columbia Streets range from 42.0 km/h on Simpson Street to 49.4 km/h on Keary Street, and 47.4 km/h on Hospital Street.
- During daylight hours when the 30 km/h playground zone is in effect on Sherbrooke Street between Buchanan Avenue and E. Columbia Street, 85th percentile traffic speeds often exceed 50 km/h, and approximately 2% of vehicles were recorded exceeding 70 km/h.
- Weekday traffic speeds on Richmond Street north and south of the 30 km/h school zone at Richard McBride Elementary School range from 52.9 km/h to 57.0 km/h. Although these speeds were recorded outside the school zone, they suggest that traffic speeds through the school zone are well in excess of the 30 km/h speed limit.
- Weekday traffic volumes on Richmond Street are as high as 5,117 vehicles per day south of Sherbrooke Street and 6,844 vehicles per day south of Alberta Street.

Traffic calming measures for Central Sapperton are shown on *Figure 5-12.*

The preferred traffic calming plan seeks to mitigate the impacts of short-cutting traffic without obstructing access for residents, and incorporates:

- Speed humps on Keary, Simpson, and Alberta Streets and Strand Avenue (where grades are 8% or less) to discourage speeding and shortcutting. As described in *Section 5.3.1*, the Crosstown Greenway is recommended to be rerouted to Keary Street, and speed humps are compatible with bicycle routes and do not negatively impact cyclists. *Figure 5-13* provides an example of a speed hump on an 8% grade on a bicycle route. It should be noted that it is not possible to install speed humps or other traffic calming measures on Hospital Street as it is a bus route and emergency response route. Further collaboration with TransLink, transit operators and BC Ambulance Service could identify a measure that minimises negative impacts their operations.
- Pinch points on Keary, Simpson, Alberta and Strand Streets approximately 60 m west of E. Columbia Street. As shown on *Figure 5-11*, a pinch point is only wide enough for a vehicle to pass though in one direction at a time, requiring motorists to yield to oncoming traffic and discouraging short-cutting. The pinch points will separate the commercial section of each street from the residential section to the west, which will be particularly important as the properties on the west side of E. Columbia Street are redeveloped. As illustrated on *Figure 5-14*, pinch points can optionally include a speed hump to discourage speeding, and they provide similar benefits as a chicane, but with minimal loss of on-street parking.
- Due to its direct alignment with Shiles Street, speed ramps in the lane between Simpson and Keary Streets are proposed to discourage speeding and short-cutting traffic between Richmond and E Columbia Streets. This recommendation is specific to this location and does not suggest that the City should develop a policy on speed ramps in lanes. Speed ramps are similar to speed humps, but are shorter in length consistent with the lower speed limit in lanes and incorporate a gap in the middle for drainage, as shown on *Figure 5-15*. Although a closure would completely prevent short-cutting through the lane, it would affect garbage / recycling pickup and other large trucks that cannot turn around in the lane and, instead, would have to back up the length of the lane (up to 300 m if the closure was located between the residential and commercial land uses on the lane). The long-term solution when the commercial land uses on the west side of E. Columbia Street redevelop is to “T” the residential lane into a new north-south lane behind the commercial buildings, so that the residential lane no longer extends to E. Columbia Street, substantially reducing short-cutting through the lane.
- The diverter on Alberta Street at E. Columbia Street would be removed.
- Two speed humps and a pinch point on Sherbrooke Street in the 30 km/h playground zone at Sapperton Park to discourage speeding and any shift in shortcutting traffic to Sherbrooke Street. The pinch point would be aligned with the park entry gate and could incorporate a raised crosswalk.
- Raised crosswalks on Richmond Street at School Street and Hospital Street to improve pedestrian safety and discourage speeding in the 30 km/h school zone. The raised crosswalk on the north side of the Hospital Street intersection would also help to encourage compliance with the all-way stop control at this intersection, which is necessary to accommodate buses turning from Hospital Street to Richmond Street. It should be noted that a raised crosswalk would not be appropriate to the south at Keary Street as this section of Richmond Street is a primary emergency response route. The future redevelopment of the Richard McBride School may require this provision to be re-evaluated at the design stage of the project.

It is also recommended that Griffiths Place intersection with Braid Street be considered as a right-in-right-out to address safety and site-line issues with this location.

Figure 5-12 Central Sapperton Traffic Calming Measures

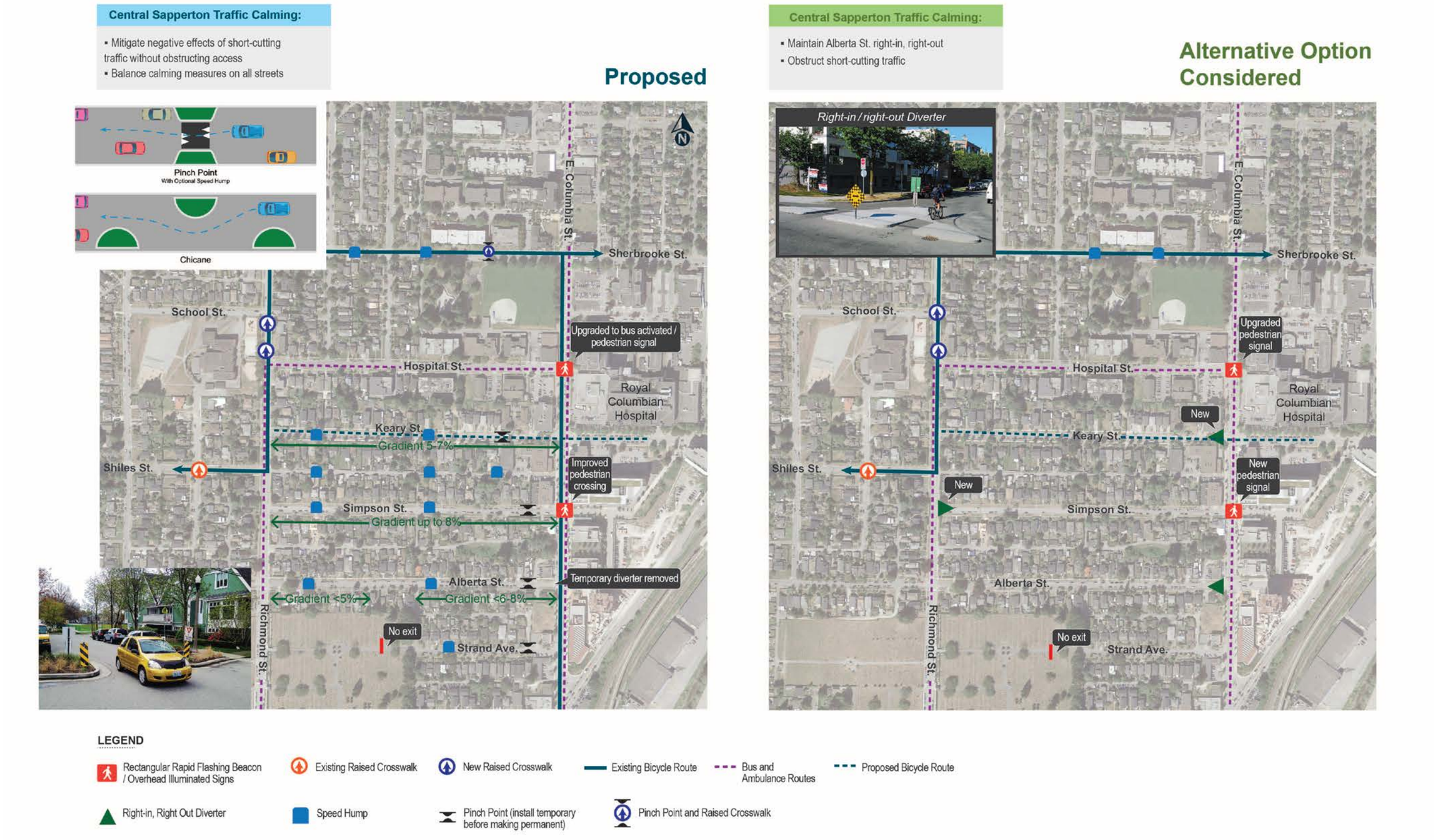


Figure 5-13 Speed hump on 8% grade on bicycle route (Vancouver)



Figure 5-14 Pinch point and chicane comparison

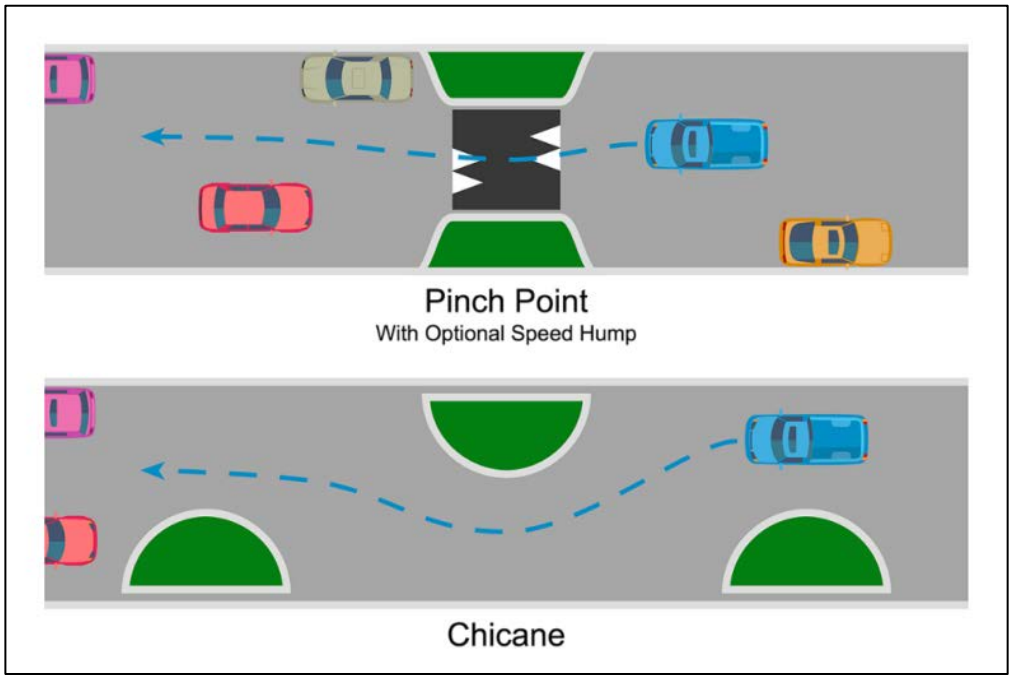


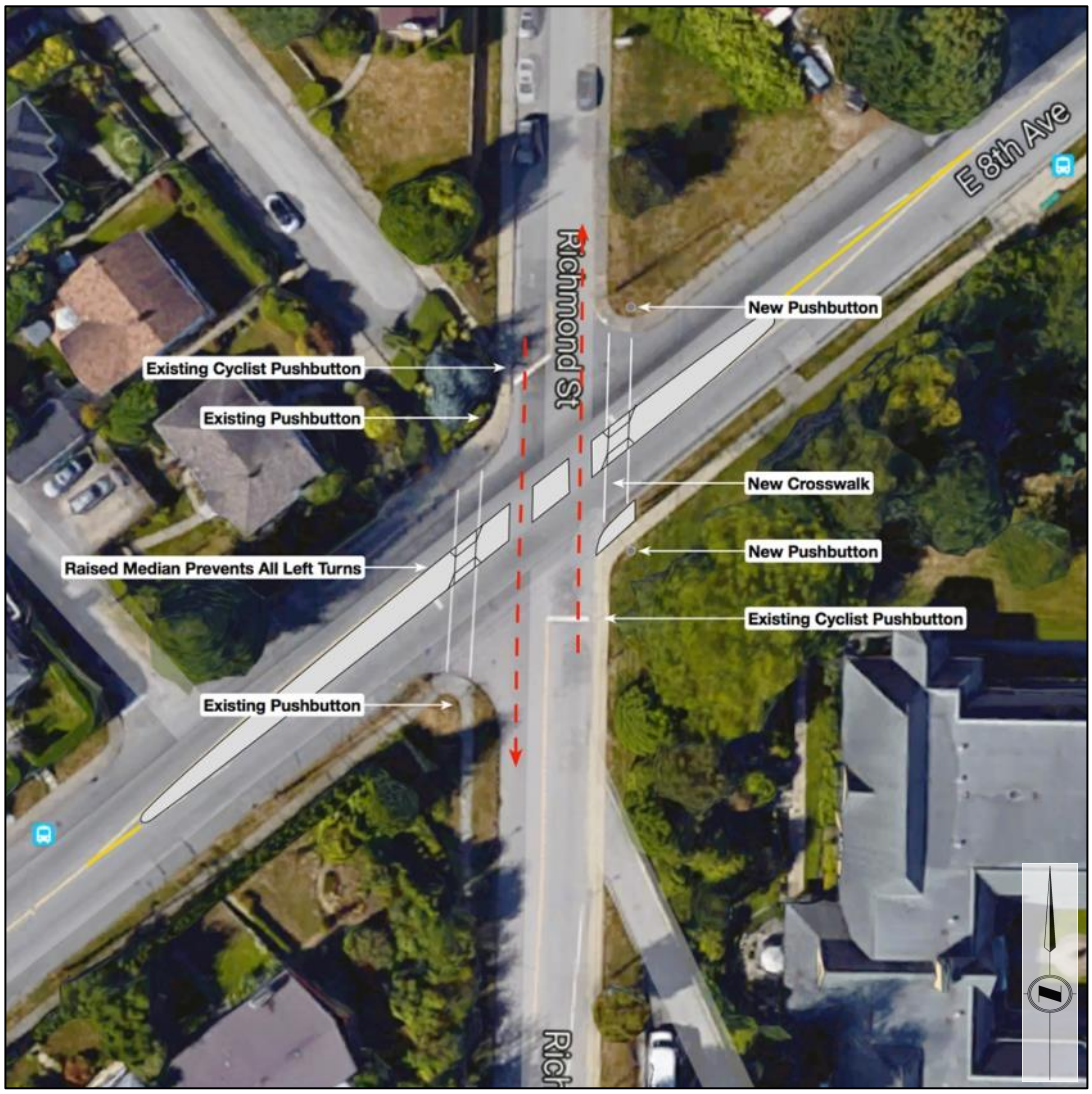
Figure 5-15 Speed ramps in lane (Vancouver)



- A median island through the intersection on E. Eighth Avenue at Richmond Street, as illustrated on *Figure 5-16*. The median island would prevent left turns to and from Richmond Street, as well as prevent through traffic north-south across E. Eighth Avenue. This would significantly reduce traffic volumes on Richmond Street, where traffic volumes are higher than desirable for a local street and bicycle route, and much of the traffic is through traffic not originating in or destined to the neighbourhood. It would be advisable to implement the median island on a temporary basis using concrete barriers to test its effectiveness before constructing a permanent median island. It would also be advisable to monitor traffic volumes and speeds on Blair and Buchanan Avenues to the east and Chilliwack and Cherry Streets to the west to identify any need for additional traffic calming measures in the event that a significant amount of traffic diverts to these streets.
- Painted and/or raised centre medians on Richmond Street between Cumberland and Alberta Streets, which would reduce traffic lane widths as a means of discouraging speeding along this section of Richmond Street, and prevent motorists from crossing the yellow directional dividing line to overtake other vehicles. Richmond Street is 12.9 m wide and could be reconfigured as follows: 2.4 m parking + 3.5 m traffic lane + 1.1 m median + 3.5 m traffic lane + 2.4 m parking. Raised medians could be constructed in short segments so as not to obstruct left turns into and out of the cemetery, and could possibly incorporate landscaping. This section of Richmond Street is not a designated bicycle route but is used by cyclists, so “Share the Road” signs could be installed at each end of the section at Cumberland and Alberta Streets.

The alternative traffic calming option for Central Sapperton followed the approach of obstructing short-cutting traffic, but in doing so also restricted access for residents. The option retained the right-in / right-out diverter on Alberta Street and added new right-in / right-out diverters on Keary Street at E. Columbia Street and on Simpson Street at Richmond Street. It would have also been necessary to consider a diverter or other measure on Sherbrooke Street at Richmond Street to discourage any shift in shortcutting traffic from other streets to Sherbrooke Street.

Figure 5-16 Conceptual Option – Median island on E. Eighth Avenue at Richmond Street



5.4.3. Upper Sapperton Traffic Calming Plan

The Upper Sapperton area is bounded by E. Sixth Avenue, Cumberland Street and Richmond Street. The focus of traffic calming in this area is the E. Sixth Avenue / Cumberland Street intersection, and nearby neighbourhood streets. Traffic data collected in November 2016 indicates that:

- Short-cutting traffic uses Harvey and Dixon Streets to circumvent lengthy traffic queues on Cumberland Street northbound at E. Sixth Avenue. Although traffic volumes on Harvey and Dixon Streets are relatively low (less than 200 vehicles per day on weekdays), traffic during the morning and afternoon peak periods is notable, when peak hour volumes amount to as much as 28% of daily traffic volumes.
- During peak periods, two-thirds to three quarters of motorists on Harvey and Dixon Streets exceed 40 km/h. At off-peak times, 85th percentile speeds are less than 40 km/h.

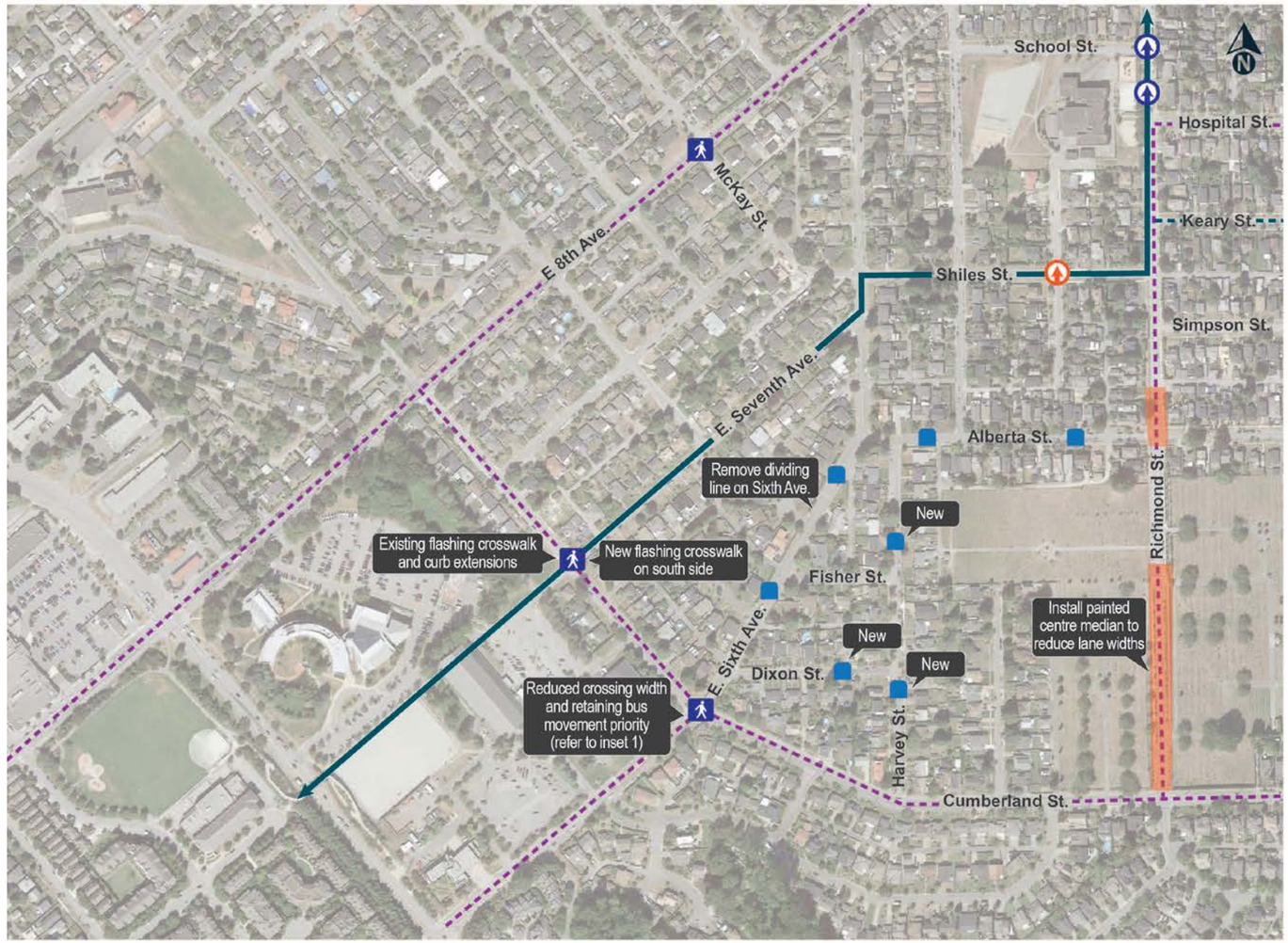
The traffic calming plan for Upper Sapperton can be found on *Figure 5-17* and includes the following measures:

- One speed hump on Dixon Street and one on Harvey Street north of Fisher Street to discourage motorists from short-cutting around the existing two speed humps on E. Sixth Avenue. With these two additional speed humps, any route means driving over two speed humps between Cumberland and Alberta Streets.
- One speed hump on Harvey Street south of Dixon Street to discourage speeding by motorists diverting around traffic queues on Cumberland Street.
- Curb extensions at the E. Sixth Avenue / Cumberland Street intersection to enhance pedestrian visibility and safety, and improve intersection safety.
- Removal of the yellow directional dividing line on E. Sixth Avenue east of Cumberland Street to restore the appearance of a local street (E. Sixth Avenue is classified as a local street) and reduce the impression of a through route.

Figure 5-17 Upper Sapperton Traffic Calming Measures

Upper Sapperton Traffic Calming:

- Additional speed humps to discourage short-cutting via Dixon and Harvey St.
- Remove yellow dividing line on E. Sixth Ave. to restore appearance of local street



Conceptual Option – Curb extensions at E. Sixth Avenue / Cumberland Street



LEGEND

New / Improved Pedestrian Crossing / Signal | Speed Hump | Existing Raised Crosswalk | New Raised Crosswalk | Existing Bicycle Route | Proposed Bicycle Route | Bus and Ambulance Routes

5.4.4. Massey–Victory Heights

Within the Massey–Victory Heights area, the primary traffic issue is motorists short-cutting between E. Eighth and E. Tenth Avenues, particularly to and from Cariboo Road. In particular, Surrey and Chilliwack Streets have been communicated to be popular short-cutting routes. Traffic data collected in November 2016 indicates that:

- Three-quarters of the traffic on Surrey Street is travelling northbound, indicating a significant proportion of short-cutting traffic, and average daily 85th percentile speeds are up to 7 km/h higher for northbound vehicles.
- Traffic volumes on Chilliwack Street are acceptable for a street of this nature (up to 466 vehicles per day), average daily 85th percentile traffic speeds are low, ranging from 24.1 km/h to 26.9 km/h.

The traffic calming plan incorporates modifications at the Surrey Street / E. Tenth Avenue intersection, described in *Section 5.3.3*. The proposed improvement incorporates a barrier through the Cariboo Road intersection to constrain right-turning motorists from Surrey Street to continuing east along E. Tenth Avenue. This would discourage motorists from short-cutting via Surrey Street and would prevent them from making unsafe manoeuvres to turn left onto Cariboo Road after turning from Surrey Street.

Discouraging short-cutting traffic from using Surrey Street would eliminate up to half of the daily traffic on Surrey Street. The City should monitor traffic conditions on nearby streets, particularly Ladner Street and Burnaby Street, to determine if there has been a significant diversion of short-cutting traffic requiring additional traffic calming measures on these streets. There have been reports of short-cutting traffic on Ladner Street, however further data is required post intervention.

Advanced queueing flashing beacons could be added on the eastbound direction of Holmes Street (near Garfield Street) and E. 8th Avenue (near Winthrop Street) to provide drivers with advanced warning of vehicles queueing back from the signals in the afternoon peak hour. This helps drivers given the grades and site-distances at these locations.

It is also recommended to install speed humps on Cumberland Street adjacent to F.W. Howay Elementary School in an effort to keep vehicle speeds at an acceptable level along the school frontage.

5.4.5. Victoria Hill

Through community engagement, the City received feedback about vehicles cutting-through Victoria Hill, along with some high vehicle speeds. The City has recently worked with the developer to implement a new raised crosswalk on E. Royal Avenue and is assessing concerns raised about the proximity of the pedestrian crossing at the intersection of Ross Drive and E. Royal Ave. It is recommended that the crossing be considered for relocation closer to the intersection to make pedestrians more visible and reduce potential conflicts.

Traffic counts undertaken in community during 2017 show acceptable vehicle volumes and speeds (average 1700 vpd & 35km/h) for streets of this nature and adjoining land use densities. It is also evident that the peak period is generally between 14:30 and 18:00 which is consistent with the rest of the City (recognising the school peak, and FHA facility nearby).

Counts undertaken along Memorial Drive in 2018 do not show any abnormalities or travel behaviour that could be of significant concern or that require further measures to be taken. A progressive measure that could be considered to manage vehicle speeds and increase the presence of pedestrians in the community would be to raise the pedestrian crossing at the intersection of Ross Drive and Memorial Drive.

In addition to the Plan, the City is currently undertaking a parking study in the community that may recommend some measures to improve/ better manage the supply and demand of on-street parking, which are out of the scope of the Plan.

5.4.6. Braid Industrial Area

Through the community engagement, there was no record of the need to provide traffic calming measures within this part of the City. The City does recognise the challenges with Braid Street (Brunette Ave – Bailey Bridge) given the impacts that the at-grade rail crossings have on access and circulation, however it is recommended to integrate any improvements in this area with future developments with the Brunette Interchange Project.

6. Parking

The Sapperton parking plan presents a balance between the needs of the City, residents and businesses in a neighbourhood seeing a significant amount of new developments in addition to the RCH expansion. It is intended to reinforce existing regulations and facilitate appropriate use of on-street parking for both residents and businesses. To further support this, as part of the RCH rezoning process a separate RCH Parking Strategy, including Travel Demand Management (TDM) Strategy, is required to demonstrate how the hospital will manage its growth over time.

A parking plan for the neighbourhood is key to ensure that the foreseeable development in Sapperton and Massey-Victory Heights is being managed to ensure the community is more functional, livable, and safer for all users who should be able to navigate throughout the neighbourhood with relative ease and park at or within a reasonable distance from their destination.

The parking plan serves multiple purposes:

- **Safety**: the plan will manage on-street parking, in accordance with City bylaws, to ensure that parking is only permitted in areas that do not negatively impact the safety of all road users.
- **Prioritise Users**: the plan is designed to balance the supply of on-street parking to meet the needs of residents, local businesses, visitors, loading, local attractions (e.g. parks), SPARC card users, and car-share. It is also designed to deter employees and visitors from parking in the residential neighbourhood for extended periods of time.
- **Consistency**: the plan will ensure consistency in practices and application so that it is clear, and will enable more systematic enforcement.

The first stage of the parking plan aims to coincide with the completion of Phase 1 of the RCH Redevelopment in spring 2020, along with a number of other major developments anticipated to be underway or complete around 2020.

The second stage is expected to be implemented to coincide with the completion of the remaining foreseeable developments in the Sapperton area, including Phases 2 &3 of the RCH redevelopment between 2020 and 2026 and the Sapperton Green Master Planned Community. With project development of the New West Aquatic Centre progressing at a rapid pace, the new facility may trigger the need for site specific parking management in the adjacent community which should be identified through the Transportation Impact Assessment. The timing should align with stage 2, and should be identified in the TIA recommendations.

6.1. Existing Conditions

The existing parking conditions are shown in *Figure 6-1*. As can be seen, there are varying parking durations, gaps in permitted areas, and overall inconsistencies making parking challenging for residents, businesses, customers, bylaw enforcement offices, and Royal Columbian Hospital patients, visitors, and employees.

From an implementation and enforcement perspective, the City can regulate on-street parking, visitor parking, local business parking (on-street) and new development parking requirements. However, the City does not have the ability to implement or enforce parking or transportation demand management strategies for private businesses and RCH, but will work with these employers to create a comprehensive parking system that also encourages use of active transportation modes and transit.

A consequence of high parking demand is that occupancy over 85% on roadways can create an increase in vehicles circulating the neighbourhood and can lead to illegally parked vehicles, resulting in safety hazards for pedestrians, cyclists and other drivers.

Removal of Paid Parking for Multi-Modal Improvements

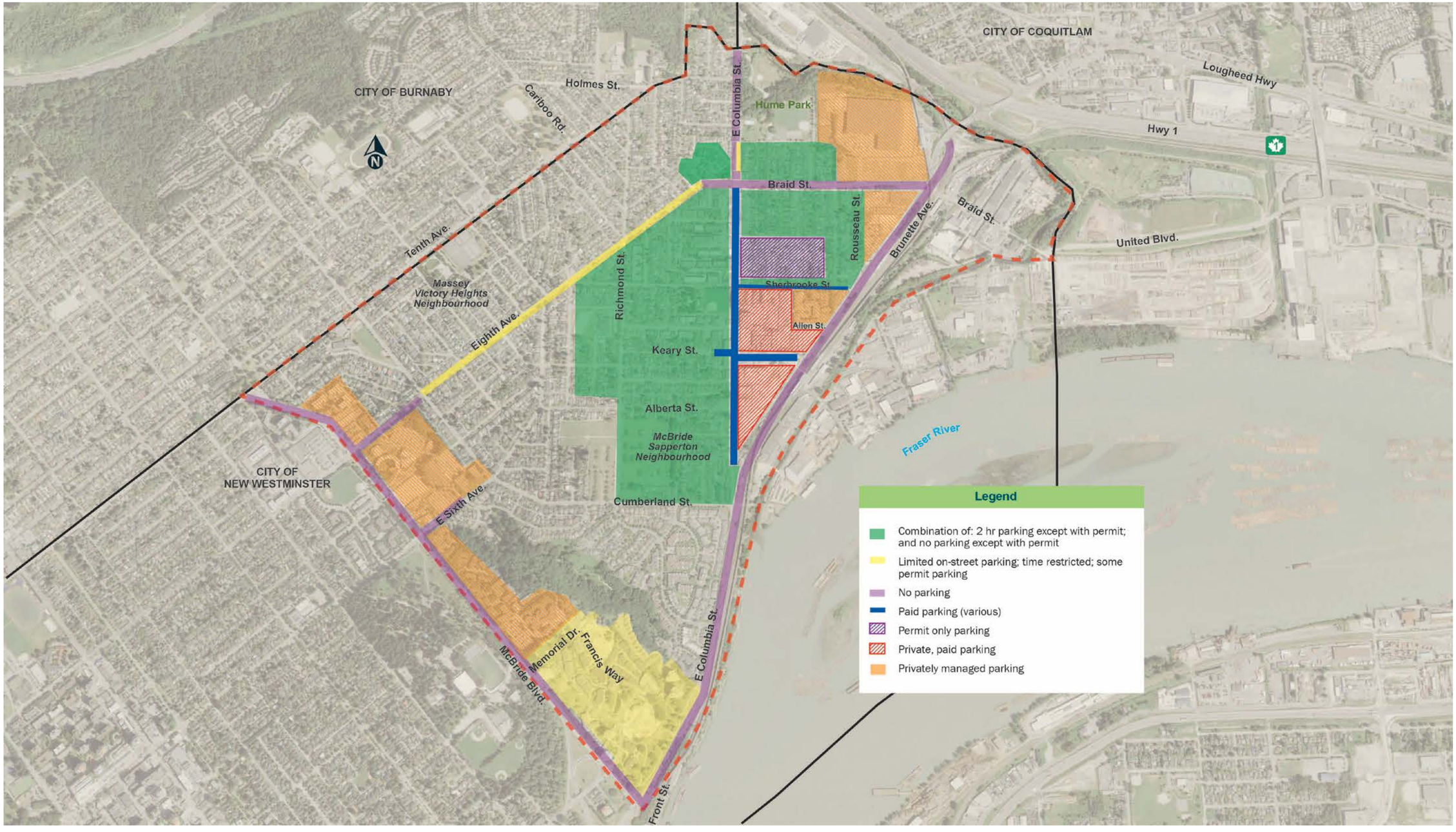
Part of the Sapperton/ Massey Victory Heights Transportation Plan includes improvements to the active transportation network that will require the removal of some on-street parking spaces to accommodate multi-modal improvements.

The bike plan, for example, recommends improving the existing bicycle route on E. Columbia and Sherbrooke Streets to establish protected facilities. These improvements would impact the paid parking on the west side of E. Columbia Street south of Sherbrooke Street, and on Sherbrooke Street (south side) between E. Columbia Street and Fader Street. These improvements will result in the loss of approximately 30 on-street parking spaces on E. Columbia Street and 25 on Sherbrooke Street, for a total of 55 paid parking spaces lost. However, some of these spaces could be maintained through the RCH redevelopment. Combined with the proposed increase to paid parking supply along side streets (90 new spaces) west of E. Columbia Street, the commercial area would have an overall gain of approximately 35 on-street paid parking spaces.

Hume Park

As residential developments come to fruition and with Hume Park being a desirable recreational location, parking demand will increase. In the long term, the City should consider the implementation of paid parking at Hume Park to incentivize the use of other modes to access the park, create more consistent parking turn over, and, in so doing, better regulate the demand and supply ratio. There are precedents for paid parking at city parks in other municipalities across the Lower Mainland and, in many instances, park users have come to anticipate paying for parking as long as the rate is reasonable.

Figure 6-1 Existing Conditions General Parking Regulations



6.1.1. Residential Permit System

Permit parking was initially installed in response to situations where a chronic and heavy demand for on-street parking after the construction of the SkyTrain line. The area expanded over time to respond to resident concerns about pressures from key businesses, attractors and/ or generators within the community.

Permit parking allows residents to have priority parking over other users in signed permit parking areas on their block. Permit parking does not guarantee permit holders the right to park in front of their own homes. In fact, permit parking does not guarantee a parking space at all; it only gives permit holders an advantage over non-permit holders, but it is not intended to address short-term intermittent parking problems generated by such activities as local businesses, events, parks, churches and construction.

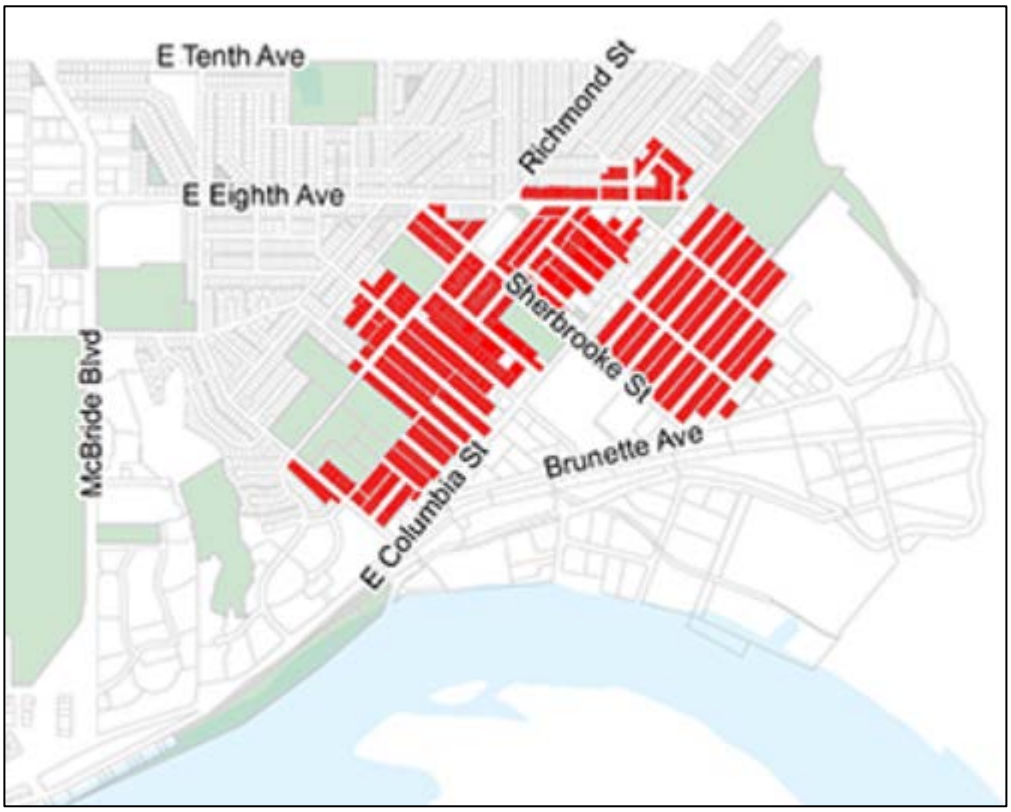
The existing permit system in place throughout the Sapperton area is a combination of two-hour parking except with a permit, or permit only parking. *Figure 6-2* illustrates the areas that are eligible in the Plan area for permit parking. The implementation of more recent permit parking areas has been driven by Sapperton residents. However, since the inception of the Plan, resident requests have been held until the Plan defines a strategy to manage the on-street parking within the study area.

The City has recently implemented a license plate recognition (LPR) system to aid in time restricted and permit parking enforcement. LPR allows vehicles to be permitted by license plate (instead of a hanging tag or decal), which helps assure that the user is a resident of the area and not someone who has purchased a permit from a resident. Additionally, residents can apply/ update their annual parking permit online, which streamlines the process and lessens the burden on residents to have to go to City Hall.

Residential parking permits are specific to a block and vehicle, and require a copy of the resident's current vehicle registration papers for each vehicle registered to an address within the permitted area. Registration papers are again required for permit renewal. Residents can purchase up to five permits per household, the first three (for two residents and one visitor) at $15 each, annually, and then fourth and fifth permits (both for residents) at $50 each. Each household is allowed only one annual visitor pass, which is transferable and can be placed on any visitor or resident vehicle, and up to four residential permits. Visitor hanging tags and one day passes are provided, and visitor parking is not part of the LPR system. Each parking permit entitles the permit holder to park within a one block radius of the block indicated on the permit. It should be noted that a household is considered any unit that has a separate electrical utility. Additionally, vehicles exceeding a gross vehicle weight of 5,500 kg, or defined as a "Recreation Vehicle", are not eligible for Residential Parking Permits.

The permit only regulation is typically in effect 24-hours, while the time limit regulation (two hours except with permit) is typically in effect between the hours of 8:00 am to 6:00 pm, Monday through Friday. This may vary in some locations, therefore the need for the Plan to develop a consistent approach to managing the curbside regulations.

Figure 6-2 Blocks that are Eligible for Permit Parking



Source: City of New Westminster

Visitor Parking

It is a goal of the City to incorporate the visitor parking program into the LPR system that is in place for residential permits. This would eliminate the need for a decal or hanging tag permit and prevent the misuse of these due to their transferability. This will require residents to register visiting vehicles online or over the phone (with vehicle license number) and allow for the purchase of additional day visitor passes, as necessary, while still having one annual visitor pass per household. This system should be implemented as soon as the City has the administrative capacity to do so.

Permit Distribution

The current system allows a resident to purchase up to five permits per household. It is recommended that this practice be reviewed by the City to ensure that blocks are not being oversubscribed with permits. A recommended option would be a reduction in the number of permits to two residential permits and one visitor permit (three permits total) per household, as defined by electrical utilities, with a maximum of six permits (four residential and two visitor) per property or land parcel. Reducing the number of permits available in each block should facilitate some availability of on-street parking.

It is also noted that a vast majority of the properties in the study area have some form of off-street parking available. One goal of reducing the total number of allowable permits per household is to encourage the use of this off-street parking, which will make more on-street parking available for those without parking on their property and for residential visitor parking. As proposed in the next section, increasing the cost of parking permits could encourage some residents to make better use of their off-street parking options.

Permit Pricing

In 2017, the City parking permit rates increased to $15 per annum. By way of comparison, in September 2017 the City of Vancouver increased the cost of their annual parking permits in the West End to $378. In other areas rates range between $38 and $78 per annum. Consistent with the Sapperton Parking Study recommendation, an increase in cost of these permits should be considered as part of a review of the City's parking permit program.

This program should include:

- Increasing the cost of permits to a market rate;
- Offering non-market rates for permits purchased before a certain date and to low-income households (or other special needs);
- Seek resident input on how to spend permit revenues;
- Increasing the rates of additional household permits to encourage off-street parking

6.1.2. Pay Parking

There is a combination of on-street paid (metered) parking and private off-street parking garages and lots primarily along E. Columbia Street; however the City only enforces the on-street paid parking. In some locations, paid parking is in high demand, while in others, visitors prefer to walk the extra distance and park in the neighbourhood to avoid paying for parking. There is also the issue of inconsistent off-street pricing set by private parking management companies that may be discouraging patrons from using specific lots. In the case of RCH, there is apparently a 12-year waiting list for a parking permit (due to limited parking supply on-site) resulting in a large number of staff that drive to work spilling into the neighbourhood.

6.1.3. New Development Parking

To build within the City of New Westminster, developers are required to provide a specific number of parking spaces based on a number of factors as described in the City's *Zoning Bylaw 150: Off-Street Parking*, which requires supply according to land use type and size, location in the City, and location relative to transit access.

As described in the OCP and MTP, it is the City's goal to reduce private vehicle mode share and encourage the use of sustainable transportation modes. Sapperton is well positioned to provide residents, workers and visitors with good access to transit and active mode options. As part of new developments, the City requires developers to provide sufficient on-site parking to meet expected demand, while encouraging them to provide programs and incentives that will reduce the need for a private vehicle. The City allows parking relaxations for developments that implement a range of TDM measures available to them (e.g. 4:1 reduction of parking stalls for providing publically available car-share vehicles on-site).

In addition, the City does not issue any parking permits to tenants of new developments that have justified that they can meet their parking demands on-site. The City requires that larger new developments must undertake a Transportation Impact Assessment (TIA) that demonstrates how they will accommodate all their transportation needs on-site and manage their impacts upon the adjoining community.

6.1.4. Commercial

Signage and Wayfinding

It is recommended that new developments with a commercial component provide appropriate directional signage to appropriately inform drivers and reduce vehicle circulation in the street network. Signs should include directions to off-street parking, such as Brewery District shopping or RCH parkades. Signage at the lot entrances are encourages to be variable, indicating the number of available spaces in a lot to inform drivers of the likelihood of finding a parking space before entering. Examples of these types of signs are shown in *Figure 6-4* to *Figure 6-6*. The City should work with private developers to implement a program of this nature, as it benefits both the developer (in terms of more income if drivers are directed to their specific parking) and the City (reduced street congestion if vehicles are directed to available parking as opposed to circling the block to find parking).

Figure 6-3 Access to Pacific Centre Parking - Vancouver



Figure 6-4 Access to Brewery District Parking



Figure 6-5 Access Signs to RCH



Time Restrictions & Parking Management Strategy

Time restrictions for both paid parking and un-paid parking are pivotal to promote appropriate parking turnover adjacent to commercial land uses and to discourage long-term parking in areas of high demand. To achieve this:

- Existing 10-hour parking signage on Keary and Sherbrooke Streets adjacent to RCH should be reduced from 10 hours to 2-hour parking
- All new pay-parking locations

Additionally, subsidized monthly parking passes should be discouraged as they do not facilitate a change in travel behaviour. It is recommended that private parking management/ organizations work with the City to implement parking management strategies that minimise the potentially negative economic impacts while discouraging people from relying on the private vehicle as a means of negotiating the community/ getting to work/ destination (e.g. set the monthly rates similar to that of a standard daily parking rates or matching the price of a transit fare).

6.1.5. Other uses of on-street parking

Shared Mobility

The City has two types of ever expanding car-sharing options available to the community, one-way (EVO) and two-way car sharing (MODO). Given the benefits of both models, the City actively encourages the use of car sharing in an effort to deflect increased private vehicle travel to alternative modes.

MODO has been active in the City for a number of years, with EVO introduced in May 2017. The vehicles are permitted to park in 2-hr resident exempt/ permit only areas in accordance with the City's *Street & Traffic Bylaw*. Additionally, the City also designates on-street spots for car-share vehicles at strategic locations.

There have been some frustrations raised in lower Sapperton since the introduction of EVO, and the City continues to work with EVO to reduce disruption to local residents while maintain an effective service. It is recommended that new developments be required to provide designated car share stalls on-site in an effort to reduce the impacts on adjacent communities.

It is recommended that the City continue to promote all forms of shared mobility, along with a monitoring and mitigation strategy to minimise negative impacts upon the local community.

6.2. Stage 1 Parking Plan

The Stage 1 Parking Plan is intended to be implemented by early 2020, in conjunction with major developments such as Phase 1 of RCH redevelopment, completion of Buildings 5 and 6 in the Brewery District, the opening of Urban Academy, and potentially the first phase of the Sapperton Green Development (refer to *Figure 6-3)*.

The Stage 1 plan affects residents, businesses and visitors in the Sapperton and Massey Victory Heights neighbourhoods. It focuses on:

- Consistently application of a standard layout of on-street parking allocation on each block
- Willingness to receive applications for new 2-hour resident exempt parking zones further afield from current zones (e.g. blocks west of Richmond Street)
- Willingness to receive applications to extend resident only parking zones for blocks within 1-block radius of commercial/ business drivers
- Remove 10-hour parking spaces along Keary Street & Sherbrooke Street and transition to pay-parking (subject to ultimate street design for these streets)
- Implement pay-parking on side-streets to commercial areas (commercial frontages only; e.g. Major Street from E. Columbia St to the lane)
- Assessing and implementing the recommendations from the Victoria Hill Parking Study (underway)
- Continued assessment and implementation of the Council approved parking strategy for Sapperton Green Master Planned Community (underway)
- Assessing and implementing the recommendations from the New West Aquatic & Community Centre redevelopment (underway)
- Engage with residents along E. 8th Ave to modify on-street parking restrictions to not allow parking during peak periods to allow for future corridor efficiencies
- Enforce the new or modified regulations (specifically in newly signed areas) to ensure the new and/or changed regulations are being followed. Expanded enforcement would require current enforcement to include newly regulated areas within their routes

Expansion of Paid Parking

As part of the traffic calming plan, “pinch points” are planned on the side streets west of E. Columbia Street to better define the residential areas from the commercial areas. These pinch points will clearly separate on-street, paid commercial parking from time restricted / permitted parking.

West of these pinch points, permit parking should be implemented. Sherbrooke Street is the only location where the pinch point is located west of the commercial area, in line with the park entrance, to accommodate park users via a raised crosswalk.

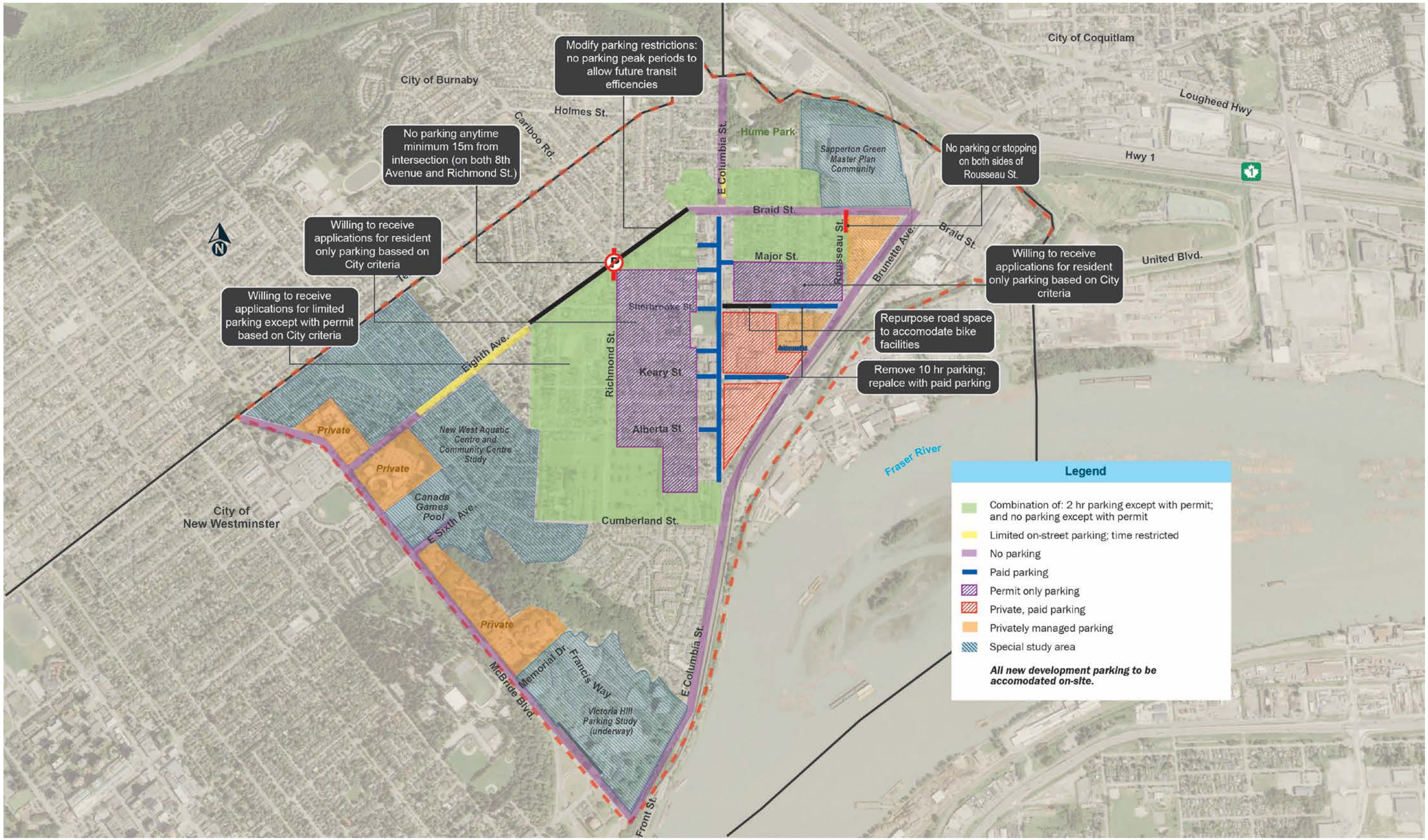
Table 6-1 shows the estimated total number of paid parking spaces on each street; in the case of Keary Street and Sherbrooke Street, this includes the paid parking spaces already in place.

Table 6-1 Estimated Paid Parking

Location	Estimated Number of Paid Parking Spaces
Sherbrooke Street	22 (including 8 existing)
Hospital Street	15
Keary Street	12 (existing)
Simpson Street	5
Alberta Street (with the removal of the diverter)	4
Strand Avenue (including existing angle parking)	11
Total Paid Parking Spaces West of E. Columbia	**110 (90 new, 20 existing)**

In some cases, paid parking has been proposed in front of multi-family residential units that all have off-street parking available for residents. In the case of some of the older, multi-family units that do not have enough parking to accommodate residents' and/or visitors' needs, the City can include these buildings in the resident and visitor parking permit program (up to two resident and one visitor permits per unit), at their discretion. The residents would be required to park within the permit regulated area and not in the paid parking area.

Figure 6-6 Stage 1 Parking Plan Area



6.3. Stage 2 Parking Plan

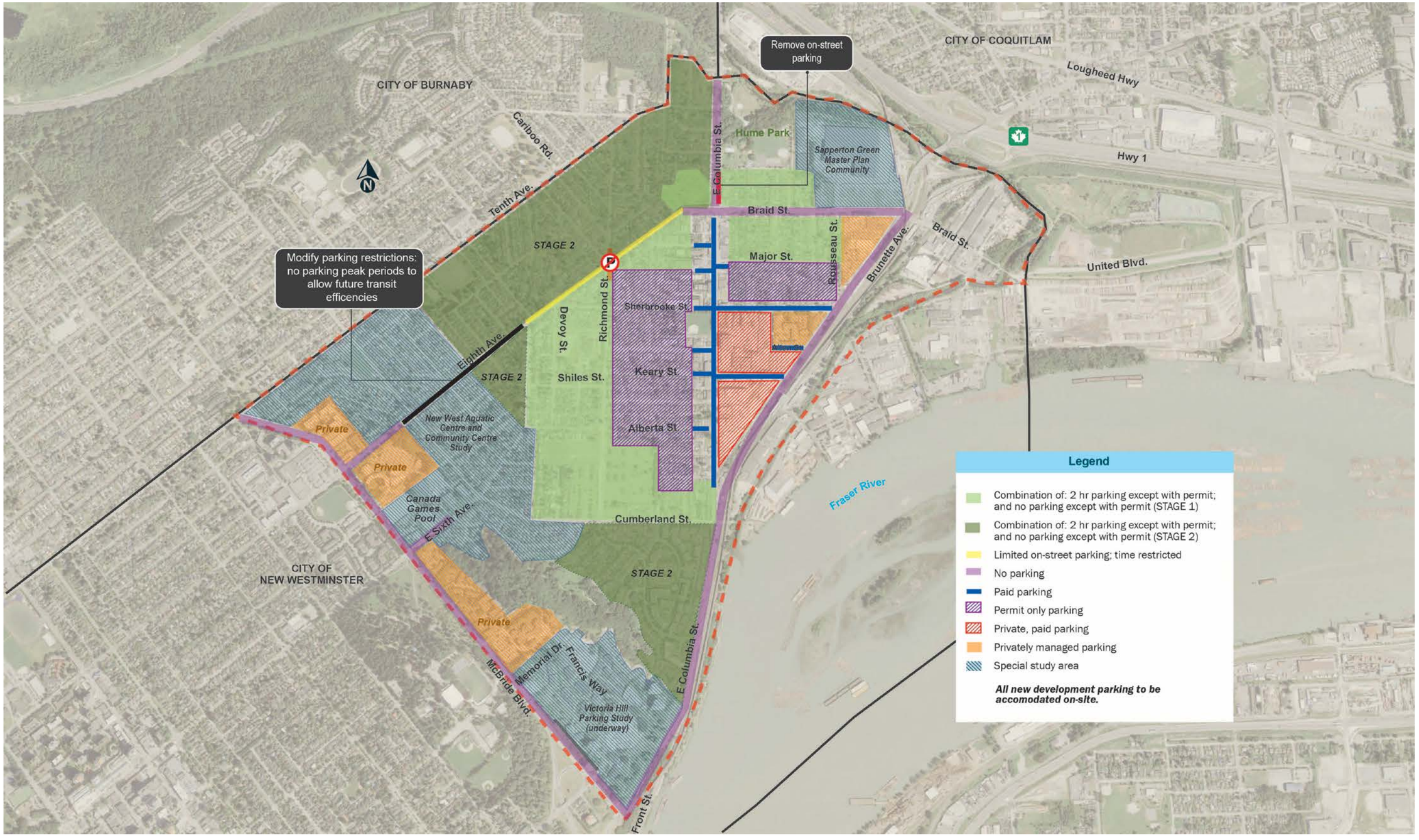
Stage 2 is intended to be implemented by 2026, in conjunction with major developments such as Phases 2 and 3 of the RCH redevelopment, completion of Buildings 7 and 8 in Brewery District, and build-out of Sapperton Green and other residential developments throughout the area. The overall plan is shown in *Figure 6-7.*

Enforcement will need to be expanded to areas where new regulatory signs are installed to ensure coverage throughout the neighbourhood and reduce any abuse of posted regulations.

The Stage 2 plan affects residents, businesses and visitors in the Sapperton and Massey Victory Heights neighbourhoods. It focuses on:

- Consistently application of a standard layout of on-street parking allocation on each block
- Willingness to receive applications for new 2-hour resident exempt parking zones further afield from current and phase 1 zones
- Willingness to receive applications to extend resident only parking zones for blocks within 1-block radius of commercial/ business drivers
- Implementing the recommendations from the Victoria Hill Parking Study (underway)
- Implementation of the Council approved parking strategy for Sapperton Green Master Planned Community (underway)
- Implementing the recommendations from the New West Aquatic & Community Centre redevelopment (underway)
- Engage with residents along E. 8th Ave to modify on-street parking restrictions to not allow parking during peak periods to allow for future corridor efficiencies
- Engage with residents in an effort to remove on-street parking along E. Columbia street north of Braid Street.
- Enforce the new or modified regulations (specifically in newly signed areas) to ensure the new and/or changed regulations are being followed. Expanded enforcement would require current enforcement to include newly regulated areas within their routes. All bylaws enforcement options should be considered for staffing, time and budgetary constraints.

Figure 6-7 Stage 2 Parking Plan



6.4. Royal Columbian Hospital Parking

As part of the RCH expansion project, the hospital is increasing their current parking supply to better accommodate the anticipated parking demand of its new, expanded facilities.

The hospital's parking requirements were evaluated based on estimated parking demand and required parking supply per City of New Westminster by-law requirements, as compared to the proposed supply. Similar to trip generation, parking demand and supply are directly linked to the uses and size of the facility.

6.4.1. Existing Conditions

A parking study for the existing hospital facilities was conducted by Bunt & Associates in February 2014. The study discussed results of a parking utilization and occupancy study, completed in 2013, and reviewed the parking needs of the hospital.

The study identified 16 parking lots associated with the hospital, providing a mix of staff and public parking, for a total of 1,017 parking spaces. The peak demand was recorded at approximately 11 AM, when 963 spaces were occupied (95% occupancy). In general, and without any electronic parking detection system in place, anything in excess of 80% occupancy is considered under-supplied because users experience considerable difficulty finding a parking space and lots appear full.

Staff Parking

The report states that approximately 76% of the 2,900 RCH staff drive to work and approximately 74% of those who drive park on-site. Of the 26% that park off-site, about half would be willing to pay for parking if it were available on-site, while the other half chooses to park elsewhere at least partially because of parking costs. While this portion of the study was focused on staff and not overall demand for hospital parking, it is indicative that the current supply of just over 1,000 spaces is not meeting the current demand.

Staff are required to have a parking permit to park on-site. Fraser Health indicated that the current waitlist for a parking pass is 12 years. With a waitlist of this length, there is a clear indication that additional parking supply is necessary as part of the expansion project, or that RCH and Fraser Health should provide accessible and reliable alternative transportation options to staff.

Visitor and Patient Parking

Based on the 2014 study, the patients and visitors to the hospital are less reliant on their cars and available parking. The survey results indicated that approximately 43% of the visitors and patients drove and parked at the hospital, with all visitor and patient parking being paid parking.

As indicated in the surveys from 2014, not all staff are willing to pay for parking on-site. This is also true of visitors and patients. In fact, if everyone was willing to pay to park, parking demand would be even higher than observed.

During the public consultation process for the Plan, it was indicated that in some cases, it's not an unwillingness to pay for parking but an inability to afford the parking prices. While Fraser Health does have a system to help those who cannot afford to park on hospital property, this option is not well known or advertised. This results in many people feeling forced to park on nearby streets, impacting residential parking and sometimes requiring injured or sick patients to circle the neighbourhood to find parking and then walk the distance between their on-street parking space and the hospital. It is evident that Fraser Health should better promote the parking subsidy system for visitors and patients.

Travel Demand Management Strategies

Transportation demand management (TDM) refers to a set of strategies aimed at reducing the demand for roadway travel, and more specifically, single occupancy vehicle travel. These strategies address many of the bi-products associated with driving, including congestion, poor air quality, less liveable communities, reduced public health, reduced environmental health, and climate change and GHG emissions. Some TDM strategies are intended to reduce total travel demand, while others are aimed at reducing peak period demand, which tend to disproportionately contribute to the bi-products of driving.

RCH currently has several programs in place to address the overall demand at their facilities:

- **Paid Parking -** The cost of parking reduces the demand for parking. However, the availability of free parking in the neighbourhood makes this strategy less effective.
- **Secured Bike Parking -** The availability of secure bike parking encourages the use of cycling as a means of transportation to / from RCH.
- **Education, Health, and Awareness -** RCH offers staff educational, health, and awareness information and programs aimed at promoting the benefits of using alternative means of transportation.
- **Bike to Work Week -** One week a year, RCH provides information and services for cyclists, including free bike maintenance and vendors.
- **Taxi Service Account -** For staff who need transportation outside of daylight hours (when walking and cycling are perceived to be less safe) or when transit service is unavailable, RCH has an account with a taxi company that will provide the necessary trip.

While efforts are being made by RCH to reduce the reliance on single occupancy vehicle trips, shift work and the regional draw of the hospital make it difficult for a large proportion of staff and patients / visitors to take transit or choose active modes. Therefore, as RCH makes plans for the future, it is important to keep this demographic in mind when developing TDM strategies.

6.4.2. Future Conditions

Proposed Parking Supply

The hospital is expected to expand to approximately 788 beds including 200 existing beds in Columbia Tower; 75 mental health beds (Phase 1 of expansion); 463 beds in the new acute tower (Phases 2 and 3 of expansion); and 50 flex beds in Columbia tower. The hospital is also expected to expand its clinic and outpatient facilities. Staff is expected to increase to approximately 5,000 staff members. While not all beds are expected to be occupied at all times, parking demand is estimated per bed available.

As part of Phase 1, the Allen Street lot (approximately 300 spaces) were eliminated but are being replaced with a 450 space, underground parking lot beneath the mental health and substance abuse facility (Phase 1). There is also additional parking proposed below the new acute tower for a total on-site parking supply of 1,655 spaces, for a total parking supply increase of 638 spaces.

Estimated Parking Demand

Parking requirements were evaluated based on estimated parking demand and required parking supply per City of New Westminster by-law requirements as compared to the proposed supply. Similar to trip generation, parking demand and supply are directly linked to the size (i.e. beds) of the development.

City of New Westminster By-Law

The City of New Westminster *Zoning Bylaw* (6680, 2001) requires one parking space for each 1,000 square feet (92.9 square metres) of gross floor area for Hospital Use and one parking space for each 358.8 square feet (33.3 square metres) of gross floor area for Medical Clinic. Additionally, 10% of all spaces provided must be designated as handicap only. The proposed size of the hospital uses is 62,623 sq. m and medical clinic is 17,929 sq. m. This results in an overall requirement of 1,212 spaces (674 and 538 spaces, respectively).

Estimated Parking Demand

According to the *Institute of Traffic Engineers (ITE), Parking Generation, 4th Edition (2010)* hospital uses generate a parking demand of approximately 3.47 per bed, on average, during the weekday for an urban hospital (in upwards of 4.72 per bed for suburban). Additionally, the parking analysis (Bunt) for the hospital in February 2014 showed a rate of 3.24 spaces per bed (412 beds and a demand for 1,335 spaces).

Table 6-2 provides a range of estimated parking demand based on the ITE and Bunt rates, as well as the potential range of beds, from 663 beds (200 existing + proposed 463 acute tower beds), to 788 beds (200 existing + proposed 463 acute tower + 75 mental health + 50 flex beds). As shown, the estimated parking demand ranges from 2,148 spaces to 3,719 spaces depending on number of beds and rate. However, while RCH has more of a regional draw from across the region and BC (likely requiring those people to drive), it is more of an urban hospital (opposed to suburban) as there are several transit routes (including SkyTrain) serving the hospital and many complementary medical-related uses within a short distance of RCH. The rates provided by Bunt are from an existing condition parking survey completed in Fall 2013, and are presented for information purposes only given that the parking situation will change with the hospital's redevelopment. Therefore, RCH is expected to generate a demand of 2,300 to 2,700 spaces.

Table 6-2 Estimated Parking Demand

Source	Rate	Parking Demand	
		663 beds	788 beds
Bunt [1]	3.24	2,148	2,553
ITE Urban	3.47	2,301	2,734
ITE Suburban	4.72	3,129	3,719
By-Law	-	1,212	
Supplied	-	1,655	

Notes:

1. From a Fall 2013 parking survey

As can be seen in *Table 6-2*, while the proposed supply exceeds the by-law requirement, it is short of the ITE estimated demand at full build by almost 1,100 spaces. Therefore, RCH will need to provide significant TDM strategies to mitigate the potential for the excess demand to seek alternative parking within the neighbourhood.

RCH has also received a variance for the requirement for handicap spaces from 10% to 4% during Phase 1 of the RCH redevelopment project (*Appendix E*). As stated in the letter, this variance would not preclude Fraser Health from meeting or exceeding the ratio in future phases, but it does allow them to keep pace with the ever-changing demand of the different users requiring on-site parking at RCH. This reduction will free up spaces for general use.

Travel Demand Management Strategies

Since the estimated parking demand will likely exceed the number of spaces provided at RCH, a more comprehensive TDM program should be implemented to encourage staff and visitors to not use their vehicles. There are four general strategies (financial incentives, marketing and education, travel time incentives, and technology accelerators) and five targeted strategies (mode choice, departure-time, route choice, trip reduction, and location / design) that can be implemented to address the parking supply shortage. However, as stated previously, shift work and the regional draw of the hospital make it difficult for all staff and patients / visitors to take transit / active modes. Therefore, in addition to the TDM strategies listed below, RCH should work with the City and local businesses to accommodate some of the excess parking demand so users are not parking throughout the neighbourhood. The following are some recommended TDM strategies:

- **Attractive and functional end-of-trip facilities** - RCH should provide improved end-of-trip facilities to encourage staff to use modes other than the personal vehicle. This could include secure bike parking, showers, and locker / changing rooms.
- **Shower facilities for all staff** - Currently staff are only able to use shower facilities if their department has them. Making shower facilities available to all staff would encourage those wanting to bike to do so.
- **Alternative mode incentives** - RCH should provide financial subsidies for non-vehicular users to encourage alternative mode choice. This could include transit subsidies, carpool prioritization, shoe allowance, bicycle allowance, etc. This could include lobbying TransLink to reinstate their Employee Pass Program that was terminated in December 2013.
- **EVO / car share program** – Provide dedicated on-site parking stalls for car-share vehicles and create a RCH car-share account so staff do not have to pay the required registration fees for these services.
- **Parking pricing** - Work with the City to achieve better on street / off street parking price consistency, and consider a parking reimbursement program for employees who carpool.
- **Shuttle service** - Provide a shuttle to / from other transit centers.

7. Multimodal Network Improvement Measures

7.1. Network Improvement Measures versus Evaluation Criteria

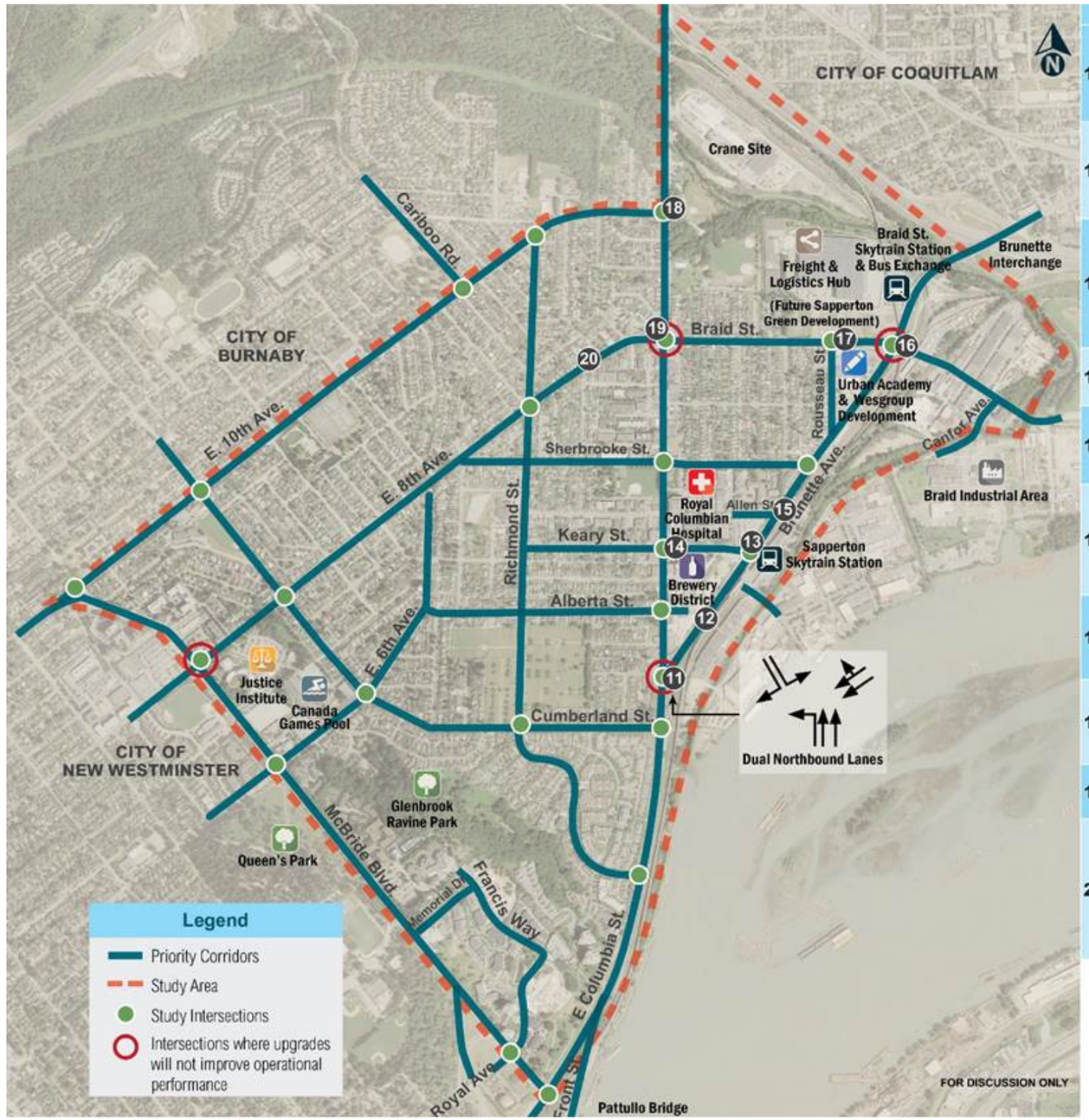
A preliminary assessment of network operational performance for Year 2042 was done assuming no network improvements (*Section 4.3.2*). This assessment indicated which locations would operate poorly in the future (*Figure 4-4*). With input from the engagement process and adherence to the City's MTP and OCP, several multimodal intervention measures were considered to improve performance as well as to encourage vehicles to say on the appropriate roads and not short-cut through neighbourhoods. These measures are shown on *Figure 7-1* and *Figure 7-2*. Conceptual layouts of several of these measures are shown on the figures. Importantly, the application of the evaluation criteria (provided in *Section 1.4*) to each measure is also included.

