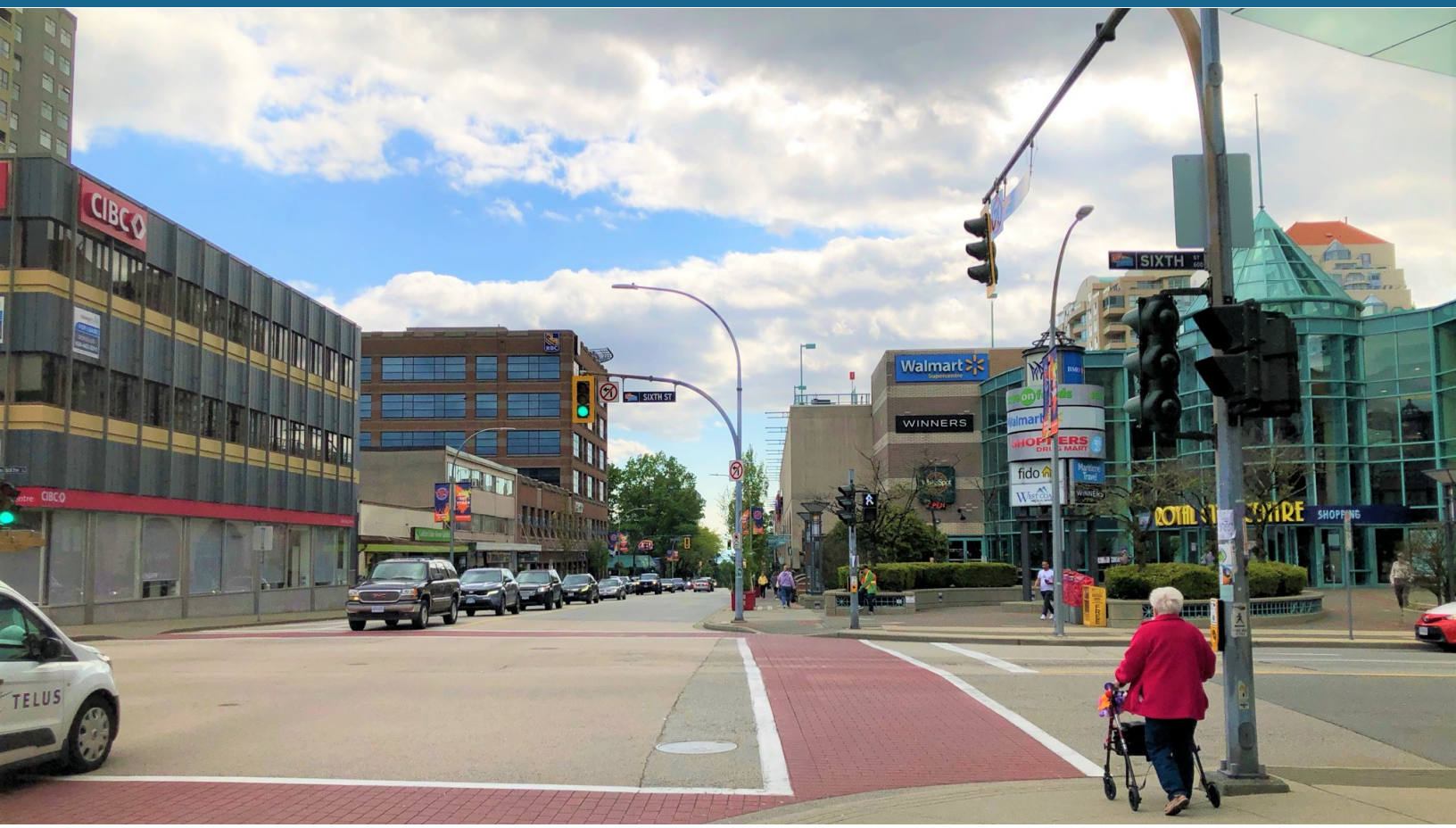

Intersection Network Screening
Road Safety Review

City of New Westminster

Safety Implementation Plan Final Report

August 2023

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Executive Summary

Introduction and Background

The **City of New Westminster** (**the City**) has been improving road safety within its road network based on identified improvements at high collision locations from previous road safety studies, such as the City's *2007 Comprehensive Road Safety Plan* and the *2016 Intersection Safety Review* (2016 Study), as prepared by **ISL Engineering and Land Services** (**ISL**). However, with significant changes in land use, such as major developments/redevelopments in City Centre, Uptown, and the Royal Columbian Hospital, revision to road/intersection conditions within/beyond the boundary of New Westminster (Front Street Mews, Braid Street Greenway, Ewen Avenue Streetscape, and roadways for the current Pattullo Bridge Replacement project), and completed improvements to local intersections in recent years, road user activities and collision trends at New Westminster intersections have changed since the previous studies.

Therefore, the City would like to update the Road Safety Plan, including a review of traffic and collision data, screening for priority locations, assessment of selected site conditions, development of recommended countermeasures and cost estimates, and ranking for implementation in the City's next five-year Capital Program. Ultimately, the study findings can assist the City in prioritizing locations for various mitigating measures (short-, medium-, and long-term basis) for investment to improve the road safety for all road users.

To continue the ongoing commitment to road safety, the City has retained ISL in association with **G. Ho Engineering Consultants Inc.** (**GHEC**) to conduct the ***2022 Intersection Network Screening Road Safety Review*** (**the Study**), which consists of three phases:

- **Phase 1: Initial Network Screening Analysis**, which included organizing project start-up meeting, reviewing collision and traffic data, establishing and confirming decision tree and selection criteria, conducting initial screening and identifying lists of high-risk locations, and organizing progress meeting.
- **Phase 2: Safety Strategy** (at top locations for following 5 years), which included undertaking secondary network screening, submitting risk identification summary package, organizing study review meeting #1, and conducting correctability analyses and recommending mitigation measures.
- **Phase 3: Road Safety Implementation Plan**, which included preparing draft road safety implementation plan report, organizing study review meeting #2, and preparing final network screening road safety implementation plan report.

Initial Network Screening Methodology

In the initial network screening, four Safety Performance Indicators (SPIs) were determined for all locations with at least one reported claim using the ICBC's claims data from January 1, 2015 to December 31, 2019:

- **Total Number of Fatal Collisions:** As recorded in ICBC collision data
- **Total Number of Vulnerable Road User (VRU)-involved Collisions:** Total number of pedestrian- or cyclist-involved collisions
- **Annual Collision Frequency (ACF)**: $\text{ACF} = \frac{\text{Total Number of Collisions from 2015 to 2019}}{5}$
- **Casualty Percentage (CAS%):** $\text{CAS\%} = \frac{\text{Total Number of Casualty Collisions from 2015 to 2019}}{\text{Total Number of Collisions from 2015 to 2019}}$

Based on the review of calculated SPIs and the consideration of a certain number of locations (over 50), the preliminary list of high-risk intersections for secondary screening was determined. It was determined that the study intersections under MOTI's judication and/or with recently completed or planned improvements were excluded from the preliminary list.

