City of Richmond

Report to Committee

To:	Public Works and Transportation Committee	**Date:**	May 17, 2019
From:	Lloyd Bie, P.Eng. Director, Transportation	**File:**	10-6450-09-01/2019-Vol 01
Re:	**Review of Collision Prone Intersections**		

Staff Recommendation

1. That the proposed short-term improvements, with respect to the top 20 high collision intersections in Richmond, be included in the 5 Year (2020-2024) Financial Plan, as outlined in the staff report titled "Review of Collision Prone Intersections" dated May 17, 2019 from the Director, Transportation; and,

2. That the City request the Minister of Public Safety and Solicitor General to provide automated speed enforcement technology at those intersections where the data indicates that speeding is a contributing factor to collisions.

Lloyd Bie, P.Eng.
Director, Transportation
(604-276-4131)

Att. 3

REPORT CONCURRENCE		
ROUTED TO:	**CONCURRENCE**	**CONCURRENCE OF GENERAL MANAGER**
Engineering RCMP	☑ ☑	
REVIEWED BY STAFF REPORT / AGENDA REVIEW SUBCOMMITTEE	**INITIALS:**	**APPROVED BY CAO**

Staff Report

Origin

At the November 21, 2018 meeting of the Public Works and Transportation Committee, the following referral was carried:

That staff investigate:

(1) potential options to improve the left turn lanes in the intersections of No. 5 Road and Cambie Road and Cambie Road and Jacombs Road including cycling lanes; and

(2) other intersections with high incident rates;

and report back.

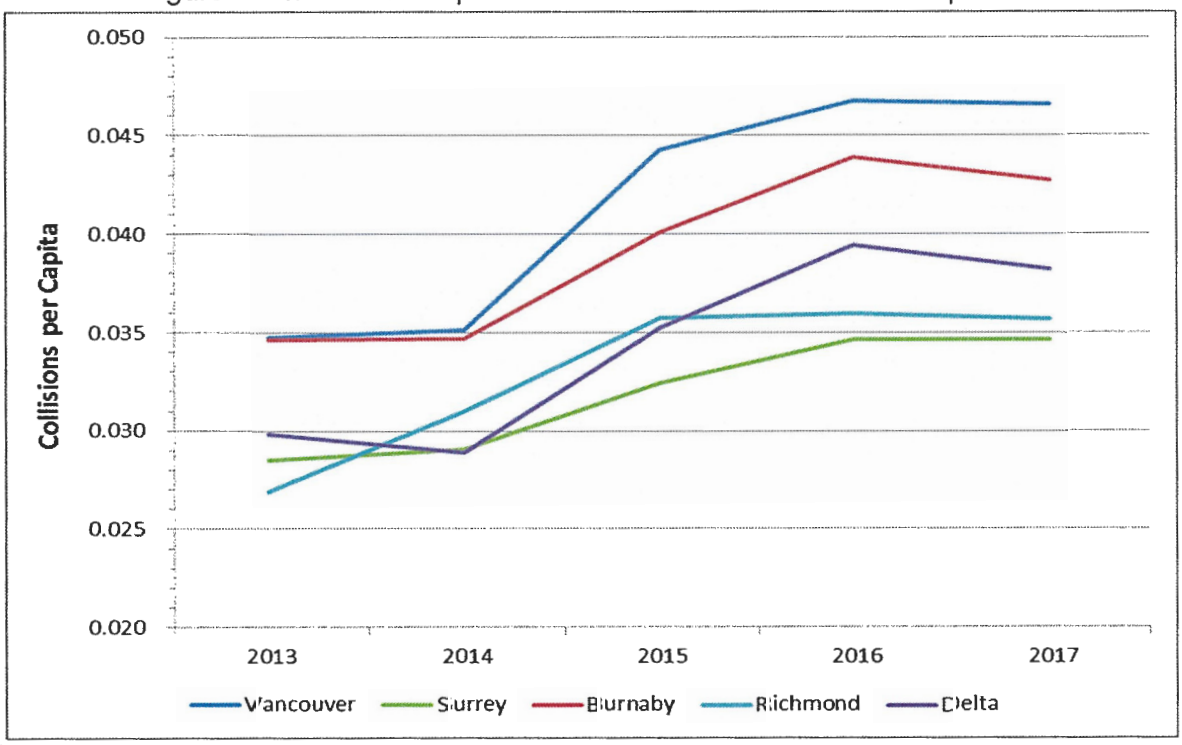
This report responds to Part (2) of the referral. Part (1) of the referral is addressed in a separate report.

Analysis

City-Wide Collision Data

Roadway collision data for Richmond and four other municipalities (Vancouver, Surrey, Delta, and Burnaby) was obtained from ICBC for the period from January 2013 to December 2017. Figure 1 illustrates the annual per capita collision rate for all collision types (fatality, injury and property damage only) for the five municipalities reviewed.

Figure 1: Annual Per Capita Collision Rate for Selected Municipalities



Notes:
(1) Data only includes crashes where sufficient location information is available to determine a latitude and longitude.
(2) Crashes on boundaries appear for both cities.

Richmond's annual per capita collision rate is on the low end for the municipalities reviewed. The highest crash locations in Richmond are at water crossings (i.e., bridges and the George Massey Tunnel) plus the on- and off-ramps for Highways 91 and 99, which are not within the City's jurisdiction. The network screening process described below focuses on City-controlled intersections with the long-term goal of decreasing the per capita collision rate for the city.

Network Screening Study

The City currently reviews the traffic safety performance of individual intersections as issues arise. A Network Screening Study is an opportunity for a holistic city-wide review of all intersections to identify those locations with the highest risk of collisions. The City partnered with ICBC on the Network Screening Study (the Study) to identify and prioritize high collision locations in order to determine where road safety improvement investments should be directed to achieve the greatest safety benefits.

The Study employs a systematic process based on the *Transportation Association of Canada Canadian Guide to In-service Road Safety Review.* Specifically, the Study uses insurance claims records and traffic volume data to assess the risk and potential to mitigate motorist, pedestrian and cyclist collisions. The output of the network screening process is a list of prioritized collision prone intersections and the identification of potential short-term and medium/long term improvements that will reduce crash rates. This information helps to determine where road safety resources can be most optimally allocated.

The Executive Summary of the Study is found in Attachment 1. The methodology and key outcomes are described briefly below.

Study Methodology

The Study was conducted in two phases; an initial screening and a secondary screening to ultimately identify a short list of the top 20 collision prone intersections.

Initial Screening

Table 1 provides a breakdown of the total number of intersections in Richmond. The initial screening began with the 818 intersections (50% of all intersections) for which ICBC collision data is available (total of 22,373 claims for the 2013-2017 period). As the five-year claims data indicated that 82% of the collisions (18,288) occurred at signalized intersections, subsequent analysis was focused on these 161 signalized intersections. Of the total number of collisions at these 161 signalized intersections, 0.08% were fatalities (14), 38% were injuries (6,946) and 62% were property damage only (11,328).

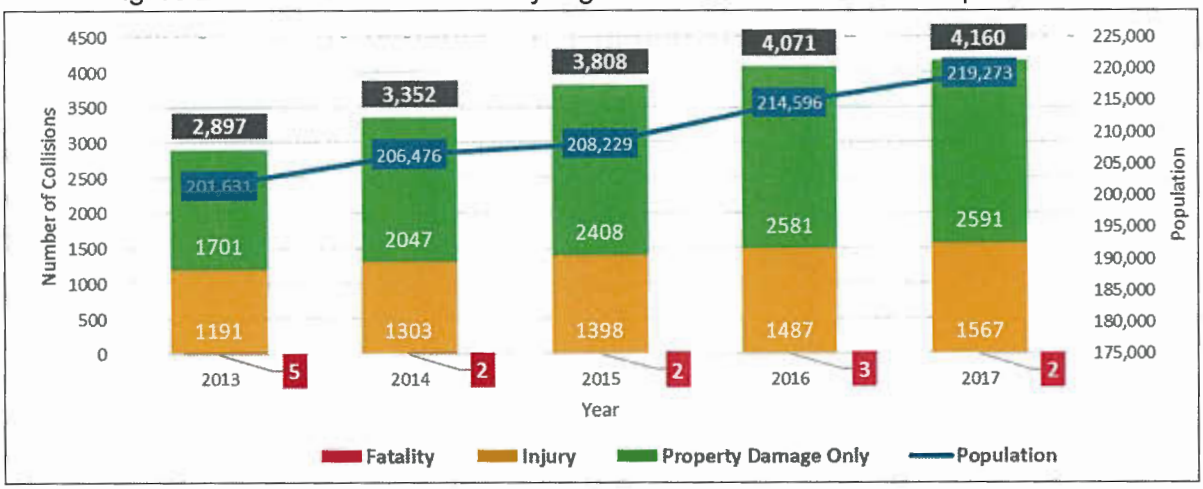
Table 1: Intersections in Richmond by Type

Intersection Type[1]	# of City Intersections			# of City Intersections with ICBC Data		
	Signalized	Non-signalized	Total	Signalized	Non-signalized	Total
City-MoTI	6	2	8	6	2	8
Major-Major	113	32	145	113	25	138
Major-Minor	43	391	434	42	326	368
Minor-Minor	0	1,030	1,030	0	304	304
Total	**162**	**1,455**	**1,617**	**161**	**657**	**818**

Notes:
(1) City-MoTI: Shared jurisdiction between City and Ministry of Transportation and Infrastructure (MoTI).
(2) Major: roadway is classified as an arterial or collector road.
(3) Minor: roadway is a local street.

Figure 2 illustrates that the annual number of collisions at the 161 signalized intersections increased from 2013 (2,897 collisions) to 2017 (4,160 collisions), indicating an 8.7% annual growth rate that outpaces the population annual growth rate of 1.7%.

Figure 2: Annual Collisions at City Signalized Intersections and Population Trend



The Study then focuses on intersections with an annual collision frequency equal to or greater than 25 collisions in the five-year period. This step resulted in 47 high collision intersections. These 47 intersections represent 29% of the 161 signalized intersections but account for 65% of the collisions.

Secondary Screening

The preliminary list of 47 high collision intersections was further prioritized using:

(1) Collision Severity Index: measures whether or not a location experiences more severe crashes (i.e., injury or fatality versus property damage only) than the City average for all intersections.

(2) Observed Collision Rate > Critical Collision Rate: this measure accounts for collision pattern randomness to ensure that only statistically meaningful locations are selected.

(3) Pedestrian-Involved Collisions: the number of pedestrian-involved collisions greater than five for the 2013-2017 period,

The Secondary Screening resulted in 20 intersections (2.4% of all Richmond intersections with collision data), which account for 23% of all ICBC claims in Richmond over the five-year period.

Intersection Safety Review Reports

Field reviews of the selected 20 intersections as well as a detailed collision analysis for the top 20 intersections were conducted using three-year data (2015-2017) to establish the most up-to-date collision patterns and identify the intersection improvements. The results of the collision data reviews and field reviews were compiled and summarized in a two-page Intersection Safety Review Report for each of the 20 intersections (Attachment 2) that includes:

- intersection layout and traffic volumes;
- collision pattern, including information of fatal collisions;
- field review observation and identified safety issues; and
- potential improvements (short-term and medium-/long-term).

Recommendations and Next Steps

Short-Term Improvements

The proposed short-term infrastructure improvements involve readily implementable measures such as improved traffic/parking signage, new or refreshed pavement markings, trimming of foliage to improve sightlines, and/or traffic signal modifications (e.g., added left-turn phase, larger lenses to improve visibility, change in signal phasing to assign priority to vulnerable road uses, etc). Additional proposed improvements include increased enforcement and education.

Attachment 3 summarizes the proposed improvements and estimated costs per intersection as well as the high-level estimate of safety benefits of the proposed improvements expressed as the percent of total collisions. The total estimated cost of the short-term improvements for all 20 intersections is approximately $500,000. Staff will include these short-term improvements in the 5 Year (2020-2024) Financial Plan, which is subject to Council approval.

Enforcement of Speeding and Red Light Running

Based on the Study findings, increased enforcement is recommended for 13 of the 20 intersections to address speeding and/or red light running violations as shown in Table 2. Of these 13 intersections, four have a red light enforcement camera (Shell Road-Alderbridge Way, No. 5 Road-Westminster Hwy, No. 5 Road-Cambie Road, and Gilbert Road-Blundell Road) and one has a red light camera that will be upgraded to provide automated speed enforcement (Garden City Road-Cambie Road). These programs operate 24 hours per day, seven days per week.

The red light camera and automated speed enforcement programs are within provincial jurisdiction. Therefore, staff recommend that the City request the Minister of Public Safety and Solicitor General to upgrade the existing four red light cameras and add cameras at the remaining eight intersections in order to provide red light and automated speed enforcement at all 13 intersections where the crash history reveals that speeding is a chronic contributing factor to collisions.

Table 2: Intersections Recommended for Increased Enforcement

Intersection	Red Light Camera?
Shell Rd-Alderbridge Way/Hwy 91	✓
Garden City Rd-Sea Island Way	×
No. 2 Rd-Westminster Hwy	×
No. 4 Rd-Alderbridge Way	×
No. 5 Rd-Westminster Hwy	✓
No. 5 Rd-Cambie Rd	✓
No. 4 Rd-Westminster Hwy	×
Garden City Rd-Cambie Rd	✓*
No. 2 Rd-Blundell Rd	×
No. 4 Rd-Cambie Rd	×
Minoru Blvd-Granville Ave	×
Gilbert Rd-Blundell Rd	✓
No. 5 Rd-Blundell Rd	×

* to be upgraded to automated speed enforcement

Staff will also share the Intersection Safety Review Reports with Richmond RCMP to enhance the targeted deployment of road safety enforcement.

Medium- and Long-Term Improvements

The proposed medium- and long-term infrastructure improvements involve substantial road geometry changes such as the road widening, addition or lengthening of left-turn lanes, redesign of existing channelized right-turn lanes, completion of pedestrian and cycling connections, and relocation of driveways. Given the scope of the proposed improvements, further analysis, design and consultation with affected property owners are required. In addition, some of the identified road improvements will require additional road right-of-way and can only proceed when the necessary additional right-of-way is available.

Staff recommend that a detailed intersection safety study and/or design be undertaken for each of the 20 intersections to confirm the exact scope of medium-/long-term improvements. Implementation of the final design will be included for Council consideration in future successive 5 Year Financial Plans, with the improvements starting with the higher ranked intersections. At that time, staff will seek potential cost-share funding from external agencies such as TransLink and ICBC.

Financial Impact

None.

Conclusion

The Network Screening Study is a comprehensive road safety analysis of City intersections that follows a standardized methodology using ICBC claims data and traffic volume data to identify high collision prone intersections. The result is a prioritized list of the top 20 high crash intersections and a customized list of short-term and medium-/long-term improvements for each intersection.

The phased implementation of the proposed improvements starting with the higher ranked intersections as part of future successive 5 Year Financial Plans are anticipated to significantly improve road safety for all users.

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FL:jc

Att. 1: Network Screening Study: Executive Summary
2: Intersection Road Safety Reports for Top 20 Intersections
3: Top 20 Intersections: Summary of Proposed Short-Term Improvements

Executive Summary

Background, Objective and Methodology

The **City of Richmond (the City)** approached the **Insurance Corporation of British Columbia (ICBC)** to undertake a joint exercise to identify high collision intersections around the City. Since 1990, ICBC has been working with the City, to invest in road safety improvements through its **Road Improvement Program (RIP)**. One of the major goals of the Program is to implement road safety improvements at collision-prone intersections in order to reduce the number of collisions and the associated claims costs to ICBC and impacts to the community as a whole.

The City and ICBC retained **ISL Engineering and Land Services (ISL)**, in association with **G. Ho Engineering Consultants (GHEC)** to undertake a **Network Screening Study** to identify collision-prone intersections within the City. The study involves a systematic process which uses insurance claims records, traffic volume data, and safety performance indicators to identify the high collision intersections. The output from the process is a list of collision-prone intersections within the City and identification of potential short-term and medium/long-term improvements.

The study methodology was comprised of three key phases: Project Initiation, Initial Screening (Selection of Candidate Intersections), and Secondary Screening (Analysis of Selected Intersections). The methodology flowchart could be found in ***Figure ES.1***.

Initial Screening

Based on the standard practice for road safety review studies, five-year of ICBC claim data for the City-wide intersections, between January 1, 2013 and December 31, 2017, was collected and reviewed. A total of **22,373** claims were identified at 818 City intersections, including 161 signalized intersections and 657 un-signalized intersections, in the five-year study period. It was found out that 18,288 collisions (82%) occurred at the signalized intersections, and high collision intersections are all controlled by traffic signals. Hence, the study focused on signalized intersections as the study intersections and their data set forms the basis of the analysis. The breakdown of the reported collisions at 161 study intersections was as follows and the collision severity summary for each intersection can be found in ***Table ES.1***:

- 14 fatal collisions (0.08% of total collisions);
- 6,946 injury collisions (38% of total collisions), which include injured drivers, passengers, cyclists, and/or pedestrians; and,
- 11,328 property damage only (PDO) collisions (62% of total collisions).

Based on the *Transportation Association of Canada Canadian Guide to In-service Road Safety Review (TAC Road Safety Review Guide)* and previous similar network screening studies in the province, the following safety performance indicator was applied to identify the high collision intersections out of the 161 study intersections:

- Annual Collision Frequency being equal or over 25 collisions (i.e. equal or over 125 collisions in five years), which accounts for collision occurrence. After filtering the collision data by removing the claims at the parking lots and unknown locations, 47 intersections were identified as high collision intersections.

Secondary Screening

Intersections with planned modifications and recent improvements (completed after the year 2013) were taken into account in selecting the top 20 collision-prone intersections; there were 6 intersections out of the 47 high collision intersections identified in Initial Screening that were removed. Based on the *TAC Road Safety Review Guide*, the remaining 41 high collision intersections were further screened based on the following safety performance indicators and process to select the top 20 collision-prone intersections:

- Collision Severity Index being greater than the City's average of 4.50, which accounts for collision severity. This resulted in 25 intersections.

The 25 intersections were shortlisted to 20 by applying the following criteria:

- Observed Collision Rate greater than the Critical Collision Rate, which accounts for collision pattern randomness. This resulted in 9 intersections.
- The number of 5-year pedestrian-involved collisions greater than 5, which accounts for the vulnerable user safety concerns. This resulted in 6 more intersections, bringing the total to 15.
- Highest Collision Severity Index. Out of the 47 intersections not yet shortlisted, the top 5 with the highest Collision Severity Index were selected to achieve the top 20 intersections.

Based on the selection criteria, the results could be found in ***Table ES.2***. ***Figure ES.2*** included the locations of the selected 20 collision-prone intersections while ***Table ES.3*** shows the safety performance indicators for these locations.