Figure 7-1 Network Improvement Measures versus Evaluation Criteria



	Improvement	Reasoning		Evaluation Criteria Met
1	• Refer to concept layout on Figure 5-7	• Provide safe crossing for cyclists / pedestrians • Reduce cut-through traffic on Surrey St. to Cariboo Rd. • Improve safety	1	Improved safety and perception of safety
			6	Bike access for all ages and abilities (AAA)
			7	A match between traffic types and road classification
2	• Refer to concept layout on Figure 5-14	• Reduce cut-through traffic • Provide safe crossing for cyclists / pedestrians • Improve visibility at intersection	1	Improved safety and perception of safety
			6	Bike access for all ages and abilities (AAA)
			7	A match between traffic types and road classification
3	• Refer to concept layout [inset]	• Provide capacity at the intersection to accommodate demand • Provide better neighbourhood access • Provide transit priority • Reduce cut-through traffic on Cumberland St.	3	Reduce reliance on private vehicles
			7	A match between traffic types and road classification
			8	Reduce delay at key intersections and along key corridors
4	• Add left turn lanes on East 10th Ave. approaches	• Reduce delay at the intersection	8	Reduce delay at key intersections and along key corridors
5	• Add westbound left turn lane onto McBride Blvd. • Remove eastbound channelized right turn, and replace with typical urban intersection	• Provide capacity at the intersection to accommodate demand • Reduce neighbourhood cut-through traffic • Improve pedestrian safety • Reduce speed	1	Improved safety and perception of safety
			7	A match between traffic types and road classification
			8	Reduce delay at key intersections and along key corridors
6	• Provide dual westbound left turn lanes onto McBride Blvd.	• Provide capacity at the intersection to accommodate demand • Reduce neighbourhood cut-through traffic	7	A match between traffic types and road classification
			8	Reduce delay at key intersections and along key corridors
7	• Prohibit westbound left turn onto McBride Blvd.	• Maintain 6th Avenue as a local connection • Reduce neighbourhood cut-through traffic • Reduce delay at the intersection	2	Enhanced livability
			7	A match between traffic types and road classification
			8	Reduce delay at key intersections and along key corridors
8	• In Peak Period (PM): only restrict left-out	• Improve intersection safety and operation • Reduce cut-through traffic in Victoria Hill in PM peak period	2	Enhanced livability
			7	A match between traffic types and road classification
9	• Refer to concept layout on Figure 5-6	• Improve cyclist and pedestrian visibility and safety • Improve signage	1	Improved safety and perception of safety
			5	Superior walkability
			6	Bike access for all ages and abilities (AAA)
10	• Refer to concept layout on Figure 5-15	• Improve cyclist and pedestrian visibility and safety • Maintain bus bypass movements	2	Enhanced livability
			5	Superior walkability

Figure 7-2 Network Improvement Measures versus Evaluation Criteria



	Improvement	Reasoning	Evaluation Criteria Met	
11	• Dual northbound lanes • Add left turn from E. Columbia St. onto Brunette Ave. northbound	• Provide capacity at the intersection to accommodate demand • Improve intersection geometry • Reduce demand on E. Columbia St. • Provide better egress from hospital	7 8	A match between traffic types and road classification Reduce delay at key intersections and along key corridors
12	• 4-lane cross section between E. Columbia St. & Spruce St. (longer term)	• Provide capacity to accommodate regional demand • Reduce neighbourhood cut-through traffic	7 8	A match between traffic types and road classification Reduce delay at key intersections and along key corridors
13	Longer term; subject to closure of Spruce at-grade crossing: • Signalized northbound left turn • Retain right-out only at Keary • Restrict access on Keary to RCH and Allen St. only; no access to E. Columbia St.	• Provide better access to Hospital • Reduce neighbourhood cut-through traffic • Provide capacity at the intersection to accommodate demand	7 8	A match between traffic types and road classification Reduce delay at key intersections and along key corridors
14	• Add southbound left turn lane • Relocate downstream bus stop • Reconfigure lanes to suit	• Reduce delay at the intersection • Provide better access to Hospital	8	Reduce delay at key intersections and along key corridors
15	• Widen Allen St. intersection at Brunette Ave. (by RCH)	• Improve sight lines at intersection • Allow capacity for entering and exiting vehicles at the same time • Improve safety	1 2	Improved safety and perception of safety Enhanced livability
16	• Add northbound left turn lane (all hours)	• Provide capacity at the intersection to accommodate demand • Reduce neighbourhood cut-through traffic • Provide access for regional traffic on major road network, especially trucks	7 8	A match between traffic types and road classification Reduce delay at key intersections and along key corridors
17	• With development, add left turn lanes on all legs of intersection • Provide safe pedestrian / bicycle crossing	• Provide additional capacity at the intersection to accommodate demand • Reduce delay at the intersection	3 8	Reduced reliance on private vehicles Reduce delay at key intersections and along key corridors
18	• Clearly designate left and right turn lanes on Holmes • Set back on-street parking to suit	• Improve intersection safety and operation • Reduce delay at the intersection	1 8	Improved safety and perception of safety Reduce delay at key intersections and along key corridors
19	• Change centre lane eastbound to shared through and left turn • Add westbound left turn lane	• Provide capacity at the intersection to accommodate demand	8	Reduce delay at key intersections and along key corridors
20	• Peak period bus priority lanes on 8 Ave. / Braid St. between Cumberland & Rousseau St • Peak period parking restriction along 8 Ave. • Subject to further resident engagement and TransLink discussions	• Provide transit priority and reliability • Encourage use of transit, together with provisions of benches at stops	3 7	Reduced reliance on private vehicles A match between traffic types and road classification

7.2. Operational Analysis

Applying the same methodology as for the current conditions, the operational performance analysis was done for the future year 2042 with network improvement measures included. As can be seen in *Table 7-1*, even with improvements some intersections, especially in the PM peak hour, operate at LOS E or worse overall. These intersections are highlighted in red italics.

For some intersections, while the overall operation performance is acceptable, there are individual movements at intersections operating at LOS E or LOS F. These are shown on *Figure 7-3* through *Figure 7-5*.

Table 7-1 Full Build-Out (Year 2042) Intersection Level of Service Results

	Intersection Name	AM		PM	
		LOS	Average Delay (1)	LOS	Average Delay (1)
1	Brunette Ave / Braid St	D	53	***F***	***128***
2	Brunette Ave / Sherbrooke St	EBR – C	22	EBR – C	18
3	Brunette Ave / Spruce St / Keary St	EBR – C	18	EBR – D	27
4	E. Columbia St / Brunette Ave / Debeck St	***E***	***79***	D	44
5	E. Columbia St / Cumberland St	EBR – B	11	EBR – B	10
6	E. Columbia St / Richmond St	B	16	C	20
7	E. Columbia St / McBride Blvd	B	14	B	17
8	Royal Ave / McBride Blvd	B	11	B	12
9	E. Sixth Ave / McBride Blvd	C	33	***E***	***76***
10	E. Eighth Ave / McBride Blvd	***E***	***69***	***F***	***128***
11	E. Tenth Ave / McBride Blvd	C	21	***E***	***69***
12	E. Tenth Ave / Cumberland St	***F***	***99***	***F***	***146***
13	E. Eighth Ave / Cumberland St	B / C	20	D	35
14	E. Sixth Ave / Cumberland St	C	21	***F***	***341***
15	Richmond St / Cumberland St	B	12	***E***	***38***
16	E. Columbia St / Alberta St	A	8	B	11
17	E. Columbia St / Keary St	B	12	C	25
18	E. Columbia St / Sherbrooke St	B	14	C	20
19	Richmond St / E. Eighth Ave	SB – D	30	See note 2	See note 2
20	E. Columbia St / Braid St / E. Eighth Ave	D	37	***F***	***117***
21	Rousseau St / Braid St	D	40	***E***	***56***
22	E. Tenth Ave / Cariboo Rd	C	34	***E***	***76***
23	Richmond St / E. Tenth Ave	NB – A / B	10	NB – B	14
24	E. Columbia St / Holmes St	C	28	***E***	***58***
25	Canfor Ave / Braid St	B	13	B	13
26	Memorial Drive / McBride Blvd	B	15	A	3
27	E. Columbia St / Front St /	B	14	C	28

Notes:
Bold indicates unacceptable operation.
1. Average delay = seconds per vehicle.
2. Delay is not reported, as once side-street LOS reaches LOS F, it is likely improvements are required.

Figure 7-3 Full Build-Out (Year 2042) Intersection Operational Performance with Improvements

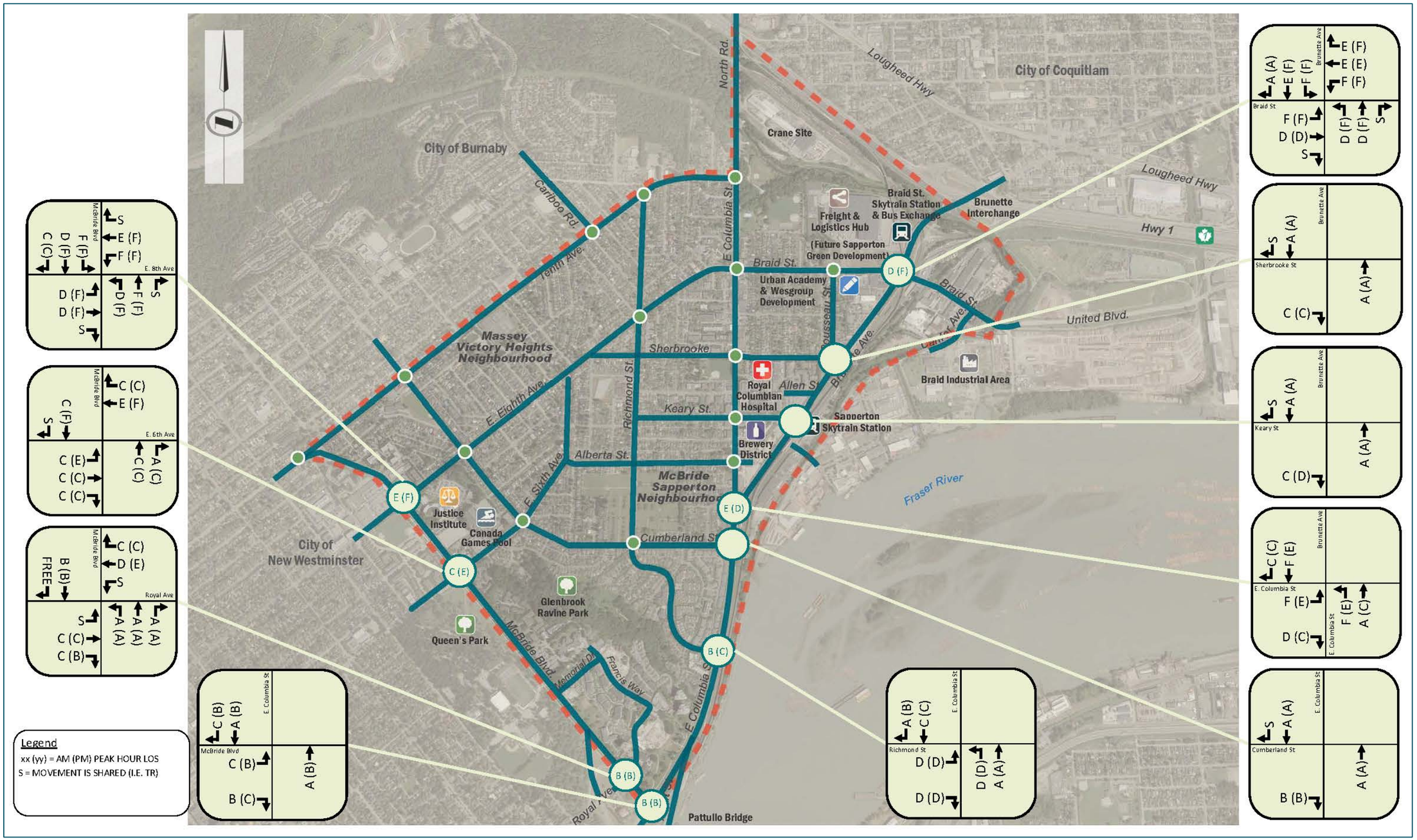


Figure 7-4 Full Build-Out (Year 2042) Intersection Operational Performance with Improvements

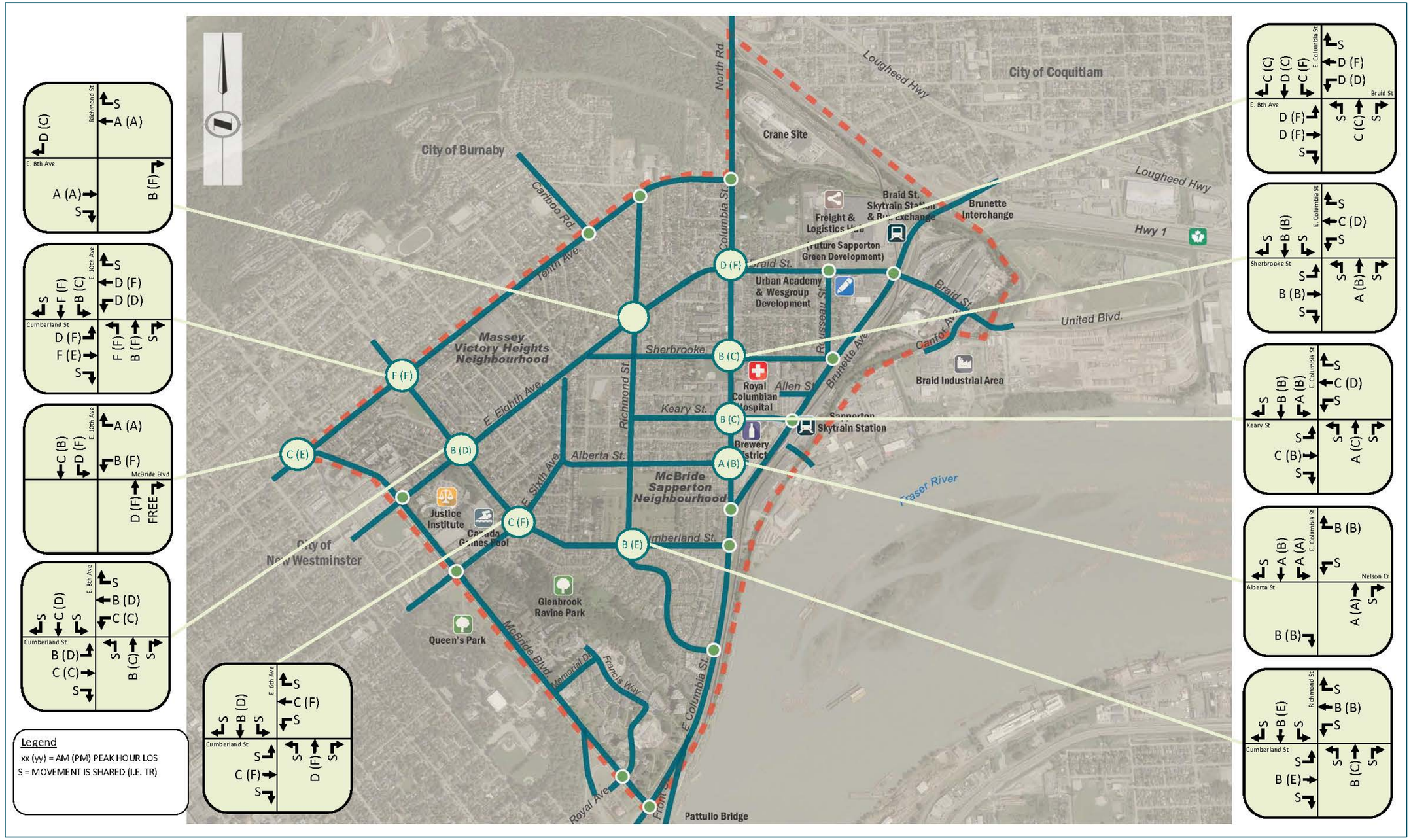
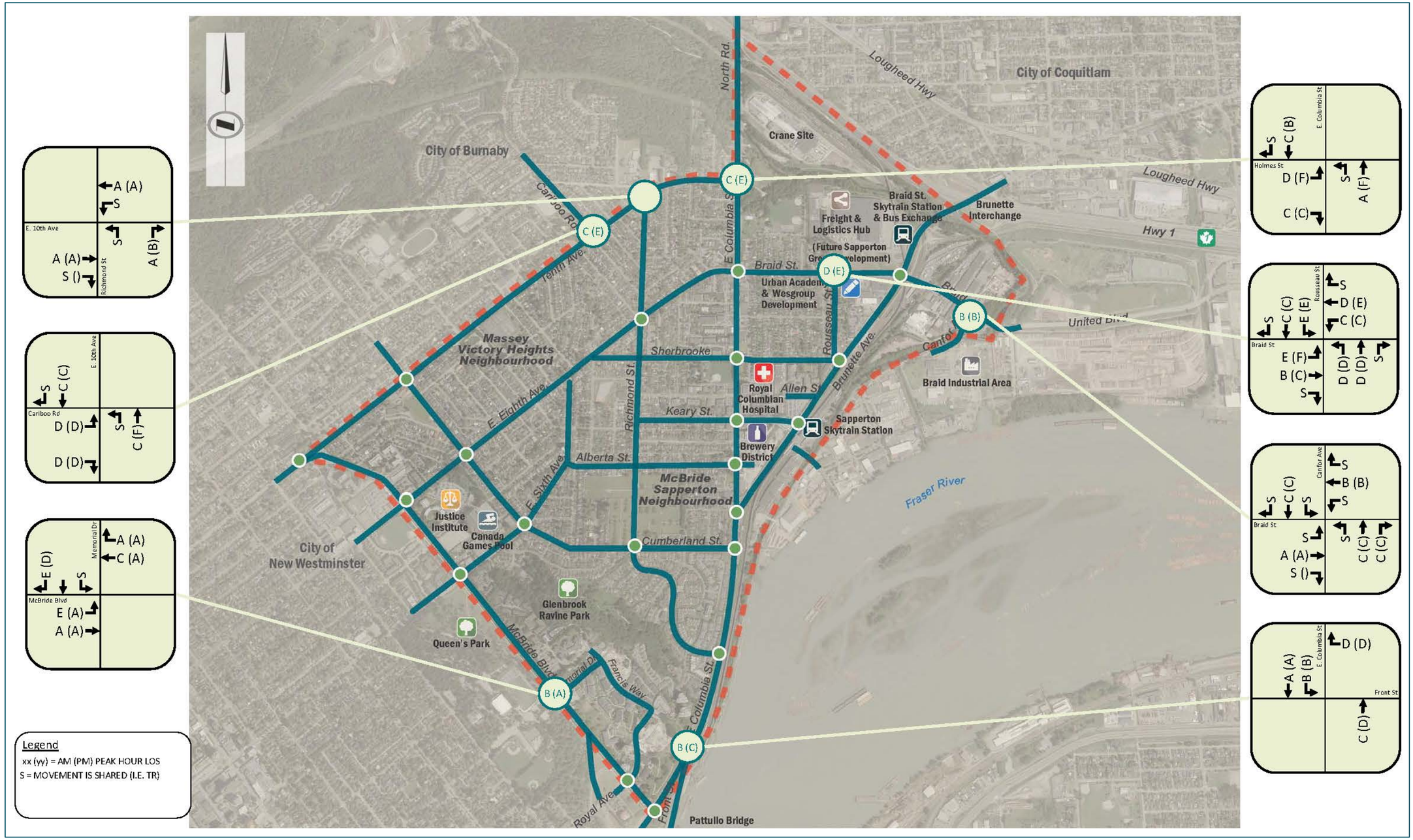


Figure 7-5 Full Build-Out (Year 2042) Intersection Operational Performance with Improvements



7.3. Summary of Findings

The City's Master Transportation Plan (MTP) provides a framework to guide transportation policies, priorities and investments over the next 25 years in the following areas:

- Walkability
- Cycling
- Transit
- Local and regional travel through the City, including regional goods movement.
- Great streets
- Neighbourhood liveability
- Programs and policies that encourage walking, cycling, and transit, and reduce reliance on the automobile

In line with the MTP, one of the main goals of the Sapperton/ Massey Victory Heights Transportation Plan is to enhance the multimodal transportation system throughout the study area, thereby providing better travel mode choices and improvements that can be sustained for years to come. Traffic calming and improved safety are equally important goals, with the objective being "to keep the right traffic on the right roads". Traffic analysis revealed that the current network is already congested, with some problem intersections that cannot be addressed with typical capacity improvement upgrades alone. Given the extent of ongoing and future development in the area, in particular the expansion of the Royal Columbian Hospital which will attract even more regional traffic to the area, the analysis of future traffic shows the situation will only get worse, emphasising the need for multimodal solutions, as well as parking strategies to help reduce the impact of this development growth on the local community.

To help achieve these goals, evaluation criteria were developed against which proposed improvements could be measured, and which criteria also addressed the comments and concerns of the City and residents' concerns raised during the engagement events. While it is evident that improvements are necessary to improve the transportation system, there was also an awareness that "restrictions beget restrictions" – in other words, movement restrictions need to be implemented with caution as they might only relocate the problem trying to be addressed, thereby forcing additional restrictions, and so on. This scenario does not serve the local community who tend to then become limited in their own flexibility of movement. The improvements however do need to be measurable to evaluate their success (or failure). *Table 7-2*, presents each improvement or intervention proposed in the Plan, and which evaluation criteria each satisfies, noting that Cost Efficiency applies to all measures. In the table, improvement themes are prioritized as follows, based on the community's feedback during the engagement process:

1. Traffic Calming Improvements
2. Intersection and Roadway Improvements
3. Improved Parking Management
4. Bicycle and Pedestrian Improvements
5. Transit Improvements

The findings also indicate that the Sapperton/ Massey Victory Heights area requires a regional solution to address its current and future traffic congestion challenges. The scale of new development and the expansion of RCH are too vast for their traffic impacts to be managed simply by shifting travellers from private vehicles to other modes such as walking, cycling and transit. While these alternative modes will provide some relief, a regional network solution to reduce the amount of through traffic will likely provide the ultimate solution for the local community. Such a solution is beyond the jurisdiction or responsibility of the City and will require regional partners such as the Ministry of Transportation and Infrastructure (MoTI), TransLink, and the Port of Vancouver, as well as neighbouring municipalities. These regional agencies' interests will primarily be driven by the need to improve the efficiency of goods movement through the Sapperton area, given its geographic proximity to major regional infrastructure, namely the Brunette Interchange at Highway 1, the Pattullo Bridge

and the Queensborough Bridge / Highway 91A. Such a regional solution is also in line with the Memorandum of Understanding (MOU) signed between the Fraser Health Authority, MoTI and the City.

Table 7-2 Proposed Improvements Measured Against Evaluation Criteria

	Description	Evaluation Criteria Satisfied
Priority 1: Traffic Calming Improvements		
A	Upper Sapperton measures	• Improved safety and perception of safety • Enhanced liveability • A match between traffic type and road classification • Strengthening and respecting the identity and history of the Sapperton neighbourhood • Cost efficiency • Fair distribution of benefits
B	Central Sapperton measures	• Improved safety and perception of safety • Enhanced liveability • A match between traffic type and road classification • Strengthening and respecting the identity and history of the Sapperton neighbourhood • Cost efficiency • Fair distribution of benefits
C	Lower Sapperton measures	• Improved safety and perception of safety • Enhanced liveability • A match between traffic type and road classification • Strengthening and respecting the identity and history of the Sapperton neighbourhood • Cost efficiency • Fair distribution of benefits
Priority 2: Network Improvements		
D	E 8th Ave and Cumberland St turn lanes	• Enhanced liveability • A match between traffic type and road classification • Reduced delay at key intersections and along key corridors • Fair distribution of benefits
E	E 10th Ave and Cumberland St left turn lanes	• Enhanced liveability • A match between traffic type and road classification • Reduced delay at key intersections and along key corridors • Fair distribution of benefits
F	E 10th Ave left turn lane to McBride Blvd	• Reduced delay at key intersections and along key corridors • Fair distribution of benefits
G	E 8th Ave dual left turn lanes to McBride Blvd	• Enhanced liveability • A match between traffic type and road classification • Reduced delay at key intersections and along key corridors • Fair distribution of benefits
H	Peak period restricted left turn from E 6th Ave to McBride Blvd	• Enhanced liveability • A match between traffic type and road classification • Fair distribution of benefits
I	Peak period restricted left turn from Memorial Dr to McBride Blvd	• Enhanced liveability • A match between traffic type and road classification • Fair distribution of benefits
J	E Columbia St and Brunette Ave intersection upgrade	• Enhanced liveability • A match between traffic type and road classification • Reduced delay at key intersections and along key corridors • Strengthening and respecting the identity and history of the Sapperton neighbourhood • Fair distribution of benefits
K	4-Laning of Brunette Ave between E Columbia St and Spruce St	• Enhanced liveability • A match between traffic type and road classification • Reduced delay at key intersections and along key corridors • Strengthening and respecting the identity and history of the Sapperton neighbourhood • Fair distribution of benefits
L	E Columbia St southbound left turn into Keary St	• Enhanced liveability • Reduced delay at key intersections and along key corridors • Fair distribution of benefits
M	Brunette Ave and Allen St access improvement	• Enhanced liveability • Reduced delay at key intersections and along key corridors

	Description	Evaluation Criteria Satisfied
		• Fair distribution of benefits
N	Brunette Ave northbound left turn into Braid St	• Enhanced liveability • A match between traffic type and road classification • Reduced delay at key intersections and along key corridors • Strengthening and respecting the identity and history of the Sapperton neighbourhood • Fair distribution of benefits
O	Braid St and Rousseau St intersection upgrade	• Enhanced liveability • A match between traffic type and road classification • Reduced delay at key intersections and along key corridors • Strengthening and respecting the identity and history of the Sapperton neighbourhood
P	Holmes St intersection upgrade at E. Columbia St to separate turn movements	• Enhanced liveability • Reduced delay at key intersections and along key corridors • Fair distribution of benefits
Q	Braid St and E Columbia St intersection improvements	• Enhanced liveability • A match between traffic type and road classification • Reduced delay at key intersections and along key corridors • Strengthening and respecting the identity and history of the Sapperton neighbourhood • Fair distribution of benefits
Priority 3: Parking Management		
R	Stage 1 Parking Plan	• Enhanced liveability • Balance between on-street parking supply and demand • Strengthening and respecting the identity and history of the Sapperton neighbourhood
S	Stage 2 Parking Plan	• Enhanced liveability • Balance between on-street parking supply and demand • Strengthening and respecting the identity and history of the Sapperton neighbourhood
Priority 4: Bicycle Routes and Pedestrian Facilities Improvements		
T	E Columbia St cycling and pedestrian crossing improvements	• Improved safety and perception of safety • Enhanced liveability • Reduced reliance on private vehicles • Superior walkability • Bike access for all ages and abilities (AAA) • A match between traffic type and road classification • Strengthening and respecting the identity and history of the Sapperton neighbourhood • Fair distribution of benefits
U	E 7th Ave / E 6th Ave / Shiles St / Richmond St improvements, including raised crossings	• Improved safety and perception of safety • Enhanced liveability • Reduced reliance on private vehicles • Superior walkability • Bike access for all ages and abilities (AAA) • A match between traffic type and road classification • Strengthening and respecting the identity and history of the Sapperton neighbourhood • Fair distribution of benefits
V	Keary St / Sherbrooke St / Fader St cycling improvements, including raised crossings	• Improved safety and perception of safety • Enhanced liveability • Reduced reliance on private vehicles • Superior walkability • Bike access for all ages and abilities (AAA) • A match between traffic type and road classification • Strengthening and respecting the identity and history of the Sapperton neighbourhood • Fair distribution of benefits
W	McBride Blvd and E Columbia St curb extension and signage	• Improved safety and perception of safety • Superior walkability • Fair distribution of benefits
X	E 10th Ave and Surrey St safety and active modes improvement	• Improved safety and perception of safety • Enhanced liveability • Reduced reliance on private vehicles • Superior walkability • Bike access for all ages and abilities (AAA) • A match between traffic type and road classification • Fair distribution of benefits
Y	E 8th Ave and Richmond St right-in, right-out and active modes improvements	• Improved safety and perception of safety

	Description	Evaluation Criteria Satisfied
		• Enhanced liveability • Reduced reliance on private vehicles • Superior walkability • Bike access for all ages and abilities (AAA) • A match between traffic type and road classification • Strengthening and respecting the identity and history of the Sapperton neighbourhood • Fair distribution of benefits
Z	E 6th Ave and Cumberland St curb extensions	• Improved safety and perception of safety • Enhanced liveability • Superior walkability • Strengthening and respecting the identity and history of the Sapperton neighbourhood • Fair distribution of benefits
AA	Sidewalks on Cumberland St and E 7th Ave	• Improved safety and perception of safety • Enhanced liveability • Reduced reliance on private vehicles • Superior walkability • Strengthening and respecting the identity and history of the Sapperton neighbourhood • Fair distribution of benefits
BB	Stop control switch at Shiles St and Devoy St	• Improved safety and perception of safety • Enhanced liveability • Bike access for all ages and abilities (AAA) • Fair distribution of benefits
CC	Paving of section of BFG along Brunette River	• Improved safety and perception of safety • Enhanced liveability • Reduced reliance on private vehicles • Bike access for all ages and abilities (AAA) • Superior walkability • Fair distribution of benefits
DD	Central Valley Greenway connection on North Road (west side)	• Improved safety and perception of safety • Enhanced liveability • Reduced reliance on private vehicles • Bike access for all ages and abilities (AAA) • Superior walkability • Fair distribution of benefits
Priority 5: Transit Improvements		
EE	Provision of bus stops and two shelters	• Enhanced liveability • Reduced reliance on private vehicles • Fair distribution of benefits
FF	Peak period bus lanes on E 8th Ave with parking restrictions and removal of impacted curb extensions	• Enhanced liveability • Reduced reliance on private vehicles • Fair distribution of benefits
GG	Increased frequency of service	• Enhanced liveability • Reduced reliance on private vehicles

8. Scheduling of Improvement Measures

There are several multimodal network improvement measures identified in this Sapperton/ Massey Victory Heights Transportation Plan that will benefit the community in the short-term. Some of these quick-win measures are within the City's sole jurisdiction and can be implemented once funding is available. Other measures will require further community and stakeholder engagement and a funding strategy, possibly partnering with agencies such as TransLink and the Insurance Corporation of BC (ICBC). In addition, developers are also a source of funding based on their developments' contributions to growth in traffic, as was determined in *Section 3.3*, and local intersection improvements adjacent to particular developments. From an overall network perspective, development funding is also required to help achieve the desired shift out of Single Occupant Vehicles to lessen the growth in vehicle traffic by contributing to the multimodal network improvements.

Table 8-1 details the improvement measures identified in this Plan with possible timing, and also indicates those measures which require further engagement with either other agencies or the community, or both, prior to moving forward. The timing is influenced to some degree by the developments expected to be completed in the area, which timing is also shown in the table. Given the study area's already congested transportation network, these developments do not necessarily serve as 'triggers' for many of these proposed improvement measures, however where they do, this has also been shown.

Table 8-1 Proposed Schedule of Improvement Measures

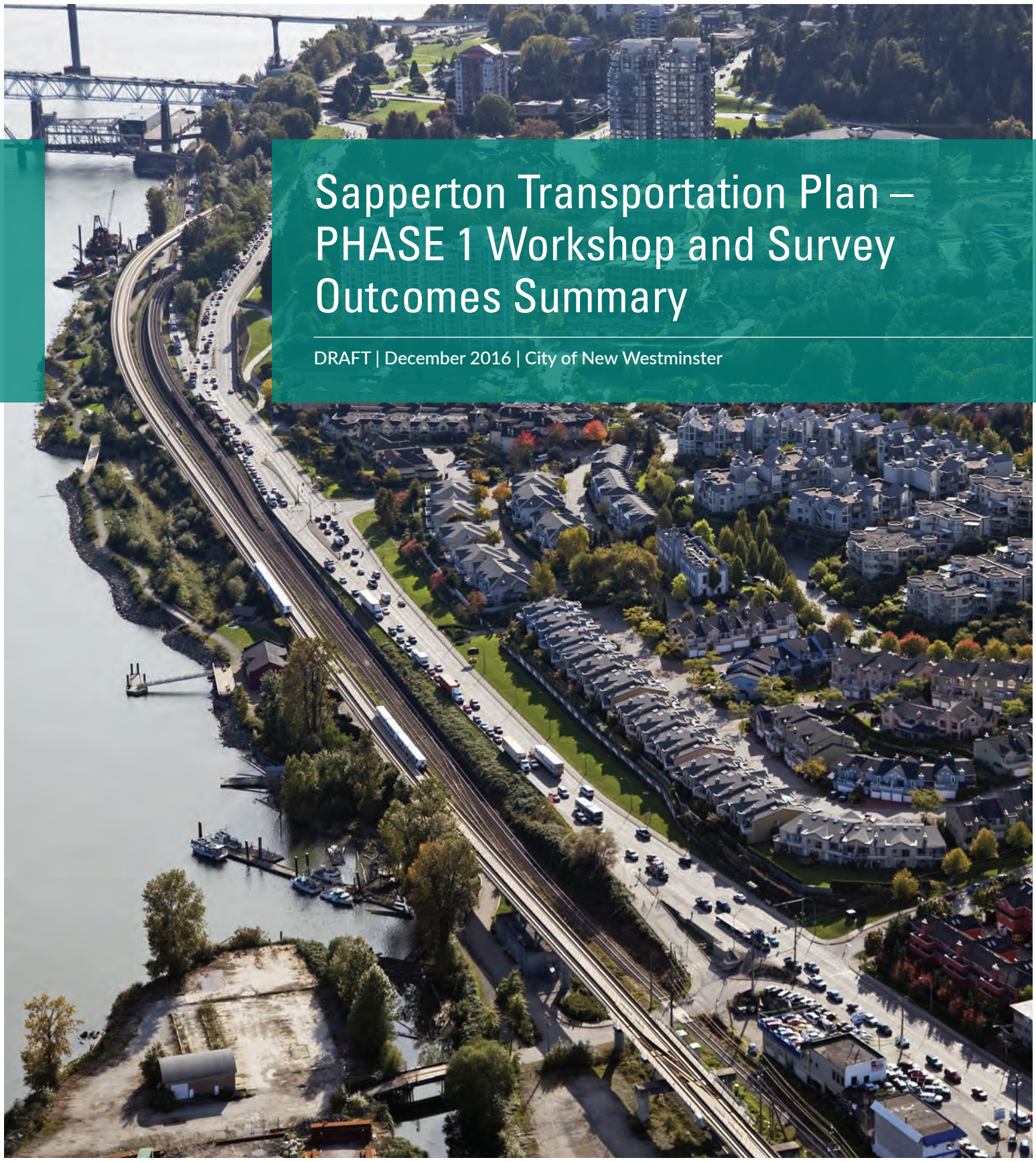
No	Recommendation	Influencing Factors / Partnership Opportunities	Short-term (1-2 years)	Medium-term (3-5 years)	Long-term (5+ years)
1	**TRAFFIC CALMING IMPROVEMENTS**				
1a	**Lower Sapperton Measures** • **New Speed Humps** • **New Traffic Circle** • **Removal of median island on Sherbrooke Street**	• Implementation of speed humps & traffic circle can occur in short – medium term as funding becomes available • Implementation to occur prior to completion of RCH Redevelopment Stage 1 • Can utilize grant funding available from TransLink & ICBC			
1b	**Central Sapperton Measures** • **New speed humps** • **New pinch-points** • **Speed ramps in lane** • **Alberta Street diverter removal** • **Raised crosswalk on Sherbrooke St. & Richmond/ Hospital St.** • **Right-in-right-out at Griffiths Place/ Braid Street** • **8th Ave/ Richmond St. median island**	• Implementation of speed humps & pinch-points can occur in short – medium term as funding becomes available • Alberta Street diverter can be removed in conjunction with the speed humps & pinch-point implementation • Raised crosswalk on Sherbrooke Street can occur in short-medium term. • Raised crosswalk at Richmond/ Hospital St. in medium term (coincide with school redevelopment) • RIRO at Griffiths Pl. can occur following engagement & safety assessment by Engineers. • Median island can occur in conjunction with 6th Ave turn restrictions & 8th Ave dual left turns.			
1c	**Upper Sapperton Measures** • **Painted centerline on Richmond St.** • **New speed humps** • **Remove centerline on 6th Ave** • **6th Ave/ Cumberland Ave intersection modifications**	• Implementation of painted centerline to occur in short-medium term • Implementation of new speed humps to occur in short- medium term • 6th Ave centerline removal to occur in short term • 6th Ave/ Cumberland Ave intersection modifications to coincide with New West Aquatic Centre & Community Centre redevelopment			
1d	**Massey Victory Heights Measures** • **Advanced warning lights on 8th Ave** • **Advanced warning lights on Holmes St.** • **Speed Humps on Cumberland Street (adjacent to elementary school)**	• Implementation of advanced lights can occur as budget becomes available • Implementation of speed humps can occur in short term • Can utilize grant funding available from ICBC			
2	**STREET LIGHTING IMPROVEMENTS**				
2a	**Implement & maintain an acceptable level of coverage for the study area based upon the City's Street Lighting Strategy**	• City-wide capital and operating budgets for maintenance/ installation • City-led projects using grants and other funding opportunities			
3	**NETWORK IMPROVEMENTS**				
3a	**E. 8th Ave & Cumberland St. turn lanes**	• Final layout and implementation to be integrated with the New West Aquatic Centre & Community Centre redevelopment & other development opportunities.			
3b	**E. 10th Ave & Cumberland St. left turn lanes**	• As part of 10th Avenue Corridor Study being undertaken in coordination with City of Burnaby			
3c	**E 10th Ave left turn lane to McBride Blvd.**	• As part of 10th Avenue Corridor Study being undertaken in coordination with City of Burnaby • Integrated with McBride Corridor Study (Study underway in 2018, with implementation targeted for 2020+) • Can utilize grant funding available from ICBC & TransLink			

No	Recommendation	Influencing Factors / Partnership Opportunities	Short-term (1-2 years)	Medium-term (3-5 years)	Long-term (5+ years)
3d	**E. 8th Ave dual left turn lanes to McBride Blvd.**	• Integrated with McBride Corridor Study (Study underway in 2018, with implementation targeted for 2020+) • Final layout and implementation to be integrated with the New West Aquatic Centre & Community Centre redevelopment, Pattullo Bridge Replacement & other development opportunities.			
3e	**Restricted left turn from E. 6th Ave to McBride Blvd.**	• Integrated with McBride Corridor Study (Study underway in 2018, with implementation targeted for 2020+) • Final layout and implementation to be integrated with the New West Aquatic Centre & Community Centre redevelopment, Pattullo Bridge Replacement & other development opportunities.			
3f	**E. Columbia Street & Brunette Ave. intersection upgrade**	• Integrated with redevelopment of the Royal Columbian Hospital & other developments along E. Columbia Street • Potential partnerships with Fraser Health Authority, TransLink, ICBC and other regional/ good movement stakeholders • Contributions from new developments through DCC Bylaw update			
3g	**Four-laning of Brunette Ave. between E. Columbia Street and Keary Street**	• Integrated with redevelopment of the Royal Columbian Hospital & other developments along E. Columbia Street • Potential partnerships with TransLink, ICBC and other regional/ good movement stakeholders			
3h	**E. Columbia St. southbound left-turn into Keary Street**	• Integrated with redevelopment of the Royal Columbian Hospital			
3i	**Brunette Ave. and Allen St. access improvement**	• Integrated with redevelopment of the Royal Columbian Hospital			
3j	**E. 8th Ave & Richmond Street intersection median island**	• In conjunction with E. 6th Ave left turn restriction at McBride Blvd & Pattullo Bridge Replacement.			
3k	**Brunette Ave northbound left-turn into Braid St.**	• In conjunction with Brunette Interchange Project & E. Columbia/ Brunette Ave intersection upgrade.			
3l	**Braid St. and Rousseau St. intersection upgrade**	• In conjunction with Urban Academy, WesGroup & QuadReal (Sapperton Green) developments			
3m	**Holmes Street/ E. Columbia Street intersection upgrade**	• Occurring in 2018 as part of Capital Budget • Opportunity to partner with ICBC			
3n	**Braid St. and E. Columbia Street intersection improvements**	• Implementation to coincide with completion of RCH redevelopment Phase 1 • Partnership opportunity with Fraser Health Authority			
4	**PEDESTRIAN & BICYCLE FACILITY IMPROVEMENTS**				
4a	**E. Columbia Street cycling & pedestrian crossing improvements**	• Following the completion of the Great Street design exercise in 2018, capitalize on partnership opportunities (FHA, TransLink, new developments) to implement a range of improvements o Examples being: Pedestrian crosswalk at Simpson St/ E. Columbia St.; Intersection upgrades for bike movements at Sherbrooke St.; Bus & pedestrian activated signal at Hospital St.			
4b	**E. 7th Ave, E. 6th Ave, Shiles St, Richmond St improvements including raised crossings**	• Implemented as part of annual capital budget & new developments			
4c	**Relocation of Crosstown Greenway from Sherbrooke St (Richmond St. – E. Columbia St.) to Keary Street (utilizing the lane behind RCH to**	• On-street improvements as part of capital budget & new developments • Improvements in the lane behind RCH as part of RCH redevelopment (Phase 1-3)			

No	Recommendation	Influencing Factors / Partnership Opportunities	Short-term (1-2 years)	Medium-term (3-5 years)	Long-term (5+ years)
	connect with Sherbrooke St.) & associated improvements				
4d	**McBride Blvd/ E. Columbia Street intersection improvements**	• Short term improvements that will last the transition period to the Pattullo Bridge replacement and associated road improvements • Opportunity to partner with TransLink & ICBC for grant funding			
4e	**E. 10th Ave & Surrey Street safety improvements**	• Implemented as part of/ or in advance of 10th Ave Corridor Study being undertaken by City of Burnaby. • Opportunity to partner with TransLink & ICBC for grant funding			
4f	**Sidewalks on Cumberland St. & E. 7th Ave**	• Can be implemented as part of Annual Capital Budget and/ or New West Aquatic Centre & Community Centre redevelopment			
4g	**Stop-control switch at Shiles St. and Devoy St.**	• Implementation as part of Annual Capital Budget			
4h	**Paving of Brunette Fraser Regional Greenway along the Brunette River**	• Implementation as part of Sapperton Green Master Planned Community			
4i	**Provide continuous riverfront connection between Braid Street section of the Brunette Fraser Regional Greenway and Westminster Pier Park**	• Implementation in partnership with TransLink, MOTI (Pattullo Bridge Replacement), Metro Vancouver			
4j	**Provide pedestrian and cyclist connection across rail lines & Brunette Ave (e.g. Sapperton Station area) to connect people to the Riverfront & BFRG**	• Implementation in partnership with TransLink and other key stakeholders			
4k	**Enhance the Brunette Fraser Regional Greenway connection/ facility along North Road with the City of Coquitlam**	• Implementation in partnership with City of Coquitlam ,TransLink & Metro Vancouver			
5	**TRANSIT IMPROVEMENTS**				
5a	**Provision of transit facilities at all stops located within the study area (including the option for a 'public art' located within the commercial centre of Sapperton)**	• Partner with Patterson, TransLink & Coast Mountain Bus Company to enhance transit facilities throughout the study area (with additional funding from new developments)			
5b	**Peak-period transit priority measures along E. 8th Ave and Braid Street**	• Implement peak-period parking restrictions and other measures along E. 8th Ave and Braid Street to improve corridor efficiency (after engagement with residents)			
5c	**Work with TransLink to improve bus speed & reliability at key locations**	• Implement a range of measures following the technical analysis by TransLink staff.			
5d	**Work with Translink to provide enhanced east-west service across the City, connecting key destinations/ services/ employers**	• In accordance with the City's Transit Priorities Document			
5e	**Transit/ Pedestrian/ Ambulance activated signal at E. Columbia Street & Hospital Street**	• In collaboration with TransLink and Coast Mountain Bus Company • Partnership opportunities with TransLink & Fraser Health Authority			
6	**PARKING MANAGEMENT**				
6a	**Stage 1 Parking Plan**	• Implement measures that will improve the utilization and management of on-street parking			

No	Recommendation	Influencing Factors / Partnership Opportunities	Short-term (1-2 years)	Medium-term (3-5 years)	Long-term (5+ years)
6b	**Stage 2 Parking Plan**	• Assess the need for expanding resident permit parking further afield resulting from a variety of external pressures and developments.			
6c	**Victoria Hill Parking Study**	• Underway in 2018, with recommended improvements being implemented shortly after the conclusion of the study			
6d	**New West Aquatics & Community Centre redevelopment**	• Transportation Impact Assessment underway in 2018, with measures being implemented in accordance with the Assessment recommendations			

Appendix A – Public Engagement Reports



Sapperton Transportation Plan – PHASE 1 Workshop and Survey Outcomes Summary

DRAFT | December 2016 | City of New Westminster

SAPPERTON Transportation Plan

Prepared for:

NEW WESTMINSTER

Submitted by:

McElhanney

Executive Summary

A predominantly residential community, Sapperton is home to the Royal Columbian Hospital (RCH), which is undergoing a major expansion over the next decade. In addition, the significant increase in mixed-use development projects within the Sapperton area is expected to add to congestion and impact traffic volumes on neighbourhood streets, while the BC Ministry of Transportation and Infrastructure's (MoTI) Brunette Avenue interchange improvement project is anticipated to result in potential road network changes that could have a profound impact on the number and type of vehicles on local streets.

The City of New Westminster (the City) is committed to implementing improvements to address neighbourhood transportation safety and livability concerns in Sapperton and to updating its traffic calming plan. Accordingly, the City has commissioned the preparation of the Sapperton Transportation Plan. In addition to the technical data gathering, analysis and modelling which underpins the Plan, the initiative also includes a significant stakeholder and community consultation component. Stakeholder and community consultation is viewed as critical to the successful development and future implementation of the Sapperton Transportation Plan: it provides the mechanism for matching interventions to community priorities, thereby helping to ensure the Plan proposals are both responsive and supported.

This report summarizes the outcomes of the Phase 1 consultation component, which comprised a community workshop, convened and facilitated by the City of New Westminster on 1 October 2016, as well as a community survey. The workshop was attended by 67 members of the community, while a total of 50 completed survey responses were received. Note that the 50 responses received are not considered a statistically significant sample of the resident population and employees of Sapperton area. The purpose of this report is to provide the City and technical team with an overview of recorded concerns and priorities; to set out the respondents' view of the qualities of a successfully planned neighbourhood; and to capture the specific interventions which were suggested via the workshop and the survey. The report is intended to provide added focus for the technical analysis and to inform intervention proposals; as well as to provide a record of "what we heard" during the Phase 1 consultation, which can be shared with the community at a future date.

The workshop and survey established that a large proportion of respondents are dependent on private vehicles for their primary transportation needs. Reasons for this are associated with work related or shopping related needs, ferrying young children or due to a physical disability. Such high levels of private vehicle dependence are an important consideration when contemplating interventions in the Sapperton transportation network. Nevertheless, there is also a strong propensity for transit use and walking amongst the Sapperton community. This is attributable to high quality transit services and the fact that Sapperton is considered to be a compact and mixed use neighbourhood with pleasant and safe streets which make walking more attractive. Many of the aspects of the transportation system which the respondents identified to be working well were associated with transit, active modes, and urban design interventions (such as parklets and wider sidewalks which enable sitting) which encourage walking and promote a sense of place.

A high degree of consistency between the workshop outcomes and survey results was observed. Transportation concerns were focussed on the penetration of through traffic and trucks into the local

neighbourhood, particularly during peak periods when the existing arterial system becomes congested. Traffic volumes, speed, enforcement and on-street parking demand were identified as key issues as well as the resulting impacts on pedestrian and cyclist safety and neighbourhood quality of life. The potential impacts of new development were also raised as an issue with concerns articulated about the possible effects of construction traffic and road closures as well as post-construction traffic and impacts on parking.

The key qualities of a successfully planned neighbourhood were considered to include:

- Designated and efficient routes for regional traffic which maintain flows and discourage rat running
- Transit oriented, traffic calmed local neighbourhoods where walking, cycling and transit are viable, attractive and safe, and where driving is a last resort
- Good pedestrian connectivity to other parts of the City

A range of specific interventions were proposed to support the realization of this vision during the workshop and via the community survey. These are detailed in the report and marked up on the accompanying neighbourhood map bases Figures 4.1 to 4.4). Highlights, arranged by theme are summarized below.

Traffic Volumes

- Enhanced regional connections
- Through traffic on designated routes
- Intersection / signal timing improvements
- Remove 8th Ave truck route

Vehicle Speeds

- Integrated traffic calming plan
- Designate emergency routes
- Reduce speed limits

Transit

- Improved bus service and frequency in evening/ off peak
- Improved skytrain frequency to Sapperton
- Better skytrain station access south of Brunette

Walking & Cycling

- More/ improved crosswalks
- Wider sidewalks and curbcuts
- Centre medians and pedestrian refuges
- Better greenway and Waterfront connectivity
- Bike routes that avoid steep grades

TDM

- More car sharing
- Fraser Health to increase and promote TDM amongst RCH employees
- City to promote TDM measures in the community

Development

- More public spaces
- Improved street lighting
- More seating

Enforcement

- Speed enforcement by NWPD
- Increased enforcement by Commercial Vehicle Unit (truck routes)
- Parking Bylaw enforcement

Parking

- RCH staff parking to be accommodated on site
- Manage parking as a system
- Additional parking at Hume Park

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ADDITIONS TO BE MADE TO REPORT:

On February 16, 2017 Transportation staff from the City met with eight residents of the 300 Block of Keary Street at the Sapperton Pensioners Hall. The intent of the discussion was to confirm that the Workshop #1 Summary Report clearly reflected the issues and concerns raised by the residents of this block. Through the discussion, the residents felt that the report required amendments to emphasise the following:

- Primary concern: Increased vehicle traffic volumes and speeds.
- Perceived cause: Port Mann Bridge tolls; full traffic light (at Keary/ E. Columbia – occurred when Brewery District Plans were approved); Alberta Street temporary diverter (implemented in 2015).
- They would like their concerns over the November 2016 vehicle volumes and speeds on their block and parallel streets to be reflected.
- They think it's important that any summary of motor vehicle volume and speed take into account the activity over a full week. For example, with regard to motor vehicle speed, they want the City to report the total number of motor vehicles exceeding the speed limit over the entire week. Also, with respect to increases in motor vehicle volume, they want the City to report on the total increase in motor vehicle volume over the entire week.
- They don't want the volume of traffic to be the measure that reduces vehicle speeds on their block – i.e. congestion as a traffic calming/speed reduction tool is not acceptable.
- In the last few years residents of Keary St feel that there has been a sharp increase in the amount of emergency services vehicles (Fire and Ambulance particularly) and trucks utilizing this block.
- Mitigation measures should take into account the lane between Simpson and Keary as it was recently resurfaced and is now feels like it's being used as a 'street'
- Potential solutions: There was general consensus between the attendees (except for one person) that they would be willing to accept some inconvenience to accessing their homes if it meant that the vehicle speeds and volumes were reduced on their block. They would be willing to accept some modifications to the on-street parking regulations (suggestion that resident exempt could be in the upper half of the block and the 2-hour closer to the hospital and commercial area.

The consultant has been requested to update the report to reflect this information, which has not yet been incorporated into this version of the document.

1. Introduction

This report has been prepared for the City of New Westminster (the City) as part of the Sapperton Transportation Plan Project. The report summarizes the outcomes of the Sapperton Transportation Plan workshop, convened and facilitated by the City of New Westminster on 1 October 2016, as well as the feedback received from a community survey. The purpose of the report is to:

1. Provide the City and technical team with an overview of recorded concerns and priorities, affording them with a focus for the technical analysis and informing the potential intervention proposals.
2. Provide a record of "what we heard" which can be shared with the community at a later date.

1.1. Study Context

A predominantly residential community, Sapperton is that is home to the Royal Columbian Hospital (RCH), which is undergoing a major expansion over the next decade. In addition, the significant increase in mixed-use development projects within the Sapperton Neighbourhood, along with smaller developments proposed along East Columbia Street, are expected to add to congestion on the City's arterial and collector road network, and to impact traffic volumes on neighbourhood streets. The City is committed to updating its neighbourhood traffic calming plan and to implementing improvements to address neighbourhood transportation safety and livability concerns. At the same time the MoTI's Brunette Avenue interchange improvement project is expected to result in potential road network changes that could have a profound impact on the type and number of vehicles using the road network throughout the area, while increased demand for on-street parking is anticipated as the neighbourhood develops. Consequently, the City has commissioned the preparation of the Sapperton Transportation Plan which is composed of three key technical components:

- RCH Transportation Impact Assessment - including a detailed access, circulation and parking plan and traffic management strategy
- Sapperton Neighbourhood Transportation Servicing Plan – intended to address the impacts and opportunities presented by the planned developments in the neighbourhood, identifying the improvements and upgrades required in order to achieve the City's Vision, Goals and Targets, and providing guidance as to the City's approach to the reconfiguration of the Brunette interchange; and
- Neighbourhood Transportation Safety and Livability Plan - to address impacts to neighbourhood streets and optimize walking, transit and cycling as the area develops

In addition to the data gathering, technical analysis and modelling which underpins each of these components, the Sapperton Transportation Plan includes a significant community consultation component.

1.2. Role of Consultation

The McBride-Sapperton and Massey-Victory Heights neighbourhoods are characterized by engaged, knowledgeable residents, who are keen to share their views, and wish to remain informed and involved throughout the process of Plan development. The Study Area is also home to several key stakeholder groups, including the Royal Columbia Hospital, businesses and service providers, as well as several schools whose inputs are important to plan development and successful implementation. Stakeholder and community consultation is viewed as critical to the successful development and future implementation of the Sapperton Transportation Plan as it provides the mechanism for matching interventions to community priorities, thereby helping to ensure the Plan proposals are both responsive and supported. Engagement with the community and stakeholders is thus a core component of Plan development, and is divided into three phases.

Phase 1 - Listen and Learn and Development of Evaluation Criteria: This included a Community Workshop on October 1, 2016, hosted by the City. The purpose of the workshop was to provide the community with an opportunity to share their experiences, opinions, concerns and issues. Outcomes from this workshop and from discussions with other stakeholders are to be used as a basis for understanding existing conditions, background and issues; establishing community and stakeholder expectations of the Plan; and to identify the evaluation criteria which will be used in developing and assessing intervention options. This report provides a summary of the workshop outcomes and the results of a parallel community survey.

Phase 2 - Confirmation of Evaluation Criteria and Presentation of Options: It is anticipated that this phase will include a forum whereby residents and other key stakeholders will be invited to review and comment on the emerging plan for addressing future transportation and parking requirements, including options for addressing neighbourhood transportation safety and livability issues, operational improvements, infrastructure upgrades, and parking strategies.

Phase 3 - Input on Draft Plan: The final phase of consultation will provide the public and other key stakeholders with an opportunity to review the Draft Sapperton Transportation Plan and help shape the content of the final document.

1.3. Structure of this Report

Section 2 of this report provides a summary of the Phase 1 workshop. Section 3 sets out the high level results from the community survey. Section 4 considers specific issues and interventions at the neighbourhood level, as identified through the workshops and surveys and includes marked up plans detailing the nature and location of the issues and interventions identified.

2. Phase 1 Community Workshop

2.1. Overview

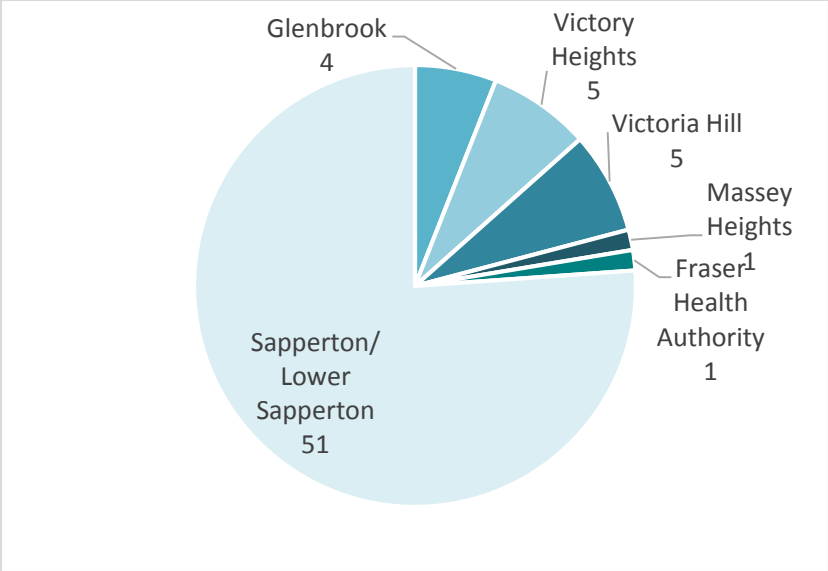
The City hosted a Community Workshop on October 1, 2016, to launch the Sapperton Transportation Plan. The purpose of the workshop was to provide the community with an opportunity to share their experiences, opinions, concerns and issues in relation to transportation in the Sapperton area. Facilitators worked with participants to identify concerns, clarify expectations, and discuss the evaluation criteria that will be used to assess options for addressing future transportation and parking requirements.

The workshop was advertised via Facebook, Twitter and in the local press. Notices were also issued via the Business Improvement Association and distributed to each address in the study area. The Eventbrite.ca website was used for event pre-registration. Most of the Eventbrite.ca traffic was directed from social media promotion including Facebook (almost 50 percent of traffic) and Twitter (just over 25 percent of traffic). A total of 57 attendees pre-registered for the workshop.

2.2. Attendance

Based on the workshop sign-in records, a total of 67 people attended the workshop. The majority of attendees were residents of the Sapperton/ Lower Sapperton Neighbourhood, as summarized in Exhibit 2.1 which was derived from the workshop sign in records. Most respondents reported that they live and play in the Sapperton area, with just two reporting that they work in the Study Area.

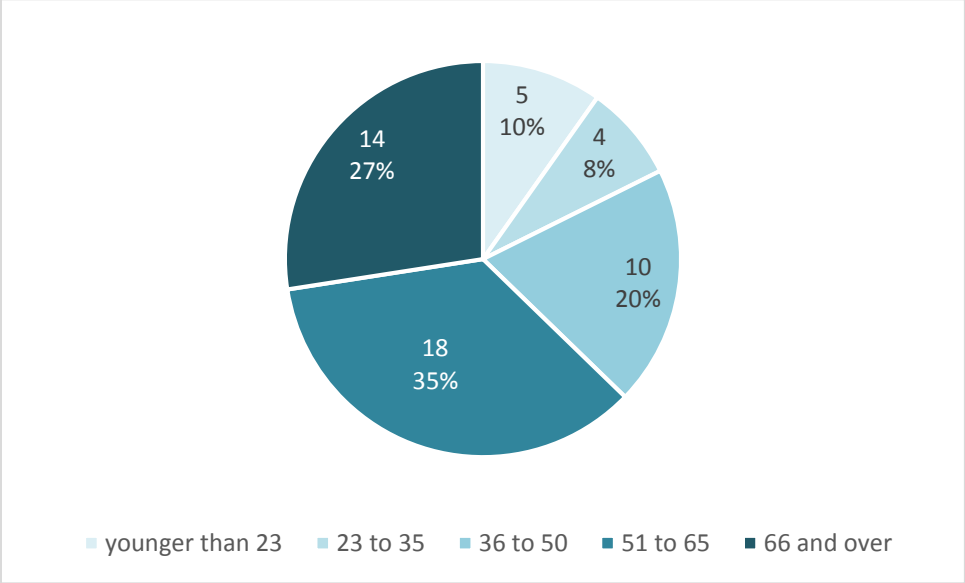
Exhibit 2.1: Workshop attendees - origin



2.3. Demographics

Attendees included representation across a broad range of age categories, with over 60 percent aged 51 or older.

Exhibit 2.2: Recorded age of attendees

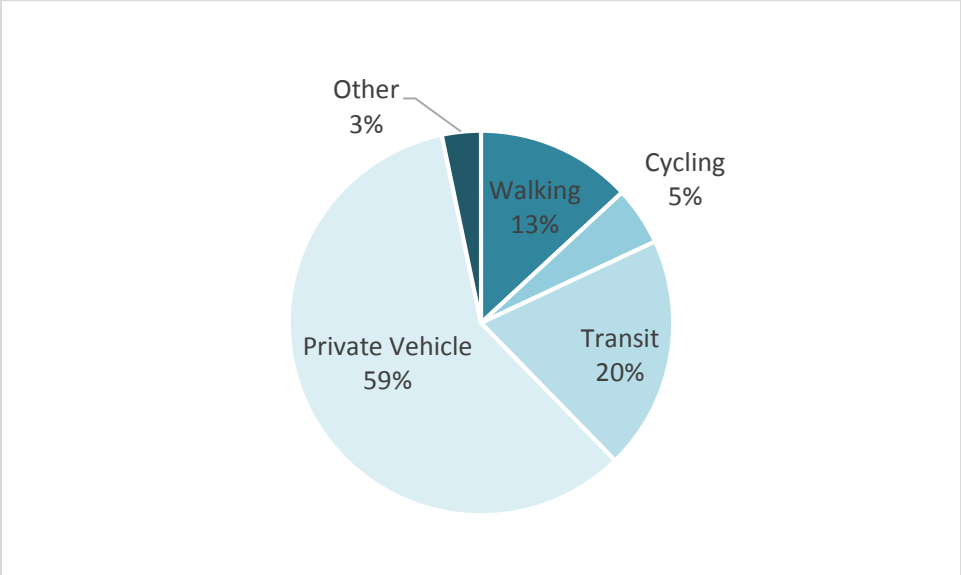


2.4.Primary Mode of Transportation

Workshop participants indicted their primary mode of transportation using a sticky dot exercise. High levels of reliance upon private vehicles (59 percent) are indicated in attendees' reported primary mode of transportation.

However, transit (20 percent) and walking (13 percent) are also well represented, reflecting the proximity and availability of Skytrain service and the mixed use nature of the community which supports walking for short trips.

Exhibit 2.3: Reported primary mode of transportation



A total of 63 percent of participants claimed that they would walk, cycle or take transit more frequently in future if enabling improvements were implemented to support these modes.

2.5. Responses to Proposed Development

Workshop attendees were invited to provide observations and questions relating to proposed developments in the Sapperton Area in the context of neighbourhood safety and livability. Respondents provided their views on sticky notes and posted these to display boards. Responses are documented below.

2.5.1. Royal Columbian Hospital

- Staff and visitors should park on hospital grounds rather on local streets
- How can Fraser Heath promote better transit use by employees?

2.5.2. Other Sapperton Developments

- Six lane Pattullo Bridge with a cut and cover tunnel on McBride to freeway in Burnaby is required to remove traffic from the neighbourhood
- A smarter toll is required on all bridges
- Better traffic flow is required on east 8th Ave/ 8th Ave

- Remove truck traffic from east 8th Ave
- Remove parking from 8th Ave, add left turn bays and signals
- East 8th Ave needs to do a better job of moving people across town, including regional traffic - or move regional traffic elsewhere
- 8th Ave does not need to be the main artery – reduce traffic on this route
- Need an effective arterial between Braid/ Brunette and Marine Drive
- Concern about new development proposals (e.g. at Strand and Columbia) without an accompanying transportation plan

2.5.3. Neighbourhood Transportation Safety and Livability

- How can traffic diversion help improve liveability and safety on residential streets?
- Intersection of Braid and Columbia requires left turn signals from Columbia onto Braid to avoid collisions
- Prevent commuters from using Chilliwack Street as short cut between 8th and 10th Ave (primarily truck traffic)
- Prevent commuters from using Surrey St to get to Burnaby/ Cariboo Road
- Too many speeders cutting up and down Keary St
- Intersection of Keary and Columbia used for drop off and pick up for medical/ hospital visits: a designated area is required for this purpose (instead of parking)
- Clogged arterials spill traffic into other areas
- Lanes need signage saying local traffic only and/ or 20 km/h
- Traffic calmed streets such as Kelly St experiencing increases in traffic and speed due to increased traffic along Columbia Ave

2.6. What is Working Well?

Workshop participants were asked to comment on what is working well within the study area. Key aspects of the Sapperton transportation system which respondents view favourably include:

- Levels of service of transit in the area
- Parklet and wide sidewalks which enable sitting
- Pedestrian connection behind RCH joining Lower Sapperton to Sapperton Skytrai
- Central Valley Greenway which has led to an increase in cycling in the neighbourhood;
- Glenbrooke Ravine trail upgrade has enabled more people to enjoy the green space

- Seating on the Boulevard near the bakery on East Columbia
- Nice neighbourhood to walk through
- Support for permit parking system which is considered to be justified
- Sidewalk on McBride
- Good walking access in Glenbrook
- Good traffic calming around school on Richmond Street
- Walkability to the Castle
- Diversion at Sherbrook and 8th Ave which has reduced traffic

2.7. Observations, Issues and Interventions

General concerns and suggested interventions raised by participants were recorded during the workshop session and are arranged by topic below. Details of these (along with those raised by survey participants) are shown on the marked up maps in Section 4 of this report, which should be read in conjunction with the comments in this section.

2.7.1. Traffic Volumes

Key issues

- Perceived increase in traffic in the neighbourhood once Port Mann Bridge tolls came into effect
- Impacts of traffic changes with implementation of the Pattullo Bridge replacement?
- Difficulties getting in and out of the neighbourhood for local residents
- Truck traffic through the neighbourhood
- Backup of traffic along Braid Street and Brunette Avenue during rush hour
- Rat-running through neighbourhood streets and lanes as drivers try to avoid congestion on Braid, Brunette, East Columbia, 6th Ave and 8th Ave
- 6th Ave/ Cumberland intersection congested during peak travel periods. People are cutting through Dixon St and Harvey St.: better intersection control required at this location
- Rat-running through the neighbourhood (Lower Sapperton; Cumberland/ 6th Ave area; Richmond St)
- Richmond/ 8th Ave intersection safety concerns (drivers taking risks when gaps in traffic are seldom available) and queueing
- Diversion occurring due to traffic calming initiatives resulting in more traffic on some streets

Suggested interventions

- Need for improved access to/ from Hwy 1
- Would like to see Stormont interchange revived – it would discourage people from using local roads in CNW and Burnaby to access Hwy 1
- Through-traffic to stay on the main roads, and local traffic on local streets – need to make arterials function more efficiently to discourage people from looking for other routes to their destination
- Consider semi-actuated signal triggered by queues rather than pedestrian-signal at Richmond/ 8th Ave intersection
- Provide a location on Brunette Avenue for residents to access their community (and Brewery District), to reduce reliance on E. Columbia Street
- Intersection improvements (including improved left turn movements) at key intersections
- Improved signal timing (e.g. at the Braid/ Brunette Intersection; McBride/ Royal; and McBride/Memorial Drive) to improve efficiency at different times of the day

2.7.2. Vehicle Speeds

Key issues

- Areas of concern include downhill lanes e.g. on Memorial Drive and Sherbrooke (which lack speed humps and signage) as well as East Columbia Street and Brunette Ave
- Perceived speeding issue on Keary Street[1]
- Speed limits on Columbia are 30km/h while local streets are 50km/h

Suggested interventions

- Designated emergency vehicle routes/ movements required (ambulances currently use Garrett Street as a staging area and route to avoid congestion)
- Need to develop an integrated traffic calming plan for the whole system/ neighbourhood to ensure that the problem is not pushed elsewhere in New Westminster
- Diversionary traffic calming to be explored in Lower Sapperton area (including Alberta and Keary Streets)

[1] However, note that data indicates that there is a significant volume of vehicles travelling over 40km/h, but few over 50km/h.

2.7.3. Transit

Key issues

- Bus route and schedule modifications have impacted residents in Victoria Hill, Lower Richmond Road and 8th Ave corridor
- Limited bus service frequency in the evenings/ off-peak times
- Poor access to Sapperton Station from south side of Brunette Ave (industrial area)

Suggested interventions

- Improved bus services (route and schedule);
- Improved access south of Sapperton Station.

2.7.4. Walking and Cycling

Key issues

- Better pedestrian and cycling access to Sapperton Landing Park required, including Sapperton Station access to other side of the tracks to enable access to Sapperton Landing Park
- Pedestrian crossing on Keary Street is dangerous, at times, when walking to Sapperton SkyTrain Station
- Need for improved pedestrian crossing facilities on East Columbia
- Incomplete Central Valley Greenway (Cumberland Street to Debeck Street) along E. Columbia Street. Gap is major drawback to pedestrian and cyclist activity in the area
- Strong support for the 'lane' that connects Sherbrooke Street to Keary Street which provides residents direct access to the Sapperton Skytrain Station
- Support for Braid St/ Fader Street greenway crossing. Utilized by children in the neighbourhood to access schools and parks. (However still perceived to be dangerous as vehicles occasionally run the red light.)
- Grades on Sherbrooke Street not supportive of bike route

Suggested interventions

- Support for raised crosswalks, special crosswalks with flashing beacons, and bump-outs
- Centre-medians and pedestrian refuges in roads to make pedestrians feel safer when crossing the road
- Wider sidewalks on Keary Street between E. Columbia St and Brunette Ave
- Connect Sapperton Landing Park with Waterfront Pier Park
- Enhanced crossing treatments E. Columbia Street (notably at Simpson Street)

- Keary Street a better bike route than Sherbrooke Street (grades less steep)
- Boulevard separating pedestrians and cyclists from vehicle lanes required on Brunette Ave
- Improved end of trip facilities (bike lockers and racks) at key destinations in community

2.7.5. Parking

Key issues

- Hospital parking on neighbourhood streets
- Perception that people are purchasing parking permits from local residents and parking on-street to access Skytrain and work at RCH
- Question as to whether there is sufficient parking at RCH or whether staff are choosing not to pay to park at their place of work
- RCH and TransLink employees parking on Richmond Street where there are no time restrictions
- Vandalism and theft are common in Lower Sapperton lanes: Residents without garages park on street rather than in lanes

Suggested interventions

- Fraser Health to accommodate their staff parking needs on-site, rather than being dependent upon on-street parking in the nearby community
- Need to manage parking as a system, not street-by-street as it shifts the problem rather than addressing it
- Additional parking is required at Hume Park to encourage usage in the summer months

2.7.6. Trucks

Key issues

- Trucks use local streets to get to destination or to avoid congestion on truck routes
- Road network design and standards do not support trucks which cannot make the turns and get stuck at traffic circles – resulting in damage to signage and landscaping
- On average 3-5 trucks/day access RCH or Save-on-Foods by using local streets

Suggested interventions

- Remove 8th Ave from the truck route network, or enforce time restrictions on use

2.7.7. Developments

Key issues

- Concern about traffic impact to community as a result of Sapperton Green development; Urban Academy development; RCH expansion;
- Concerns about impacts during construction (e.g. of the RCH expansion) including:
  - Increase in trucks accessing the area
  - Construction workers parking on-street
  - Road closures during construction
  - Noise and air pollution from the construction

Suggested interventions

- Improve the sense of community:
  - Create more public spaces and squares
  - Place benches on local streets for resting point and social interaction
  - Improve street lighting throughout neighbourhood

2.7.8. Enforcement

Key issues

- Illegal driver behaviour (e.g. running of red lights/ 4 way stops, speeding) and lack of enforcement
- No enforcement of trucks (e.g. routes)
- Parking contraventions (exceeding time limits on-street and parking in Modo spots)

Suggested interventions

- Need improved speed enforcement from NWPD
- Need increased enforcement from Commercial Vehicle Unit (trucks not utilizing truck routes; noise from engine brakes)
- Increased enforcement by CNW Bylaw Enforcement (on-street parking; vehicles parking in Modo-designated spots)

2.7.9. Transportation Demand Management (TDM)

Suggested interventions

- More car-share within the community

- Fraser Health to increase and promote TDM measures with RCH employees to discourage private vehicle dependence
- City to promote TDM measures in the community

2.7.10. Other

Suggested interventions

- Whistle cessation required at Spruce St/ Cumberland St

2.8. What Does Success Look Like?

2.8.1. Key qualities of a successfully planned neighbourhood

Workshop attendees were invited to provide a view on what a successfully planned neighbourhood might look like. There was a general acknowledgement that, with development, the transportation dynamic will change but that it should be planned and managed effectively. Key messages are highlighted below:

- Less regional traffic rat-running through neighbourhoods, especially commercial vehicles
- Optimizing and enhancing key routes for vehicle movement to keep traffic moving, and discouraging people from looking for alternative routes
- Fewer vehicles on local streets
- Traffic calming measures, while still allowing vehicular access to neighbourhood (but willing to accept inconvenience if it discourages regional traffic from rat-running)
- Transit oriented communities, with residential streets that are safe and livable for people who live there
- Driving is a last resort – travel is dominated by other modes for most trips, supported by ubiquitous car sharing
- Improved pedestrian connectivity to other areas in the City
- Sustainable transportation options to be promoted as viable/ attractive/ safe options to the community

2.8.2. Specific interventions

Specific interventions associated with the achievement of these objectives were also identified by workshop participants and are grouped by theme and recorded below:

Pattullo bridge replacement

- Build a bigger Pattullo and redirect traffic under the City to Stormont and freeway
- New bridge crossing to align/ connect with 10th Ave and Highway 1
- Don't replace Pattullo – move the bridge further east to Coquitlam

Through traffic/ commuter traffic

- Eliminate Pattullo traffic – gridlock down Cumberland and Richmond during evening rush hour: eliminate left turn at McBride and 6th between 3PM and 6PM
- Divert commuter traffic around outer edge of the City, not thorough the neighbourhoods
- Stop commuters using Surrey St and Richmond St to get to Burnaby and Cariboo Road
- Permit vehicles to enter Surrey Street from 10th Ave only and do not allow an exit onto 10th Ave

Walking and Cycling

- Improved walk and bike connections to the rest of the City e.g. Pier Park
- East-west connection access across Glenbrooke Ravine and a complete Waterfront trail
- Enhanced access for bikes and pedestrians to SkyTrain stations

Traffic Calming

- Not giving in to small sections of the City
- Traffic calming that makes it difficult for regional commuters to cut across neighbourhoods e.g. Vancouver's West End

Vehicle Speeds

- Make speed limit 30 km/h everywhere except arterials
- Enforce speed limits on Columbia Ave and Keary St (generating revenue for the City)

3. Community Survey Outcomes

3.1. Survey Administration and Design

The City developed a survey which was administered online using the MetroQuest platform, accessible via a link from the Sapperton Transportation Plan project page on the City's website. Residents and businesses within the Study Area were invited to complete the survey online between 30 September and 14 October 2016. Two tablets were also made available at the October workshop, enabling attendees to complete the survey online at the workshop. Workshop attendees were also offered the opportunity of completing hardcopy versions of the same survey as an alternative to the digital survey completion.