Secondary Network Screening Methodology

The observed and critical collision rates, which indicate if the intersection is prone to collisions, were calculated for the preliminary high-risk intersections using the mid-year (2017) average daily traffic (ADT) data provided by the City. For the secondary screening, four selection criteria were suggested and confirmed with the City as follows:

- Observed Collision Rate (CR) over Critical Collision Rate ($CR_{critical}$)

$$\mathbf{CR} = \frac{\text{Total Number of Collisions from 2015 to 2019}}{\text{ADT} \times R_{MEV}} \qquad \mathbf{CR_{critical}} = CR_{avg} + k\sqrt{CR_{avg}/m + \frac{1}{2m}}$$

$$R_{MEV} = \frac{1{,}826\ (\text{Total Number of Days from 2015 to 2019})}{1{,}000{,}000}, \quad CR_{avg} = \frac{\text{Total Number of Collisions from 2015 to 2019}}{\text{Five-year Million Entering Vehicles for Top 75 Locations}}$$

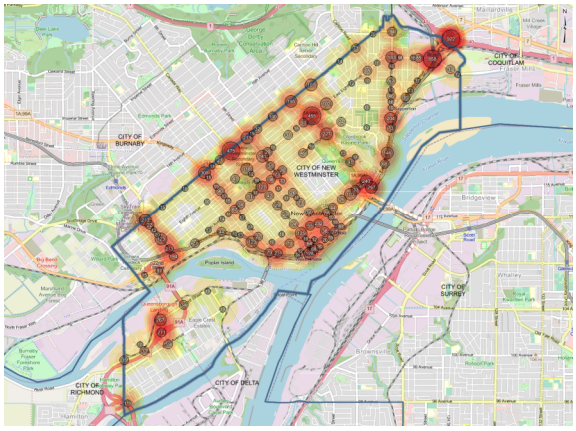
k (statistical constant) = 1.64 (for 90% confidence level), m = $\text{ADT} \times R_{MEV}$

- Collision Severity Index (CSI) ≥ the City's average CSI for intersection collisions (4.77)

$$\mathbf{CSI} = \frac{100 \text{ x Fatal Collisions} + 10 \text{ x Injury Collisions} + \text{Property Damage Only Collisions}}{5\text{-Year Total Number of Collisions}(2015-2019)}$$

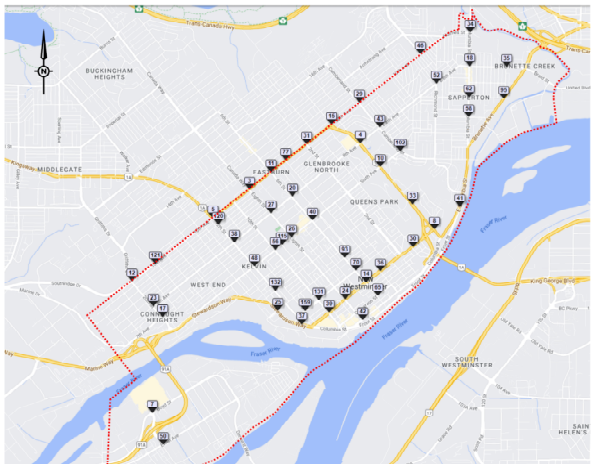
- Total number of VRU-involved collisions ≥ 3
- At least one reported a fatal collision

Collision Data Review



As a standard practice for road safety review studies, the five-year ICBC claims data, between January 1, 2015 and December 31, 2019 provided by the City was reviewed. It was confirmed with the City that the 2020 claims data be excluded for this Study due to various reasons such as reduced traffic volumes/number of collisions caused by the Covid-19 pandemic and the potential delay in finalizing the claims data. The dataset included a total of **28,558** ICBC reported claims. After filtering out the irrelevant claims such as parking-related incidents (10,393 claims), a total of **18,165** claims including intersection collisions (13,234 claims) and mid-block collisions (4,931 claims), were considered for city-wide collision review. Based on the descriptions from claim data, it was also found that 37% of the incidents were reported as casualty (fatal or injury) collisions.

Initial Network Screening



Based on the agreed **Network Screening Decision Tree**, 51 locations were short-listed as high collision risk:

- 8 locations (5 full traffic signals, 1 pedestrian signal, 2 stop-controlled) reported a fatal collision between 2015-2019.
- 6 locations (6 full traffic signals) with more than or equal to 5 VRU collisions in total.
- 18 locations (18 full traffic signals) have at least 12 collisions per year and a casualty percentage higher than the City's average.
- 19 locations (10 full traffic signals and 9 stop-controlled) with annual collision frequencies over 2, more than 2 VRU collisions, and a casualty percentage more than 38%.

Mid-Block Collisions Corridor

The mid-block collisions along various major corridors within in City of New Westminster were also reviewed, and the corridors with the high number of collisions (over 60 collisions for 5 years or at least one per month on average) were summarized below:

S. No.	Corridor Name	Corridor Type	INJURIES	PDO	Total Collision
1	Pattullo Bridge	Bridge	262	517	779
2	Queensborough Bridge	Bridge	155	202	357
3	Columbia Street	Collector	51	201	252
4	Stewardson Way	Arterial	46	94	140
5	McBride Boulevard	Arterial	32	76	108
6	Royal Avenue	Arterial	17	67	84
7	E Columbia Street	Arterial	12	66	78
8	Sixth Street	Collector	7	61	68
9	Carnarvon Street	Collector	3	64	67
10	Brunette Avenue	Arterial	14	52	66
11	Eighth Avenue	Collector	13	52	65

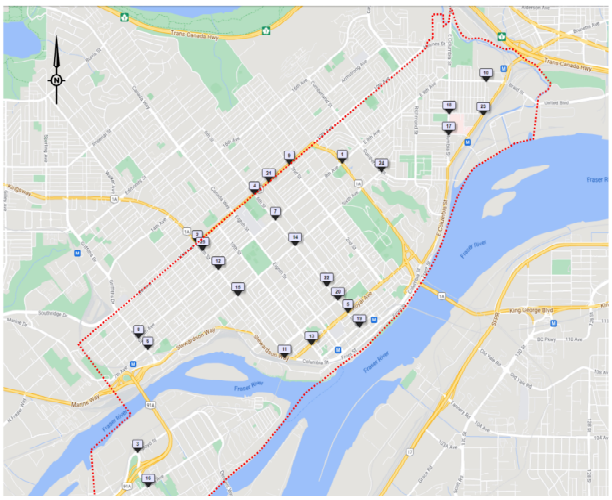
Within the City's road network, the bridges appear to be the highest-risk corridors, recording 779 collisions on Pattullo Bridge, and 357 collisions on Queensborough Bridge from 2015 to 2019. It is noted that the mid-block collisions did not include the intersection collisions along the corridors and the number of reported collisions along Pattullo Bridge included both within the Cities of New Westminster and Surry. In addition, Columbia Street, Stewardson Way and McBride Boulevard are the corridors with over 100 collisions for the 5-year study period.

Comparison with 2016 Study

Based on the initial network screening process, 51 high collision intersections were selected. Compared to the 50 high collision risk locations found in the 2016 Study and it was summarized as:

- 28 of them are new locations that were not included in the 2016 Study.
- 23 of them are common high collision risk intersections for both studies.
- 5 intersections in 2016 Study are not considered in this study.

Identification of Top 25 High-risk Intersections



The total number of intersections selected from initial screening is 51 locations, and then they were further reviewed in secondary screening. Intersections that were identified difficult to provide improvements, were filtered out based on past experience, land availability and site visit.