Field Review

Field reviews of the selected 20 collision-prone intersections were conducted in April 2019 by three experienced Road Safety Reviewers. All 20 selected intersections were examined by drive-through/walk-through for all intersection approaches, providing safety reviewers with driver's/pedestrian's/cyclist's perspective of potential traffic safety issues. During the field reviews, potential safety issues were identified for all road modes (passenger cars, trucks, cycling, walking, and transit vehicles), using the *Site Visit Sample Observation Report* from the *TAC Road Safety Review Guide*.

Intersection Safety Review Report

Collision analysis for the selected 20 collision-prone intersections was focused on the most recent available 3-year period (2015-2017), in order to establish the most up-to-date collision patterns and identify the most relevant intersection improvements. The results of the collision data reviews (2015-2017) and field reviews were compiled and summarized in a two-page *Safety Review Report* for each of the 20 intersections, including:

- Intersection Layout and Traffic Volumes
- Collision Pattern, including information of fatal collisions
- Field Review Observation and Identified Safety Issues
- Potential Improvements (Short-term and Medium-/Long-term)

Fatal Collisions

Although the number of fatal collisions has already been included in calculating the collision severity index at each intersection, the occurrence of fatal collisions generates significant impacts to the community as a whole. It is noted that the selected 20 collision-prone intersections include 10 out of 14 fatal collisions, and the information of these fatal collisions were reviewed and discussed in the corresponding Intersection Safety Review Report. The locations and information of the remaining fatal collisions (four collisions) at City's intersections were as follow and it is suggested that an in-depth review of the contributing factors causing these fatal collisions needs to be conducted in the future studies:

- Knight Street and Westminster Highway: *a rear-end collision occurred at the westbound approach in the afternoon of May 2013*
- Garden City Road and Westminster Highway: *an off-road collision occurred at the eastbound approach in the morning of July 2013*
- Gilbert Road and River Road: *an off-road collision occurred at the southbound approach in the morning of October 2014*
- No. 3 Road and Westminster Highway: *no details were available for a collision occurred in the afternoon of October 2016*

Conclusion and Recommendations

From the Intersection safety review reports for the selected 20 collision-prone intersections, the site-specific short-term, medium-term, and long-term improvements were identified. In general, these proposed mitigation measures could be grouped into four categories (4E's): Engineering, Enforcement, Evaluation & Monitoring, and Education & Encouragement.

Engineering – improving/designing transportation systems/facilities/ infrastructures to anticipate human error so the consequence is not death or severe injury, for example:

- Construct new infrastructure, signals, street lighting, pedestrian and bicycle facilities, etc.
- Optimize and (re) prioritize existing transportation infrastructure and operations (e.g. traffic signals, roads, etc.) to enhance safety for all road users
- Upgrade signage and pavement markings to retain visibility and conspicuity

Enforcement – working with local law enforcement to enhance education, awareness, and enforcement in adjusting high-risk behaviours (speeding, disobeying, illegal movements, etc.) by:

- Increase enforcement and education on vehicle infractions
- Increase enforcement and education on cyclist infractions
- Increase enforcement and education on pedestrian infractions

Evaluation or **Monitoring** – monitoring if road safety strategies work through observing behaviour, surveying conflicts, monitoring programs/initiatives, as well as adjusting legislation (if needed), for example:

- Review the lane configuration at intersections based on traffic volumes/delays
- Review adequate pedestrian/bicycle connections to the nearest bus stops
- Review posted speed limits to confirm appropriateness and collect speed data

Education or **Encouragement** – teaching, encouraging, engaging all road users within the community, including drivers and vulnerable users (pedestrians/cyclists – i.e. students) to change behaviours through road safety, such as:

- Encourage the use of alternate mode and provide public information (Traffic Safety Awareness Week)
- Educate campaigns to school students (STARS – Safer Traffic Around Richmond Schools)
- Encourage the importance of road safety for truck drivers

It is recommended that the City of Richmond implement the suggested short-term improvements. In addition to the suggested medium/long-term improvements, it is recommended that the City could consider the following:

- Undertake a detailed intersection safety study and/or design at each of the 20 intersections
- Conduct a corridor-wide improvement strategy that may provide a more comprehensive strategy to deal with the safety issues more effectively, compared to improvements at isolated intersections, such as Blundell Road and No. 4 Road. Corridor-wide strategies can often be expected to provide a "halo" effect (i.e. the implementation of the improvement could impact the extent of the corridor).
- Work with ICBC through its Road Improvement Program (RIP) to conduct a traffic operation and road safety review for the selected intersections or corridors.
- Continue to collaborate with partners (such as RCMP, School Board, and Province Government) on road safety programs/initiatives.

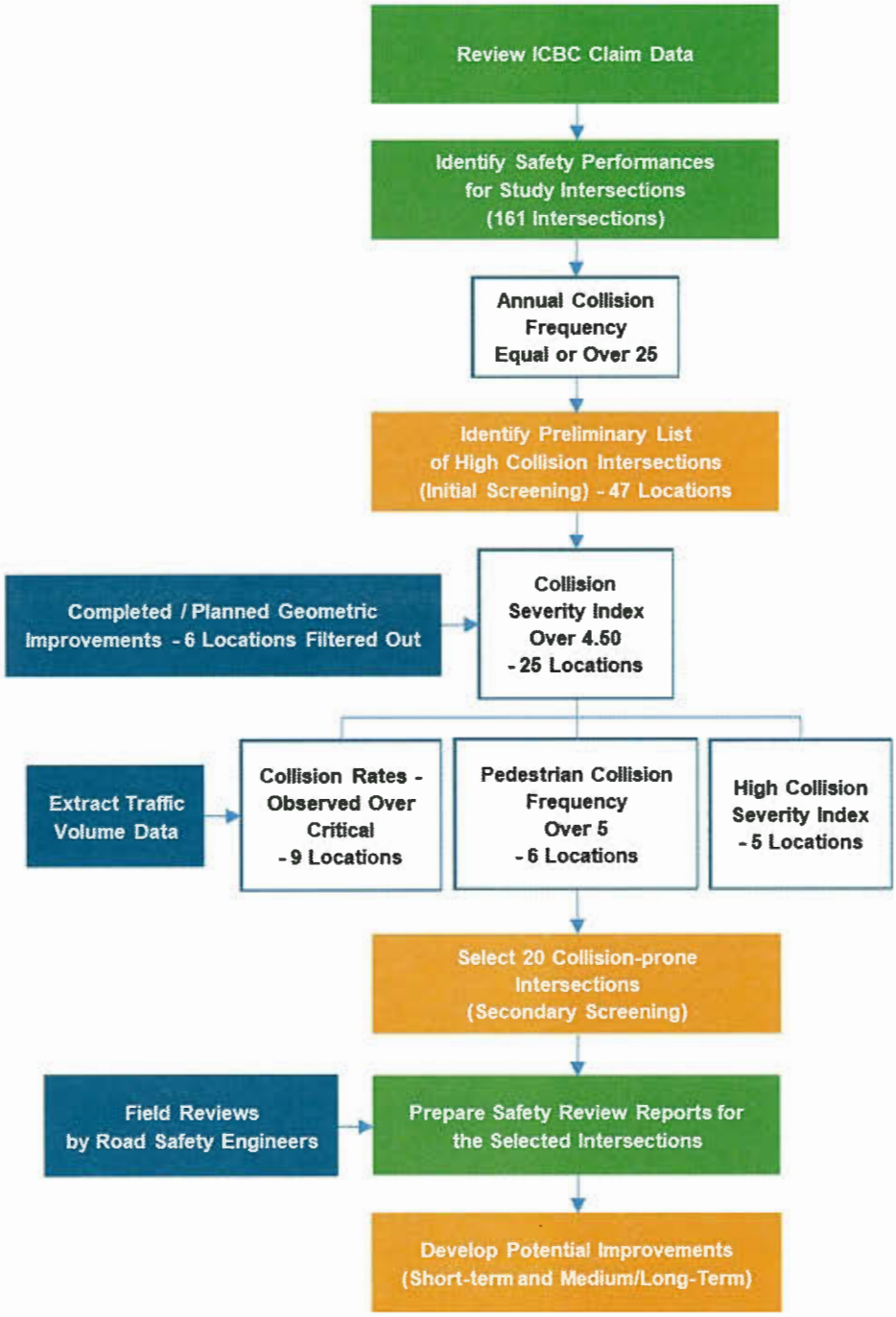


Figure ES.1 Study Methodology Flowchart

Table ES.1 Summary of 5-year ICBC Unfiltered Collision Data for Study Intersections (161 Signalized Intersections)

	Collision Data	ICBC Claim Data (2013-2017)				
No.	Intersection	Fatal	Injury	Property Damage Only	Total	Annual Frequency
1	No. 5 Road & Steveston Highway		172	471	643	128.6
2	Shell Road & Alderbridge Way / Highway 91	1	267	283	551	110.2
3	Garden City Road & Westminster Highway	1	178	334	513	102.6
4	No. 3 Road & Westminster Highway	1	134	372	507	101.4
5	Garden City Road & Alderbridge Way		191	307	498	99.6
6	No. 3 Road & Alderbridge Way		131	266	397	79.4
7	Garden City Road & Sea Island Way	1	152	244	397	79.4
8	No. 2 Road & Westminster Highway		164	224	388	77.6
9	No. 5 Road & Westminster Highway		169	219	388	77.6
10	No. 4 Road & Alderbridge Way		158	224	382	76.4
11	No. 5 Road & Cambie Road	1	140	217	358	71.6
12	Great Canadian Way & Bridgeport Road		108	230	338	67.6
13	No. 4 Road & Westminster Highway	2	133	164	299	59.8
14	Garden City Road & Cambie Road	1	105	167	273	54.6
15	No. 5 Road & Bridgeport Road		89	179	268	53.6
16	No. 3 Road & Cambie Road		58	199	257	51.4
17	No. 2 Road & Blundell Road		107	146	253	50.6
18	Garden City Road & Granville Avenue		103	142	245	49.0
19	No. 3 Road & Granville Avenue	1	91	143	235	47.0
20	Sweden Way & Bridgeport Road		82	152	234	46.8
21	Minoru Boulevard & Westminster Highway		77	152	229	45.8
22	No. 3 Road & Blundell Road		76	152	228	45.6
23	Gilbert Road & Westminster Highway		74	152	226	45.2
24	No. 4 Road & Blundell Road		109	104	213	42.6
25	No. 4 Road & Cambie Road		86	111	197	39.4
26	Hazelbridge Way / Mall Access & Alderbridge Way		63	122	185	37.0
27	Garden City Road & Blundell Road	2	85	95	182	36.4
28	No. 2 Road & Granville Avenue		67	108	175	35.0
29	Minoru Boulevard & Granville Avenue		69	105	174	34.8
30	Shell Road & Bridgeport Road		85	86	171	34.2
31	No. 3 Road & Lansdowne Road		56	111	167	33.4
32	No. 3 Road & Leslie Road		41	123	164	32.8
33	No. 1 Road & Francis Road		65	95	160	32.0
34	Cooney Road & Westminster Highway		45	112	157	31.4
35	Shell Road & Cambie Road		67	89	156	31.2
36	Garden City Road & Lansdowne Road		62	92	154	30.8
37	Knight Street & Westminster Highway	1	52	94	147	29.4
38	Gilbert Road & Granville Avenue		53	88	141	28.2
39	Jacombs Road / Sidaway Road & Westminster Highway		60	81	141	28.2
40	Shell Road & Westminster Highway		56	80	136	27.2
41	Cooney Road / St. Albans Road & Granville Avenue		41	91	132	26.4
42	No. 1 Road & Steveston Highway		56	76	132	26.4
43	No. 3 Road & Saba Road		38	93	131	26.2
44	Hazelbridge Way & Cambie Road		32	98	130	26.0
45	Gilbert Road & Blundell Road		64	64	128	25.6
46	Gilbert Road & River Road (River Parkway)	1	45	82	128	25.6
47	No. 3 Road & Williams Road		52	75	127	25.4
48	No. 6 Road & Westminster Highway		55	71	126	25.2
49	No. 5 Road & Blundell Road	1	61	63	125	25.0
50	No. 3 Road & Cook Road		41	84	125	25.0
51	No. 2 Road & Francis Road		58	67	125	25.0
52	Bridgeport Road & Viking Way		44	79	123	24.6
53	Kwantlen Street & Alderbridge Way		33	90	123	24.6
54	No. 3 Road & Ackroyd Road		36	85	121	24.2
55	No. 2 Road & Steveston Highway		42	78	120	24.0
56	Alexandra Road & Hazelbridge Way		37	80	117	23.4
57	Garden City Road & Odlin Road		39	76	115	23.0
58	Nelson Road & Westminster Highway		43	71	114	22.8
59	No. 3 Road & Francis Road		51	62	113	22.6
60	No. 4 Road & Williams Road		41	71	112	22.4
61	Coppersmith Place & Steveston Highway		37	74	111	22.2
62	Ackroyd Road & Cooney Road		41	66	107	21.4
63	No. 1 Road & Blundell Road		38	68	106	21.2
64	Blundell Road & St Albans Road		44	60	104	20.8
65	Elmbridge Way & Gilbert Road		35	69	104	20.8
66	Blundell Road & Railway Avenue		52	46	98	19.6
67	Cook Road & Garden City Road		34	63	97	19.4
68	Granville Avenue & No. 4 Road		50	47	97	19.4
69	No. 4 Road & Steveston Highway		33	64	97	19.4
70	Cooney Road & Lansdowne Road / Mall Access		35	61	96	19.2
71	No. 1 Road & Westminster Highway		34	60	94	18.8
72	No. 2 Road & Williams Road		50	44	94	18.8
73	Cambie Road & No. 6 Road		39	53	92	18.4
74	Cambie Road & Jacombs Road		38	51	89	17.8
75	Cook Road & Cooney Road		39	46	85	17.0
76	Sexsmith Road & Sea Island Way		35	50	85	17.0
77	No. 1 Road & Williams Road		47	37	84	16.8
78	Shell Road & Westminster Highway		33	49	82	16.4
79	Capstan Way & Garden City Road		35	43	78	15.6
80	Alderbridge Way & Minoru Boulevard		22	53	75	15.0
81	Gilbert Road & Williams Road		35	40	75	15.0
82	Francis Road & Gilbert Road		35	38	73	14.6
83	Railway Avenue & Steveston Highway		27	45	72	14.4
84	Cambie Road & St Edwards Drive		33	38	71	14.2
85	Francis Road & Railway Avenue		40	31	71	14.2
86	Granville Avenue & No. 1 Road		37	33	70	14.0
87	No. 3 Road & Park Road & Mall Access		29	41	70	14.0
88	Capstan Way & No. 3 Road		23	45	68	13.6
89	No. 3 Road & Steveston Highway		28	40	68	13.6
90	Cambie Road & Sexsmith Road		25	42	67	13.4
91	Browngate Road & Hazelbridge Way		15	50	65	13.0
92	Alderbridge Way & Lansdowne Road		26	37	63	12.6
93	Alderbridge Way & Westminster Highway		27	36	63	12.6
94	Bridgeport Road & St EdwaRoads Drive		22	41	63	12.6
95	Alderbridge Way & Elmbridge Way		15	47	62	12.4
96	Hazelbridge Way & Leslie Road		12	50	62	12.4
97	Kwantlen Street & Lansdowne Road		27	34	61	12.2
98	Bridgeport Road & Simpson Road		29	29	58	11.6
99	Buswell Street & Granville Avenue		17	41	58	11.6
100	Gilbert Road & Lansdowne Road		22	36	58	11.6
101	Blundell Road & Minoru Boulevard		16	41	57	11.4
102	Bridgeport Road & No. 6 Road		21	36	57	11.4
103	No. 5 Road & Williams Road		26	31	57	11.4
104	No. 4 Road & Odlin Road		26	29	55	11.0
105	Gilbert Road & Steveston Highway		22	32	54	10.8
106	Browngate Road & No. 3 Road		18	35	53	10.6
107	Francis Road & GaRoaden City Road		24	27	51	10.2
108	GaRoaden Cty Road & Williams Road		24	26	50	10.0
109	Francis Road & No. 4 Road		17	32	49	9.8
110	Cambie Road & Viking Way		20	28	48	9.6
111	Lynas Lane & Westminster Highway		19	27	46	9.2
112	Graybar Road & Westminster Highway		14	31	45	9.0
113	Granville Avenue & Railway Avenue		19	25	44	8.8
114	No. 8 Road & Westminster Highway		21	23	44	8.8
115	No. 2 Road & WoodwaRoads Road		25	18	43	8.6
116	Buswell Street & Cook Road		15	27	42	8.4
117	Lansdowne Road & Minoru Boulevard		13	28	41	8.2
118	Moncton Street & No. 1 Road		4	36	40	8.0
119	Railway Avenue & Williams Road		15	25	40	8.0
120	Fraserwood Place & Westminster Highway		17	22	39	7.8
121	Hollybridge Way & River Road		16	22	38	7.6
122	Horseshoe Way & No. 5 Road & Riverside Way		6	32	38	7.6
123	Alberta Road & No. 4 Road		14	23	37	7.4
124	Garrison Road & No. 2 Road		15	20	35	7.0
125	Ackroyd Road & Elmbridge Way & Minoru Boulevard		15	18	33	6.6
126	SeawaRoad Gate & Steveston Highway		13	19	32	6.4
127	Blundell Road & No. 8 Road		10	21	31	6.2
128	Mortfield Gate & Steveston Highway		15	15	30	6.0
129	Chatham Street & No. 1 Road		7	22	29	5.8
130	Elmbridge Way & Westminster Highway		12	16	28	5.6
131	Capstan Way & Sexsmith Road		10	15	25	5.0
132	Buswell Street & Saba Road		12	12	24	4.8
133	Cooney Road & Saba Road		9	15	24	4.8
134	Maple Road & No. 2 Road		3	21	24	4.8
135	Mclean Avenue & Westminster Highway		12	12	24	4.8
136	Bridgeport Road & Mclennan Avenue		8	15	23	4.6
137	Great Canadian Way & Van Horne Way		8	13	21	4.2
138	Mcmillan Way & Westminster Highway		7	13	20	4.0
139	Minoru Boulevard & Minoru Gate & Mall Access		7	11	18	3.6
140	Garry Street & No. 1 Road		5	12	17	3.4
141	Gilley Road & Westminster Highway		7	10	17	3.4
142	Mayfield Place & No. 6 Road		9	8	17	3.4
143	Cambie Road & Stolberg Street		9	7	16	3.2
144	Alderbridge Way & Cedarbridge Way		7	8	15	3.0
145	Great Canadian Way & River Road		3	9	12	2.4
146	Elmbridge Way & Hollybridge Way		1	10	11	2.2
147	Gollner Avenue & Minoru Boulevard		3	8	11	2.2
148	Oval Way & River Road		6	5	11	2.2
149	Mcclelland Road & Alderbridge Way		2	9	11	2.2
150	Commerce Parkway & No. 6 Road		5	4	9	1.8
151	Greenland Drive & No. 5 Road		3	5	8	1.6
152	Jacombs Road & Smallwood Place		3	5	8	1.6
153	No. 1 Road & Osmond Avenue		4	4	8	1.6
154	No. 2 Road & Wallace Road		3	5	8	1.6
155	Alderbridge Way & May Drive		3	4	7	1.4
156	Cedarbridge Way & Lansdowne Road		3	3	6	1.2
157	Hazelbridge Way & Sweet Avenue		3	3	6	1.2
158	Moncton Street & Railway Avenue		4	2	6	1.2
159	Minoru Boulevard & MuRoadoch Avenue & Mall Access		2	2	4	0.8
160	Hollybridge Way & Lansdowne Road		2		2	0.4
161	Pearson Way & River Road			2	2	0.4