The survey included questions about respondents' primary mode of transportation, the reason for their transportation choices, as well as steps the City might take to improve transportation or encourage more sustainable modes.

The survey also sought feedback from respondents about aspects of the transportation infrastructure that work well, how the City could encourage residents to drive less, and whether respondents support traffic calming in principle.

Respondents were asked to identify the top five transportation problems in their neighbourhoods, as well as aspects of the transportation network they liked.

3.2. Survey Participation

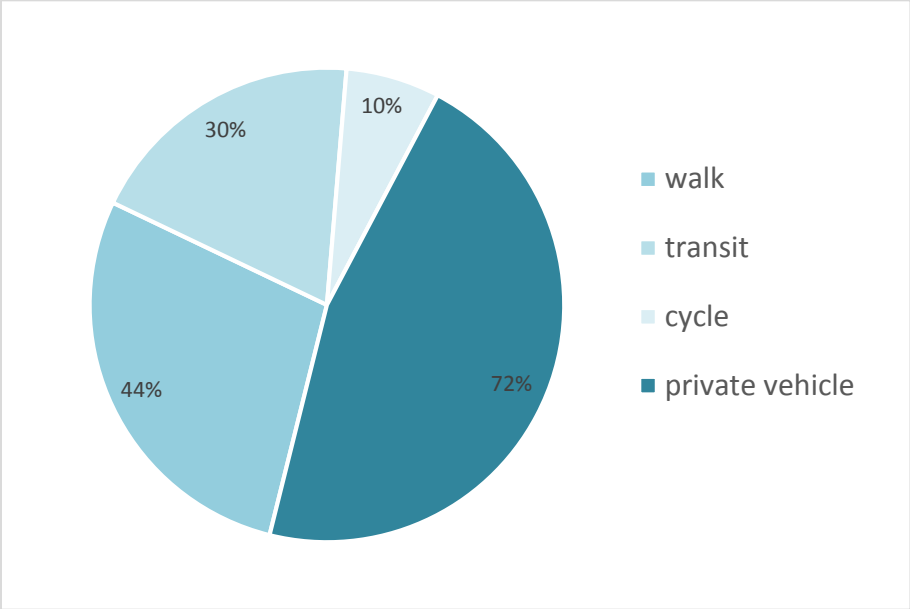
A total of 50 completed surveys were received, of which 17 were hard copy responses, and 33 were submitted online. Hardcopy and online responses were combined into a single data base to enable integrated analysis of results. Where appropriate, data have been quantified to allow the generality versus the specificity of responses to be gauged. However, note that the 50 responses received are not considered a statistically significant sample of the resident population and employees of Sapperton area. Nevertheless, the responses received do provide valuable insights into the concerns and aspirations of participants who are part of the Sapperton community. A relatively high degree of consistency between the survey responses was observed, and well as close consistency between survey response and the feedback received via the workshop.

3.3. Survey Responses

3.3.1. Respondents' Primary Mode of Transportation

Given that there was no restriction on the number of transportation modes that could be selected in the response, several respondents selected more than one primary mode. The percentages shown in the chart in Exhibit 3.1 reflect the percentage of total number of survey respondents who selected the mode, and thus adds up to more than 100 percent.

Exhibit 3.1: Survey Respondents' Primary Modes of Transportation



Private vehicles were identified as a primary mode of transportation by the majority of survey respondents (72 percent). However, a surprisingly high number of respondents (44 percent) indicated that walking is also amongst their primary modes of transportation, while 30 percent indicated that they use transit. Just 10 percent reported that cycling was a primary mode of transportation. As with the information collected from open house attendees, the private vehicle was reported as the dominant mode. However, the number of respondents reporting that walking as a primary mode was higher amongst survey respondents. This is likely owing to the fact that survey respondents were able to report more than one mode in their responses, and reflects the fact that walking is also the start and end mode to every transit journey.

3.3.2. Reliance on Private Vehicles

In total, 48 percent (24 of 50 survey respondents) indicated that they rely on a private vehicle for their primary transportation needs. The reasons provided for reliance on a private vehicle included:

- Physical disability

- Travelling outside of the Sapperton neighbourhood
- Work-related reasons (work location, commute time/ distance, transporting tools/ equipment),
- Ferrying young children
- Errands such as shopping (which requires transportation of larger loads and packages)

3.3.3. Reasons for Walking, Cycling and Taking Transit in Sapperton

Respondents provided a variety of reasons for using alternative modes to the private vehicle, the most commonly cited being:

- The fact that Sapperton is a compact and mixed use neighbourhood which supports local shopping, services, and restaurants encourages walking
- Pleasant and safe streets that make walking more attractive
- Exercise/ health
- The convenience and accessibility of Skytrain
- Unreliable auto travel times and the high cost of parking

3.3.4. What can the City do to Improve Walking, Cycling and Transit in Sapperton?

Survey respondents offered a range of suggestions for how the City could improve the experience of walking, cycling or using transit in Sapperton which might encourage more frequent use of these modes:

- Walking: more crosswalks; improved crosswalk visibility (more prominent, use of, flashing lights); enforcement of pedestrian priority at crosswalks; improved lighting; curb cuts; wider sidewalks; vehicle speed enforcement; fence or barrier to provide sense of separation from vehicles on major routes; more trails; tree lined streets; more pedestrian priority across the neighbourhood – make cars the guests in Sapperton.
- Cycling: separated facilities; better protection from cars/ trucks; improved connections to Waterfront; more trails; bike paths that follow flatter terrain/ avoid steep hills and are routed away from heavy traffic and noise.
- Transit: improved bus service during peak periods, extended transit hours; more bus shelters, more responsive bus routing, diversion of the 128 bus route away from 6th Ave; improved Skytrain frequency to Sapperton; more crosswalks near the Skytrain.

Respondents also identified locales where, in their view, specific interventions are required including:

- Royal Ave East: At Ross Drive/ Memorial Drive: crosswalk should be elevated to a speed bump to curb drivers from speeding through the pedestrian crosswalk.

- East Columbia: connection between the East Columbia off-road path at Cumberland and rest of the pathway should be improved; East Columbia bike lane is in the "door zone" in front of Save-on Foods; East Columbia to North Road is a safer path than the Hume Park MUP (which suffers from too many off leash dogs and a blind corner on a descent); East Columbia to North Road should be part to cycling infrastructure.
- Brunette Ave and E Columbia Street should be widened and lined with trees.
- Better accessibility between Sapperton Landing and New West Quay/ Pier Park.

3.3.5. Reasons for Driving

Respondents' reasons for driving included:

- Convenience
- Shorter travel times
- Local topography and weather (both of which are considered a disincentive to walking and cycling)
- Traffic volumes in the neighbourhood, which result in streets being perceived as unattractive or unsafe for walking and cycling

3.3.6. How can the City Encourage Residents to Drive Less?

Respondents' suggestions for how the City might encourage residents to drive less included:

- Encouraging more mixed use development
- Implementing pedestrian priority across the neighbourhood
- Removing through traffic/ crosstown traffic (to make walking and cycling safer and more enjoyable)
- Better signage
- Free transit shuttles
- Introducing traffic calming

3.3.7. Reducing Vehicle Shortcutting Through Neighbourhoods

Respondents were asked whether or not they supported the implementation of measures which would make it inconvenient for vehicles to short cut through Sapperton.

In total, 42 percent (21 out of 50 survey respondents) indicated their support for such measures, while 16 percent (8 respondents) indicated moderate support with reservations including concerns about:

impacts of diversion; efficiency of investment in traffic calming; impacts on residents' access; the need to consider traffic calming as a system rather than a band aid in individual neighbourhoods.

Six percent of respondents (3 respondents) indicated that they do not support traffic calming. Their reasons included: the risk of pitting individual neighbourhoods against one another; and the perception that calming measures are unfair because they result in greater volumes of traffic in other neighbourhoods as a result of diversion.

36 percent of respondents did not answer this question.

3.3.8. Transportation Problems in the Neighbourhood

Respondents were asked to report up to five priority transportation problems in the Study Area. The most commonly cited problems included the following:

- "Free" Pattullo Bridge causing traffic increase in neighbourhood
- Truck volumes, trucks blocking intersections and crosswalks; truck noise and air emissions
- Traffic on East Columbia that should be on Brunette
- Rat running through the neighbourhood
- No true arterials: many collectors have better access so through traffic takes undesirable routes
- Vehicle speeds
- Free parking (including hospital parking in residential areas)
- Width of streets (streets too wide/ streets not wide enough)
- Poor local bus service
- Insufficient crosswalks
- Lack of traffic enforcement (speed, illegal turns, texting and driving, truck drivers, pedestrian right of way at crosswalks)

3.3.9. Nature of Transportation Problems

Respondents were asked whether the transportation problems in their neighbourhood relate to motor vehicles, or whether they include problems associated with walking, cycling and transit.

The majority of respondents who answered this question (30 percent, or 15 survey respondents) indicated that problems are associated with vehicles and trucks in the neighbourhood. Eight percent of survey participants (four respondents) indicated that problems are associated with all travel modes. Six percent of survey participants (three respondents) were of the view that the problems are mainly associated with cyclists and pedestrians who are lacking in street smarts and/ or are not paying attention. A further four percent (two respondents) felt that transit and bus services should be improved in the neighbourhood.

The remainder of the survey participants did not answer this question.

3.3.10. Positive Features of the Neighbourhood Transportation Network

Survey participants were asked to identify the aspects of their neighbourhood transportation network that they like, with the option of selecting five from a predetermined list. Transit, traffic calming, sidewalks and pleasant looking streets received the highest approval rating form respondents as indicated in Table 3.1.

Table 3.1: Positive Features of the Neighbourhood Transportation Network

Feature	Proportion of respondents indicating approval (%)
Transit	30
Traffic Calming	28
Sidewalks	28
Pleasant looking streets	26
On-street parking	20
Traffic signals	16
Bus shelters	14
Bicycle facilities	12

In addition, respondents provided specific comments and recommendations on the following aspects of the transportation system:

Parking

- Less on-street parking, more parking to be provided on hospital grounds
- Fewer residents parking on the street (and renting out their back yard parking to hospital employees)
- On-street parking should not be the primary parking area for residents (for many it is)
- The amount of off street parking provided in new construction should be increased (i.e. three spots for a new house with secondary suite)

Traffic Signals

- Good flashers on 8th Ave
- Remove push to walk buttons to encourage walking
- Cyclists should obey traffic signals and not use pedestrian signals

Sidewalks

- Curb cuts/ wheelchair ramps required

4. Neighbourhood-Specific Issues and Interventions

4.1. Overview

Workshop and survey participants identified their local neighbourhoods and also provided detailed information on the issues within their neighborhoods and proposed interventions to address these issues.

We have elected to record spatially the neighbourhood specific feedback received from workshop participants and via the survey, using marked up neighbourhood base maps of the, ensuring that these inputs are captured in a clear and meaningful manner and will be most useful to the technical team, providing a focus for Analysis and Intervention. Four study area maps have been prepared as detailed below.

4.2. Regional Context

Figure 4.1 situates the Study Area in terms of the regional context and identifies the issues and interventions which workshop and survey participants considered to be relevant to the Sapperton Transportation Plan. These issues relate largely to regional connections including the Pattullo Bridge and through traffic on arterial routes.

Figure 4.1: Regional Connections



4.3. Sapperton

Figure 4.2 combines the neighbourhoods of Sapperton and Lower Sapperton, identifying both general and specific issues and interventions relevant to this area. Given that this is the higher density “heart” of the study area, and the focus of ongoing development, the majority of issues and interventions suggested by workshop and survey participants are focussed on this neighbourhood and include concerns about truck traffic, parking, rat running, traffic volumes, and safe pedestrian and cycle access.

Figure 4.2: Sapperton Neighbourhood

Legend
- Study Area Boundary
- Location Specific Issue
- Location Specific Intervention

Cut throughs of neighbourhood occur when intersection backs up
Drivers run red when lights change
More parking at Hume Park
Braid Skytrain Station
Hwy 1
Kelly St. used by delivery vehicles
Traffic backups on Braid St./Brunette Ave. – blocking local traffic
Too much traffic on side streets trying to access Braid St.
Tenth Ave.
Kelly St.
Fader St.
Garrett St.
Wilson St.
Rousseau St.
Brunette Ave.
Braid St.
Major St.
E. Columbia St.
Traffic on Major St. trying to access Rousseau St.
United Blvd.
Safe bike route needed from Sherbrooke St. to Uptown & Waterfront
Sherbrooke St.
Speeding on Sherbrook St.
Diversion on Sherbrook St. at Wilson St. causes increased traffic to Garret St.
Truck traffic & volume
RCH emergency vehicle access and circulation
Royal Columbian Hospital
Keary St. traffic result of city interventions
Make intersection pedestrian controlled
Traffic light cause of cut-through in neighbourood
Cut through occuring on alleyway between Keary & Simpson St.
Keary St.
Widen sidewalk
Improve pedestrian accesss to Brewery district
Sapperton Skytrain Station
Richmond St.: Keary/Simpson St. diversion a problem
Simpson St.
Crosswalk on E. Columbia St. at Simpson St.
Curb cuts for strollers on Simpson St. needed
Pedestrian connection needed
Better landscaping of bulges on Richmond St. required
Alberta St. used by RCH staff
Lack of pedestrian crossing opportunities on Brunette Ave.
Richmond St.
Dangerous intersection
Brunette laning – too many bottle-necks (lane changes) for efficient traffic flow

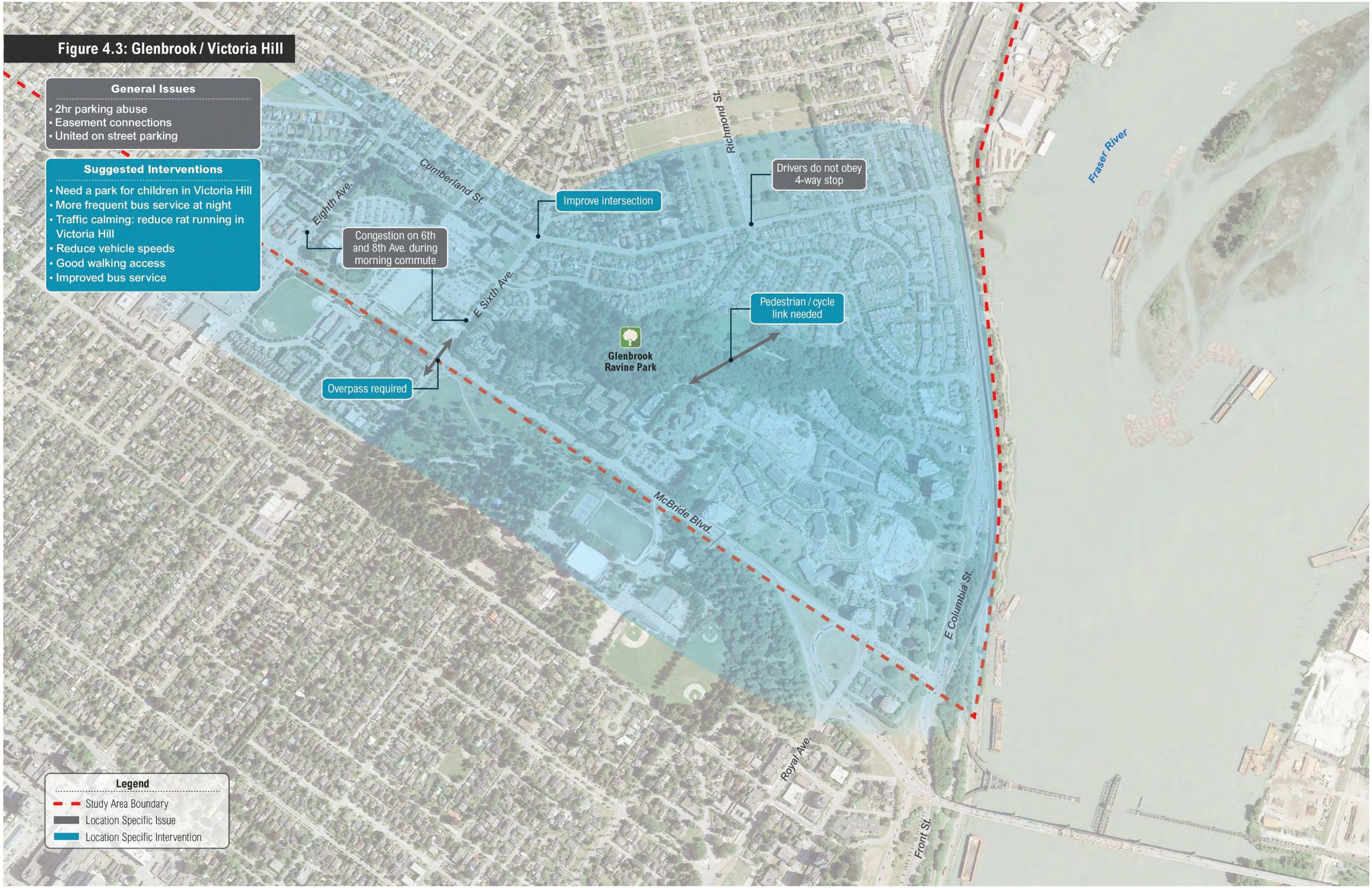
General Issues
- No curb cuts
- Traffic volume
- No bus shelters
- Inconsistent crosswalk treatments confuse drivers
- Future construction traffic (RCH & Urban Academy)
- Foot traffic access behind RCH during construction
- Non-resident through traffic
- Speeding (Braid St. & side streets)
- Congestion on Braid St./Brunette Ave.)
- Parking incursion in Modo spots
- Hospital parking on surrounding streets
- Rat running
- 2hr parking abuse
- All greenways 30km/hr
- Backlane traffic/speed
- Reduce idling cars
- Too much truck traffic on Columbia St.
- Sidewalk too narrow - trucks too close to pedestrians

Suggested Interventions
- Restrict access to/from arterials to improve flow
- More frequent crosstown buses
- Pedestrian responsive intersection signals
- Use of roundabouts for traffic calming
- Synch traffic signals for better traffic flow
- Aggressive speed bumps
- Speed restrictions of 30km/h
- Speed enforcement
- CVSA/police checks of trucks in neighbourhood
- Easier access in/out of neighbourhood
- Vibrant neighbourhood with multiple transportation modes
- Improve traffic flow on connectors
- Transit passes for hospital staff to reduce on-streetparking
- Bike route should run up Keary St. - too many vehicles on Keary St.
- Calming on Keary St.
  - Paint a centre line
  - Enforce parking close to curb
  - Enforce speed limit
- All Streets east of 8th Ave. to be one way
- Complete greenway to Quay

4.4. Glenbrook/ Victoria Hill

Figure 4.3 includes inputs received which are specific to the Glenbrook/ Victoria Hill neighbourhood. This incorporates responses from the workshop and survey as well as an email received from a resident. Located on the southern edge of the Study Area, adjacent to Glenbrook Ravine Park, the main concerns in this neighbourhood relate to peak hour traffic volumes (for example on 6th and 8th Avenues) and connectivity across the ravine.

Figure 4.3: Glenbrook / Victoria Hill



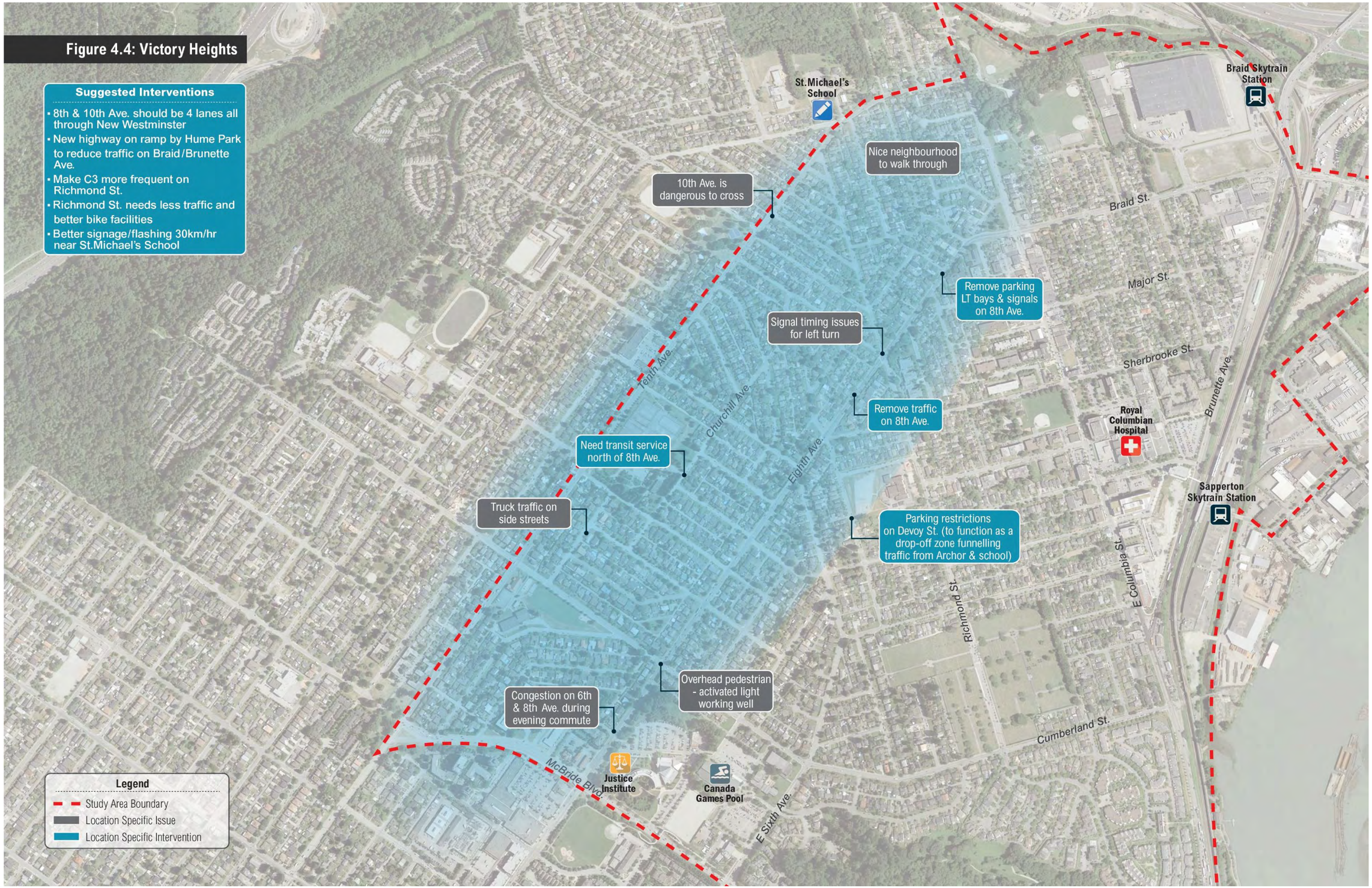
4.5. Victory Heights

Figure 4.4 considers inputs relating specifically to the Victory Heights neighbourhood, located in the north edge of the study area. The focus of concern in this area includes traffic volumes and speed, neighbourhood rat running and need for improved bus transit.

Figure 4.4: Victory Heights

Suggested Interventions

- 8th & 10th Ave. should be 4 lanes all through New Westminster
- New highway on ramp by Hume Park to reduce traffic on Braid/Brunette Ave.
- Make C3 more frequent on Richmond St.
- Richmond St. needs less traffic and better bike facilities
- Better signage/flashing 30km/hr near St.Michael's School



5. Next Steps

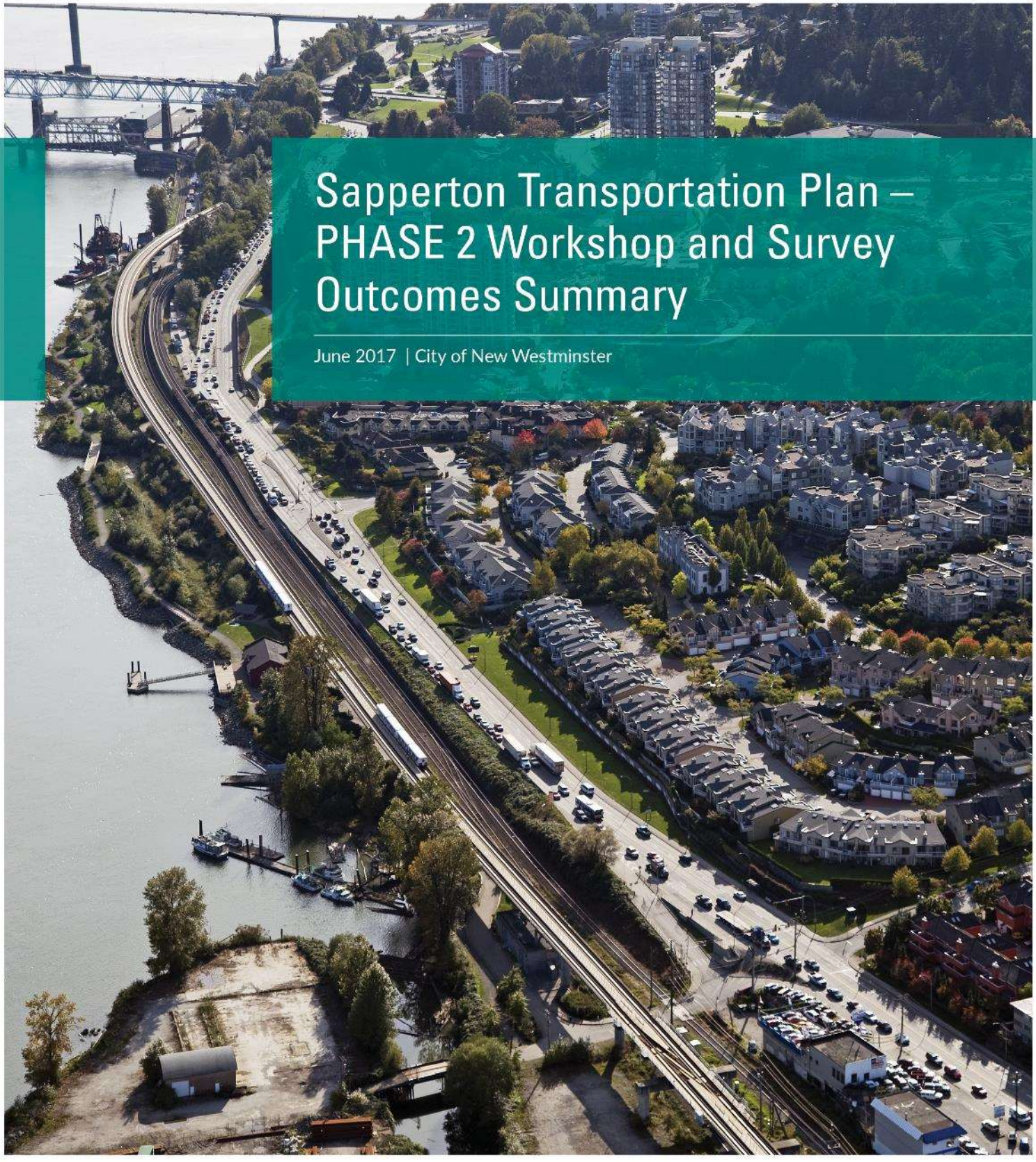
5.1. Identify Evaluation Criteria

Next steps include working with the Technical Team and the Client Group to identify evaluation criteria that correspond to City and stakeholder expectations and community values articulated through the Phase 1 consultation. These will be verified with the community during future consultation phases and will be used in the identification, evaluation and prioritization of proposed interventions in the Sapperton transportation network.

5.2. Develop Engagement Approach

While consultation is being led by the City in partnership with RCH as required, McElhanney is contracted to provide support by advising on the overall consultation plan as well as the content and format of public and stakeholder engagement activities for Phases 2 and 3.

The next step will be for McElhanney to provide a memo setting out recommendations in respect of the ongoing stakeholder and community engagement approach, including on-line consultation activities, stakeholder meetings, workshops and/ or an open house, as well as the provision of feedback to the community in respect of Phase 1 outcomes. The intention is for these recommendations to be discussed further with the City, with a preferred approach and optimal roles for both McElhanney and City staff to be agreed, taking into account the knowledge and expertise of team members as well as project schedule and budgetary constraints.



Sapperton Transportation Plan – PHASE 2 Workshop and Survey Outcomes Summary

June 2017 | City of New Westminster

SAPPERTON Transportation Plan

Prepared for:

NEW WESTMINSTER

Submitted by:

McElhanney

1. Context

Sapperton is a predominantly residential community and home to the Royal Columbian Hospital (RCH). The neighbourhood is undergrowing major growth in both residential and employment amenities. Recently, Sapperton has seen a significant increase in mixed-use and high-rise development projects, which are expected to add to congestion and impact traffic volumes on neighbourhood streets. At the same time, RCH is undergoing a major expansion over the next decade. Lastly, there are several regional infrastructure projects that will impact the vehicle circulation on local streets, including the Brunette Avenue interchange improvement project and replacement of the Pattullo Bridge.

The City of New Westminster (the City) is committed to implementing improvements to address neighbourhood transportation safety and livability concerns in Sapperton. The goal is to establish a traffic calming plan and a sustainable transportation plan consistent with the City's Master Transportation Plan and Official Community Plan. Accordingly, the City is preparing the Sapperton Transportation Plan (the Plan). A separate RCH Traffic Study is a component of the overall project.

In addition to the technical data gathering, analysis and traffic modelling, which underpins the Plan, the initiative also includes a significant stakeholder and community engagement component. Public engagement is being undertaken in 3 phases:

- Phase 1 – Listen and Learn and Development of Evaluation Criteria
- Phase 2 – Confirmation of Evaluation Criteria and Presentation of Options
- Phase 3 – Input on Draft Plan



During the Phase 1 community workshop we heard about peoples' transportation concerns and what participants value most about the neighbourhood. Building on what we heard, and based on further technical analysis, the project team developed a set of evaluation criteria and identified potential intervention options. As part of this Phase 2 engagement, we sought feedback on these elements via a community workshop (held on April 8, 2017) and by means of an online community survey.

This report sets out the outcome from the Phase 2 engagement effort. Section 2 provides a high level overview of the engagement process, while the remaining sections (3 through 6) are structured in a similar manner to the workshop and community survey, both of which considered four key themes, as follows:

- EVALUATION CRITERIA
- TRAFFIC OPERATIONS AND TRAFFIC CALMING
- SUSTAINABLE TRANSPORTATION
- PARKING

A concluding commentary is provided in Section 7.

2. Phase 2 Engagement Process

The Community Working Group: A Community Working Group (CWG) made up of volunteers from the Residents' and Business Association was set up to advise on key issues as the Transportation Plan develops. The first meeting was held at City Hall on March 9, 2017 and attended by six representatives as well as four members of the Project Team. The focus of the meeting was to introduce the working group members to the project and to review the draft evaluation criteria. Feedback received from the Working Group led to revision of the evaluation criteria, prior to presentation thereof at the Community Workshop.

Community Workshop: A Community Workshop was held on April 8, 2017. Held at the Pensioners' Hall in Sapperton, this event was attended by 25 community members. The format included a short presentation on the Study Process and the evaluation criteria, followed by round table discussion on specific topics, including: traffic operations and traffic calming. parking. and sustainable transportation. Attendees circulated through each of the topic tables during the 2.5 hour session, allowing all attendees to discuss and offer view on each of the topics.

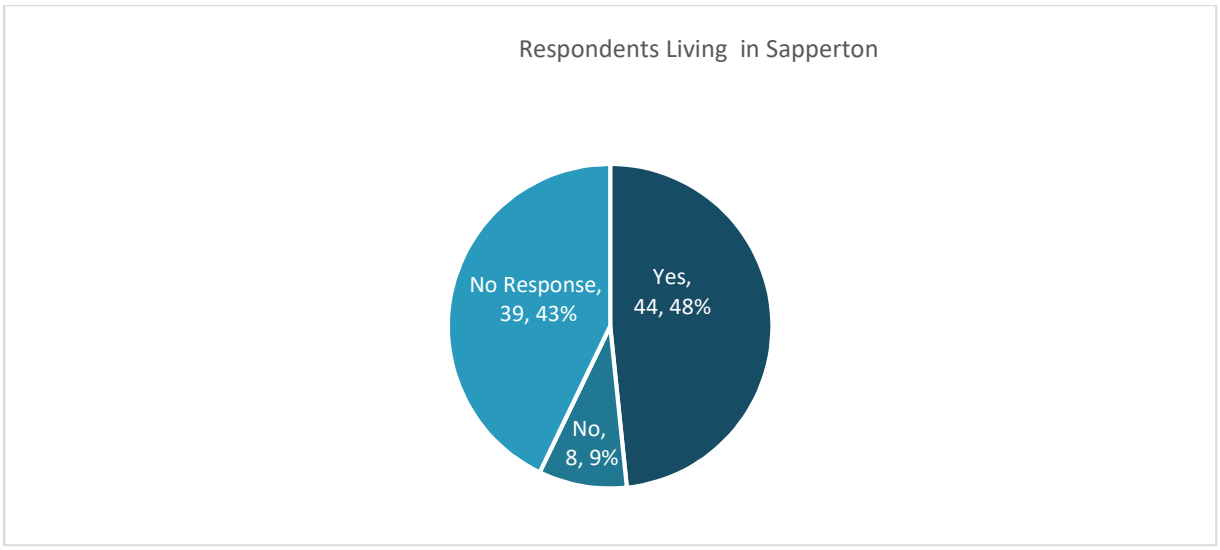
Community Survey: A community survey was developed to capture initial feedback on the evaluation criteria and the initial intervention approaches. Hard copies of the survey were made available at the Community Workshop, so that attendees could provide responses as part of their participation in the round-table discussion process. The Community Workshop materials were also posted online, along with an electronic survey format, allowing attendees to submit responses after the workshop, while also allowing participation from a broader range of attendees.

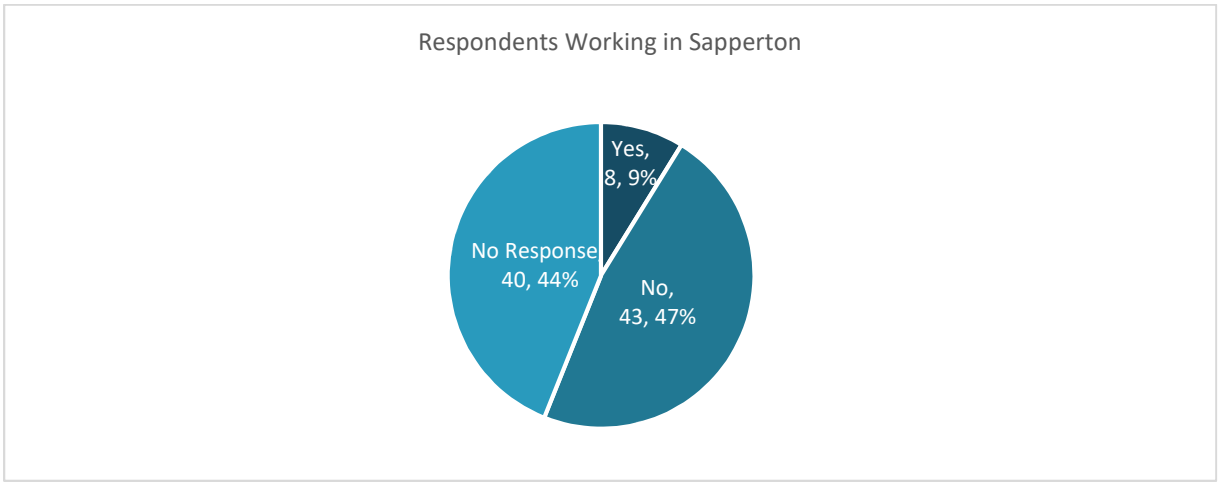
In total, 6 hard copy and 85 online survey responses were received. The responses were collated into a single database to allow consistent reporting of results.

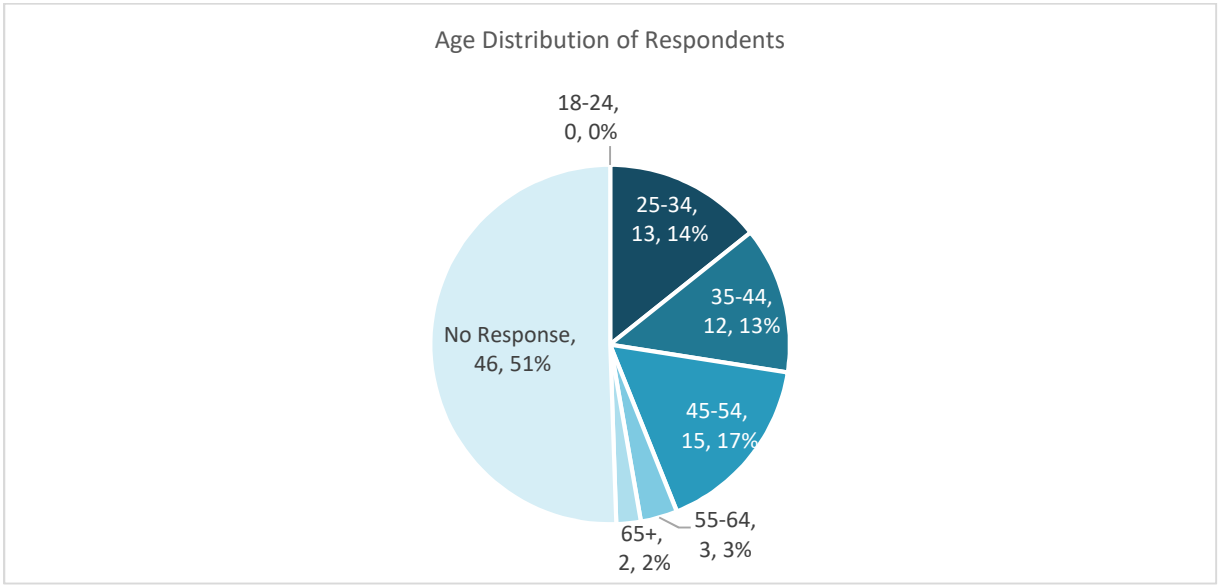
It is notable that of the 85 online responses, 39 were not formally submitted (by clicking the "submit" button). Analysis of these "in progress" surveys indicates that many of the respondents only answered the first few questions relating to the evaluation criteria, traffic operations and traffic calming, but did not answer the later questions relating to active transportation or parking. Note also that responses to all questions were optional, with a relatively high proportion of respondents from both the "in progress" and "submitted" responses electing not to answer some questions.

However, analysis of survey responses indicates little variation in attitudes between the "submitted" and "in progress" survey results.

Finally, survey responses indicate that of those who elected to share demographic data, 85 percent live in Sapperton, while 16 percent work in Sapperton. Around 90 percent of those respondents who provided age information were aged between 25 and 54, with the age of respondents more or less equally split between each of the 10 year cohorts. Demographic details provided by survey respondents are set out in the charts which follow.


Respondents Living in Sapperton
No Response, 39, 43%
Yes, 44, 48%
No, 8, 9%


Respondents Working in Sapperton
Yes, 8, 9%
No Response 40, 44%
No, 43, 47%


Age Distribution of Respondents
18-24, 0, 0%
25-34, 13, 14%
35-44, 12, 13%
45-54, 15, 17%
55-64, 3, 3%
65+, 2, 2%
No Response, 46, 51%

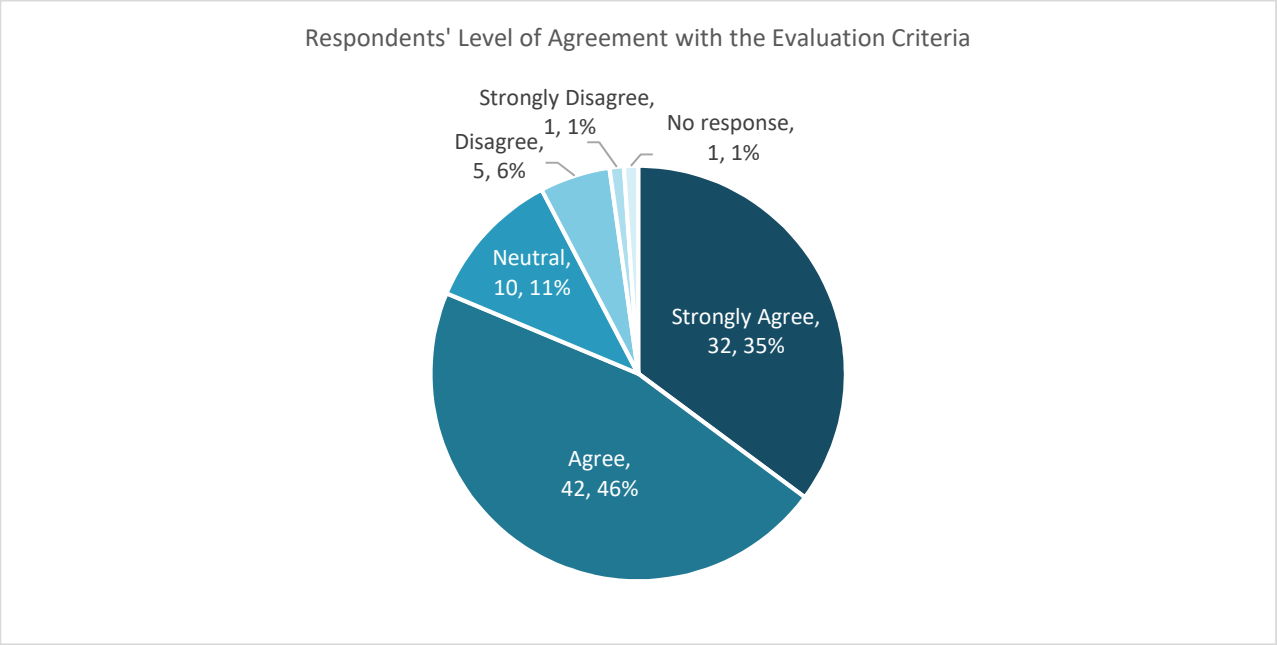
3. Evaluation Criteria

Evaluation criteria and evaluation measures are intended to provide the basis for the project team to asses and prioritize potential interventions. The measures identified in **bold** in the table which follows are the primary measures by which the project team will evaluate the alignment between proposed interventions and the evaluation criteria during the Plan's preparation. These and other measures identified may also be used longer term by the City to monitor the Plan's implementation and success.

Evaluation Criteria		***Proposed Evaluation Measures***
1	Improved safety and perception of safety	**Vehicle speeds** Perceived vehicle speeds Number, frequency, and severity of vehicle collisions
2	Enhanced livability	**Traffic volumes by type** Noise and emissions[1] from traffic Mix of compatible land uses
3	Reduced reliance on private vehicles	**Mode share** (compared to Official Community Plan transit usage goals) Access to alternative mobility options (bus, Skytrain, car share, cycling and walking) across the community
4	Balance between on-street parking supply and demand	**Parking stall occupancy rates of ~85%** Availability of on-street parking for residents and businesses
5	Superior walkability	**Safe, comfortable and convenient pedestrian connections between key destinations (transit, retail, local amenities etc.)** "Popsicle" Test: proportion of households who would permit a Grade 5 child to walk from home to the local store to purchase a popsicle.
6	Bike access for all ages and abilities (AAA)	**Safe, comfortable and convenient cycling corridors between key destinations (transit, retail, local amenities etc.)**
7	A match between traffic type and road classification	**Proportion of through traffic on local streets.**
8	Reduced delay at key intersections and along key corridors	**Improved levels of service, a reduction in delay per vehicle, and lower volume to capacity ratios on key corridors and at key intersections.**
9	Strengthening and respecting the identity and history of the Sapperton neighbourhood	**Interventions acknowledge the importance of the history of the Sapperton neighbourhood and are scaled to respect the character and livability of the area**.
10	Fair distribution of benefits	**Project prioritization to ensure that benefits are distributed throughout the study area.**
11	Cost efficiency	**Number / quality of benefits accrued relative to investment required.**

[1] Traffic volumes may be used as proxy for emissions and noise in the planning stage.

Workshop feedback on the evaluation criteria indicated a high level of agreement with the criteria set out above. This was echoed in the survey responses, which indicated that 81 percent of all respondents[2] agreed or strongly agreed with the criteria proposed, while 12 percent were neutral or had no response, and 7 percent disagreed or strongly disagreed. Of those who disagreed or strongly disagreed, 5 provided additional comments about the potential impacts of bike lanes on parking, while 1 disagreed that the perception of safety is important, and commented that "enhanced livability" was too vague.



Based on the responses received, it is considered that the evaluation criteria are fit for purpose and should be used in intervention option evaluation and for ongoing monitoring of Plan implementation.

[2] There was little difference between the "submitted" and "in progress" responses to this question.

4. Traffic Operations and Traffic Calming

We heard during Phase 1 that the community is concerned about congestion, traffic volumes, travel times, through traffic, and travel speeds. Traffic operations and traffic calming work hand-in-hand to address these issues.

Proposals to Improve Traffic Operations

Combining what we heard in the Phase 1 consultation with the analysis of both current and future traffic operations, intersections and corridors with operational deficiencies (long delays, long queues, volume exceeding capacity) and compliance issues (through cutting, illegal maneuvers) were identified.

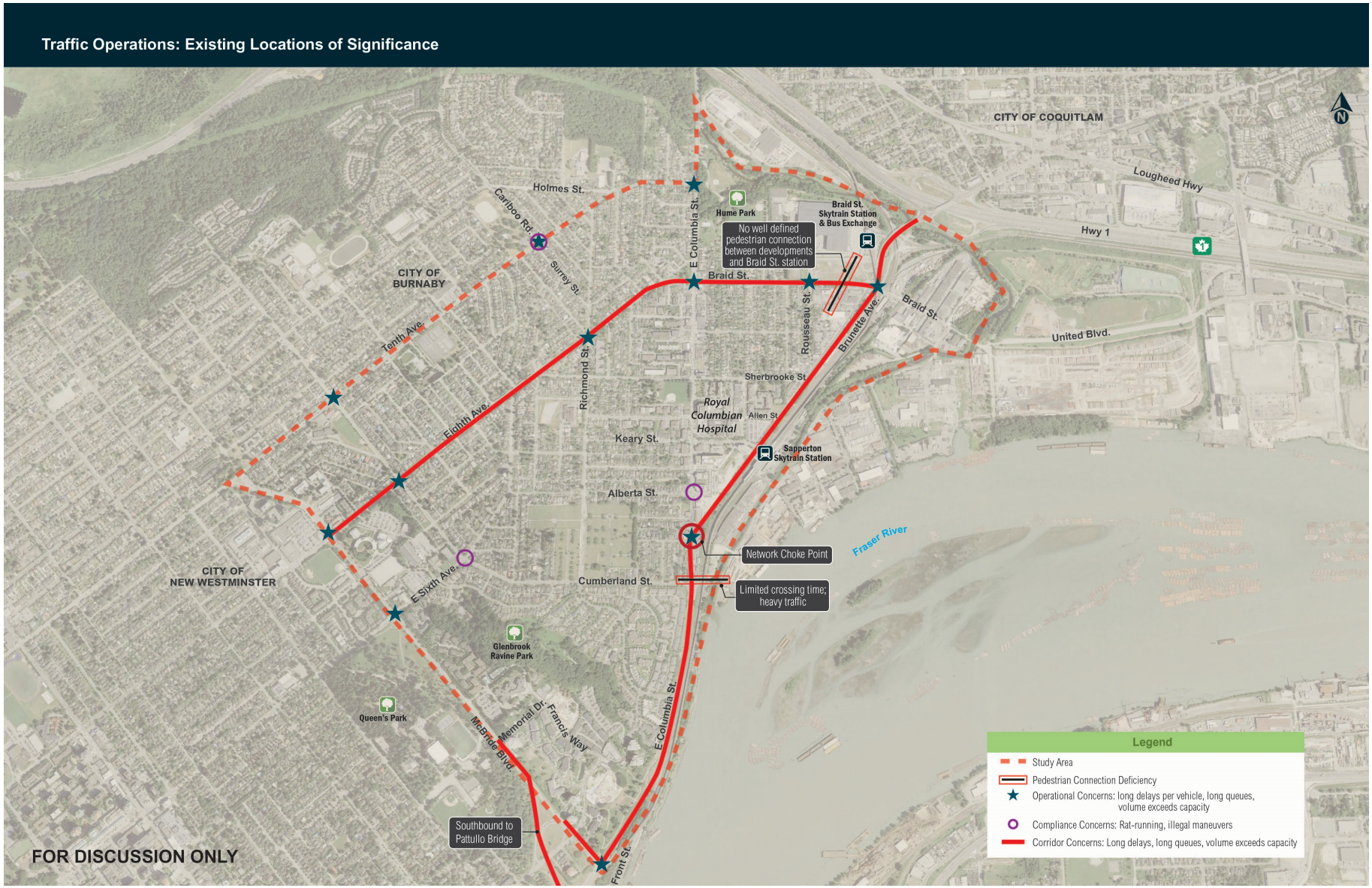
Working within the City's policy of "no net increase in road network capacity," measures to address operational issues are localized and limited to changes such as signal timing adjustments, signal operation adjustments, additional turn and / or through lanes, or changes of the traffic control type (e.g. roundabout, signal). Other measures might include traffic calming, medians / barriers, increased enforcement, and / or enhanced street environment (landscaping, surface treatments, improved sidewalks and crosswalks).

Workshop participants and survey respondents were asked to comment on the proposed improvements to traffic operations shown on the plans which follow.

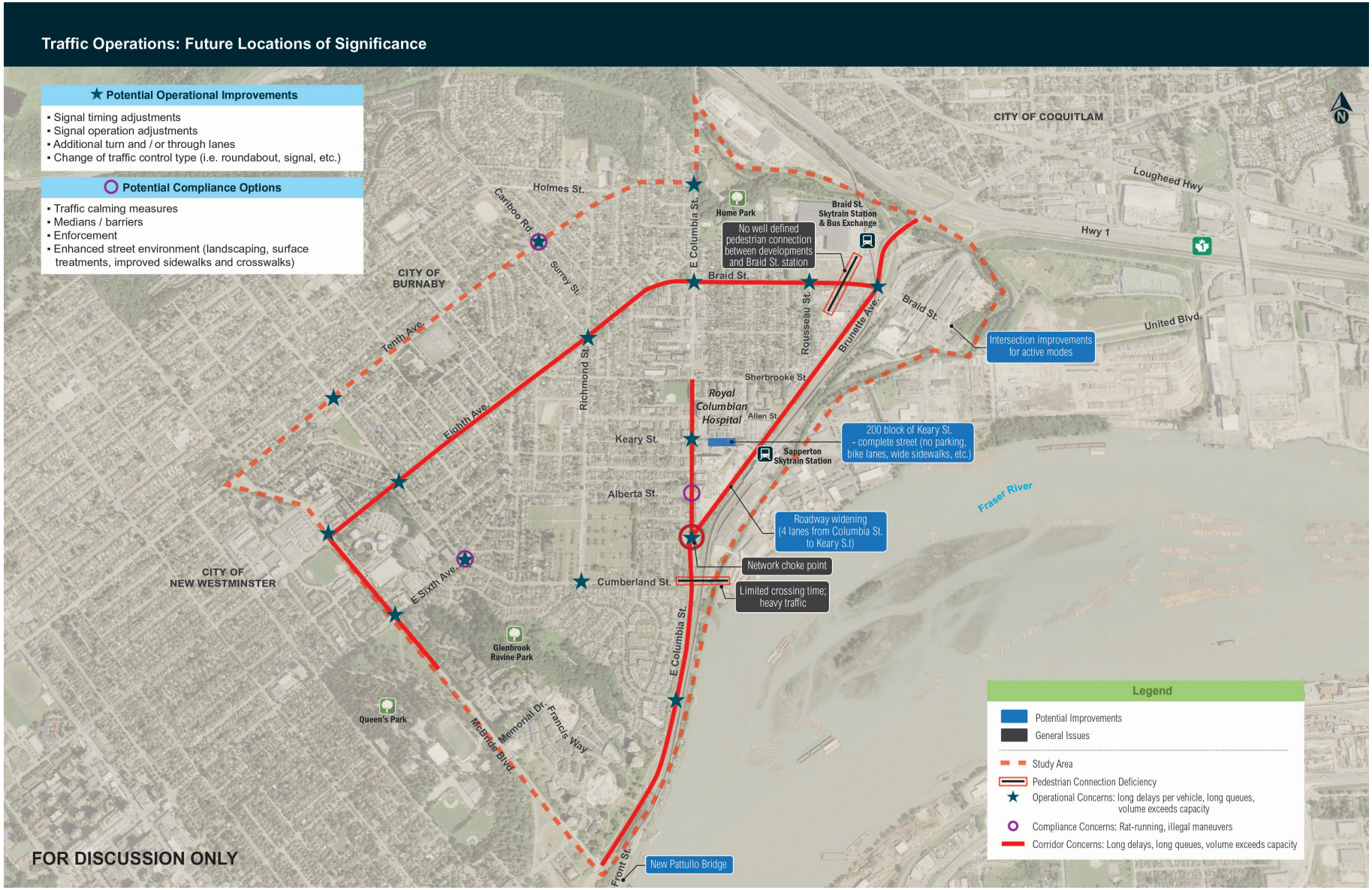
Key areas where workshop participants considered attention should be focused, include:

- Traffic congestion on East Columbia, Cumberland Street and Sixth Avenue.
- Fuel trucks not local to the area using East Columbia and rerouting throughout the neighbourhood.
- More speed enforcement required on East Columbia.
- Vehicles short cutting onto Kent Street off Richmond Street.
- Restrict left turns at Sixth Avenue and McBride Avenue and Eighth Avenue and McBride Blvd.
- Right turn from McBride to Eighth Avenue no longer channelized, and is now creating right-turn back-ups on McBride: drivers to be encouraged to use Sixth Avenue at McBride instead.
- Shortcutting on Dixon Street because of backups on Sixth Avenue waiting to turn onto McBride to access Pattullo Bridge.
- Coordination of traffic with Brunette Highway and East Columbia Street.
- No direct routes to Brunette Highway.
- In general, no systematic way to drive through the Sapperton Neighbourhood area.

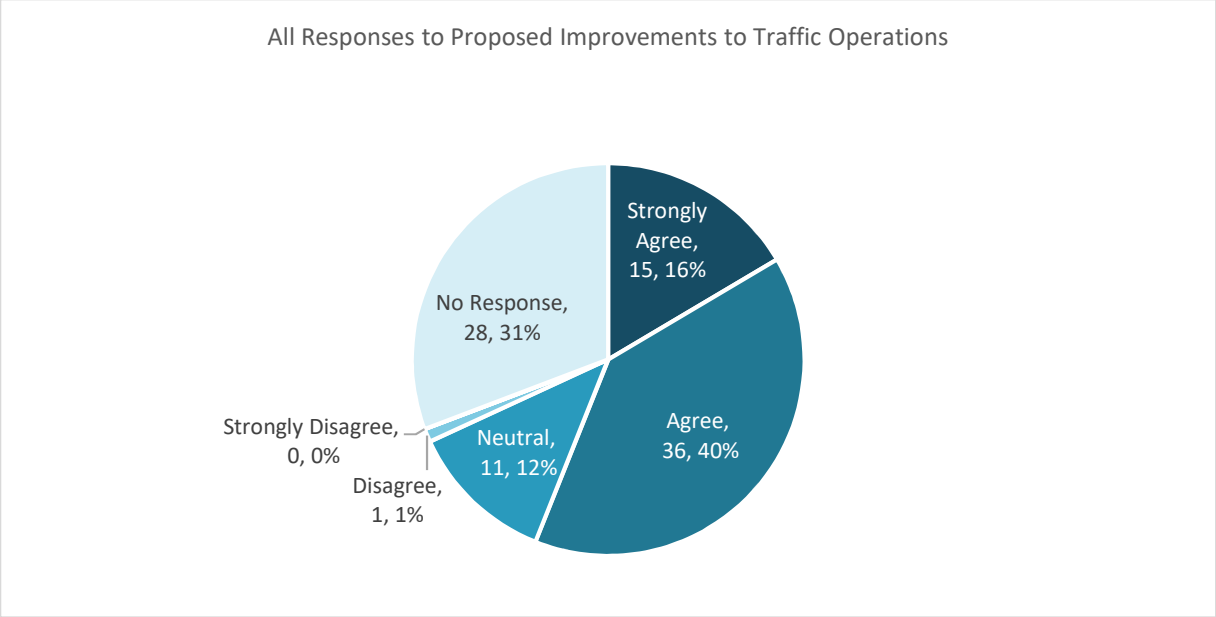
Traffic Operations: Existing Locations of Significance



Traffic Operations: Future Locations of Significance



Community survey responses to the proposed measures to improve traffic operations are set out below.



Of the survey participants who provided a response, 80 percent either agreed or strongly agreed with the proposed interventions. Results between the completed and in-progress surveys are very similar. The only difference is that the in-progress results show a larger percentage of no responses. In addition, 1 percent of in-progress respondents disagree with the proposed improvements to traffic operations while none of the completed responses show disagreement.

Proposed Traffic Calming Measures

Traffic calming seeks to provide a balance between mitigating or eliminating the impacts of unwanted traffic through neighbourhoods versus restricting residents' access and shifting unwanted traffic to appropriate streets.

Possible intervention options for traffic calming are shown on the plans which follow. For Sapperton and Lower Sapperton, two options are presented, one of which is a "restrictive" approach with physical obstructions that block shortcutting traffic, but also restrict access for residents. The other is a "softer" approach that does not restrict access but instead incorporates traffic calming measures to help ensure that motorists who do drive through the neighbourhood do so at appropriate speeds and in a safe manner. For Upper Sapperton, an expansion of the existing traffic calming measures is suggested to mitigate traffic impacts on other streets.

Traffic Calming - Lower Sapperton

Lower Sapperton Traffic Calming #1

- Maintain existing measures
- Mitigate effects of short-cutting traffic without overly obstructing access

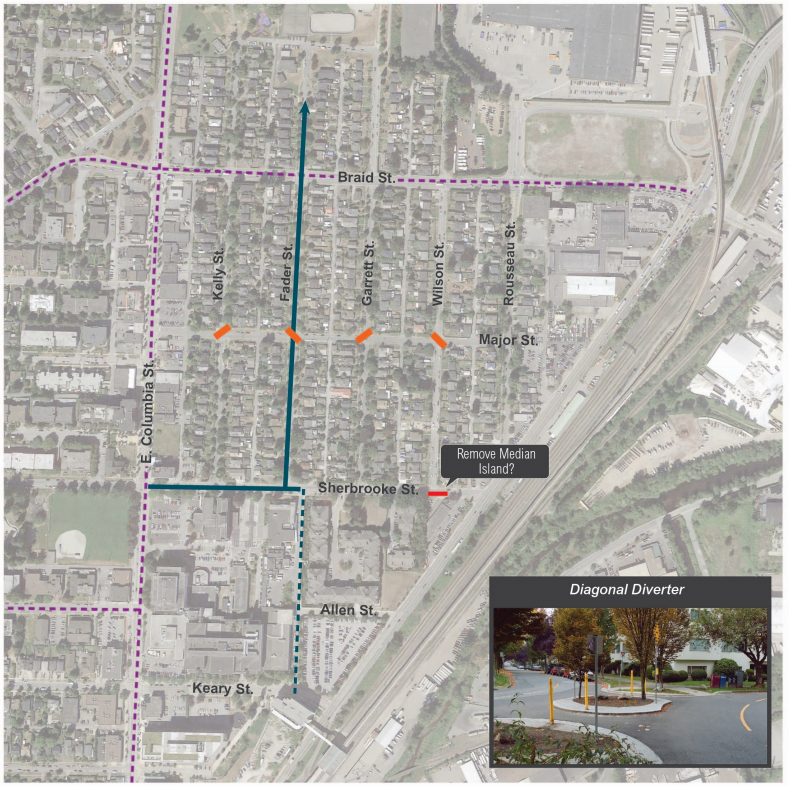


LEGEND

Traffic Circle | Speed Hump | Bus Routes | Existing Bicycle Route | Potential Bicycle Route (Fraser Health)

Lower Sapperton Traffic Calming #2

- Obstruct through access (residents can use adjacent parallel lanes for local access)



LEGEND

Diverter (Remove existing traffic circles)
Existing speed humps to be removed over time
Bus Routes | Existing Bicycle Route | Potential Bicycle Route (Fraser Health)

SAPPERTON Transportation Plan

NEW WESTMINSTER

Traffic Calming - Sapperton

Sapperton Traffic Calming #1

- Maintain Alberta St. right-in, right-out
- Obstruct short-cutting traffic



Sapperton Traffic Calming #2

- Mitigate negative effects of short-cutting traffic without obstructing access



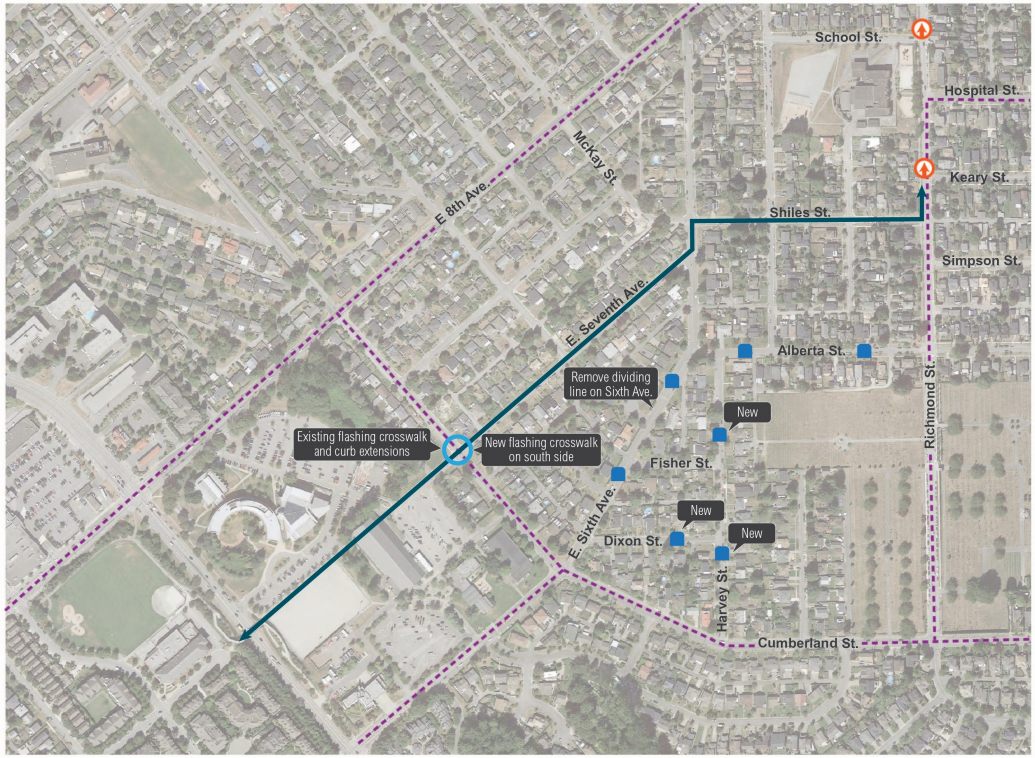
LEGEND

Right-in, Right Out Diverter | Rectangular Rapid Flashing Beacon / Overhead Illuminated Signs | Speed Hump | Bus Routes | Existing Bicycle Route | Potential Bicycle Route (Fraser Health) | Raised Crosswalk

Traffic Calming - Upper Sapperton

Upper Sapperton Traffic Calming

- Additional speed humps to discourage short-cutting via Dixon and Harvey St.
- Remove yellow dividing line on Sixth Ave. to restore appearence of local street



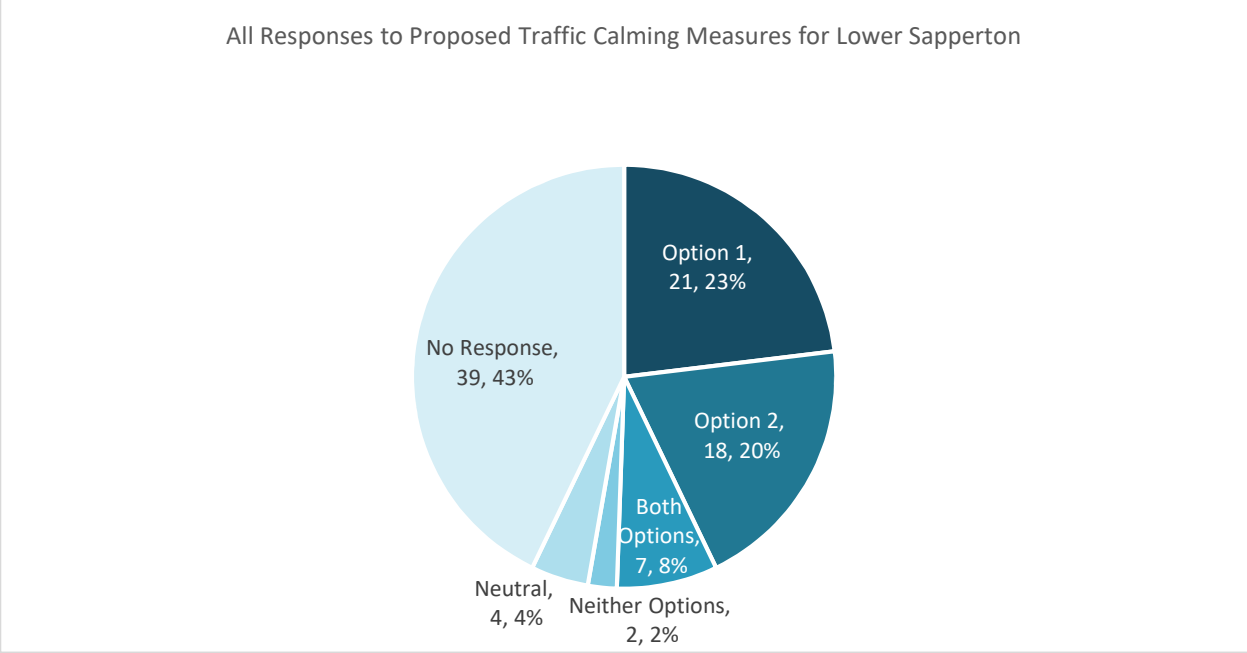
LEGEND

Speed Hump | Bus Routes | Existing Bicycle Route | Raised Crosswalk

Feedback provided by workshop participants included:

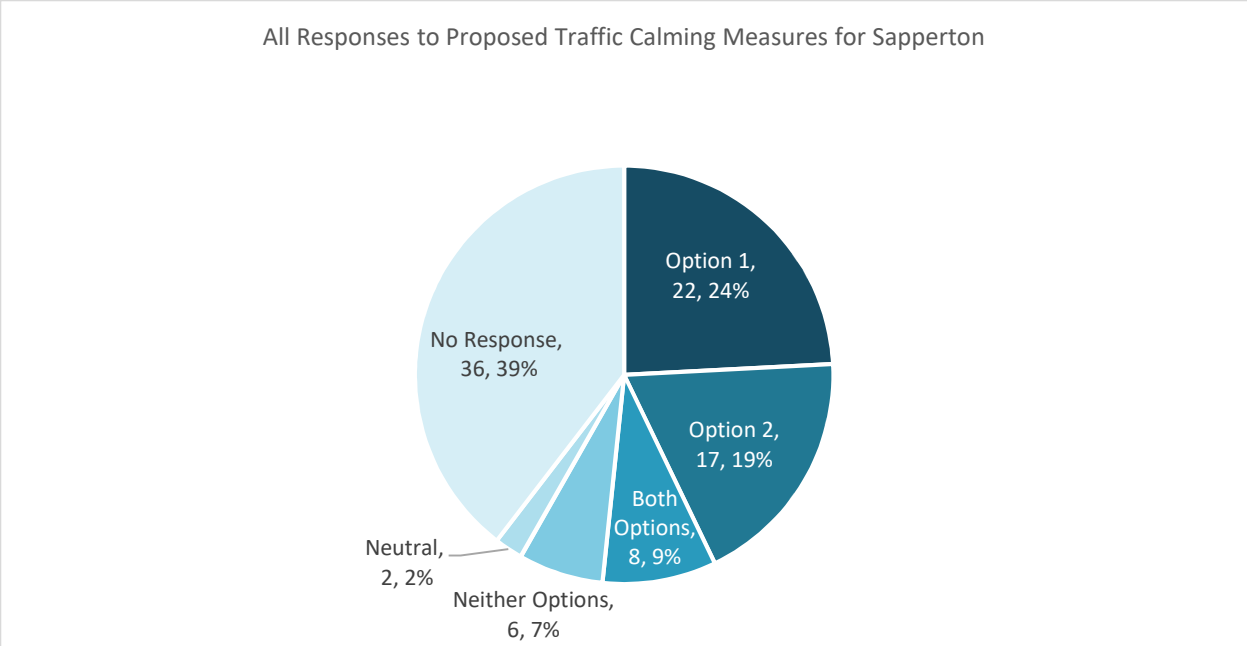
- Drivers are shortcutting and speeding along Surrey Street and Ladner Street.
- Speed humps required in the lane between Simpson Street and Keary Street. Ladner Street and Surrey Street. and on Kent Street.
- Speed humps required on Sherbrooke Street East of Columbia to alleviate speeding.
- Speed Humps required on Kent Street off Richmond Street.
- A less restrictive approach to traffic calming was generally articulated as preferred (with the exception being Alberta Street and Keary Street)
- Need for traffic calming neighbourhood signs and education regarding traffic circles.