- 5 intersections, with a total score of three points or above, were selected as top 25. 1 of which is difficult to improve, thus, was not selected for further analysis.
- 14 intersections, with a total score of two points or above, were selected as top 25. 4 of which with lower collision rates, recently improved and difficult to improve were not selected for further analysis.
- 23 intersections had a total score of one point. 12 of which with lower VRU collision, collision rates and casualty percentages were not selected for further analysis.
- 9 intersections were not selected, as they did not meet any criteria.

Common Safety Issues/Trends for Top 25 Intersections

Based on the collision review and field review, the identified issues (operational, geometric, signal, vulnerable users, and others) for each of the 25 intersections, were summarized and it was noted that the most common safety issues/trends from the 25 intersections include:

Operational:

- High through volume(s) and queue(s) – *16 intersections*
- On-street parking close to intersection – *12 intersections*
- Considerable lane changing/weaving – *11 intersections*
- Significant heavy vehicle volume(s) – *8 intersections*
- High left-turn volume(s) and queues(s) – *8 intersections*

Geometric:

- Steep gradient on approach(es) – *16 intersections*
- Wide lane(s) – *12 intersections*

Signal:

- Poor traffic signal head(s) visibility – *7 intersections*

Vulnerable Road User:

- Substantial pedestrian crossing volume(s) – *13 intersections*
- Inadequate cyclist facilities – *9 intersections*

Others:

- Inadequate street lighting – *10 intersections*

City-wide Countermeasures

According to the results of the common safety issues/trends in Phase 2, the top 10 identified common safety issues/trends were further analyzed to develop potential City-wide countermeasures. These City-wide countermeasures were categorized into phased approaches as follows:

- Short-term (less than 2 years)
- Medium-term (2 to 5 years)
- Long-term (over 5 years)

The City-wide countermeasures for each identified common safety issue/trend were summarized in a table, along with a brief description, sample photos, affected collision types, and number of selected locations with the identified issue.

Intersection Safety Countermeasures

The collision data analysis results and field review observations were summarized into a two-pages Intersection Safety Review Report with the following information included in each sheet:

- Intersection Information
- Collision Statistics (2015-2019)
- Field Review Observations (June 2022)
- Site Observation Photos
- Potential Improvements

1.0 Introduction

The City of New Westminster (the City) has been improving road safety within its road network (**Figure 1.1**) based on identified improvements at high collision locations from previous road safety studies, such as the City's *2007 Comprehensive Road Safety Plan* and the *2016 Intersection Safety Review* (2016 Study), as prepared by ISL Engineering and Land Services (ISL). However, with significant changes in land use, such as major developments/redevelopments in City Centre, Uptown, and the Royal Columbian Hospital, revision to road/intersection conditions within/beyond the boundary of New Westminster (Front Street Mews, Braid Street Greenway, Ewen Avenue Streetscape, and roadways for the current Pattullo Bridge Replacement project), and completed improvements to local intersections in recent years, road user activities and collision trends at New Westminster intersections have changed since the previous studies.

Therefore, the City would like to update the Road Safety Plan, including a review of traffic and collision data, screening for priority locations, assessment of selected site conditions, development of recommended countermeasures and cost estimates, and ranking for implementation in the City's next five-year Capital Program. Ultimately, it is to assist the City in prioritizing locations for various mitigating measures (short-, medium-, and long-term basis) for investment to improve the road safety for all road users.

To continue the ongoing commitment to road safety, the City has retained ISL in association with G. Ho Engineering Consultants Inc. (GHEC) to conduct the *2022 Intersection Network Screening Road Safety Review* (the Study), which consists of three phases:

- Phase 1: Initial Network Screening Analysis
- Phase 2: Safety Strategy (at top locations for following 5 years)
- Phase 3: Road Safety Implementation Plan

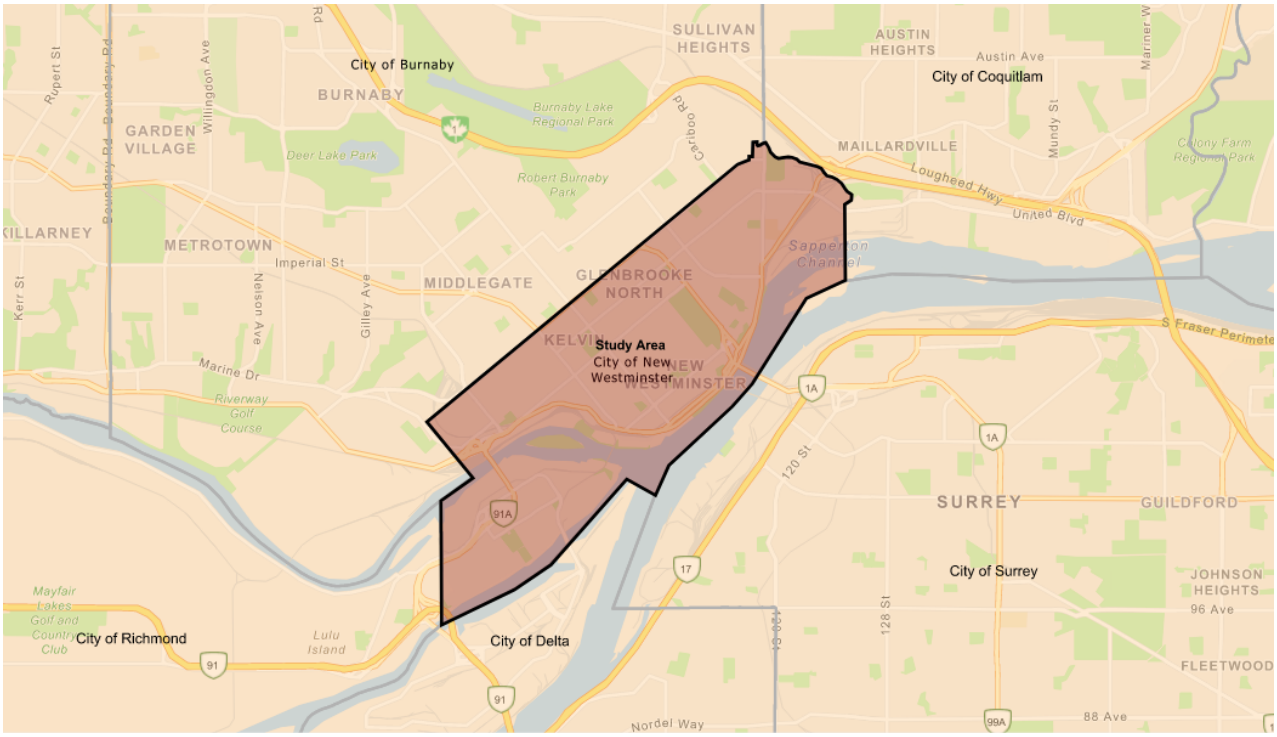


Figure 1.1: Study Area - City of New Westminster

2.0 Study Tasks

The following tasks were proposed and completed (except Task 11 and 12 at this stage):