Table ES.2 Summary of Selection Criteria Assessment for 47 High Collision Intersections

ID	Intersection	Annual Collision Frequency (Equal or Over 25.0)	Collision Severity Index (Over 4.50)	Observed Collision Rate (Over Critical Collision Rate)	Total Pedestrian-involved Collisions (Over 5)	"Selection Rationale"
1	No. 5 Road & Steveston Highway	✓	×			Not Selected - Recently Improved and Does not meet the Criteria
2	Shell Road & Alderbridge Way / Highway 91	✓	✓	✓		Selected - Meets the Criteria
3	Garden City Road & Westminster Highway	✓	×			Not Selected - Does not meet the Criteria
4	Garden City Road & Alderbridge Way	✓	✓			Not Selected - Recently Improved
5	No. 3 Road & Westminster Highway	✓	×			Not Selected - Does not meet the Criteria
6	Garden City Road & Sea Island Way	✓	✓	✓		Selected - Meets the Criteria
7	No. 3 Road & Alderbridge Way	✓	×			Not Selected - To Be Modified and Does not meet the Criteria
8	No. 2 Road & Westminster Highway	✓	✓	✓		Selected - Meets the Criteria
9	No. 4 Road & Alderbridge Way	✓	✓	✓		Selected - Meets the Criteria
10	No. 5 Road & Westminster Highway	✓	✓	✓		Selected - Meets the Criteria
11	No. 5 Road & Cambie Road	✓	✓	✓		Selected - Meets the Criteria
12	Great Canadian Way & Bridgeport Road	✓	×			Not Selected - Does not meet the Criteria
13	No. 4 Road & Westminster Highway	✓	✓	×	×	Selected - Meets the Criteria (i.e. High CSI)
14	Garden City Road & Cambie Road	✓	✓	×	✓	Selected - Meets the Criteria
15	No. 5 Road & Bridgeport Road	✓	×			Not Selected - Does not meet the Criteria
16	Garden City Road & Granville Avenue	✓	✓	✓		Selected - Meets the Criteria
17	Sweden Way & Bridgeport Road	✓	×			Not Selected - Does not meet the Criteria
18	Minoru Boulevard & Westminster Highway	✓	×			Not Selected - Does not meet the Criteria
19	No. 2 Road & Blundell Road	✓	✓	✓		Selected - Meets the Criteria
20	No. 3 Road & Granville Avenue	✓	✓	×	✓	Selected - Meets the Criteria
21	No. 3 Road & Blundell Road	✓	×			Not Selected - Does not meet the Criteria
22	Gilbert Road & Westminster Highway	✓	×			Not Selected - Does not meet the Criteria
23	No. 4 Road & Blundell Road	✓	✓	✓		Selected - Meets the Criteria
24	No. 3 Road & Cambie Road	✓	×			Not Selected - Does not meet the Criteria
25	No. 4 Road & Cambie Road	✓	✓	×	✓	Selected - Meets the Criteria
26	Hazelbridge Way / Mall Access & Alderbridge Way	✓	×			Not Selected - Does not meet the Criteria
27	No. 2 Road & Granville Avenue	✓	×			Not Selected - Does not meet the Criteria
28	Shell Road & Bridgeport Road	✓	✓	×	×	Selected - Meets the Criteria (i.e. High CSI)
29	Minoru Boulevard & Granville Avenue	✓	✓	×	✓	Selected - Meets the Criteria
30	No. 3 Road & Lansdowne Road	✓	×			Not Selected - Does not meet the Criteria
31	Garden City Road & Blundell Road	✓	✓	×	✓	Selected - Meets the Criteria
32	No. 3 Road & Leslie Road	✓	×			Not Selected - Does not meet the Criteria
33	Shell Road & Cambie Road	✓	✓	×	×	Not Selected - Does not meet the Criteria (i.e. Low CSI)
34	Garden City Road & Lansdowne Road	✓	✓	×	×	Not Selected - Does not meet the Criteria (i.e. Low CSI)
35	Cooney Road & Westminster Highway	✓	×			Not Selected - Does not meet the Criteria
36	No. 1 Road & Francis Road	✓	✓	×	×	Selected - Meets the Criteria (i.e. High CSI)
37	Knight Street & Westminster Highway	✓	✓	×	×	Not Selected - Does not meet the Criteria (i.e. Low CSI)
38	Jacombs Road / Sidaway Road & Westminster Highway	✓	✓	×	×	Not Selected - Does not meet the Criteria (i.e. Low CSI)
39	Gilbert Road & Granville Avenue	✓	×			Not Selected - Does not meet the Criteria
40	Shell Road & Westminster Highway	✓	✓	×	×	Not Selected - Does not meet the Criteria (i.e. Low CSI)
41	Cooney Road / St. Albans Road & Granville Avenue	✓	×			Not Selected - Recently Improved and Does not meet the Criteria
42	No. 1 Road & Steveston Highway	✓	✓	×	✓	Selected - Meets the Criteria
43	Gilbert Road & Blundell Road	✓	✓	×	×	Selected - Meets the Criteria (i.e. High CSI)
44	Gilbert Road & River Road (River Parkway)	✓	✓			Not Selected - To Be Modified
45	No. 5 Road & Blundell Road	✓	✓	×	×	Selected - Meets the Criteria (i.e. High CSI)
46	Hazelbridge Way & Cambie Road	✓	×			Not Selected - Does not meet the Criteria
47	No. 2 Road & Francis Road	✓	✓			Not Selected - To Be Modified

Figure ES.2 Locations of the 20 Selected Collision-Prone Intersections

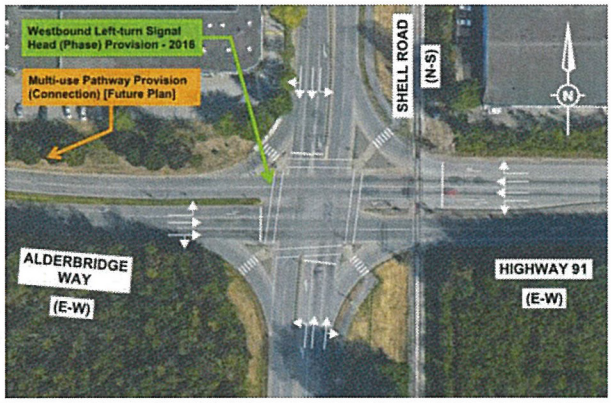
Table ES.3 Safety Performance Summary for the 20 Selected Collision-Prone Intersections

Site #	Intersection	Annual Collision Frequency	Collision Severity Index	Observed / Critical Collision Rate	Total 5-Year Number of Pedestrian involved Collisions	Total 5-Year Number of Fatal Collisions
1	Shell Road & Alderbridge Way / Highway 91	110.2	5.54	5.23 / 3.27	0	1
2	Garden City Road & Sea Island Way	79.2	4.70	3.51 / 3.26	2	1
3	No. 2 Road & Westminster Highway	76.6	4.85	3.63 / 3.27	3	0
4	No. 4 Road & Alderbridge Way	76.4	4.72	3.54 / 3.27	0	0
5	No. 5 Road & Westminster Highway	76.2	4.97	4.28 / 3.30	1	0
6	No. 5 Road & Cambie Road	66.2	4.97	4.91 / 3.35	4	1
7	No. 4 Road & Westminster Highway	59.8	5.67	2.57 / 3.26	0	2
8	Garden City Road & Cambie Road	52.4	4.95	3.08 / 3.31	7	1
9	Garden City Road & Granville Avenue	48.8	4.80	5.27 / 3.42	3	0
10	No. 2 Road & Blundell Road	44.4	5.14	3.64 / 3.36	5	0
11	No. 3 Road & Granville Avenue	44.2	4.95	2.44 / 3.30	14	1
12	No. 4 Road & Blundell Road	42.6	5.61	3.39 / 3.36	0	0
13	No. 4 Road & Cambie Road	39.0	4.97	3.08 / 3.36	5	0
14	Shell Road & Bridgeport Road	34.2	5.47	2.83 / 3.37	3	0
15	Minoru Boulevard & Granville Avenue	34.2	4.63	2.65 / 3.35	12	0
16	Garden City Road & Blundell Road	32.2	6.65	3.35 / 3.41	8	2
17	No. 1 Road & Francis Road	29.6	4.89	2.99 / 3.41	0	0
18	No. 1 Road & Steveston Highway	26.0	4.88	2.08 / 3.36	5	0
19	Gilbert Road & Blundell Road	25.6	5.50	2.14 / 3.37	3	0
20	No. 5 Road & Blundell Road	25.0	6.18	2.73 / 3.42	0	1

SHELL ROAD & ALDERBRIDGE WAY / HIGHWAY 91

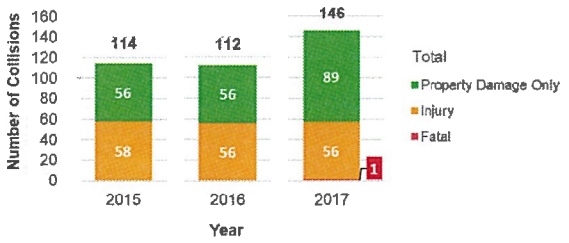
INTERSECTION INFORMATION

Site #:	1
Intersection Type:	4-Legged
Traffic Control Type:	Signalized - P/P LT for SB & E-W
N-S Street Classification:	Arterial (Bike Route - MUP)
E-W Street Classification:	Provincial - Arterial (MRN)
Surrounding Land Use:	Commercial / Industrial
Daily Traffic Volume (2015):	57,800 Entering Vehicles



COLLISION STATISTICS (2015-2017)

Collision Frequency:	124.0 per year	(Total = 372)
Collision Severity Index:	5.38	(Casualty = 46%)
Collision Rate OBS. / CRT.:	5.23 / 3.27	[2013-2017]
Collision with Pedestrian:	0	
Collision with Cyclist:	1	



Highest % Month:	December (10%)
Highest % Day of Week:	Friday (22%)
Highest % Time Period:	3 PM - 6 PM (30%)
Top 3 Collision Types:	Rear End (70%) Left Turn (13%) Sideswipe (8%)

IDENTIFIED OPERATIONAL AND SAFETY ISSUES

Geometric:

- Rural perception at wide intersection with channelized right-turn islands – *overall*
- Lane drop after intersection – *south leg*
- Inadequate sight distance due to nearby foliage – *southwest corner*
- Presence of railway crossing – *east leg; two sets of westbound signal heads with one stop bar*

Signal:

- Lack of left-turn phase – *northbound approach*

Vulnerable Road User:

- Long pedestrian crossing distance – *north-south directions*
- Old pedestrian pushbuttons – *east side corners; along multi-use pathway*

Collision (Data Review):

- High collision frequency (over 50.0), high collision severity index (over 5.00), and a collision-prone location (observed over critical collision rate)
- Annual number of collisions increased in 2017
- High number of rear-end collisions reported on Highway 91 westbound – *103 out of total 254 collisions*
- High number of right-turn rear-end collisions occurred at Highway 91 westbound designated/channelized right-turn – *over 50% of total 30 collisions; unexpected yield control with high vehicle speed*
- High proportion of left-turn opposing collisions occurred in the east-west directions – *over 80% of total; 22 collisions involved westbound (horizontal curve on the eastbound approach) and 15 collisions involved eastbound*
- High proportion of sideswipe collisions occurred with east-west movements – *16 out of total 29 collisions; changing lanes to avoid right-turn vehicles to merge*
- Three collisions reported in the north-south directions due to U-turn movements
- One fatal collision reported involving a westbound left-turn opposing collision and hitting a third vehicle on Shell Road during Friday noon on August 2017

SHELL ROAD & ALDERBRIDGE WAY / HIGHWAY 91

Operational (Field Review):

- Congestion / long queues during peak periods – *east-west approaches*
- Significant left-/right-turn volumes/queues during peak periods – *southbound and east-west approaches; high number of turning-related conflicts were observed*
- Significant lane changing/weaving activities – *east-west legs; to avoid merging vehicles from right-turns*
- High vehicle speed – *east-west legs (free flow, especially to/from highway); presence of red-light camera for eastbound approach*
- Unexpected yield control with designated right-turn lane – *east side corners; designated right-turn bay for westbound approach*
- Broken motor vehicle parts were noticed at the southeast channelized island

Other:

- Missing/inconsistent pavement marking – *east leg; no elephant feet and green bike path marking on crosswalks connecting multi-use pathways, similar to the southeast corner*
- Faded pavement marking – *southeast corner; dashed merge line*
- Missing road sign – *all corners (no pedestrian crosswalk signage) and south leg (no merge sign)*

POTENTIAL IMPROVEMENTS

Short-Term (Potential Safety Benefit = 20 to 30% of Total Collisions):

- Upgrade pedestrian pushbuttons to the latest standard – *east side corners; to be consistent overall*
- Provide pedestrian crosswalk signs – *all corners*
- Provide merge sign – *south leg (southbound)*
- Regularly repaint dashed merge line – *southeast corner*
- Regularly trim foliage to provide adequate sight distance – *southwest corner*
- Paint elephant feet and green bike path pavement marking along crosswalk – *east leg; similar to the southeast corner*
- Install enlarged Yield sign or two Yield signs – *westbound approach*
- Consider the provision of protected-only left-turn phase – *westbound approach*
- Conduct warrant analysis for adding left-turn phase – *northbound approach*
- Enlarge signal lenses to 300-300-300 millimetres for primary traffic signal heads – *all approaches*

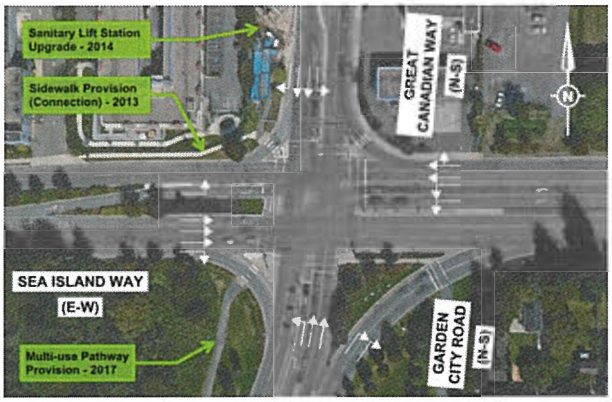
Medium/Long-Term:

- Add left-turn phase (if warranted) – *northbound approach*
- Provide clear gateway signage, such as "Freeway Ends" – *westbound approach*
- Install speed radar board – *westbound direction*
- Remove or modify angle of channelized right-turn in coordination with MoTI – *east side corners (to/from highway); traffic operation and geometric design to confirm*
- Increase property setback with future redevelopment – *southwest corner*
- Review the need of installing advance warning flasher in coordination with MoTI – *westbound approach*
- Work with MoTI to lower speed zones before the intersection – *westbound approach*
- Explore the feasibility to increase left-turn storage in coordination with MoTI – *eastbound and westbound approaches*
- Consider a feasibility study to provide the grade separation in coordination with MoTI and CP Railway – *east-west movements; connecting Alderbridge Way and Highway 91*
- Enhance police enforcements for vehicle speeding violations in coordination with RCMP – *all approaches*
- Review traffic lane widths and curb return radii as a measure to reduce collisions involving speeding and right-turn lanes

GARDEN CITY ROAD / GREAT CANADIAN WAY & SEA ISLAND WAY

INTERSECTION INFORMATION

Site #:	2
Intersection Type:	4-Legged
Traffic Control Type:	Signalized - P/P LT for EB
N-S Street Classification:	Arterial (Bike Route & MUP)
E-W Street Classification:	Provincial (Bike Route - WL)
Surrounding Land Use:	Retail / Residential
Daily Traffic Volume (2015):	61,800 Entering Vehicles



COLLISION STATISTICS (2015-2017)

Collision Frequency:	81.3 per year	(Total = 244)
Collision Severity Index:	4.80	(Casualty = 38%)
Collision Rate OBS. / CRT.:	3.51 / 3.26	[2013-2017]
Collision with Pedestrian:	2	
Collision with Cyclist:	1	

Highest % Month:	December (12%)
Highest % Day of Week:	Thursday (18%)
Highest % Time Period:	3 PM - 6 PM (30%)
Top 3 Collision Types:	Rear End (52%) Sideswipe (27%) Left Turn (12%)

IDENTIFIED OPERATIONAL AND SAFETY ISSUES

Geometric:

- First signalized intersection from Oak Street Bridge (southbound)
- Horizontal curve immediately before/after intersection – *south leg*
- Dual right-turn lanes with signal operation – *northbound approach; limited sight distance to crossing pedestrians and eastbound vehicles*
- Commercial driveways close to intersection – *northeast quadrant (gas station)*
- Inadequate sight distance due to nearby foliage – *southwest corner; conflict between eastbound right-turn vehicles and northbound pedestrians/bicycles*

Signal:

- Protected-permissive left-turn phase for eastbound single lane and protected-only left-turn phase for westbound dual lanes
- Long gap for pedestrian crossing green time after red signal for vehicles – *northbound channelized right-turn*

Vulnerable Road User:

- Inadequate bicycle facility – *west leg (no elephant feet on crosswalks connecting multi-use pathways) and northeast corner (narrow shoulder on the west side of the island, not consistent with southeast island)*
- Northbound bike lane is disappeared along the channelized right-turn island
- Long pedestrian crossing distance – *north-south directions*

Collision (Data Review):

- High collision frequency (over 50.0), and a collision-prone location (observed over critical collision rate)
- High proportion of rear-end collisions reported on Sea Island Way approaches – *70% of total 121 collisions*
- High number of right-turn rear-end collisions occurred at westbound channelized right-turn – *over 50% of total 30 collisions*
- High number of left-turn opposing collisions occurred with eastbound left-turns – *20 collisions*
- High proportion of "red-light running" collisions occurred in the eastbound direction – *8 out of total 12 collisions*
- High number of sideswipe collisions occurred with northbound movements – *24 collisions (39% of total)*
- One fatal collision reported during a weekday afternoon on December 2017; location and type are not available

GARDEN CITY ROAD / GREAT CANADIAN WAY & SEA ISLAND WAY

Operational (Field Review):

- Congestion / long queues during peak periods – *all directions*
- Significant left/right-turn volumes/queues during peak periods – *all approaches*
- Significant lane changing/weaving activities – *northbound and east-west directions; especially to/from highway*
- Vehicle queue spillback from downstream – *north (signalized intersection) and east (interchange on-ramp) legs*

Other:

- Missing pavement marking – *north side corners; dashed merge line (similar to southwest corner)*
- Missing road sign – *north side and southwest corners; no pedestrian/bicycle crosswalk signage as well as object marker signage*
- Inappropriate road sign – *north side and southwest corners; yield sign far from actual merge point and before pedestrian crosswalk*

POTENTIAL IMPROVEMENTS

Short-Term (Potential Safety Benefit = 5 to 15% of Total Collisions):

- Regularly trim foliage to provide adequate sight distance – *southwest corner*
- Paint elephant feet along crosswalk – *west leg*
- Paint dashed merge line – *north side corners; similar to southwest corner*
- Provide pedestrian/bicycle crosswalk signage – *north side and southwest corners*
- Provide object marker signage – *north side and southwest corners*
- Consider the provision of protected-only left-turn phase – *eastbound approach*

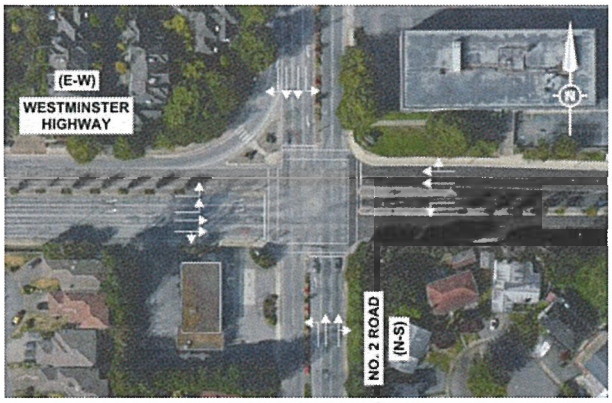
Medium/Long-Term:

- Review and update the Garden City Road signal coordination with the signal at Bridgeport Road in coordination with MoTI – *overall*
- Remove or modify angle of channelized right-turn in coordination with MoTI – *east-west approaches; traffic operation and geometric design to confirm*
- Realign northbound dual right-turn lane in coordination with MoTI to improve sight line and eliminate the lane drop by developing the right-turn lanes as auxiliary lanes with future redevelopment – *south leg*
- Provide westbound right-turn lane with future redevelopment – *southwest quadrants*
- Review driveway locations with future redevelopment – *northeast quadrant*
- Design for adequate sight distance with future redevelopment – *southwest corner*
- Enhance police enforcement for speeding and red-light running violation in coordination with RCMP and ICBC – *all approaches*
- Review traffic lane widths and curb return radii as a measure to reduce collisions involving speeding and right-turn lanes

NO. 2 ROAD & WESTMINSTER HIGHWAY

INTERSECTION INFORMATION

Site #:	3
Intersection Type:	4-Legged
Traffic Control Type:	Signalized - P/P LT in all directions
N-S Street Classification:	Arterial (MRN) (Bike Route - NL)
E-W Street Classification:	Arterial (MRN - EL)
Surrounding Land Use:	Retail / Office / Residential
Daily Traffic Volume (2015):	57,800 Entering Vehicles



COLLISION STATISTICS (2015-2017)

Collision Frequency:	71.7 per year	(Total = 215)
Collision Severity Index:	4.47	(Casualty = 39%)
Collision Rate OBS. / CRT.:	3.63 / 3.27	[2013-2017]
Collision with Pedestrian:	2	
Collision with Cyclist:	2	

Highest % Month:	February (11%)
Highest % Day of Week:	Friday (19%)
Highest % Time Period:	3 PM - 6 PM (20%)
Top 3 Collision Types:	Rear End (58%) Left Turn (16%) Sideswipe (12%)

IDENTIFIED OPERATIONAL AND SAFETY ISSUES

Geometric:

- Misalignment of left-turn lanes – *north-south approaches*
- Commercial driveways close to intersection – *southwest quadrant (gas station)*
- Inadequate sight distance due to nearby foliage and insufficient property setback – *northwest (channelized right-turn) and south side corners*
- Wide left-turn crossing distance – *southbound approach; especially for heavy vehicles*
- Long designated channelized right-turn with auxiliary lane – *southbound approach (wide turning radius); high vehicle speed conflicts between crossing pedestrians and weaving vehicles to designated right-turn lane to Lynas Lane*

Signal:

- Dual left-turn lanes with protected/permitted phase – *eastbound approach (right-turn-on-red is prohibited for westbound approach); conflict with east-west crossing pedestrians*

Vulnerable Road User:

- Limited visibility to crosswalk for right-turn drivers – *southbound approach*
- Narrow sidewalk with the presence of utility poles – *south side*
- Long pedestrian crossing distance – *north-south directions*
- On-street bike lane ended at channelized right-turn lane – *southbound approach*
- On-street near-side bus stop – *westbound approach*

Collision (Data Review):

- High collision frequency (over 50.0), and a collision-prone location (observed over critical collision rate)
- High proportion of rear-end collisions reported in southbound direction (35%), followed by westbound (24%)
- High proportion of left-turn opposing collisions reported in the east-west directions – *70% of total; eastbound with 13 collisions and westbound with 8 collisions*
- High proportion of sideswipe collisions occurred with southbound movements – *12 collisions (48% of total)*
- Two pedestrian-involved collisions reported between eastbound left-turn vehicles and pedestrians crossing No. 2 Road on north leg

NO. 2 ROAD & WESTMINSTER HIGHWAY

Collision (Data Review) – *CONTINUED*:

- One cyclist-involved collision reported between northbound left-turn vehicle and a bicycle crossing Westminster Highway on west leg, the other collision occurred between a bicycle on No. 2 Road and vehicle exiting a parking lot turning right

Operational (Field Review):

- Congestion / long queues during peak periods – *all directions*
- Significant left/right-turn volumes/queues during peak periods – *all approaches*
- High vehicle speed during non-congested periods – *north leg; to/from No. 2 Road Bridge*
- Unexpected auxiliary lane with designated right-turn lane – *southbound approach; right-turn vehicles stopped to yield westbound through traffic*
- Unexpected vehicle slow down to enter commercial driveway – *southbound direction; to gas station*
- Broken vehicle parts were found at the southbound right-turn channelized island

Other:

- Missing road sign – *northwest corner; no Added Lane Sign for eastbound drivers and no object marker sign for westbound drivers*

POTENTIAL IMPROVEMENTS

Short-Term (Potential Safety Benefit = 20 to 30% of Total Collisions):

- Consider conducting a detailed traffic operations and safety review study, including the functional design of the recommended geometric layout – *overall*
- Regularly trim foliage – *northwest and south side corners*
- Provide additional signage and pavement markings for designated right-turn only lane further upstream – *southbound approach*
- Provide Added Lane Sign – *southbound approach*
- Paint guiding line – *southbound approach*
- Check intergreen time to verify the possible contributing cause for high number of left-turn opposing collisions – *overall*
- Change left-turn signal phasing from protected/permission to protected-only – *eastbound and westbound approach*
- Enlarge signal lenses to 300-300-300 millimetres for primary traffic signal heads – all approaches

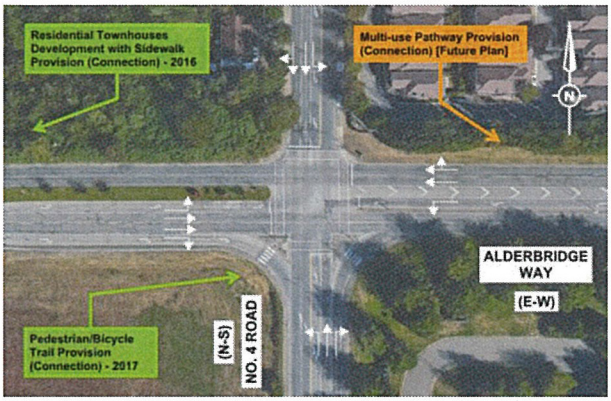
Medium/Long-Term:

- Install advance warning flashers (if warranted) – *southbound approach*
- Provide adequate sight distance with future redevelopment – *south side corners*
- Enhance police enforcements for vehicle speeding violations in coordination with RCMP – *all approaches, particularly southbound*
- Review traffic lane widths and curb return radii as a measure to reduce collisions involving speeding and right-turn lanes

NO. 4 ROAD & ALDERBRIDGE WAY

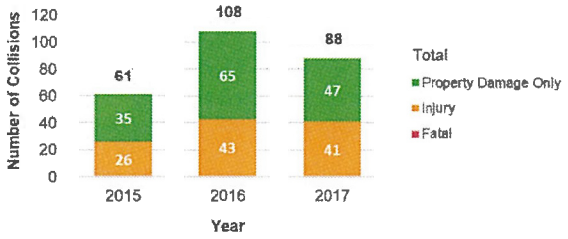
INTERSECTION INFORMATION

Site #:	4
Intersection Type:	4-Legged
Traffic Control Type:	Signalized - P/P LT for E-W
N-S Street Classification:	Arterial
E-W Street Classification:	Arterial (MRN)
Surrounding Land Use:	Residential / Recreational / Civic
Daily Traffic Volume (2015):	59,200 Entering Vehicles



COLLISION STATISTICS (2015-2017)

Collision Frequency:	85.7 per year	(Total = 257)
Collision Severity Index:	4.85	(Casualty = 43%)
Collision Rate OBS. / CRT.:	3.54 / 3.27	[2013-2017]
Collision with Pedestrian:	0	
Collision with Cyclist:	0	



Highest % Month:	October (12%)
Highest % Day of Week:	Wednesday (20%)
Highest % Time Period:	3 PM - 6 PM (23%)
Top 3 Collision Types:	Rear End (79%)
	Left Turn (11%)
	Sideswipe (5%)

IDENTIFIED OPERATIONAL AND SAFETY ISSUES

Geometric:

- Rural perception at wide intersection with channelized right-turn islands – *overall*
- Misalignment of left-turn bays with wide medians – *east-west approaches; westbound vehicles were spotted crossing the painted median*
- Lane drop from through to designated right-turn lane – *northbound approach*
- Residential driveways close to intersection – *southbound approach*
- Designated right-turn lane with yield control to through traffic – *eastbound and northbound approaches*

Signal:

- Lack of left-turn phase with left-turn bay provided – *north-south approaches*

Vulnerable Road User:

- Long pedestrian crossing distance – *north-south directions*
- Incomplete pedestrian connection – *northwest corner*
- Old pedestrian pushbuttons – *southwest corner*

Collision (Data Review):

- High collision frequency (over 50.0), and a collision-prone location (observed over critical collision rate)
- High number of rear-end collisions reported on northbound direction – *88 collisions (49% of total 180 collisions), majority were* right-turn rear-end collisions – *76 collisions*
- High proportion of left-turn rear-end collisions reported on westbound– *10 out of total 17 collisions*
- High proportion of sideswipe collisions occurred on east-west approaches – *10 out of total 13 collisions*
- High proportion of left-turn opposing collisions reported in the east-west directions – *over 80% of total; westbound with 11 collisions and eastbound with 10 collisions*
- Four right-angle collisions reported – *3 collisions occurred due to red-light running in the north-south directions*

Operational (Field Review):

- Congestion / long queues during peak periods – *all approaches*
- Significant lane changing/weaving activities – *northbound approach*
- High vehicle speed – *east-west legs; especially to/from highway*

NO. 4 ROAD & ALDERBRIDGE WAY

Operational (Field Review) – *CONTINUED*:

- Unexpected yield control with designated right-turn lane and high vehicle speed – *northbound and eastbound approach*
- Faded pavement marking – *southeast corner; dashed merge lines*
- Poor pavement condition – *overall intersection*

Other:

- Missing road sign – *northbound and eastbound approaches (no pedestrian crosswalk signs at channelized islands)*
- Broken vehicle parts were found at the eastbound channelized island
- Insufficient street lighting – *south side corner*

POTENTIAL IMPROVEMENTS

Short-Term (Potential Safety Benefit = 20 to 30% of Total Collisions):

- Provide pedestrian crosswalk signs – *south side corners; at channelized islands*
- Upgrade pedestrian pushbuttons to the latest standard – *southwest corner*
- Regularly repaint dashed merge line – *southeast corner*
- Review signal progression – *east-west approaches*
- Conduct warrant analysis for adding left-turn phase – *north-south approaches*
- Enlarge signal lenses to 300-300-300 millimetres for primary traffic signal heads – *all approaches*
- Install enlarged Yield Sign or two Yield signs at channelized right-turn lane – *eastbound and northbound approaches*

Medium/Long-Term:

- Add left-turn phase (if warranted) – *north-south approaches*
- Remove or reconstruct right-turn channelized island – *south side corners*
- Consider to install red-light camera (under ICBC jurisdiction) – *east-west approaches*
- Complete pedestrian connection with future redevelopment – *northwest corner*
- Review and improve street lighting (if required) – *south side corners*
- Enhance police enforcements for vehicle speeding and red-light running violations in coordination with RCMP and ICBC – *east-west approaches*
- Review traffic lane widths and curb return radii as a measure to reduce collisions involving speeding and right-turn lanes

NO. 5 ROAD & WESTMINSTER HIGHWAY

INTERSECTION INFORMATION

Site #:	5
Intersection Type:	4-Legged
Traffic Control Type:	Signalized - P/P LT in all directions
N-S Street Classification:	Arterial
E-W Street Classification:	Arterial (MRN) (Bike Route)
Surrounding Land Use:	Retail / Residential
Daily Traffic Volume (2015):	48,800 Entering Vehicles

COLLISION STATISTICS (2015-2017)

Collision Frequency:	85.3 per year	(Total = 256)
Collision Severity Index:	4.90	(Casualty = 34%)
Collision Rate OBS. / CRT.:	4.28 / 3.30	[2013-2017]
Collision with Pedestrian:	0	
Collision with Cyclist:	1	

Highest % Month:	December (11%)
Highest % Day of Week:	Wednesday/Thursday (18%)
Highest % Time Period:	3 PM - 6 PM (34%)
Top 3 Collision Types:	Rear End (65%) Sideswipe (15%) Left Turn (8%)

IDENTIFIED OPERATIONAL AND SAFETY ISSUES

Geometric:

- Rural perception at wide intersection with channelized right-turn islands – *overall*
- Undivided roadway – *south leg; conflicts with traffic turning to/from commercial driveways were observed*
- Short merging distance after intersection – *south leg*
- Right-turn lane immediately after intersection – *west leg; to Nature Park*

Signal:

- None

Vulnerable Road User:

- Inadequate/inconsistent bicycle facility – *east-west directions (no pavement markings east leg)*
- Long pedestrian crossing distance – *north-south directions*

Collision (Data Review):

- High collision frequency (over 50.0), and a collision-prone location (observed over critical collision rate)
- Annual number of collisions slightly increased from 2015 to 2017
- High number of rear-end collisions reported on southbound (37%), followed by westbound (27%)
- High number of right-turn rear-end collisions on southbound – *41 collisions (26% of total collisions)*
- High number of sideswipe collisions occurred on Westminster Highway approaches – *20 out of 37 total collisions*
- High proportion of left-turn opposing collisions reported in the east-west direction – 62% of total; *eastbound with 6 collisions and westbound with 6 collisions*
- Four collisions occurred by U-turn movements – *2 on westbound and 2 on northbound*
- One cyclist-involved collision reported as a bicycle hit by eastbound vehicle turning right onto gas station

Operational (Field Review):

- Congestion / long queues during peak periods – *east-west directions; to/from highways*
- Significant lane changing/weaving activities – *all directions; conflicts between southbound left-turn and northbound right turn vehicles*
- High vehicle speed – *all directions; especially southbound and westbound from highways; presence of red-light camera for northbound approach*

NO. 5 ROAD & WESTMINSTER HIGHWAY

Operational (Field Review) – *CONTINUED*:

- Commercial driveways close to intersection – *southeast quadrant (gas station)*
- Heavy vehicle was observed to roll over to the southwest corner curb

Other:

- Faded pavement marking – *east leg (lane merge arrows)*
- Missing road sign – *north side corners; pedestrian crosswalk signs at channelized islands*
- Inadequate/inconsistent road sign – *all approaches (designated right-turn lane signs)*
- Insufficient street lighting – *southeast corners*

POTENTIAL IMPROVEMENTS

Short-Term (Potential Safety Benefit = 15 to 25% of Total Collisions):

- Provide pedestrian crosswalk signs – *north side corners*
- Regularly repaint lane merge arrow pavement markings – *east leg*
- Paint green bike path markings – *northeast corner; similar to the northwest corner*
- Provide additional designated right-turn signs – *southbound and east-west approaches*
- Enlarge signal lenses to 300-300-300 millimetres for primary traffic signal heads – *all approaches*
- Install enlarged Yield Sign or two Yield signs at channelized right-turn lane – *southbound and westbound approaches*

Medium/Long-Term:

- Remove or reconstruct right-turn channelized island – *north side corners*
- Review and redesign designated and channelized right-turn – *westbound approach (to northbound); adding auxiliary lane instead of yield control*
- Review the posted speed limit of Westminster Highway – *reduce from 60 to 50 kilometres per hour (if warranted)*
- Improve bike connection – *east-west direction; provision of off-road multi-use pathway with green paint and elephant's feet crossing instead of single file operation*
- Review and improve street lighting (if required) – *southeast corner*
- Enhance police enforcements for vehicle speeding, red-light running, and U-turn violations in coordination with RCMP and ICBC – *all approaches*
- Review traffic lane widths and curb return radii as a measure to reduce collisions involving speeding and right-turn lanes

NO. 5 ROAD & CAMBIE ROAD

INTERSECTION INFORMATION

Site #:	6
Intersection Type:	4-Legged
Traffic Control Type:	Signalized - P/P LT in all directions
N-S Street Classification:	Arterial
E-W Street Classification:	Arterial (MRN)
Surrounding Land Use:	Retail / School / Residential
Daily Traffic Volume (2015):	37,000 Entering Vehicles

COLLISION STATISTICS (2015-2017)

Collision Frequency:	76.0 per year	(Total = 228)
Collision Severity Index:	4.87	(Casualty = 43%)
Collision Rate OBS. / CRT.:	4.91 / 3.35	[2013-2017]
Collision with Pedestrian:	5	
Collision with Cyclist:	1	

Highest % Month:	September/December (12%)
Highest % Day of Week:	Friday (21%)
Highest % Time Period:	3 PM - 6 PM (36%)
Top 3 Collision Types:	Rear End (44%) Left Turn (26%) Sideswipe (22%)

IDENTIFIED OPERATIONAL AND SAFETY ISSUES

Geometric:

- Lack of left-turn bay – *all approaches; limited visibility of through traffic for left-turn drivers*
- Commercial and residential driveways close to intersection – *northwest, southeast, and southwest quadrants*
- Missing/broken flexile delineator – *west leg; at the commercial driveway location (most likely accessing/egressing)*

Signal:

- Provision of left-turn phase without left-turn bay – *all approaches*
- No countdown for pedestrian signal phases – *all directions*

Vulnerable Road User:

- Inadequate pedestrian facility – *overall (narrow letdowns) and northeast corner (small waiting area)*
- Substantial pedestrian crossing activities – *all legs (to/from school, shopping centre, and nearby southeast park, etc.)*

Collision (Data Review):