Community survey responses to traffic calming measures proposed for Sapperton, Lower Sapperton and Upper Sapperton are set out below.

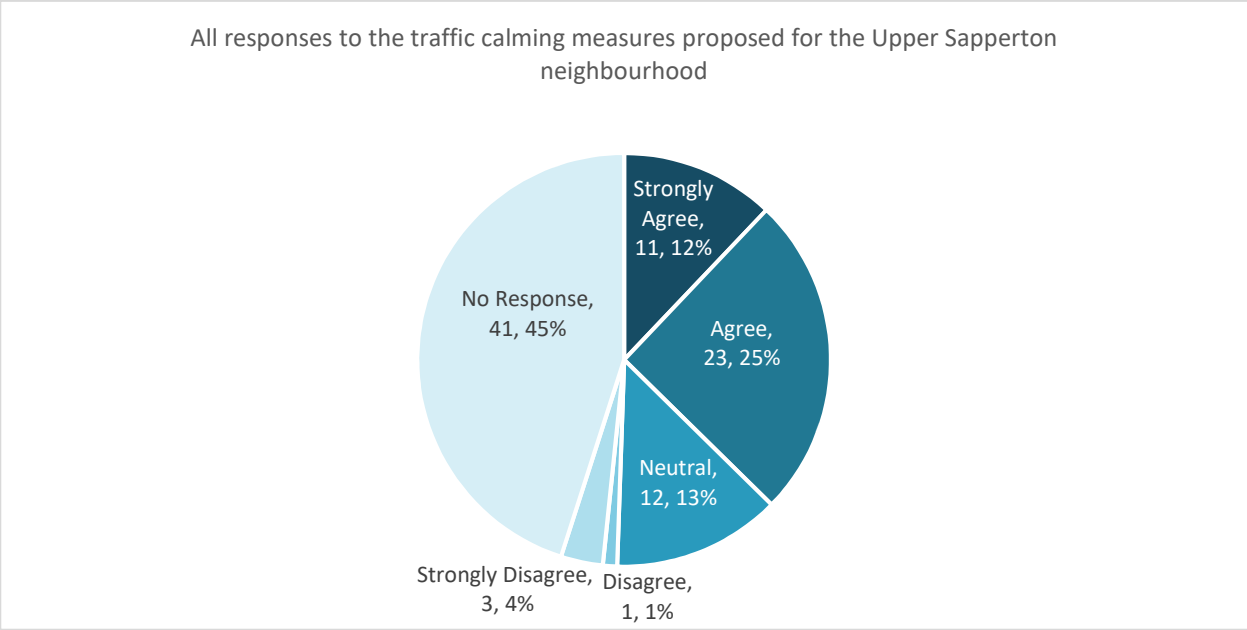


Of the survey participants who provided a response, most were in favour of some form of traffic calming in Lower Sapperton. A small majority of respondents preferred Option 1 – which does not overly obstruct access. None of those who disagreed provided supporting comments. Keary St was identified as a priority location for raised crosswalks owing to its heavy use by pedestrians to access RCH and Skytrain and the incidence of speeding.

Similarly, most survey participants who provided a response were in favour of some form of traffic calming in Sapperton. However, a small majority of respondents (21 versus 18) preferred Option 1 – which includes obstructing short cutting traffic. Those who were not in favour raised concerns about business access and parking, impacts to cyclists, potential diversion/ increased traffic on routes with schools and parks, and access for residents.



Most survey participants who provided a response were in favour of some form of traffic calming in Upper Sapperton. Those who disagreed with traffic calming identified concerns about the cost versus the effectiveness of speed bumps and raised crosswalks.



5. Sustainable Modes

Sustainable modes include cycling, walking and transit. During Phase 1 we heard about the importance of cycling and walking as an alternative to the private car: which enables access to transit, helps maintain healthy lifestyles, provides recreation, and enhances the sense of place within community. We also heard that people are concerned about pedestrian and cyclist safety, the need to give priority for active modes, provision of safe crossing facilities, and grades on walking and bike routes. Proposed interventions are shown on the plan which follows. The current transit routes are shown on a separate plan.

Workshop participants and survey respondents were asked to comment on these proposed improvements. Key areas where workshop participants considered interventions should be focused, include:

Pedestrian Facilities

- Improvements to the pedestrian crossing at the intersection of Richmond Street and Hospital Street at the Richard McBride Elementary School.
- Support for proposed pedestrian crossings on Columbia Street and Hospital Street and Columbia Street and Simpson Street.
- More green spaces/ landscaping and improved lighting on East Columbia to improve the pedestrian experience, as well as safety and security.
- Improving safety for pedestrians crossing at intersections.
- Provide direct pedestrian route(s) between Sapperton and Brunette Highway.
- Reducing the speed limit to 30 km/hr speed limit across the area.
- Marked crosswalks required at intersections in front of Save On Foods grocery store.
- Co-ordination of traffic on Brunette Avenue and East Columbia.
- Measures to improve security in the area behind the Amazon Facility: this area is perceived as unsafe and women tend to feel wary walking alone in this area after dark.
- Provide multi-use pathways on one side of the street, making it clear that both pedestrians and cyclists share the space.
- Corner light at Allan Street and Brunette Highway, and Sherbrooke Street and Brunette Highway useful to warn pedestrians. Button preferred to slow the road traffic.
- No easy pedestrian access to Metro Vancouver Park from East Columbia: Increase connection opportunities, and wayfinding signage to allow better access to this area, and improved connections to the New Westminster Waterfront.
- Support for Cumberland Street connection to the industrial area.
- Narrow area on Columbia Street is unsafe for walking: space in front of the church on East Columbia to be utilized as a potential solution to improve the pedestrian experience in this area.

Bicycle Routes and Pedestrian Facilities



Transit Routes



- Need for a pedestrian route between Francis Way and East Columbia identified, with improved wayfinding signs to make this easier for pedestrians.
- More pedestrian crossing points are required on East Columbia.
- Support for connection from Sapperton Skytrain Station, east to the Metro Vancouver Park.
- Improved way finding to the Royal Columbian Hospital from the Sky Train Station required.
- Need for increased pedestrian connections to area south of Cumberland Street identified.
- Train noise excessive, this needs to be addressed.

Cycling Facilities

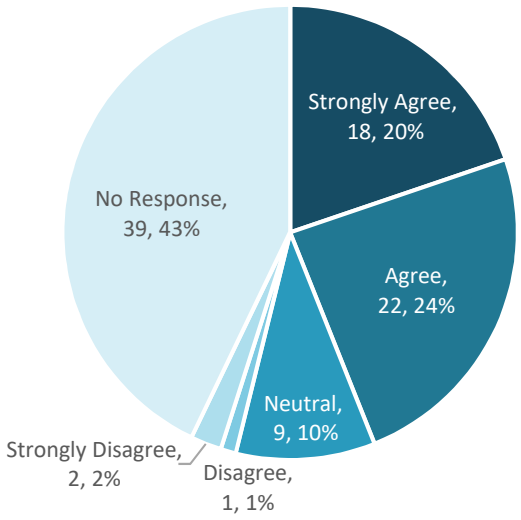
- Traffic coordination between Brunette and East Columbia required.
- Support for a Keary Street cycle route, with a designated lane to protect cyclists preferred.
- Improved/ increased signage for cyclists at Brunette and Braid required.
- The cycling route through Debeck is difficult to navigate: support for proposed new direct route.
- Improved safety for cyclists and pedestrians at Brunette Avenue-Allan Street, and Sherbrooke Street -Brunette Avenue intersections required.
- Cyclists currently use Cumberland Street to Tenth Avenue as cycling route owing to lack of curbed humps and parking on that route: could be considered for cycle route.
- Support for Cariboo Connector Route as cycling route.
- Potential cycle route here to be considered on Columbia Street: this could have the added benefit of slowing traffic through this stretch.

Transit

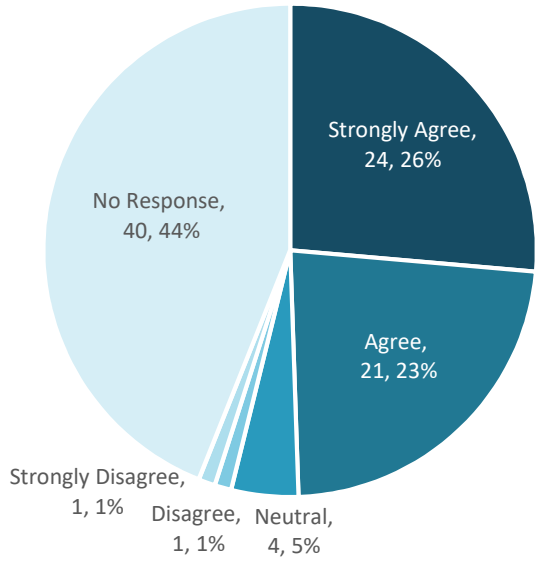
- No systematic, efficient way to move throughout the Sapperton Community.
- New bus shelter required at Jamison Court on the C9 community shuttle route.
- Modify the C9 bus route to accommodate those heading to the Hospital.
- More frequent stops on the community shuttle routes.
- Improved / increased bus service required.
- Bus shelter required adjacent to the hospital sign on East Columbia.

Community survey responses to sustainable transport measures follow. Of those survey participants who responded, the vast majority agreed or strongly agreed with the proposed improvements to the cycling network. Of the small minority who disagreed, concerns were raised about cost, impact on traffic flow, and driver behaviour. Similarly, the vast majority agreed with the proposed pedestrian improvements. Amongst the small minority who disagreed, the need for improved access between Lower Sapperton and Sapperton Station and to Braid Station was identified, as well as improved access to Sapperton Landing would be nice for both cyclists and pedestrians.

All responses to the proposed bike route improvements



All responses to the proposed pedestrian improvements



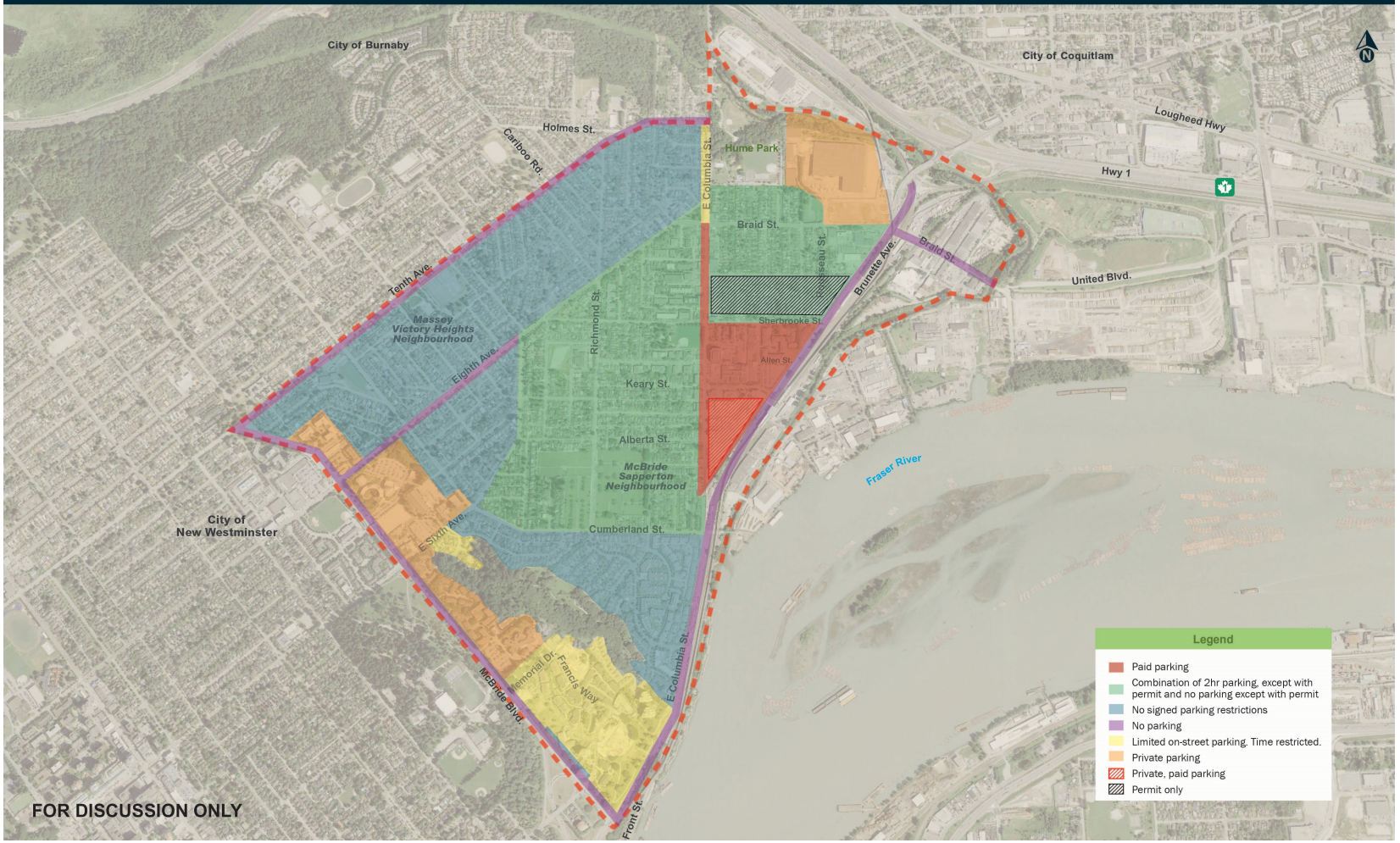
6. Parking

We heard during Phase 1 that residents are frustrated with the lack of available on-street parking, and are worried about the impacts of new development on on-street parking availability. We've heard concerns that parking locations are not being used by the appropriate user, the overall system is inconsistent, and additional regulation is needed. Proposed focus areas for interventions are shown on the plan which follows. The proposed parking strategies are separated into commercial and residential areas and options, but are not mutually exclusive. Discussion at the community workshop was focussed on the following considerations:

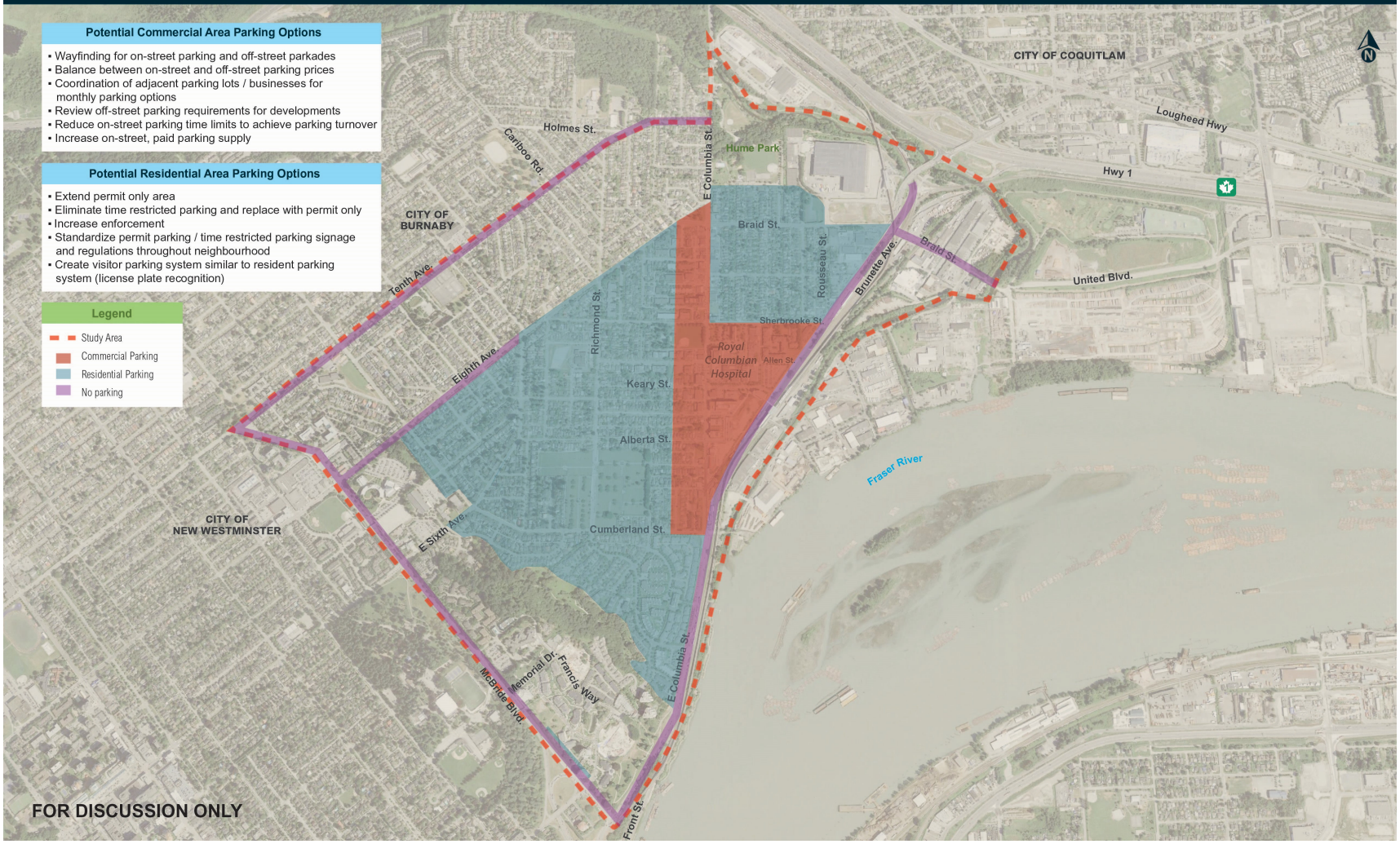
Residents' Parking

- The permit parking system is generally considered to be working well.
- Division of opinion as to the effectiveness of the 2-hour parking restriction on Keary Street, with some considering that it is working well, and Keary Street residents expressing concerns that on-street parking is saturated.
- A consistent approach to parking management required at Shiles Street and Devoy Street (half of which are permit parking and half not).
- Vehicles circulate around Kent street in search of parking, which causes traffic challenges.
- Parking signage to be increased throughout the neighbourhoods to provide improved clarity (as to restrictions, and areas available for public parking areas) and coverage.
- Issue of residents creating off-street parking on their lots to be addressed. (However, note that some participants thought that back yards rentals for parking where parkers can access via through lanes or driveways was a good idea.)
- Car free days in the community to be considered.
- Pricing incentives to be introduced to encourage non-vehicle trips, especially for locals.
- Secure and safe bike parking and facilities to be provided at key destinations (including local businesses) to encourage cycling and alterative modes of transportation especially for local trips.
- Restrict the number of parking permits to the number of available parking spaces only, don't give out more than available.
- Make people park on their property rather than turning on-site parking into storage or living space
- Illegal parking to be tackled by enforcement or bylaw changes required.
- Parking encroaches on the intersection at Eighth and Richmond, making intersection unsafe: this needs to be addressed
- SkyTrain users treat on street parking as "park and ride". The 1km radius surrounding Sky train station should be changed to permit-only parking.
- Businesses should provide subsidized parking to ensure affordability for employees.
- Short stay parking time restrictions in business areas supported.

Existing Conditions General Parking Regulations



Potential Parking Options



Royal Columbian Hospital (RCH) Parking

- Parking at RCH is restrictive and unaffordable, solutions required.
- A waitlist exists for parking at employee parking at RCH. RCH to implement travel management plan (which incentivises RCH employees to use transit) and/ or to provide more parking to prevent parking on the street.
- Establish a system to accommodate parking overflow / demand from RCH
- Provide a shuttle between Skytrain Station and RCH/ local businesses to improve transit use and reduce demand for parking.
- Implement free parking on Sundays for businesses and the hospital.
- Some visitors to hospital require long term parking (10 hours or more) which needs to be addressed to accommodate patient needs and avoid impacts to the community.

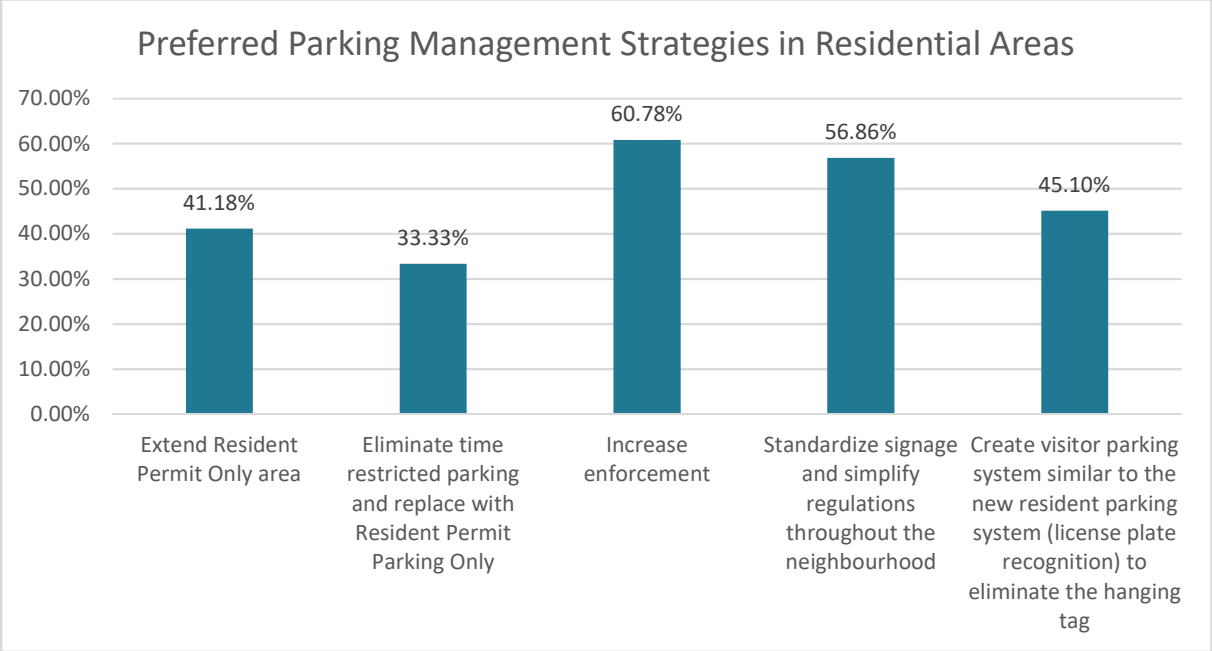
Visitor Parking

- Visitor parking system should permit visitors in the neighbourhood.
- Online visitor parking registration and monitoring to identify violations of permit system required.
- Victory Heights Area has very limited visitor parking with not enough stalls available.
- Paid for visitor permit with license plate registration generally supported.
- Sale of permits is a problem, establish a system to prevent this such as license plate recognition enforcement for permit, visitor, and pay parking.

Parking Policy

- With redevelopment, smaller homes are being replaced by larger homes and tenants which spill over parking onto streets. a policy needs to be implemented.
- Parking stall sizes in new developments are too small, causing encroachment into other parking stalls and reducing overall capacity.
- Parking restrictions on lots to be relaxed.
- Implement parking time limits and restrictions during working hours.
- Driveways on lots could be used to provide additional parking, but City of New Westminster policy does not allow driveways if not grandfathered.
- Those residents renting out parking should be required to register as a business with relevant bylaws applicable.
- New developments and RCH require time restricted, equitable, paid parking systems to be implemented, to spread demand outside of less restricted/ less expensive locations.
- Home-based businesses have one on-street parking spot and one off-street parking spot, but some people are not registering their home-based businesses.

Survey participants were asked to identify their preferred parking management approaches. Survey results are set out below.





Increased enforcement, simplified regulations and standardized signage were the approaches most favoured for residential parking management. These options were favoured by more than 50 percent of the survey participants who responded to this question. Review of parking requirements in new developments, and improved signage/ wayfinding for on- and off-street parking were the approaches most favoured for parking management in commercial areas, and were supported by more than 50 percent of the survey participants who responded to this question.

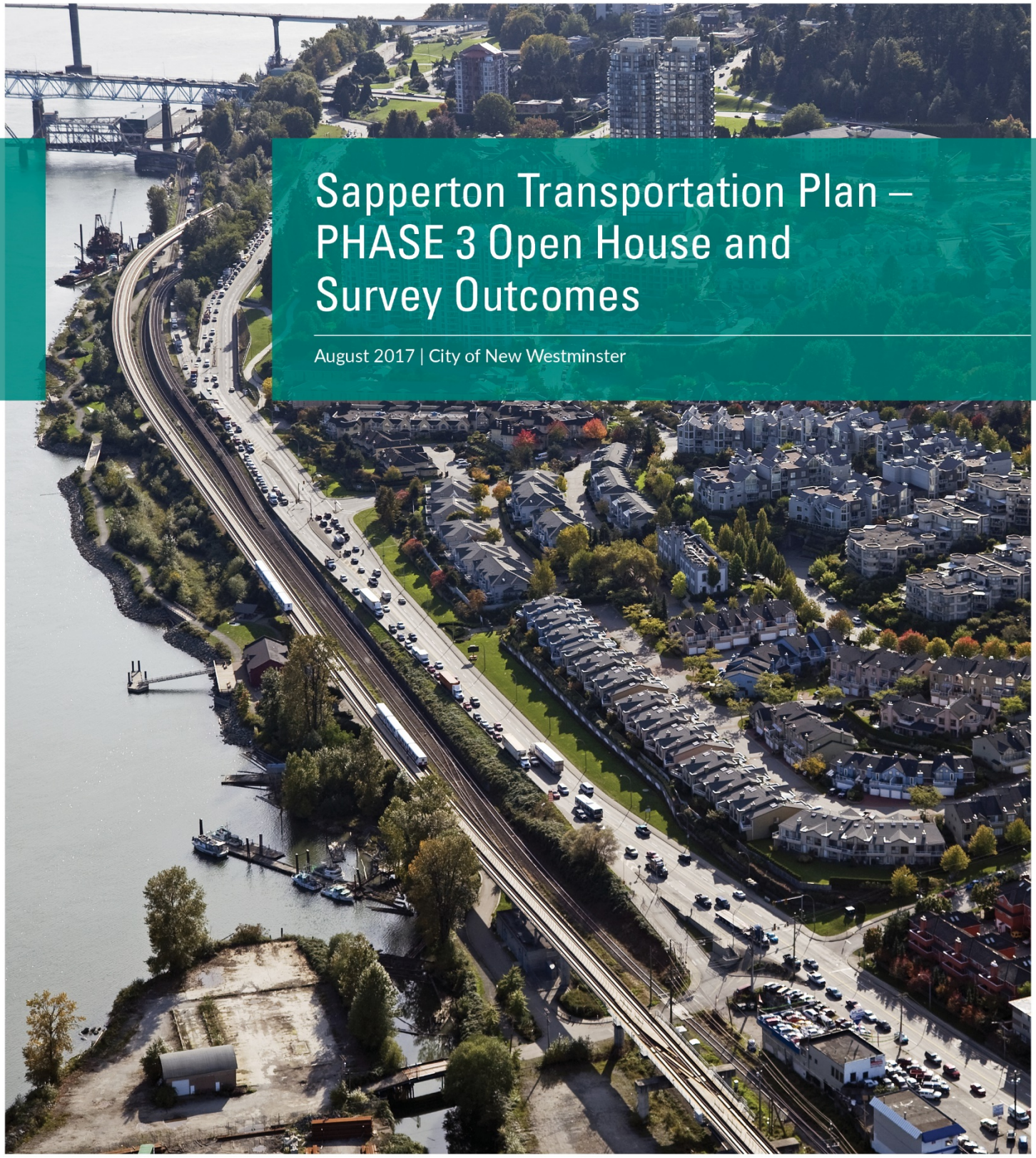
7. Concluding Commentary

Although the number of people participating in the workshop, and the total number of survey completions during Phase 2 of the consultation were relatively low, the responses received from those who took the time to provide their inputs are instructive. Key conclusions, based on the responses received from workshop participants and survey respondents follow:

- There was widespread support amongst participants for the evaluation criteria identified.
- There is general support for the proposed improvements to traffic operations. Areas where it is considered that focussed attention is required include:
  - East Columbia, Cumberland Street and Sixth Avenue
  - Vehicles shortcutting off Richmond Street and Dixon Street
  - Vehicles shortcutting and speeding on Surrey Street and Ladner Street
  - Left turns onto McBride from Sixth and Eighth Avenues
  - Lack of direct routes to Brunette Avenue
- While respondents were generally in favour of traffic calming in principle, there was no clear preference for a particular traffic calming approach (obstructing shortcutting traffic versus mitigating negative effects of shortcutting).
- The following locations were identified as priority locations for traffic calming
  - Sherbrooke Street, East of Columbia
  - Alberta Street
  - Keary Street
- The following locations were identified as potential additional locations for traffic calming:
  - The lanes between Simpson Street and Keary Street. Ladner Street and Surrey Street. and on Kent Street
- There is general support for the proposed improvements to sustainable modes, and support for a cycle route (including separated facilities) on Keary Street, with respondents identifying additional interventions as follows:
  - Improved pedestrian connections between the neighbourhood and the SkyTrain Stations, including improved signage to key destinations (e.g. RCH).
  - Improved/ additional crossings on East Columbia and Cumberland Street
  - Improved end of trip bicycle facilities at major destinations
  - Improved signage for cyclists on Brunette and Braid to enhance wayfinding.
  - Improved co-ordination of traffic between East Columbia and Brunette to improve safety.

  - Consideration of a cycle route on Cumberland to Tenth Avenue.
  - Provision of bus shelter on East Columbia (adjacent to the Hospital sign).
  - Increased/ improved bus services, with more frequent stops on community shuttle routes.

- While the parking permit system and parking restrictions are generally considered to be working well in the neighbourhood, a consistent approach to parking management and clear signage were key interventions that attracted support.
- There was support for a system to improve permitting for visitors in residential areas.
- Views on residents' participation in the parking 'market' were varied. Some considered that residents' rental of backyard space to external parkers should be prevented, while others thought that anyone providing such parking should have to apply for a business licence so the situation can be better managed/ controlled.
- There was a widely held view that RCH needs to address employee and patient/ visitor parking, including consideration of parking provision, affordability and Travel Demand Management (with incentives for employees to use transit).
- Survey participants favoured increased enforcement, simplification of regulations and improved parking signage in residential areas.
- In commercial areas, survey participants favoured a review of off-street parking requirements in new development and improved/additional signage to direct parkers to on- and off-street parking locations.



Sapperton Transportation Plan – PHASE 3 Open House and Survey Outcomes

August 2017 | City of New Westminster

SAPPERTON Transportation Plan

Prepared for:

NEW WESTMINSTER

Submitted by:

McElhanney

1. Context

Sapperton is a predominantly residential community and home to the Royal Columbian Hospital (RCH). The neighbourhood is undergrowing major growth in both residential and employment amenities. Recently, Sapperton has seen a significant increase in mixed-use and high-rise development projects, which are expected to add to congestion and impact traffic volumes on neighbourhood streets. At the same time, RCH is undergoing a major expansion over the next decade. Lastly, there are several regional infrastructure projects that will impact the vehicle circulation on local streets, including the Brunette Avenue interchange improvement project and replacement of the Pattullo Bridge.

The City of New Westminster (the City) is committed to implementing improvements to address neighbourhood transportation safety and livability concerns in Sapperton. The goal is to establish a traffic calming plan and a sustainable transportation plan consistent with the City's Master Transportation Plan and Official Community Plan. Accordingly, the City is preparing the Sapperton Transportation Plan (the Plan). A separate RCH Traffic Study is a component of the overall project.

In addition to the technical data gathering, analysis and traffic modelling which underpins the Plan, the initiative also includes a significant stakeholder and community engagement component. Public engagement was undertaken in three phases:

- Phase 1 – Listen and Learn and Development of Evaluation Criteria
- Phase 2 – Confirmation of Evaluation Criteria and Presentation of Options
- Phase 3 – Input on Draft Plan



During the Phase 1 community workshop (held on October 1, 2016) we heard about peoples' transportation concerns and what participants value most about the neighbourhood. Building on what we heard, and based on further technical analysis, the project team developed a set of evaluation criteria and identified potential intervention options. As part of the Phase 2 engagement, we sought feedback on these elements via a community workshop (held on April 8, 2017) and by means of an online community survey. Based on inputs received and further technical analysis we prepared a draft Plan which was the subject of an Open House held at the Sapperton Pensioners' Hall on June 8, 2017.

This report provides the outcome from the Phase 3 Open House and parallel community survey.

2. Phase 3 Engagement Process

Community Open House: The drop-in format Open House was lively and well-attended. In total, 49 attendees provided sign in details at the door.

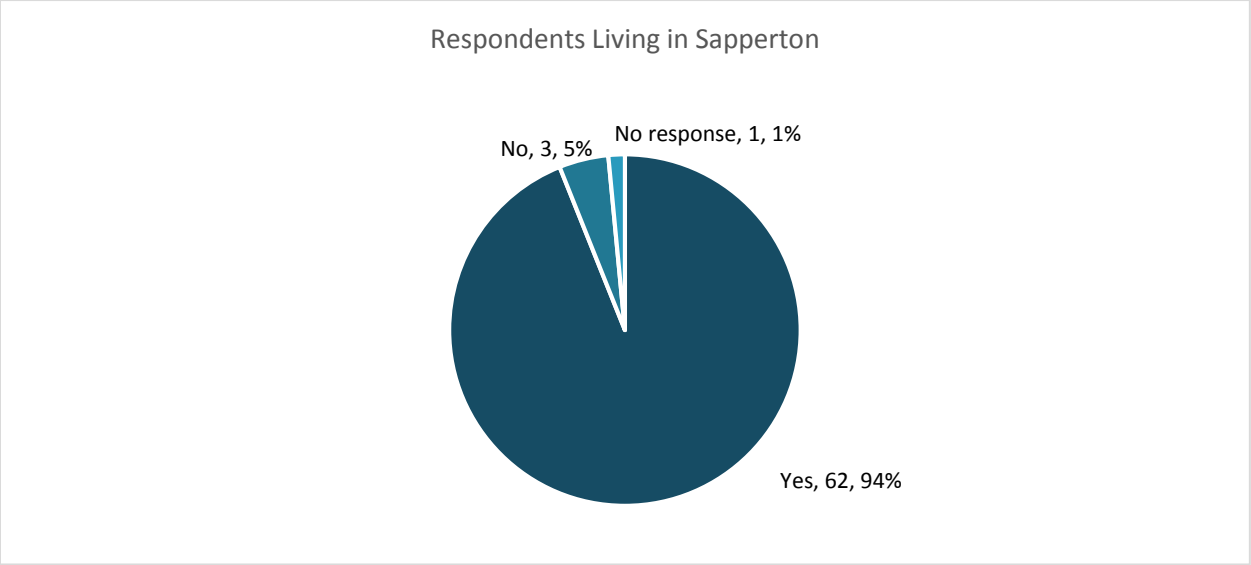
A series of twelve panels exhibiting draft Plan proposals were on display. City and consultant staff were available to explain concepts and answer questions.

Community Survey: A community survey was developed to capture feedback on the draft Plan proposals. Hard copy survey forms were made available for attendees to complete on-site at the Open House. Online versions of the display panels and survey were also available for people to review and complete at their leisure. The survey response period was open for two weeks.

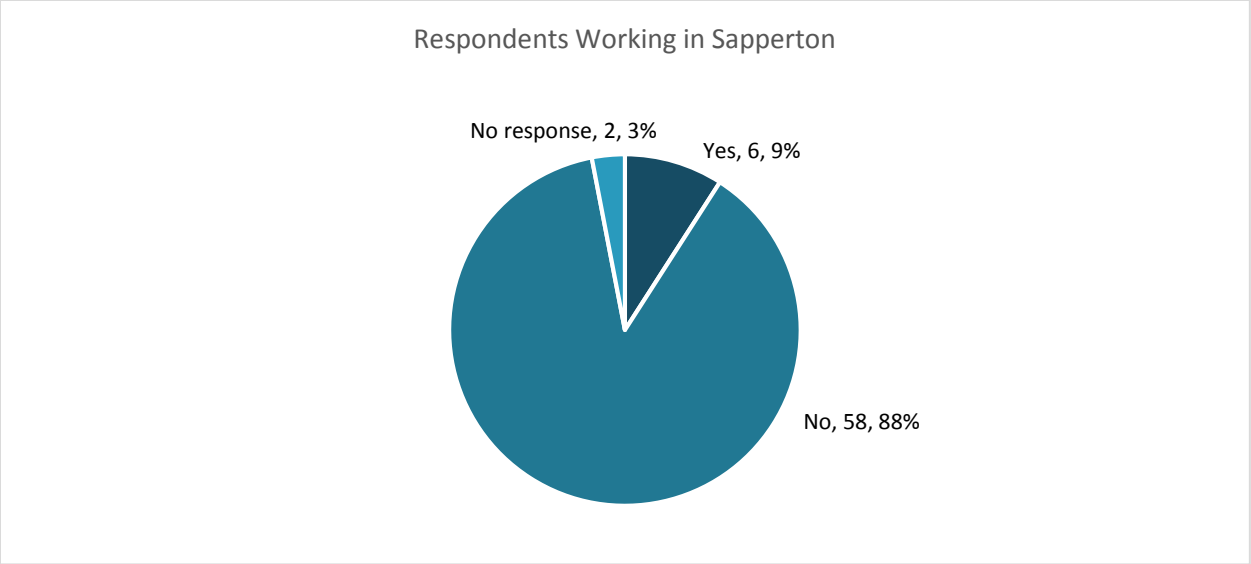
In total, 18 hard copy and 48 online survey responses were received, with only one "in progress"[1] but complete, online response received which was assumed to be submitted.

The responses were collated into a single database to allow consistent reporting of results.

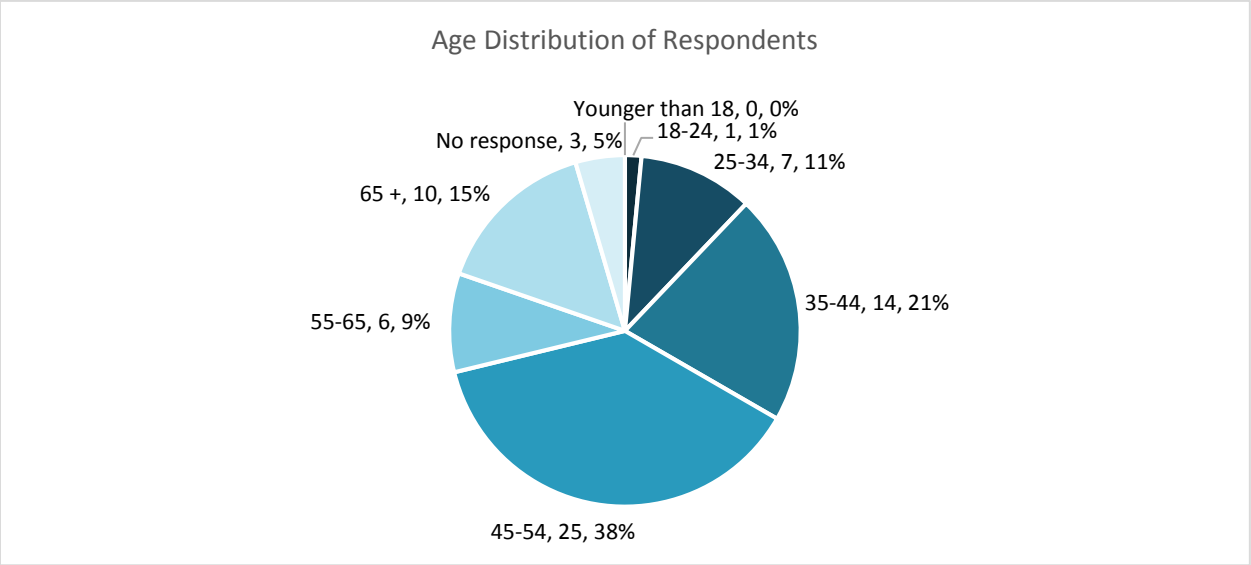
Survey responses indicate that, 94 percent of respondents (62 respondents) live in Sapperton, while 9 (6 respondents) percent work in Sapperton.



[1] "In progress" response indicate that the respondent has not formally completed the survey by clicking the "submit" button.

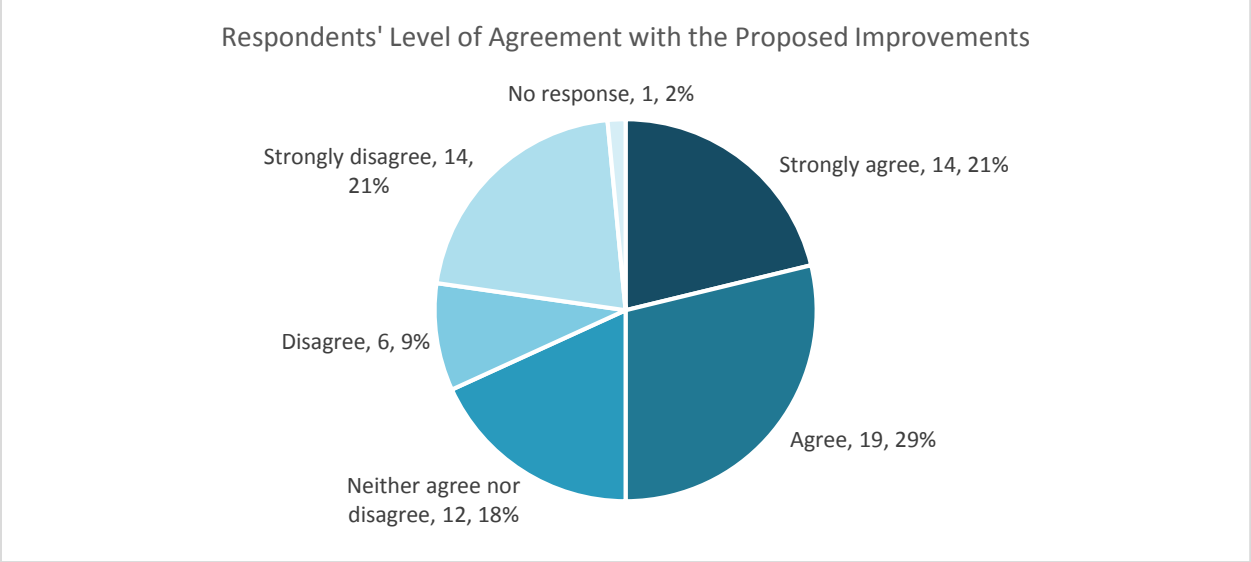


Respondents included representation across a broad range of age categories. As depicted in the chart below, 12% (8 respondents) were under the age of 35 years. Around 60% (39 respondents) were between the ages of 35 and 54 years old, while 15% of survey participants (10 respondents) were aged 65 and over.



3. Level of Support for Proposed Improvements

Respondents were asked about the extent to which they agreed or disagreed with the proposed improvements, in general.



Of the survey participants who provided a response, 50% (33 respondents) either agreed or strongly agreed with the proposed improvements, while 30% (20 respondents) expressed some form of disagreement of which 21% expressed strong disagreement with some of the draft plan proposals.

4. Specific Improvements with which People Disagree/ Agree

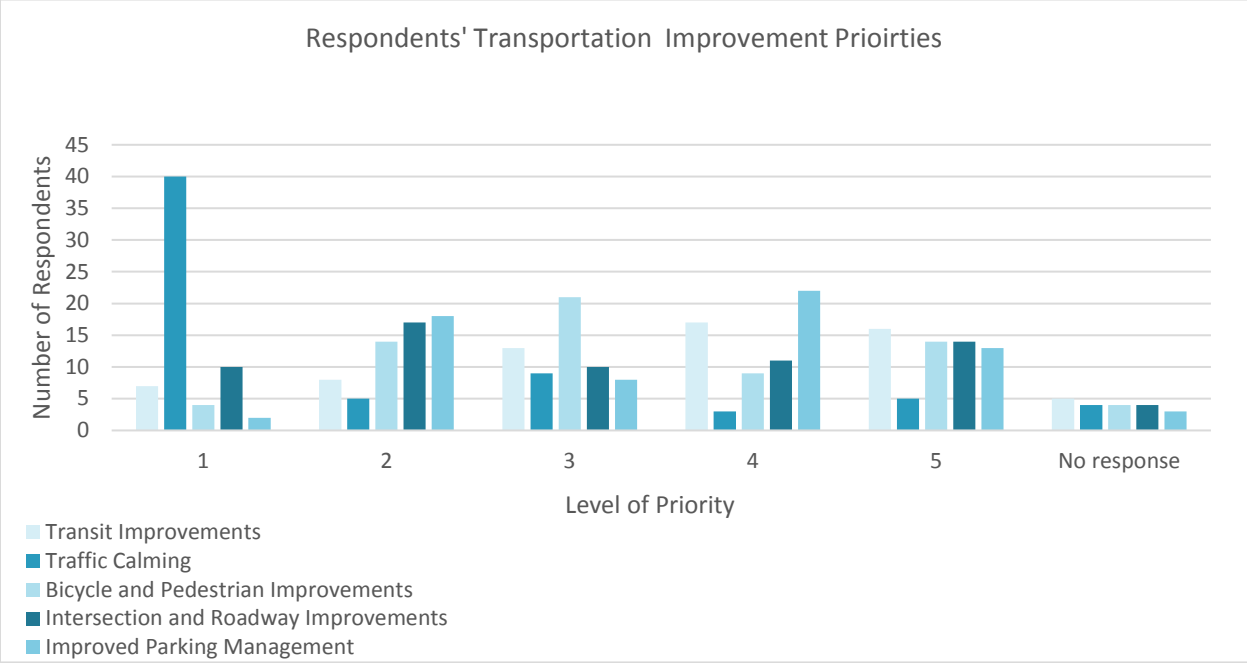
60 respondents provided additional comments. These comments are consolidated below.

- 36% of survey participants who submitted comments (22 respondents) were concerned with the proposed parking changes, especially the removal of parking on Surrey St. They claimed that lack of parking was not addressed and that the removal of parking spaces to accommodate bicycle lanes is unfair to the community, particularly the elderly and those with mobility issues. Of the 22 rsepondents who commented on this issue, a total of 11 respondents expressed frustration with the lack of on-street parking capacity and disagreed with the elimination of parking on east side of Surrey St. A further 9 respondents disagreed with removing parking to accommodate bike lanes specifically, while 2 respondents argued that the cycling volumes are insufficiently high to justify the need for more bicycle lanes at the expense of parking.

- 13% of survey participants who submitted comments (8 respondents) were in favour of permit parking on residential streets, the streets near RCH, the Sky Train and the Brewery District. One respondent specifically advocated for parking the on Keary St. between Richmond St. and Columbia St. to be permit parking only and in turn, for the provision of free parking on Columbia St. and parking lots near the hospital.
- 10% of survey participants who submitted comments (6 respondents) expressed frustration with cars shortcutting through residential areas and questioned whether the proposed improvements go far enough to prevent rat running. These respondents expressed concerns about the volume of traffic on local roads and support for initiatives by the City to discourage shortcutting.
- 15% of survey participants who submitted comments (9 respondents) agree that additional traffic calming measures should be installed on Keary St. to reduce traffic volume and speed.
- 8% of survey participants who submitted comments (5 respondents) support the proposed traffic calming improvements, particularly the speed bumps on Alberta St. and Strand Ave.
- In contrast, 5% (3 respondents) of survey participants who submitted comments complained that there are too many pinch points.
- 7% of survey participants who submitted comments (4 respondents) agreed with restricting right-outs at Surrey Street.
- 5% of survey participants who submitted comments (3 respondents) support the removal of the diverter on Alberta St. and 2% (1 respondent) disagrees with its removal. In addition, 5% of these survey participants (3 respondents) requested a diverter to be placed on Keary St., while 2% (1 respondent) requested that the diverter on Simpson St. be removed.
- 10% of survey participants who submitted comments (6 respondents) requested installing pedestrian crosswalks and curb extensions on Keary St. due to high pedestrian traffic to RCH and Skytrain, and across Sherbrook St. at Buchanan Ave. to provide safe access to the new Sapperton Park.
- 2% of survey participants who submitted comments (1 respondent) requested that some of the signalized intersections be replaced by actuated traffic signals.
- 2% of survey participants who submitted comments (1 respondent) commented that turning right onto Eastbound 8th Avenue from McBride is difficult due to heavy pedestrian traffic.

(Please note that this summary includes additional comments provided by respondents in response to Question 4 of the Survey.)

5. Improvement Priorities



As is evident from the chart, survey participants ranked Traffic Calming Improvements ahead of all other improvements as their overall highest priority, with Intersection and Roadway Improvements being the second highest overall priority, followed by Improved Parking Management. Bicycle and Pedestrian, and Transit Improvements were lower priorities based on the responses received.

6. Conclusions

50 percent of the survey respondents agree or strongly agree with the improvements proposed compared 18 percent with who neither agree nor disagree and further 30 percent (20 respondents) who disagree or strongly disagree. 45 percent (9 respondents) of those who disagree or strongly disagree with the proposals expressed specific concerns about the removal of parking on Surrey Street, while 15 percent (3 respondents) of those who disagree or strongly disagree support additional interventions to reduce traffic volumes on Keary St. It is considered that these particular aspects of the draft Plan require further consideration and consultation.

Appendix B – Traffic Volume Data

Unadjusted Intersection Volumes

Unadjusted by Seasonality and Annual Growth Rate															
Location	Date	Time	SBL	SBT	SBR	NBL	NBT	NBR	EBL	EBT	EBR	WBL	WBT	WBR	Total
Brunette Ave & Braid St	10/16/2013	7:00 AM	12	292	105	0	149	21	29	9	2	52	23	18	712
Brunette Ave & Braid St	10/16/2013	7:15 AM	7	295	131	2	209	23	116	20	0	47	18	11	879
Brunette Ave & Braid St	10/16/2013	7:30 AM	14	317	147	2	222	21	43	9	0	46	25	20	866
Brunette Ave & Braid St	10/16/2013	7:45 AM	12	268	100	1	231	24	130	30	4	35	22	14	871
Brunette Ave & Braid St	10/16/2013	8:00 AM	13	302	111	2	181	21	100	30	2	43	19	9	833
Brunette Ave & Braid St	10/16/2013	8:15 AM	9	297	121	1	218	24	94	13	4	60	26	16	883
Brunette Ave & Braid St	10/16/2013	8:30 AM	14	287	112	1	122	8	128	17	1	31	19	15	755
Brunette Ave & Braid St	10/16/2013	8:45 AM	19	292	121	0	261	26	92	23	2	45	28	11	920
Cariboo Rd/Surrey St & 10th Ave	6/2/2015	7:00 AM	0	129	7	109	23	0	2	0	78	0	0	0	348
Cariboo Rd/Surrey St & 10th Ave	6/2/2015	7:15 AM	0	148	4	105	24	0	2	0	99	0	1	0	383
Cariboo Rd/Surrey St & 10th Ave	6/2/2015	7:30 AM	0	134	6	101	29	0	7	0	100	0	0	0	377
Cariboo Rd/Surrey St & 10th Ave	6/2/2015	7:45 AM	0	146	4	95	36	0	9	0	93	0	0	0	383
Cariboo Rd/Surrey St & 10th Ave	6/2/2015	8:00 AM	0	152	9	87	33	0	4	0	98	0	1	1	385
Cariboo Rd/Surrey St & 10th Ave	6/2/2015	8:15 AM	0	157	5	88	53	1	7	0	97	0	1	1	410
Cariboo Rd/Surrey St & 10th Ave	6/2/2015	8:30 AM	0	130	9	107	76	5	18	0	82	0	2	2	431
Cariboo Rd/Surrey St & 10th Ave	6/2/2015	8:45 AM	0	113	5	91	52	1	13	0	104	0	0	0	379
Cumberland St & 10th Ave	6/2/2015	7:00 AM	11	191	4	11	128	9	4	34	27	6	44	15	484
Cumberland St & 10th Ave	6/2/2015	7:15 AM	4	193	5	13	120	10	1	47	17	12	71	9	502
Cumberland St & 10th Ave	6/2/2015	7:30 AM	9	215	4	9	138	11	5	55	18	4	51	11	530
Cumberland St & 10th Ave	6/2/2015	7:45 AM	11	206	11	12	129	9	5	52	25	4	71	9	544
Cumberland St & 10th Ave	6/2/2015	8:00 AM	14	197	11	14	146	10	5	48	19	16	83	12	575
Cumberland St & 10th Ave	6/2/2015	8:15 AM	13	201	10	15	141	12	10	52	23	4	67	9	557
Cumberland St & 10th Ave	6/2/2015	8:30 AM	11	184	9	14	147	25	14	72	28	10	67	8	589
Cumberland St & 10th Ave	6/2/2015	8:45 AM	22	181	7	14	135	12	8	58	17	6	42	12	514
Cumberland St & E 6th Ave	11/30/2016	7:00 AM	0	8	5	40	3	30	2	6	25	47	28	0	194
Cumberland St & E 6th Ave	11/30/2016	7:15 AM	0	11	0	60	2	28	0	17	28	81	25	1	253
Cumberland St & E 6th Ave	11/30/2016	7:30 AM	0	9	4	46	6	20	0	16	41	85	31	0	258
Cumberland St & E 6th Ave	11/30/2016	7:45 AM	0	16	4	60	15	33	2	27	48	76	22	0	303
Cumberland St & E 6th Ave	11/30/2016	8:00 AM	1	24	6	56	9	39	0	12	49	88	21	0	305
Cumberland St & E 6th Ave	11/30/2016	8:15 AM	0	32	12	56	5	38	1	20	37	72	21	0	294
Cumberland St & E 6th Ave	11/30/2016	8:30 AM	0	21	0	39	17	47	4	36	41	65	25	0	295
Cumberland St & E 6th Ave	11/30/2016	8:45 AM	0	23	4	51	22	33	5	28	41	87	25	0	319
E Columbia St & Alberta St	12/1/2016	7:00 AM	5	94	3	0	82	8	0	1	1	0	0	2	196
E Columbia St & Alberta St	12/1/2016	7:15 AM	17	103	3	0	83	12	0	0	0	4	0	3	225
E Columbia St & Alberta St	12/1/2016	7:30 AM	13	92	2	0	71	18	0	0	0	1	0	1	198
E Columbia St & Alberta St	12/1/2016	7:45 AM	16	78	6	0	97	25	0	0	3	2	0	1	228
E Columbia St & Alberta St	12/1/2016	8:00 AM	28	101	6	0	72	12	0	0	0	5	0	3	227
E Columbia St & Alberta St	12/1/2016	8:15 AM	23	91	6	0	73	14	0	0	0	10	0	4	221
E Columbia St & Alberta St	12/1/2016	8:30 AM	29	84	0	0	81	19	0	0	1	9	0	4	227
E Columbia St & Alberta St	12/1/2016	8:45 AM	28	99	5	0	95	18	0	0	2	0	0	2	249
E Columbia St & Braid St	6/12/2013	6:30 AM	10	82	109	9	53	17	30	80	3	17	118	4	532
E Columbia St & Braid St	6/12/2013	6:45 AM	15	98	95	2	43	22	21	73	0	21	119	9	518
E Columbia St & Braid St	6/12/2013	7:00 AM	7	109	110	9	42	11	37	91	3	16	125	15	575
E Columbia St & Braid St	6/12/2013	7:15 AM	18	125	131	5	52	25	32	86	5	11	107	8	605
E Columbia St & Braid St	6/12/2013	7:30 AM	13	108	132	5	71	25	31	97	0	22	120	7	631
E Columbia St & Braid St	6/12/2013	7:45 AM	15	130	151	5	50	27	59	85	1	17	93	5	638
E Columbia St & Braid St	6/12/2013	8:00 AM	26	125	153	9	64	15	48	80	5	17	111	8	661
E Columbia St & Braid St	6/12/2013	8:15 AM	15	122	141	9	52	14	54	95	3	29	94	5	633
E Columbia St & Brunette Ave	6/12/2013	6:30 AM	0	69	0	1	85	279	0	0	0	355	0	2	791
E Columbia St & Brunette Ave	6/12/2013	6:45 AM	0	80	0	0	92	243	0	0	1	293	0	4	713
E Columbia St & Brunette Ave	6/12/2013	7:00 AM	0	105	0	0	69	218	0	0	1	344	0	3	740
E Columbia St & Brunette Ave	6/12/2013	7:15 AM	0	102	0	0	75	258	0	0	0	298	0	2	735
E Columbia St & Brunette Ave	6/12/2013	7:30 AM	0	106	0	0	70	304	0	0	0	331	0	5	816
E Columbia St & Brunette Ave	6/12/2013	7:45 AM	0	104	0	0	71	259	0	0	0	295	0	6	735
E Columbia St & Brunette Ave	6/12/2013	8:00 AM	0	72	0	0	84	239	0	0	0	352	0	5	752
E Columbia St & Brunette Ave	6/12/2013	8:15 AM	0	136	0	0	80	207	0	0	0	250	0	2	675
E Columbia St & Front St	6/20/2013	6:30 AM	50	325	0	0	239	0	0	0	0	0	0	88	702
E Columbia St & Front St	6/20/2013	6:45 AM	52	307	0	0	226	0	0	0	0	0	0	86	671
E Columbia St & Front St	6/20/2013	7:00 AM	54	327	0	0	224	0	0	0	0	0	0	66	671
E Columbia St & Front St	6/20/2013	7:15 AM	55	325	0	0	192	0	0	0	0	0	0	89	661

Unadjusted by Seasonality and Annual Growth Rate															
Location	Date	Time	SBL	SBT	SBR	NBL	NBT	NBR	EBL	EBT	EBR	WBL	WBT	WBR	Total
E Columbia St & Front St	6/20/2013	7:30 AM	64	325	0	0	260	0	0	0	0	0	0	67	716
E Columbia St & Front St	6/20/2013	7:45 AM	59	343	0	0	245	0	0	0	0	0	0	86	733
E Columbia St & Front St	6/20/2013	8:00 AM	56	324	0	0	246	0	0	0	0	0	0	93	719
E Columbia St & Front St	6/20/2013	8:15 AM	71	350	0	0	223	0	0	0	0	0	0	86	730
E. Columbia St & Alberta St	2/5/2015	7:00 AM	8	95	2	1	61	9	3	3	0	2	1	1	186
E. Columbia St & Alberta St	2/5/2015	7:15 AM	4	86	1	0	60	4	4	3	0	2	1	1	166
E. Columbia St & Alberta St	2/5/2015	7:30 AM	15	120	0	3	80	12	5	9	0	1	2	1	248
E. Columbia St & Alberta St	2/5/2015	7:45 AM	19	99	3	1	72	15	2	7	0	4	2	4	228
E. Columbia St & Alberta St	2/5/2015	8:00 AM	19	120	5	0	69	13	7	5	0	5	0	2	245
E. Columbia St & Alberta St	2/5/2015	8:15 AM	18	127	4	3	69	14	2	6	2	7	2	4	258
E. Columbia St & Alberta St	2/5/2015	8:30 AM	15	117	1	3	68	15	7	5	3	5	2	2	243
E. Columbia St & Alberta St	2/5/2015	8:45 AM	31	99	4	0	83	17	10	5	2	2	0	7	260
East Columbia St & Alberta St	6/2/2015	7:00 AM	6	90	3	1	72	6	0	0	0	0	1	5	184
East Columbia St & Alberta St	6/2/2015	7:15 AM	15	105	1	0	73	11	0	1	1	4	0	3	214
East Columbia St & Alberta St	6/2/2015	7:30 AM	19	104	2	0	80	14	0	0	2	6	1	1	229
East Columbia St & Alberta St	6/2/2015	7:45 AM	24	101	2	0	87	19	0	1	4	5	0	3	246
East Columbia St & Alberta St	6/2/2015	8:00 AM	19	100	7	0	93	17	3	0	1	2	0	1	243
East Columbia St & Alberta St	6/2/2015	8:15 AM	16	108	2	0	77	19	0	1	2	7	0	2	234
East Columbia St & Alberta St	6/2/2015	8:30 AM	23	104	5	0	73	9	1	0	1	8	0	3	227
East Columbia St & Alberta St	6/2/2015	8:45 AM	25	82	0	0	75	20	0	4	1	11	0	8	226
McBride Blvd & E. Columbia St	5/15/2013	7:00 AM	0	304	75	0	80	0	131	0	6	0	0	0	596
McBride Blvd & E. Columbia St	5/15/2013	7:15 AM	0	276	89	0	108	0	167	0	13	0	0	0	653
McBride Blvd & E. Columbia St	5/15/2013	7:30 AM	0	281	86	0	98	0	169	0	9	0	0	0	643
McBride Blvd & E. Columbia St	5/15/2013	7:45 AM	0	291	94	0	73	0	156	0	13	0	0	0	627
McBride Blvd & E. Columbia St	5/15/2013	8:00 AM	0	288	98	0	106	0	151	0	13	0	0	0	656
McBride Blvd & E. Columbia St	5/15/2013	8:15 AM	0	303	109	0	88	0	146	0	16	0	0	0	662
McBride Blvd & E. Columbia St	5/15/2013	8:30 AM	0	303	64	0	75	0	139	0	11	0	0	0	592
McBride Blvd & E. Columbia St	5/15/2013	8:45 AM	0	320	82	0	73	0	181	0	14	0	0	0	670
McBride Blvd & Memorial Dr	11/18/2014	7:00 AM	14	0	11	0	0	0	5	196	0	0	370	8	604
McBride Blvd & Memorial Dr	11/18/2014	7:15 AM	5	0	9	0	0	0	10	313	0	0	388	3	728
McBride Blvd & Memorial Dr	11/18/2014	7:30 AM	15	0	10	0	0	0	12	326	0	0	425	7	795
McBride Blvd & Memorial Dr	11/18/2014	7:45 AM	12	0	11	0	0	0	14	362	0	0	375	9	783
McBride Blvd & Memorial Dr	11/18/2014	8:00 AM	11	0	15	0	0	0	19	252	0	0	398	13	708
McBride Blvd & Memorial Dr	11/18/2014	8:15 AM	14	0	15	0	0	0	14	218	0	0	365	6	632
McBride Blvd & Memorial Dr	11/18/2014	8:30 AM	10	0	13	0	0	0	19	267	0	0	385	11	705
McBride Blvd & Memorial Dr	11/18/2014	8:45 AM	5	0	7	0	0	0	17	229	0	0	383	10	651
Richmond St & Alberta St	2/5/2015	7:00 AM	0	33	0	1	29	4	3	0	1	4	0	0	75
Richmond St & Alberta St	2/5/2015	7:15 AM	0	57	1	1	36	3	2	2	1	3	0	1	107
Richmond St & Alberta St	2/5/2015	7:30 AM	2	69	3	2	32	8	6	1	1	4	1	1	130
Richmond St & Alberta St	2/5/2015	7:45 AM	1	74	3	0	35	6	0	0	0	3	1	1	124
Richmond St & Alberta St	2/5/2015	8:00 AM	2	61	3	0	40	5	0	0	0	0	1	1	113
Richmond St & Alberta St	2/5/2015	8:15 AM	2	52	7	0	47	5	1	0	0	2	0	3	119
Richmond St & Alberta St	2/5/2015	8:30 AM	2	49	5	1	42	4	0	1	1	3	0	4	112
Richmond St & Alberta St	2/5/2015	8:45 AM	4	84	9	0	50	6	3	1	2	1	1	4	165
Richmond St. & Alberta St.	6/2/2015	7:00 AM	1	40	1	0	33	0	1	0	1	3	0	0	80
Richmond St. & Alberta St.	6/2/2015	7:15 AM	0	48	0	0	38	2	3	0	0	1	0	1	93
Richmond St. & Alberta St.	6/2/2015	7:30 AM	0	69	0	2	50	1	3	0	1	2	0	2	130
Richmond St. & Alberta St.	6/2/2015	7:45 AM	1	79	1	0	54	4	5	1	1	2	0	1	149
Richmond St. & Alberta St.	6/2/2015	8:00 AM	2	60	5	2	37	3	1	0	1	3	2	7	123
Richmond St. & Alberta St.	6/2/2015	8:15 AM	1	56	9	0	37	3	1	2	0	0	1	3	113
Richmond St. & Alberta St.	6/2/2015	8:30 AM	0	55	2	1	48	2	1	0	1	1	2	3	116
Richmond St. & Alberta St.	6/2/2015	8:45 AM	0	83	6	1	45	3	4	1	2	1	0	4	150
McBride St & Royal Ave	10/20/2016	7:00 AM	11	31	5	9	7	35	0	106	0	94	7	7	312
McBride St & Royal Ave	10/20/2016	7:15 AM	7	40	6	11	12	48	0	100	0	112	5	10	351
McBride St & Royal Ave	10/20/2016	7:30 AM	19	33	14	10	9	42	0	110	0	89	7	9	342
McBride St & Royal Ave	10/20/2016	7:45 AM	19	34	6	9	6	33	0	92	0	109	16	14	338
McBride St & Royal Ave	10/20/2016	8:00 AM	14	34	7	14	7	46	0	96	0	112	13	7	350
McBride St & Royal Ave	10/20/2016	8:15 AM	14	45	10	19	15	40	0	83	0	103	8	11	348
McBride St & Royal Ave	10/20/2016	8:30 AM	17	26	6	12	8	53	0	107	1	92	9	5	336
McBride St & Royal Ave	10/20/2016	8:45 AM	10	31	8	7	11	60	1	128	0	110	11	8	385

Unadjusted by Seasonality and Annual Growth Rate															
Location	Date	Time	SBL	SBT	SBR	NBL	NBT	NBR	EBL	EBT	EBR	WBL	WBT	WBR	Total
Canfor Ave & Braid St	2/2/2017	7:00 AM	0	0	0	11	0	10	0	26	10	11	52	0	120
Canfor Ave & Braid St	2/2/2017	7:15 AM	0	0	1	13	0	5	0	50	16	13	73	0	171
Canfor Ave & Braid St	2/2/2017	7:30 AM	1	0	0	14	0	4	0	42	11	25	71	1	169
Canfor Ave & Braid St	2/2/2017	7:45 AM	0	0	1	6	0	16	1	49	15	27	64	0	179
Canfor Ave & Braid St	2/2/2017	8:00 AM	1	0	0	12	1	4	0	40	9	15	65	1	148
Canfor Ave & Braid St	2/2/2017	8:15 AM	0	0	1	10	0	9	1	33	10	13	44	0	121
Canfor Ave & Braid St	2/2/2017	8:30 AM	0	0	2	13	0	6	0	40	7	15	49	0	132
Canfor Ave & Braid St	2/2/2017	8:45 AM	0	0	1	13	1	12	0	32	18	18	46	0	141
E Columbia St & Cumberland Ave	2/2/2017	7:00 AM	0	444	15	0	314	0	0	0	1	0	0	0	774
E Columbia St & Cumberland Ave	2/2/2017	7:15 AM	0	432	8	0	320	2	0	0	3	0	0	2	767
E Columbia St & Cumberland Ave	2/2/2017	7:30 AM	0	426	18	0	314	0	0	0	1	0	0	0	759
E Columbia St & Cumberland Ave	2/2/2017	7:45 AM	0	417	23	0	342	2	0	0	0	0	0	0	784
E Columbia St & Cumberland Ave	2/2/2017	8:00 AM	0	485	20	0	245	2	0	0	0	0	0	0	752
E Columbia St & Cumberland Ave	2/2/2017	8:15 AM	0	420	14	0	358	1	0	0	2	0	0	1	796
E Columbia St & Cumberland Ave	2/2/2017	8:30 AM	0	446	14	1	322	0	0	0	1	0	0	0	784
E Columbia St & Cumberland Ave	2/2/2017	8:45 AM	0	382	17	0	322	0	0	0	0	0	0	0	721
E Columbia St & Holmes St	2/2/2017	7:00 AM	0	185	138	7	95	0	23	0	10	0	0	0	458
E Columbia St & Holmes St	2/2/2017	7:15 AM	0	241	171	6	90	0	28	0	9	0	0	0	545
E Columbia St & Holmes St	2/2/2017	7:30 AM	0	198	158	6	89	0	16	0	4	0	0	0	471
E Columbia St & Holmes St	2/2/2017	7:45 AM	0	240	172	8	101	0	34	0	4	0	0	0	559
E Columbia St & Holmes St	2/2/2017	8:00 AM	0	267	190	5	94	0	31	0	8	0	0	0	595
E Columbia St & Holmes St	2/2/2017	8:15 AM	0	212	223	3	116	0	65	0	6	0	0	0	625
E Columbia St & Holmes St	2/2/2017	8:30 AM	0	216	183	11	149	0	65	0	10	0	0	0	634
E Columbia St & Holmes St	2/2/2017	8:45 AM	0	219	119	6	132	0	84	0	8	0	0	0	568
E Columbia St & Richmond St	2/15/2017	7:00 AM	0	413	6	6	251	0	12	0	11	0	0	0	699
E Columbia St & Richmond St	2/15/2017	7:15 AM	0	419	15	6	246	0	13	0	13	0	0	0	712
E Columbia St & Richmond St	2/15/2017	7:30 AM	0	419	9	6	310	0	13	0	10	0	0	0	767
E Columbia St & Richmond St	2/15/2017	7:45 AM	0	447	6	9	327	0	13	0	14	0	0	0	816
E Columbia St & Richmond St	2/15/2017	8:00 AM	0	426	4	9	271	0	17	0	15	0	0	0	742
E Columbia St & Richmond St	2/15/2017	8:15 AM	0	474	10	6	311	0	14	0	14	0	0	0	829
E Columbia St & Richmond St	2/15/2017	8:30 AM	0	428	13	7	287	0	19	0	11	0	0	0	765
E Columbia St & Richmond St	2/15/2017	8:45 AM	0	401	10	11	347	0	13	0	15	0	0	0	797
McBride Blvd & 6th Ave	2/15/2017	7:00 AM	57	58	10	4	27	14	0	238	15	1	388	40	852
McBride Blvd & 6th Ave	2/15/2017	7:15 AM	34	73	9	3	45	12	0	285	10	0	381	48	900
McBride Blvd & 6th Ave	2/15/2017	7:30 AM	58	92	7	7	42	25	0	293	8	0	374	29	935
McBride Blvd & 6th Ave	2/15/2017	7:45 AM	51	95	12	11	50	19	0	296	16	0	390	48	988
McBride Blvd & 6th Ave	2/15/2017	8:00 AM	48	100	15	5	63	9	0	265	22	0	330	38	895
McBride Blvd & 6th Ave	2/15/2017	8:15 AM	34	108	7	7	47	20	0	239	22	2	384	36	906
McBride Blvd & 6th Ave	2/15/2017	8:30 AM	32	118	11	9	82	15	0	252	27	0	342	49	937
McBride Blvd & 6th Ave	2/15/2017	8:45 AM	19	99	10	6	65	14	0	222	27	2	366	38	868
McBride Blvd & 8th Ave	2/1/2017	7:00 AM	52	79	12	15	46	17	38	174	7	46	167	11	664
McBride Blvd & 8th Ave	2/1/2017	7:15 AM	80	169	24	19	51	32	27	176	1	55	256	12	902
McBride Blvd & 8th Ave	2/1/2017	7:30 AM	55	123	24	16	71	40	36	229	5	65	304	10	978
McBride Blvd & 8th Ave	2/1/2017	7:45 AM	63	126	20	20	72	29	39	196	11	63	242	32	913
McBride Blvd & 8th Ave	2/1/2017	8:00 AM	64	139	30	10	85	34	18	154	11	54	281	16	896
McBride Blvd & 8th Ave	2/1/2017	8:15 AM	54	170	23	35	94	38	43	189	11	85	262	13	1,017
McBride Blvd & 8th Ave	2/1/2017	8:30 AM	63	148	35	28	83	16	44	189	9	60	236	18	929
McBride Blvd & 8th Ave	2/1/2017	8:45 AM	54	176	31	32	80	25	36	149	8	61	230	24	906
McBride Blvd & 10th Ave	2/15/2017	7:00 AM	91	143	0	0	44	140	0	0	0	310	0	75	803
McBride Blvd & 10th Ave	2/15/2017	7:15 AM	92	146	0	0	41	163	0	0	0	316	0	73	831
McBride Blvd & 10th Ave	2/15/2017	7:30 AM	79	132	0	0	43	167	0	0	0	275	0	67	763
McBride Blvd & 10th Ave	2/15/2017	7:45 AM	94	147	0	0	61	160	0	0	0	287	0	82	831
McBride Blvd & 10th Ave	2/15/2017	8:00 AM	95	132	0	0	65	174	0	0	0	301	0	89	856
McBride Blvd & 10th Ave	2/15/2017	8:15 AM	80	153	0	0	77	154	0	0	0	259	0	92	815
McBride Blvd & 10th Ave	2/15/2017	8:30 AM	82	129	0	0	104	183	0	0	0	291	0	95	884
McBride Blvd & 10th Ave	2/15/2017	8:45 AM	76	127	0	0	72	138	0	0	0	282	0	88	783
Richmond St & 8th Ave	2/15/2017	7:00 AM	0	0	2	2	4	11	2	83	2	22	208	1	337
Richmond St & 8th Ave	2/15/2017	7:15 AM	0	5	2	6	5	17	1	94	2	9	211	1	353
Richmond St & 8th Ave	2/15/2017	7:30 AM	2	3	3	1	2	17	4	114	0	16	249	0	411
Richmond St & 8th Ave	2/15/2017	7:45 AM	1	6	5	3	9	21	3	101	3	20	181	1	354