Phase 1: Initial Network Screening Analysis

1. Organize Project Start-up Meeting – *confirmed the scope of work and study jurisdiction with the City as well as the City's expectation of study outcomes and timeline on November 2, 2021.*
2. Compile / Review Collision and Traffic Data – *collected and reviewed ICBC (2015-2019) claims data, and traffic volumes data, if available.*
3. Establish and Confirm Decision Tree and Selection Criteria – *developed the network screening decision tree and selection criteria, which were discussed and confirmed with the City during the progress meeting.*
4. Conduct Initial Screening and Identify Lists of High-risk Locations – *determined safety performance indicators for all intersections and identified the preliminary list of high-risk intersections.*
5. Organize Progress Meeting – *summarized study findings from Tasks 2 to 4 and presented the confirmed preliminary list of high-risk locations during the progress meeting on April 7, 2022.*

Phase 2: Safety Strategy (at top locations for following 5 years)

6. Undertake Secondary Network Screening (including Field Reviews) – *prioritized and identified the high-risk intersections based on additional criteria such as collision rate, collision severity index (CSI), vulnerable road users (VRU) collision confirmed the list of selected 25 intersections with the City on June 24, 2022, and then conducted detailed collision analysis and field reviews by ISL Road Safety Engineers in July 2022 for selected 25 intersections.*
7. Submit Risk Identification Summary Package – *prepared and submitted an Intersection Safety Review Summary Package to compile and illustrate all study findings during secondary network screening and field reviews, including the list of detailed corridor-wide collisions and intersection safety review summary sheet examples for two intersections (signalized and unsignalized).*
8. Organize Study Review Meeting #1 – *summarized study findings from Tasks 6 to 7 with the City and organized a review meeting on 24 June 2022.*
9. Conduct Correctability Analyses and Recommend Mitigation Measures – *identified the top potential city-wide and site-specific issues and provided mitigation measures focusing on key areas under the consideration of engineering, enforcement, education/encouragement, and legislation/regulation.*

Phase 3: Road Safety Implementation Plan

10. Prepare Draft Road Safety Implementation Plan Report – *categorized, prioritized, and strategized short-term (less than 2 years), medium-term (2 to 5 years), and long-term (over 5 years) measures for the implementation plan. A comprehensive Draft Implementation Plan Report (this report) summarizing all study processes, findings, and recommendations, was submitted on 30 October 2022 to the City.*
11. Organize Study Review Meeting #2 – *discussed the feedback on study findings with the City on 31 May 2023 before finalizing the Network Screening Road Safety Implementation report.*
12. Prepare Final Network Screening Road Safety Implementation Plan Report – *submitted the Final Network Screening Road Safety Implementation Report with the Execute Summary on 21 August 21, 2023 to incorporate all City's comments.*

3.0 Network Screening Methodology

3.1 Initial Network Screening

Based on the safety review practice from the *TAC Canadian Guide to In-service Road Safety Review Guide (TAC Road Safety Guide)*, previous similar network screening studies in the province, and the available collision and traffic data, a network screening methodology (decision tree) was developed for this Study that is illustrated step-by-step in **Figure 3.1**. The decision tree was then confirmed during the progress meeting with the City.

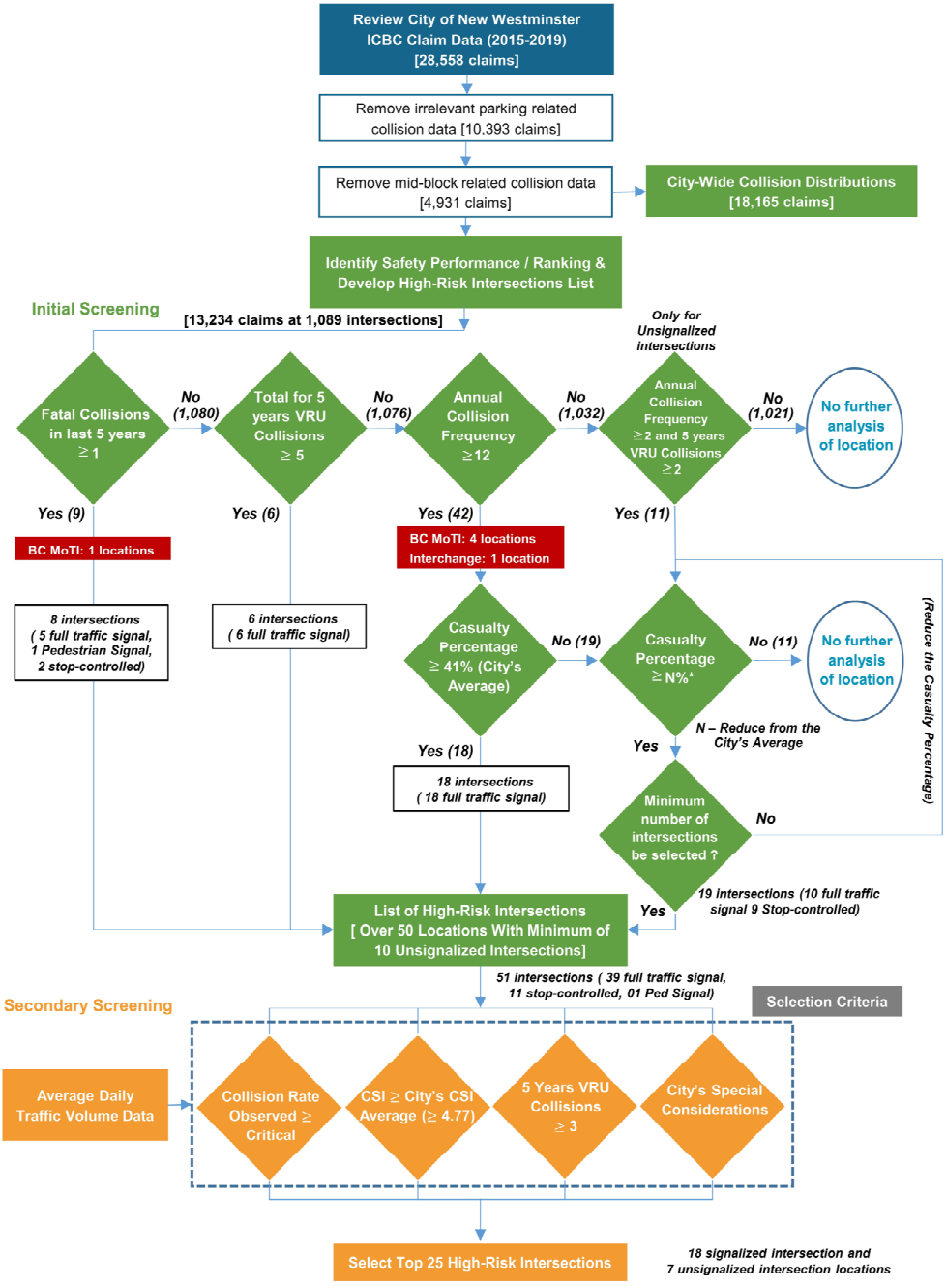


Figure 3.1: Network Screening Decision Tree

Accordingly, in the initial network screening, four Safety Performance Indicators (SPIs) were determined for all locations with at least one reported claim using the ICBC's claims data from January 1, 2015 to December 31, 2019:

- **Total Number of Fatal Collisions:** As recorded in ICBC collision data
- **Total Number of Vulnerable Road User (VRU)-involved Collisions:** Total number of pedestrian- or cyclist-involved collisions
- **Annual Collision Frequency (ACF)**: $\text{ACF} = \frac{\text{Total Number of Collisions from 2015 to 2019}}{5}$
- **Casualty Percentage (CAS%):** $\text{CAS\%} = \frac{\text{Total Number of Casualty Collisions from 2015 to 2019}}{\text{Total Number of Collisions from 2015 to 2019}}$

Based on the review of calculated SPIs and the consideration of a certain number of locations (over 50), the preliminary list of high-risk intersections for secondary screening was determined using the following criteria:

- ACF ≥ 12 (i.e., one collision per month)
- CAS% ≥ the City's average for intersection collisions (41%)
- Intersections with at least one reported a fatal collision
- Total number of VRU-involved collisions ≥ 5 (one per year)

However, due to the lower number of collisions for unsignalized intersections, it is agreed that the criteria are revised (see below) to allow a certain number of unsignalized intersections in the list:

- ACF ≥ 2 and VRU-involved collisions ≥ 2
- CAS% ≥ (38%)

Study intersections that meet at least one of the above criteria were considered in the preliminary list. It was determined that the study intersections under MOTI's judication and/or with recently completed or planned improvements were excluded from the preliminary list.

3.2 Secondary Network Screening

The observed and critical collision rates, which indicate if the intersection is prone to collisions, were calculated for the preliminary high-risk intersections using the mid-year (2017) average daily traffic (ADT) data provided by the City. For the secondary screening, four selection criteria were suggested and confirmed with the City as follows:

- Observed Collision Rate (CR) over Critical Collision Rate ($CR_{critical}$)

  $$\mathbf{CR} = \frac{\text{Total Number of Collisions from 2015 to 2019}}{\text{ADT} \times R_{MEV}} \qquad \mathbf{CR_{critical}} = CR_{avg} + k\sqrt{CR_{avg}/m + \frac{1}{2m}}$$

  $$R_{MEV} = \frac{1{,}826\ (\text{Total Number of Days from 2015 to 2019})}{1{,}000{,}000}, \quad CR_{avg} = \frac{\text{Total Number of Collisions from 2015 to 2019}}{\text{Five-year Million Entering Vehicles for Top 75 Locations}}$$

  k (statistical constant) = 1.64 (for 90% confidence level), $m = \text{ADT} \times R_{MEV}$

- Collision Severity Index (CSI) ≥ the City's average CSI for intersection collisions (4.77)

  $$\mathbf{CSI} = \frac{100 \text{ x Fatal Collisions} + 10 \text{ x Injury Collisions} + \text{Property Damage Only Collisions}}{\text{5-Year Total Number of Collisions (2015-2019)}}$$

- Total number of VRU-involved collisions ≥ 3
- At least one reported a fatal collision

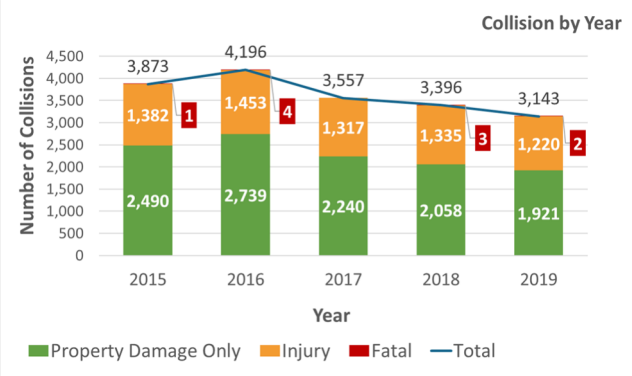
Considering the agreed selection criteria (see **Figure 3.1**), locations with more criteria achieved were selected for further collision analysis and field reviews.

4.0 Initial Network Screening Analysis

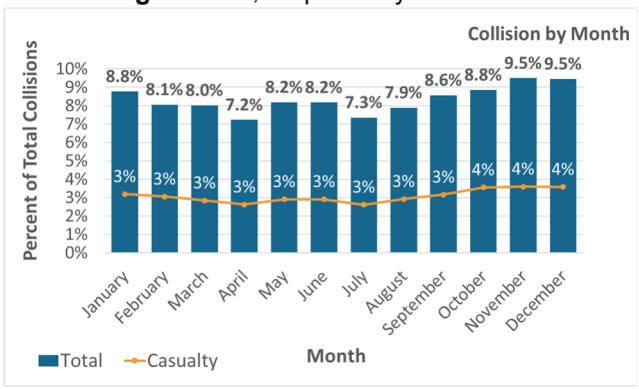
4.1 Collision Data and Temporal Distributions

As a standard practice for road safety review studies, the five-year ICBC claims data, between January 1, 2015 and December 31, 2019 provided by the City was reviewed. It was confirmed with the City that the 2020 claims data be excluded for this Study due to various reasons such as reduced traffic volumes/number of collisions caused by the Covid-19 pandemic and the potential delay in finalizing the claims data. The dataset included a total of **28,558** ICBC reported claims. After filtering out the irrelevant claims such as parking-related incidents (10,393 claims), a total of **18,165** claims including intersection collisions (13,234 claims) and mid-block collisions (4,931 claims), were considered for city-wide collision review. Based on the descriptions from claim data, it was also found that 37% of the incidents were reported as casualty (fatal or injury) collisions.

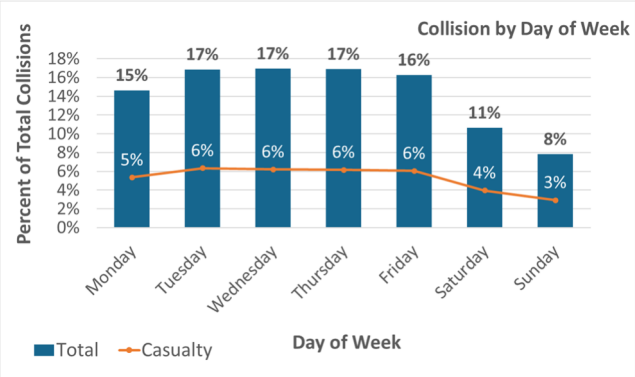
The ICBC claims were then reviewed to identify the year, month, day of week, and starting hour of each reported incident. The temporal collision distributions of all collisions and collisions related to vulnerable road users (VRU), such as pedestrians and cyclists, are summarized in **Figures 4.1** and **Figures 4.2**, respectively.



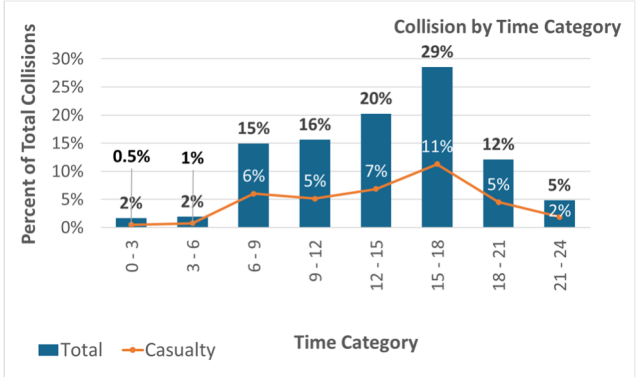
Yearly: 2016 had the highest number of total and injury collisions. The total number of collisions decreased from 2016 to 2019, while the casualty percentages were increased from 2016 to 2019



Monthly: December and November had the highest percentages of collisions (9.5%). 27% of total collisions occurred in fall (September to November) – could be related to poor weather and wet road surface conditions.