- High collision frequency (over 50.0), and a collision-prone location (observed over critical collision rate)
- High number of rear-end collisions reported on Cambie Road approaches – *over 60% of total 90 collisions*
- High number of left-turn opposing collisions reported for westbound (18) and eastbound (15)
- High number of sideswipe collisions occurred on all approaches
- One fatal collision reported including a driver who had fallen asleep and hit a cyclist (exact location is not available) around 3 AM on September 2013

Operational (Field Review):

- Congestion / long queues during peak periods – *eastbound and westbound directions*
- Significant lane changing/weaving activities – *all approaches; due to lack of left-turn bays*
- Left-turn vehicles from commercial driveway created conflicts with Cambie Road traffic – *east-west direction*
- Future development in close vicinity – *northwest and southeast quadrants (townhouses and commercial building; generate more traffic in the near future)*
- Drivers did not identify when left-turn phase will be provided, generating weaving activities, particularly with vehicles turning from commercial driveways
- High vehicle speed – *east-west directions; presence of red-light camera for eastbound approach*

NO. 5 ROAD & CAMBIE ROAD

Operational (Field Review) – *CONTINUED*:

- Jaywalkers were observed crossing No. 5 Road between commercial stores

Other:

- None

POTENTIAL IMPROVEMENTS

Short-Term (Potential Safety Benefit = 20 to 30% of Total Collisions):

- Replace and install flexible delineators to restrict left-turn movements – *west leg*
- Review and adjust signal timing to provide priority and/or dedicated pedestrian phase during high pedestrian crossing activities – *after school and weekends*
- Enlarge signal lenses to 300-300-300 millimetres for primary traffic signal heads – *east-west approaches*

Medium/Long-Term:

- Add left-turn bay with future redevelopment – *all approaches, particularly east-west directions*
- Review driveway locations with future redevelopment – *northwest, southeast, ad southwest quadrants*
- Conduct detailed in-service operation and safety study, including collisions at shopping centre driveways – *overall*
- Review and widen letdown and increase waiting area (if required) – *overall*

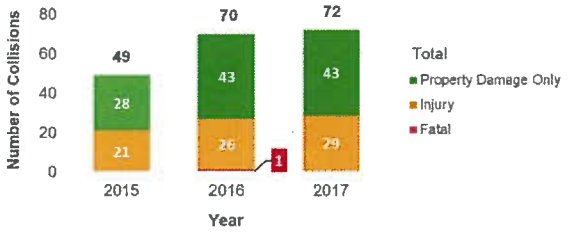
NO. 4 ROAD & WESTMINSTER HIGHWAY

INTERSECTION INFORMATION

Site #:	7
Intersection Type:	4-Legged
Traffic Control Type:	Signalized - P/P LT in all directions
N-S Street Classification:	Arterial
E-W Street Classification:	Arterial (MRN) (Bike Route)
Surrounding Land Use:	Resi. / Rec. / Inst.
Daily Traffic Volume (2015):	63,800 Entering Vehicles

COLLISION STATISTICS (2015-2017)

Collision Frequency:	63.7 per year	(Total = 191)
Collision Severity Index:	5.10	(Casualty = 40%)
Collision Rate OBS. / CRT.:	2.57 / 3.26	[2013-2017]
Collision with Pedestrian:	0	
Collision with Cyclist:	1	



Highest % Month:	November (15%)
Highest % Day of Week:	Thursday (18%)
Highest % Time Period:	3 PM - 6 PM (35%)
Top 3 Collision Types:	Rear End (63%) Sideswipe (15%) Left Turn (15%)

IDENTIFIED OPERATIONAL AND SAFETY ISSUES

Geometric:

- Misalignment of left-turn bays with wide medians – *east-west approaches*
- Lane drop after intersection due to on-street parking during off-peak periods – *south leg*
- Institutional driveways close to intersection – *southeast quadrant (vet hospital)*

Signal:

- Old pedestrian pushbuttons – *southwest corner*

Vulnerable Road User:

- Narrow sidewalk with the presence of utility poles – *northeast, southeast, and southwest quadrants*
- Inadequate pedestrian facility/connection – *east-west legs; no raised sidewalk and road curb*
- Inadequate bicycle facility on bike route – *east-west approach; signed and pavement markings*
- Long pedestrian crossing distance – *north-south directions*
- On-street near-side bus stop – *eastbound approach*

Collision (Data Review):

- High collision frequency (over 50.0), and high collision severity index (over 5.00)
- Annual number of collisions increased from 2015 to 2017
- High number of rear-end collisions reported on Westminster Highway approaches – *65% of total 114 collisions*
- High number of left-turn opposing collisions reported for eastbound (13) and northbound (5)
- High number of sideswipe collisions reported on eastbound and southbound directions – *8 collisions each*
- 3 collisions occurred between northbound vehicles and vehicles exiting the vet hospital parking lot turning left onto No. 4 Road
- One cyclist-involved collision occurred between southbound right-turn vehicle and bicycle crossing Westminster Highway on west leg
- One fatal collision reported due to a eastbound left-turn opposing collision and hitting a third vehicle stopped on No. 4 Road southbound during Sunday noon in October 2016
- One fatal collision reported with no clear descriptions during Saturday PM peak period on November 2013

NO. 4 ROAD & WESTMINSTER HIGHWAY

Operational (Field Review):

- Congestion / long queues during peak periods – *east-west directions*
- High vehicle speed – *east-west directions and northbound*

Operational (Field Review) – *CONTINUED*:

- Future development nearby and in close vicinity – *southwest (residential) and southeast quadrants; generate more traffic in the near future*
- Insufficient road sign – *east-west legs; bike signage and pavement markings, especially to alert right-turn vehicles*
- Damaged signal pole with heavy tire marks and broken vehicle parts were noticed at the northwest corner; suspect westbound off-road collision to the right side

Other:

- Insufficient street lighting – *northwest and southeast corners*

POTENTIAL IMPROVEMENTS

Short-Term (Potential Safety Benefit = 15 to 25% of Total Collisions):

- Upgrade pedestrian pushbuttons to the latest standard – *southwest corners*
- Provide bike route related signage and pavement markings before/after intersection – *east-west legs*
- Improve east-west crossings for cyclists – *elephant's feet and green paint*
- Enlarge signal lenses to 300-300-300 millimetres for primary traffic signal heads – *all approaches*

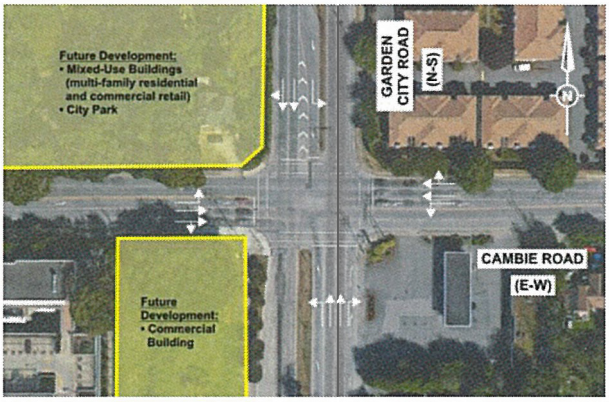
Medium/Long-Term:

- Extend left-turn bay with future redevelopment – *east-west approaches*
- Review driveway locations with future redevelopment – *northeast, southeast, and southwest quadrants*
- Improve pedestrian facility/connection with future redevelopment – *northeast, southeast, and southwest quadrants*
- Review and widen letdown and increase waiting area (if required) – *overall*
- Review and improve street lighting (if required) – *northwest and southeast corners*
- Enhance police enforcements for vehicle speeding violations in coordination with RCMP – *east-west approaches*
- Review traffic lane widths and curb return radii as a measure to reduce collisions involving speeding
- Consider to install red-light camera (under ICBC jurisdiction) – *westbound approach*

GARDEN CITY ROAD & CAMBIE ROAD

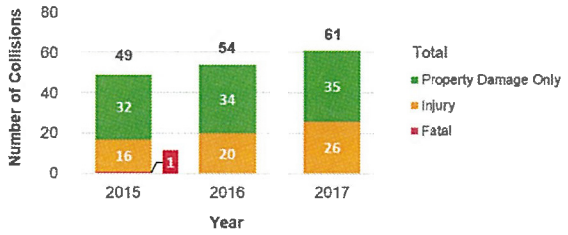
INTERSECTION INFORMATION

Site #:	8
Intersection Type:	4-Legged
Traffic Control Type:	Signalized - P/P LT for NB & E-W
N-S Street Classification:	Arterial (Bike Route)
E-W Street Classification:	Arterial (MRN)
Surrounding Land Use:	Residential / Commercial
Daily Traffic Volume (2015):	46,600 Entering Vehicles



COLLISION STATISTICS (2015-2017)

Collision Frequency:	54.7 per year	(Total = 164)
Collision Severity Index:	5.01	(Casualty = 38%)
Collision Rate OBS. / CRT.:	3.08 / 3.31	[2013-2017]
Collision with Pedestrian:	5	
Collision with Cyclist:	0	



Highest % Month:	November (14%)
Highest % Day of Week:	Saturday (21%)
Highest % Time Period:	3 PM - 6 PM (32%)
Top 3 Collision Types:	Rear End (57%) Sideswipe (16%) Left Turn (11%)

IDENTIFIED OPERATION AND SAFETY ISSUES

Geometric:

- Misalignment of left-turn bays with wide medians – *north-south approaches*
- Designated right-turn bay adjacent to commercial driveways – *northbound approach; increase lane weaving activities*
- Commercial driveways close to intersection – *southeast quadrants (gas station)*
- Inadequate sight distance due to nearby foliage – *northwest corner*

Signal:

- Lack of left-turn phase with left-turn bay provided – *southbound approach*

Vulnerable Road User:

- Narrow sidewalk with the presence of utility poles – *west side*
- No raised sidewalk – *south leg (east side)*
- Bike lane transition from designated to single file with vehicles – *northbound approach*
- Long pedestrian crossing distance – *east-west directions*
- On-street near-side bus stop – *westbound approach*

Collision (Data Review):

- High collision frequency (over 50.0), and high collision severity index (over 5.00)
- Annual number of collisions increased from 2015 to 2017
- High number of rear-end collisions reported on Garden City approaches – *over 60% of total 91 collisions*
- High number of sideswipe collisions occurred on Cambie Road approaches – *17 collisions (74% of total)*
- One fatal collision reported of a vehicle turning left from Cambie Road onto Garden City Road (direction is not available) and hitting a pedestrian crossing Garden City Road during weekday PM peak period on January 2015

Operational (Field Review):

- Congestion / long queues during peak periods – *all directions*
- Significant left/right-turn volumes/queues during peak periods – *all approaches*
- Significant lane changing/weaving activities – *east-west legs*
- *High vehicle speed – southbound approach (mainly to/from highway); presence of red-light camera for northbound approach*

GARDEN CITY ROAD & CAMBIE ROAD

Operational (Field Review) – *CONTINUED*:

- Vehicle queue spillback from downstream – *east leg; unexpected vehicle slow down to enter gas station*
- Long left-turn queue block through traffic lane – *northbound*
- Future development nearby – *northwest (mixed-use) and southwest (commercial) quadrants; generate more traffic in the near future*
- Notices to look for collision incident witnesses on June 2017 were found on utility poles at the intersection

Other:

- Insufficient street lighting – *northeast and southwest corners*

POTENTIAL IMPROVEMENTS

Short-Term (Potential Safety Benefit = 15 to 25% of Total Collisions):

- Conduct warrant analysis for adding left-turn phase – *southbound approach*
- Consider the provision of protected-only left-turn phase – *north-south directions*
- Regularly trim foliage – *northwest corner*
- Enlarge signal lenses to 300-300-300 millimetres for primary traffic signal heads – *all approaches*

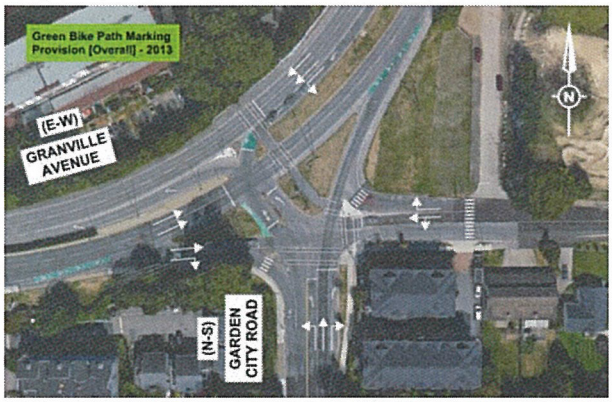
Medium/Long-Term:

- Add left-turn phase (if warranted) – *southbound approach*
- Review driveway locations with future redevelopment – *northwest and south side quadrants*
- Review and widen sidewalk with future redevelopment (if required) – *west side and south leg (east side)*
- Provide designated bike lane with future redevelopment – *northbound approach*
- Provide designated right-turn bay with future redevelopment – *southbound approach*
- Review and improve street lighting (if required) – *northeast and southwest corners*

GARDEN CITY ROAD & GRANVILLE AVENUE

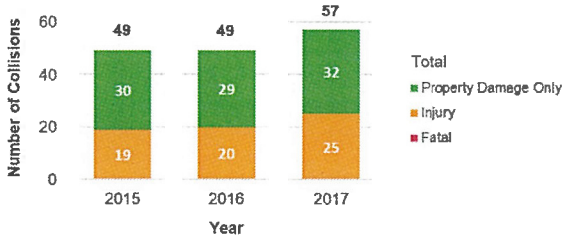
INTERSECTION INFORMATION

Site #:	9
Intersection Type:	3/4-Legged (Non-typical and busy)
Traffic Control Type:	Signalized
N-S Street Classification:	Arterial (Bike Route - NL)
E-W Street Classification:	Arterial (Bike Route - WL)
Surrounding Land Use:	Residential / Park
Daily Traffic Volume (2015):	25,400 Entering Vehicles



COLLISION STATISTICS (2015-2017)

Collision Frequency:	51.7 per year	(Total = 155)
Collision Severity Index:	4.72	(Casualty = 41%)
Collision Rate OBS. / CRT.:	5.27 / 3.42	[2013-2017]
Collision with Pedestrian:	3	
Collision with Cyclist:	5	



Highest % Month:	April/October/November (10%)
Highest % Day of Week:	Saturday (18%)
Highest % Time Period:	3 PM - 6 PM (23%)
Top 3 Collision Types:	Rear End (77%) Sideswipe (11%) Cyclist Involved (3%)

IDENTIFIED OPERATIONAL AND SAFETY ISSUES

Geometric:

- Confusing intersection layout with major traffic flow on westbound left-turn and southbound right-turn
- Left-turn merging to through traffic – *northbound from Garden City Road to Granville Avenue*
- Horizontal curve immediately before/after intersection – *north and west legs (poor visibility to intersection)*
- Skewed intersection layout – *central section and merging/auxiliary area (undesirable skew angles)*
- Channelized right-turn auxiliary lane – *east and south legs (increase lane changing/merging activities)*
- Sharp right-turn corner – *westbound approach; to Garden City Road (northbound)*
- Residential driveways close to intersection – *east leg*

Signal:

- Complex signal operation due to traffic layout and major vehicle movements
- Limited signal visibility – *southbound on Garden City Road*
- No countdown for pedestrian signal phases – *all directions*

Vulnerable Road User:

- Segmented and long pedestrian waiting time to cross intersection – *overall*
- Not ideal experience for cyclist – *overall; especially crossing by channelized island*
- On-street bus stop close to intersection – *east leg (eastbound)*

Collision (Data Review):

- High collision frequency (over 50.0), and a collision-prone location (observed over critical collision rate)
- Annual number of collisions increased from 2016 to 2017
- High number of rear-end collisions reported on northbound far-side merging to Garden City – *50 out of total 115 collisions*
- 12 right-turn rear-end collisions occurred on westbound channelized right-turn
- High number of sideswipe collisions occurred with northbound major movements – *10 collisions (59% of total)*
- Three pedestrian-involved collisions occurred – *one collision between westbound vehicle and a pedestrian crossing Granville Avenue on east leg, one collision between southbound vehicle and a pedestrian crossing Garden City Road on north leg, and one collision without any details*

GARDEN CITY ROAD & GRANVILLE AVENUE

Collision (Data Review) – *CONTINUED*:

- Five cyclist-involved collision occurred – *three collisions between eastbound right-turn vehicles and eastbound through bicycles, one collision between westbound right-turn vehicle and northbound bicycle, and one collision between northbound right-turn vehicle and southbound left-turn bicycle*

Operational (Field Review):

- Congestion / long queues during peak periods – *southbound and eastbound approaches*
- Vehicle queue spillback from downstream – *northbound and eastbound approaches*

Other:

- Inadequate pavement marking – *southeast (no dashed merge line) and southwest corner (no green bike lane marking)*
- Inappropriate pavement marking – *east leg; marked and signed crosswalk end at residential driveway*
- Missing road sign – *east-west approaches (no designated right-turn only signs) and southwest corner (no pedestrian crosswalk signs)*
- Inappropriate road sign – *eastbound approach (yield sign instead of Added Lane Sign); some right-turn drivers were confuse to stop or not*

POTENTIAL IMPROVEMENTS

Short-Term (Potential Safety Benefit = 15 to 25% of Total Collisions):

- Consider conducting a feasibility study for intersection configuration options
- Replace Yield sign with Added Lane sign – *eastbound approach*
- Paint guiding line – *southbound approach; specifically for bicycles*
- Enlarge signal lenses to 300-300-300 millimetres for primary traffic signal heads – *all approaches*

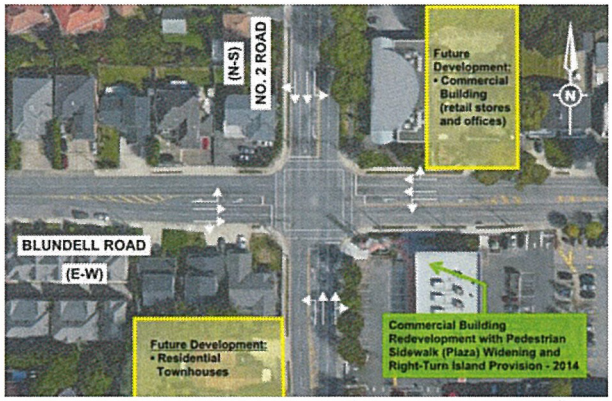
Medium/Long-Term:

- Remove or modify angle of channelized right-turn – *eastbound and westbound approaches; traffic operation and geometric design to confirm*

NO. 2 ROAD & BLUNDELL ROAD

INTERSECTION INFORMATION

Site #:	10
Intersection Type:	4-Legged
Traffic Control Type:	Signalized - P/P LT in all directions
N-S Street Classification:	Arterial (MRN)
E-W Street Classification:	Arterial
Surrounding Land Use:	Commercial / Residential
Daily Traffic Volume (2015):	33,400 Entering Vehicles



COLLISION STATISTICS (2015-2017)