Unadjusted by Seasonality and Annual Growth Rate															
Location	Date	Time	SBL	SBT	SBR	NBL	NBT	NBR	EBL	EBT	EBR	WBL	WBT	WBR	Total
Richmond St & 8th Ave	2/15/2017	8:00 AM	1	9	8	4	5	17	8	156	1	12	206	1	428
Richmond St & 8th Ave	2/15/2017	8:15 AM	2	8	10	4	3	13	16	95	2	12	219	1	385
Richmond St & 8th Ave	2/15/2017	8:30 AM	1	10	8	4	4	14	13	130	2	16	227	1	430
Richmond St & 8th Ave	2/15/2017	8:45 AM	3	6	8	3	8	25	8	126	2	15	205	1	410
Richmond St & 10th Ave	2/2/2017	7:00 AM	0	0	0	0	0	2	0	22	0	1	120	0	145
Richmond St & 10th Ave	2/2/2017	7:15 AM	0	0	0	0	0	4	0	35	0	0	129	0	168
Richmond St & 10th Ave	2/2/2017	7:30 AM	0	0	0	0	0	2	0	22	0	1	167	0	192
Richmond St & 10th Ave	2/2/2017	7:45 AM	0	0	0	2	0	3	0	33	0	2	167	0	207
Richmond St & 10th Ave	2/2/2017	8:00 AM	0	0	0	0	0	1	0	31	0	2	138	0	172
Richmond St & 10th Ave	2/2/2017	8:15 AM	0	0	0	0	0	5	0	56	0	3	162	0	226
Richmond St & 10th Ave	2/2/2017	8:30 AM	0	0	0	2	0	14	0	78	2	4	117	0	217
Richmond St & 10th Ave	2/2/2017	8:45 AM	0	0	0	1	0	4	0	68	2	6	98	0	179
Richmond St & Cumberland St	2/1/2017	7:00 AM	1	0	54	11	2	0	28	2	4	1	12	2	117
Richmond St & Cumberland St	2/1/2017	7:15 AM	0	3	71	16	5	0	47	3	8	0	14	0	167
Richmond St & Cumberland St	2/1/2017	7:30 AM	0	4	53	18	8	0	28	0	7	2	18	2	140
Richmond St & Cumberland St	2/1/2017	7:45 AM	0	5	68	24	9	0	36	6	13	1	27	0	189
Richmond St & Cumberland St	2/1/2017	8:00 AM	1	5	74	19	3	2	32	6	16	1	24	1	184
Richmond St & Cumberland St	2/1/2017	8:15 AM	0	7	76	23	4	0	52	3	14	1	20	1	201
Richmond St & Cumberland St	2/1/2017	8:30 AM	3	6	48	20	11	0	61	9	17	2	15	4	196
Richmond St & Cumberland St	2/1/2017	8:45 AM	3	12	53	20	7	0	48	4	16	0	13	3	179
Rousseau St & Braid St	11/28/2013	7:30:00 AM	18	0	11	1	2	10	16	153	4	3	164	19	401
Rousseau St & Braid St	11/28/2013	7:45:00 AM	29	1	15	1	2	6	14	147	1	2	158	33	409
Rousseau St & Braid St	11/28/2013	8:00:00 AM	15	1	7	0	1	5	2	140	3	5	141	13	333
Rousseau St & Braid St	11/28/2013	8:15:00 AM	18	0	6	2	0	4	13	130	1	6	126	11	317
Brunette Ave & Sherbrooke St	11/28/2013	7:30:00 AM	0	349	25	0	0	0	0	0	3	0	0	0	377
Brunette Ave & Sherbrooke St	11/28/2013	7:45:00 AM	0	381	17	0	0	0	0	0	7	0	0	0	405
Brunette Ave & Sherbrooke St	11/28/2013	8:00:00 AM	0	379	17	0	0	0	0	0	2	0	0	0	398
Brunette Ave & Sherbrooke St	11/28/2013	8:15:00 AM	0	363	13	0	0	0	0	0	3	0	0	0	379
Brunette Ave & Keary St	11/28/2013	7:30:00 AM	0	366	39	0	212	0	0	0	2	0	0	0	619
Brunette Ave & Keary St	11/28/2013	7:45:00 AM	0	327	35	0	237	0	0	0	6	0	0	0	605
Brunette Ave & Keary St	11/28/2013	8:00:00 AM	0	336	22	0	264	0	0	0	5	0	0	0	627
Brunette Ave & Keary St	11/28/2013	8:15:00 AM	0	316	22	0	255	0	0	0	4	0	0	0	597
E Columbia St & Sherbrooke St	11/28/2013	7:30:00 AM	7	128	4	4	85	5	11	5	7	6	5	4	271
E Columbia St & Sherbrooke St	11/28/2013	7:45:00 AM	7	129	7	7	102	1	3	13	14	6	14	6	309
E Columbia St & Sherbrooke St	11/28/2013	8:00:00 AM	5	144	9	4	100	5	7	8	14	9	6	4	315
E Columbia St & Sherbrooke St	11/28/2013	8:15:00 AM	5	156	5	2	97	1	10	8	8	6	14	7	319
E Columbia St & Keary St	11/28/2013	7:30:00 AM	12	81	1	0	53	12	2	6	4	8	12	16	207
E Columbia St & Keary St	11/28/2013	7:45:00 AM	11	97	7	0	84	17	5	11	2	3	10	8	255
E Columbia St & Keary St	11/28/2013	8:00:00 AM	7	115	8	2	74	17	5	8	2	5	5	16	264
E Columbia St & Keary St	11/28/2013	8:15:00 AM	8	123	11	1	77	7	2	6	1	3	6	8	253
8th Ave & Cumberland St	10/16/2008	7:00 AM	6	207	11	0	107	12	11	24	12	10	58	17	475
8th Ave & Cumberland St	10/16/2008	7:15 AM	9	179	9	0	108	6	13	33	35	10	76	20	498
8th Ave & Cumberland St	10/16/2008	7:30 AM	14	276	6	0	135	17	11	40	38	10	92	17	656
8th Ave & Cumberland St	10/16/2008	7:45 AM	13	229	5	0	132	16	18	36	18	6	86	26	585
8th Ave & Cumberland St	10/16/2008	8:00 AM	2	226	8	0	96	16	10	29	15	10	68	21	501
8th Ave & Cumberland St	10/16/2008	8:15 AM	12	251	9	0	129	17	17	28	18	11	56	31	579
8th Ave & Cumberland St	10/16/2008	8:30 AM	7	200	6	0	129	21	18	42	23	18	47	29	540
8th Ave & Cumberland St	10/16/2008	8:45 AM	9	199	21	0	129	26	13	39	30	8	53	23	550

Adjusted Intersection Volumes

Adjusted by Seasonality and Annual Growth Rate														
Location	Time	SBL	SBT	SBR	NBL	NBT	NBR	EBL	EBT	EBR	WBL	WBT	WBR	Total
Brunette Ave & Braid St	7:00:00 AM	13	310	111	0	158	22	31	10	2	55	24	19	755
Brunette Ave & Braid St	7:15:00 AM	7	313	139	2	222	24	123	21	0	50	19	12	932
Brunette Ave & Braid St	7:30:00 AM	15	336	156	2	236	22	46	10	0	49	27	21	920
Brunette Ave & Braid St	7:45:00 AM	13	284	106	1	245	25	138	32	4	37	23	15	923
Brunette Ave & Braid St	8:00:00 AM	14	320	118	2	192	22	106	32	2	46	20	10	884
Brunette Ave & Braid St	8:15:00 AM	10	315	128	1	231	25	100	14	4	64	28	17	937
Brunette Ave & Braid St	8:30:00 AM	15	305	119	1	129	8	136	18	1	33	20	16	801
Brunette Ave & Braid St	8:45:00 AM	20	310	128	0	277	28	98	24	2	48	30	12	977
Cariboo Rd/Surrey St & 10th Ave	7:00:00 AM	0	132	7	111	23	0	2	0	80	0	0	0	355
Cariboo Rd/Surrey St & 10th Ave	7:15:00 AM	0	151	4	107	24	0	2	0	101	0	1	0	390
Cariboo Rd/Surrey St & 10th Ave	7:30:00 AM	0	137	6	103	30	0	7	0	102	0	0	0	385
Cariboo Rd/Surrey St & 10th Ave	7:45:00 AM	0	149	4	97	37	0	9	0	95	0	0	0	391
Cariboo Rd/Surrey St & 10th Ave	8:00:00 AM	0	155	9	89	34	0	4	0	100	0	1	1	393
Cariboo Rd/Surrey St & 10th Ave	8:15:00 AM	0	160	5	90	54	1	7	0	99	0	1	1	418
Cariboo Rd/Surrey St & 10th Ave	8:30:00 AM	0	133	9	109	78	5	18	0	84	0	2	2	440
Cariboo Rd/Surrey St & 10th Ave	8:45:00 AM	0	115	5	93	53	1	13	0	106	0	0	0	386
Cumberland St & 10th Ave	7:00:00 AM	11	195	4	11	131	9	4	35	28	6	45	15	494
Cumberland St & 10th Ave	7:15:00 AM	4	197	5	13	122	10	1	48	17	12	72	9	510
Cumberland St & 10th Ave	7:30:00 AM	9	219	4	9	141	11	5	56	18	4	52	11	539
Cumberland St & 10th Ave	7:45:00 AM	11	210	11	12	132	9	5	53	26	4	72	9	554
Cumberland St & 10th Ave	8:00:00 AM	14	201	11	14	149	10	5	49	19	16	85	12	585
Cumberland St & 10th Ave	8:15:00 AM	13	205	10	15	144	12	10	53	23	4	68	9	566
Cumberland St & 10th Ave	8:30:00 AM	11	188	9	14	150	26	14	73	29	10	68	8	600
Cumberland St & 10th Ave	8:45:00 AM	22	185	7	14	138	12	8	59	17	6	43	12	523
Cumberland St & E 6th Ave	7:00:00 AM	0	8	5	41	3	31	2	6	26	48	29	0	199
Cumberland St & E 6th Ave	7:15:00 AM	0	11	0	61	2	29	0	17	29	83	26	1	259
Cumberland St & E 6th Ave	7:30:00 AM	0	9	4	47	6	20	0	16	42	87	32	0	263
Cumberland St & E 6th Ave	7:45:00 AM	0	16	4	61	15	34	2	28	49	78	22	0	309
Cumberland St & E 6th Ave	8:00:00 AM	1	24	6	57	9	40	0	12	50	90	21	0	310
Cumberland St & E 6th Ave	8:15:00 AM	0	33	12	57	5	39	1	20	38	73	21	0	299
Cumberland St & E 6th Ave	8:30:00 AM	0	21	0	40	17	48	4	37	42	66	26	0	301
Cumberland St & E 6th Ave	8:45:00 AM	0	23	4	52	22	34	5	29	42	89	26	0	326
E Columbia St & Alberta St	7:00:00 AM	5	98	3	0	86	8	0	1	1	0	0	2	204
E Columbia St & Alberta St	7:15:00 AM	18	108	3	0	87	13	0	0	0	4	0	3	236
E Columbia St & Alberta St	7:30:00 AM	14	96	2	0	74	19	0	0	0	1	0	1	207
E Columbia St & Alberta St	7:45:00 AM	17	82	6	0	101	26	0	0	3	2	0	1	238
E Columbia St & Alberta St	8:00:00 AM	29	106	6	0	75	13	0	0	0	5	0	3	237
E Columbia St & Alberta St	8:15:00 AM	24	95	6	0	76	15	0	0	0	10	0	4	230
E Columbia St & Alberta St	8:30:00 AM	30	88	0	0	85	20	0	0	1	9	0	4	237
E Columbia St & Alberta St	8:45:00 AM	29	104	5	0	99	19	0	0	2	0	0	2	260
E Columbia St & Braid St	6:30:00 AM	11	87	116	10	56	18	32	85	3	18	125	4	565
E Columbia St & Braid St	6:45:00 AM	16	104	101	2	46	23	22	78	0	22	126	10	550
E Columbia St & Braid St	7:00:00 AM	7	116	117	10	45	12	39	97	3	17	133	16	612
E Columbia St & Braid St	7:15:00 AM	19	133	139	5	55	27	34	91	5	12	114	8	642
E Columbia St & Braid St	7:30:00 AM	14	115	140	5	75	27	33	103	0	23	127	7	669
E Columbia St & Braid St	7:45:00 AM	16	138	160	5	53	29	63	90	1	18	99	5	677
E Columbia St & Braid St	8:00:00 AM	28	133	162	10	68	16	51	85	5	18	118	8	702
E Columbia St & Braid St	8:15:00 AM	16	130	150	10	55	15	57	101	3	31	100	5	673
E Columbia St & Brunette Ave	6:30:00 AM	0	73	0	1	90	296	0	0	0	377	0	2	839
E Columbia St & Brunette Ave	6:45:00 AM	0	85	0	0	98	258	0	0	1	311	0	4	757
E Columbia St & Brunette Ave	7:00:00 AM	0	111	0	0	73	231	0	0	1	365	0	3	784
E Columbia St & Brunette Ave	7:15:00 AM	0	108	0	0	80	274	0	0	0	316	0	2	780
E Columbia St & Brunette Ave	7:30:00 AM	0	113	0	0	74	323	0	0	0	351	0	5	866
E Columbia St & Brunette Ave	7:45:00 AM	0	110	0	0	75	275	0	0	0	313	0	6	779
E Columbia St & Brunette Ave	8:00:00 AM	0	76	0	0	89	254	0	0	0	374	0	5	798
E Columbia St & Brunette Ave	8:15:00 AM	0	144	0	0	85	220	0	0	0	265	0	2	716
E Columbia St & Front St	6:30:00 AM	53	345	0	0	254	0	0	0	0	0	0	93	745
E Columbia St & Front St	6:45:00 AM	55	326	0	0	240	0	0	0	0	0	0	91	712
E Columbia St & Front St	7:00:00 AM	57	347	0	0	238	0	0	0	0	0	0	70	712
E Columbia St & Front St	7:15:00 AM	58	345	0	0	204	0	0	0	0	0	0	95	702

Adjusted by Seasonality and Annual Growth Rate														
Location	Time	SBL	SBT	SBR	NBL	NBT	NBR	EBL	EBT	EBR	WBL	WBT	WBR	Total
E Columbia St & Front St	7:30:00 AM	68	345	0	0	276	0	0	0	0	0	0	71	760
E Columbia St & Front St	7:45:00 AM	63	364	0	0	260	0	0	0	0	0	0	91	778
E Columbia St & Front St	8:00:00 AM	59	344	0	0	261	0	0	0	0	0	0	99	763
E Columbia St & Front St	8:15:00 AM	75	372	0	0	237	0	0	0	0	0	0	91	775
E. Columbia St & Alberta St	7:00:00 AM	9	104	2	1	67	10	3	3	0	2	1	1	203
E. Columbia St & Alberta St	7:15:00 AM	4	95	1	0	66	4	4	3	0	2	1	1	181
E. Columbia St & Alberta St	7:30:00 AM	16	132	0	3	88	13	5	10	0	1	2	1	271
E. Columbia St & Alberta St	7:45:00 AM	21	109	3	1	79	16	2	8	0	4	2	4	249
E. Columbia St & Alberta St	8:00:00 AM	21	132	5	0	76	14	8	5	0	5	0	2	268
E. Columbia St & Alberta St	8:15:00 AM	20	140	4	3	76	15	2	7	2	8	2	4	283
E. Columbia St & Alberta St	8:30:00 AM	16	129	1	3	75	16	8	5	3	5	2	2	265
E. Columbia St & Alberta St	8:45:00 AM	34	109	4	0	91	19	11	5	2	2	0	8	285
East Columbia St & Alberta St	7:00:00 AM	6	92	3	1	73	6	0	0	0	0	1	5	187
East Columbia St & Alberta St	7:15:00 AM	15	107	1	0	75	11	0	1	1	4	0	3	218
East Columbia St & Alberta St	7:30:00 AM	19	106	2	0	82	14	0	0	2	6	1	1	233
East Columbia St & Alberta St	7:45:00 AM	24	103	2	0	89	19	0	1	4	5	0	3	250
East Columbia St & Alberta St	8:00:00 AM	19	102	7	0	95	17	3	0	1	2	0	1	247
East Columbia St & Alberta St	8:15:00 AM	16	110	2	0	79	19	0	1	2	7	0	2	238
East Columbia St & Alberta St	8:30:00 AM	23	106	5	0	75	9	1	0	1	8	0	3	231
East Columbia St & Alberta St	8:45:00 AM	26	84	0	0	77	20	0	4	1	11	0	8	231
McBride Blvd & E. Columbia St	7:00:00 AM	0	329	81	0	87	0	142	0	7	0	0	0	646
McBride Blvd & E. Columbia St	7:15:00 AM	0	299	96	0	117	0	181	0	14	0	0	0	707
McBride Blvd & E. Columbia St	7:30:00 AM	0	305	93	0	106	0	183	0	10	0	0	0	697
McBride Blvd & E. Columbia St	7:45:00 AM	0	315	102	0	79	0	169	0	14	0	0	0	679
McBride Blvd & E. Columbia St	8:00:00 AM	0	312	106	0	115	0	164	0	14	0	0	0	711
McBride Blvd & E. Columbia St	8:15:00 AM	0	328	118	0	95	0	158	0	17	0	0	0	716
McBride Blvd & E. Columbia St	8:30:00 AM	0	328	69	0	81	0	151	0	12	0	0	0	641
McBride Blvd & E. Columbia St	8:45:00 AM	0	347	89	0	79	0	196	0	15	0	0	0	726
McBride Blvd & Memorial Dr	7:00:00 AM	15	0	12	0	0	0	5	208	0	0	393	8	641
McBride Blvd & Memorial Dr	7:15:00 AM	5	0	10	0	0	0	11	332	0	0	412	3	773
McBride Blvd & Memorial Dr	7:30:00 AM	16	0	11	0	0	0	13	346	0	0	451	7	844
McBride Blvd & Memorial Dr	7:45:00 AM	13	0	12	0	0	0	15	384	0	0	398	10	832
McBride Blvd & Memorial Dr	8:00:00 AM	12	0	16	0	0	0	20	267	0	0	422	14	751
McBride Blvd & Memorial Dr	8:15:00 AM	15	0	16	0	0	0	15	231	0	0	387	6	670
McBride Blvd & Memorial Dr	8:30:00 AM	11	0	14	0	0	0	20	283	0	0	409	12	749
McBride Blvd & Memorial Dr	8:45:00 AM	5	0	7	0	0	0	18	243	0	0	406	11	690
Richmond St & Alberta St	7:00:00 AM	0	36	0	1	32	4	3	0	1	4	0	0	81
Richmond St & Alberta St	7:15:00 AM	0	63	1	1	40	3	2	2	1	3	0	1	117
Richmond St & Alberta St	7:30:00 AM	2	76	3	2	35	9	7	1	1	4	1	1	142
Richmond St & Alberta St	7:45:00 AM	1	81	3	0	38	7	0	0	0	3	1	1	135
Richmond St & Alberta St	8:00:00 AM	2	67	3	0	44	5	0	0	0	0	1	1	123
Richmond St & Alberta St	8:15:00 AM	2	57	8	0	52	5	1	0	0	2	0	3	130
Richmond St & Alberta St	8:30:00 AM	2	54	5	1	46	4	0	1	1	3	0	4	121
Richmond St & Alberta St	8:45:00 AM	4	92	10	0	55	7	3	1	2	1	1	4	180
Richmond St. & Alberta St.	7:00:00 AM	1	41	1	0	34	0	1	0	1	3	0	0	82
Richmond St. & Alberta St.	7:15:00 AM	0	49	0	0	39	2	3	0	0	1	0	1	95
Richmond St. & Alberta St.	7:30:00 AM	0	70	0	2	51	1	3	0	1	2	0	2	132
Richmond St. & Alberta St.	7:45:00 AM	1	81	1	0	55	4	5	1	1	2	0	1	152
Richmond St. & Alberta St.	8:00:00 AM	2	61	5	2	38	3	1	0	1	3	2	7	125
Richmond St. & Alberta St.	8:15:00 AM	1	57	9	0	38	3	1	2	0	0	1	3	115
Richmond St. & Alberta St.	8:30:00 AM	0	56	2	1	49	2	1	0	1	1	2	3	118
Richmond St. & Alberta St.	8:45:00 AM	0	85	6	1	46	3	4	1	2	1	0	4	153
McBride St & Royal Ave	7:00:00 AM	11	31	5	9	7	35	0	106	0	94	7	7	312
McBride St & Royal Ave	7:15:00 AM	7	40	6	11	12	48	0	100	0	112	5	10	351
McBride St & Royal Ave	7:30:00 AM	19	33	14	10	9	42	0	110	0	89	7	9	342
McBride St & Royal Ave	7:45:00 AM	19	34	6	9	6	33	0	92	0	109	16	14	338
McBride St & Royal Ave	8:00:00 AM	14	34	7	14	7	46	0	96	0	112	13	7	350
McBride St & Royal Ave	8:15:00 AM	14	45	10	19	15	40	0	83	0	103	8	11	348
McBride St & Royal Ave	8:30:00 AM	17	26	6	12	8	53	0	107	1	92	9	5	336
McBride St & Royal Ave	8:45:00 AM	10	31	8	7	11	60	1	128	0	110	11	8	385

Adjusted by Seasonality and Annual Growth Rate														
Location	Time	SBL	SBT	SBR	NBL	NBT	NBR	EBL	EBT	EBR	WBL	WBT	WBR	Total
Canfor Ave & Braid St	7:00:00 AM	0	0	0	12	0	11	0	27	11	12	55	0	128
Canfor Ave & Braid St	7:15:00 AM	0	0	1	14	0	5	0	53	17	14	77	0	181
Canfor Ave & Braid St	7:30:00 AM	1	0	0	15	0	4	0	44	12	26	75	1	178
Canfor Ave & Braid St	7:45:00 AM	0	0	1	6	0	17	1	52	16	29	68	0	190
Canfor Ave & Braid St	8:00:00 AM	1	0	0	13	1	4	0	42	10	16	69	1	157
Canfor Ave & Braid St	8:15:00 AM	0	0	1	11	0	10	1	35	11	14	47	0	130
Canfor Ave & Braid St	8:30:00 AM	0	0	2	14	0	6	0	42	7	16	52	0	139
Canfor Ave & Braid St	8:45:00 AM	0	0	1	14	1	13	0	34	19	19	49	0	150
E Columbia St & Cumberland Ave	7:00:00 AM	0	469	16	0	332	0	0	0	1	0	0	0	818
E Columbia St & Cumberland Ave	7:15:00 AM	0	457	8	0	338	2	0	0	3	0	0	2	810
E Columbia St & Cumberland Ave	7:30:00 AM	0	450	19	0	332	0	0	0	1	0	0	0	802
E Columbia St & Cumberland Ave	7:45:00 AM	0	441	24	0	362	2	0	0	0	0	0	0	829
E Columbia St & Cumberland Ave	8:00:00 AM	0	513	21	0	259	2	0	0	0	0	0	0	795
E Columbia St & Cumberland Ave	8:15:00 AM	0	444	15	0	378	1	0	0	2	0	0	1	841
E Columbia St & Cumberland Ave	8:30:00 AM	0	471	15	1	340	0	0	0	1	0	0	0	828
E Columbia St & Cumberland Ave	8:45:00 AM	0	404	18	0	340	0	0	0	0	0	0	0	762
E Columbia St & Holmes St	7:00:00 AM	0	196	146	7	100	0	24	0	11	0	0	0	484
E Columbia St & Holmes St	7:15:00 AM	0	255	181	6	95	0	30	0	10	0	0	0	577
E Columbia St & Holmes St	7:30:00 AM	0	209	167	6	94	0	17	0	4	0	0	0	497
E Columbia St & Holmes St	7:45:00 AM	0	254	182	8	107	0	36	0	4	0	0	0	591
E Columbia St & Holmes St	8:00:00 AM	0	282	201	5	99	0	33	0	8	0	0	0	628
E Columbia St & Holmes St	8:15:00 AM	0	224	236	3	123	0	69	0	6	0	0	0	661
E Columbia St & Holmes St	8:30:00 AM	0	228	193	12	158	0	69	0	11	0	0	0	671
E Columbia St & Holmes St	8:45:00 AM	0	231	126	6	140	0	89	0	8	0	0	0	600
E Columbia St & Richmond St	7:00:00 AM	0	437	6	6	265	0	13	0	12	0	0	0	739
E Columbia St & Richmond St	7:15:00 AM	0	443	16	6	260	0	14	0	14	0	0	0	753
E Columbia St & Richmond St	7:30:00 AM	0	443	10	6	328	0	14	0	11	0	0	0	812
E Columbia St & Richmond St	7:45:00 AM	0	473	6	10	346	0	14	0	15	0	0	0	864
E Columbia St & Richmond St	8:00:00 AM	0	450	4	10	286	0	18	0	16	0	0	0	784
E Columbia St & Richmond St	8:15:00 AM	0	501	11	6	329	0	15	0	15	0	0	0	877
E Columbia St & Richmond St	8:30:00 AM	0	452	14	7	303	0	20	0	12	0	0	0	808
E Columbia St & Richmond St	8:45:00 AM	0	424	11	12	367	0	14	0	16	0	0	0	844
McBride Blvd & 6th Ave	7:00:00 AM	60	61	11	4	29	15	0	252	16	1	410	42	901
McBride Blvd & 6th Ave	7:15:00 AM	36	77	10	3	48	13	0	301	11	0	403	51	953
McBride Blvd & 6th Ave	7:30:00 AM	61	97	7	7	44	26	0	310	8	0	395	31	986
McBride Blvd & 6th Ave	7:45:00 AM	54	100	13	12	53	20	0	313	17	0	412	51	1,045
McBride Blvd & 6th Ave	8:00:00 AM	51	106	16	5	67	10	0	280	23	0	349	40	947
McBride Blvd & 6th Ave	8:15:00 AM	36	114	7	7	50	21	0	253	23	2	406	38	957
McBride Blvd & 6th Ave	8:30:00 AM	34	125	12	10	87	16	0	266	29	0	362	52	993
McBride Blvd & 6th Ave	8:45:00 AM	20	105	11	6	69	15	0	235	29	2	387	40	919
McBride Blvd & 8th Ave	7:00:00 AM	55	84	13	16	49	18	40	184	7	49	177	12	704
McBride Blvd & 8th Ave	7:15:00 AM	85	179	25	20	54	34	29	186	1	58	271	13	955
McBride Blvd & 8th Ave	7:30:00 AM	58	130	25	17	75	42	38	242	5	69	321	11	1,033
McBride Blvd & 8th Ave	7:45:00 AM	67	133	21	21	76	31	41	207	12	67	256	34	966
McBride Blvd & 8th Ave	8:00:00 AM	68	147	32	11	90	36	19	163	12	57	297	17	949
McBride Blvd & 8th Ave	8:15:00 AM	57	180	24	37	99	40	45	200	12	90	277	14	1,075
McBride Blvd & 8th Ave	8:30:00 AM	67	156	37	30	88	17	47	200	10	63	249	19	983
McBride Blvd & 8th Ave	8:45:00 AM	57	186	33	34	85	26	38	158	8	64	243	25	957
McBride Blvd & 10th Ave	7:00:00 AM	96	151	0	0	47	148	0	0	0	328	0	79	849
McBride Blvd & 10th Ave	7:15:00 AM	97	154	0	0	43	172	0	0	0	334	0	77	877
McBride Blvd & 10th Ave	7:30:00 AM	84	140	0	0	45	177	0	0	0	291	0	71	808
McBride Blvd & 10th Ave	7:45:00 AM	99	155	0	0	64	169	0	0	0	303	0	87	877
McBride Blvd & 10th Ave	8:00:00 AM	100	140	0	0	69	184	0	0	0	318	0	94	905
McBride Blvd & 10th Ave	8:15:00 AM	85	162	0	0	81	163	0	0	0	274	0	97	862
McBride Blvd & 10th Ave	8:30:00 AM	87	136	0	0	110	193	0	0	0	308	0	100	934
McBride Blvd & 10th Ave	8:45:00 AM	80	134	0	0	76	146	0	0	0	298	0	93	827
Richmond St & 8th Ave	7:00:00 AM	0	0	2	2	4	12	2	88	2	23	220	1	356
Richmond St & 8th Ave	7:15:00 AM	0	5	2	6	5	18	1	99	2	10	223	1	372
Richmond St & 8th Ave	7:30:00 AM	2	3	3	1	2	18	4	121	0	17	263	0	434
Richmond St & 8th Ave	7:45:00 AM	1	6	5	3	10	22	3	107	3	21	191	1	373

Adjusted by Seasonality and Annual Growth Rate														
Location	Time	SBL	SBT	SBR	NBL	NBT	NBR	EBL	EBT	EBR	WBL	WBT	WBR	Total
Richmond St & 8th Ave	8:00:00 AM	1	10	8	4	5	18	8	165	1	13	218	1	452
Richmond St & 8th Ave	8:15:00 AM	2	8	11	4	3	14	17	100	2	13	231	1	406
Richmond St & 8th Ave	8:30:00 AM	1	11	8	4	4	15	14	137	2	17	240	1	454
Richmond St & 8th Ave	8:45:00 AM	3	6	8	3	8	26	8	133	2	16	217	1	431
Richmond St & 10th Ave	7:00:00 AM	0	0	0	0	0	2	0	23	0	1	127	0	153
Richmond St & 10th Ave	7:15:00 AM	0	0	0	0	0	4	0	37	0	0	136	0	177
Richmond St & 10th Ave	7:30:00 AM	0	0	0	0	0	2	0	23	0	1	177	0	203
Richmond St & 10th Ave	7:45:00 AM	0	0	0	2	0	3	0	35	0	2	177	0	219
Richmond St & 10th Ave	8:00:00 AM	0	0	0	0	0	1	0	33	0	2	146	0	182
Richmond St & 10th Ave	8:15:00 AM	0	0	0	0	0	5	0	59	0	3	171	0	238
Richmond St & 10th Ave	8:30:00 AM	0	0	0	2	0	15	0	82	2	4	124	0	229
Richmond St & 10th Ave	8:45:00 AM	0	0	0	1	0	4	0	72	2	6	104	0	189
Richmond St & Cumberland St	7:00:00 AM	1	0	57	12	2	0	30	2	4	1	13	2	124
Richmond St & Cumberland St	7:15:00 AM	0	3	75	17	5	0	50	3	8	0	15	0	176
Richmond St & Cumberland St	7:30:00 AM	0	4	56	19	8	0	30	0	7	2	19	2	147
Richmond St & Cumberland St	7:45:00 AM	0	5	72	25	10	0	38	6	14	1	29	0	200
Richmond St & Cumberland St	8:00:00 AM	1	5	78	20	3	2	34	6	17	1	25	1	193
Richmond St & Cumberland St	8:15:00 AM	0	7	80	24	4	0	55	3	15	1	21	1	211
Richmond St & Cumberland St	8:30:00 AM	3	6	51	21	12	0	64	10	18	2	16	4	207
Richmond St & Cumberland St	8:45:00 AM	3	13	56	21	7	0	51	4	17	0	14	3	189
Rousseau St & Braid St	7:30:00 AM	19	0	12	1	2	11	17	166	4	3	178	21	434
Rousseau St & Braid St	7:45:00 AM	31	1	16	1	2	6	15	159	1	2	171	36	441
Rousseau St & Braid St	8:00:00 AM	16	1	8	0	1	5	2	152	3	5	153	14	360
Rousseau St & Braid St	8:15:00 AM	19	0	6	2	0	4	14	141	1	6	136	12	341
Brunette Ave & Sherbrooke St	7:30:00 AM	0	378	27	0	0	0	0	0	3	0	0	0	408
Brunette Ave & Sherbrooke St	7:45:00 AM	0	412	18	0	0	0	0	0	8	0	0	0	438
Brunette Ave & Sherbrooke St	8:00:00 AM	0	410	18	0	0	0	0	0	2	0	0	0	430
Brunette Ave & Sherbrooke St	8:15:00 AM	0	393	14	0	0	0	0	0	3	0	0	0	410
Brunette Ave & Keary St	7:30:00 AM	0	396	42	0	229	0	0	0	2	0	0	0	669
Brunette Ave & Keary St	7:45:00 AM	0	354	38	0	257	0	0	0	6	0	0	0	655
Brunette Ave & Keary St	8:00:00 AM	0	364	24	0	286	0	0	0	5	0	0	0	679
Brunette Ave & Keary St	8:15:00 AM	0	342	24	0	276	0	0	0	4	0	0	0	646
E Columbia St & Sherbrooke St	7:30:00 AM	8	139	4	4	92	5	12	5	8	6	5	4	292
E Columbia St & Sherbrooke St	7:45:00 AM	8	140	8	8	110	1	3	14	15	6	15	6	334
E Columbia St & Sherbrooke St	8:00:00 AM	5	156	10	4	108	5	8	9	15	10	6	4	340
E Columbia St & Sherbrooke St	8:15:00 AM	5	169	5	2	105	1	11	9	9	6	15	8	345
E Columbia St & Keary St	7:30:00 AM	13	88	1	0	57	13	2	6	4	9	13	17	223
E Columbia St & Keary St	7:45:00 AM	12	105	8	0	91	18	5	12	2	3	11	9	276
E Columbia St & Keary St	8:00:00 AM	8	124	9	2	80	18	5	9	2	5	5	17	284
E Columbia St & Keary St	8:15:00 AM	9	133	12	1	83	8	2	6	1	3	6	9	273
8th Ave & Cumberland St	7:00:00 AM	7	243	13	0	125	14	13	28	14	12	68	20	557
8th Ave & Cumberland St	7:15:00 AM	11	210	11	0	127	7	15	39	41	12	89	23	585
8th Ave & Cumberland St	7:30:00 AM	16	323	7	0	158	20	13	47	45	12	108	20	769
8th Ave & Cumberland St	7:45:00 AM	15	268	6	0	155	19	21	42	21	7	101	30	685
8th Ave & Cumberland St	8:00:00 AM	2	265	9	0	112	19	12	34	18	12	80	25	588
8th Ave & Cumberland St	8:15:00 AM	14	294	11	0	151	20	20	33	21	13	66	36	679
8th Ave & Cumberland St	8:30:00 AM	8	234	7	0	151	25	21	49	27	21	55	34	632
8th Ave & Cumberland St	8:45:00 AM	11	233	25	0	151	30	15	46	35	9	62	27	644

Appendix C – Model Validation Report

EMME Model Validation

1.0 Model Description

The transportation model used for the Sapperton Transportation Plan is built from the Gateway Sub Area Model (GSAM), which was initially developed in 2005 for the Gateway Program. The GSAM was an update of a strategic planning model for the Greater Vancouver area, and incorporated the latest travel and trip information available at that time. It also introduced greater transportation network refinement in the Gateway study area, as well as the capability of modelling drivers' reactions to tolls. The GSAM was developed for both the AM peak and Midday time periods and provided vehicle forecasts for four classes as follows:

- Single occupancy vehicles (SOV) - passenger vehicles with only one occupant;
- High occupancy vehicles (HOV) - passenger vehicles with two or more occupants;
- Light trucks - single unit trucks (2 axles); and
- Heavy truck - multiple unit trucks (3 or more axles).

The passenger car models (SOV & HOV) are based on the standard four stage modelling procedure:

(i) Trip generation;
(ii) Trip distribution;
(iii) Mode choice; and
(iv) Trip assignment.

The light and heavy truck models were developed for these time periods based on a regional truck survey of local trucks, as well as surveys at external regional network entry points and special truck generators (e.g., ports and inter-modal terminals).

For the Sapperton Transportation Plan and the prior Regional Connection Study done for the City, the AM peak period GSAM was further refined, in particular in New Westminster, and updated to the current land use and latest traffic conditions to produce a validated 2016 base year. In addition, future year (2022 and 2031) networks were developed. To better model drivers' response to tolls, a logit toll diversion procedure has been developed, calibrated and incorporated into the trip assignment stage.

The toll logit procedure was incorporated to better reflect the elasticity of how drivers react to the toll. A single point toll would normally be applied within the GSAM, however this approach resulted in elasticities that were too high, in other words, too many vehicles were avoiding the point tolls in the model. The logit procedure was developed and enhanced using information from actual usage data from the Port Mann Bridge and reflects how users react to the toll. The logit model is applied to each vehicle class demand matrix and estimates the number of trips that are willing to use the toll route based on the derived benefit ("utility") for the toll route users. The utility is determined based on the relationship between the time and cost difference between the toll route and the free alternative. The primary factors that influence the decision are the toll level, travel time-savings, perception of improved reliability and safety, the users' value of travel time savings (VTTS), and vehicle operating cost savings.

2.0 Model Validation

Prior to the development of the future year transportation networks, the model underwent an iterative process of calibration and validation to ensure the base model was behaving in a matter that was consistent with the current observed traffic patterns and behaviours. It is important to ensure that the model traffic volumes and

travel times in the base year 2016 are in line with observed conditions, as this provides confidence in the model's ability of producing robust forecasts for future horizon year scenarios.

The following specific activities were completed:

- Update of land use to the latest Metro Vancouver Regional Growth Strategy (RGS) as well as the New Westminster land use assumptions provided to McElhanney by the City of New Westminster.
- Update of road and transit networks to latest conditions and development of future networks.
- Refinements to the traffic area zones (TAZ), specifically in the City of New Westminster, and the road network coding, in and around New Westminster and project locations.
- Comparison of traffic volumes at key regional locations and crossings against the latest traffic counts, where available, and against the 2011 TransLink Screenline Survey, where more recent traffic counts were not available.
- Comparison of travel times along key travel routes in and around New Westminster against observed travel times.
- Development of reasonably constrained demand adjust matrices in the model to assist the model to better represent base year traffic conditions and vehicle trip distribution. Further details of the specifics in this regard are provided in the next section.

2.1 Demand Adjust

Transportation demand models are generally difficult to calibrate and validate. This is due to the sheer number of matrices and variables used in the model, making it difficult to match actual observed traffic volumes, which in themselves can vary significantly. As such, a demand adjustment procedure is typically applied to get the modelled traffic values to converge as close as possible to observed traffic counts. This procedure, however, must be applied with caution as too much adjustment can result in the modelled traffic demand matrices becoming so distorted that they lose their intended purpose of representing actual trip distribution patterns. In order to keep the model true to its purpose and calibration parameters, the level of demand adjustment must be constrained so as to minimize significant distortion of the modelled demand matrices.

For this study, the distribution and the magnitude of demand adjust for each origin-destination (OD) pair was plotted in a histogram for both the HOV and SOV vehicles. These plots are presented in *Figures A-1 and A-2*. The x-axis shows the level of demand adjustment (trips) and the y-axis shows the number of OD pairs that fall within each demand adjustment level. As seen in the figures, the majority of demand adjustment is between -0.1 and 0.1 trips. This is considered a very modest level of demand adjustment and shows that the four step model used for this study provides reliable results when representing actual travel patterns.

Figure A-1: HOV Demand Adjust Incremental Matrix

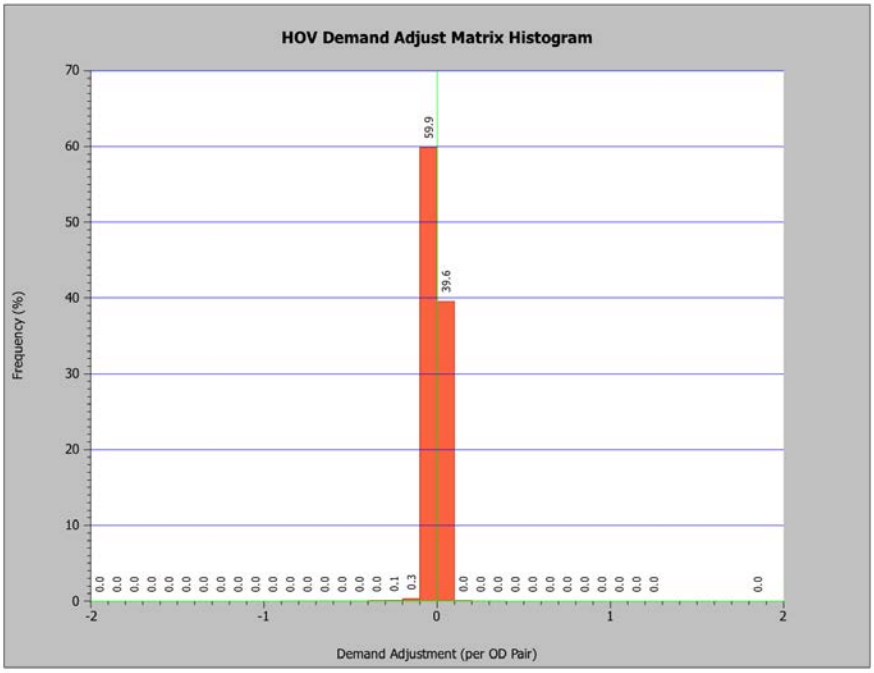
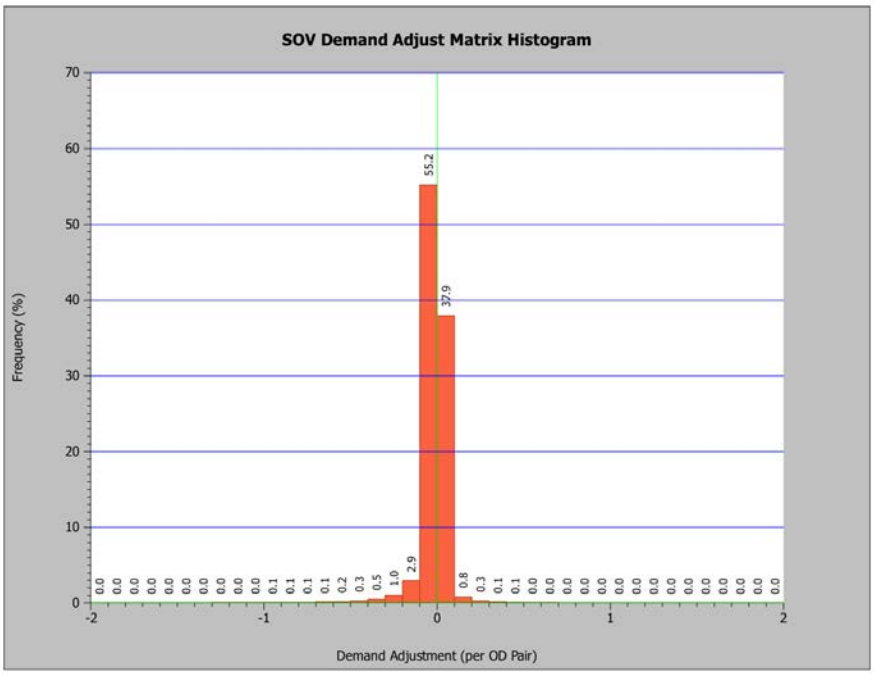


Figure A-2: SOV Demand Adjust Incremental Matrix



The sum of all demand adjustments applied to the model was calculated for the entire region as a percentage of the total demand. This provides a useful metric for the total level of demand adjustment and is a further indicator of the model's reliability. For SOV the demand adjust total reduced the total regional demand by 7%, while the reduction for HOV was 3%, calculated as the sum of all adjustments by OD pairs divided by the sum total of the original demand. In addition, the impact of demand adjust was calculated across all the South

Fraser Crossings, namely George Massey Tunnel, Alex Fraser Bridge, Pattullo Bridge, Port Mann Bridge and Golden Ears Bridge. Demand adjust reduced the total traffic across these facilities by 12%.

2.2 Traffic Volume Validation

Traffic volumes from the model were plotted against the latest available observed traffic counts at all 2011 TransLink Screenline locations as shown in *Figures A-3*. A second plot was also produced comparing the river crossings and traffic count locations in New Westminster and North Surrey as shown in *Figures A-4*. Both these scatterplots illustrate a strong fit of traffic volumes (R^2 greater than 0.9) at the regional and study area level. Aggregated across all screenline locations, the modelled volume is very close to the observed count totals: 250,700 vph modelled vs. 249,800 vph observed. This equates to a difference of about 0.4%.

Figure A-3: Model vs. Observed Scatterplot (All Points)

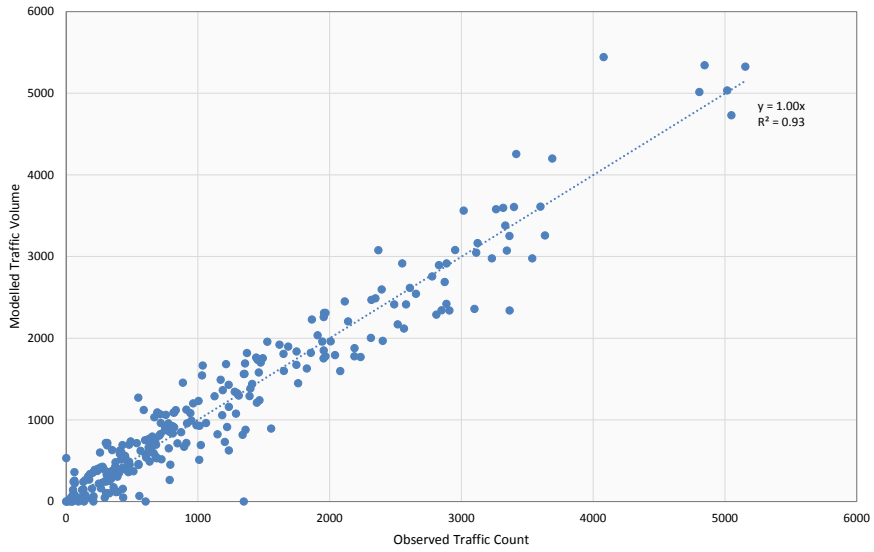


Figure A-4: Model vs. Observed Scatterplot (Select Points)

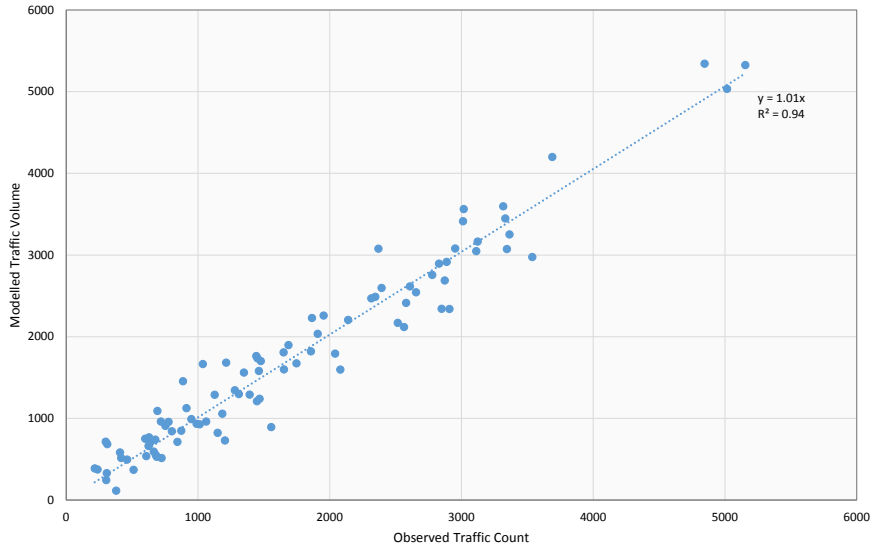


Table A-1 shows the observed versus modelled traffic volumes for locations within the study area. Note that traffic counts were summarized from permanent count locations except those highlighted in blue, which are taken from short counts (typically only one day or one week counts). The reliability of a short counts does not consider day-to-day and seasonal fluctuation and, as such, some caution should be exercised when drawing comparisons to the modelled values. To confirm the accuracy of these volumes, a test called the "GEH statistic" is applied. The GEH statistic reflects the level of error associated with the magnitude of the value being analyzed. For example, a 10% error on a count of 100 cars (i.e. 10 vehicles) is of less significance than a 10% error on a count of 3,000 cars (i.e. 300 vehicles). A GEH statistic less than five is very good while a value below ten is acceptable, especially for short counts. For this model, most locations have a GEH of less than ten, which is a good fit.

The GEH statistic for specific traffic volumes is calculated as follows:

$$GEH = \sqrt{\frac{2(M-C)^2}{M+C}}$$

where: M is the modelled volume and C is the actual volume.

2.3 Travel Time Validation

The AM peak hour (7:30 AM to 8:30 AM) travel time in the model across corridors in and around New Westminster were compared against actual peak hour travel times obtained from Google Maps. Seven key corridors were selected and compared in both directions for a total of 14 routes listed below and illustrated in *Figures A-5*.

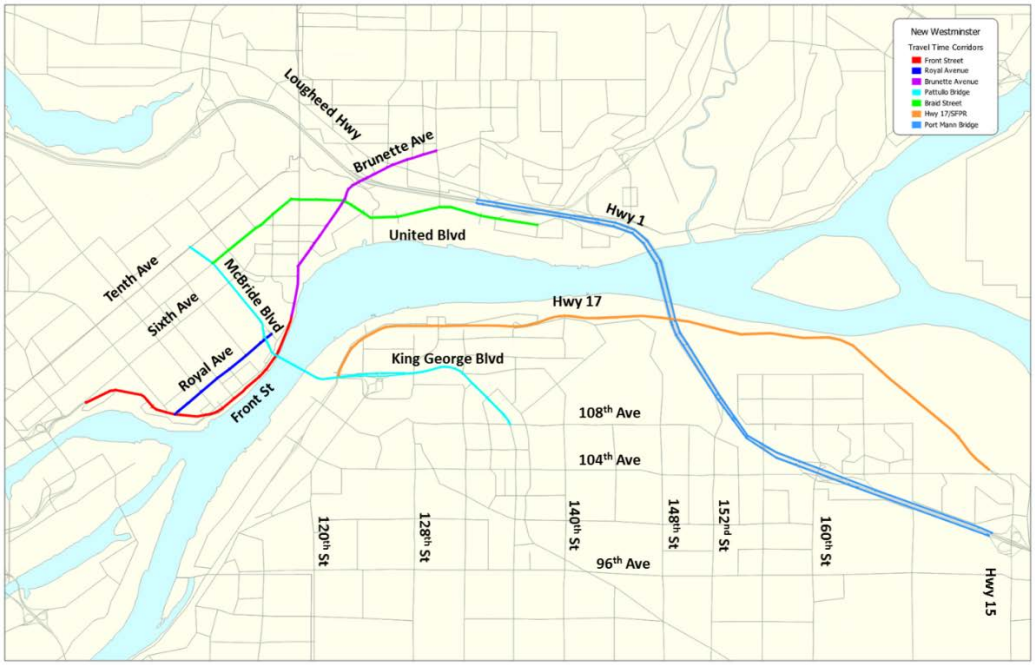
1. Front Street (EB): River Dr to E. Columbia St
2. Front Street (WB): E. Columbia St to River Dr
3. Royal Avenue (EB): Columbia St to McBride Blvd
4. Royal Avenue (WB): McBride Blvd to Columbia St
5. Brunette Avenue (EB): E. Columbia St (@ Front St) to Brunette Ave (@ King Edward St)
6. Brunette Avenue (WB): Brunette Ave (@ King Edward St) to E. Columbia St (@ Front St)
7. Pattullo Bridge (SB): McBride Blvd (@ 10th Ave) to King George Blvd (@ 108th Avenue)
8. Pattullo Bridge (NB): King George Blvd (@ 108th Ave) to McBride Blvd (@ 10th Avenue)
9. Braid Street (EB): E. 8 Ave (@ McBride Blvd) to Braid St to United Blvd (@ Schooner St)
10. Braid Street (WB): United Blvd (@ Schooner St) to Braid St to E. 8th Ave (@ McBride Blvd)
11. Hwy 17/SFPR (EB): North of 104th Ave Intersection to Pattullo Bridge Underpass
12. Hwy 17/SFRP (WB): Pattullo Bridge Underpass to North of 104th Ave Intersection
13. Port Mann Bridge (EB/SB): West of Lougheed Hwy (Hwy 7) Exit to West of Hwy 15/Hwy 17 Exit
14. Port Mann Bridge (WB/NB): West of Hwy 15/Hwy 17 On Ramp to West of Hwy 7 On Ramp

Table A-1: AM Peak Hour Observed vs Modelled Traffic Volumes

Location	DIR	OBS	MODEL	DIFF	% DIFF	GEH
Massey Tunnel	NB	4,806	5,015	209	4.3%	3.0
Massey Tunnel	SB	1,452	1,735	283	19.5%	7.1
Alex Fraser	NB	5,016	5,035	19	0.4%	0.3
Alex Fraser	SB	2,778	2,756	(22)	-0.8%	0.4
Pattullo Bridge	NB	3,017	3,562	545	18.1%	9.5
Pattullo Bridge	SB	2,369	3,077	708	29.9%	13.6
Port Mann	WB	5,049	4,729	(320)	-6.3%	4.6
Port Mann	EB	3,600	3,611	11	0.3%	0.2
Golden Ears Bridge	NB	989	933	(56)	-5.7%	1.8
Golden Ears Bridge	SB	2,041	1,792	(249)	-12.2%	5.7
Hwy 91 (W of Nelson Rd)	WB	3,538	2,976	(562)	-15.9%	9.8
Hwy 91 (W of Nelson Rd)	EB	3,112	3,048	(64)	-2.1%	1.2
Hwy 17 (N of Hwy 99)	NB	462	495	33	7.1%	1.5
Hwy 17 (N of Hwy 99)	SB	844	712	(132)	-15.6%	4.7
Hwy 17 (S of Hwy 91 Con)	NB	599	750	151	25.2%	5.8
Hwy 17 (S of Hwy 91 Con)	SB	1,467	1,240	(227)	-15.5%	6.2
Hwy 17 (N of Hwy 91 Con)	NB	1,556	894	(662)	-42.6%	18.9
Hwy 17 (N of Hwy 91 Con)	SB	912	1,125	213	23.4%	6.7
Hwy 17 (E of 136 St)	NB	1,013	927	(86)	-8.5%	2.8
Hwy 17 (E of 136 St)	SB	1,447	1,210	(237)	-16.4%	6.5
Fraser Hwy (E of 188 St)	WB	638	705	67	10.6%	2.6
Fraser Hwy (E of 188 St)	EB	718	961	243	33.9%	8.4
152 St (S of 72 Ave)	NB	873	848	(25)	-2.9%	0.9
152 St (S of 72 Ave)	SB	950	990	40	4.2%	1.3
KGB (S of 72 Ave)	NB	1,280	1,344	64	5.0%	1.8
KGB (S of 72 Ave)	SB	801	843	42	5.2%	1.5
Scott Rd (N of 72 Ave)	NB	776	957	181	23.3%	6.1
Scott Rd (N of 72 Ave)	SB	628	768	140	22.3%	5.3
Front St (E of 6th St)	EB	303	244	(59)	-19.5%	3.6
Front St (E of 6th St)	WB	237	373	136	57.5%	7.8
8th Ave (W of McBride Blvd)	EB	417	514	97	23.2%	4.5
8th Ave (W of McBride Blvd)	WB	686	530	(156)	-22.8%	6.3
6th Ave (W of McBride Blvd)	EB	300	716	416	138.5%	18.4
6th Ave (W of McBride Blvd)	WB	408	583	175	42.8%	7.9
North Rd (S of Hwy 1)	NB	692	1,091	399	57.6%	13.4
North Rd (S of Hwy 1)	SB	1,649	1,808	159	9.6%	3.8
United Blvd (E of Braid St)	EB	216	386	170	78.9%	9.8
United Blvd (E of Braid St)	WB	311	686	375	120.5%	16.8
Brunette Ave (Hwy 1)	EB	886	1,454	568	64.1%	16.6
Brunette Ave (Hwy 1)	WB	1,036	1,666	630	60.8%	17.1
Queensborough Bridge	NB	2,952	3,079	127	4.3%	2.3
Queensborough Bridge	SB	2,829	2,895	66	2.3%	1.2

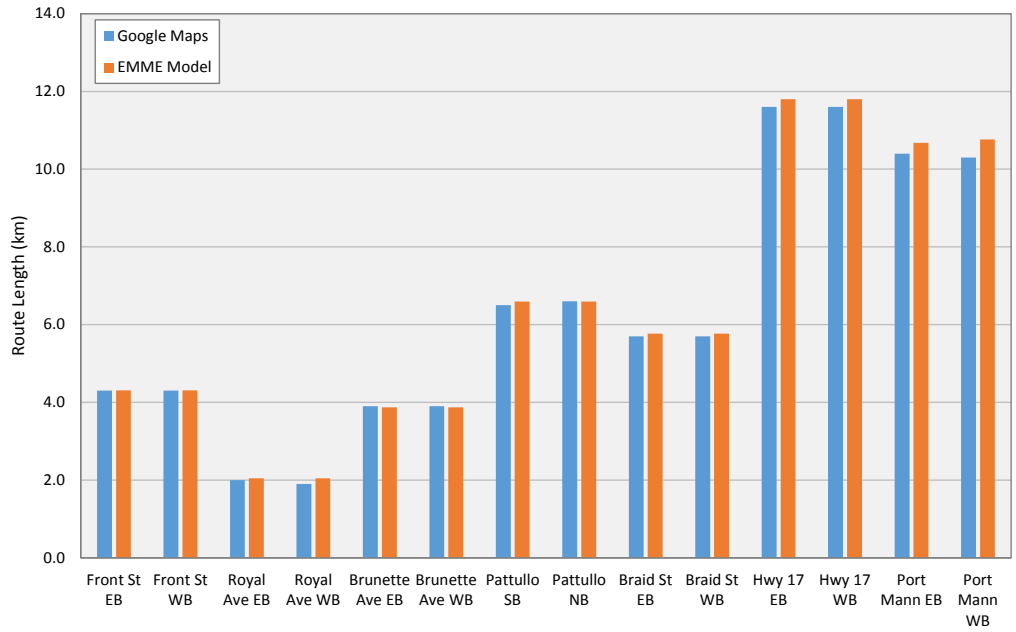
Note: Blue highlighted values are from short counts. All others are from permanent count stations

Figure A-5: Travel Time Corridors



For each route, Google Maps was used to collect 25 sample points over a period of five weekday peak hours. (7:30 AM to 8:30 AM). Outliers were screened out to obtain a representative range of typical travel times. To compare travel speeds for each route, the travel distance was compared to ensure consistency between routes in the EMME model and Google Maps. As seen in *Figures A-6*, the route selection from the model versus Google Maps is consistent.

Figure A-6: Route Length Comparison: Model vs. Google Maps

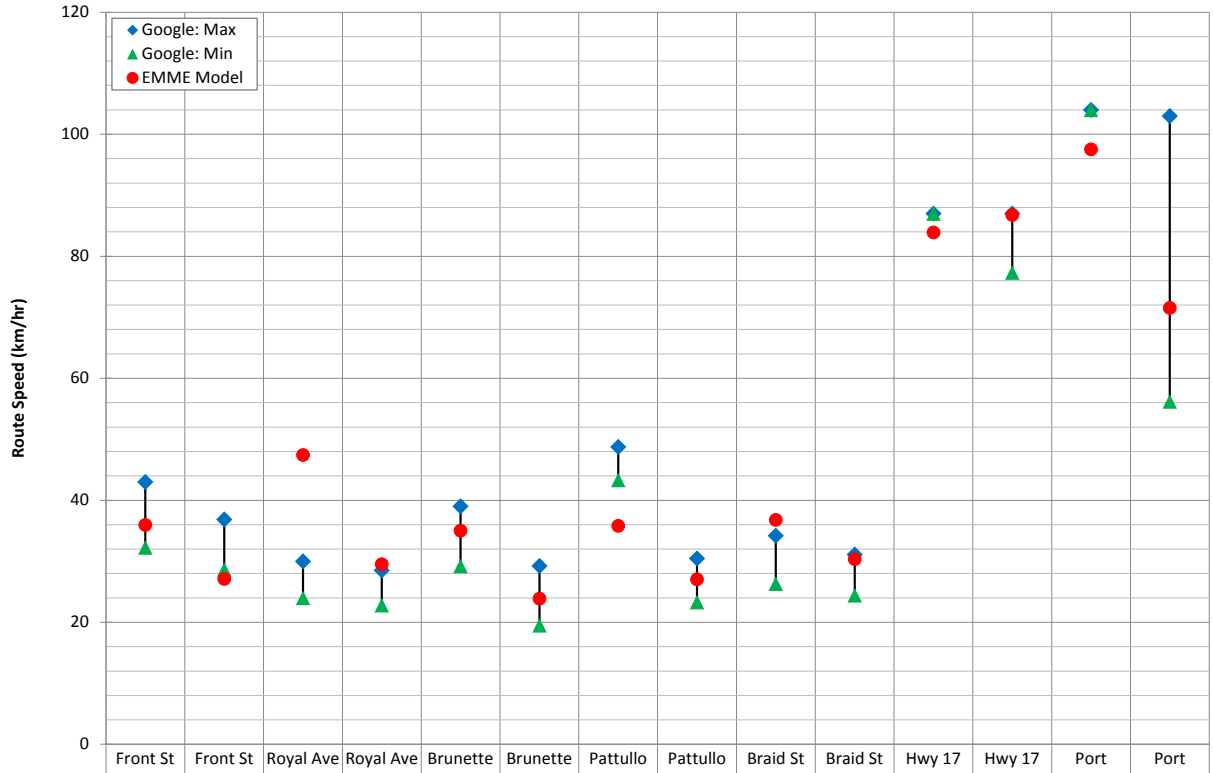


The comparison of the travel speeds in the model versus those from Google Maps is shown in *Figures A-7*. All of the routes have fairly consistent travel speeds except westbound Port Mann Bridge. The observed travel time varied between six and 11 minutes: about 20% of the observations on Google Maps were six minutes, and 20% were ten or 11 minutes. Reasons for these variances include:

- The AM peak hour on westbound Port Mann through lanes typically ends by 7:30 AM which results in faster times over the bridge later in the AM period
- The impact of incidents which are a regular occurrence

In general, the modelled travel times and speeds are in line with observed ranges. The largest variation occurs on Royal Avenue eastbound, i.e. the off peak direction - the model travel speed is about 20 km/hr faster than the Google Maps travel speed. The most likely reasons for this variance is that Royal Avenue eastbound has a steep incline and regional models typically do not capture this type of topographic feature. In a more detailed stage of analysis, further work could be done to improve this off peak direction travel time validation. Across all the peak direction movements, westbound or northbound, the model travel times and speed validate very well.