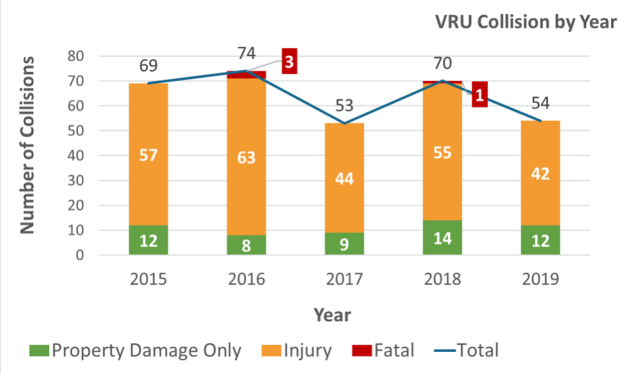


Daily: Tuesdays to Thursdays had the highest number of collisions (17%). In general, the number of collisions that occurred on weekdays (16%) is higher than on weekends (9%), which could be due to higher commuter traffic volumes within the City.

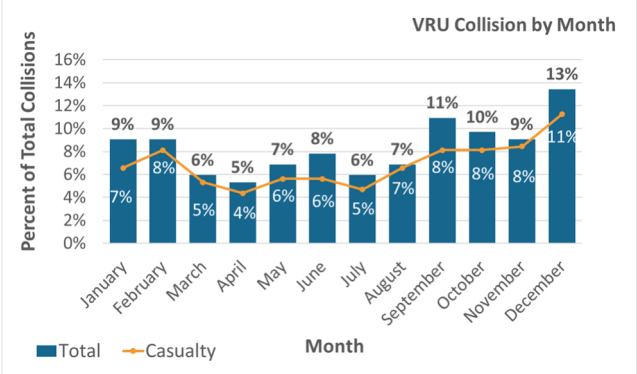


Hourly: Using the 3-hour time category as provided in the ICBC dataset, 29% of the total collisions occurred between 1500 and 1800 hours, which tends to be associated with high PM peak traffic volumes and shopping activities/after school time .

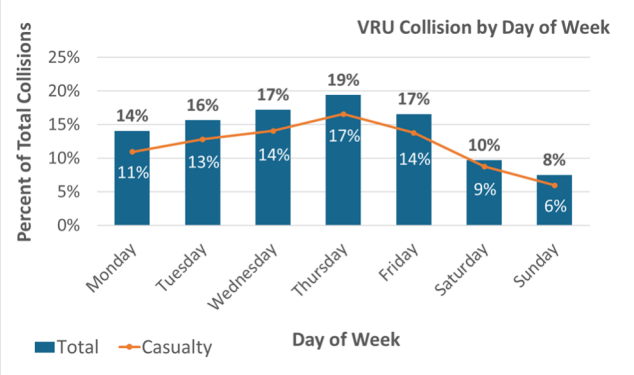
Figures 4.1: Temporal Distributions of City-wide Collisions – ICBC 2015-2019 Claims Data



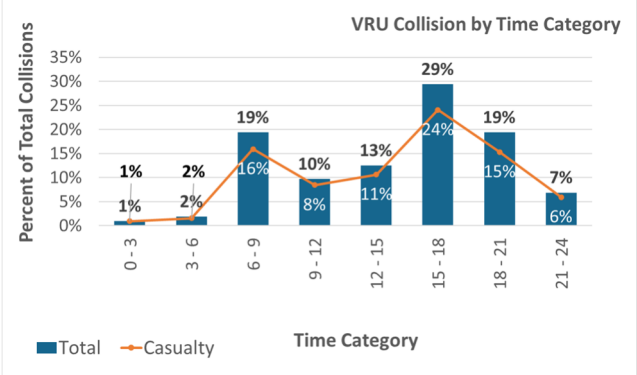
Yearly: Out of 320 total VRU collisions, 74 collisions occurred in 2016 (the highest). The total number of collisions and casualty percentages fluctuated through the five-year study period.



Monthly: December had the highest number of VRU collisions (13%). 32% of VRU collisions occurred in fall (December to February) – could be related to poor weather, road surface conditions and reduced daytime light.



Daily: Thursdays had the highest number of VRU collisions (19%). In general, the number of VRU collisions that occurred on weekdays (17%) is higher than on weekends (9%), which could be due to more conflicts for VRU's with higher commuter traffic volumes in the City.



Hourly: Using the 3-hour time category as provided in the ICBC dataset, 29% of the VRU collisions occurred between 1500 and 1800 hours, which tends to be associated with more conflicts for VRU's with high PM peak traffic volumes and shopping activities/after school time.

Figures 4.2: Temporal Distributions of City-wide VRU Collisions – ICBC 2015-2019 Claims Data

4.2 Fatal Collisions

Based on the ICBC collision data, 10 fatal collisions occurred between 2015 and 2019. The locations of these fatal collisions are indicated in **Figure 4.3** and the details from the claim data can be found below.

Spatial Patterns:

- All the ten fatal collisions occurred at intersections and all of them reported in different locations except two incidents found at Stewardson Way & Twelfth Street.
- Five collisions were reported as vehicle-vehicle collisions while four collisions occurred between two conflicting movements, such as left-turn opposing and right angle. The remaining one collision was reported as rear end.
- Four pedestrian-involved collisions– three of which are pedestrian jaywalking cases, while the other one is a pedestrian slipped from the skateboard and fell in front of the vehicle.
- One cyclist-involved collision – a cyclist fell suddenly into the path of a heavy truck.
- One collision occurred in dark conditions with no or minimal illumination.
- Three collisions occurred when the road surface was wet, while one of them happened in rainy weather.

Temporal Patterns:

- 2016 had the highest number of fatal collisions (four)
- Two collisions were reported for the month of November and June
- Friday had the highest number of fatal collisions (four)
- AM peak (6 AM to 9 AM) and PM peak (3 PM to 6 PM) reported three collisions each

For fatal collisions reported at the 25 selected locations, more detailed descriptions for each collision extracted from ICBC claims are provided in **Section 5.2** of this report.