Collision Frequency:	35.0 per year	(Total = 105)
Collision Severity Index:	4.51	(Casualty = 39%)
Collision Rate OBS. / CRT.:	3.64 / 3.36	[2013-2017]
Collision with Pedestrian:	1	
Collision with Cyclist:	0	

Highest % Month:	May / September (143%)
Highest % Day of Week:	Wednesday (20%)
Highest % Time Period:	9 AM - 12 PM (26%)
Top 3 Collision Types:	Rear End (49%) Sideswipe (26%) Left Turn (7%)

IDENTIFIED OPERATIONAL AND SAFETY ISSUES

Geometric:

- Lane drop after intersection due to on-street parking during off-peak period – *west leg*
- Residential driveways close to intersection – *south (west side) and west (vehicles turning left to exit from driveways) legs*

Signal:

- No countdown for pedestrian signal phases – *all directions*

Vulnerable Road User:

- Substantial pedestrian crossing activities – *all directions*; *to/from retail stores and nearby schools*

Collision (Data Review):

- A collision-prone location (observed over critical collision rate)
- Annual number of collisions dropped from 2015
- High proportion of total number of collisions occurred during late morning peak period (9 AM to 12 PM) due to high shopping activities
- High number of rear-end collisions reported on No. 2 Road approaches – *33 out of total 48 collisions*
- High proportion of sideswipe collisions occurred at the north-south legs – *15 out of total 25 collisions*
- High proportion of left-turn opposing collisions occurred with northbound left-turn movements – *4 out of total 7 collisions*
- The pedestrian-involved collision reported between a southbound left-turn vehicle and a pedestrian crossing east leg
- 24 extra collisions reported at the signalized intersection of No. 2 Road and Blundell Centre driveway (south of the study intersection)

Operational (Field Review):

- Heavy traffic volumes – *all directions; peak (commuting trips) and off-peak (shopping trips) periods*
- Significant lane changing/weaving activities – *south and east legs; crossing two/three lanes to/from commercial driveways*

NO. 2 ROAD & BLUNDELL ROAD

Operational (Field Review) – *CONTINUED*:

- High vehicle speed – *southbound and eastbound approaches; long distance of nearby traffic controls for through movements*
- Future development nearby – *northeast (commercial) and southwest (residential) quadrants; generate more traffic in the near future*

Other:

- Broken flexible delineators – *south leg; which were installed on the centreline to restrict left-turn movements from commercial and residential driveways*

POTENTIAL IMPROVEMENTS

Short-Term (Potential Safety Benefit = 5 to 15% of Total Collisions):

- Review and relocate/remove on-street parking close to the intersection – *west leg*
- Replace broken flexible delineators – *south leg*
- Provide signal progression for traffic signals at Blundell Road and Blundell Centre driveway – *north-south approaches*

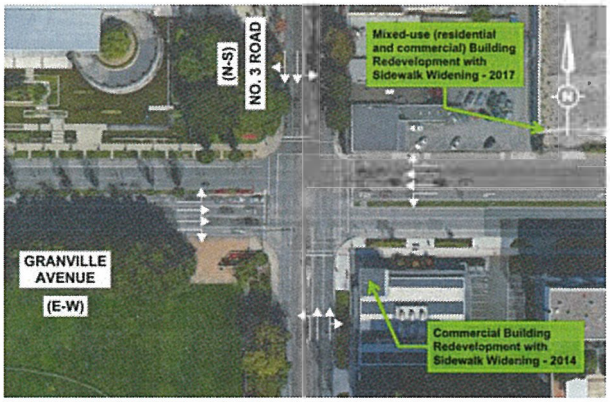
Medium/Long-Term:

- Increase left-turn bay storage length with future development – *northbound approach*
- Enhance police enforcements on vehicle speeding violations in coordination with RCMP – *southbound direction*
- Consider left-turn movement restriction at driveways for future development – *east leg*
- Consider adding left-turn bay to commercial development with future redevelopment – southbound
- Review on-site vehicle circulation and access with strip mall owner to reduce left-in and left-out movements into and out of the mall, especially the access on the south leg – *overall*
- Conduct detailed in-service operation and safety study, including collisions at shopping centre driveways – *overall*
- Review traffic lane widths and curb return radii as a measure to reduce collisions involving speeding

NO. 3 ROAD & GRANVILLE AVENUE

INTERSECTION INFORMATION

Site #:	11
Intersection Type:	4-Legged
Traffic Control Type:	Signalized - P/P LT in all directions
N-S Street Classification:	Arterial
E-W Street Classification:	Arterial (Bike Route)
Surrounding Land Use:	Retail / Park / Civic / Residential
Daily Traffic Volume (2015):	49,600 Entering Vehicles



COLLISION STATISTICS (2015-2017)

Collision Frequency:	47.3 per year	(Total = 142)
Collision Severity Index:	5.88	(Casualty = 47%)
Collision Rate OBS. / CRT.:	2.44 / 3.30	[2013-2017]
Collision with Pedestrian:	12	(1 Fatal)
Collision with Cyclist:	5	

Highest % Month:	November (13%)
Highest % Day of Week:	Wednesday (16%)
Highest % Time Period:	3 PM - 6 PM (30%)
Top 3 Collision Types:	Rear End (59%)
	Sideswipe (15%)
	Pedestrian Involved (9%)

IDENTIFIED OPERATIONAL AND SAFETY ISSUES

Geometric:

- Designated right-turn bays at a busy intersection – *east-west approaches*
- Sharp right-turn corner – *northeast corner*
- Long left-turn distance – *north-south approaches; damaged central island on the east leg (most likely chipped by southbound left-turn vehicles)*
- Inadequate sight distance due to insufficient property setback – *northeast corner*
- Special crosswalks immediately before/after intersection – *north leg*

Signal:

- No countdown for pedestrian signal phases – *all directions*

Vulnerable Road User:

- Substantial pedestrian/bicycle crossing activities – *all legs (to/from City Hall, park, retail stores, bus stops, shopping centre, etc.)*
- Long pedestrian crossing distance – *north-south directions*
- Bike lane share with right-turn lane – *east-west approaches*
- On-street near-side bus stop – *southbound approach*

Collision (Data Review):

- High collision severity index (over 5.00); high pedestrian-related incidents
- Annual number of collisions were similar in three years
- High number of left-turn rear-end collisions occurred on Granville Avenue approaches – *12 out of total 15 collisions*
- All right-turn rear-end collisions occurred on No. 3 Road approaches – *6 collisions*
- High proportion of sideswipe collisions occurred with northbound movement – *47% of total (9 collisions)*
- 7 out of 12 total pedestrian-involved collisions occurred between eastbound left-turn vehicles and pedestrians crossing north leg (3) and between northbound left-turn vehicles and pedestrians crossing west leg (4)
- One fatal collision reported of a westbound vehicle turning left from No. 3 Road northbound onto Granville Avenue hitting a pedestrian crossing Granville Avenue during noon time on November 2015

NO. 3 ROAD & GRANVILLE AVENUE

Operational (Field Review):

- Congestion / long queues during peak periods – *north-south directions*
- Significant left-/right-turn volumes/queues during peak periods – *all approaches; right-turn vehicles merge in advance along on-street bike lane to avoid any queue*
- Lots of pedestrian crossing activities during the red pedestrian signal phase – *all approaches*

Other:

- Insufficient street lighting – *northeast corner*

POTENTIAL IMPROVEMENTS

Short-Term (Potential Safety Benefit = 20 to 30% of Total Collisions):

- Review and adjust signal timing to provide priority and/or dedicated pedestrian phase – *all directions*
- Delay turning traffic for pedestrian/bicycle crossing – *overall*
- Paint guiding line – *north-south approaches*
- Paint coloured pavement marking for crosswalk to alert drivers for substantial pedestrian/bicycle crossing activities (i.e. the City typically uses Redwood, Pantone #18-1443) – *all legs*
- Enlarge signal lenses to 300-300-300 millimetres for primary traffic signal heads – *all approaches*

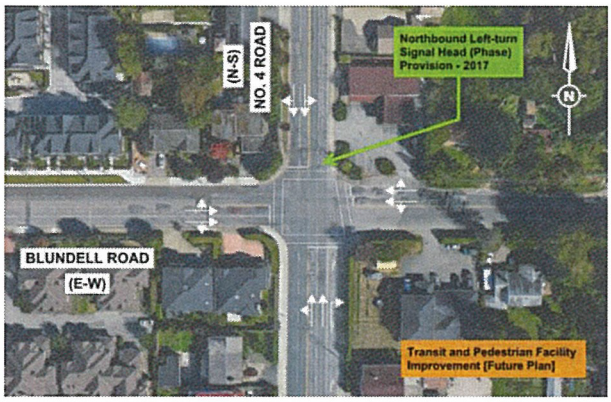
Medium/Long-Term:

- Review and widen corner and provide adequate sight distance with future redevelopment (if required) – *northeast corner*
- Provide designated bike lane by separating with right-turn lane with future redevelopments – *east-west approaches*
- Enhance police enforcements for pedestrian crossing violations in coordination with RCMP – *all approaches*

NO. 4 ROAD & BLUNDELL ROAD

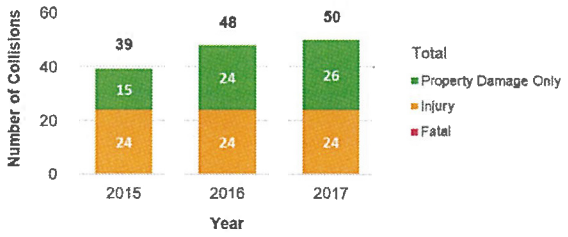
INTERSECTION INFORMATION

Site #:	12
Intersection Type:	4-Legged
Traffic Control Type:	Signalized - P/P LT for N-S & EB
N-S Street Classification:	Arterial
E-W Street Classification:	Arterial
Surrounding Land Use:	Residential / Institutional
Daily Traffic Volume (2015):	34,500 Entering Vehicles



COLLISION STATISTICS (2015-2017)

Collision Frequency:	45.7 per year	(Total = 137)
Collision Severity Index:	5.73	(Casualty = 53%)
Collision Rate OBS. / CRT.:	3.39 / 3.36	[2013-2017]
Collision with Pedestrian:	1	
Collision with Cyclist:	1	



Highest % Month:	January (15%)
Highest % Day of Week:	Friday (20%)
Highest % Time Period:	3 PM - 6 PM (36%)
Top 3 Collision Types:	Rear End (42%) Left Turn (28%) Sideswipe (13%)

IDENTIFIED OPERATIONAL AND SAFETY ISSUES

Geometric:

- Lack of left-turn bay – *all approaches; limited visibility of through traffic for left-turn drivers*
- Wide receiving lane – *east leg; conflicts between northbound right-turn and southbound left-turn vehicles*
- Lane drop with short merge lane after intersection – *east leg*
- Residential and institutional driveways close to intersection – *north, east, and west legs*
- Inadequate sight distance due to nearby foliage and insufficient property setback – *northwest and south side corners*

Signal:

- Provision of left-turn phase without left-turn bay – *north-south and eastbound approaches*
- Lack of left-turn phase – *westbound approach*

Vulnerable Road User:

- No raised sidewalk and road curb – *east leg*
- Narrow sidewalk – *east side*
- Small pedestrian waiting area – *all corners*
- Narrow letdown – *north side corners*

Collision (Data Review):

- Annual number of collisions increased from 2015 to 2017
- High collision severity index (over 5.00), and a collision-prone location (observed over critical collision rate)
- High number of rear-end collisions reported on the westbound approach (33%), followed by northbound (29%)
- High proportions of left-turn opposing collisions occurred in north-south directions – over 60% of total; *12 collisions involved northbound left-turns and 11 collisions involved southbound left-turns*
- High proportions of sideswipe collisions occurred in the southbound direction (35%), followed by eastbound (29%)
- 11 right-angle collisions occurred in total – *3 collisions were reported when there was a power outage and intersection was operating as four-way stop-controlled; north-south directions had the highest number of collisions due to running the red light*
- A pedestrian-involved collision reported between a southbound through vehicle and a pedestrian crossing No. 4 Road (north/south leg)
- A cyclist-involved collision reported between a westbound left-turn vehicle and a bicycle crossing south leg

NO. 4 ROAD & BLUNDELL ROAD

Operational (Field Review):

- Heavy traffic volume – *east-west directions*
- Significant lane changing/weaving activities – *all directions; due to lack of left-turn bays and existence of lane drop*
- On-street parking close to intersection during off-peak periods – *west leg*
- Future development in close vicinity – *northeast and northwest quadrants (residential); generate more traffic in the near future*

Other:

- None

POTENTIAL IMPROVEMENTS

Short-Term (Potential Safety Benefit = 10 to 20% of Total Collisions):

- Re-paint approach lanes as left-turn only lane and shared through-right lane – *eastbound and westbound approach; reduce receiving lane as one lane with pavement marking*
- Review and relocate/remove on-street parking – *west leg*

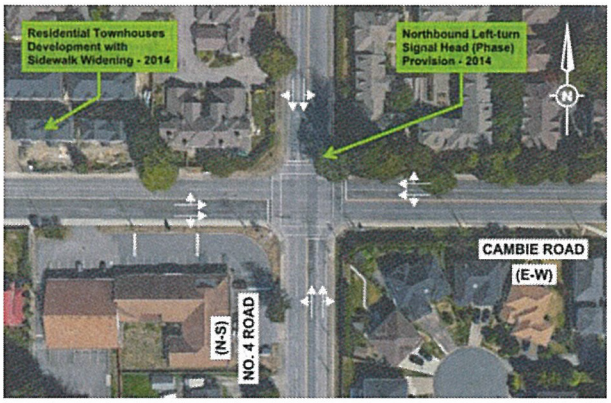
Medium/Long-Term:

- Add left-turn bay with future development – *north-south approaches then east-west approaches; traffic operation and geometric design to confirm*
- Consider to install red-light camera (under ICBC jurisdiction) – *southbound approach*
- Review driveway locations with future redevelopment – *overall*
- Design for adequate sight distance with future redevelopment – *overall*
- Review and widen pedestrian sidewalks, waiting areas, and letdowns (if required) – *overall*

NO. 4 ROAD & CAMBIE ROAD

INTERSECTION INFORMATION

Site #:	13
Intersection Type:	4-Legged
Traffic Control Type:	Signalized - P/P LT for N-S & WB
N-S Street Classification:	Arterial
E-W Street Classification:	Arterial (MRN)
Surrounding Land Use:	Residential / Retail
Daily Traffic Volume (2015):	34,700 Entering Vehicles



COLLISION STATISTICS (2015-2017)

Collision Frequency:	39.3 per year	(Total = 118)
Collision Severity Index:	4.97	(Casualty = 44%)
Collision Rate OBS. / CRT.:	3.08 / 3.36	[2013-2017]
Collision with Pedestrian:	4	
Collision with Cyclist:	0	

Highest % Month:	November (19%)
Highest % Day of Week:	Friday (22%)
Highest % Time Period:	3 PM - 6 PM (22%)
Top 3 Collision Types:	Rear End (42%) Left Turn (29%) Sideswipe (18%)

IDENTIFIED OPERATIONAL AND SAFETY ISSUES

Geometric:

- Lack of left-turn bay – *all approaches; limited visibility of through traffic for left-turn drivers*
- Lane drop after intersection – *north leg*
- Commercial driveways close to intersection – *south leg*
- Inadequate sight distance due to nearby tree trunk – *northeast corner*

Signal:

- Limited signal head visibility – *northern approach; due to nearby foliage and signal pole setback and foliage at the northeast corner*
- Provision of left-turn phase without left-turn bay – *north-south and westbound approaches*
- Lack of left-turn phase – *eastbound approach*
- Delay pedestrian crossing timing – *east leg; for southbound left-turn movement*

Vulnerable Road User:

- Narrow sidewalk with the presence of utility poles – *east leg (south side)*
- Narrow letdown – *all corners*

Collision (Data Review):

- Annual number of collisions increased from 2015 to 2017
- High number of rear-end collisions reported on eastbound approach – *37% of total 47 collisions*
- High number of left-turn opposing collisions reported for northbound (16 collisions) and for westbound (7 collisions)
- High number of sideswipe collisions occurred with southbound movement – *21 collisions (39% of total)*
- All pedestrian-involved collisions (4 collisions) occurred between vehicles turning left/right from No. 4 Road onto Cambie Road while pedestrians crossing Cambie Road

Operational (Field Review):

- Congestion / long queues during peak periods – *east-west approaches*
- Significant lane changing/weaving activities – *all approaches; due to lack of left-turn bays*
- High vehicle speed – *east-west legs; to/from overpass*

NO. 4 ROAD & CAMBIE ROAD

Operational (Field Review) – *CONTINUED*:

- "SPEED KILLS" sign was noted in the eastbound approach indicating high vehicle speed identified
- Notices looking for witnesses on a vehicle collisions dated September 2018 were found on utility poles

Other:

- Insufficient street lighting – *northeast corner*

POTENTIAL IMPROVEMENTS

Short-Term (Potential Safety Benefit = 15 to 25% of Total Collisions):

- Regularly trim foliage – *northeast corner*
- Add a near-side tertiary traffic signal head – *northbound approach*
- Enlarge signal lenses to 300-300-300 millimetres for primary traffic signal heads – *east-west approaches*
- Conduct warrant analysis for adding left-turn phase – *eastbound approach*
- Add left-turn bay – *east-west approaches; traffic operation and geometric design to confirm (feasibility/design)*
- Review and adjust signal timing to provide priority and/or dedicated pedestrian phase – all approaches
- Advance merge sign before the intersection OR provide two exit lane and merge further north – *northbound approach*

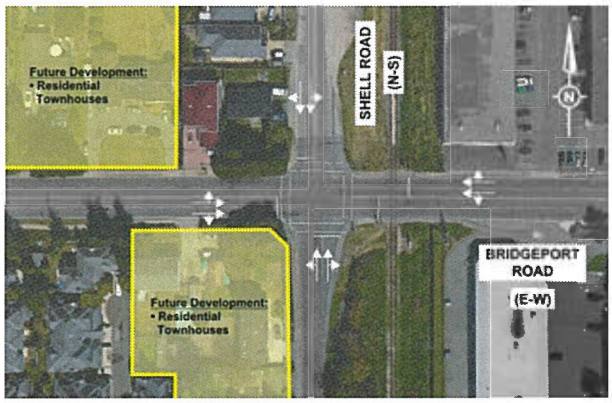
Medium/Long-Term:

- Add left-turn phase (if warranted) – *eastbound approach*
- Add left-turn bay – *east-west approaches; traffic operation and geometric design to confirm (construction)*
- Review and widen sidewalk and letdowns (if required) – *overall*
- Enhance police enforcements for vehicle speeding violations in coordination with RCMP – *east-west approaches*
- Review traffic lane widths and curb return radii as a measure to reduce collisions involving speeding
- Consider to install red-light camera (under ICBC jurisdiction) – *westbound approach*