Figure A-7: Route Speed Comparison: Modelled vs. Google Maps

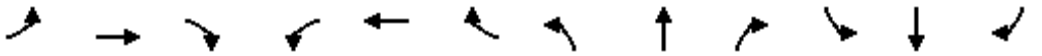


	Front St EB	Front St WB	Royal Ave EB	Royal Ave WB	Brunette Ave EB	Brunette Ave WB	Pattullo SB	Pattullo NB	Braid St EB	Braid St WB	Hwy 17 EB	Hwy 17 WB	Port Mann EB	Port Mann WB
Google: Max	43	37	30	29	39	29	49	30	34	31	87	87	104	103
Google: Min	32	29	24	23	29	20	43	23	26	24	87	77	104	56
EMME Model	36	27	47	30	35	24	36	27	37	30	84	87	98	72

Appendix D – Detailed Traffic Analysis

Existing

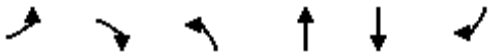
AM Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	470	106	12	169	84	54	6	940	98	56	1359	550
Future Volume (vph)	470	106	12	169	84	54	6	940	98	56	1359	550
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-2%			0%			0%			-5%	
Total Lost time (s)	8.9	8.9		8.8	8.8	8.8		7.5		8.7	9.5	4.0
Lane Util. Factor	0.97	1.00		1.00	1.00	1.00		0.91		1.00	0.95	1.00
Frt	1.00	0.98		1.00	1.00	0.85		0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00		1.00		0.95	1.00	1.00
Satd. Flow (prot)	3414	1824		1601	1685	1432		4194		1702	3405	1523
Flt Permitted	0.95	1.00		0.95	1.00	1.00		0.93		0.95	1.00	1.00
Satd. Flow (perm)	3414	1824		1601	1685	1432		3893		1702	3405	1523
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	480	108	12	172	86	55	6	959	100	57	1387	561
RTOR Reduction (vph)	0	2	0	0	0	0	0	8	0	0	0	0
Lane Group Flow (vph)	480	118	0	172	86	55	0	1057	0	57	1387	561
Heavy Vehicles (%)	2%	2%	2%	11%	11%	11%	20%	20%	20%	7%	7%	7%
Turn Type	Split	NA		Split	NA	Perm	Perm	NA		Prot	NA	Free
Protected Phases	7	7		8	8			2		1	6	
Permitted Phases						8	2					Free
Actuated Green, G (s)	23.6	23.6		19.4	19.4	19.4		54.6		9.3	67.6	140.8
Effective Green, g (s)	23.6	23.6		19.4	19.4	19.4		54.6		9.3	70.6	140.8
Actuated g/C Ratio	0.17	0.17		0.14	0.14	0.14		0.39		0.07	0.50	1.00
Clearance Time (s)	8.9	8.9		8.8	8.8	8.8		7.5		8.7	12.5	
Vehicle Extension (s)	4.0	4.0		4.0	4.0	4.0		4.0		4.0	4.0	
Lane Grp Cap (vph)	572	305		220	232	197		1509		112	1707	1523
v/s Ratio Prot	c0.14	0.06		c0.11	0.05					0.03	c0.41	
v/s Ratio Perm						0.04		0.27				0.37
v/c Ratio	0.84	0.39		0.78	0.37	0.28		0.70		0.51	0.81	0.37
Uniform Delay, d1	56.8	52.1		58.7	55.2	54.4		36.2		63.5	29.5	0.0
Progression Factor	1.00	1.00		1.00	1.00	1.00		1.00		1.00	1.00	1.00
Incremental Delay, d2	10.9	1.1		17.3	1.4	1.1		1.6		4.9	3.2	0.7
Delay (s)	67.6	53.3		75.9	56.5	55.5		37.8		68.4	32.8	0.7
Level of Service	E	D		E	E	E		D		E	C	A
Approach Delay (s)		64.8			67.0			37.8			24.8	
Approach LOS		E			E			D			C	

Intersection Summary			
HCM 2000 Control Delay	37.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	140.8	Sum of lost time (s)	33.9
Intersection Capacity Utilization	83.6%	ICU Level of Service	E
Analysis Period (min)	15		

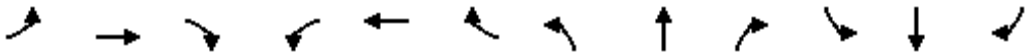
c Critical Lane Group



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	16	0	1051	1450	70
Future Volume (Veh/h)	0	16	0	1051	1450	70
Sign Control	Stop			Free	Free	
Grade	-10%			-2%	2%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	0	17	0	1095	1510	73
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	2094	792	1510			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2094	792	1510			
tC, single (s)	6.8	6.9	4.6			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.5			
p0 queue free %	100	95	100			
cM capacity (veh/h)	47	337	342			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	17	548	548	1007	576
Volume Left	0	0	0	0	0
Volume Right	17	0	0	0	73
cSH	337	1700	1700	1700	1700
Volume to Capacity	0.05	0.32	0.32	0.59	0.34
Queue Length 95th (m)	1.2	0.0	0.0	0.0	0.0
Control Delay (s)	16.2	0.0	0.0	0.0	0.0
Lane LOS	C				
Approach Delay (s)	16.2	0.0		0.0	
Approach LOS	C				

Intersection Summary			
Average Delay	0.1		
Intersection Capacity Utilization	53.5%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	17	0	0	0	0	1068	0	0	1364	120
Future Volume (Veh/h)	0	0	17	0	0	0	0	1068	0	0	1364	120
Sign Control		Stop			Stop			Free			Free	
Grade		-9%			0%			2%			0%	
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	0	0	17	0	0	0	0	1090	0	0	1392	122
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	2543	2543	757	1803	2604	1090	1514			1090		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2543	2543	757	1803	2604	1090	1514			1090		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.6			4.3		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.5			2.3		
p0 queue free %	100	100	95	100	100	100	100			100		
cM capacity (veh/h)	14	28	355	49	25	214	340			586		

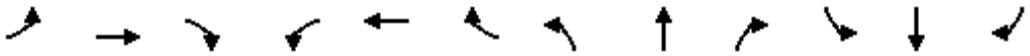
Direction, Lane #	EB 1	WB 1	NB 1	SB 1	SB 2
Volume Total	17	0	1090	928	586
Volume Left	0	0	0	0	0
Volume Right	17	0	0	0	122
cSH	355	1700	1700	1700	1700
Volume to Capacity	0.05	0.00	0.64	0.55	0.34
Queue Length 95th (m)	1.1	0.0	0.0	0.0	0.0
Control Delay (s)	15.6	0.0	0.0	0.0	0.0
Lane LOS	C	A			
Approach Delay (s)	15.6	0.0	0.0	0.0	
Approach LOS	C	A			

Intersection Summary				
Average Delay	0.1			
Intersection Capacity Utilization	61.1%	ICU Level of Service		B
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	1377	0	19	0	323	1072	0	443	0
Future Volume (vph)	0	0	0	1377	0	19	0	323	1072	0	443	0
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-5%			2%			2%			-5%	
Total Lost time (s)				6.2		6.2		6.2	6.2		6.2	
Lane Util. Factor				0.97		1.00		1.00	1.00		0.95	
Frt				1.00		0.85		1.00	0.85		1.00	
Flt Protected				0.95		1.00		1.00	1.00		1.00	
Satd. Flow (prot)				3103		1431		1653	1405		3571	
Flt Permitted				0.95		1.00		1.00	1.00		1.00	
Satd. Flow (perm)				3103		1431		1653	1405		3571	
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	0	0	0	1513	0	21	0	355	1178	0	487	0
RTOR Reduction (vph)	0	0	0	0	0	8	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	1513	0	13	0	355	1178	0	487	0
Heavy Vehicles (%)	0%	0%	0%	10%	10%	10%	12%	12%	12%	2%	2%	2%
Turn Type				Prot		Perm		NA	pm+ov		NA	
Protected Phases				4				2	4		2	
Permitted Phases						4			2			
Actuated Green, G (s)				59.2		59.2		23.4	82.6		23.4	
Effective Green, g (s)				59.2		59.2		23.4	82.6		23.4	
Actuated g/C Ratio				0.62		0.62		0.25	0.87		0.25	
Clearance Time (s)				6.2		6.2		6.2	6.2		6.2	
Vehicle Extension (s)				3.0		3.0		3.0	3.0		3.0	
Lane Grp Cap (vph)				1933		891		407	1405		879	
v/s Ratio Prot				0.49				0.21	c0.52		0.14	
v/s Ratio Perm						0.01			0.32			
v/c Ratio				0.78		0.01		0.87	0.84		0.55	
Uniform Delay, d1				13.2		6.8		34.4	3.0		31.2	
Progression Factor				1.00		1.00		1.15	1.00		1.00	
Incremental Delay, d2				3.2		0.0		16.6	4.1		0.8	
Delay (s)				16.4		6.8		56.3	7.1		32.0	
Level of Service				B		A		E	A		C	
Approach Delay (s)		0.0			16.3			18.5			32.0	
Approach LOS		A			B			B			C	

Intersection Summary			
HCM 2000 Control Delay	19.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	15.4
Intersection Capacity Utilization	73.3%	ICU Level of Service	D
Analysis Period (min)	15		

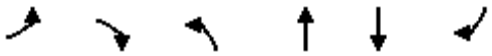
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	3	0	0	1	0	1331	5	0	1800	77
Future Volume (Veh/h)	0	0	3	0	0	1	0	1331	5	0	1800	77
Sign Control		Stop			Yield			Free			Free	
Grade		-12%			6%			0%			-3%	
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	0	0	3	0	0	1	0	1372	5	0	1856	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)											168	
pX, platoon unblocked	0.89	0.89	0.89	0.89	0.89		0.89					
vC, conflicting volume	2582	3268	968	2306	3310	688	1935			1372		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2530	3300	717	2220	3348	688	1804			1372		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.3			4.2		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.3			2.3		
p0 queue free %	100	100	99	100	100	100	100			100		
cM capacity (veh/h)	13	8	336	22	7	393	266			471		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	3	1	915	462	1237	698
Volume Left	0	0	0	0	0	0
Volume Right	3	1	0	5	0	79
cSH	336	393	1700	1700	1700	1700
Volume to Capacity	0.01	0.00	0.54	0.27	0.73	0.41
Queue Length 95th (m)	0.2	0.1	0.0	0.0	0.0	0.0
Control Delay (s)	15.8	14.2	0.0	0.0	0.0	0.0
Lane LOS	C	B				
Approach Delay (s)	15.8	14.2	0.0		0.0	
Approach LOS	C	B				

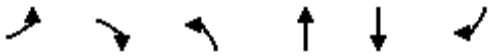
Intersection Summary				
Average Delay	0.0			
Intersection Capacity Utilization	63.6%	ICU Level of Service	B	
Analysis Period (min)	15			



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	61	57	32	1289	1818	30
Future Volume (vph)	61	57	32	1289	1818	30
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)	-12%			1%	-1%	
Total Lost time (s)	8.4	8.4	6.0	5.5	5.5	5.5
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1884	1685	1622	3244	3338	1493
Flt Permitted	0.95	1.00	0.06	1.00	1.00	1.00
Satd. Flow (perm)	1884	1685	104	3244	3338	1493
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	64	60	34	1357	1914	32
RTOR Reduction (vph)	0	53	0	0	0	5
Lane Group Flow (vph)	64	7	34	1357	1914	27
Heavy Vehicles (%)	0%	0%	9%	9%	7%	7%
Turn Type	Prot	Perm	pm+pt	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	6.6	6.6	69.5	69.5	59.6	59.6
Effective Green, g (s)	11.6	11.6	69.5	69.5	59.6	59.6
Actuated g/C Ratio	0.12	0.12	0.73	0.73	0.63	0.63
Clearance Time (s)	13.4	13.4	6.0	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	230	205	138	2373	2094	936
v/s Ratio Prot	c0.03		0.01	c0.42	c0.57	
v/s Ratio Perm		0.00	0.17			0.02
v/c Ratio	0.28	0.04	0.25	0.57	0.91	0.03
Uniform Delay, d1	37.9	36.8	15.6	5.9	15.5	6.7
Progression Factor	1.00	1.00	1.42	0.69	0.79	0.72
Incremental Delay, d2	0.7	0.1	0.7	0.8	5.7	0.0
Delay (s)	38.6	36.8	22.9	4.8	18.0	4.9
Level of Service	D	D	C	A	B	A
Approach Delay (s)	37.7			5.3	17.8	
Approach LOS	D			A	B	

Intersection Summary			
HCM 2000 Control Delay	13.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	19.9
Intersection Capacity Utilization	67.4%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	637	52	0	395	1260	419
Future Volume (vph)	637	52	0	395	1260	419
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)	-10%			-1%	7%	
Total Lost time (s)	9.6			6.4	6.4	13.6
Lane Util. Factor	0.97			0.95	0.95	1.00
Frt	0.99			1.00	1.00	0.85
Flt Protected	0.96			1.00	1.00	1.00
Satd. Flow (prot)	3273			3572	3362	1504
Flt Permitted	0.96			1.00	1.00	1.00
Satd. Flow (perm)	3273			3572	3362	1504
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	650	53	0	403	1286	428
RTOR Reduction (vph)	7	0	0	0	0	0
Lane Group Flow (vph)	696	0	0	403	1286	428
Heavy Vehicles (%)	10%	10%	0%	0%	2%	2%
Turn Type	Prot			NA	NA	custom
Protected Phases	6			4	7 8	6
Permitted Phases						7
Actuated Green, G (s)	20.2			49.8	49.8	34.5
Effective Green, g (s)	24.2			49.8	43.8	34.5
Actuated g/C Ratio	0.27			0.55	0.49	0.38
Clearance Time (s)	13.6			6.4		13.6
Vehicle Extension (s)	3.0			3.0		3.0
Lane Grp Cap (vph)	880			1976	1636	576
v/s Ratio Prot	c0.21			0.11	c0.38	0.17
v/s Ratio Perm						0.12
v/c Ratio	0.79			0.20	0.79	0.74
Uniform Delay, d1	30.6			10.1	19.2	23.9
Progression Factor	0.78			1.00	1.00	1.00
Incremental Delay, d2	4.8			0.2	2.6	5.2
Delay (s)	28.6			10.4	21.8	29.1
Level of Service	C			B	C	C
Approach Delay (s)	28.6			10.4	23.6	
Approach LOS	C			B	C	

Intersection Summary			
HCM 2000 Control Delay	23.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	26.0
Intersection Capacity Utilization	69.4%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	421	0	380	40	38	52	37	161	66	146	37
Future Volume (vph)	0	421	0	380	40	38	52	37	161	66	146	37
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-5%			10%			-4%			8%	
Total Lost time (s)		4.5		3.5	4.5	4.5		4.5	3.5		4.5	4.5
Lane Util. Factor		0.95		1.00	1.00	1.00		1.00	1.00		1.00	1.00
Frt		1.00		1.00	1.00	0.85		1.00	0.85		1.00	0.85
Flt Protected		1.00		0.95	1.00	1.00		0.97	1.00		0.98	1.00
Satd. Flow (prot)		3253		1623	1709	1452		1783	1559		1768	1526
Flt Permitted		1.00		0.45	1.00	1.00		0.59	1.00		0.87	1.00
Satd. Flow (perm)		3253		765	1709	1452		1084	1559		1560	1526
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	430	0	388	41	39	53	38	164	67	149	38
RTOR Reduction (vph)	0	0	0	0	0	12	0	0	107	0	0	31
Lane Group Flow (vph)	0	430	0	388	41	27	0	91	57	0	216	7
Heavy Vehicles (%)	12%	12%	12%	4%	4%	4%	4%	4%	4%	0%	0%	0%
Turn Type		NA		pm+pt	NA	Perm	Perm	NA	pm+ov	Perm	NA	Perm
Protected Phases		4		3	8			2	3		6	
Permitted Phases				8		8	2		2	6		6
Actuated Green, G (s)		46.0		63.4	63.4	63.4		17.6	31.5		17.6	17.6
Effective Green, g (s)		46.0		63.4	63.4	63.4		17.6	31.5		17.6	17.6
Actuated g/C Ratio		0.51		0.70	0.70	0.70		0.20	0.35		0.20	0.20
Clearance Time (s)		4.5		3.5	4.5	4.5		4.5	3.5		4.5	4.5
Vehicle Extension (s)		3.0		3.0	3.0	3.0		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1662		671	1203	1022		211	545		305	298
v/s Ratio Prot		0.13		c0.09	0.02				0.02			
v/s Ratio Perm				c0.32		0.02		0.08	0.02		c0.14	0.00
v/c Ratio		0.26		0.58	0.03	0.03		0.43	0.11		0.71	0.02
Uniform Delay, d1		12.4		5.5	4.0	4.0		31.8	19.7		33.8	29.3
Progression Factor		1.00		1.88	0.08	0.00		1.00	1.00		1.00	1.00
Incremental Delay, d2		0.4		1.0	0.0	0.0		1.4	0.1		7.3	0.0
Delay (s)		12.8		11.2	0.4	0.0		33.2	19.8		41.1	29.3
Level of Service		B		B	A	A		C	B		D	C
Approach Delay (s)		12.8			9.4			24.6			39.4	
Approach LOS		B			A			C			D	

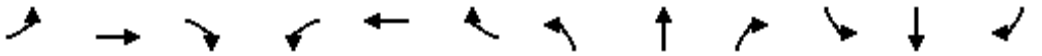
Intersection Summary			
HCM 2000 Control Delay	18.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	65.6%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1156	71	0	1562	160	31	214	77	202	417	43
Future Volume (vph)	0	1156	71	0	1562	160	31	214	77	202	417	43
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-1%			-2%			-6%			1%	
Total Lost time (s)		5.5			5.5	5.5	5.9	5.9	5.9	5.9	5.9	5.9
Lane Util. Factor		0.95			0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.99			1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		1.00			1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		3372			3519	1574	1830	1927	1638	1768	1861	1582
Flt Permitted		1.00			1.00	1.00	0.13	1.00	1.00	0.48	1.00	1.00
Satd. Flow (perm)		3372			3519	1574	257	1927	1638	893	1861	1582
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	1230	76	0	1662	170	33	228	82	215	444	46
RTOR Reduction (vph)	0	4	0	0	0	24	0	0	60	0	0	20
Lane Group Flow (vph)	0	1302	0	0	1662	146	33	228	22	215	444	26
Heavy Vehicles (%)	5%	5%	5%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA	Perm	Perm	NA	Perm	Perm	NA	Perm
Protected Phases		6			2			4			8	
Permitted Phases						2	4		4	8		8
Actuated Green, G (s)		77.2			77.2	77.2	31.4	31.4	31.4	31.4	31.4	31.4
Effective Green, g (s)		77.2			77.2	77.2	31.4	31.4	31.4	31.4	31.4	31.4
Actuated g/C Ratio		0.64			0.64	0.64	0.26	0.26	0.26	0.26	0.26	0.26
Clearance Time (s)		5.5			5.5	5.5	5.9	5.9	5.9	5.9	5.9	5.9
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)		2169			2263	1012	67	504	428	233	486	413
v/s Ratio Prot		0.39			c0.47			0.12			0.24	
v/s Ratio Perm						0.09	0.13		0.01	c0.24		0.02
v/c Ratio		0.60			0.73	0.14	0.49	0.45	0.05	0.92	0.91	0.06
Uniform Delay, d1		12.4			14.5	8.4	37.5	37.1	33.2	43.1	43.0	33.3
Progression Factor		0.92			1.45	1.22	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		0.8			1.5	0.2	5.6	0.6	0.1	38.3	21.6	0.1
Delay (s)		12.3			22.4	10.4	43.1	37.7	33.2	81.4	64.5	33.3
Level of Service		B			C	B	D	D	C	F	E	C
Approach Delay (s)		12.3			21.3			37.2			67.7	
Approach LOS		B			C			D			E	

Intersection Summary			
HCM 2000 Control Delay	27.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	11.4
Intersection Capacity Utilization	87.1%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	143	812	41	292	1189	79	86	340	149	250	590	102
Future Volume (vph)	143	812	41	292	1189	79	86	340	149	250	590	102
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-2%			1%			-1%			-2%	
Total Lost time (s)	6.6	6.1	6.1	6.3	6.1		6.4	6.1		6.5	6.1	6.1
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	0.95		1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	0.99		1.00	0.95		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1709	3419	1529	1733	3435		1786	3408		1743	3485	1559
Flt Permitted	0.08	1.00	1.00	0.18	1.00		0.18	1.00		0.27	1.00	1.00
Satd. Flow (perm)	152	3419	1529	330	3435		333	3408		487	3485	1559
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	152	864	44	311	1265	84	91	362	159	266	628	109
RTOR Reduction (vph)	0	0	27	0	4	0	0	42	0	0	0	85
Lane Group Flow (vph)	152	864	17	311	1345	0	91	479	0	266	628	24
Heavy Vehicles (%)	5%	5%	5%	2%	2%	2%	0%	0%	0%	3%	3%	3%
Turn Type	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases	1	6		5	2		3	8		7	4	
Permitted Phases	6		6	2			8			4		4
Actuated Green, G (s)	56.1	47.5	47.5	66.8	52.7		33.3	25.9		33.6	26.1	26.1
Effective Green, g (s)	56.1	47.5	47.5	66.8	52.7		33.3	25.9		33.6	26.1	26.1
Actuated g/C Ratio	0.47	0.40	0.40	0.56	0.44		0.28	0.22		0.28	0.22	0.22
Clearance Time (s)	6.6	6.1	6.1	6.3	6.1		6.4	6.1		6.5	6.1	6.1
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	182	1353	605	348	1508		182	735		214	757	339
v/s Ratio Prot	0.06	0.25		c0.10	c0.39		0.03	0.14		c0.08	0.18	
v/s Ratio Perm	0.33		0.01	c0.39			0.11			c0.27		0.02
v/c Ratio	0.84	0.64	0.03	0.89	0.89		0.50	0.65		1.24	0.83	0.07
Uniform Delay, d1	25.2	29.3	22.2	19.2	31.0		34.0	42.9		41.1	44.8	37.3
Progression Factor	1.00	1.00	1.00	0.81	0.97		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	26.8	2.3	0.1	17.9	6.0		2.2	2.1		142.4	7.5	0.1
Delay (s)	52.0	31.6	22.2	33.5	36.2		36.2	45.0		183.5	52.3	37.4
Level of Service	D	C	C	C	D		D	D		F	D	D
Approach Delay (s)		34.2			35.7			43.7			85.5	
Approach LOS		C			D			D			F	

Intersection Summary			
HCM 2000 Control Delay	48.0	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.06		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	25.3
Intersection Capacity Utilization	94.3%	ICU Level of Service	F
Analysis Period (min)	15		

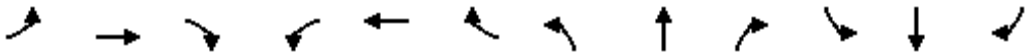
c Critical Lane Group



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	1109	326	259	693	368	597
Future Volume (vph)	1109	326	259	693	368	597
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)	6%		0%			-4%
Total Lost time (s)	5.3	5.3	6.0	4.0		6.0
Lane Util. Factor	0.97	1.00	1.00	1.00		0.95
Frt	1.00	0.85	1.00	0.85		1.00
Flt Protected	0.95	1.00	1.00	1.00		0.98
Satd. Flow (prot)	3247	1497	1781	1514		3557
Flt Permitted	0.95	1.00	1.00	1.00		0.70
Satd. Flow (perm)	3247	1497	1781	1514		2522
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	1167	343	273	729	387	628
RTOR Reduction (vph)	0	187	0	0	0	0
Lane Group Flow (vph)	1167	156	273	729	0	1015
Heavy Vehicles (%)	3%	3%	5%	5%	0%	0%
Turn Type	Prot	Prot	NA	Free	pm+pt	NA
Protected Phases	8	8	2		1	6
Permitted Phases				Free	6	
Actuated Green, G (s)	50.1	50.1	48.6	110.0		48.6
Effective Green, g (s)	50.1	50.1	48.6	110.0		48.6
Actuated g/C Ratio	0.46	0.46	0.44	1.00		0.44
Clearance Time (s)	5.3	5.3	6.0			6.0
Vehicle Extension (s)	3.0	3.0	3.0			3.0
Lane Grp Cap (vph)	1478	681	786	1514		1114
v/s Ratio Prot	c0.36	0.10	0.15			
v/s Ratio Perm				0.48		c0.40
v/c Ratio	0.79	0.23	0.35	0.48		0.91
Uniform Delay, d1	25.5	18.2	20.2	0.0		28.7
Progression Factor	1.00	1.00	1.00	1.00		0.78
Incremental Delay, d2	4.4	0.8	0.3	1.1		1.2
Delay (s)	29.8	19.0	20.5	1.1		23.7
Level of Service	C	B	C	A		C
Approach Delay (s)	27.4		6.4			23.7
Approach LOS	C		A			C

Intersection Summary			
HCM 2000 Control Delay	20.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	17.5
Intersection Capacity Utilization	88.8%	ICU Level of Service	E
Analysis Period (min)	15		

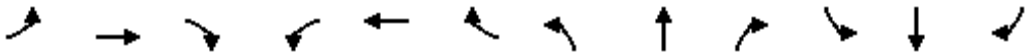
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	25	211	86	24	237	35	47	532	39	47	835	36
Future Volume (vph)	25	211	86	24	237	35	47	532	39	47	835	36
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-3%			1%			1%			-7%	
Total Lost time (s)		5.4			5.4			5.7			5.7	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.96			0.98			0.99			0.99	
Flt Protected		1.00			1.00			1.00			1.00	
Satd. Flow (prot)		1641			1642			1654			1729	
Flt Permitted		0.96			0.95			0.90			0.94	
Satd. Flow (perm)		1582			1574			1490			1637	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	26	220	90	25	247	36	49	554	41	49	870	38
RTOR Reduction (vph)	0	26	0	0	9	0	0	4	0	0	2	0
Lane Group Flow (vph)	0	310	0	0	299	0	0	640	0	0	955	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	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)		15.0			15.0			28.9			28.9	
Effective Green, g (s)		15.0			15.0			28.9			28.9	
Actuated g/C Ratio		0.27			0.27			0.53			0.53	
Clearance Time (s)		5.4			5.4			5.7			5.7	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		431			429			782			860	
v/s Ratio Prot												
v/s Ratio Perm		c0.20			0.19			0.43			c0.58	
v/c Ratio		0.72			0.70			0.82			1.11	
Uniform Delay, d1		18.1			18.0			10.9			13.1	
Progression Factor		1.00			1.00			1.57			1.00	
Incremental Delay, d2		5.7			4.9			8.9			65.5	
Delay (s)		23.8			22.8			26.0			78.5	
Level of Service		C			C			C			E	
Approach Delay (s)		23.8			22.8			26.0			78.5	
Approach LOS		C			C			C			E	

Intersection Summary			
HCM 2000 Control Delay	47.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	55.0	Sum of lost time (s)	11.1
Intersection Capacity Utilization	102.0%	ICU Level of Service	G
Analysis Period (min)	15		

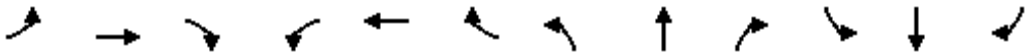
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	63	149	100	31	251	78	0	506	68	36	888	25
Future Volume (vph)	63	149	100	31	251	78	0	506	68	36	888	25
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-9%			11%			9%			-9%	
Total Lost time (s)		5.5			5.5			5.5	5.5		7.5	
Lane Util. Factor		1.00			1.00			1.00	1.00		0.95	
Frt		0.96			0.97			1.00	0.85		1.00	
Flt Protected		0.99			1.00			1.00	1.00		1.00	
Satd. Flow (prot)		1815			1675			1685	1432		3517	
Flt Permitted		0.83			0.95			1.00	1.00		0.79	
Satd. Flow (perm)		1529			1591			1685	1432		2777	
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	72	169	114	35	285	89	0	575	77	41	1009	28
RTOR Reduction (vph)	0	20	0	0	17	0	0	0	42	0	3	0
Lane Group Flow (vph)	0	335	0	0	392	0	0	575	35	0	1075	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	6%	6%	6%	5%	5%	5%
Turn Type	Perm	NA		Perm	NA			NA	Perm	Perm	NA	
Protected Phases		4			4			6			2	
Permitted Phases	4			4			6		6	2		
Actuated Green, G (s)		21.1			21.1			26.6	26.6		21.1	
Effective Green, g (s)		21.1			21.1			26.6	26.6		24.6	
Actuated g/C Ratio		0.36			0.36			0.45	0.45		0.42	
Clearance Time (s)		5.5			5.5			5.5	5.5		11.0	
Vehicle Extension (s)		3.0			3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)		549			571			763	648		1163	
v/s Ratio Prot								0.34				
v/s Ratio Perm		0.22			c0.25				0.02		c0.39	
v/c Ratio		0.61			0.69			0.75	0.05		0.92	
Uniform Delay, d1		15.4			16.0			13.3	9.0		16.2	
Progression Factor		1.00			1.00			1.00	1.00		1.00	
Incremental Delay, d2		1.9			3.4			6.8	0.2		13.5	
Delay (s)		17.3			19.4			20.1	9.2		29.7	
Level of Service		B			B			C	A		C	
Approach Delay (s)		17.3			19.4			18.8			29.7	
Approach LOS		B			B			B			C	

Intersection Summary			
HCM 2000 Control Delay	23.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	58.7	Sum of lost time (s)	13.0
Intersection Capacity Utilization	96.9%	ICU Level of Service	F
Analysis Period (min)	15		

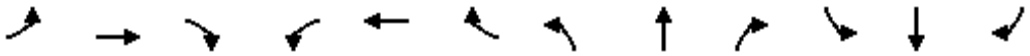
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	3	76	179	328	96	0	222	35	133	1	82	26
Future Volume (vph)	3	76	179	328	96	0	222	35	133	1	82	26
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	3	80	188	345	101	0	234	37	140	1	86	27

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	271	446	411	114
Volume Left (vph)	3	345	234	1
Volume Right (vph)	188	0	140	27
Hadj (s)	-0.41	0.15	-0.09	-0.14
Departure Headway (s)	6.4	6.5	6.4	7.3
Degree Utilization, x	0.48	0.80	0.73	0.23
Capacity (veh/h)	501	530	534	412
Control Delay (s)	15.1	30.8	25.2	12.4
Approach Delay (s)	15.1	30.8	25.2	12.4
Approach LOS	C	D	D	B

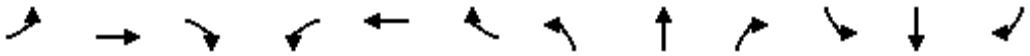
Intersection Summary				
Delay	23.8			
Level of Service	C			
Intersection Capacity Utilization	79.0%	ICU Level of Service	D	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	157	15	53	5	94	4	88	25	2	1	19	258
Future Volume (vph)	157	15	53	5	94	4	88	25	2	1	19	258
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Hourly flow rate (vph)	176	17	60	6	106	4	99	28	2	1	21	290

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	253	116	129	312
Volume Left (vph)	176	6	99	1
Volume Right (vph)	60	4	2	290
Hadj (s)	0.00	-0.01	0.18	-0.56
Departure Headway (s)	5.2	5.4	5.5	4.6
Degree Utilization, x	0.36	0.17	0.20	0.39
Capacity (veh/h)	643	597	594	736
Control Delay (s)	11.1	9.5	9.9	10.5
Approach Delay (s)	11.1	9.5	9.9	10.5
Approach LOS	B	A	A	B

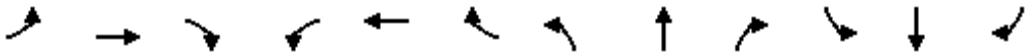
Intersection Summary				
Delay	10.5			
Level of Service	B			
Intersection Capacity Utilization	53.7%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	3	18	0	9	0	301	68	91	410	22
Future Volume (vph)	0	0	3	18	0	9	0	301	68	91	410	22
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-9%			10%			4%			-7%	
Total Lost time (s)			5.4		5.4			5.2		5.2	5.2	
Lane Util. Factor			1.00		1.00			1.00		1.00	1.00	
Frt			0.86		0.96			0.98		1.00	0.99	
Flt Protected			1.00		0.97			1.00		0.95	1.00	
Satd. Flow (prot)			1691		1644			1735		1768	1847	
Flt Permitted			1.00		0.97			1.00		0.53	1.00	
Satd. Flow (perm)			1691		1644			1735		994	1847	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	0	0	3	19	0	9	0	314	71	95	427	23
RTOR Reduction (vph)	0	0	3	0	27	0	0	7	0	0	2	0
Lane Group Flow (vph)	0	0	0	0	1	0	0	378	0	95	448	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	3%	3%	4%	4%	4%
Turn Type			Perm	Perm	NA			NA		Perm	NA	
Protected Phases					8			2			6	
Permitted Phases			4	8						6		
Actuated Green, G (s)			1.0		1.0			27.0		27.0	27.0	
Effective Green, g (s)			1.0		1.0			27.0		27.0	27.0	
Actuated g/C Ratio			0.03		0.03			0.70		0.70	0.70	
Clearance Time (s)			5.4		5.4			5.2		5.2	5.2	
Vehicle Extension (s)			3.0		3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)			43		42			1213		695	1291	
v/s Ratio Prot								0.22			c0.24	
v/s Ratio Perm			0.00		0.00					0.10		
v/c Ratio			0.00		0.02			0.31		0.14	0.35	
Uniform Delay, d1			18.3		18.3			2.2		1.9	2.3	
Progression Factor			1.00		1.00			1.00		1.00	1.00	
Incremental Delay, d2			0.0		0.2			0.1		0.1	0.2	
Delay (s)			18.3		18.5			2.4		2.0	2.5	
Level of Service			B		B			A		A	A	
Approach Delay (s)		18.3			18.5			2.4			2.4	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	2.9	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.34		
Actuated Cycle Length (s)	38.6	Sum of lost time (s)	10.6
Intersection Capacity Utilization	48.5%	ICU Level of Service	A
Analysis Period (min)	15		

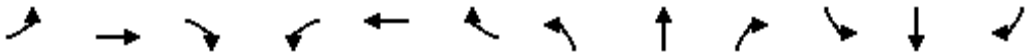
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	14	33	9	20	35	52	3	286	52	46	493	33
Future Volume (vph)	14	33	9	20	35	52	3	286	52	46	493	33
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-6%			7%			7%			-7%	
Total Lost time (s)		5.3			5.3			5.0			5.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.98			0.93			0.98			0.99	
Flt Protected		0.99			0.99			1.00			1.00	
Satd. Flow (prot)		1860			1639			1592			1788	
Flt Permitted		0.88			0.92			1.00			0.95	
Satd. Flow (perm)		1654			1520			1586			1707	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	15	35	10	22	38	56	3	308	56	49	530	35
RTOR Reduction (vph)	0	9	0	0	48	0	0	7	0	0	2	0
Lane Group Flow (vph)	0	52	0	0	68	0	0	360	0	0	612	0
Heavy Vehicles (%)	0%	0%	0%	2%	2%	2%	11%	11%	11%	7%	7%	7%
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)		6.0			6.0			23.7			23.7	
Effective Green, g (s)		6.0			6.0			23.7			23.7	
Actuated g/C Ratio		0.15			0.15			0.59			0.59	
Clearance Time (s)		5.3			5.3			5.0			5.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		248			228			939			1011	
v/s Ratio Prot												
v/s Ratio Perm		0.03			c0.05			0.23			c0.36	
v/c Ratio		0.21			0.30			0.38			0.60	
Uniform Delay, d1		14.9			15.1			4.3			5.2	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.4			0.7			0.3			1.0	
Delay (s)		15.3			15.9			4.6			6.2	
Level of Service		B			B			A			A	
Approach Delay (s)		15.3			15.9			4.6			6.2	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	7.1	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	40.0	Sum of lost time (s)	10.3
Intersection Capacity Utilization	70.7%	ICU Level of Service	C
Analysis Period (min)	15		

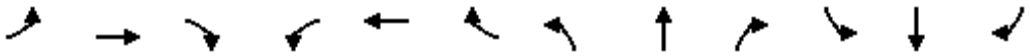
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	34	37	47	28	41	22	16	359	10	24	549	25
Future Volume (vph)	34	37	47	28	41	22	16	359	10	24	549	25
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-2%			5%			0%			0%	
Total Lost time (s)		4.0			4.0			4.0			4.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.95			0.97			1.00			0.99	
Flt Protected		0.99			0.98			1.00			1.00	
Satd. Flow (prot)		1712			1704			1646			1768	
Flt Permitted		0.89			0.91			0.97			0.98	
Satd. Flow (perm)		1545			1567			1606			1737	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	36	39	49	29	43	23	17	378	11	25	578	26
RTOR Reduction (vph)	0	41	0	0	19	0	0	1	0	0	2	0
Lane Group Flow (vph)	0	83	0	0	76	0	0	405	0	0	627	0
Heavy Vehicles (%)	3%	3%	3%	2%	2%	2%	13%	13%	13%	5%	5%	5%
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)		6.3			6.3			25.8			25.8	
Effective Green, g (s)		6.3			6.3			25.8			25.8	
Actuated g/C Ratio		0.16			0.16			0.64			0.64	
Clearance Time (s)		4.0			4.0			4.0			4.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		242			246			1033			1117	
v/s Ratio Prot												
v/s Ratio Perm		c0.05			0.05			0.25			c0.36	
v/c Ratio		0.34			0.31			0.39			0.56	
Uniform Delay, d1		15.1			15.0			3.4			4.0	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.8			0.7			0.2			0.6	
Delay (s)		15.9			15.7			3.7			4.6	
Level of Service		B			B			A			A	
Approach Delay (s)		15.9			15.7			3.7			4.6	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	6.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	40.1	Sum of lost time (s)	8.0
Intersection Capacity Utilization	56.0%	ICU Level of Service	B
Analysis Period (min)	15		

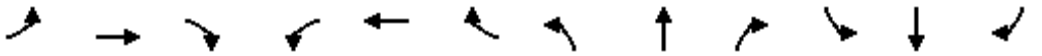
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	32	493	6	64	903	3	12	20	72	6	27	27
Future Volume (Veh/h)	32	493	6	64	903	3	12	20	72	6	27	27
Sign Control		Free			Free			Stop			Stop	
Grade		-9%			7%			1%			2%	
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)	35	536	7	70	982	3	13	22	78	7	29	29
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	985			543			1775	1734	540	1818	1736	984
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	985			543			1775	1734	540	1818	1736	984
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	95			93			66	72	86	81	63	90
cM capacity (veh/h)	701			1026			38	77	542	37	78	304

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	35	543	70	985	113	65
Volume Left	35	0	70	0	13	7
Volume Right	0	7	0	3	78	29
cSH	701	1700	1026	1700	147	99
Volume to Capacity	0.05	0.32	0.07	0.58	0.77	0.66
Queue Length 95th (m)	1.2	0.0	1.7	0.0	36.0	24.7
Control Delay (s)	10.4	0.0	8.8	0.0	83.5	93.1
Lane LOS	B		A		F	F
Approach Delay (s)	0.6		0.6		83.5	93.1
Approach LOS					F	F

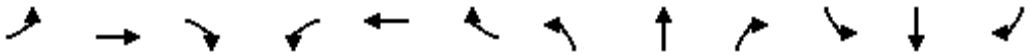
Intersection Summary				
Average Delay	9.1			
Intersection Capacity Utilization	70.0%	ICU Level of Service		C
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	204	379	9	90	444	25	30	251	87	65	452	536
Future Volume (vph)	204	379	9	90	444	25	30	251	87	65	452	536
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-5%			3%			1%			2%	
Total Lost time (s)	5.0	5.0			5.0			5.0		5.0	5.0	5.0
Lane Util. Factor	1.00	0.95			0.95			0.95		1.00	1.00	1.00
Frt	1.00	1.00			0.99			0.96		1.00	1.00	0.85
Flt Protected	0.95	1.00			0.99			1.00		0.95	1.00	1.00
Satd. Flow (prot)	1786	3559			3285			3266		1725	1816	1543
Flt Permitted	0.95	1.00			0.99			0.83		0.50	1.00	1.00
Satd. Flow (perm)	1786	3559			3285			2731		907	1816	1543
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	210	391	9	93	458	26	31	259	90	67	466	553
RTOR Reduction (vph)	0	2	0	0	4	0	0	30	0	0	0	361
Lane Group Flow (vph)	210	398	0	0	573	0	0	350	0	67	466	192
Heavy Vehicles (%)	2%	2%	2%	5%	5%	5%	4%	4%	4%	2%	2%	2%
Turn Type	Split	NA		Split	NA		Perm	NA		Perm	NA	Perm
Protected Phases	4	4		3	3			6			2	
Permitted Phases							6			2		2
Actuated Green, G (s)	17.6	17.6			18.6			27.2		27.2	27.2	27.2
Effective Green, g (s)	17.6	17.6			18.6			27.2		27.2	27.2	27.2
Actuated g/C Ratio	0.22	0.22			0.24			0.35		0.35	0.35	0.35
Clearance Time (s)	5.0	5.0			5.0			5.0		5.0	5.0	5.0
Vehicle Extension (s)	4.0	4.0			4.0			4.0		4.0	4.0	4.0
Lane Grp Cap (vph)	400	798			779			947		314	630	535
v/s Ratio Prot	c0.12	0.11			c0.17						c0.26	
v/s Ratio Perm								0.13		0.07		0.12
v/c Ratio	0.53	0.50			0.74			0.37		0.21	0.74	0.36
Uniform Delay, d1	26.7	26.6			27.6			19.2		18.1	22.5	19.1
Progression Factor	1.00	1.00			1.00			1.00		1.00	1.00	1.00
Incremental Delay, d2	1.6	0.7			3.9			0.3		0.5	4.8	0.6
Delay (s)	28.3	27.2			31.5			19.5		18.5	27.3	19.7
Level of Service	C	C			C			B		B	C	B
Approach Delay (s)		27.6			31.5			19.5			22.9	
Approach LOS		C			C			B			C	

Intersection Summary			
HCM 2000 Control Delay	25.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	78.4	Sum of lost time (s)	15.0
Intersection Capacity Utilization	79.7%	ICU Level of Service	D
Analysis Period (min)	15		

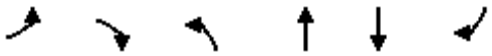
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	37	481	7	14	569	74	4	5	26	85	2	42
Future Volume (vph)	37	481	7	14	569	74	4	5	26	85	2	42
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-9%			3%			-2%			0%	
Total Lost time (s)	6.3	5.7			5.7			5.5		5.5	5.5	
Lane Util. Factor	1.00	0.95			0.95			1.00		1.00	1.00	
Frt	1.00	1.00			0.98			0.90		1.00	0.86	
Flt Protected	0.95	1.00			1.00			0.99		0.95	1.00	
Satd. Flow (prot)	1786	3563			3243			1691		1493	1346	
Flt Permitted	0.27	1.00			0.94			0.96		0.73	1.00	
Satd. Flow (perm)	509	3563			3048			1639		1150	1346	
Peak-hour factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	42	540	8	16	639	83	4	6	29	96	2	47
RTOR Reduction (vph)	0	1	0	0	12	0	0	24	0	0	40	0
Lane Group Flow (vph)	42	547	0	0	726	0	0	15	0	96	9	0
Heavy Vehicles (%)	4%	4%	4%	6%	6%	6%	0%	0%	0%	19%	19%	19%
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	1	6			2			4			8	
Permitted Phases	6			2			4			8		
Actuated Green, G (s)	32.4	32.4			24.1			8.2		8.2	8.2	
Effective Green, g (s)	32.4	32.4			24.1			8.2		8.2	8.2	
Actuated g/C Ratio	0.63	0.63			0.47			0.16		0.16	0.16	
Clearance Time (s)	6.3	5.7			5.7			5.5		5.5	5.5	
Vehicle Extension (s)	3.0	3.0			3.0			4.0		3.0	3.0	
Lane Grp Cap (vph)	367	2228			1418			259		182	213	
v/s Ratio Prot	0.00	c0.15									0.01	
v/s Ratio Perm	0.07				c0.24			0.01		c0.08		
v/c Ratio	0.11	0.25			0.51			0.06		0.53	0.04	
Uniform Delay, d1	4.4	4.3			9.7			18.5		20.0	18.5	
Progression Factor	1.00	1.00			1.00			1.00		1.00	1.00	
Incremental Delay, d2	0.1	0.1			0.3			0.1		2.7	0.1	
Delay (s)	4.6	4.3			10.0			18.6		22.8	18.6	
Level of Service	A	A			B			B		C	B	
Approach Delay (s)		4.4			10.0			18.6			21.3	
Approach LOS		A			B			B			C	

Intersection Summary			
HCM 2000 Control Delay	9.1	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	51.8	Sum of lost time (s)	17.5
Intersection Capacity Utilization	52.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	27	396	386	158	601	24
Future Volume (vph)	27	396	386	158	601	24
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)	-10%			-6%	13%	
Total Lost time (s)	5.0	5.0		6.1	6.1	
Lane Util. Factor	1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	0.99	
Flt Protected	0.95	1.00		0.97	1.00	
Satd. Flow (prot)	1866	1669		1861	1740	
Flt Permitted	0.95	1.00		0.38	1.00	
Satd. Flow (perm)	1866	1669		731	1740	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	28	417	406	166	633	25
RTOR Reduction (vph)	0	230	0	0	2	0
Lane Group Flow (vph)	28	187	0	572	656	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	11.1	11.1		40.1	40.1	
Effective Green, g (s)	11.1	11.1		40.1	40.1	
Actuated g/C Ratio	0.18	0.18		0.64	0.64	
Clearance Time (s)	5.0	5.0		6.1	6.1	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	332	297		470	1119	
v/s Ratio Prot	0.02				0.38	
v/s Ratio Perm		c0.11		c0.78		
v/c Ratio	0.08	0.63		1.22	0.59	
Uniform Delay, d1	21.4	23.7		11.1	6.4	
Progression Factor	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	4.1		115.8	0.8	
Delay (s)	21.5	27.8		126.9	7.1	
Level of Service	C	C		F	A	
Approach Delay (s)	27.4			126.9	7.1	
Approach LOS	C			F	A	

Intersection Summary			
HCM 2000 Control Delay	53.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.09		
Actuated Cycle Length (s)	62.3	Sum of lost time (s)	11.1
Intersection Capacity Utilization	84.6%	ICU Level of Service	E
Analysis Period (min)	15		

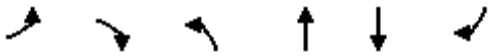
c Critical Lane Group



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	170	0	8	671	2	11
Future Volume (Veh/h)	170	0	8	671	2	11
Sign Control	Free			Free	Stop	
Grade	-11%			14%	-2%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	193	0	9	763	2	13
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)	263					
pX, platoon unblocked						
vC, conflicting volume			193		974	193
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			193		974	193
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		99	98
cM capacity (veh/h)			1392		280	854

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	193	772	15
Volume Left	0	9	2
Volume Right	0	0	13
cSH	1700	1392	671
Volume to Capacity	0.11	0.01	0.02
Queue Length 95th (m)	0.0	0.1	0.5
Control Delay (s)	0.0	0.2	10.5
Lane LOS		A	B
Approach Delay (s)	0.0	0.2	10.5
Approach LOS			B

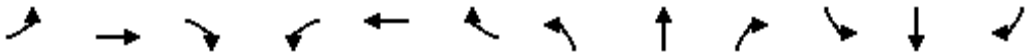
Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	52.8%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	155	22	23	452	941	764
Future Volume (vph)	155	22	23	452	941	764
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)	-12%			-6%	6%	
Total Lost time (s)	8.1			6.0	6.0	
Lane Util. Factor	1.00			0.95	0.95	
Frt	0.98			1.00	0.93	
Flt Protected	0.96			1.00	1.00	
Satd. Flow (prot)	1868			3580	3153	
Flt Permitted	0.96			0.80	1.00	
Satd. Flow (perm)	1868			2863	3153	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	172	24	26	502	1046	849
RTOR Reduction (vph)	5	0	0	0	180	0
Lane Group Flow (vph)	191	0	0	528	1715	0
Heavy Vehicles (%)	0%	0%	2%	2%	2%	2%
Turn Type	Prot		Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases			2			
Actuated Green, G (s)	7.2			56.1	56.1	
Effective Green, g (s)	11.8			56.1	56.1	
Actuated g/C Ratio	0.14			0.68	0.68	
Clearance Time (s)	12.7			6.0	6.0	
Vehicle Extension (s)	3.0			3.0	3.0	
Lane Grp Cap (vph)	268			1958	2157	
v/s Ratio Prot	c0.10				c0.54	
v/s Ratio Perm				0.18		
v/c Ratio	0.71			0.27	0.80	
Uniform Delay, d1	33.5			5.0	9.0	
Progression Factor	1.00			1.00	1.00	
Incremental Delay, d2	8.6			0.1	2.1	
Delay (s)	42.1			5.1	11.1	
Level of Service	D			A	B	
Approach Delay (s)	42.1			5.1	11.1	
Approach LOS	D			A	B	

Intersection Summary			
HCM 2000 Control Delay	12.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	82.0	Sum of lost time (s)	14.1
Intersection Capacity Utilization	73.8%	ICU Level of Service	D
Analysis Period (min)	15		

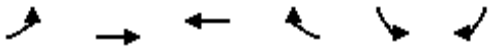
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	2	196	56	85	259	2	45	1	35	2	0	2
Future Volume (vph)	2	196	56	85	259	2	45	1	35	2	0	2
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		0%			-5%			0%			0%	
Total Lost time (s)		6.7			6.7			6.3	6.3		5.6	
Lane Util. Factor		1.00			1.00			1.00	1.00		1.00	
Frt		0.97			1.00			1.00	0.85		0.93	
Flt Protected		1.00			0.99			0.95	1.00		0.98	
Satd. Flow (prot)		1728			1803			1372	1223		972	
Flt Permitted		1.00			0.84			0.95	1.00		1.00	
Satd. Flow (perm)		1724			1528			1372	1223		997	
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	2	228	65	99	301	2	52	1	41	2	0	2
RTOR Reduction (vph)	0	10	0	0	0	0	0	0	36	0	4	0
Lane Group Flow (vph)	0	285	0	0	402	0	0	53	5	0	0	0
Heavy Vehicles (%)	5%	5%	5%	5%	5%	5%	30%	30%	30%	75%	75%	75%
Turn Type	Perm	NA		Perm	NA		Split	NA	Perm	Perm	NA	
Protected Phases		6			2		3	3			4	
Permitted Phases	6			2					3	4		
Actuated Green, G (s)		25.2			25.2			6.4	6.4		0.9	
Effective Green, g (s)		25.2			25.2			6.4	6.4		0.9	
Actuated g/C Ratio		0.49			0.49			0.13	0.13		0.02	
Clearance Time (s)		6.7			6.7			6.3	6.3		5.6	
Vehicle Extension (s)		3.0			3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)		850			753			171	153		17	
v/s Ratio Prot								c0.04				
v/s Ratio Perm		0.17			c0.26				0.00		c0.00	
v/c Ratio		0.34			0.53			0.31	0.03		0.00	
Uniform Delay, d1		7.9			8.9			20.3	19.6		24.7	
Progression Factor		1.00			1.00			1.00	1.00		1.00	
Incremental Delay, d2		0.2			0.7			1.0	0.1		0.1	
Delay (s)		8.1			9.6			21.4	19.7		24.8	
Level of Service		A			A			C	B		C	
Approach Delay (s)		8.1			9.6			20.7			24.8	
Approach LOS		A			A			C			C	

Intersection Summary			
HCM 2000 Control Delay	10.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.47		
Actuated Cycle Length (s)	51.1	Sum of lost time (s)	18.6
Intersection Capacity Utilization	55.4%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	68	1323	1658	37	56	55
Future Volume (vph)	68	1323	1658	37	56	55
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)		-4%	7%		8%	
Total Lost time (s)	6.2	5.4	4.6	4.6	4.7	
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	
Frt	1.00	1.00	1.00	0.85	0.93	
Flt Protected	0.95	1.00	1.00	1.00	0.98	
Satd. Flow (prot)	1777	3554	3362	1504	1602	
Flt Permitted	0.07	1.00	1.00	1.00	0.98	
Satd. Flow (perm)	138	3554	3362	1504	1602	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	74	1438	1802	40	61	60
RTOR Reduction (vph)	0	0	0	10	32	0
Lane Group Flow (vph)	74	1438	1802	30	89	0
Turn Type	pm+pt	NA	NA	Perm	Prot	
Protected Phases	1	6	2		8	
Permitted Phases	6			2		
Actuated Green, G (s)	97.9	97.9	86.6	86.6	12.0	
Effective Green, g (s)	97.9	97.9	86.6	86.6	12.0	
Actuated g/C Ratio	0.82	0.82	0.72	0.72	0.10	
Clearance Time (s)	6.2	5.4	4.6	4.6	4.7	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	193	2899	2426	1085	160	
v/s Ratio Prot	0.02	c0.40	c0.54		c0.06	
v/s Ratio Perm	0.29			0.02		
v/c Ratio	0.38	0.50	0.74	0.03	0.55	
Uniform Delay, d1	11.2	3.4	10.0	4.7	51.4	
Progression Factor	3.47	0.42	1.00	1.00	1.00	
Incremental Delay, d2	1.0	0.5	2.1	0.0	4.1	
Delay (s)	39.9	1.9	12.1	4.8	55.6	
Level of Service	D	A	B	A	E	
Approach Delay (s)		3.8	12.0		55.6	
Approach LOS		A	B		E	

Intersection Summary			
HCM 2000 Control Delay	9.9	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	15.5
Intersection Capacity Utilization	71.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	0	352	1034	0	289	1551
Future Volume (vph)	0	352	1034	0	289	1551
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)	0%		1%			5%
Total Lost time (s)		6.5	7.0		6.5	4.0
Lane Util. Factor		1.00	0.95		1.00	0.95
Frt		0.86	1.00		1.00	1.00
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		1190	3305		1575	3150
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		1190	3305		1575	3150
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	0	356	1044	0	292	1567
RTOR Reduction (vph)	0	45	0	0	0	0
Lane Group Flow (vph)	0	311	1044	0	292	1567
Heavy Vehicles (%)	36%	36%	7%	7%	10%	10%
Turn Type		Over	NA		Prot	NA
Protected Phases		4	2		4	Free
Permitted Phases						
Actuated Green, G (s)		28.6	52.9		28.6	95.0
Effective Green, g (s)		28.6	52.9		28.6	95.0
Actuated g/C Ratio		0.30	0.56		0.30	1.00
Clearance Time (s)		6.5	7.0		6.5	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)		358	1840		474	3150
v/s Ratio Prot		c0.26	c0.32		0.19	0.50
v/s Ratio Perm						
v/c Ratio		0.87	0.57		0.62	0.50
Uniform Delay, d1		31.4	13.6		28.5	0.0
Progression Factor		1.00	1.00		0.52	1.00
Incremental Delay, d2		19.3	1.3		1.3	0.3
Delay (s)		50.7	14.9		16.1	0.3
Level of Service		D	B		B	A
Approach Delay (s)	50.7		14.9			2.8
Approach LOS	D		B			A

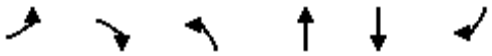
Intersection Summary			
HCM 2000 Control Delay	11.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	63.0%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

PM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	969	245	5	146	96	108	0	1334	79	49	915	431
Future Volume (vph)	969	245	5	146	96	108	0	1334	79	49	915	431
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-2%			0%			0%			-5%	
Total Lost time (s)	8.9	8.9		8.8	8.8	8.8		7.5		8.7	9.5	4.0
Lane Util. Factor	0.97	1.00		1.00	1.00	1.00		0.91		1.00	0.95	1.00
Frt	1.00	1.00		1.00	1.00	0.85		0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00		1.00		0.95	1.00	1.00
Satd. Flow (prot)	3447	1865		1661	1748	1486		4604		1718	3437	1537
Flt Permitted	0.95	1.00		0.95	1.00	1.00		1.00		0.95	1.00	1.00
Satd. Flow (perm)	3447	1865		1661	1748	1486		4604		1718	3437	1537
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	1020	258	5	154	101	114	0	1404	83	52	963	454
RTOR Reduction (vph)	0	1	0	0	0	0	0	4	0	0	0	0
Lane Group Flow (vph)	1020	262	0	154	101	114	0	1483	0	52	963	454
Heavy Vehicles (%)	1%	1%	1%	7%	7%	7%	10%	10%	10%	6%	6%	6%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	100	0	0	0
Turn Type	Split	NA		Split	NA	Perm		NA		Prot	NA	Free
Protected Phases	7	7		8	8			2		1	6	
Permitted Phases						8						Free
Actuated Green, G (s)	43.2	43.2		17.6	17.6	17.6		50.2		8.2	62.1	153.1
Effective Green, g (s)	43.2	43.2		17.6	17.6	17.6		50.2		8.2	65.1	153.1
Actuated g/C Ratio	0.28	0.28		0.11	0.11	0.11		0.33		0.05	0.43	1.00
Clearance Time (s)	8.9	8.9		8.8	8.8	8.8		7.5		8.7	12.5	
Vehicle Extension (s)	4.0	4.0		4.0	4.0	4.0		4.0		4.0	4.0	
Lane Grp Cap (vph)	972	526		190	200	170		1509		92	1461	1537
v/s Ratio Prot	c0.30	0.14		c0.09	0.06			c0.32		0.03	c0.28	
v/s Ratio Perm						0.08						0.30
v/c Ratio	1.05	0.50		0.81	0.51	0.67		0.98		0.57	0.66	0.30
Uniform Delay, d1	54.9	45.9		66.1	63.7	65.0		51.0		70.7	35.1	0.0
Progression Factor	1.00	1.00		1.00	1.00	1.00		1.00		1.00	1.00	1.00
Incremental Delay, d2	42.7	1.0		23.4	2.7	10.8		19.1		9.3	1.2	0.5
Delay (s)	97.7	46.9		89.5	66.4	75.8		70.1		80.0	36.3	0.5
Level of Service	F	D		F	E	E		E		F	D	A
Approach Delay (s)		87.3			78.9			70.1			26.8	
Approach LOS		F			E			E			C	

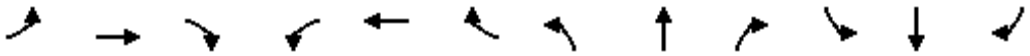
Intersection Summary			
HCM 2000 Control Delay	61.8	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	153.1	Sum of lost time (s)	33.9
Intersection Capacity Utilization	95.8%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	18	0	1435	1018	46
Future Volume (Veh/h)	0	18	0	1435	1018	46
Sign Control	Stop			Free	Free	
Grade	-10%			-2%	2%	
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86
Hourly flow rate (vph)	0	21	0	1669	1184	53
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	2045	618	1184			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2045	618	1184			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	95	100			
cM capacity (veh/h)	50	438	591			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	21	834	834	789	448
Volume Left	0	0	0	0	0
Volume Right	21	0	0	0	53
cSH	438	1700	1700	1700	1700
Volume to Capacity	0.05	0.49	0.49	0.46	0.26
Queue Length 95th (m)	1.1	0.0	0.0	0.0	0.0
Control Delay (s)	13.6	0.0	0.0	0.0	0.0
Lane LOS	B				
Approach Delay (s)	13.6	0.0		0.0	
Approach LOS	B				

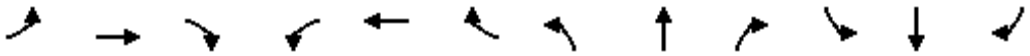
Intersection Summary			
Average Delay	0.1		
Intersection Capacity Utilization	44.1%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	52	0	0	2	0	1506	0	0	1004	35
Future Volume (Veh/h)	0	0	52	0	0	2	0	1506	0	0	1004	35
Sign Control		Stop			Stop			Free			Free	
Grade		-9%			0%			2%			0%	
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	0	0	54	0	0	2	0	1553	0	0	1035	36
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	2608	2606	536	2124	2624	1553	1071			1553		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2608	2606	536	2124	2624	1553	1071			1553		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	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 %	100	100	89	100	100	98	100			100		
cM capacity (veh/h)	12	25	495	26	24	104	652			422		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1	SB 2
Volume Total	54	2	1553	690	381
Volume Left	0	0	0	0	0
Volume Right	54	2	0	0	36
cSH	495	104	1700	1700	1700
Volume to Capacity	0.11	0.02	0.91	0.41	0.22
Queue Length 95th (m)	2.8	0.4	0.0	0.0	0.0
Control Delay (s)	13.2	40.2	0.0	0.0	0.0
Lane LOS	B	E			
Approach Delay (s)	13.2	40.2	0.0	0.0	
Approach LOS	B	E			

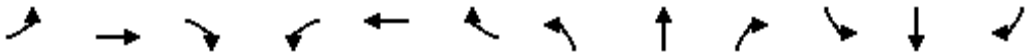
Intersection Summary				
Average Delay	0.3			
Intersection Capacity Utilization	91.4%	ICU Level of Service	F	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	1034	0	17	2	417	1543	0	471	0
Future Volume (vph)	0	0	0	1034	0	17	2	417	1543	0	471	0
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-5%			2%			2%			-5%	
Total Lost time (s)				6.2		6.2		6.2	6.2		6.2	
Lane Util. Factor				0.97		1.00		1.00	1.00		0.95	
Frt				1.00		0.85		1.00	0.85		1.00	
Flt Protected				0.95		1.00		1.00	1.00		1.00	
Satd. Flow (prot)				3220		1485		1763	1499		3643	
Flt Permitted				0.95		1.00		1.00	1.00		1.00	
Satd. Flow (perm)				3220		1485		1760	1499		3643	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	0	0	1055	0	17	2	426	1574	0	481	0
RTOR Reduction (vph)	0	0	0	0	0	7	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	1055	0	10	0	428	1574	0	481	0
Heavy Vehicles (%)	0%	0%	0%	6%	6%	6%	5%	5%	5%	0%	0%	0%
Turn Type				Prot		Perm	Perm	NA	pm+ov		NA	
Protected Phases				4				2	4		2	
Permitted Phases						4	2		2			
Actuated Green, G (s)				57.1		57.1		30.5	87.6		30.5	
Effective Green, g (s)				57.1		57.1		30.5	87.6		30.5	
Actuated g/C Ratio				0.57		0.57		0.30	0.88		0.30	
Clearance Time (s)				6.2		6.2		6.2	6.2		6.2	
Vehicle Extension (s)				3.0		3.0		3.0	3.0		3.0	
Lane Grp Cap (vph)				1838		847		536	1499		1111	
v/s Ratio Prot				0.33					c0.60		0.13	
v/s Ratio Perm						0.01		0.24	0.45			
v/c Ratio				0.57		0.01		0.80	1.05		0.43	
Uniform Delay, d1				13.7		9.3		31.9	6.2		27.8	
Progression Factor				1.00		1.00		1.23	1.00		1.00	
Incremental Delay, d2				1.3		0.0		5.9	34.3		0.3	
Delay (s)				15.0		9.3		45.1	40.5		28.1	
Level of Service				B		A		D	D		C	
Approach Delay (s)		0.0			14.9			41.5			28.1	
Approach LOS		A			B			D			C	

Intersection Summary			
HCM 2000 Control Delay	31.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	1.24		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	15.4
Intersection Capacity Utilization	103.3%	ICU Level of Service	G
Analysis Period (min)	15		

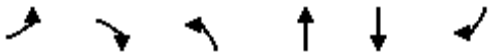
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	9	0	0	5	0	1930	0	0	1388	109
Future Volume (Veh/h)	0	0	9	0	0	5	0	1930	0	0	1388	109
Sign Control		Stop			Yield			Free			Free	
Grade		-12%			6%			0%			-3%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	0	0	10	0	0	6	0	2144	0	0	1542	121
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)											168	
pX, platoon unblocked	0.90	0.90	0.90	0.90	0.90		0.90					
vC, conflicting volume	2674	3746	832	2925	3807	1072	1663			2144		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2638	3830	588	2917	3898	1072	1513			2144		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	7.7	4.3			4.2		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.7	2.3			2.2		
p0 queue free %	100	100	98	100	100	96	100			100		
cM capacity (veh/h)	10	4	412	6	3	162	368			245		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	10	6	1429	715	1028	635
Volume Left	0	0	0	0	0	0
Volume Right	10	6	0	0	0	121
cSH	412	162	1700	1700	1700	1700
Volume to Capacity	0.02	0.04	0.84	0.42	0.60	0.37
Queue Length 95th (m)	0.6	0.9	0.0	0.0	0.0	0.0
Control Delay (s)	14.0	28.1	0.0	0.0	0.0	0.0
Lane LOS	B	D				
Approach Delay (s)	14.0	28.1	0.0		0.0	
Approach LOS	B	D				

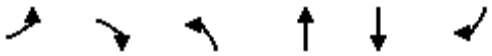
Intersection Summary				
Average Delay	0.1			
Intersection Capacity Utilization	64.8%	ICU Level of Service	C	
Analysis Period (min)	15			



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	53	72	74	1867	1331	63
Future Volume (vph)	53	72	74	1867	1331	63
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)	-12%			1%	-1%	
Total Lost time (s)	8.4	8.4	6.0	5.5	5.5	5.5
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1884	1685	1668	3336	3434	1536
Flt Permitted	0.95	1.00	0.12	1.00	1.00	1.00
Satd. Flow (perm)	1884	1685	208	3336	3434	1536
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	56	76	78	1965	1401	66
RTOR Reduction (vph)	0	67	0	0	0	14
Lane Group Flow (vph)	56	9	78	1965	1401	52
Heavy Vehicles (%)	0%	0%	6%	6%	4%	4%
Turn Type	Prot	Perm	pm+pt	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	6.5	6.5	74.6	74.6	62.9	62.9
Effective Green, g (s)	11.5	11.5	74.6	74.6	62.9	62.9
Actuated g/C Ratio	0.12	0.12	0.75	0.75	0.63	0.63
Clearance Time (s)	13.4	13.4	6.0	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	216	193	238	2488	2159	966
v/s Ratio Prot	c0.03		0.02	c0.59	0.41	
v/s Ratio Perm		0.01	0.23			0.03
v/c Ratio	0.26	0.05	0.33	0.79	0.65	0.05
Uniform Delay, d1	40.4	39.4	7.9	7.9	11.6	7.1
Progression Factor	1.00	1.00	0.57	0.83	1.21	1.17
Incremental Delay, d2	0.6	0.1	0.4	1.3	1.4	0.1
Delay (s)	41.0	39.5	4.9	7.8	15.4	8.5
Level of Service	D	D	A	A	B	A
Approach Delay (s)	40.1			7.7	15.1	
Approach LOS	D			A	B	

Intersection Summary			
HCM 2000 Control Delay	11.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	19.9
Intersection Capacity Utilization	68.8%	ICU Level of Service	C
Analysis Period (min)	15		

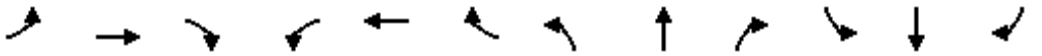
c Critical Lane Group



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	629	39	0	897	644	524
Future Volume (vph)	629	39	0	897	644	524
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)	-10%			-1%	7%	
Total Lost time (s)	9.6			6.4	6.4	13.6
Lane Util. Factor	0.97			0.95	0.95	1.00
Frt	0.99			1.00	1.00	0.85
Flt Protected	0.96			1.00	1.00	1.00
Satd. Flow (prot)	3403			3572	3430	1534
Flt Permitted	0.96			1.00	1.00	1.00
Satd. Flow (perm)	3403			3572	3430	1534
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	676	42	0	965	692	563
RTOR Reduction (vph)	7	0	0	0	0	0
Lane Group Flow (vph)	711	0	0	965	692	563
Heavy Vehicles (%)	6%	6%	0%	0%	0%	0%
Turn Type	Prot			NA	NA	custom
Protected Phases	6			4	7 8	6
Permitted Phases						7
Actuated Green, G (s)	9.4			42.6	42.6	31.0
Effective Green, g (s)	13.4			42.6	36.6	31.0
Actuated g/C Ratio	0.19			0.59	0.51	0.43
Clearance Time (s)	13.6			6.4		13.6
Vehicle Extension (s)	3.0			3.0		3.0
Lane Grp Cap (vph)	633			2113	1743	660
v/s Ratio Prot	c0.21			c0.27	0.20	c0.11
v/s Ratio Perm						0.26
v/c Ratio	1.12			0.46	0.40	0.85
Uniform Delay, d1	29.3			8.2	10.9	18.4
Progression Factor	0.78			1.00	1.00	1.00
Incremental Delay, d2	74.5			0.7	0.1	10.4
Delay (s)	97.3			8.9	11.1	28.8
Level of Service	F			A	B	C
Approach Delay (s)	97.3			8.9	19.0	
Approach LOS	F			A	B	

Intersection Summary			
HCM 2000 Control Delay	34.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	72.0	Sum of lost time (s)	26.0
Intersection Capacity Utilization	58.5%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	467	0	458	47	115	24	71	197	38	86	16
Future Volume (vph)	0	467	0	458	47	115	24	71	197	38	86	16
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-5%			10%			-4%			8%	
Total Lost time (s)		4.5		3.5	4.5	4.5		4.5	3.5		4.5	4.5
Lane Util. Factor		0.95		1.00	1.00	1.00		1.00	1.00		1.00	1.00
Frt		1.00		1.00	1.00	0.85		1.00	0.85		1.00	0.85
Flt Protected		1.00		0.95	1.00	1.00		0.99	1.00		0.98	1.00
Satd. Flow (prot)		3312		1639	1725	1466		1794	1545		1769	1526
Flt Permitted		1.00		0.40	1.00	1.00		0.88	1.00		0.86	1.00
Satd. Flow (perm)		3312		683	1725	1466		1608	1545		1548	1526
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	497	0	487	50	122	26	76	210	40	91	17
RTOR Reduction (vph)	0	0	0	0	0	32	0	0	76	0	0	15
Lane Group Flow (vph)	0	497	0	487	50	90	0	102	134	0	131	2
Heavy Vehicles (%)	10%	10%	10%	3%	3%	3%	5%	5%	5%	0%	0%	0%
Turn Type		NA		pm+pt	NA	Perm	Perm	NA	pm+ov	Perm	NA	Perm
Protected Phases		4		3	8			2	3		6	
Permitted Phases				8		8	2		2	6		6
Actuated Green, G (s)		32.6		53.2	53.2	53.2		9.8	26.9		9.8	9.8
Effective Green, g (s)		32.6		53.2	53.2	53.2		9.8	26.9		9.8	9.8
Actuated g/C Ratio		0.45		0.74	0.74	0.74		0.14	0.37		0.14	0.14
Clearance Time (s)		4.5		3.5	4.5	4.5		4.5	3.5		4.5	4.5
Vehicle Extension (s)		3.0		3.0	3.0	3.0		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1499		731	1274	1083		218	577		210	207
v/s Ratio Prot		0.15		c0.16	0.03				0.06			
v/s Ratio Perm				c0.33		0.06		0.06	0.03		c0.08	0.00
v/c Ratio		0.33		0.67	0.04	0.08		0.47	0.23		0.62	0.01
Uniform Delay, d1		12.7		4.1	2.5	2.6		28.7	15.5		29.4	26.9
Progression Factor		1.00		3.57	0.87	0.93		1.00	1.00		1.00	1.00
Incremental Delay, d2		0.6		1.8	0.0	0.1		1.6	0.2		5.7	0.0
Delay (s)		13.3		16.3	2.2	2.6		30.3	15.7		35.0	26.9
Level of Service		B		B	A	A		C	B		D	C
Approach Delay (s)		13.3			12.7			20.5			34.1	
Approach LOS		B			B			C			C	

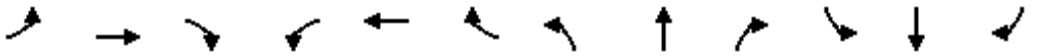
Intersection Summary			
HCM 2000 Control Delay	16.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	72.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	63.6%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1170	3	0	1209	287	61	584	392	121	319	47
Future Volume (vph)	0	1170	3	0	1209	287	61	584	392	121	319	47
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-1%			-2%			-6%			1%	
Total Lost time (s)		5.5			5.5	5.5	5.9	5.9	5.9	5.9	5.9	5.9
Lane Util. Factor		0.95			0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		1.00			1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		1.00			1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		3433			3590	1606	1830	1927	1638	1768	1861	1582
Flt Permitted		1.00			1.00	1.00	0.44	1.00	1.00	0.15	1.00	1.00
Satd. Flow (perm)		3433			3590	1606	842	1927	1638	271	1861	1582
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1232	3	0	1273	302	64	615	413	127	336	49
RTOR Reduction (vph)	0	0	0	0	0	58	0	0	18	0	0	15
Lane Group Flow (vph)	0	1235	0	0	1273	244	64	615	395	127	336	34
Heavy Vehicles (%)	4%	4%	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA	Perm	Perm	NA	Perm	Perm	NA	Perm
Protected Phases		6			2			4			8	
Permitted Phases						2	4		4	8		8
Actuated Green, G (s)		55.3			55.3	55.3	43.3	43.3	43.3	43.3	43.3	43.3
Effective Green, g (s)		55.3			55.3	55.3	43.3	43.3	43.3	43.3	43.3	43.3
Actuated g/C Ratio		0.50			0.50	0.50	0.39	0.39	0.39	0.39	0.39	0.39
Clearance Time (s)		5.5			5.5	5.5	5.9	5.9	5.9	5.9	5.9	5.9
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)		1725			1804	807	331	758	644	106	732	622
v/s Ratio Prot		c0.36			0.35			0.32			0.18	
v/s Ratio Perm						0.15	0.08		0.24	c0.47		0.02
v/c Ratio		0.72			0.71	0.30	0.19	0.81	0.61	1.20	0.46	0.05
Uniform Delay, d1		21.2			21.1	16.0	21.9	29.7	26.7	33.4	24.7	20.7
Progression Factor		1.00			0.91	0.80	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		2.6			2.0	0.8	0.3	6.6	1.7	150.1	0.5	0.0
Delay (s)		23.8			21.2	13.6	22.2	36.3	28.4	183.5	25.1	20.7
Level of Service		C			C	B	C	D	C	F	C	C
Approach Delay (s)		23.8			19.7			32.5			64.0	
Approach LOS		C			B			C			E	

Intersection Summary			
HCM 2000 Control Delay	29.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	11.4
Intersection Capacity Utilization	87.2%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	227	816	25	351	869	113	215	608	157	215	652	59
Future Volume (vph)	227	816	25	351	869	113	215	608	157	215	652	59
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-2%			1%			-1%			-2%	
Total Lost time (s)	6.6	6.1	6.1	6.3	6.1		6.4	6.1		6.5	6.1	6.1
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	0.95		1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	0.98		1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1760	3519	1574	1768	3475		1786	3462		1726	3452	1544
Flt Permitted	0.14	1.00	1.00	0.14	1.00		0.19	1.00		0.13	1.00	1.00
Satd. Flow (perm)	263	3519	1574	268	3475		353	3462		235	3452	1544
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)	247	887	27	382	945	123	234	661	171	234	709	64
RTOR Reduction (vph)	0	0	17	0	8	0	0	19	0	0	0	48
Lane Group Flow (vph)	247	887	10	382	1060	0	234	813	0	234	709	16
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	0%	0%	0%	4%	4%	4%
Turn Type	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases	1	6		5	2		3	8		7	4	
Permitted Phases	6		6	2			8			4		4
Actuated Green, G (s)	50.3	42.9	42.9	62.6	48.9		35.5	27.9		41.4	30.9	30.9
Effective Green, g (s)	50.3	42.9	42.9	62.6	48.9		35.5	27.9		41.4	30.9	30.9
Actuated g/C Ratio	0.42	0.36	0.36	0.52	0.41		0.30	0.23		0.34	0.26	0.26
Clearance Time (s)	6.6	6.1	6.1	6.3	6.1		6.4	6.1		6.5	6.1	6.1
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	202	1258	562	311	1416		195	804		211	888	397
v/s Ratio Prot	0.08	0.25		c0.14	0.30		0.08	0.23		c0.10	0.21	
v/s Ratio Perm	0.44		0.01	c0.50			0.28			c0.28		0.01
v/c Ratio	1.22	0.71	0.02	1.23	0.75		1.20	1.01		1.11	0.80	0.04
Uniform Delay, d1	29.7	33.1	24.9	26.7	30.3		38.7	46.0		33.5	41.6	33.4
Progression Factor	1.43	1.18	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	132.4	2.9	0.0	127.8	3.7		128.7	34.5		94.2	5.1	0.0
Delay (s)	174.9	42.1	25.0	154.4	34.0		167.5	80.5		127.7	46.7	33.5
Level of Service	F	D	C	F	C		F	F		F	D	C
Approach Delay (s)		70.0			65.7			99.6			64.7	
Approach LOS		E			E			F			E	

Intersection Summary			
HCM 2000 Control Delay	74.3	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.26		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	25.3
Intersection Capacity Utilization	98.6%	ICU Level of Service	F
Analysis Period (min)	15		

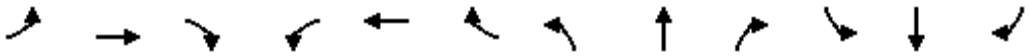
c Critical Lane Group



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	814	408	601	752	321	282
Future Volume (vph)	814	408	601	752	321	282
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)	6%		0%			-4%
Total Lost time (s)	5.3	5.3	6.0	4.0		6.0
Lane Util. Factor	0.97	1.00	1.00	1.00		0.95
Frt	1.00	0.85	1.00	0.85		1.00
Flt Protected	0.95	1.00	1.00	1.00		0.97
Satd. Flow (prot)	3344	1542	1852	1574		3462
Flt Permitted	0.95	1.00	1.00	1.00		0.54
Satd. Flow (perm)	3344	1542	1852	1574		1933
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	848	425	626	783	334	294
RTOR Reduction (vph)	0	155	0	0	0	0
Lane Group Flow (vph)	848	270	626	783	0	628
Heavy Vehicles (%)	0%	0%	1%	1%	2%	2%
Turn Type	Prot	Prot	NA	Free	pm+pt	NA
Protected Phases	8	8	2		1	6
Permitted Phases				Free	6	
Actuated Green, G (s)	62.0	62.0	46.7	120.0		46.7
Effective Green, g (s)	62.0	62.0	46.7	120.0		46.7
Actuated g/C Ratio	0.52	0.52	0.39	1.00		0.39
Clearance Time (s)	5.3	5.3	6.0			6.0
Vehicle Extension (s)	3.0	3.0	3.0			3.0
Lane Grp Cap (vph)	1727	796	720	1574		752
v/s Ratio Prot	0.25	0.17	c0.34			
v/s Ratio Perm				c0.50		0.32
v/c Ratio	0.49	0.34	0.87	0.50		3.67dl
Uniform Delay, d1	18.8	17.0	33.8	0.0		33.2
Progression Factor	0.98	2.11	1.00	1.00		1.10
Incremental Delay, d2	0.6	0.7	10.9	1.1		3.7
Delay (s)	18.9	36.6	44.7	1.1		40.0
Level of Service	B	D	D	A		D
Approach Delay (s)	24.8		20.5			40.0
Approach LOS	C		C			D