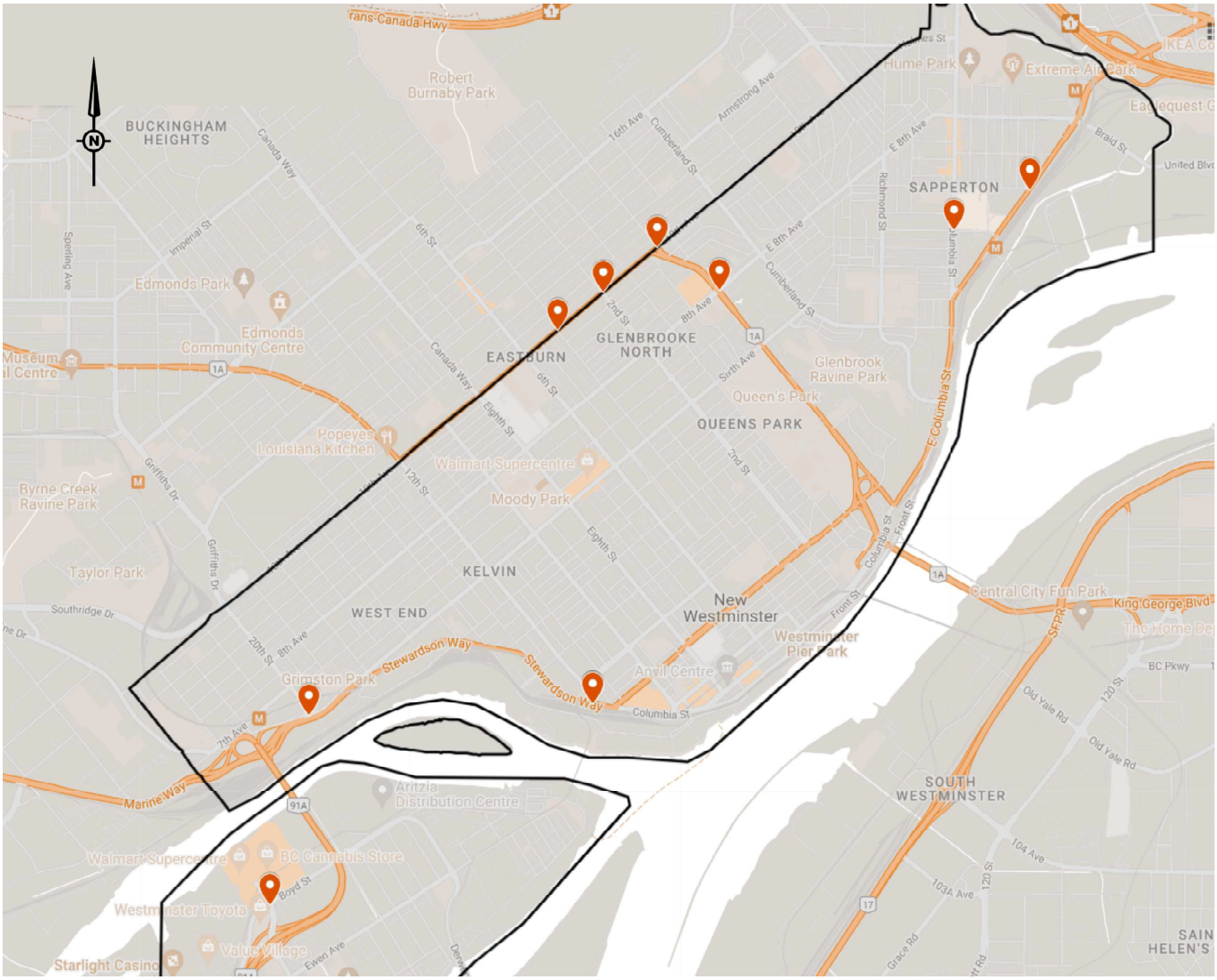


Figure 4.3: Locations of Fatal Collisions (ICBC Collision Data 2015-2019)

4.3 Heat Maps

A heat map is a graphical representation to visualize the density of geographic data within a specified area, such as a city, a country, or even the world. It is used to determine the high concentration of collision occurrences within the city, based on the intensity of the colour corresponding to the magnitude of the values that it represents. So that it can help people to focus on certain area(s) in order to handle the identified issues For City's intersections reported no less than ten collisions in a 5-year study period, and the following four heat maps were developed based on ICBC 2015-2019 claims data and included in **Appendix A**.

- 5-year vehicle collisions (also shown in **Figure 4.4**)
- 5-year casualty collisions
- 5-year pedestrian-involved collisions
- 5-year cyclists-involved collisions

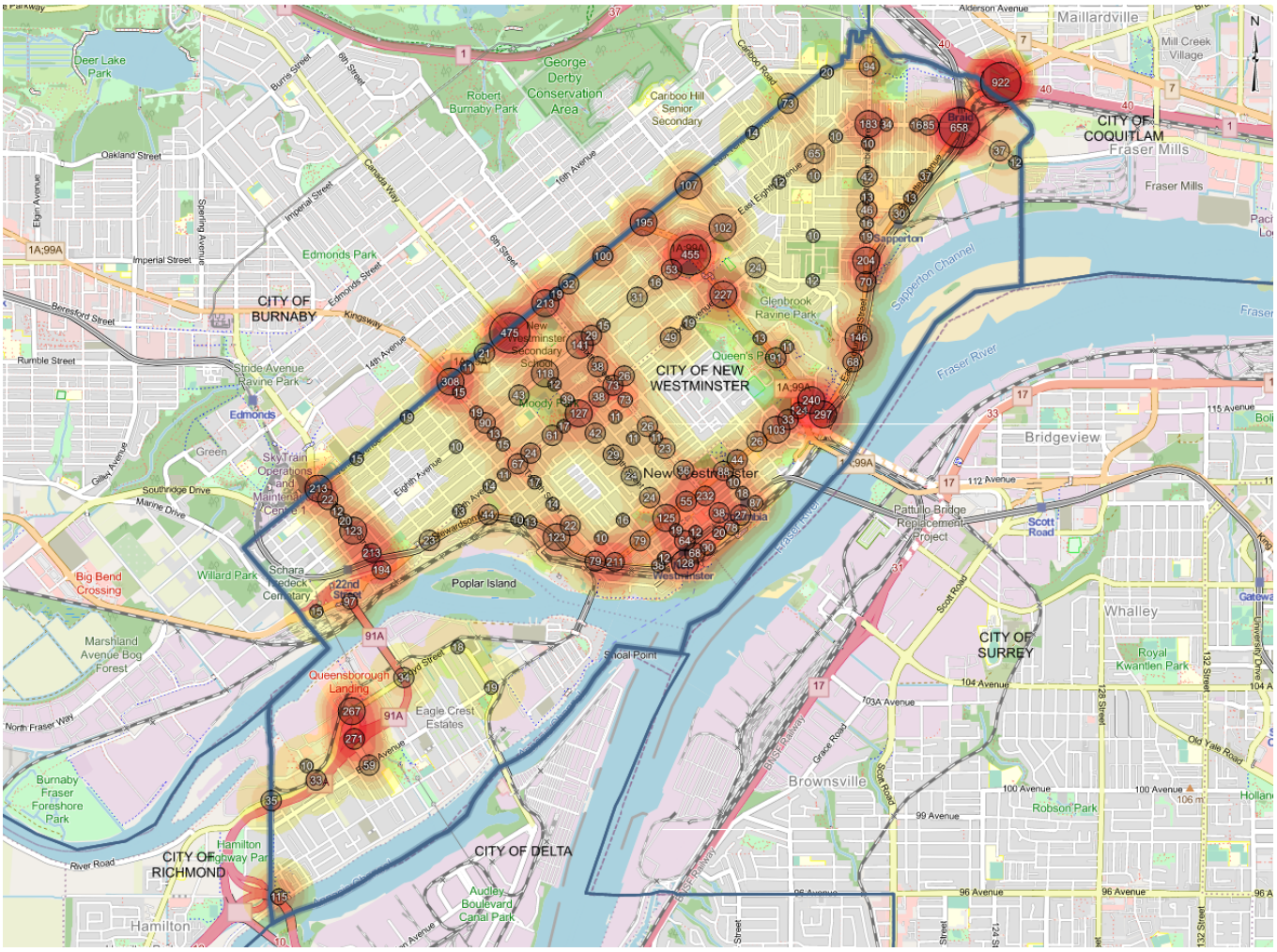


Figure 4.4: 5-year (2015-2019) Vehicle Collisions Heat Map in the City of New Westminster