SHELL ROAD & BRIDGEPORT ROAD

INTERSECTION INFORMATION

Site #:	14
Intersection Type:	4-Legged
Traffic Control Type:	Signalized - P/P LT for WB
N-S Street Classification:	Arterial
E-W Street Classification:	Arterial (MRN)
Surrounding Land Use:	Residential / Industrial
Daily Traffic Volume (2015):	33,200 Entering Vehicles



COLLISION STATISTICS (2015-2017)

Collision Frequency:	37.7 per year	(Total = 113)
Collision Severity Index:	6.18	(Casualty = 58%)
Collision Rate OBS. / CRT.:	2.83 / 3.37	[2013-2017]
Collision with Pedestrian:	5	
Collision with Cyclist:	0	

Highest % Month:	July (12%)
Highest % Day of Week:	Monday (18%)
Highest % Time Period:	9 AM - 12 PM / 3 PM - 6 PM (23%)
Top 3 Collision Types:	Rear End (49%) Left Turn (23%) Sideswipe (11%)

IDENTIFIED OPERATIONAL AND SAFETY ISSUES

Geometric:

- Lack of left-turn bay – *all approaches; limited visibility of through traffic for left-turn drivers*
- Wide receiving lane – *north leg; conflicts between westbound right-turn and eastbound left-turn vehicles and two northbound through vehicles*
- Short merge lane after intersection – *north leg*
- Residential driveways close to intersection – *north and west legs*
- Inadequate sight distance due to nearby foliage and insufficient property setback – *west side corners*
- Presence of railway crossing – *east leg; two sets of westbound signal heads with one stop bar*

Signal:

- Lack of left-turn phase – *north-south and eastbound approaches*
- Provision of left-turn phase without left-turn bay – *westbound approach*

Vulnerable Road User:

- Inadequate pedestrian/bicycle facility/connection – *overall intersection; conflicts between right-turn vehicles and crossing pedestrians/bicycles*

Collision (Data Review):

- Annual number of collisions increased from 2015 to 2017
- High collision severity index (over 5.00)
- High number of rear-end collisions reported on Bridgeport Road approaches – *85%; 25 occurred on westbound*
- All left-turn opposing collisions occurred in the east-west directions – *14 for westbound and 11 for eastbound*
- High number of sideswipe collisions occurred on westbound (6 collisions), followed by eastbound (3 collisions)
- Two pedestrian-involved collisions (out of five) reported between vehicles turning right from Shell Road onto Bridgeport Road and pedestrians crossing Bridgeport Road

Operational (Field Review):

- Significant left-turn volumes/queues during peak periods – *east-west approaches; aggressive turning manoeuvers*
- Significant lane changing/weaving activities – *all directions; due to lack of left-turn bays*
- On-street parking close to intersection – *north leg; right-angle parking stalls along east side*

SHELL ROAD & BRIDGEPORT ROAD

Operational (Field Review) – *CONTINUED*:

- Future development nearby – *west side (residential); generate more traffic in the near future*
- Notices to look for collision incident witnesses on February 2019 were found on utility poles at the intersection

Other:

- Insufficient street lighting – *southwest corner*

POTENTIAL IMPROVEMENTS

Short-Term (Potential Safety Benefit = 5 to 15% of Total Collisions):

- Review and relocate/remove right-angle parking spaces close to the intersection – *north leg*
- Regularly trim foliage to provide adequate sight distance – southwest corner

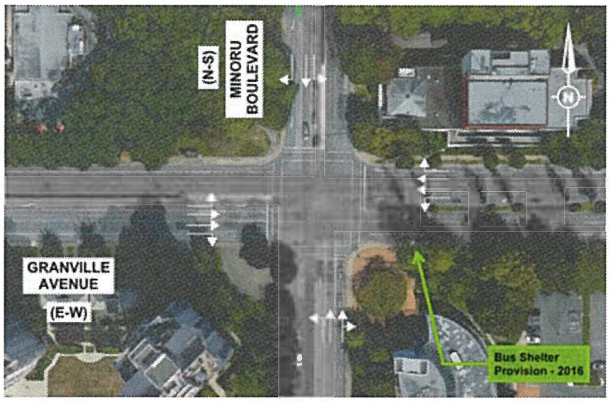
Medium/Long-Term:

- Repaint pavement marking to realign/convert approaches to one left-turn (align with opposite left-turn) with one shared through-right lane – *north-south approaches*
- Add left-turn bays with future redevelopments – *east-west approaches*
- Rearrange or relocate driveway locations away from the intersection with future redevelopment – *west side*
- Improve pedestrian/bicycle facility/connection – *overall*
- Review and improve street lighting (if required) – *southwest corner*

MINORU BOULEVARD & GRANVILLE AVENUE

INTERSECTION INFORMATION

Site #:	15
Intersection Type:	4-Legged
Traffic Control Type:	Signalized - P/P LT for SB & E-W
N-S Street Classification:	Arterial (Bike Route - NL)
E-W Street Classification:	Arterial (Bike Route)
Surrounding Land Use:	Residential / Office / Civic / Park
Daily Traffic Volume (2015):	35,400 Entering Vehicles



COLLISION STATISTICS (2015-2017)

Collision Frequency:	34.0 per year	(Total = 102)
Collision Severity Index:	5.24	(Casualty = 47%)
Collision Rate OBS. / CRT.:	2.65 / 3.35	[2013-2017]
Collision with Pedestrian:	12	
Collision with Cyclist:	0	

Highest % Month:	September (22%)
Highest % Day of Week:	Wednesday (22%)
Highest % Time Period:	9 AM - 12 AM (25%)
Top 3 Collision Types:	Rear End (55%) Sideswipe (16%) Pedestrian Involved (12%)

IDENTIFIED OPERATIONAL AND SAFETY ISSUES

Geometric:

- Horizontal curve as well as institutional driveway before intersection – *southbound approach; vehicles weaving between the library loading area and intersection turning bays*
- Designated right-turn bays at a busy intersection – *east-west approaches*
- Lane drop from through to designated right-turn lane – *southbound approach*
- Wide receiving lane – *south leg; conflict between eastbound right-turn and westbound left-turn vehicles*
- On-street parking close to intersection – *south leg*

Signal:

- Lack of left-turn phase with left-turn bay provided – *northbound approach*
- No countdown for pedestrian signal phases – *all directions*

Vulnerable Road User:

- Substantial pedestrian/bicycle crossing activities – *all legs (to/from community centres, school, City Hall, shopping centre, park, etc.)*
- Special crosswalks near intersection – *north leg*

Collision (Data Review):

- Annual number of collisions increased in 2017
- High collision severity index (over 5.00)
- High number of rear-end collisions reported on southbound direction (39%), followed by eastbound (35%)
- High proportion of left-turn rear-end collisions occurred on eastbound – *11 out of total 13 collisions*
- High proportion of sideswipe collisions occurred on Granville Avenue approaches – *11 collisions (69% of total)*
- 7 right-angle collisions occurred – *4 collisions reported due to southbound vehicles running the red light*
- 6 out of 12 total pedestrian-involved collisions (50%) occurred between northbound left-turn vehicles (no left-turn phase) and pedestrians crossing west leg

Operational (Field Review):

- Congestion / long queues during peak periods – *east-west approaches*
- Significant left/right-turn volumes/queues during peak periods – *all approaches; conflict between right-turn vehicles and crossing pedestrians/bicycles*

MINORU BOULEVARD & GRANVILLE AVENUE

Operational (Field Review) – *CONTINUED*:

- Significant lane changing/weaving activities – *southbound approach (marked on-street bicycle lane crossing designated right-turn lane) and east-west directions (conflicts between right-turn vehicles and through bicycles/buses)*
- Existing bike facility is confusing to drivers/cyclists and too much information to process – *southbound; just before the taper, road user sees "Bike Lane Ends", overhead lane designation signs, green paint, bike symbol, Yield to Bike Cycle sign, and lane drop.*

Other:

- Insufficient street lighting – *northwest and south side corners*

POTENTIAL IMPROVEMENTS

Short-Term (Potential Safety Benefit = 15 to 25% of Total Collisions):

- Review and adjust signal timing to provide priority and/or dedicated pedestrian phase – *all directions*
- Review and increase pedestrian crossing timing (if warranted) – *north-south directions*
- Conduct warrant analysis for adding left-turn phase – *northbound approach*
- Review and extend signal timings – *eastbound approach (specifically left-turn)*
- Paint green to crosswalk to alert drivers for high crossing activities – *all approaches*
- Enlarge signal lenses to 300-300-300 millimetres for primary traffic signal heads – *all approaches*

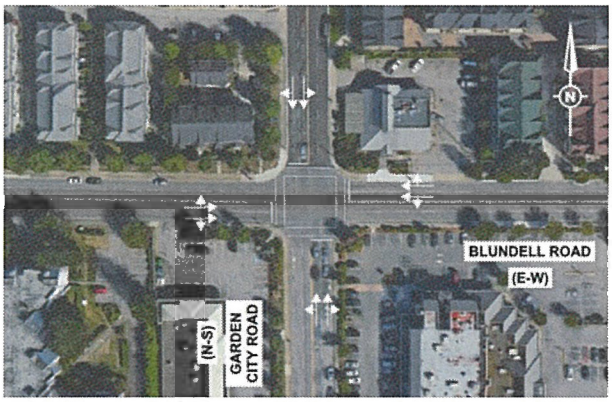
Medium/Long-Term:

- Add left-turn phase (if warranted) – *northbound approach*
- Consider conducting redesign of southbound approach to improve the crossing facilities
- Provide off-street multi-use pathway – *south leg (west side)*
- Consider to install red-light camera (under ICBC jurisdiction) – *westbound approach*
- Review and improve street lighting (if required) – *northwest and south side corners*
- Enhance police enforcements for vehicle red-light running violations in coordination with RCMP and ICBC – *all approaches*
- Enhance police enforcements for pedestrian crossing violations in coordination with RCMP – *all approaches*

GARDEN CITY ROAD & BLUNDELL ROAD

INTERSECTION INFORMATION

Site #:	16
Intersection Type:	4-Legged
Traffic Control Type:	Signalized - P/P LT in all directions
N-S Street Classification:	Arterial
E-W Street Classification:	Arterial
Surrounding Land Use:	Commercial / Residential
Daily Traffic Volume (2015):	26,400 Entering Vehicles



COLLISION STATISTICS (2015-2017)

Collision Frequency:	22.0 per year	(Total = 66)
Collision Severity Index:	4.68	(Casualty = 41%)
Collision Rate OBS. / CRT.:	3.35 / 3.41	[2013-2017]
Collision with Pedestrian:	1	
Collision with Cyclist:	0	

Highest % Month:	April / November (14%)
Highest % Day of Week:	Thursday (24%)
Highest % Time Period:	3 PM - 6 PM (30%)
Top 3 Collision Types:	Rear End (44%)
	Sideswipe (34%)
	Left Turn (15%)

IDENTIFIED OPERATIONAL AND SAFETY ISSUES

Geometric:

- Lack of left-turn bay – *all approaches; limited visibility of through traffic for left-turn drivers*
- Lane drop after intersection due to on-street parking during off-peak periods – *north, south, and west legs*
- Commercial driveways close to intersection – *northeast and southwest quadrants*

Signal:

- Provision of left-turn phase without left-turn bay – *all approaches*
- No countdown for pedestrian signal phases – *all directions*

Vulnerable Road User:

- Narrow letdown – *northeast corner*
- Substantial pedestrian/bicycle crossing activities – *all legs (to/from retail stores and nearby schools); conflict between left/right-turn vehicles and crossing pedestrians*

Collision (Data Review):

- Annual number of collisions were similar in three years
- High number of rear-end collisions reported on westbound (54%), followed by northbound (25%)
- High number of sideswipe collisions occurred on westbound (40%), followed by southbound (25%)
- High number of left-turn opposing collisions reported for E-W direction (over 65% of total)
- The pedestrian-involved collision occurred between a right-turning vehicle from Garden City Road (NB/SB) and a pedestrian crossing Blundell Road
- 26 extra collisions reported at the driveways (south and east legs) of Garden City Shopping Centre, located on the southeast corner of study intersection
- A fatal collision occurred between a vehicle exiting the shopping centre driveway to go westbound on Blundell Road and an eastbound vehicle during weekday AM peak period on February 2016
- Another fatal collision reported including an eastbound vehicle hitting a pedestrian who was jaywalking across Blundell Road during weekday AM peak period on October 2014

Operational (Field Review):

- Congestion / long queues during peak periods – *all approaches; especially shopping trips during weekend afternoon*

GARDEN CITY ROAD & BLUNDELL ROAD

Operational (Field Review) – *CONTINUED*:

- Significant lane changing/weaving activities – *all directions; due to lack of left-turn bays and allowance of on-street parking*
- On-street parking close to intersection – *northbound approaches; blocking through traffic from using curb lane and then change lane to avoid left-turn vehicles*
- Unfamiliar drivers may be confuse when the left-turn phase is on in each approach
- Jaywalkers crossing Garden City Road and Blundell Road were observed

Other:

- None

POTENTIAL IMPROVEMENTS

Short-Term (Potential Safety Benefit = 5 to15% of Total Collisions):

- Review and relocate/remove on-street parking next to shopping centre and close to intersection – *northbound approach*

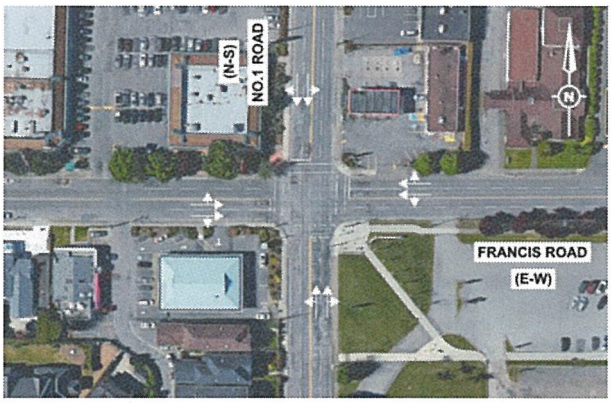
Medium/Long-Term:

- Provide left-turn bays with future redevelopments in the future – *overall*
- Conduct detailed in-service operation and safety study, including collisions at shopping centre driveways – *overall*
- Review and widen letdown (if required) – *northeast corner*

NO. 1 ROAD & FRANCIS ROAD

INTERSECTION INFORMATION

Site #:	17
Intersection Type:	4-Legged
Traffic Control Type:	Signalized - P/P LT for N-S & WB
N-S Street Classification:	Arterial
E-W Street Classification:	Arterial
Surrounding Land Use:	Comm. / Rec. / Inst. / Resi.
Daily Traffic Volume (2015):	27,200 Entering Vehicles



COLLISION STATISTICS (2015-2017)

Collision Frequency:	27.3 per year	(Total = 82)
Collision Severity Index:	4.73	(Casualty = 41%)
Collision Rate OBS. / CRT.:	2.99 / 3.41	[2013-2017]
Collision with Pedestrian:	0	
Collision with Cyclist:	2	

Highest % Month:	May / June (13%)
Highest % Day of Week:	Friday / Wednesday (20%)
Highest % Time Period:	3 PM - 6 PM (29%)
Top 3 Collision Types:	Rear End (31%) Left Turn (30%) Sideswipe (26%)

IDENTIFIED OPERATIONAL AND SAFETY ISSUES

Geometric:

- Lack of left-turn bay – *all approaches; limited visibility of through traffic for left-turn drivers*
- Lane drop after intersection due to on-street parking during off-peak periods – *south, east, and west legs*
- Commercial and recreational driveways close to intersection – *north, east, and west legs*

Signal:

- Lack of left-turn phase – *eastbound approach*
- Provision of left-turn phase without left-turn bay – *north-south and westbound approaches*
- No countdown for pedestrian signal phases – *all directions*

Vulnerable Road User:

- Substantial pedestrian crossing activities – *all legs (to/from retail stores and nearby community centres and schools); conflict between left/right-turn vehicles and crossing pedestrians*
- No bicycle facilities provided – *overall intersection*

Collision (Data Review):

- High number of rear-end collisions occurred on No. 1 Road approaches – *10 for northbound and 7 for southbound; out of total 24 collisions*
- High number of left-turn opposing collisions occurred on N-S direction – *85%; 22 out of total 23 collisions*
- High proportion of sideswipe collisions reported for northbound (6), followed by eastbound/southbound (4); out of total 20 collisions
- Two cyclist-involved collisions occurred between vehicles turning left/right from No. 1 Road onto Francis Road and bicycle crossing east/west leg of the study intersection
- 20 extra collisions reported at the driveways of Seafair Centre (shopping plaza) located on the northwest corner of the intersection – *14 collisions at the driveway along No. 1 Road and 6 collisions at the driveway to Francis Road*

Operational (Field Review):

- Significant left-turn volumes/queues during commuter and school peak periods – *north-south approaches; aggressive turning manoeuvers*
- Significant lane changing/weaving activities – *all directions; due to lack of left-turn bays*
- Road work and lane closure on the northwest corner during the field review in early April

NO. 1 ROAD & FRANCIS ROAD

Other:

- None

POTENTIAL IMPROVEMENTS

Short-Term (Potential Safety Benefit = 10 to 20% of Total Collisions):

- Review and adjust signal timing to provide priority and/or dedicated pedestrian phase – *all approaches*
- Paint green pavement marking for crosswalk to alert drivers for substantial pedestrian crossing activities – *all legs*
- Review and relocate/remove on-street parking close to intersection – *south, east, and west legs*
- Conduct warrant analysis for adding left-turn phase – *eastbound approach*
- Educate community centre children and school students regarding safe pedestrian crossing – *overall*

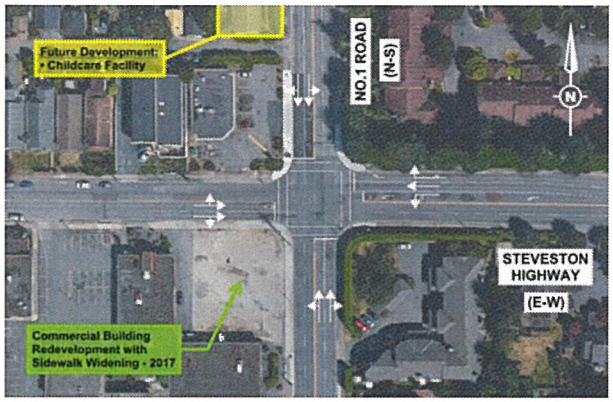
Medium/Long-Term:

- Consolidate commercial driveways with future redevelopment – *north leg*
- Add left-turn phase (if warranted) – *eastbound approach*
- Add left-turn bays with future redevelopments in the future – *all approaches, particular north-south directions*
- Conduct a detailed in-service operation and safety study to include the safety review of nearby commercial driveways – *overall*