Intersection Summary			
HCM 2000 Control Delay	25.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.5
Intersection Capacity Utilization	89.0%	ICU Level of Service	E
Analysis Period (min)	15		

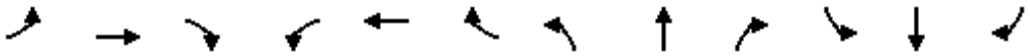
dl Defacto Left Lane. Recode with 1 though lane as a left lane.
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	66	330	63	31	262	98	59	840	80	56	557	22
Future Volume (vph)	66	330	63	31	262	98	59	840	80	56	557	22
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-3%			1%			1%			-7%	
Total Lost time (s)		5.4			5.4			5.7			5.7	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.98			0.97			0.99			1.00	
Flt Protected		0.99			1.00			1.00			1.00	
Satd. Flow (prot)		1665			1612			1652			1727	
Flt Permitted		0.84			0.93			0.94			0.86	
Satd. Flow (perm)		1412			1505			1549			1488	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	68	340	65	32	270	101	61	866	82	58	574	23
RTOR Reduction (vph)	0	10	0	0	20	0	0	5	0	0	2	0
Lane Group Flow (vph)	0	463	0	0	383	0	0	1004	0	0	653	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	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)		18.6			18.6			30.3			30.3	
Effective Green, g (s)		18.6			18.6			30.3			30.3	
Actuated g/C Ratio		0.31			0.31			0.51			0.51	
Clearance Time (s)		5.4			5.4			5.7			5.7	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		437			466			782			751	
v/s Ratio Prot												
v/s Ratio Perm		c0.33			0.25			c0.65			0.44	
v/c Ratio		1.06			0.82			1.28			0.87	
Uniform Delay, d1		20.7			19.2			14.8			13.1	
Progression Factor		1.00			1.00			2.26			1.00	
Incremental Delay, d2		59.9			11.1			134.7			13.1	
Delay (s)		80.6			30.3			168.3			26.2	
Level of Service		F			C			F			C	
Approach Delay (s)		80.6			30.3			168.3			26.2	
Approach LOS		F			C			F			C	

Intersection Summary			
HCM 2000 Control Delay	93.4	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.20		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	11.1
Intersection Capacity Utilization	126.7%	ICU Level of Service	H
Analysis Period (min)	15		

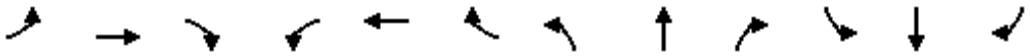
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	80	205	148	58	382	0	0	831	202	23	767	35
Future Volume (vph)	80	205	148	58	382	0	0	831	202	23	767	35
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-9%			11%			9%			-9%	
Total Lost time (s)		5.5			5.5			5.5	5.5		7.5	
Lane Util. Factor		1.00			1.00			1.00	1.00		0.95	
Frt		0.95			1.00			1.00	0.85		0.99	
Flt Protected		0.99			0.99			1.00	1.00		1.00	
Satd. Flow (prot)		1848			1722			1734	1474		3444	
Flt Permitted		0.76			0.86			1.00	1.00		0.69	
Satd. Flow (perm)		1419			1485			1734	1474		2371	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	85	218	157	62	406	0	0	884	215	24	816	37
RTOR Reduction (vph)	0	25	0	0	0	0	0	0	105	0	4	0
Lane Group Flow (vph)	0	435	0	0	468	0	0	884	110	0	873	0
Heavy Vehicles (%)	0%	0%	0%	2%	2%	2%	3%	3%	3%	7%	7%	7%
Turn Type	Perm	NA		Perm	NA			NA	Perm	Perm	NA	
Protected Phases		4			4			6			2	
Permitted Phases	4			4			6		6	2		
Actuated Green, G (s)		25.1			25.1			37.5	37.5		32.0	
Effective Green, g (s)		25.1			25.1			37.5	37.5		35.5	
Actuated g/C Ratio		0.34			0.34			0.51	0.51		0.48	
Clearance Time (s)		5.5			5.5			5.5	5.5		11.0	
Vehicle Extension (s)		3.0			3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)		483			506			883	751		1143	
v/s Ratio Prot								c0.51				
v/s Ratio Perm		0.31			c0.32				0.07		0.37	
v/c Ratio		0.90			0.92			1.00	0.15		0.76	
Uniform Delay, d1		23.1			23.3			18.0	9.6		15.6	
Progression Factor		1.00			1.00			1.00	1.00		1.00	
Incremental Delay, d2		19.7			22.8			30.6	0.4		4.9	
Delay (s)		42.7			46.2			48.6	10.0		20.5	
Level of Service		D			D			D	A		C	
Approach Delay (s)		42.7			46.2			41.1			20.5	
Approach LOS		D			D			D			C	

Intersection Summary			
HCM 2000 Control Delay	35.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	73.6	Sum of lost time (s)	13.0
Intersection Capacity Utilization	91.5%	ICU Level of Service	F
Analysis Period (min)	15		

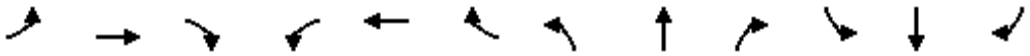
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	21	195	120	203	133	4	430	47	325	10	54	44
Future Volume (vph)	21	195	120	203	133	4	430	47	325	10	54	44
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	23	217	133	226	148	4	478	52	361	11	60	49

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	373	378	891	120
Volume Left (vph)	23	226	478	11
Volume Right (vph)	133	4	361	49
Hadj (s)	-0.20	0.11	-0.14	-0.23
Departure Headway (s)	7.1	7.4	6.9	8.1
Degree Utilization, x	0.74	0.77	1.70	0.27
Capacity (veh/h)	373	378	529	385
Control Delay (s)	27.6	31.3	340.0	14.1
Approach Delay (s)	27.6	31.3	340.0	14.1
Approach LOS	D	D	F	B

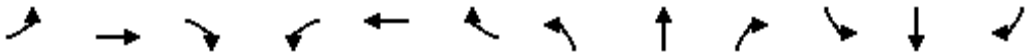
Intersection Summary				
Delay	185.4			
Level of Service	F			
Intersection Capacity Utilization	102.3%	ICU Level of Service	G	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	375	48	108	5	95	9	56	22	1	3	23	211
Future Volume (vph)	375	48	108	5	95	9	56	22	1	3	23	211
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	391	50	113	5	99	9	58	23	1	3	24	220

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	554	113	82	247
Volume Left (vph)	391	5	58	3
Volume Right (vph)	113	9	1	220
Hadj (s)	0.02	-0.04	0.13	-0.53
Departure Headway (s)	5.1	5.7	6.3	5.3
Degree Utilization, x	0.78	0.18	0.14	0.36
Capacity (veh/h)	554	569	513	613
Control Delay (s)	23.4	9.9	10.3	11.3
Approach Delay (s)	23.4	9.9	10.3	11.3
Approach LOS	C	A	B	B

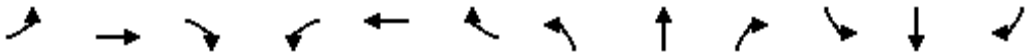
Intersection Summary			
Delay	17.8		
Level of Service	C		
Intersection Capacity Utilization	66.6%	ICU Level of Service	C
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	10	62	0	80	0	393	38	64	382	18
Future Volume (vph)	0	0	10	62	0	80	0	393	38	64	382	18
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-9%			10%			4%			-7%	
Total Lost time (s)			5.4		5.4			5.2		5.2	5.2	
Lane Util. Factor			1.00		1.00			1.00		1.00	1.00	
Frt			0.86		0.92			0.99		1.00	0.99	
Flt Protected			1.00		0.98			1.00		0.95	1.00	
Satd. Flow (prot)			1691		1606			1776		1821	1904	
Flt Permitted			1.00		0.98			1.00		0.50	1.00	
Satd. Flow (perm)			1691		1606			1776		957	1904	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	0	10	63	0	82	0	401	39	65	390	18
RTOR Reduction (vph)	0	0	8	0	67	0	0	5	0	0	2	0
Lane Group Flow (vph)	0	0	2	0	78	0	0	435	0	65	406	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	2%	2%	1%	1%	1%
Turn Type			Perm	Perm	NA			NA		Perm	NA	
Protected Phases					8			2			6	
Permitted Phases			4	8						6		
Actuated Green, G (s)			6.4		6.4			19.0		19.0	19.0	
Effective Green, g (s)			6.4		6.4			19.0		19.0	19.0	
Actuated g/C Ratio			0.18		0.18			0.53		0.53	0.53	
Clearance Time (s)			5.4		5.4			5.2		5.2	5.2	
Vehicle Extension (s)			3.0		3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)			300		285			937		505	1004	
v/s Ratio Prot								c0.25			0.21	
v/s Ratio Perm			0.00		0.05					0.07		
v/c Ratio			0.01		0.27			0.46		0.13	0.40	
Uniform Delay, d1			12.2		12.8			5.3		4.3	5.1	
Progression Factor			1.00		1.00			1.00		1.00	1.00	
Incremental Delay, d2			0.0		0.5			0.4		0.1	0.3	
Delay (s)			12.2		13.3			5.7		4.4	5.4	
Level of Service			B		B			A		A	A	
Approach Delay (s)		12.2			13.3			5.7			5.2	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	6.6	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	36.0	Sum of lost time (s)	10.6
Intersection Capacity Utilization	53.7%	ICU Level of Service	A
Analysis Period (min)	15		

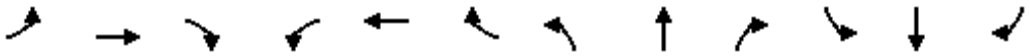
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	51	17	5	35	30	112	4	468	12	26	433	41
Future Volume (vph)	51	17	5	35	30	112	4	468	12	26	433	41
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-6%			7%			7%			-7%	
Total Lost time (s)		5.3			5.3			5.0			5.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.99			0.91			1.00			0.99	
Flt Protected		0.97			0.99			1.00			1.00	
Satd. Flow (prot)		1846			1635			1746			1836	
Flt Permitted		0.76			0.91			1.00			0.96	
Satd. Flow (perm)		1459			1505			1740			1768	
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	56	19	5	38	33	123	4	514	13	29	476	45
RTOR Reduction (vph)	0	4	0	0	96	0	0	1	0	0	4	0
Lane Group Flow (vph)	0	76	0	0	98	0	0	530	0	0	546	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	3%	3%	3%	4%	4%	4%
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)		8.8			8.8			20.7			20.7	
Effective Green, g (s)		8.8			8.8			20.7			20.7	
Actuated g/C Ratio		0.22			0.22			0.52			0.52	
Clearance Time (s)		5.3			5.3			5.0			5.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		322			332			904			919	
v/s Ratio Prot												
v/s Ratio Perm		0.05			c0.07			0.30			c0.31	
v/c Ratio		0.24			0.30			0.59			0.59	
Uniform Delay, d1		12.7			12.9			6.6			6.6	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.4			0.5			1.0			1.0	
Delay (s)		13.1			13.4			7.6			7.7	
Level of Service		B			B			A			A	
Approach Delay (s)		13.1			13.4			7.6			7.7	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	8.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	39.8	Sum of lost time (s)	10.3
Intersection Capacity Utilization	64.0%	ICU Level of Service	B
Analysis Period (min)	15		

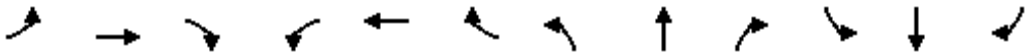
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	61	161	39	44	86	45	18	554	75	24	421	27
Future Volume (vph)	61	161	39	44	86	45	18	554	75	24	421	27
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-2%			5%			0%			0%	
Total Lost time (s)		4.0			4.0			4.0			4.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.98			0.97			0.98			0.99	
Flt Protected		0.99			0.99			1.00			1.00	
Satd. Flow (prot)		1830			1739			1803			1798	
Flt Permitted		0.90			0.89			0.98			0.96	
Satd. Flow (perm)		1674			1569			1777			1729	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	64	169	41	46	91	47	19	583	79	25	443	28
RTOR Reduction (vph)	0	11	0	0	21	0	0	9	0	0	4	0
Lane Group Flow (vph)	0	263	0	0	163	0	0	672	0	0	492	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	2%	2%	2%	3%	3%	3%
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)		12.2			12.2			24.9			24.9	
Effective Green, g (s)		12.2			12.2			24.9			24.9	
Actuated g/C Ratio		0.27			0.27			0.55			0.55	
Clearance Time (s)		4.0			4.0			4.0			4.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		452			424			981			954	
v/s Ratio Prot												
v/s Ratio Perm		c0.16			0.10			c0.38			0.28	
v/c Ratio		0.58			0.38			0.69			0.52	
Uniform Delay, d1		14.2			13.4			7.3			6.3	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		1.9			0.6			2.0			0.5	
Delay (s)		16.2			14.0			9.3			6.8	
Level of Service		B			B			A			A	
Approach Delay (s)		16.2			14.0			9.3			6.8	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	10.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	45.1	Sum of lost time (s)	8.0
Intersection Capacity Utilization	66.4%	ICU Level of Service	C
Analysis Period (min)	15		

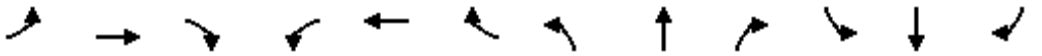
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	19	963	8	39	662	7	5	29	184	6	11	17
Future Volume (Veh/h)	19	963	8	39	662	7	5	29	184	6	11	17
Sign Control		Free			Free			Stop			Stop	
Grade		-9%			7%			1%			2%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	21	1070	9	43	736	8	6	32	204	7	12	19
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	744			1079			1964	1946	1074	2158	1947	740
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	744			1079			1964	1946	1074	2158	1947	740
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	98			93			83	46	24	0	80	95
cM capacity (veh/h)	868			643			36	60	269	5	59	420

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	21	1079	43	744	242	38
Volume Left	21	0	43	0	6	7
Volume Right	0	9	0	8	204	19
cSH	868	1700	643	1700	166	21
Volume to Capacity	0.02	0.63	0.07	0.44	1.46	1.78
Queue Length 95th (m)	0.6	0.0	1.6	0.0	117.2	37.7
Control Delay (s)	9.2	0.0	11.0	0.0	288.7	757.2
Lane LOS	A		B		F	F
Approach Delay (s)	0.2		0.6		288.7	757.2
Approach LOS					F	F

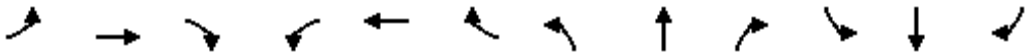
Intersection Summary			
Average Delay	45.8		
Intersection Capacity Utilization	73.2%	ICU Level of Service	D
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	462	758	10	65	429	50	29	398	194	57	394	243
Future Volume (vph)	462	758	10	65	429	50	29	398	194	57	394	243
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-5%			3%			1%			2%	
Total Lost time (s)	5.0	5.0			5.0			5.0		5.0	5.0	5.0
Lane Util. Factor	1.00	0.95			0.95			0.95		1.00	1.00	1.00
Frt	1.00	1.00			0.99			0.95		1.00	1.00	0.85
Flt Protected	0.95	1.00			0.99			1.00		0.95	1.00	1.00
Satd. Flow (prot)	1803	3600			3237			3202		1759	1852	1574
Flt Permitted	0.95	1.00			0.99			0.84		0.26	1.00	1.00
Satd. Flow (perm)	1803	3600			3237			2684		483	1852	1574
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	497	815	11	70	461	54	31	428	209	61	424	261
RTOR Reduction (vph)	0	1	0	0	7	0	0	45	0	0	0	177
Lane Group Flow (vph)	497	825	0	0	578	0	0	623	0	61	424	84
Heavy Vehicles (%)	1%	1%	1%	6%	6%	6%	5%	5%	5%	0%	0%	0%
Turn Type	Split	NA		Split	NA		Perm	NA		Perm	NA	Perm
Protected Phases	4	4		3	3			6			2	
Permitted Phases							6			2		2
Actuated Green, G (s)	23.5	23.5			24.7			30.0		30.0	30.0	30.0
Effective Green, g (s)	23.5	23.5			24.7			30.0		30.0	30.0	30.0
Actuated g/C Ratio	0.25	0.25			0.27			0.32		0.32	0.32	0.32
Clearance Time (s)	5.0	5.0			5.0			5.0		5.0	5.0	5.0
Vehicle Extension (s)	4.0	4.0			4.0			4.0		4.0	4.0	4.0
Lane Grp Cap (vph)	454	907			857			863		155	596	506
v/s Ratio Prot	c0.28	0.23			c0.18						0.23	
v/s Ratio Perm								c0.23		0.13		0.05
v/c Ratio	1.09	0.91			0.67			0.72		0.39	0.71	0.17
Uniform Delay, d1	34.9	33.8			30.6			27.9		24.5	27.8	22.6
Progression Factor	1.00	1.00			1.00			1.00		1.00	1.00	1.00
Incremental Delay, d2	70.4	13.0			2.3			3.2		2.2	4.3	0.2
Delay (s)	105.2	46.9			32.9			31.1		26.8	32.1	22.9
Level of Service	F	D			C			C		C	C	C
Approach Delay (s)		68.8			32.9			31.1			28.4	
Approach LOS		E			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	45.8	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	93.2	Sum of lost time (s)	15.0
Intersection Capacity Utilization	98.5%	ICU Level of Service	F
Analysis Period (min)	15		

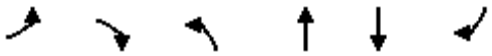
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	42	1062	5	5	440	80	7	3	30	80	1	60
Future Volume (vph)	42	1062	5	5	440	80	7	3	30	80	1	60
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-9%			3%			-2%			0%	
Total Lost time (s)	6.3	5.7			5.7			5.5		5.5	5.5	
Lane Util. Factor	1.00	0.95			0.95			1.00		1.00	1.00	
Frt	1.00	1.00			0.98			0.90		1.00	0.85	
Flt Protected	0.95	1.00			1.00			0.99		0.95	1.00	
Satd. Flow (prot)	1786	3569			3226			1684		1493	1340	
Flt Permitted	0.35	1.00			0.94			0.92		0.73	1.00	
Satd. Flow (perm)	653	3569			3045			1571		1146	1340	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	45	1142	5	5	473	86	8	3	32	86	1	65
RTOR Reduction (vph)	0	0	0	0	18	0	0	27	0	0	55	0
Lane Group Flow (vph)	45	1147	0	0	546	0	0	16	0	86	11	0
Heavy Vehicles (%)	4%	4%	4%	6%	6%	6%	0%	0%	0%	19%	19%	19%
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	1	6			2			4			8	
Permitted Phases	6			2			4			8		
Actuated Green, G (s)	32.0	32.0			23.5			7.5		7.5	7.5	
Effective Green, g (s)	32.0	32.0			23.5			7.5		7.5	7.5	
Actuated g/C Ratio	0.63	0.63			0.46			0.15		0.15	0.15	
Clearance Time (s)	6.3	5.7			5.7			5.5		5.5	5.5	
Vehicle Extension (s)	3.0	3.0			3.0			4.0		3.0	3.0	
Lane Grp Cap (vph)	461	2252			1411			232		169	198	
v/s Ratio Prot	0.00	c0.32									0.01	
v/s Ratio Perm	0.06				0.18			0.01		c0.08		
v/c Ratio	0.10	0.51			0.39			0.07		0.51	0.05	
Uniform Delay, d1	4.0	5.1			8.9			18.6		19.9	18.6	
Progression Factor	1.00	1.00			1.00			1.00		1.00	1.00	
Incremental Delay, d2	0.1	0.2			0.2			0.2		2.4	0.1	
Delay (s)	4.0	5.3			9.1			18.8		22.3	18.7	
Level of Service	A	A			A			B		C	B	
Approach Delay (s)		5.2			9.1			18.8			20.7	
Approach LOS		A			A			B			C	

Intersection Summary			
HCM 2000 Control Delay	7.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	50.7	Sum of lost time (s)	17.5
Intersection Capacity Utilization	56.4%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	36	506	495	451	212	24
Future Volume (vph)	36	506	495	451	212	24
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)	-10%			-6%	13%	
Total Lost time (s)	5.0	5.0		6.1	6.1	
Lane Util. Factor	1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	0.99	
Flt Protected	0.95	1.00		0.97	1.00	
Satd. Flow (prot)	1866	1669		1878	1725	
Flt Permitted	0.95	1.00		0.71	1.00	
Satd. Flow (perm)	1866	1669		1370	1725	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	37	522	510	465	219	25
RTOR Reduction (vph)	0	443	0	0	5	0
Lane Group Flow (vph)	37	79	0	975	239	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	9.1	9.1		40.1	40.1	
Effective Green, g (s)	9.1	9.1		40.1	40.1	
Actuated g/C Ratio	0.15	0.15		0.67	0.67	
Clearance Time (s)	5.0	5.0		6.1	6.1	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	281	251		911	1147	
v/s Ratio Prot	0.02				0.14	
v/s Ratio Perm		c0.05		c0.71		
v/c Ratio	0.13	0.31		1.07	0.21	
Uniform Delay, d1	22.2	22.8		10.1	3.9	
Progression Factor	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.2	0.7		50.5	0.1	
Delay (s)	22.4	23.5		60.6	4.0	
Level of Service	C	C		E	A	
Approach Delay (s)	23.5			60.6	4.0	
Approach LOS	C			E	A	

Intersection Summary			
HCM 2000 Control Delay	41.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	60.3	Sum of lost time (s)	11.1
Intersection Capacity Utilization	85.6%	ICU Level of Service	E
Analysis Period (min)	15		

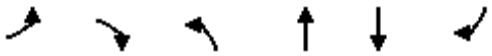
c Critical Lane Group



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	439	3	4	240	0	8
Future Volume (Veh/h)	439	3	4	240	0	8
Sign Control	Free			Free	Stop	
Grade	-11%			14%	-2%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	477	3	4	261	0	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)	263					
pX, platoon unblocked						
vC, conflicting volume			480		748	478
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			480		748	478
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	98
cM capacity (veh/h)			1093		382	591

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	480	265	9
Volume Left	0	4	0
Volume Right	3	0	9
cSH	1700	1093	591
Volume to Capacity	0.28	0.00	0.02
Queue Length 95th (m)	0.0	0.1	0.4
Control Delay (s)	0.0	0.2	11.2
Lane LOS		A	B
Approach Delay (s)	0.0	0.2	11.2
Approach LOS			B

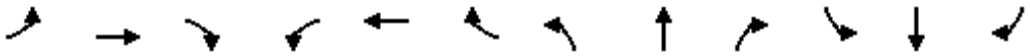
Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	33.9%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	456	22	41	895	581	300
Future Volume (vph)	456	22	41	895	581	300
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)	-12%			-6%	6%	
Total Lost time (s)	8.1			6.0	6.0	
Lane Util. Factor	1.00			0.95	0.95	
Frt	0.99			1.00	0.95	
Flt Protected	0.95			1.00	1.00	
Satd. Flow (prot)	1881			3653	3271	
Flt Permitted	0.95			0.88	1.00	
Satd. Flow (perm)	1881			3212	3271	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	465	22	42	913	593	306
RTOR Reduction (vph)	2	0	0	0	140	0
Lane Group Flow (vph)	485	0	0	955	759	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%
Turn Type	Prot		Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases			2			
Actuated Green, G (s)	7.1			21.6	21.6	
Effective Green, g (s)	11.7			21.6	21.6	
Actuated g/C Ratio	0.25			0.46	0.46	
Clearance Time (s)	12.7			6.0	6.0	
Vehicle Extension (s)	3.0			3.0	3.0	
Lane Grp Cap (vph)	464			1463	1490	
v/s Ratio Prot	c0.26				0.23	
v/s Ratio Perm				c0.30		
v/c Ratio	1.05			0.65	0.51	
Uniform Delay, d1	17.9			10.0	9.1	
Progression Factor	1.00			1.00	1.00	
Incremental Delay, d2	54.4			1.1	0.3	
Delay (s)	72.3			11.1	9.4	
Level of Service	E			B	A	
Approach Delay (s)	72.3			11.1	9.4	
Approach LOS	E			B	A	

Intersection Summary			
HCM 2000 Control Delay	23.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	47.4	Sum of lost time (s)	14.1
Intersection Capacity Utilization	95.5%	ICU Level of Service	F
Analysis Period (min)	15		

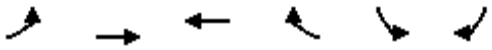
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	395	44	23	202	0	74	0	283	0	0	0
Future Volume (vph)	0	395	44	23	202	0	74	0	283	0	0	0
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		0%			-5%			0%			0%	
Total Lost time (s)		6.7			6.7			6.3	6.3			
Lane Util. Factor		1.00			1.00			1.00	1.00			
Frt		0.99			1.00			1.00	0.85			
Flt Protected		1.00			0.99			0.95	1.00			
Satd. Flow (prot)		1741			1817			1709	1529			
Flt Permitted		1.00			0.92			0.95	1.00			
Satd. Flow (perm)		1741			1677			1709	1529			
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	0	434	48	25	222	0	81	0	311	0	0	0
RTOR Reduction (vph)	0	4	0	0	0	0	0	0	239	0	0	0
Lane Group Flow (vph)	0	478	0	0	247	0	0	81	72	0	0	0
Heavy Vehicles (%)	6%	6%	6%	5%	5%	5%	4%	4%	4%	0%	0%	0%
Turn Type		NA		Perm	NA		Split	NA	Perm			
Protected Phases		6			2		3	3			4	
Permitted Phases				2					3	4		
Actuated Green, G (s)		16.4			16.4			8.9	8.9			
Effective Green, g (s)		16.4			16.4			8.9	8.9			
Actuated g/C Ratio		0.43			0.43			0.23	0.23			
Clearance Time (s)		6.7			6.7			6.3	6.3			
Vehicle Extension (s)		3.0			3.0			3.0	3.0			
Lane Grp Cap (vph)		745			718			397	355			
v/s Ratio Prot		c0.27						c0.05				
v/s Ratio Perm					0.15				0.05			
v/c Ratio		0.64			0.34			0.20	0.20			
Uniform Delay, d1		8.6			7.3			11.8	11.8			
Progression Factor		1.00			1.00			1.00	1.00			
Incremental Delay, d2		1.9			0.3			0.3	0.3			
Delay (s)		10.5			7.6			12.1	12.1			
Level of Service		B			A			B	B			
Approach Delay (s)		10.5			7.6			12.1			0.0	
Approach LOS		B			A			B			A	

Intersection Summary			
HCM 2000 Control Delay	10.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	38.3	Sum of lost time (s)	18.6
Intersection Capacity Utilization	52.9%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	52	1662	1499	65	0	47
Future Volume (vph)	52	1662	1499	65	0	47
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)		-4%	7%		8%	
Total Lost time (s)	6.2	5.4	4.6	4.6		6.2
Lane Util. Factor	1.00	0.95	0.95	1.00		1.00
Frt	1.00	1.00	1.00	0.85		0.86
Flt Protected	0.95	1.00	1.00	1.00		1.00
Satd. Flow (prot)	1777	3554	3396	1519		1553
Flt Permitted	0.14	1.00	1.00	1.00		1.00
Satd. Flow (perm)	259	3554	3396	1519		1553
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	54	1731	1561	68	0	49
RTOR Reduction (vph)	0	0	0	10	0	47
Lane Group Flow (vph)	54	1731	1561	58	0	2
Heavy Vehicles (%)	2%	2%	1%	1%	0%	0%
Turn Type	pm+pt	NA	NA	Perm		Perm
Protected Phases	1	6	2			
Permitted Phases	6			2		1
Actuated Green, G (s)	104.6	110.0	94.2	94.2		5.0
Effective Green, g (s)	104.6	110.0	94.2	94.2		5.0
Actuated g/C Ratio	0.95	1.00	0.86	0.86		0.05
Clearance Time (s)	6.2	5.4	4.6	4.6		6.2
Vehicle Extension (s)	3.0	3.0	3.0	3.0		3.0
Lane Grp Cap (vph)	315	3554	2908	1300		70
v/s Ratio Prot	0.01	c0.49	c0.46			
v/s Ratio Perm	0.15			0.04		0.00
v/c Ratio	0.17	0.49	0.54	0.04		0.03
Uniform Delay, d1	1.4	0.0	2.1	1.2		50.2
Progression Factor	0.40	1.00	1.00	1.00		1.00
Incremental Delay, d2	0.2	0.3	0.7	0.1		0.2
Delay (s)	0.7	0.3	2.8	1.2		50.4
Level of Service	A	A	A	A		D
Approach Delay (s)		0.3	2.7		50.4	
Approach LOS		A	A		D	

Intersection Summary			
HCM 2000 Control Delay	2.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	10.8
Intersection Capacity Utilization	56.6%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group



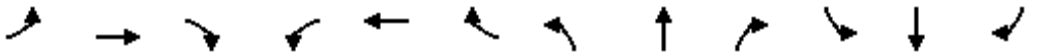
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	0	336	1526	0	275	1127
Future Volume (vph)	0	336	1526	0	275	1127
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)	0%		1%			5%
Total Lost time (s)		6.5	7.0		6.5	4.0
Lane Util. Factor		1.00	0.95		1.00	0.95
Frt		0.86	1.00		1.00	1.00
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		1337	3467		1650	3300
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		1337	3467		1650	3300
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	0	369	1677	0	302	1238
RTOR Reduction (vph)	0	13	0	0	0	0
Lane Group Flow (vph)	0	356	1677	0	302	1238
Heavy Vehicles (%)	21%	21%	2%	2%	5%	5%
Turn Type		Over	NA		Prot	NA
Protected Phases		4	2		4	Free
Permitted Phases						
Actuated Green, G (s)		28.9	57.6		28.9	100.0
Effective Green, g (s)		28.9	57.6		28.9	100.0
Actuated g/C Ratio		0.29	0.58		0.29	1.00
Clearance Time (s)		6.5	7.0		6.5	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)		386	1996		476	3300
v/s Ratio Prot		c0.27	c0.48		0.18	0.38
v/s Ratio Perm						
v/c Ratio		0.92	0.84		0.63	0.38
Uniform Delay, d1		34.5	17.4		31.0	0.0
Progression Factor		1.00	1.00		0.53	1.00
Incremental Delay, d2		27.2	4.5		2.3	0.3
Delay (s)		61.7	21.9		18.7	0.3
Level of Service		E	C		B	A
Approach Delay (s)	61.7		21.9			3.9
Approach LOS	E		C			A

Intersection Summary			
HCM 2000 Control Delay	18.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	75.9%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Future Build-Out (mitigated)

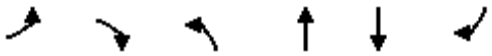
AM Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	790	190	30	170	115	40	15	1130	120	50	1580	920
Future Volume (vph)	790	190	30	170	115	40	15	1130	120	50	1580	920
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-2%			0%			0%			-5%	
Total Lost time (s)	8.9	8.9		8.8	8.8	8.8	7.5	7.5		8.7	9.5	4.0
Lane Util. Factor	0.97	1.00		1.00	1.00	1.00	1.00	0.91		1.00	0.95	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3414	1814		1601	1685	1432	1481	4194		1702	3405	1523
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.07	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3414	1814		1601	1685	1432	107	4194		1702	3405	1523
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	806	194	31	173	117	41	15	1153	122	51	1612	939
RTOR Reduction (vph)	0	4	0	0	0	0	0	8	0	0	0	0
Lane Group Flow (vph)	806	221	0	173	117	41	15	1267	0	51	1612	939
Heavy Vehicles (%)	2%	2%	2%	11%	11%	11%	20%	20%	20%	7%	7%	7%
Turn Type	Split	NA		Split	NA	Perm	Perm	NA		Prot	NA	Free
Protected Phases	7	7		8	8			2		1	6	
Permitted Phases						8	2					Free
Actuated Green, G (s)	36.1	36.1		16.2	16.2	16.2	58.1	58.1		7.4	69.2	151.7
Effective Green, g (s)	36.1	36.1		16.2	16.2	16.2	58.1	58.1		7.4	72.2	151.7
Actuated g/C Ratio	0.24	0.24		0.11	0.11	0.11	0.38	0.38		0.05	0.48	1.00
Clearance Time (s)	8.9	8.9		8.8	8.8	8.8	7.5	7.5		8.7	12.5	
Vehicle Extension (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)	812	431		170	179	152	40	1606		83	1620	1523
v/s Ratio Prot	c0.24	0.12		c0.11	0.07			0.30		0.03	c0.47	
v/s Ratio Perm						0.03	0.14					0.62
v/c Ratio	0.99	0.51		1.02	0.65	0.27	0.38	0.79		0.61	1.00	0.62
Uniform Delay, d1	57.7	50.2		67.8	65.1	62.3	33.7	41.4		70.8	39.6	0.0
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	29.6	1.4		73.7	9.1	1.3	7.9	2.8		14.5	21.1	1.9
Delay (s)	87.3	51.5		141.5	74.2	63.6	41.6	44.2		85.2	60.6	1.9
Level of Service	F	D		F	E	E	D	D		F	E	A
Approach Delay (s)		79.5			108.0			44.2			39.9	
Approach LOS		E			F			D			D	

Intersection Summary			
HCM 2000 Control Delay	53.0	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.05		
Actuated Cycle Length (s)	151.7	Sum of lost time (s)	33.9
Intersection Capacity Utilization	96.9%	ICU Level of Service	F
Analysis Period (min)	15		

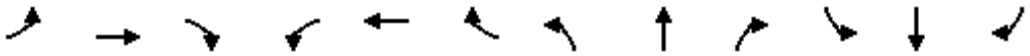
c Critical Lane Group



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	40	0	1260	1600	280
Future Volume (Veh/h)	0	40	0	1260	1600	280
Sign Control	Stop			Free	Free	
Grade	-10%			-2%	2%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	0	42	0	1313	1667	292
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	2470	980	1667			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2470	980	1667			
tC, single (s)	6.8	6.9	4.6			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.5			
p0 queue free %	100	83	100			
cM capacity (veh/h)	26	254	292			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	42	656	656	1111	848
Volume Left	0	0	0	0	0
Volume Right	42	0	0	0	292
cSH	254	1700	1700	1700	1700
Volume to Capacity	0.17	0.39	0.39	0.65	0.50
Queue Length 95th (m)	4.4	0.0	0.0	0.0	0.0
Control Delay (s)	22.0	0.0	0.0	0.0	0.0
Lane LOS	C				
Approach Delay (s)	22.0	0.0		0.0	
Approach LOS	C				

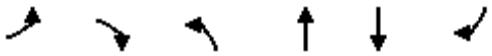
Intersection Summary				
Average Delay	0.3			
Intersection Capacity Utilization	64.6%	ICU Level of Service	C	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	40	0	0	130	0	1130	0	0	1380	260
Future Volume (Veh/h)	0	0	40	0	0	130	0	1130	0	0	1380	260
Sign Control		Stop			Stop			Free			Free	
Grade		-9%			0%			2%			0%	
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	0	0	41	0	0	133	0	1153	0	0	1408	265
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	2250	2694	836	1898	2826	576	1673			1153		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2250	2694	836	1898	2826	576	1673			1153		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.6			4.3		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.5			2.3		
p0 queue free %	100	100	87	100	100	71	100			100		
cM capacity (veh/h)	17	22	315	38	18	465	290			553		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	41	133	576	576	939	734
Volume Left	0	0	0	0	0	0
Volume Right	41	133	0	0	0	265
cSH	315	465	1700	1700	1700	1700
Volume to Capacity	0.13	0.29	0.34	0.34	0.55	0.43
Queue Length 95th (m)	3.4	8.9	0.0	0.0	0.0	0.0
Control Delay (s)	18.1	15.8	0.0	0.0	0.0	0.0
Lane LOS	C	C				
Approach Delay (s)	18.1	15.8	0.0		0.0	
Approach LOS	C	C				

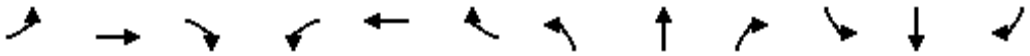
Intersection Summary				
Average Delay	0.9			
Intersection Capacity Utilization	57.7%	ICU Level of Service	B	
Analysis Period (min)	15			



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	240	550	550	1090	1390	60
Future Volume (vph)	240	550	550	1090	1390	60
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)	-5%			2%	2%	
Total Lost time (s)	6.2	6.0	6.0	6.0	6.2	6.2
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1786	1598	1571	3142	3199	1431
Flt Permitted	0.95	1.00	0.07	1.00	1.00	1.00
Satd. Flow (perm)	1786	1598	120	3142	3199	1431
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	264	604	604	1198	1527	66
RTOR Reduction (vph)	0	3	0	0	0	15
Lane Group Flow (vph)	264	601	604	1198	1527	51
Heavy Vehicles (%)	2%	2%	12%	12%	10%	10%
Turn Type	Prot	pm+ov	pm+pt	NA	NA	Perm
Protected Phases	4	5	5	2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	18.8	52.8	89.0	89.0	48.8	48.8
Effective Green, g (s)	18.8	52.8	89.0	89.0	48.8	48.8
Actuated g/C Ratio	0.16	0.44	0.74	0.74	0.41	0.41
Clearance Time (s)	6.2	6.0	6.0	6.0	6.2	6.2
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	279	703	500	2330	1300	581
v/s Ratio Prot	c0.15	0.24	c0.34	0.38	0.48	
v/s Ratio Perm		0.13	c0.55			0.04
v/c Ratio	0.95	0.85	1.21	0.51	1.17	0.09
Uniform Delay, d1	50.1	30.2	37.5	6.5	35.6	21.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	39.2	9.9	111.2	0.8	87.0	0.3
Delay (s)	89.3	40.1	148.7	7.3	122.6	22.2
Level of Service	F	D	F	A	F	C
Approach Delay (s)	55.0			54.7	118.4	
Approach LOS	E			D	F	

Intersection Summary			
HCM 2000 Control Delay	78.6	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.19		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.4
Intersection Capacity Utilization	99.7%	ICU Level of Service	F
Analysis Period (min)	15		

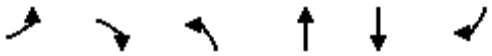
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	5	0	0	0	0	1580	5	0	1850	85
Future Volume (Veh/h)	0	0	5	0	0	0	0	1580	5	0	1850	85
Sign Control		Stop			Yield			Free			Free	
Grade		-12%			6%			0%			-3%	
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	0	0	5	0	0	0	0	1629	5	0	1907	88
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)											168	
pX, platoon unblocked	0.61	0.61	0.61	0.61	0.61		0.61					
vC, conflicting volume	2766	3580	998	2590	3626	817	1995			1629		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2615	3953	0	2326	4029	817	1349			1629		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.3			4.2		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.3			2.3		
p0 queue free %	100	100	99	100	100	100	100			100		
cM capacity (veh/h)	8	2	664	12	2	323	278			373		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	5	0	1086	548	1271	724
Volume Left	0	0	0	0	0	0
Volume Right	5	0	0	5	0	88
cSH	664	1700	1700	1700	1700	1700
Volume to Capacity	0.01	0.00	0.64	0.32	0.75	0.43
Queue Length 95th (m)	0.2	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	10.5	0.0	0.0	0.0	0.0	0.0
Lane LOS	B	A				
Approach Delay (s)	10.5	0.0	0.0		0.0	
Approach LOS	B	A				

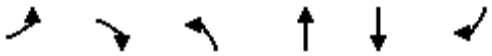
Intersection Summary				
Average Delay	0.0			
Intersection Capacity Utilization	65.3%	ICU Level of Service	C	
Analysis Period (min)	15			



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	20	100	50	1660	1900	30
Future Volume (vph)	20	100	50	1660	1900	30
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)	-12%			1%	-1%	
Total Lost time (s)	8.4	8.4	6.0	5.5	5.5	5.5
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1884	1685	1622	3244	3338	1493
Flt Permitted	0.95	1.00	0.06	1.00	1.00	1.00
Satd. Flow (perm)	1884	1685	97	3244	3338	1493
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	21	105	53	1747	2000	32
RTOR Reduction (vph)	0	94	0	0	0	5
Lane Group Flow (vph)	21	11	53	1747	2000	27
Heavy Vehicles (%)	0%	0%	9%	9%	7%	7%
Turn Type	Prot	Perm	pm+pt	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	5.1	5.1	76.0	76.0	64.7	64.7
Effective Green, g (s)	10.1	10.1	76.0	76.0	64.7	64.7
Actuated g/C Ratio	0.10	0.10	0.76	0.76	0.65	0.65
Clearance Time (s)	13.4	13.4	6.0	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	190	170	154	2465	2159	965
v/s Ratio Prot	c0.01		0.02	c0.54	c0.60	
v/s Ratio Perm		0.01	0.24			0.02
v/c Ratio	0.11	0.06	0.34	0.71	0.93	0.03
Uniform Delay, d1	40.9	40.7	18.0	6.2	15.6	6.3
Progression Factor	1.00	1.00	2.23	0.35	1.00	1.00
Incremental Delay, d2	0.3	0.2	0.9	1.2	8.4	0.1
Delay (s)	41.1	40.8	41.0	3.4	23.9	6.4
Level of Service	D	D	D	A	C	A
Approach Delay (s)	40.9			4.5	23.6	
Approach LOS	D			A	C	

Intersection Summary			
HCM 2000 Control Delay	15.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	19.9
Intersection Capacity Utilization	71.9%	ICU Level of Service	C
Analysis Period (min)	15		

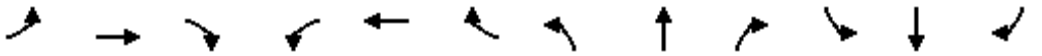
c Critical Lane Group



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	90	340	0	370	460	350
Future Volume (vph)	90	340	0	370	460	350
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)	-10%			-1%	7%	
Total Lost time (s)	9.6	9.6		6.4	6.4	13.6
Lane Util. Factor	1.00	1.00		0.95	0.95	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	0.95	1.00		1.00	1.00	1.00
Satd. Flow (prot)	1696	1518		3572	3362	1504
Flt Permitted	0.95	1.00		1.00	1.00	1.00
Satd. Flow (perm)	1696	1518		3572	3362	1504
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	92	347	0	378	469	357
RTOR Reduction (vph)	0	254	0	0	0	0
Lane Group Flow (vph)	92	93	0	378	469	357
Heavy Vehicles (%)	10%	10%	0%	0%	2%	2%
Turn Type	Prot	Perm		NA	NA	custom
Protected Phases	6			4	7 8	6
Permitted Phases		6				7
Actuated Green, G (s)	12.3	12.3		57.7	57.7	36.4
Effective Green, g (s)	16.3	16.3		57.7	51.7	36.4
Actuated g/C Ratio	0.18	0.18		0.64	0.57	0.40
Clearance Time (s)	13.6	13.6		6.4		13.6
Vehicle Extension (s)	3.0	3.0		3.0		3.0
Lane Grp Cap (vph)	307	274		2290	1931	608
v/s Ratio Prot	0.05			0.11	c0.14	c0.08
v/s Ratio Perm		0.06				0.16
v/c Ratio	0.30	0.34		0.17	0.24	0.59
Uniform Delay, d1	31.9	32.2		6.5	9.5	20.9
Progression Factor	0.78	0.44		1.00	1.00	1.00
Incremental Delay, d2	0.5	0.7		0.2	0.1	1.5
Delay (s)	25.6	15.0		6.6	9.5	22.4
Level of Service	C	B		A	A	C
Approach Delay (s)	17.2			6.6	15.1	
Approach LOS	B			A	B	

Intersection Summary			
HCM 2000 Control Delay	13.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.44		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	26.0
Intersection Capacity Utilization	48.0%	ICU Level of Service	A
Analysis Period (min)	15		

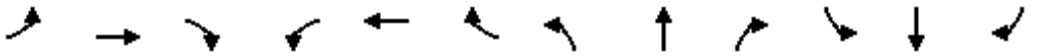
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	260	1020	340	40	0	50	40	80	60	150	100
Future Volume (vph)	0	260	1020	340	40	0	50	40	80	60	150	100
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-5%			10%			-4%			8%	
Total Lost time (s)		4.5	4.0	3.5	4.5			4.5	3.5		4.5	4.5
Lane Util. Factor		1.00	1.00	1.00	1.00			1.00	1.00		1.00	1.00
Frt		1.00	0.85	1.00	1.00			1.00	0.85		1.00	0.85
Flt Protected		1.00	1.00	0.95	1.00			0.97	1.00		0.99	1.00
Satd. Flow (prot)		1712	1455	1623	1709			1785	1559		1770	1526
Flt Permitted		1.00	1.00	0.52	1.00			0.61	1.00		0.88	1.00
Satd. Flow (perm)		1712	1455	889	1709			1110	1559		1581	1526
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	265	1041	347	41	0	51	41	82	61	153	102
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	54	0	0	82
Lane Group Flow (vph)	0	265	1041	347	41	0	0	92	28	0	214	20
Heavy Vehicles (%)	12%	12%	12%	4%	4%	4%	4%	4%	4%	0%	0%	0%
Turn Type		NA	Free	pm+pt	NA	Perm	Perm	NA	pm+ov	Perm	NA	Perm
Protected Phases		4		3	8			2	3		6	
Permitted Phases			Free	8		8	2		2	6		6
Actuated Green, G (s)		47.0	90.0	63.6	63.6			17.4	30.5		17.4	17.4
Effective Green, g (s)		47.0	90.0	63.6	63.6			17.4	30.5		17.4	17.4
Actuated g/C Ratio		0.52	1.00	0.71	0.71			0.19	0.34		0.19	0.19
Clearance Time (s)		4.5		3.5	4.5			4.5	3.5		4.5	4.5
Vehicle Extension (s)		3.0		3.0	3.0			3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		894	1455	735	1207			214	528		305	295
v/s Ratio Prot		0.15		0.07	0.02				0.01			
v/s Ratio Perm			c0.72	0.27				0.08	0.01		0.14	0.01
v/c Ratio		0.30	0.72	0.47	0.03			0.43	0.05		0.70	0.07
Uniform Delay, d1		12.2	0.0	5.3	4.0			31.9	20.0		33.9	29.7
Progression Factor		1.00	1.00	0.48	0.10			1.00	1.00		1.00	1.00
Incremental Delay, d2		0.8	3.0	0.5	0.1			1.4	0.0		7.1	0.1
Delay (s)		13.0	3.0	3.0	0.4			33.3	20.1		41.0	29.8
Level of Service		B	A	A	A			C	C		D	C
Approach Delay (s)		5.1			2.7			27.1			37.4	
Approach LOS		A			A			C			D	

Intersection Summary			
HCM 2000 Control Delay	11.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	65.3%	ICU Level of Service	C
Analysis Period (min)	15		

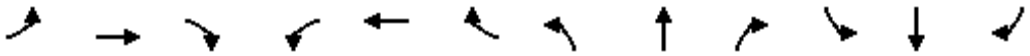
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1350	100	0	1675	135	55	275	365	0	470	15
Future Volume (vph)	0	1350	100	0	1675	135	55	275	365	0	470	15
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-1%			-2%			-6%			1%	
Total Lost time (s)		5.5			5.5	5.5	6.0	5.9	5.9		5.9	5.9
Lane Util. Factor		0.95			0.95	1.00	1.00	1.00	1.00		1.00	1.00
Frt		0.99			1.00	0.85	1.00	1.00	0.85		1.00	0.85
Flt Protected		1.00			1.00	1.00	0.95	1.00	1.00		1.00	1.00
Satd. Flow (prot)		3367			3519	1574	1830	1927	1638		1861	1582
Flt Permitted		1.00			1.00	1.00	0.11	1.00	1.00		1.00	1.00
Satd. Flow (perm)		3367			3519	1574	209	1927	1638		1861	1582
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	1436	106	0	1782	144	59	293	388	0	500	16
RTOR Reduction (vph)	0	4	0	0	0	41	0	0	14	0	0	11
Lane Group Flow (vph)	0	1538	0	0	1782	103	59	293	374	0	500	5
Heavy Vehicles (%)	5%	5%	5%	2%	2%	2%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA	Perm	pm+pt	NA	Perm		NA	Perm
Protected Phases		6			2		7	4			8	
Permitted Phases						2	4		4			8
Actuated Green, G (s)		59.9			59.9	59.9	48.7	48.7	48.7		35.9	35.9
Effective Green, g (s)		59.9			59.9	59.9	48.7	48.7	48.7		35.9	35.9
Actuated g/C Ratio		0.50			0.50	0.50	0.41	0.41	0.41		0.30	0.30
Clearance Time (s)		5.5			5.5	5.5	6.0	5.9	5.9		5.9	5.9
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1680			1756	785	176	782	664		556	473
v/s Ratio Prot		0.46			c0.51		0.02	0.15			c0.27	
v/s Ratio Perm						0.07	0.12		c0.23			0.00
v/c Ratio		0.92			1.01	0.13	0.34	0.37	0.56		0.90	0.01
Uniform Delay, d1		27.7			30.1	16.1	26.6	25.0	27.5		40.3	29.6
Progression Factor		0.88			0.49	0.20	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2		3.9			19.4	0.2	1.1	0.3	1.1		17.3	0.0
Delay (s)		28.4			34.2	3.4	27.7	25.3	28.6		57.6	29.6
Level of Service		C			C	A	C	C	C		E	C
Approach Delay (s)		28.4			31.9			27.2			56.7	
Approach LOS		C			C			C			E	

Intersection Summary			
HCM 2000 Control Delay	32.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.4
Intersection Capacity Utilization	91.6%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	180	870	40	280	1290	95	100	440	165	410	675	135
Future Volume (vph)	180	870	40	280	1290	95	100	440	165	410	675	135
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-2%			1%			-1%			-2%	
Total Lost time (s)	6.6	6.1	6.1	6.3	6.1		6.4	6.1		6.5	6.1	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	0.95		0.97	0.95	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	0.96		1.00	0.97	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1709	3419	1529	1733	3431		1786	3425		3380	3398	
Flt Permitted	0.11	1.00	1.00	0.09	1.00		0.16	1.00		0.95	1.00	
Satd. Flow (perm)	195	3419	1529	169	3431		295	3425		3380	3398	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	191	926	43	298	1372	101	106	468	176	436	718	144
RTOR Reduction (vph)	0	0	30	0	4	0	0	32	0	0	14	0
Lane Group Flow (vph)	191	926	13	298	1469	0	106	612	0	436	848	0
Heavy Vehicles (%)	5%	5%	5%	2%	2%	2%	0%	0%	0%	3%	3%	3%
Turn Type	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA		Prot	NA	
Protected Phases	1	6		5	2		3	8		7	4	
Permitted Phases	6		6	2			8					
Actuated Green, G (s)	46.7	36.9	36.9	61.3	44.9		33.8	25.5		14.5	31.8	
Effective Green, g (s)	46.7	36.9	36.9	61.3	44.9		33.8	25.5		14.5	31.8	
Actuated g/C Ratio	0.39	0.31	0.31	0.51	0.37		0.28	0.21		0.12	0.27	
Clearance Time (s)	6.6	6.1	6.1	6.3	6.1		6.4	6.1		6.5	6.1	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	199	1051	470	322	1283		186	727		408	900	
v/s Ratio Prot	0.08	0.27		c0.14	c0.43		0.04	0.18		c0.13	c0.25	
v/s Ratio Perm	0.29		0.01	0.33			0.12					
v/c Ratio	0.96	0.88	0.03	0.93	1.14		0.57	0.84		1.07	0.94	
Uniform Delay, d1	30.2	39.5	29.0	35.2	37.5		34.3	45.3		52.8	43.2	
Progression Factor	1.44	0.85	1.00	1.16	0.48		1.00	1.00		1.00	1.00	
Incremental Delay, d2	43.3	8.1	0.1	13.0	68.3		4.0	8.7		64.0	17.6	
Delay (s)	86.7	41.7	29.1	54.0	86.3		38.3	54.0		116.8	60.8	
Level of Service	F	D	C	D	F		D	D		F	E	
Approach Delay (s)		48.6			80.9			51.8			79.6	
Approach LOS		D			F			D			E	

Intersection Summary			
HCM 2000 Control Delay	68.7	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.13		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	25.3
Intersection Capacity Utilization	101.0%	ICU Level of Service	G
Analysis Period (min)	15		

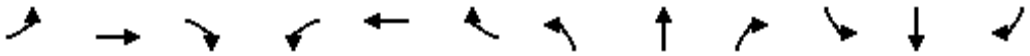
c Critical Lane Group



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	1155	485	415	760	390	650
Future Volume (vph)	1155	485	415	760	390	650
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)	6%		0%			-4%
Total Lost time (s)	5.3	5.3	6.0	4.0	6.2	6.0
Lane Util. Factor	0.97	1.00	1.00	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3247	1497	1781	1514	1813	3625
Flt Permitted	0.95	1.00	1.00	1.00	0.17	1.00
Satd. Flow (perm)	3247	1497	1781	1514	326	3625
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	1216	511	437	800	411	684
RTOR Reduction (vph)	0	101	0	0	0	0
Lane Group Flow (vph)	1216	410	437	800	411	684
Heavy Vehicles (%)	3%	3%	5%	5%	0%	0%
Turn Type	Prot	custom	NA	Free	pm+pt	NA
Protected Phases	8	8	2		1	6
Permitted Phases		1		Free	6	
Actuated Green, G (s)	46.0	67.4	35.1	120.0	62.7	62.7
Effective Green, g (s)	46.0	67.4	35.1	120.0	62.7	62.7
Actuated g/C Ratio	0.38	0.56	0.29	1.00	0.52	0.52
Clearance Time (s)	5.3	5.3	6.0		6.2	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	1244	906	520	1514	435	1894
v/s Ratio Prot	c0.37	0.17	0.25		c0.17	0.19
v/s Ratio Perm		0.10		0.53	c0.32	
v/c Ratio	0.98	0.45	0.84	0.53	0.94	0.36
Uniform Delay, d1	36.5	15.5	39.8	0.0	28.2	16.9
Progression Factor	0.34	0.23	1.00	1.00	1.69	1.63
Incremental Delay, d2	4.0	0.0	11.7	1.3	4.8	0.0
Delay (s)	16.5	3.6	51.5	1.3	52.5	27.4
Level of Service	B	A	D	A	D	C
Approach Delay (s)	12.7		19.0			36.8
Approach LOS	B		B			D

Intersection Summary			
HCM 2000 Control Delay	21.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.5
Intersection Capacity Utilization	92.9%	ICU Level of Service	F
Analysis Period (min)	15		

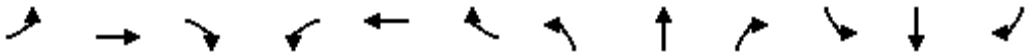
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	30	365	115	5	185	10	165	700	70	70	995	105
Future Volume (vph)	30	365	115	5	185	10	165	700	70	70	995	105
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-3%			1%			1%			-7%	
Total Lost time (s)	5.4	5.4		5.4	5.4		6.0	5.7		5.7	5.7	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.96		1.00	0.99		1.00	0.99		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)	1623	1647		1591	1663		1591	1652		1655	1718	
Flt Permitted	0.50	1.00		0.14	1.00		0.06	1.00		0.29	1.00	
Satd. Flow (perm)	856	1647		226	1663		95	1652		514	1718	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	31	380	120	5	193	10	172	729	73	73	1036	109
RTOR Reduction (vph)	0	10	0	0	2	0	0	3	0	0	3	0
Lane Group Flow (vph)	31	490	0	5	201	0	172	799	0	73	1142	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			8		5	2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	29.6	29.6		29.6	29.6		79.3	79.3		64.3	64.3	
Effective Green, g (s)	29.6	29.6		29.6	29.6		79.3	79.3		64.3	64.3	
Actuated g/C Ratio	0.25	0.25		0.25	0.25		0.66	0.66		0.54	0.54	
Clearance Time (s)	5.4	5.4		5.4	5.4		6.0	5.7		5.7	5.7	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	211	406		55	410		174	1091		275	920	
v/s Ratio Prot		c0.30			0.12		0.07	c0.48			c0.66	
v/s Ratio Perm	0.04			0.02			0.57			0.14		
v/c Ratio	0.15	1.21		0.09	0.49		0.99	0.73		0.27	1.24	
Uniform Delay, d1	35.3	45.2		34.8	38.7		40.1	13.4		15.1	27.9	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.3	114.4		0.7	0.9		64.2	4.4		2.3	117.7	
Delay (s)	35.7	159.6		35.6	39.7		104.3	17.7		17.4	145.6	
Level of Service	D	F		D	D		F	B		B	F	
Approach Delay (s)		152.4			39.6			33.0			137.9	
Approach LOS		F			D			C			F	

Intersection Summary			
HCM 2000 Control Delay	98.7	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.21		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.1
Intersection Capacity Utilization	121.6%	ICU Level of Service	H
Analysis Period (min)	15		

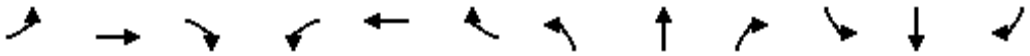
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	85	205	215	120	170	85	0	635	90	25	915	10
Future Volume (vph)	85	205	215	120	170	85	0	635	90	25	915	10
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-9%			11%			9%			-9%	
Total Lost time (s)	5.5	5.5		5.5	5.5			5.5			7.5	
Lane Util. Factor	1.00	1.00		1.00	1.00			0.95			0.95	
Frt	1.00	0.92		1.00	0.95			0.98			1.00	
Flt Protected	0.95	1.00		0.95	1.00			1.00			1.00	
Satd. Flow (prot)	1821	1769		1646	1646			3143			3527	
Flt Permitted	0.51	1.00		0.29	1.00			1.00			0.91	
Satd. Flow (perm)	982	1769		510	1646			3143			3199	
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	97	233	244	136	193	97	0	722	102	28	1040	11
RTOR Reduction (vph)	0	14	0	0	25	0	0	11	0	0	1	0
Lane Group Flow (vph)	97	463	0	136	265	0	0	813	0	0	1078	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	6%	6%	6%	5%	5%	5%
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	
Protected Phases		4			4			6			2	
Permitted Phases	4			4			6			2		
Actuated Green, G (s)	27.7	27.7		27.7	27.7			35.0			29.5	
Effective Green, g (s)	27.7	27.7		27.7	27.7			35.0			33.0	
Actuated g/C Ratio	0.38	0.38		0.38	0.38			0.47			0.45	
Clearance Time (s)	5.5	5.5		5.5	5.5			5.5			11.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)	369	664		191	618			1492			1432	
v/s Ratio Prot		0.26			0.16			0.26				
v/s Ratio Perm	0.10			c0.27							c0.34	
v/c Ratio	0.26	0.70		0.71	0.43			0.55			0.75	
Uniform Delay, d1	15.9	19.5		19.6	17.1			13.7			17.0	
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2	0.4	3.2		11.8	0.5			1.4			3.7	
Delay (s)	16.3	22.7		31.4	17.6			15.1			20.7	
Level of Service	B	C		C	B			B			C	
Approach Delay (s)		21.6			22.0			15.1			20.7	
Approach LOS		C			C			B			C	

Intersection Summary			
HCM 2000 Control Delay	19.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	73.7	Sum of lost time (s)	13.0
Intersection Capacity Utilization	99.0%	ICU Level of Service	F
Analysis Period (min)	15		

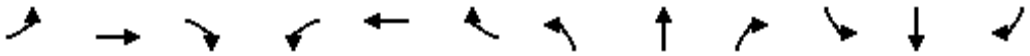
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	15	120	195	250	95	0	170	100	145	0	50	25
Future Volume (vph)	15	120	195	250	95	0	170	100	145	0	50	25
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	16	126	205	263	100	0	179	105	153	0	53	26

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	347	363	437	79
Volume Left (vph)	16	263	179	0
Volume Right (vph)	205	0	153	26
Hadj (s)	-0.35	0.14	-0.13	-0.20
Departure Headway (s)	6.1	6.5	6.2	7.1
Degree Utilization, x	0.59	0.65	0.75	0.16
Capacity (veh/h)	548	517	558	398
Control Delay (s)	17.3	20.9	25.3	11.4
Approach Delay (s)	17.3	20.9	25.3	11.4
Approach LOS	C	C	D	B

Intersection Summary				
Delay	20.9			
Level of Service	C			
Intersection Capacity Utilization	79.8%	ICU Level of Service	D	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	210	15	55	10	90	10	70	70	5	0	50	260
Future Volume (vph)	210	15	55	10	90	10	70	70	5	0	50	260
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Hourly flow rate (vph)	236	17	62	11	101	11	79	79	6	0	56	292

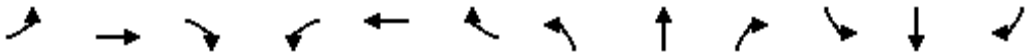
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	315	123	164	348
Volume Left (vph)	236	11	79	0
Volume Right (vph)	62	11	6	292
Hadj (s)	0.03	-0.04	0.11	-0.50
Departure Headway (s)	5.5	5.8	5.8	5.0
Degree Utilization, x	0.48	0.20	0.27	0.48
Capacity (veh/h)	607	539	548	676
Control Delay (s)	13.6	10.3	10.9	12.4
Approach Delay (s)	13.6	10.3	10.9	12.4
Approach LOS	B	B	B	B

Intersection Summary				
Delay	12.3			
Level of Service	B			
Intersection Capacity Utilization	60.1%	ICU Level of Service	B	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	200	30	0	30	0	430	180	160	550	65
Future Volume (vph)	0	0	200	30	0	30	0	430	180	160	550	65
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-9%			10%			4%			-7%	
Total Lost time (s)			5.4		5.4			5.2		5.2	5.2	
Lane Util. Factor			1.00		1.00			1.00		1.00	1.00	
Frt			0.86		0.93			0.96		1.00	0.98	
Flt Protected			1.00		0.98			1.00		0.95	1.00	
Satd. Flow (prot)			1691		1617			1709		1768	1832	
Flt Permitted			1.00		0.98			1.00		0.34	1.00	
Satd. Flow (perm)			1691		1617			1709		640	1832	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	0	0	208	31	0	31	0	448	188	167	573	68
RTOR Reduction (vph)	0	0	172	0	33	0	0	21	0	0	6	0
Lane Group Flow (vph)	0	0	36	0	29	0	0	615	0	167	635	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	3%	3%	4%	4%	4%
Turn Type			Perm	Perm	NA			NA		Perm	NA	
Protected Phases					8			2			6	
Permitted Phases			4	8						6		
Actuated Green, G (s)			7.5		7.5			25.0		25.0	25.0	
Effective Green, g (s)			7.5		7.5			25.0		25.0	25.0	
Actuated g/C Ratio			0.17		0.17			0.58		0.58	0.58	
Clearance Time (s)			5.4		5.4			5.2		5.2	5.2	
Vehicle Extension (s)			3.0		3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)			294		281			991		371	1062	
v/s Ratio Prot								c0.36			0.35	
v/s Ratio Perm			c0.02		0.02					0.26		
v/c Ratio			0.12		0.10			0.62		0.45	0.60	
Uniform Delay, d1			15.0		15.0			5.9		5.1	5.8	
Progression Factor			1.00		1.00			1.00		1.00	1.00	
Incremental Delay, d2			0.2		0.2			1.2		0.9	0.9	
Delay (s)			15.2		15.1			7.2		6.0	6.7	
Level of Service			B		B			A		A	A	
Approach Delay (s)		15.2			15.1			7.2			6.6	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	8.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	43.1	Sum of lost time (s)	10.6
Intersection Capacity Utilization	65.7%	ICU Level of Service	C
Analysis Period (min)	15		

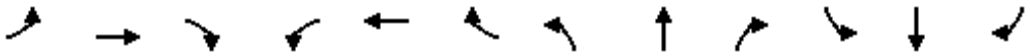
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	20	130	15	40	50	110	0	360	120	100	730	30
Future Volume (vph)	20	130	15	40	50	110	0	360	120	100	730	30
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-6%			7%			7%			-7%	
Total Lost time (s)		5.3			5.3			5.0		5.0	5.0	
Lane Util. Factor		1.00			1.00			1.00		1.00	1.00	
Frt		0.99			0.93			0.97		1.00	0.99	
Flt Protected		0.99			0.99			1.00		0.95	1.00	
Satd. Flow (prot)		1892			1622			1571		1719	1799	
Flt Permitted		0.95			0.91			1.00		0.42	1.00	
Satd. Flow (perm)		1807			1494			1571		752	1799	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	22	140	16	43	54	118	0	387	129	108	785	32
RTOR Reduction (vph)	0	4	0	0	52	0	0	14	0	0	2	0
Lane Group Flow (vph)	0	174	0	0	163	0	0	502	0	108	815	0
Heavy Vehicles (%)	0%	0%	0%	2%	2%	2%	11%	11%	11%	7%	7%	7%
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		12.7			12.7			34.8		34.8	34.8	
Effective Green, g (s)		12.7			12.7			34.8		34.8	34.8	
Actuated g/C Ratio		0.22			0.22			0.60		0.60	0.60	
Clearance Time (s)		5.3			5.3			5.0		5.0	5.0	
Vehicle Extension (s)		3.0			3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)		397			328			945		452	1083	
v/s Ratio Prot								0.32			c0.45	
v/s Ratio Perm		0.10			c0.11					0.14		
v/c Ratio		0.44			0.50			0.53		0.24	0.75	
Uniform Delay, d1		19.5			19.7			6.7		5.3	8.4	
Progression Factor		1.00			1.00			1.00		1.00	1.00	
Incremental Delay, d2		0.8			1.2			0.6		0.3	3.0	
Delay (s)		20.2			20.9			7.3		5.6	11.4	
Level of Service		C			C			A		A	B	
Approach Delay (s)		20.2			20.9			7.3			10.7	
Approach LOS		C			C			A			B	

Intersection Summary			
HCM 2000 Control Delay	11.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	57.8	Sum of lost time (s)	10.3
Intersection Capacity Utilization	100.1%	ICU Level of Service	G
Analysis Period (min)	15		

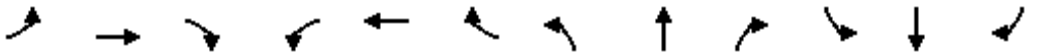
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	55	80	80	90	80	70	10	430	50	30	750	30
Future Volume (vph)	55	80	80	90	80	70	10	430	50	30	750	30
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-2%			5%			0%			0%	
Total Lost time (s)		4.0			4.0			4.0			4.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.95			0.96			0.99			0.99	
Flt Protected		0.99			0.98			1.00			1.00	
Satd. Flow (prot)		1720			1686			1631			1769	
Flt Permitted		0.87			0.78			0.98			0.97	
Satd. Flow (perm)		1514			1340			1605			1727	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	58	84	84	95	84	74	11	453	53	32	789	32
RTOR Reduction (vph)	0	38	0	0	26	0	0	6	0	0	2	0
Lane Group Flow (vph)	0	188	0	0	227	0	0	511	0	0	851	0
Heavy Vehicles (%)	3%	3%	3%	2%	2%	2%	13%	13%	13%	5%	5%	5%
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)		13.0			13.0			31.1			31.1	
Effective Green, g (s)		13.0			13.0			31.1			31.1	
Actuated g/C Ratio		0.25			0.25			0.60			0.60	
Clearance Time (s)		4.0			4.0			4.0			4.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		377			334			958			1030	
v/s Ratio Prot												
v/s Ratio Perm		0.12			c0.17			0.32			c0.49	
v/c Ratio		0.50			0.68			0.53			0.83	
Uniform Delay, d1		16.8			17.7			6.2			8.3	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		1.0			5.4			0.6			5.5	
Delay (s)		17.8			23.1			6.8			13.9	
Level of Service		B			C			A			B	
Approach Delay (s)		17.8			23.1			6.8			13.9	
Approach LOS		B			C			A			B	

Intersection Summary			
HCM 2000 Control Delay	13.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	52.1	Sum of lost time (s)	8.0
Intersection Capacity Utilization	86.5%	ICU Level of Service	E
Analysis Period (min)	15		

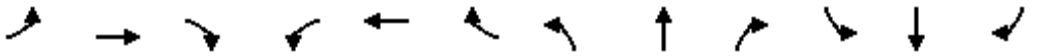
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	680	30	0	950	10	0	0	40	0	0	130
Future Volume (Veh/h)	0	680	30	0	950	10	0	0	40	0	0	130
Sign Control		Free			Free			Stop			Stop	
Grade		-9%			7%			1%			2%	
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)	0	739	33	0	1033	11	0	0	43	0	0	141
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	1044			772			1935	1800	756	1837	1810	1038
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1044			772			1935	1800	756	1837	1810	1038
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	89	100	100	50
cM capacity (veh/h)	666			843			25	80	408	53	79	283

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	772	1044	43	141
Volume Left	0	0	0	0
Volume Right	33	11	43	141
cSH	1700	1700	408	283
Volume to Capacity	0.45	0.61	0.11	0.50
Queue Length 95th (m)	0.0	0.0	2.7	19.8
Control Delay (s)	0.0	0.0	14.9	29.8
Lane LOS			B	D
Approach Delay (s)	0.0	0.0	14.9	29.8
Approach LOS			B	D

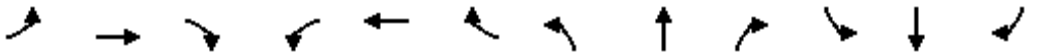
Intersection Summary			
Average Delay	2.4		
Intersection Capacity Utilization	66.9%	ICU Level of Service	C
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	260	515	5	205	510	95	15	350	130	165	655	400
Future Volume (vph)	260	515	5	205	510	95	15	350	130	165	655	400
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-5%			3%			1%			2%	
Total Lost time (s)	5.0	5.0		5.0	5.0			5.0		5.0	5.0	5.0
Lane Util. Factor	0.91	0.91		1.00	0.95			0.95		1.00	1.00	1.00
Frt	1.00	1.00		1.00	0.98			0.96		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00		0.95	1.00	1.00
Satd. Flow (prot)	1625	3408		1667	3256			3261		1725	1816	1543
Flt Permitted	0.95	1.00		0.95	1.00			0.80		0.40	1.00	1.00
Satd. Flow (perm)	1625	3408		1667	3256			2622		728	1816	1543
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	268	531	5	211	526	98	15	361	134	170	675	412
RTOR Reduction (vph)	0	1	0	0	15	0	0	36	0	0	0	239
Lane Group Flow (vph)	241	562	0	211	609	0	0	474	0	170	675	173
Heavy Vehicles (%)	2%	2%	2%	5%	5%	5%	4%	4%	4%	2%	2%	2%
Turn Type	Split	NA		Split	NA		Perm	NA		Perm	NA	Perm
Protected Phases	4	4		3	3			6			2	
Permitted Phases							6			2		2
Actuated Green, G (s)	22.8	22.8		20.8	20.8			38.6		38.6	38.6	38.6
Effective Green, g (s)	22.8	22.8		20.8	20.8			38.6		38.6	38.6	38.6
Actuated g/C Ratio	0.23	0.23		0.21	0.21			0.40		0.40	0.40	0.40
Clearance Time (s)	5.0	5.0		5.0	5.0			5.0		5.0	5.0	5.0
Vehicle Extension (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	4.0
Lane Grp Cap (vph)	381	799		356	696			1041		289	721	612
v/s Ratio Prot	0.15	c0.16		0.13	c0.19						c0.37	
v/s Ratio Perm								0.18		0.23		0.11
v/c Ratio	0.63	0.70		0.59	0.88			0.46		0.59	0.94	0.28
Uniform Delay, d1	33.4	34.1		34.4	36.9			21.6		23.0	28.1	19.9
Progression Factor	1.00	1.00		1.00	1.00			1.00		1.00	1.00	1.00
Incremental Delay, d2	3.8	3.0		3.1	12.2			0.4		3.6	19.6	0.3
Delay (s)	37.3	37.1		37.5	49.1			22.0		26.6	47.7	20.2
Level of Service	D	D		D	D			C		C	D	C
Approach Delay (s)		37.2			46.2			22.0			35.9	
Approach LOS		D			D			C			D	