NO. 1 ROAD & STEVESTON HIGHWAY

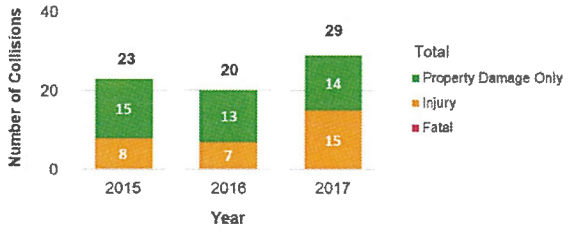
INTERSECTION INFORMATION

Site #:	18
Intersection Type:	4-Legged
Traffic Control Type:	Signalized - P/P LT for SB & WB
N-S Street Classification:	Arterial
E-W Street Classification:	Arterial
Surrounding Land Use:	Commercial / Residential
Daily Traffic Volume (2015):	34,300 Entering Vehicles



COLLISION STATISTICS (2015-2017)

Collision Frequency:	24.0 per year	(Total = 72)
Collision Severity Index:	4.75	(Casualty = 42%)
Collision Rate OBS. / CRT.:	2.08 / 3.36	[2013-2017]
Collision with Pedestrian:	3	
Collision with Cyclist:	0	



Highest % Month:	December (14%)
Highest % Day of Week:	Saturday (19%)
Highest % Time Period:	3 PM - 6 PM (19%)
Top 3 Collision Types:	Rear End (30%) Left Turn (30%) Sideswipe (19%)

IDENTIFIED OPERATIONAL AND SAFETY ISSUES

Geometric:

- Lack of left-turn bay – *north-south and eastbound approaches; limited visibility of through traffic for left-turn drivers*
- Misalignment of left-turn lanes – *east-west approaches*
- Wide receiving lane – *west leg; conflicts between southbound right-turn and northbound left-turn vehicles*
- Commercial driveways and laneway close to intersection – *north and west legs*
- Inadequate sight distance due to nearby foliage and insufficient property setback – *east side corners*

Signal:

- Lack of left-turn phase – *northbound and eastbound approaches*
- Provision of left-turn phase without left-turn bay – *southbound approach*
- No countdown for pedestrian signal phases – *all directions*

Vulnerable Road User:

- Substantial pedestrian crossing activities – *all legs (to/from retail stores and nearby community centres and schools); conflict between left/right-turn vehicles and crossing pedestrians*
- Narrow letdown – *southeast corner*
- Small pedestrian waiting area – *northwest corner*

Collision (Data Review):

- High number of rear-end collisions occurred on westbound (7) and northbound (7), out of total 20 collisions
- High number of left-turn opposing collisions occurred for westbound (7) and southbound (7), out of total 19 collisions
- High number of sideswipe collisions reported for northbound and eastbound (4 each), out of total 11 collisions
- 7 right-angle collisions occurred – *4 collisions occurred when there was a power outage and intersection was operating as four-way stop-controlled*
- Two pedestrian-involved collisions occurred between westbound left-turn vehicles and pedestrians crossing south leg, and one pedestrian-involved collision reported between a southbound left-turn vehicle and a pedestrian crossing east leg
- High number of collisions occurred on Saturday due to high shopping activities and pedestrians walking to Steveston Village

NO. 1 ROAD & STEVESTON HIGHWAY

Operational (Field Review):

- Significant lane changing/weaving activities – *all approaches; due to lack of left-turn bays and existence of lane drop*
- On-street parking close to intersection – *west leg; no parking restriction with new development*
- Future development nearby – *northwest quadrant (institutional); generate more traffic in the near future*

Other:

- Missing pavement marking – *south leg (incomplete crosswalk)*
- Insufficient street lighting – *northwest corner*

POTENTIAL IMPROVEMENTS

Short-Term (Potential Safety Benefit = 15 to 25% of Total Collisions):

- Review and adjust signal timing to provide priority and/or dedicated pedestrian phase – *all approaches*
- Repaint approach to one left-turn lane plus one shared through-right lane and align with opposite left-turn lane – *eastbound approach*
- Add overhead lane designated sign – *westbound approach*
- Add on-street parking restriction zone close to intersection – *west leg*
- Add additional Designated Right-turn sign upstream – *westbound approach*
- Regularly trim foliage – *northeast corner*

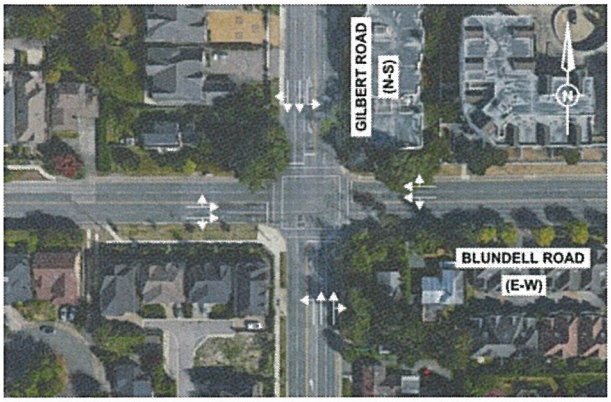
Medium/Long-Term:

- Add left-turn bays with future redevelopments in the future – *north-south approaches*
- Close driveways near intersection with future redevelopment – *north and west legs*

GILBERT ROAD & BLUNDELL ROAD

INTERSECTION INFORMATION

Site #:	19
Intersection Type:	4-Legged
Traffic Control Type:	Signalized - P/P LT for E-W
N-S Street Classification:	Arterial
E-W Street Classification:	Arterial
Surrounding Land Use:	Residential
Daily Traffic Volume (2015):	32,700 Entering Vehicles



COLLISION STATISTICS (2015-2017)

Collision Frequency:	25.7 per year	(Total = 77)
Collision Severity Index:	5.32	(Casualty = 48%)
Collision Rate OBS. / CRT.:	2.14 / 3.37	[2013-2017]
Collision with Pedestrian:	3	
Collision with Cyclist:	1	

Highest % Month:	May (14%)
Highest % Day of Week:	Tuesday (27%)
Highest % Time Period:	3 PM - 6 PM (29%)
Top 3 Collision Types:	Rear End (39%) Left Turn (23%) Sideswipe (16%)

IDENTIFIED OPERATIONAL AND SAFETY ISSUES

Geometric:

- Lack of left-turn bay – *east-west approaches; limited visibility of through traffic for left-turn drivers*
- Lane drop after intersection due to on-street parking during off-peak periods – *east-west legs*
- Residential driveways and laneway close to intersection – *north, south, and east legs*
- Inadequate sight distance due to nearby foliage and insufficient property setback – *north side and southeast corners*

Signal:

- Lack of left-turn phase with left-turn bay provided – *north-south approaches*
- Provision of left-turn phase without left-turn bay – *east-west approaches*

Vulnerable Road User:

- Narrow letdown – *northeast corner*
- Small waiting area – *northeast corner; pedestrians close to tight right-turn vehicles*
- No bicycle facilities provided – *overall intersection*

Collision (Data Review):

- High collision severity index (over 5.00)
- High number of rear-end collisions occurred on westbound (11), followed by northbound (6); out of total 29 collisions
- High number of left-turn opposing collisions occurred for westbound (7), followed by southbound (4) out of total 17 collisions
- High number of sideswipe collisions reported for eastbound (42%) – *5 out of total 12 collisions*
- 9 right-angle collisions occurred – *6 collisions reported due to vehicles running the red light on in the east-west directions*
- Two out of total three pedestrian-involved collisions reported between left-turning vehicles and pedestrians crossing east leg and south leg
- The cyclist-involved collision reported between a vehicle turning right from Gilbert Road and a bicycle crossing Gilbert Road in front of the vehicle (north or south leg)

GILBERT ROAD & BLUNDELL ROAD

Operational (Field Review):

- Significant lane changing/weaving activities – *east-west approaches (due to lack of left-turn bays); two-way left-turn lane is also available on the north leg*
- High vehicle speed – *north-south legs; presence of red-light camera for westbound approach*

Other:

- None

POTENTIAL IMPROVEMENTS

Short-Term (Potential Safety Benefit = 10 to 20% of Total Collisions):

- Conduct warrant analysis for adding left-turn phase – *north-south approaches*
- Check intergreen time to verify the possible contributing cause for high number of right-angle collisions – *overall*
- Review and relocate/remove on-street parking close to intersection – *north, south, and east legs*
- Regularly trim foliage – *north side and southeast corners*

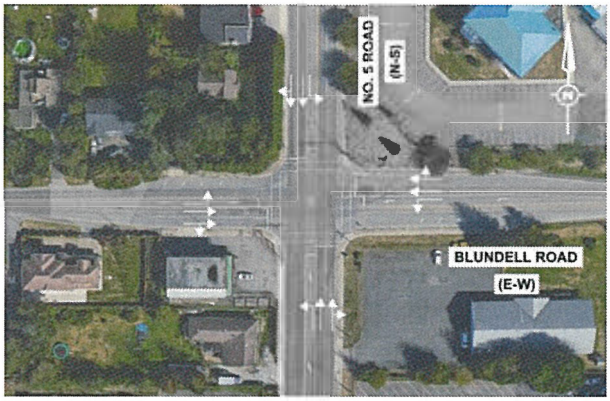
Medium/Long-Term:

- Add left-turn phase (if warranted) – *north-south approaches*
- Add left-turn bays with future redevelopments in the future – *east-west approaches*
- Enhance police enforcements for vehicle speeding violations in coordination with RCMP – *north-south legs*
- Review traffic lane widths and curb return radii as a measure to reduce collisions involving speeding

NO. 5 ROAD & BLUNDELL ROAD

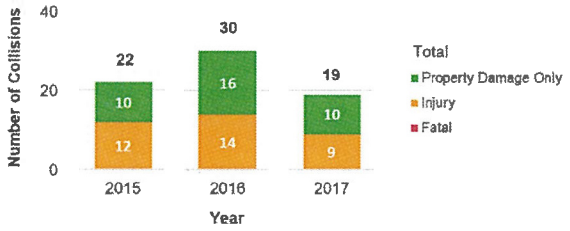
INTERSECTION INFORMATION

Site #:	20
Intersection Type:	4-Legged
Traffic Control Type:	Signalized
N-S Street Classification:	Arterial
E-W Street Classification:	Arterial
Surrounding Land Use:	Inst. / Comm. / Resi.
Daily Traffic Volume (2015):	25,100 Entering Vehicles



COLLISION STATISTICS (2015-2017)

Collision Frequency:	23.7 per year	(Total = 71)
Collision Severity Index:	5.44	(Casualty = 49%)
Collision Rate OBS. / CRT.:	2.73 / 3.42	[2013-2017]
Collision with Pedestrian:	0	
Collision with Cyclist:	0	



Highest % Month:	November (14%)
Highest % Day of Week:	Wednesday (24%)
Highest % Time Period:	3 PM - 6 PM (30%)
Top 3 Collision Types:	Rear End (59%) Sideswipe (16%) Left Turn (10%)

IDENTIFIED OPERATIONAL AND SAFETY ISSUES

Geometric:

- Horizontal and vertical curves before/after intersection – *east leg*
- Merge lane after intersection – *east-west legs*
- Lane drop after intersection due to on-street parking during off-peak periods – *north-south legs*
- Commercial, institutional, and residential driveways close to intersection – *south and west legs*
- Inadequate sight distance due to nearby foliage and insufficient property setback – *northwest corner*

Signal:

- Lack of left-turn phase with left-turn bay provided – *all approaches*
- Old pedestrian pushbuttons – *all corners*

Vulnerable Road User:

- Narrow sidewalk with utility poles – *northwest quadrant*
- No bicycle facilities provided – *overall intersection*

Collision (Data Review):

- High collision severity index (over 5.00)
- High number of rear-end collisions occurred on eastbound (14), followed by northbound (9); out of total 41 collisions
- High proportion of sideswipe collisions reported for eastbound – *40%; 4 out of total 11 collisions*
- High proportion of left-turn opposing collisions occurred for westbound left-turn movement – *3 out of total 6 collisions*
- 4 right-angle collisions occurred – *2 collisions occurred when there was a power outage and intersection was operating as four-way stop-controlled*
- A fatal collision reported between an eastbound vehicle going through the intersection and a northbound vehicle running the red light around weekday noon time on September 2013

Operational (Field Review):

- Significant left-turn volumes/queues during peak periods – *northbound and east-west approaches*
- Significant lane changing/weaving activities – *east-west directions*
- High vehicle speed – *north-south directions*

NO. 5 ROAD & BLUNDELL ROAD

Other:

- None

POTENTIAL IMPROVEMENTS

Short-Term (Potential Safety Benefit = 5 to 15% of Total Collisions):

- Conduct warrant analysis for adding left-turn phase – *east-west approaches*
- Convert curb lane to right-turn only lane to avoid sideswipes – *east-west approaches*
- Upgrade pedestrian pushbuttons to the latest standard – *all corners*
- Review and relocate/remove on-street parking close to intersection – *east-west legs*

Medium/Long-Term:

- Add left-turn phase (if warranted) – *east-west approaches*
- Consider widening Blundell at intersections from two to four lanes overall
- Review and relocate/remove commercial driveways close to intersection with future redevelopment – *southwest quadrant*
- Review and widen letdown (if required) – *northeast corner*
- Enhance police enforcements for vehicle speeding violations in coordination with RCMP – *north-south legs*
- Review traffic lane widths and curb return radii as a measure to reduce collisions involving speeding

Top 20 Intersections: Summary of Proposed Short-Term Improvements

Intersection		Pavement Markings & Barriers	Signage	Traffic Signals	Trim Foliage for Sightlines	Street Parking	Education / Study	Est. Total Cost	Est. Safety Benefit
1	Shell Rd-Alderbridge Way/Hwy 91	Upgrade Crosswalk Markings/ Repaint Merge Lines	Add Yield/ Merge/ Crosswalk Signs	Enlarge Lenses/ Upgrade Ped Buttons/ Warrant for LT Phase	SW Corner	-	-	$41,600	20-30%
		$13,700	$3,400	$23,000	$1,500	-	-		
2	Garden City Rd-Sea Island Way	Upgrade Crosswalk Markings/ Add Merge Lines	Add Object Marker/ Crosswalk Signs	Warrant for LT Phase	SW Corner	-	-	$6000	5-15%
		$3,000	$1,450	Staff Time	$1,500	-	-		
3	No. 2 Rd-Westminster Hwy	Add Guide Lines/Add RT Markings	Add New Lane/RT Only Lane Signs	Enlarge Lenses/ Warrant for LT Phase	SW Corner/ South Side	-	Traffic Operations & Safety Review	$54,600	20-30%
		$1,300	$800	$23,000	$4,500	-	$25,000		
4	No. 4 Rd-Alderbridge Way	Repaint Merge Lines	Add Yield/ Crosswalk Signs	Enlarge Lenses/ Review Signal Progression/ Upgrade Ped Buttons/ Warrant for LT Phase	-	-	-	$25,700	20-30%
		$900	$2,800	$22,000	-	-	-		
5	No. 5 Rd-Westminster Hwy	Upgrade Crosswalk Markings/ Add Merge Lines	Add Yield/ RT Lane/ Crosswalk Signs	Enlarge Lenses	-	-	-	$29,200	15-25%
		$4,600	$3,600	$21,000	-	-	-		
6	No. 5 Rd-Cambie Rd	Replace Barriers	-	Enlarge Lenses/Review Dedicated Ped Phase	-	-	-	$22,500	20-30%
		$1,500	-	$21,000	-	-	-		
7	No. 4 Rd-Westminster Hwy	Upgrade Crosswalk Markings	Add Bike Route Signs	Enlarge Lenses/ Upgrade Ped Buttons	-	-	-	$51,000	15-25%
		$26,600	$1,400	$23,000	-	-	-		
8	Garden City Rd-Cambie Rd	Add Guide Line	Add New Lane Sign	Enlarge Lenses/ Warrant for LT Phase	NW Corner	-	-	$23,500	15-25%
		$500	$250	$21,000	$1,500	-	-		
9	Garden City Rd-Granville Ave	Add Guide Line	Add New Lane Sign	Enlarge Lenses	-	-	Feasibilility Study Traffic Control Changes	$66,800	15-25%
		$500	$250	$16,000	-	-	$50,000		
10	No. 2 Rd-Blundell Rd	Replace Barriers	-	Review Signal Progression	-	Review Location on W Leg	-	$5,000	5-15%
		$5,000	-	Staff Time	-	Staff Time	-		

Top 20 Intersections by Location

Intersection		Pavement Markings & Barriers	Signage	Traffic Signals	Trim Foliage for Sightlines	Street Parking	Education / Study	Est. Total Cost	Est. Safety Benefit
11	No. 3 Rd-Granville Ave	Upgrade Crosswalk Markings/ Add Guide Line	-	Enlarge Lenses/Review Dedicated Ped Phase	-	-	-	$67,000	20-30%
		$46,000	-	$21,000	-	-	-		
12	No. 4 Rd-Blundell Rd	Repaint Lane Lines	-	-	-	Review Location on W Leg	-	$1,200	10-20%
		$1,200	-	-	-	Staff Time	-		
13	No. 4 Rd-Cambie Rd	-	Add Merge Sign	Add Tertiary Signal/ Enlarge Lenses/ Review Dedicated Ped Phase/ Warrant for LT Phase	NE Corner	-	Design to Add LT Bays	19000	15-25%
		-	$400	$17,000	$1,500	-	Staff Time		
14	Shell Rd-Bridgeport Rd	-	-	-	SW Corner	Review Location on N Leg	-	$1,500	5-15%
		-	-	-	$1,500	Staff Time	-		
15	Minoru Blvd-Granville Ave	Add Bike Lane Lines	-	Enlarge Lenses/ Review Dedicated Ped Phase/ Review Signal Timing/ Warrant for LT Phase	-	-	-	$31,000	15-25%
		$10,000	-	$21,000	-	-	-		
16	Garden City Rd-Blundell Rd	-	-	-	-	Review Location NB Approach	-	$0	5-15%
		-	-	-	-	Staff Time	-		
17	No. 1 Rd-Francis Rd	Add Bike Lane Lines	-	Review Dedicated Ped Phase/ Warrant for LT Phase	-	Review Location on S, E, W Legs	Pedestrian Education Campaign	$45,000	10-20%
		$45,000	-	-	-	Staff Time	Staff Time		
18	No. 1 Rd-Steveston Hwy	Repaint Lane Lines	Add RT/ Overhead Lane Signs	Review Dedicated Ped Phase	NE Corner	Restrict Parking on W Leg	-	$3500	15-25%
		$600	$950	-	$1,500	Staff Time	-		
19	Gilbert Rd-Blundell Rd	-	-	Warrant for LT Phase	North Side/ SE Corner	Review Location on N, S, E Legs	-	$4,500	10-20%
		-	-	-	$4,500	Staff Time	-		
20	No. 5 Rd-Blundell Rd	Convert Curb Lane to RT Lane	-	Upgrade Ped Buttons/ Warrant for LT Phase	-	Review Location on E, W Legs	-	$1,400	5-15%
		$1,400	-	-	-	Staff Time	-		
Total		**$161,800**	**$15,300**	**$229,000**	**$18,000**	**$0**	**$75,000**	**$499,100**	

Notes: RT = Right-Turn / LT = Left-Turn / N = North / S = South / W = West / E = East
Estimated Safety Benefit = % of collisions that improvement would address based on collision history