Intersection Summary			
HCM 2000 Control Delay	36.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	97.2	Sum of lost time (s)	15.0
Intersection Capacity Utilization	99.3%	ICU Level of Service	F
Analysis Period (min)	15		

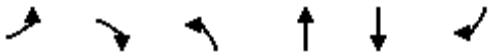
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	230	430	130	80	470	550	20	30	120	500	20	320
Future Volume (vph)	230	430	130	80	470	550	20	30	120	500	20	320
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-9%			3%			-2%			0%	
Total Lost time (s)	6.3	5.7		5.7	5.7		5.5	5.5		6.0	5.5	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		0.97	1.00	
Frt	1.00	0.97		1.00	0.92		1.00	0.88		1.00	0.86	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1786	3447		1651	3035		1795	1663		2897	1350	
Flt Permitted	0.09	1.00		0.41	1.00		0.54	1.00		0.95	1.00	
Satd. Flow (perm)	165	3447		718	3035		1011	1663		2897	1350	
Peak-hour factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	258	483	146	90	528	618	22	34	135	562	22	360
RTOR Reduction (vph)	0	22	0	0	169	0	0	123	0	0	230	0
Lane Group Flow (vph)	258	607	0	90	977	0	22	46	0	562	152	0
Heavy Vehicles (%)	4%	4%	4%	6%	6%	6%	0%	0%	0%	19%	19%	19%
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Prot	NA	
Protected Phases	1	6			2			4		3	8	
Permitted Phases	6			2			4					
Actuated Green, G (s)	59.3	59.3		39.3	39.3		10.0	10.0		24.0	40.0	
Effective Green, g (s)	59.3	59.3		39.3	39.3		10.0	10.0		24.0	40.0	
Actuated g/C Ratio	0.54	0.54		0.36	0.36		0.09	0.09		0.22	0.36	
Clearance Time (s)	6.3	5.7		5.7	5.7		5.5	5.5		6.0	5.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		4.0	4.0		3.0	3.0	
Lane Grp Cap (vph)	289	1849		255	1079		91	150		629	488	
v/s Ratio Prot	c0.11	0.18			0.32			0.03		c0.19	c0.11	
v/s Ratio Perm	c0.37			0.13			0.02					
v/c Ratio	0.89	0.33		0.35	0.91		0.24	0.31		0.89	0.31	
Uniform Delay, d1	31.2	14.4		26.2	33.8		46.7	47.0		42.0	25.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	27.3	0.1		0.8	10.7		1.9	1.6		15.1	0.4	
Delay (s)	58.5	14.5		27.1	44.5		48.6	48.6		57.1	25.7	
Level of Service	E	B		C	D		D	D		E	C	
Approach Delay (s)		27.3			43.2			48.6			44.4	
Approach LOS		C			D			D			D	

Intersection Summary			
HCM 2000 Control Delay	39.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	110.5	Sum of lost time (s)	23.5
Intersection Capacity Utilization	91.0%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	75	585	315	350	630	15
Future Volume (vph)	75	585	315	350	630	15
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)	-10%			-6%	13%	
Total Lost time (s)	5.0	6.0		6.1	6.1	
Lane Util. Factor	1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		0.98	1.00	
Satd. Flow (prot)	1866	1669		1882	1743	
Flt Permitted	0.95	1.00		0.22	1.00	
Satd. Flow (perm)	1866	1669		433	1743	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	79	616	332	368	663	16
RTOR Reduction (vph)	0	82	0	0	1	0
Lane Group Flow (vph)	79	534	0	700	678	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%
Turn Type	Prot	pm+ov	pm+pt	NA	NA	
Protected Phases	4	5	5	2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	8.3	37.1		84.3	49.5	
Effective Green, g (s)	8.3	37.1		84.3	49.5	
Actuated g/C Ratio	0.08	0.36		0.81	0.48	
Clearance Time (s)	5.0	6.0		6.1	6.1	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	149	597		754	832	
v/s Ratio Prot	0.04	c0.25		c0.26	0.39	
v/s Ratio Perm		0.07		c0.50		
v/c Ratio	0.53	0.90		0.93	0.82	
Uniform Delay, d1	45.8	31.5		7.4	23.2	
Progression Factor	1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.6	15.9		17.5	6.2	
Delay (s)	49.4	47.3		24.9	29.4	
Level of Service	D	D		C	C	
Approach Delay (s)	47.6			24.9	29.4	
Approach LOS	D			C	C	

Intersection Summary			
HCM 2000 Control Delay	34.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	103.7	Sum of lost time (s)	17.1
Intersection Capacity Utilization	92.0%	ICU Level of Service	F
Analysis Period (min)	15		

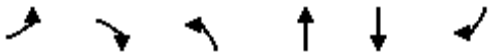
c Critical Lane Group



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	265	0	10	720	0	10
Future Volume (Veh/h)	265	0	10	720	0	10
Sign Control	Free			Free	Stop	
Grade	-11%			14%	-2%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	301	0	11	818	0	11
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)	263					
pX, platoon unblocked						
vC, conflicting volume			301		1141	301
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			301		1141	301
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		100	99
cM capacity (veh/h)			1272		222	743

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	301	829	11
Volume Left	0	11	0
Volume Right	0	0	11
cSH	1700	1272	743
Volume to Capacity	0.18	0.01	0.01
Queue Length 95th (m)	0.0	0.2	0.3
Control Delay (s)	0.0	0.2	9.9
Lane LOS		A	A
Approach Delay (s)	0.0	0.2	9.9
Approach LOS			A

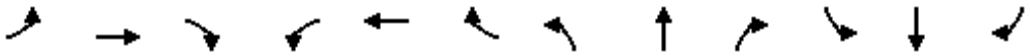
Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	57.1%	ICU Level of Service	B
Analysis Period (min)	15		



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	220	40	40	655	1090	850
Future Volume (vph)	220	40	40	655	1090	850
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)	-12%			-6%	6%	
Total Lost time (s)	8.1	8.1		6.0	6.0	
Lane Util. Factor	1.00	1.00		0.95	0.95	
Frt	1.00	0.85		1.00	0.93	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	1884	1685		3579	3158	
Flt Permitted	0.95	1.00		0.62	1.00	
Satd. Flow (perm)	1884	1685		2212	3158	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	244	44	44	728	1211	944
RTOR Reduction (vph)	0	35	0	0	136	0
Lane Group Flow (vph)	244	9	0	772	2019	0
Heavy Vehicles (%)	0%	0%	2%	2%	2%	2%
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	15.7	15.7		64.0	64.0	
Effective Green, g (s)	20.3	20.3		64.0	64.0	
Actuated g/C Ratio	0.21	0.21		0.65	0.65	
Clearance Time (s)	12.7	12.7		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	388	347		1438	2053	
v/s Ratio Prot	c0.13				c0.64	
v/s Ratio Perm		0.01		0.35		
v/c Ratio	0.63	0.03		0.54	0.98	
Uniform Delay, d1	35.6	31.2		9.2	16.7	
Progression Factor	1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.2	0.0		0.4	16.0	
Delay (s)	38.8	31.2		9.6	32.7	
Level of Service	D	C		A	C	
Approach Delay (s)	37.6			9.6	32.7	
Approach LOS	D			A	C	

Intersection Summary			
HCM 2000 Control Delay	27.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	98.4	Sum of lost time (s)	14.1
Intersection Capacity Utilization	83.2%	ICU Level of Service	E
Analysis Period (min)	15		

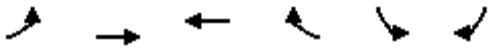
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	270	60	160	265	0	50	0	95	5	0	5
Future Volume (vph)	0	270	60	160	265	0	50	0	95	5	0	5
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		0%			-5%			0%			0%	
Total Lost time (s)		6.7			6.7			6.3	6.3		5.6	
Lane Util. Factor		1.00			1.00			1.00	1.00		1.00	
Frt		0.98			1.00			1.00	0.85		0.93	
Flt Protected		1.00			0.98			0.95	1.00		0.98	
Satd. Flow (prot)		1738			1792			1367	1223		972	
Flt Permitted		1.00			0.71			0.95	1.00		1.00	
Satd. Flow (perm)		1738			1298			1367	1223		997	
Peak-hour factor, PHF	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Adj. Flow (vph)	0	314	70	186	308	0	58	0	110	6	0	6
RTOR Reduction (vph)	0	9	0	0	0	0	0	0	98	0	12	0
Lane Group Flow (vph)	0	375	0	0	494	0	0	58	12	0	0	0
Heavy Vehicles (%)	5%	5%	5%	5%	5%	5%	30%	30%	30%	75%	75%	75%
Turn Type		NA		Perm	NA		Split	NA	Perm	Perm	NA	
Protected Phases		6			2		3	3			4	
Permitted Phases	6			2					3	4		
Actuated Green, G (s)		31.4			31.4			6.2	6.2		0.9	
Effective Green, g (s)		31.4			31.4			6.2	6.2		0.9	
Actuated g/C Ratio		0.55			0.55			0.11	0.11		0.02	
Clearance Time (s)		6.7			6.7			6.3	6.3		5.6	
Vehicle Extension (s)		3.0			3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)		955			713			148	132		15	
v/s Ratio Prot		0.22						c0.04				
v/s Ratio Perm					c0.38				0.01		c0.00	
v/c Ratio		0.39			0.69			0.39	0.09		0.01	
Uniform Delay, d1		7.4			9.3			23.7	22.9		27.7	
Progression Factor		1.00			1.00			1.00	1.00		1.00	
Incremental Delay, d2		0.3			2.9			1.7	0.3		0.3	
Delay (s)		7.6			12.3			25.4	23.2		28.0	
Level of Service		A			B			C	C		C	
Approach Delay (s)		7.6			12.3			24.0			28.0	
Approach LOS		A			B			C			C	

Intersection Summary			
HCM 2000 Control Delay	12.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	57.1	Sum of lost time (s)	18.6
Intersection Capacity Utilization	64.0%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	130	1750	1730	60	70	100
Future Volume (vph)	130	1750	1730	60	70	100
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)		-4%	7%		8%	
Total Lost time (s)	6.2	5.4	4.6	4.6	4.7	
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	
Frt	1.00	1.00	1.00	0.85	0.92	
Flt Protected	0.95	1.00	1.00	1.00	0.98	
Satd. Flow (prot)	1777	3554	3362	1504	1588	
Flt Permitted	0.05	1.00	1.00	1.00	0.98	
Satd. Flow (perm)	89	3554	3362	1504	1588	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	141	1902	1880	65	76	109
RTOR Reduction (vph)	0	0	0	17	48	0
Lane Group Flow (vph)	141	1902	1880	48	137	0
Turn Type	pm+pt	NA	NA	Perm	Prot	
Protected Phases	1	6	2		8	
Permitted Phases	6			2		
Actuated Green, G (s)	94.4	94.4	78.7	78.7	15.5	
Effective Green, g (s)	94.4	94.4	78.7	78.7	15.5	
Actuated g/C Ratio	0.79	0.79	0.66	0.66	0.13	
Clearance Time (s)	6.2	5.4	4.6	4.6	4.7	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	214	2795	2204	986	205	
v/s Ratio Prot	0.06	c0.54	c0.56		c0.09	
v/s Ratio Perm	0.46			0.03		
v/c Ratio	0.66	0.68	0.85	0.05	0.67	
Uniform Delay, d1	32.9	5.9	16.1	7.3	49.8	
Progression Factor	1.67	0.35	1.00	1.00	1.00	
Incremental Delay, d2	4.8	0.9	4.4	0.1	8.0	
Delay (s)	59.8	2.9	20.6	7.4	57.8	
Level of Service	E	A	C	A	E	
Approach Delay (s)		6.9	20.1		57.8	
Approach LOS		A	C		E	

Intersection Summary			
HCM 2000 Control Delay	15.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	15.5
Intersection Capacity Utilization	79.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

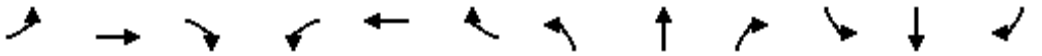


Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	0	350	1340	0	250	1800
Future Volume (vph)	0	350	1340	0	250	1800
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)	0%		1%			5%
Total Lost time (s)		6.5	7.0		6.5	4.0
Lane Util. Factor		1.00	0.95		1.00	0.95
Frt		0.86	1.00		1.00	1.00
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		1190	3305		1575	3150
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		1190	3305		1575	3150
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	0	354	1354	0	253	1818
RTOR Reduction (vph)	0	16	0	0	0	0
Lane Group Flow (vph)	0	338	1354	0	253	1818
Heavy Vehicles (%)	36%	36%	7%	7%	10%	10%
Turn Type		Over	NA		Prot	NA
Protected Phases		4	2		4	Free
Permitted Phases						
Actuated Green, G (s)		32.5	54.0		32.5	100.0
Effective Green, g (s)		32.5	54.0		32.5	100.0
Actuated g/C Ratio		0.32	0.54		0.32	1.00
Clearance Time (s)		6.5	7.0		6.5	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)		386	1784		511	3150
v/s Ratio Prot		c0.28	c0.41		0.16	0.58
v/s Ratio Perm						
v/c Ratio		0.88	0.76		0.50	0.58
Uniform Delay, d1		31.8	17.9		27.1	0.0
Progression Factor		1.00	1.00		0.67	1.00
Incremental Delay, d2		19.3	3.1		0.4	0.4
Delay (s)		51.1	21.0		18.7	0.4
Level of Service		D	C		B	A
Approach Delay (s)	51.1		21.0			2.6
Approach LOS	D		C			A

Intersection Summary			
HCM 2000 Control Delay	13.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	71.5%	ICU Level of Service	C
Analysis Period (min)	15		

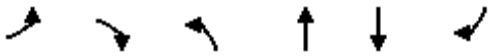
c Critical Lane Group

PM Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	1260	220	70	180	80	130	280	1430	120	100	930	630
Future Volume (vph)	1260	220	70	180	80	130	280	1430	120	100	930	630
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-2%			0%			0%			-5%	
Total Lost time (s)	8.9	8.9		8.8	8.8	8.8	8.7	7.5		8.7	9.5	4.0
Lane Util. Factor	0.97	1.00		1.00	1.00	1.00	1.00	0.91		1.00	0.95	1.00
Frt	1.00	0.96		1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3447	1803		1661	1748	1486	1615	4589		1718	3437	1537
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.08	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3447	1803		1661	1748	1486	143	4589		1718	3437	1537
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	1326	232	74	189	84	137	295	1505	126	105	979	663
RTOR Reduction (vph)	0	8	0	0	0	0	0	6	0	0	0	0
Lane Group Flow (vph)	1326	298	0	189	84	137	295	1625	0	105	979	663
Heavy Vehicles (%)	1%	1%	1%	7%	7%	7%	10%	10%	10%	6%	6%	6%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	100	0	0	0
Turn Type	Split	NA		Split	NA	Perm	pm+pt	NA		Prot	NA	Free
Protected Phases	7	7		8	8		5	2		1	6	
Permitted Phases						8	2					Free
Actuated Green, G (s)	44.1	44.1		16.2	16.2	16.2	63.8	47.5		8.3	34.5	150.0
Effective Green, g (s)	44.1	44.1		16.2	16.2	16.2	63.8	47.5		8.3	37.5	150.0
Actuated g/C Ratio	0.29	0.29		0.11	0.11	0.11	0.43	0.32		0.06	0.25	1.00
Clearance Time (s)	8.9	8.9		8.8	8.8	8.8	8.7	7.5		8.7	12.5	
Vehicle Extension (s)	4.0	4.0		4.0	4.0	4.0	3.0	4.0		4.0	4.0	
Lane Grp Cap (vph)	1013	530		179	188	160	220	1453		95	859	1537
v/s Ratio Prot	c0.38	0.17		c0.11	0.05		c0.15	c0.35		0.06	0.28	
v/s Ratio Perm						0.09	c0.42					0.43
v/c Ratio	1.31	0.56		1.06	0.45	0.86	1.34	1.12		1.11	1.14	0.43
Uniform Delay, d1	53.0	44.8		66.9	62.7	65.8	47.0	51.2		70.8	56.2	0.0
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	146.2	1.7		82.8	2.3	34.5	180.7	63.1		123.6	76.8	0.9
Delay (s)	199.2	46.5		149.7	65.0	100.3	227.7	114.4		194.5	133.1	0.9
Level of Service	F	D		F	E	F	F	F		F	F	A
Approach Delay (s)		170.5			115.8			131.7			86.6	
Approach LOS		F			F			F			F	

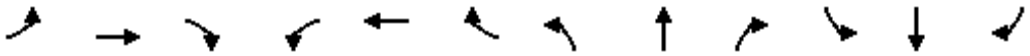
Intersection Summary			
HCM 2000 Control Delay	127.9	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.37		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	35.9
Intersection Capacity Utilization	115.0%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	80	0	1850	1030	230
Future Volume (Veh/h)	0	80	0	1850	1030	230
Sign Control	Stop			Free	Free	
Grade	-10%			-2%	2%	
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86
Hourly flow rate (vph)	0	93	0	2151	1198	267
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	2407	732	1198			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2407	732	1198			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	75	100			
cM capacity (veh/h)	29	369	584			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	93	1076	1076	799	666
Volume Left	0	0	0	0	0
Volume Right	93	0	0	0	267
cSH	369	1700	1700	1700	1700
Volume to Capacity	0.25	0.63	0.63	0.47	0.39
Queue Length 95th (m)	7.5	0.0	0.0	0.0	0.0
Control Delay (s)	18.0	0.0	0.0	0.0	0.0
Lane LOS	C				
Approach Delay (s)	18.0	0.0		0.0	
Approach LOS	C				

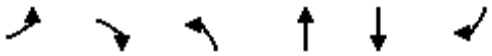
Intersection Summary				
Average Delay	0.5			
Intersection Capacity Utilization	55.9%	ICU Level of Service	B	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	300	0	0	0	0	1920	0	0	1060	60
Future Volume (Veh/h)	0	0	300	0	0	0	0	1920	0	0	1060	60
Sign Control		Stop			Stop			Free			Free	
Grade		-9%			0%			2%			0%	
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	0	0	309	0	0	0	0	1979	0	0	1093	62
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	2114	3103	578	2834	3134	990	1155			1979		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2114	3103	578	2834	3134	990	1155			1979		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	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 %	100	100	34	100	100	100	100			100		
cM capacity (veh/h)	30	12	465	3	11	249	606			288		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	309	0	990	990	729	426
Volume Left	0	0	0	0	0	0
Volume Right	309	0	0	0	0	62
cSH	465	1700	1700	1700	1700	1700
Volume to Capacity	0.66	0.00	0.58	0.58	0.43	0.25
Queue Length 95th (m)	36.3	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	26.8	0.0	0.0	0.0	0.0	0.0
Lane LOS	D	A				
Approach Delay (s)	26.8	0.0	0.0		0.0	
Approach LOS	D	A				

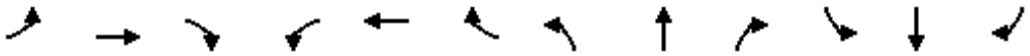
Intersection Summary				
Average Delay	2.4			
Intersection Capacity Utilization	57.8%	ICU Level of Service	B	
Analysis Period (min)	15			



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	530	490	350	1470	1120	240
Future Volume (vph)	530	490	350	1470	1120	240
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)	-5%			2%	2%	
Total Lost time (s)	6.2	6.2	6.2	6.2	6.2	6.2
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1821	1630	1675	3351	3319	1485
Flt Permitted	0.95	1.00	0.08	1.00	1.00	1.00
Satd. Flow (perm)	1821	1630	149	3351	3319	1485
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	541	500	357	1500	1143	245
RTOR Reduction (vph)	0	2	0	0	0	70
Lane Group Flow (vph)	541	498	357	1500	1143	175
Heavy Vehicles (%)	0%	0%	5%	5%	6%	6%
Turn Type	Prot	pm+ov	pm+pt	NA	NA	Perm
Protected Phases	4	5	5	2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	37.7	60.2	69.9	69.9	41.2	41.2
Effective Green, g (s)	37.7	60.2	69.9	69.9	41.2	41.2
Actuated g/C Ratio	0.31	0.50	0.58	0.58	0.34	0.34
Clearance Time (s)	6.2	6.2	6.2	6.2	6.2	6.2
Vehicle Extension (s)	3.0	0.2	0.2	3.0	0.2	0.2
Lane Grp Cap (vph)	572	901	372	1951	1139	509
v/s Ratio Prot	c0.30	0.10	c0.18	0.45	0.34	
v/s Ratio Perm		0.20	c0.38			0.12
v/c Ratio	0.95	0.55	0.96	0.77	1.00	0.34
Uniform Delay, d1	40.2	20.6	37.5	18.9	39.4	29.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	24.7	0.4	35.5	3.0	27.5	1.8
Delay (s)	64.8	21.0	73.0	21.9	66.9	31.2
Level of Service	E	C	E	C	E	C
Approach Delay (s)	43.8			31.7	60.6	
Approach LOS	D			C	E	

Intersection Summary			
HCM 2000 Control Delay	44.0	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.6
Intersection Capacity Utilization	97.4%	ICU Level of Service	F
Analysis Period (min)	15		

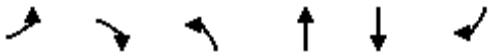
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	0	20	0	0	0	0	1850	0	0	1600	70
Future Volume (Veh/h)	0	0	20	0	0	0	0	1850	0	0	1600	70
Sign Control		Stop			Yield			Free			Free	
Grade		-12%			6%			0%			-3%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	0	0	22	0	0	0	0	2056	0	0	1778	78
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)											168	
pX, platoon unblocked	0.67	0.67	0.67	0.67	0.67		0.67					
vC, conflicting volume	2845	3873	928	2967	3912	1028	1856			2056		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2768	4305	0	2951	4363	1028	1291			2056		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	7.7	4.3			4.2		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.7	2.3			2.2		
p0 queue free %	100	100	97	100	100	100	100			100		
cM capacity (veh/h)	6	1	730	4	1	175	336			265		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	22	0	1371	685	1185	671
Volume Left	0	0	0	0	0	0
Volume Right	22	0	0	0	0	78
cSH	730	1700	1700	1700	1700	1700
Volume to Capacity	0.03	0.00	0.81	0.40	0.70	0.39
Queue Length 95th (m)	0.7	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	10.1	0.0	0.0	0.0	0.0	0.0
Lane LOS	B	A				
Approach Delay (s)	10.1	0.0	0.0		0.0	
Approach LOS	B	A				

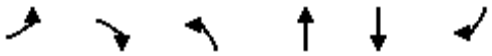
Intersection Summary				
Average Delay	0.1			
Intersection Capacity Utilization	57.7%	ICU Level of Service	B	
Analysis Period (min)	15			



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	10	350	210	1900	1540	60
Future Volume (vph)	10	350	210	1900	1540	60
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)	-12%			1%	-1%	
Total Lost time (s)	8.4	8.4	6.0	5.5	5.5	5.5
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1884	1685	1668	3336	3434	1536
Flt Permitted	0.95	1.00	0.07	1.00	1.00	1.00
Satd. Flow (perm)	1884	1685	119	3336	3434	1536
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	11	368	221	2000	1621	63
RTOR Reduction (vph)	0	212	0	0	0	12
Lane Group Flow (vph)	11	156	221	2000	1621	51
Heavy Vehicles (%)	0%	0%	6%	6%	4%	4%
Turn Type	Prot	Perm	pm+pt	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	10.1	10.1	71.0	71.0	52.8	52.8
Effective Green, g (s)	15.1	15.1	71.0	71.0	52.8	52.8
Actuated g/C Ratio	0.15	0.15	0.71	0.71	0.53	0.53
Clearance Time (s)	13.4	13.4	6.0	5.5	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	284	254	273	2368	1813	811
v/s Ratio Prot	0.01		0.10	c0.60	c0.47	
v/s Ratio Perm		c0.09	0.47			0.03
v/c Ratio	0.04	0.61	0.81	0.84	0.89	0.06
Uniform Delay, d1	36.3	39.7	29.2	10.5	21.1	11.5
Progression Factor	1.00	1.00	1.62	0.49	1.00	1.00
Incremental Delay, d2	0.1	4.3	4.7	1.1	7.3	0.1
Delay (s)	36.3	44.1	52.1	6.2	28.4	11.7
Level of Service	D	D	D	A	C	B
Approach Delay (s)	43.8			10.8	27.7	
Approach LOS	D			B	C	

Intersection Summary			
HCM 2000 Control Delay	20.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	19.9
Intersection Capacity Utilization	77.6%	ICU Level of Service	D
Analysis Period (min)	15		

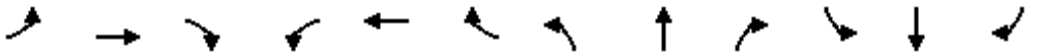
c Critical Lane Group



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	110	420	0	800	270	450
Future Volume (vph)	110	420	0	800	270	450
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)	-10%			-1%	7%	
Total Lost time (s)	9.6	9.6		6.4	6.4	13.6
Lane Util. Factor	1.00	1.00		0.95	0.95	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	0.95	1.00		1.00	1.00	1.00
Satd. Flow (prot)	1760	1575		3572	3430	1534
Flt Permitted	0.95	1.00		1.00	1.00	1.00
Satd. Flow (perm)	1760	1575		3572	3430	1534
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	118	452	0	860	290	484
RTOR Reduction (vph)	0	310	0	0	0	0
Lane Group Flow (vph)	118	142	0	860	290	484
Heavy Vehicles (%)	6%	6%	0%	0%	0%	0%
Turn Type	Prot	Perm		NA	NA	custom
Protected Phases	6			4	7 8	6
Permitted Phases		6				7
Actuated Green, G (s)	24.3	24.3		45.7	45.7	52.1
Effective Green, g (s)	28.3	28.3		45.7	39.7	52.1
Actuated g/C Ratio	0.31	0.31		0.51	0.44	0.58
Clearance Time (s)	13.6	13.6		6.4		13.6
Vehicle Extension (s)	3.0	3.0		3.0		3.0
Lane Grp Cap (vph)	553	495		1813	1513	888
v/s Ratio Prot	0.07			c0.24	0.08	c0.15
v/s Ratio Perm		0.09				0.17
v/c Ratio	0.21	0.29		0.47	0.19	0.55
Uniform Delay, d1	22.7	23.2		14.4	15.4	11.7
Progression Factor	0.83	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.2	0.3		0.9	0.1	0.7
Delay (s)	19.1	23.4		15.3	15.4	12.3
Level of Service	B	C		B	B	B
Approach Delay (s)	22.5			15.3	13.5	
Approach LOS	C			B	B	

Intersection Summary			
HCM 2000 Control Delay	16.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	26.0
Intersection Capacity Utilization	47.7%	ICU Level of Service	A
Analysis Period (min)	15		

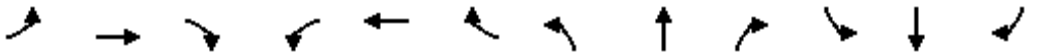
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	330	1080	400	10	100	20	130	90	80	110	20
Future Volume (vph)	0	330	1080	400	10	100	20	130	90	80	110	20
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-5%			10%			-4%			8%	
Total Lost time (s)		4.5	4.0	3.5	4.5	4.5		4.5	3.5		4.5	4.5
Lane Util. Factor		1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00
Frt		1.00	0.85	1.00	1.00	0.85		1.00	0.85		1.00	0.85
Flt Protected		1.00	1.00	0.95	1.00	1.00		0.99	1.00		0.98	1.00
Satd. Flow (prot)		1743	1482	1639	1725	1466		1805	1545		1759	1526
Flt Permitted		1.00	1.00	0.44	1.00	1.00		0.94	1.00		0.68	1.00
Satd. Flow (perm)		1743	1482	754	1725	1466		1711	1545		1220	1526
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	351	1149	426	11	106	21	138	96	85	117	21
RTOR Reduction (vph)	0	0	0	0	0	31	0	0	61	0	0	17
Lane Group Flow (vph)	0	351	1149	426	11	75	0	159	35	0	202	4
Heavy Vehicles (%)	10%	10%	10%	3%	3%	3%	5%	5%	5%	0%	0%	0%
Turn Type		NA	Free	pm+pt	NA	Perm	Perm	NA	pm+ov	Perm	NA	Perm
Protected Phases		4		3	8			2	3		6	
Permitted Phases			Free	8		8	2		2	6		6
Actuated Green, G (s)		44.7	90.0	63.3	63.3	63.3		17.7	32.8		17.7	17.7
Effective Green, g (s)		44.7	90.0	63.3	63.3	63.3		17.7	32.8		17.7	17.7
Actuated g/C Ratio		0.50	1.00	0.70	0.70	0.70		0.20	0.36		0.20	0.20
Clearance Time (s)		4.5		3.5	4.5	4.5		4.5	3.5		4.5	4.5
Vehicle Extension (s)		3.0		3.0	3.0	3.0		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		865	1482	678	1213	1031		336	563		239	300
v/s Ratio Prot		0.20		0.11	0.01				0.01			
v/s Ratio Perm			c0.78	0.34		0.05		0.09	0.01		0.17	0.00
v/c Ratio		0.41	0.78	0.63	0.01	0.07		0.47	0.06		0.85	0.01
Uniform Delay, d1		14.3	0.0	6.4	4.0	4.2		32.0	18.6		34.8	29.1
Progression Factor		1.00	1.00	0.29	0.24	0.02		1.00	1.00		1.00	1.00
Incremental Delay, d2		1.4	4.0	1.7	0.0	0.1		1.1	0.0		23.0	0.0
Delay (s)		15.7	4.0	3.5	1.0	0.2		33.1	18.6		57.8	29.1
Level of Service		B	A	A	A	A		C	B		E	C
Approach Delay (s)		6.8			2.8			27.6			55.1	
Approach LOS		A			A			C			E	

Intersection Summary			
HCM 2000 Control Delay	12.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	73.8%	ICU Level of Service	D
Analysis Period (min)	15		

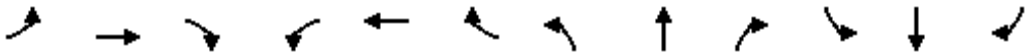
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1600	5	0	1170	340	170	550	390	0	770	160
Future Volume (vph)	0	1600	5	0	1170	340	170	550	390	0	770	160
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-1%			-2%			-6%			1%	
Total Lost time (s)		5.5			5.5	5.5	6.0	5.9	5.9		5.9	5.9
Lane Util. Factor		0.95			0.95	1.00	1.00	1.00	1.00		1.00	1.00
Frt		1.00			1.00	0.85	1.00	1.00	0.85		1.00	0.85
Flt Protected		1.00			1.00	1.00	0.95	1.00	1.00		1.00	1.00
Satd. Flow (prot)		3433			3590	1606	1830	1927	1638		1861	1582
Flt Permitted		1.00			1.00	1.00	0.08	1.00	1.00		1.00	1.00
Satd. Flow (perm)		3433			3590	1606	164	1927	1638		1861	1582
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1684	5	0	1232	358	179	579	411	0	811	168
RTOR Reduction (vph)	0	0	0	0	0	71	0	0	12	0	0	51
Lane Group Flow (vph)	0	1689	0	0	1232	287	179	579	399	0	811	117
Heavy Vehicles (%)	4%	4%	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type		NA			NA	Perm	pm+pt	NA	Perm		NA	Perm
Protected Phases		6			2		7	4			8	
Permitted Phases						2	4		4			8
Actuated Green, G (s)		52.5			52.5	52.5	56.1	56.1	56.1		41.1	41.1
Effective Green, g (s)		52.5			52.5	52.5	56.1	56.1	56.1		41.1	41.1
Actuated g/C Ratio		0.44			0.44	0.44	0.47	0.47	0.47		0.34	0.34
Clearance Time (s)		5.5			5.5	5.5	6.0	5.9	5.9		5.9	5.9
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		1501			1570	702	201	900	765		637	541
v/s Ratio Prot		c0.49			0.34		c0.07	0.30			c0.44	
v/s Ratio Perm						0.18	0.35		0.24			0.07
v/c Ratio		1.13			0.78	0.41	0.89	0.64	0.52		1.27	0.22
Uniform Delay, d1		33.8			28.9	23.1	29.8	24.3	22.5		39.5	28.0
Progression Factor		1.55			0.91	0.83	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2		57.3			3.5	1.5	35.1	1.6	0.6		134.9	0.2
Delay (s)		109.5			29.9	20.8	64.8	25.9	23.1		174.4	28.2
Level of Service		F			C	C	E	C	C		F	C
Approach Delay (s)		109.5			27.9			30.9			149.3	
Approach LOS		F			C			C			F	

Intersection Summary			
HCM 2000 Control Delay	75.8	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.17		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.4
Intersection Capacity Utilization	111.4%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	235	1050	45	325	1200	110	265	590	190	365	950	105
Future Volume (vph)	235	1050	45	325	1200	110	265	590	190	365	950	105
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-2%			1%			-1%			-2%	
Total Lost time (s)	6.6	6.1	6.1	6.3	6.1		6.4	6.1		6.5	6.1	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	0.95		0.97	0.95	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	0.96		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1760	3519	1574	1768	3492		1786	3441		3348	3400	
Flt Permitted	0.12	1.00	1.00	0.10	1.00		0.14	1.00		0.95	1.00	
Satd. Flow (perm)	219	3519	1574	185	3492		270	3441		3348	3400	
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)	255	1141	49	353	1304	120	288	641	207	397	1033	114
RTOR Reduction (vph)	0	0	35	0	6	0	0	26	0	0	7	0
Lane Group Flow (vph)	255	1141	14	353	1418	0	288	822	0	397	1140	0
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	0%	0%	0%	4%	4%	4%
Turn Type	pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA		Prot	NA	
Protected Phases	1	6		5	2		3	8		7	4	
Permitted Phases	6		6	2			8					
Actuated Green, G (s)	44.3	33.9	33.9	58.9	41.9		39.5	27.9		14.5	30.9	
Effective Green, g (s)	44.3	33.9	33.9	58.9	41.9		39.5	27.9		14.5	30.9	
Actuated g/C Ratio	0.37	0.28	0.28	0.49	0.35		0.33	0.23		0.12	0.26	
Clearance Time (s)	6.6	6.1	6.1	6.3	6.1		6.4	6.1		6.5	6.1	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	214	994	444	337	1219		235	800		404	875	
v/s Ratio Prot	0.10	0.32		c0.16	c0.41		0.12	0.24		c0.12	c0.34	
v/s Ratio Perm	0.34		0.01	0.35			0.28					
v/c Ratio	1.19	1.15	0.03	1.05	1.16		1.23	1.03		0.98	1.30	
Uniform Delay, d1	31.6	43.0	31.2	37.3	39.0		34.7	46.0		52.6	44.6	
Progression Factor	1.45	0.84	1.00	1.48	1.06		1.00	1.00		1.00	1.00	
Incremental Delay, d2	110.0	73.9	0.1	55.3	80.7		133.2	39.0		39.9	144.8	
Delay (s)	155.7	109.9	31.2	110.5	122.1		167.9	85.0		92.6	189.3	
Level of Service	F	F	C	F	F		F	F		F	F	
Approach Delay (s)		115.3			119.8			106.1			164.5	
Approach LOS		F			F			F			F	

Intersection Summary			
HCM 2000 Control Delay	127.7	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.25		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	25.3
Intersection Capacity Utilization	117.5%	ICU Level of Service	H
Analysis Period (min)	15		

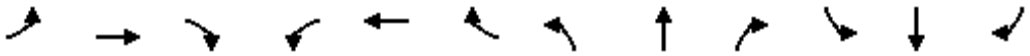
c Critical Lane Group



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	1110	480	730	865	500	400
Future Volume (vph)	1110	480	730	865	500	400
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)	6%		0%			-4%
Total Lost time (s)	5.3	5.3	6.0	4.0	6.2	6.0
Lane Util. Factor	0.97	1.00	1.00	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3344	1542	1852	1574	1777	3554
Flt Permitted	0.95	1.00	1.00	1.00	0.08	1.00
Satd. Flow (perm)	3344	1542	1852	1574	152	3554
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	1156	500	760	901	521	417
RTOR Reduction (vph)	0	32	0	0	0	0
Lane Group Flow (vph)	1156	468	760	901	521	417
Heavy Vehicles (%)	0%	0%	1%	1%	2%	2%
Turn Type	Prot	custom	NA	Free	pm+pt	NA
Protected Phases	8	8	2		1	6
Permitted Phases		1		Free	6	
Actuated Green, G (s)	34.7	59.5	43.0	120.0	74.0	74.0
Effective Green, g (s)	34.7	59.5	43.0	120.0	74.0	74.0
Actuated g/C Ratio	0.29	0.50	0.36	1.00	0.62	0.62
Clearance Time (s)	5.3	5.3	6.0		6.2	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	966	832	663	1574	429	2191
v/s Ratio Prot	c0.35	0.16	0.41		c0.25	0.12
v/s Ratio Perm		0.14		0.57	c0.50	
v/c Ratio	1.20	0.56	1.15	0.57	1.21	0.19
Uniform Delay, d1	42.6	21.1	38.5	0.0	38.8	10.0
Progression Factor	0.51	0.37	1.00	1.00	0.49	1.14
Incremental Delay, d2	89.5	0.1	82.8	1.5	98.6	0.0
Delay (s)	111.1	7.9	121.3	1.5	117.7	11.4
Level of Service	F	A	F	A	F	B
Approach Delay (s)	79.9		56.3			70.4
Approach LOS	E		E			E

Intersection Summary			
HCM 2000 Control Delay	68.6	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.24		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.5
Intersection Capacity Utilization	114.8%	ICU Level of Service	H
Analysis Period (min)	15		

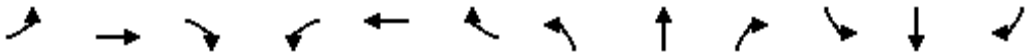
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	75	455	80	25	475	70	170	960	105	80	880	70
Future Volume (vph)	75	455	80	25	475	70	170	960	105	80	880	70
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-3%			1%			1%			-7%	
Total Lost time (s)	5.4	5.4		5.4	5.4		6.0	5.7		6.0	5.7	
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	0.98		1.00	0.99		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)	1623	1671		1591	1643		1591	1650		1655	1723	
Flt Permitted	0.10	1.00		0.11	1.00		0.07	1.00		0.07	1.00	
Satd. Flow (perm)	173	1671		185	1643		118	1650		128	1723	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	77	469	82	26	490	72	175	990	108	82	907	72
RTOR Reduction (vph)	0	5	0	0	5	0	0	3	0	0	2	0
Lane Group Flow (vph)	77	546	0	26	557	0	175	1095	0	82	977	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	39.6	39.6		39.6	39.6		65.6	56.6		61.0	54.3	
Effective Green, g (s)	39.6	39.6		39.6	39.6		65.6	56.6		61.0	54.3	
Actuated g/C Ratio	0.33	0.33		0.33	0.33		0.55	0.47		0.51	0.45	
Clearance Time (s)	5.4	5.4		5.4	5.4		6.0	5.7		6.0	5.7	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	57	551		61	542		174	778		150	779	
v/s Ratio Prot		0.33			0.34		c0.07	c0.66		0.03	0.57	
v/s Ratio Perm	c0.45			0.14			0.47			0.25		
v/c Ratio	1.35	0.99		0.43	1.03		1.01	1.41		0.55	1.25	
Uniform Delay, d1	40.2	40.0		31.3	40.2		35.9	31.7		26.3	32.9	
Progression Factor	1.00	1.00		1.00	1.00		1.44	0.77		1.00	1.00	
Incremental Delay, d2	238.4	35.7		4.7	46.1		43.2	186.2		4.0	124.7	
Delay (s)	278.6	75.7		36.1	86.3		95.1	210.6		30.4	157.6	
Level of Service	F	E		D	F		F	F		C	F	
Approach Delay (s)		100.6			84.0			194.8			147.7	
Approach LOS		F			F			F			F	

Intersection Summary			
HCM 2000 Control Delay	145.7	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.38		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.1
Intersection Capacity Utilization	127.9%	ICU Level of Service	H
Analysis Period (min)	15		

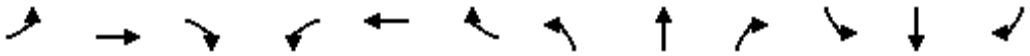
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	70	180	360	110	565	80	0	775	245	40	905	30
Future Volume (vph)	70	180	360	110	565	80	0	775	245	40	905	30
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-9%			11%			9%			-9%	
Total Lost time (s)	5.5	5.5		5.5	5.5			5.5			7.5	
Lane Util. Factor	1.00	1.00		1.00	1.00			0.95			0.95	
Frt	1.00	0.90		1.00	0.98			0.96			1.00	
Flt Protected	0.95	1.00		0.95	1.00			1.00			1.00	
Satd. Flow (prot)	1857	1759		1646	1701			3176			3448	
Flt Permitted	0.13	1.00		0.23	1.00			1.00			0.72	
Satd. Flow (perm)	258	1759		403	1701			3176			2491	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	74	191	383	117	601	85	0	824	261	43	963	32
RTOR Reduction (vph)	0	29	0	0	5	0	0	30	0	0	2	0
Lane Group Flow (vph)	74	545	0	117	681	0	0	1055	0	0	1036	0
Heavy Vehicles (%)	0%	0%	0%	2%	2%	2%	3%	3%	3%	7%	7%	7%
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	
Protected Phases		4			4			6			2	
Permitted Phases	4			4			6			2		
Actuated Green, G (s)	42.7	42.7		42.7	42.7			44.6			39.1	
Effective Green, g (s)	42.7	42.7		42.7	42.7			44.6			42.6	
Actuated g/C Ratio	0.43	0.43		0.43	0.43			0.45			0.43	
Clearance Time (s)	5.5	5.5		5.5	5.5			5.5			11.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)	112	764		175	738			1440			1079	
v/s Ratio Prot		0.31			c0.40			0.33				
v/s Ratio Perm	0.29			0.29							c0.42	
v/c Ratio	0.66	0.71		0.67	0.92			0.73			0.96	
Uniform Delay, d1	22.1	22.8		22.2	26.2			22.0			27.0	
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2	13.7	3.2		9.3	17.0			3.3			19.3	
Delay (s)	35.7	25.9		31.5	43.3			25.3			46.3	
Level of Service	D	C		C	D			C			D	
Approach Delay (s)		27.1			41.6			25.3			46.3	
Approach LOS		C			D			C			D	

Intersection Summary			
HCM 2000 Control Delay	35.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	98.3	Sum of lost time (s)	13.0
Intersection Capacity Utilization	122.1%	ICU Level of Service	H
Analysis Period (min)	15		

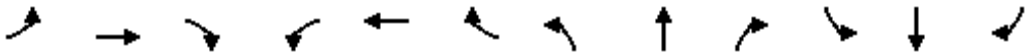
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	75	240	190	330	185	10	550	80	205	10	120	105
Future Volume (vph)	75	240	190	330	185	10	550	80	205	10	120	105
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	83	267	211	367	206	11	611	89	228	11	133	117

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	561	584	928	261
Volume Left (vph)	83	367	611	11
Volume Right (vph)	211	11	228	117
Hadj (s)	-0.20	0.11	-0.02	-0.26
Departure Headway (s)	8.5	8.8	8.7	9.3
Degree Utilization, x	1.33	1.43	2.25	0.67
Capacity (veh/h)	430	418	421	379
Control Delay (s)	188.6	233.0	587.5	29.6
Approach Delay (s)	188.6	233.0	587.5	29.6
Approach LOS	F	F	F	D

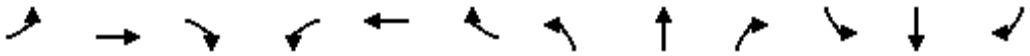
Intersection Summary			
Delay	340.5		
Level of Service	F		
Intersection Capacity Utilization	134.0%	ICU Level of Service	H
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	340	35	85	10	100	15	90	160	5	20	175	270
Future Volume (vph)	340	35	85	10	100	15	90	160	5	20	175	270
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	354	36	89	10	104	16	94	167	5	21	182	281

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total (vph)	479	130	266	484
Volume Left (vph)	354	10	94	21
Volume Right (vph)	89	16	5	281
Hadj (s)	0.04	-0.06	0.06	-0.34
Departure Headway (s)	7.0	8.1	7.6	6.6
Degree Utilization, x	0.93	0.29	0.56	0.89
Capacity (veh/h)	506	400	448	484
Control Delay (s)	49.6	14.4	19.7	41.8
Approach Delay (s)	49.6	14.4	19.7	41.8
Approach LOS	E	B	C	E

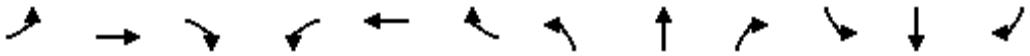
Intersection Summary				
Delay	37.6			
Level of Service	E			
Intersection Capacity Utilization	84.9%	ICU Level of Service	E	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	180	140	0	90	0	555	60	120	705	25
Future Volume (vph)	0	0	180	140	0	90	0	555	60	120	705	25
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-9%			10%			4%			-7%	
Total Lost time (s)			5.4		5.4			5.2		5.2	5.2	
Lane Util. Factor			1.00		1.00			1.00		1.00	1.00	
Frt			0.86		0.95			0.99		1.00	0.99	
Flt Protected			1.00		0.97			1.00		0.95	1.00	
Satd. Flow (prot)			1691		1633			1774		1821	1907	
Flt Permitted			1.00		0.97			1.00		0.32	1.00	
Satd. Flow (perm)			1691		1633			1774		605	1907	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	0	184	143	0	92	0	566	61	122	719	26
RTOR Reduction (vph)	0	0	124	0	43	0	0	6	0	0	2	0
Lane Group Flow (vph)	0	0	60	0	192	0	0	621	0	122	743	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	2%	2%	1%	1%	1%
Turn Type			Perm	Perm	NA			NA		Perm	NA	
Protected Phases					8			2			6	
Permitted Phases			4	8						6		
Actuated Green, G (s)			11.1		11.1			24.6		24.6	24.6	
Effective Green, g (s)			11.1		11.1			24.6		24.6	24.6	
Actuated g/C Ratio			0.24		0.24			0.53		0.53	0.53	
Clearance Time (s)			5.4		5.4			5.2		5.2	5.2	
Vehicle Extension (s)			3.0		3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)			405		391			942		321	1013	
v/s Ratio Prot								0.35			c0.39	
v/s Ratio Perm			0.04		0.12					0.20		
v/c Ratio			0.15		0.49			0.66		0.38	0.73	
Uniform Delay, d1			13.9		15.2			7.8		6.4	8.3	
Progression Factor			1.00		1.00			1.00		1.00	1.00	
Incremental Delay, d2			0.2		1.0			1.7		0.8	2.8	
Delay (s)			14.0		16.1			9.5		7.1	11.1	
Level of Service			B		B			A		A	B	
Approach Delay (s)		14.0			16.1			9.5			10.6	
Approach LOS		B			B			A			B	

Intersection Summary			
HCM 2000 Control Delay	11.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	46.3	Sum of lost time (s)	10.6
Intersection Capacity Utilization	78.1%	ICU Level of Service	D
Analysis Period (min)	15		

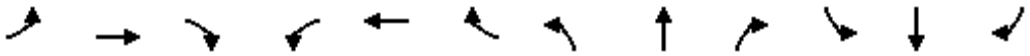
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	30	70	10	200	90	140	10	560	85	40	590	35
Future Volume (vph)	30	70	10	200	90	140	10	560	85	40	590	35
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-6%			7%			7%			-7%	
Total Lost time (s)		5.3			5.3			5.0		5.0	5.0	
Lane Util. Factor		1.00			1.00			1.00		1.00	1.00	
Frt		0.99			0.96			0.98		1.00	0.99	
Flt Protected		0.99			0.98			1.00		0.95	1.00	
Satd. Flow (prot)		1877			1687			1721		1768	1846	
Flt Permitted		0.85			0.81			0.99		0.30	1.00	
Satd. Flow (perm)		1610			1395			1703		553	1846	
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	33	77	11	220	99	154	11	615	93	44	648	38
RTOR Reduction (vph)	0	4	0	0	19	0	0	6	0	0	3	0
Lane Group Flow (vph)	0	117	0	0	454	0	0	713	0	44	683	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	3%	3%	3%	4%	4%	4%
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)		29.5			29.5			38.2		38.2	38.2	
Effective Green, g (s)		29.5			29.5			38.2		38.2	38.2	
Actuated g/C Ratio		0.38			0.38			0.49		0.49	0.49	
Clearance Time (s)		5.3			5.3			5.0		5.0	5.0	
Vehicle Extension (s)		3.0			3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)		608			527			834		270	904	
v/s Ratio Prot											0.37	
v/s Ratio Perm		0.07			c0.33			c0.42		0.08		
v/c Ratio		0.19			0.86			0.85		0.16	0.76	
Uniform Delay, d1		16.3			22.4			17.5		11.0	16.1	
Progression Factor		1.00			1.00			1.00		1.00	1.00	
Incremental Delay, d2		0.2			13.5			8.5		0.3	3.6	
Delay (s)		16.4			35.9			26.0		11.3	19.8	
Level of Service		B			D			C		B	B	
Approach Delay (s)		16.4			35.9			26.0			19.3	
Approach LOS		B			D			C			B	

Intersection Summary			
HCM 2000 Control Delay	25.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	78.0	Sum of lost time (s)	10.3
Intersection Capacity Utilization	84.2%	ICU Level of Service	E
Analysis Period (min)	15		

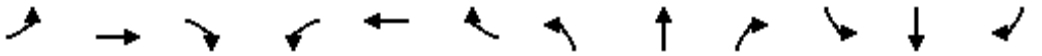
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	60	155	55	110	230	60	35	620	80	50	575	50
Future Volume (vph)	60	155	55	110	230	60	35	620	80	50	575	50
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-2%			5%			0%			0%	
Total Lost time (s)		4.0			4.0			4.0			4.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.97			0.98			0.99			0.99	
Flt Protected		0.99			0.99			1.00			1.00	
Satd. Flow (prot)		1817			1763			1803			1791	
Flt Permitted		0.84			0.81			0.95			0.92	
Satd. Flow (perm)		1536			1452			1722			1649	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	63	163	58	116	242	63	37	653	84	53	605	53
RTOR Reduction (vph)	0	14	0	0	10	0	0	8	0	0	6	0
Lane Group Flow (vph)	0	270	0	0	411	0	0	766	0	0	705	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	2%	2%	2%	3%	3%	3%
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)		17.3			17.3			28.9			28.9	
Effective Green, g (s)		17.3			17.3			28.9			28.9	
Actuated g/C Ratio		0.32			0.32			0.53			0.53	
Clearance Time (s)		4.0			4.0			4.0			4.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		490			463			918			879	
v/s Ratio Prot												
v/s Ratio Perm		0.18			c0.28			c0.44			0.43	
v/c Ratio		0.55			0.89			0.83			0.80	
Uniform Delay, d1		15.2			17.5			10.6			10.3	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		1.3			18.2			6.6			5.3	
Delay (s)		16.6			35.7			17.2			15.7	
Level of Service		B			D			B			B	
Approach Delay (s)		16.6			35.7			17.2			15.7	
Approach LOS		B			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	20.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	54.2	Sum of lost time (s)	8.0
Intersection Capacity Utilization	91.8%	ICU Level of Service	F
Analysis Period (min)	15		

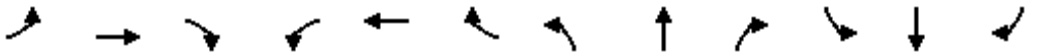
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	1040	30	0	840	70	0	0	210	0	0	90
Future Volume (Veh/h)	0	1040	30	0	840	70	0	0	210	0	0	90
Sign Control		Free			Free			Stop			Stop	
Grade		-9%			7%			1%			2%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	0	1156	33	0	933	78	0	0	233	0	0	100
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	1011			1189			2244	2184	1172	2378	2161	972
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1011			1189			2244	2184	1172	2378	2161	972
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	1	100	100	68
cM capacity (veh/h)	690			584			20	46	236	0	48	309

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	1189	1011	233	100
Volume Left	0	0	0	0
Volume Right	33	78	233	100
cSH	1700	1700	236	309
Volume to Capacity	0.70	0.59	0.99	0.32
Queue Length 95th (m)	0.0	0.0	69.5	10.4
Control Delay (s)	0.0	0.0	99.4	22.1
Lane LOS			F	C
Approach Delay (s)	0.0	0.0	99.4	22.1
Approach LOS			F	C

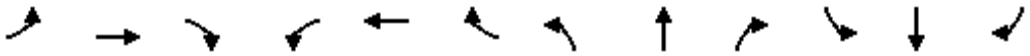
Intersection Summary			
Average Delay	10.0		
Intersection Capacity Utilization	78.1%	ICU Level of Service	D
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	500	820	10	170	640	240	60	500	180	230	450	190
Future Volume (vph)	500	820	10	170	640	240	60	500	180	230	450	190
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-5%			3%			1%			2%	
Total Lost time (s)	5.0	5.0		5.0	5.0			5.0		5.0	5.0	5.0
Lane Util. Factor	0.91	0.91		1.00	0.95			0.95		1.00	1.00	1.00
Frt	1.00	1.00		1.00	0.96			0.96		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00		0.95	1.00	1.00
Satd. Flow (prot)	1641	3436		1651	3167			3232		1759	1852	1574
Flt Permitted	0.95	1.00		0.95	1.00			0.73		0.24	1.00	1.00
Satd. Flow (perm)	1641	3436		1651	3167			2379		438	1852	1574
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	538	882	11	183	688	258	65	538	194	247	484	204
RTOR Reduction (vph)	0	1	0	0	32	0	0	26	0	0	0	119
Lane Group Flow (vph)	463	967	0	183	914	0	0	771	0	247	484	85
Heavy Vehicles (%)	1%	1%	1%	6%	6%	6%	5%	5%	5%	0%	0%	0%
Turn Type	Split	NA		Split	NA		Perm	NA		Perm	NA	Perm
Protected Phases	4	4		3	3			6			2	
Permitted Phases							6			2		2
Actuated Green, G (s)	30.0	30.0		25.0	25.0			50.0		50.0	50.0	50.0
Effective Green, g (s)	30.0	30.0		25.0	25.0			50.0		50.0	50.0	50.0
Actuated g/C Ratio	0.25	0.25		0.21	0.21			0.42		0.42	0.42	0.42
Clearance Time (s)	5.0	5.0		5.0	5.0			5.0		5.0	5.0	5.0
Vehicle Extension (s)	4.0	4.0		4.0	4.0			4.0		4.0	4.0	4.0
Lane Grp Cap (vph)	410	859		343	659			991		182	771	655
v/s Ratio Prot	c0.28	0.28		0.11	c0.29						0.26	
v/s Ratio Perm								0.32		c0.56		0.05
v/c Ratio	1.13	1.13		0.53	1.39			0.78		1.36	0.63	0.13
Uniform Delay, d1	45.0	45.0		42.3	47.5			30.2		35.0	27.6	21.6
Progression Factor	1.00	1.00		1.00	1.00			1.00		1.00	1.00	1.00
Incremental Delay, d2	84.6	71.5		2.0	183.1			4.2		192.1	1.8	0.1
Delay (s)	129.6	116.5		44.3	230.6			34.4		227.1	29.5	21.7
Level of Service	F	F		D	F			C		F	C	C
Approach Delay (s)		120.8			200.4			34.4			80.0	
Approach LOS		F			F			C			E	

Intersection Summary			
HCM 2000 Control Delay	116.8	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.30		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	114.6%	ICU Level of Service	H
Analysis Period (min)	15		

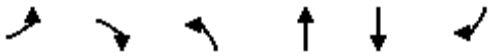
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	300	790	160	10	480	500	40	20	130	690	10	510
Future Volume (vph)	300	790	160	10	480	500	40	20	130	690	10	510
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		-9%			3%			-2%			0%	
Total Lost time (s)	6.3	5.7		5.7	5.7		5.5	5.5		6.0	5.5	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		0.97	1.00	
Frt	1.00	0.97		1.00	0.92		1.00	0.87		1.00	0.85	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1786	3481		1651	3050		1795	1644		2897	1341	
Flt Permitted	0.10	1.00		0.28	1.00		0.45	1.00		0.95	1.00	
Satd. Flow (perm)	185	3481		488	3050		859	1644		2897	1341	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	323	849	172	11	516	538	43	22	140	742	11	548
RTOR Reduction (vph)	0	14	0	0	153	0	0	55	0	0	220	0
Lane Group Flow (vph)	323	1007	0	11	901	0	43	107	0	742	339	0
Heavy Vehicles (%)	4%	4%	4%	6%	6%	6%	0%	0%	0%	19%	19%	19%
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Prot	NA	
Protected Phases	1	6			2			4		3	8	
Permitted Phases	6			2			4					
Actuated Green, G (s)	54.4	54.4		34.4	34.4		13.3	13.3		29.0	48.3	
Effective Green, g (s)	54.4	54.4		34.4	34.4		13.3	13.3		29.0	48.3	
Actuated g/C Ratio	0.48	0.48		0.30	0.30		0.12	0.12		0.25	0.42	
Clearance Time (s)	6.3	5.7		5.7	5.7		5.5	5.5		6.0	5.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		4.0	4.0		3.0	3.0	
Lane Grp Cap (vph)	280	1662		147	921		100	191		737	568	
v/s Ratio Prot	c0.14	0.29			0.30			0.07		c0.26	c0.25	
v/s Ratio Perm	c0.41			0.02			0.05					
v/c Ratio	1.15	0.61		0.07	0.98		0.43	0.56		1.01	0.60	
Uniform Delay, d1	33.9	21.9		28.4	39.4		46.8	47.5		42.5	25.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	101.9	0.6		0.2	24.2		4.0	4.5		34.8	1.7	
Delay (s)	135.8	22.5		28.6	63.6		50.8	52.1		77.3	27.0	
Level of Service	F	C		C	E		D	D		E	C	
Approach Delay (s)		49.7			63.2			51.8			55.7	
Approach LOS		D			E			D			E	

Intersection Summary			
HCM 2000 Control Delay	55.5	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.08		
Actuated Cycle Length (s)	113.9	Sum of lost time (s)	23.5
Intersection Capacity Utilization	105.2%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	30	570	400	650	610	25
Future Volume (vph)	30	570	400	650	610	25
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)	-10%			-6%	13%	
Total Lost time (s)	5.0	6.0		6.1	6.1	
Lane Util. Factor	1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	0.99	
Flt Protected	0.95	1.00		0.98	1.00	
Satd. Flow (prot)	1866	1669		1891	1740	
Flt Permitted	0.95	1.00		0.28	1.00	
Satd. Flow (perm)	1866	1669		539	1740	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	31	588	412	670	629	26
RTOR Reduction (vph)	0	93	0	0	1	0
Lane Group Flow (vph)	31	495	0	1082	654	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%
Turn Type	Prot	pm+ov	pm+pt	NA	NA	
Protected Phases	4	5	5	2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	4.7	37.0		89.3	51.0	
Effective Green, g (s)	4.7	37.0		89.3	51.0	
Actuated g/C Ratio	0.04	0.35		0.85	0.49	
Clearance Time (s)	5.0	6.0		6.1	6.1	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	83	587		873	844	
v/s Ratio Prot	0.02	c0.26		c0.38	0.38	
v/s Ratio Perm		0.04		c0.67		
v/c Ratio	0.37	0.84		1.24	0.77	
Uniform Delay, d1	48.8	31.4		7.9	22.3	
Progression Factor	1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.8	10.7		117.5	4.5	
Delay (s)	51.6	42.1		125.4	26.8	
Level of Service	D	D		F	C	
Approach Delay (s)	42.6			125.4	26.8	
Approach LOS	D			F	C	

Intersection Summary			
HCM 2000 Control Delay	76.2	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.27		
Actuated Cycle Length (s)	105.1	Sum of lost time (s)	17.1
Intersection Capacity Utilization	112.6%	ICU Level of Service	H
Analysis Period (min)	15		

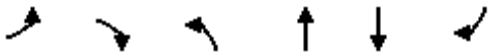
c Critical Lane Group



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	680	0	10	580	0	10
Future Volume (Veh/h)	680	0	10	580	0	10
Sign Control	Free			Free	Stop	
Grade	-11%			14%	-2%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	739	0	11	630	0	11
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)	263					
pX, platoon unblocked						
vC, conflicting volume			739		1391	739
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			739		1391	739
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		100	97
cM capacity (veh/h)			876		157	421

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	739	641	11
Volume Left	0	11	0
Volume Right	0	0	11
cSH	1700	876	421
Volume to Capacity	0.43	0.01	0.03
Queue Length 95th (m)	0.0	0.3	0.6
Control Delay (s)	0.0	0.3	13.8
Lane LOS		A	B
Approach Delay (s)	0.0	0.3	13.8
Approach LOS			B

Intersection Summary			
Average Delay		0.3	
Intersection Capacity Utilization		49.6%	ICU Level of Service A
Analysis Period (min)		15	

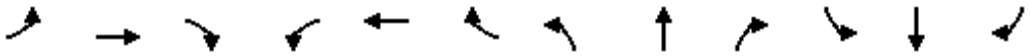


Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	490	80	180	1090	970	490
Future Volume (vph)	490	80	180	1090	970	490
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)	-12%			-6%	6%	
Total Lost time (s)	8.1	8.1		6.0	6.0	
Lane Util. Factor	1.00	1.00		0.95	0.95	
Frt	1.00	0.85		1.00	0.95	
Flt Protected	0.95	1.00		0.99	1.00	
Satd. Flow (prot)	1884	1685		3635	3274	
Flt Permitted	0.95	1.00		0.50	1.00	
Satd. Flow (perm)	1884	1685		1832	3274	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	500	82	184	1112	990	500
RTOR Reduction (vph)	0	37	0	0	53	0
Lane Group Flow (vph)	500	45	0	1296	1437	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	26.3	26.3		75.0	75.0	
Effective Green, g (s)	30.9	30.9		75.0	75.0	
Actuated g/C Ratio	0.26	0.26		0.62	0.62	
Clearance Time (s)	12.7	12.7		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	485	433		1145	2046	
v/s Ratio Prot	c0.27				0.44	
v/s Ratio Perm		0.03		c0.71		
v/c Ratio	1.03	0.10		1.42dl	0.70	
Uniform Delay, d1	44.6	34.0		22.5	15.0	
Progression Factor	1.00	1.00		1.00	1.00	
Incremental Delay, d2	49.0	0.1		70.7	1.1	
Delay (s)	93.6	34.1		93.2	16.2	
Level of Service	F	C		F	B	
Approach Delay (s)	85.2			93.2	16.2	
Approach LOS	F			F	B	

Intersection Summary			
HCM 2000 Control Delay	57.7	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	14.1
Intersection Capacity Utilization	124.6%	ICU Level of Service	H
Analysis Period (min)	15		

dl Defacto Left Lane. Recode with 1 though lane as a left lane.

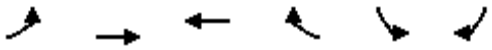
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	5	360	70	125	370	5	60	5	85	5	0	5
Future Volume (vph)	5	360	70	125	370	5	60	5	85	5	0	5
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
Grade (%)		0%			-5%			0%			0%	
Total Lost time (s)		6.7			6.7			6.3	6.3		5.6	
Lane Util. Factor		1.00			1.00			1.00	1.00		1.00	
Frt		0.98			1.00			1.00	0.85		0.93	
Flt Protected		1.00			0.99			0.96	1.00		0.98	
Satd. Flow (prot)		1725			1801			1719	1529		1702	
Flt Permitted		0.99			0.78			0.96	1.00		1.00	
Satd. Flow (perm)		1717			1430			1719	1529		1744	
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	5	396	77	137	407	5	66	5	93	5	0	5
RTOR Reduction (vph)	0	8	0	0	0	0	0	0	83	0	10	0
Lane Group Flow (vph)	0	470	0	0	549	0	0	71	10	0	0	0
Heavy Vehicles (%)	6%	6%	6%	5%	5%	5%	4%	4%	4%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA		Split	NA	Perm	Perm	NA	
Protected Phases		6			2		3	3			4	
Permitted Phases	6			2					3	4		
Actuated Green, G (s)		30.2			30.2			6.2	6.2		0.9	
Effective Green, g (s)		30.2			30.2			6.2	6.2		0.9	
Actuated g/C Ratio		0.54			0.54			0.11	0.11		0.02	
Clearance Time (s)		6.7			6.7			6.3	6.3		5.6	
Vehicle Extension (s)		3.0			3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)		927			772			190	169		28	
v/s Ratio Prot								c0.04				
v/s Ratio Perm		0.27			c0.38				0.01		c0.00	
v/c Ratio		0.51			0.71			0.37	0.06		0.01	
Uniform Delay, d1		8.1			9.6			23.0	22.2		27.1	
Progression Factor		1.00			1.00			1.00	1.00		1.00	
Incremental Delay, d2		0.4			3.1			1.2	0.2		0.1	
Delay (s)		8.6			12.7			24.3	22.4		27.1	
Level of Service		A			B			C	C		C	
Approach Delay (s)		8.6			12.7			23.2			27.1	
Approach LOS		A			B			C			C	

Intersection Summary			
HCM 2000 Control Delay	12.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	55.9	Sum of lost time (s)	18.6
Intersection Capacity Utilization	74.1%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	70	1850	1490	90	0	70
Future Volume (vph)	70	1850	1490	90	0	70
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)		-4%	7%		8%	
Total Lost time (s)	6.2	5.4	4.6	4.6		6.2
Lane Util. Factor	1.00	0.95	0.95	1.00		1.00
Frt	1.00	1.00	1.00	0.85		0.86
Flt Protected	0.95	1.00	1.00	1.00		1.00
Satd. Flow (prot)	1777	3554	3396	1519		1553
Flt Permitted	0.14	1.00	1.00	1.00		1.00
Satd. Flow (perm)	260	3554	3396	1519		1553
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	73	1927	1552	94	0	73
RTOR Reduction (vph)	0	0	0	14	0	66
Lane Group Flow (vph)	73	1927	1552	80	0	7
Heavy Vehicles (%)	2%	2%	1%	1%	0%	0%
Turn Type	pm+pt	NA	NA	Perm		Perm
Protected Phases	1	6	2			
Permitted Phases	6			2		1
Actuated Green, G (s)	114.6	120.0	102.0	102.0		7.2
Effective Green, g (s)	114.6	120.0	102.0	102.0		7.2
Actuated g/C Ratio	0.95	1.00	0.85	0.85		0.06
Clearance Time (s)	6.2	5.4	4.6	4.6		6.2
Vehicle Extension (s)	3.0	3.0	3.0	3.0		3.0
Lane Grp Cap (vph)	339	3554	2886	1291		93
v/s Ratio Prot	0.01	c0.54	0.46			
v/s Ratio Perm	0.19			0.05		0.00
v/c Ratio	0.22	0.54	0.54	0.06		0.08
Uniform Delay, d1	1.6	0.0	2.5	1.4		53.3
Progression Factor	1.97	1.00	1.00	1.00		1.00
Incremental Delay, d2	0.0	0.1	0.7	0.1		0.4
Delay (s)	3.2	0.1	3.2	1.5		53.6
Level of Service	A	A	A	A		D
Approach Delay (s)		0.2	3.1		53.6	
Approach LOS		A	A		D	

Intersection Summary			
HCM 2000 Control Delay	2.5	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	10.8
Intersection Capacity Utilization	57.0%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	0	340	1770	0	180	1790
Future Volume (vph)	0	340	1770	0	180	1790
Ideal Flow (vphpl)	1850	1850	1850	1850	1850	1850
Grade (%)	0%		1%			5%
Total Lost time (s)		6.5	7.0		6.5	4.0
Lane Util. Factor		1.00	0.95		1.00	0.95
Frt		0.86	1.00		1.00	1.00
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		1337	3467		1650	3300
Flt Permitted		1.00	1.00		0.95	1.00
Satd. Flow (perm)		1337	3467		1650	3300
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	0	374	1945	0	198	1967
RTOR Reduction (vph)	0	3	0	0	0	0
Lane Group Flow (vph)	0	371	1945	0	198	1967
Heavy Vehicles (%)	21%	21%	2%	2%	5%	5%
Turn Type		Over	NA		Prot	NA
Protected Phases		4	2		4	Free
Permitted Phases						
Actuated Green, G (s)		32.1	54.4		32.1	100.0
Effective Green, g (s)		32.1	54.4		32.1	100.0
Actuated g/C Ratio		0.32	0.54		0.32	1.00
Clearance Time (s)		6.5	7.0		6.5	
Vehicle Extension (s)		3.0	3.0		3.0	
Lane Grp Cap (vph)		429	1886		529	3300
v/s Ratio Prot		c0.28	c0.56		0.12	0.60
v/s Ratio Perm						
v/c Ratio		0.87	1.03		0.37	0.60
Uniform Delay, d1		31.9	22.8		26.2	0.0
Progression Factor		1.00	1.00		0.60	1.00
Incremental Delay, d2		16.5	29.2		0.3	0.5
Delay (s)		48.4	52.0		16.1	0.5
Level of Service		D	D		B	A
Approach Delay (s)	48.4		52.0			1.9
Approach LOS	D		D			A

Intersection Summary			
HCM 2000 Control Delay	27.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	83.1%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Appendix E – Fraser Health Variance Letter

Geoff Roberts
Director
Parking, Access and Commuter Services
Tel: 604-930-5407 x 765609
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Central City Office Tower
Suite 100
13450 - 102 Avenue
Surrey, BC
V3T 5X3

www.fraserhealth.ca

March 14th 2017

Mr. Rupinder Basi, MCIP, RPP
Senior Planner
City of New Westminster
Development Services, Planning
511 Royal Avenue,
New Westminster, BC V3L 1H9

Dear Mr. Basi,

Re: Required reduction in the number of Parking Stalls for Disabled Persons
Phase 1 - Royal Columbian Hospital (RCH) Redevelopment Project

Fraser Health, Parking Administration is seeking a reduction in the number of disabled persons parking stalls required for Phase 1 of the Royal Columbian Hospital (RCH) Redevelopment Project. A reduction from the City's current Zoning Bylaw of 10% to 4% is in alignment with similarly situated Hospital facilities and other municipal standards in effect throughout the Lower Mainland.

Fraser Health collectively administers its entire RCH parking inventory campus wide with no distinction between certain facilities. This better enables us to meet the changeable parking dynamics in place between expanding site wide programs and user groups. We continue to monitor and adapt these regular random to disabled stall ratios making routine adjustments as demand requires. This is evident through a recent (12) disabled persons stall expansion within the Main Entry lot.

A relaxation of the existing City of New Westminster Zoning By-law for disabled persons parking from 10% to 4% will not preclude us from meeting or exceeding this ratio in future project phases as we endeavor to keep pace with the myriad of different users requiring on-site parking access to the Royal Columbian Hospital.

We trust this meets your immediate information requirements in support of the requested City of New Westminster Zoning By-law variance for disabled persons parking at the Royal Columbian Hospital. Upon review, should you wish to discuss this matter in further detail please contact myself at any time.

Sincerely,

Geoff Roberts
Director
Parking, Access and Commuter Services
Lower Mainland Integrated Protection Services

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