4.4 Mid-block Collisions Corridor

The mid-block collisions along various major corridors within in City of New Westminster were also reviewed, and the corridors with the high number of collisions (over 60 collisions for 5 years or at least one per month on average) were summarized below:

Table 4.1: Corridor-wide Mid-block Collisions (ICBC 2015-2019)

S. No.	Corridor Name	Corridor Type	INJURIES	PDO	Total Collision
1	Pattullo Bridge	Bridge	262	517	779
2	Queensborough Bridge	Bridge	155	202	357
3	Columbia Street	Collector	51	201	252
4	Stewardson Way	Arterial	46	94	140
5	McBride Boulevard	Arterial	32	76	108
6	Royal Avenue	Arterial	17	67	84
7	E Columbia Street	Arterial	12	66	78
8	Sixth Street	Collector	7	61	68
9	Carnarvon Street	Collector	3	64	67
10	Brunette Avenue	Arterial	14	52	66
11	Eighth Avenue	Collector	13	52	65

Within the City's road network, the bridges appear to be the highest-risk corridors, recording 779 collisions on Pattullo Bridge, and 357 collisions on Queensborough Bridge from 2015 to 2019. It is noted that the mid-block collisions did not include the intersection collisions along the corridors and the number of reported collisions along Pattullo Bridge included both within the Cities of New Westminster and Surry. In addition, Columbia Street, Stewardson Way and McBride Boulevard are the corridors with over 100 collisions for the 5-year study period.

4.5 Initial Network Screening

After filtering out the mid-block incidents (4,931 claims), a total of **18,165** ICBC claims were identified to have occurred across **1,089** intersections within New Westminster (excluding locations under MOTI's jurisdiction). The average casualty percentage was found to be about 37%. The collision data for all 1,089 intersections were reviewed and summarized. The collision summary for all 1,089 intersections is in **Appendix B** which includes ID number, intersection name, ministry/municipality as boundary, 5 years collision numbers, 5-year total number of collisions, annual collision frequency, reported number of fatal collision, total number of casualty collisions, casualty percentage, 5-year VRU-involved (pedestrian and/or cyclist) collisions.

Based on the agreed **Network Screening Decision Tree**, 51 locations were short-listed as high collision risk:

- 8 locations (5 full traffic signals, 1 pedestrian signal, 2 stop-controlled) reported a fatal collision between 2015-2019 (excluded one fatal collision at an intersection operated by MOTI)
- 6 locations (6 full traffic signals) with more than or equal to 5 VRU collisions in total
- 18 locations (18 full traffic signals) have at least 12 collisions per year and a casualty percentage higher than the City's average
- 19 locations (10 full traffic signals and 9 stop-controlled) with annual collision frequencies over 2, more than 2 VRU collisions, and a casualty percentage more than 38%

The locations of selected 51 high collision risk intersections are illustrated in **Figure 4.5** and summarized in **Table 4.2**.

Table 4.2: List of Top 51 High Collision Risk Intersections and Traffic Control (Initial Network Screening)

ID	Intersection	Traffic Control
3	TENTH AVE & EIGHT ST	Full Traffic Signal
4	EIGHT AVE & MCBRIDE BLVD	Full Traffic Signal
5	TENTH AVE & TWELFTH ST	Full Traffic Signal
7	BOYD ST & HOWES ST	Full Traffic Signal
8	ROYAL AVE & MCBRIDE BLVD	Full Traffic Signal
10	SIXTH AVE & MCBRIDE BLVD	Full Traffic Signal
11	TENTH AVE & SIXTH ST	Full Traffic Signal
12	TENTH AVE & TWENTIETH ST	Full Traffic Signal
14	ROYAL AVE & SIXTH ST	Full Traffic Signal
15	TENTH AVE & MCBRIDE BLVD	Full Traffic Signal
17	SEVENTH AVE & TWENTIETH ST	Full Traffic Signal
18	BRAID ST & COLUMBIA ST	Full Traffic Signal
20	EIGHTH AVE & SIXTH ST	Full Traffic Signal
23	EIGHTH AVE & TWENTIETH ST	Full Traffic Signal
24	ROYAL AVE & EIGHTH ST	Full Traffic Signal
25	QUAYSIDE DR & STEWARDSON WAY & THIRD	Full Traffic Signal
26	SIXTH AVE & EIGHTH ST	Full Traffic Signal
27	EIGHTH AVE & EIGHTH ST	Full Traffic Signal
29	TENTH AVE & CUMBERLAND ST	Full Traffic Signal
30	ROYAL AVE & FIRST ST	Full Traffic Signal
31	TENTH AVE & SECOND ST	Pedestrian Signal
33	MCBRIDE BLVD & MEMORIAL DR	Full Traffic Signal
34	COLUMBIA ST & HOLMES ST	Full Traffic Signal
35	BRAID ST & ROUSSEAU ST	Full Traffic Signal
36	ROYAL AVE & FOURTH ST	Full Traffic Signal

ID	Intersection	Traffic Control
37	STEWARDSON WAY & TWELFTH ST	Full Traffic Signal
38	EIGHTH AVE & TWELFTH ST	Full Traffic Signal
39	ROYAL AVE & TENTH ST	Full Traffic Signal
40	SIXTH AVE & SIXTH ST	Full Traffic Signal
41	COLUMBIA ST & FRONT ST	Full Traffic Signal
42	COLUMBIA ST & EIGHTH ST	Full Traffic Signal
43	EIGHTH AVE & CUMBERLAND ST	Full Traffic Signal
46	TENTH AVE & SURREY ST	Full Traffic Signal
48	SIXTH AVE & TWELFTH ST	Full Traffic Signal
50	EWEN AVE & HOWES ST	Full Traffic Signal
52	EIGHTH AVE & RICHMOND ST	Full Traffic Signal
56	SIXTH AVE & TENTH ST	Full Traffic Signal
58	COLUMBIA ST & KEARY ST	Full Traffic Signal
62	COLUMBIA ST & SHERBROOKE ST	Full Traffic Signal
65	CARNARVON ST & SIXTH ST	Full Traffic Signal
70	QUEENS AVE & SIXTH ST	RRFB
77	TENTH AVE & FOURTH ST	Stop-controlled
93	THIRD AVE & SIXTH ST	Stop-controlled
95	BRUNETTE AVE & SHERBROOKE ST	Stop-controlled
102	SIXTH AVE & CUMBERLAND ST	Stop-controlled
115	SIXTH AVE & NINTH ST	RRFB
120	LONDON ST & TWELFTH ST	RRFB
121	TENTH AVE & EIGHTEENTH ST	Stop-controlled
131	QUEENS AVE & TENTH ST	Stop-controlled
132	FOURTH AVE & TWELFTH ST	Stop-controlled
159	QUEENS AVE & ELEVENTH ST	Stop-controlled

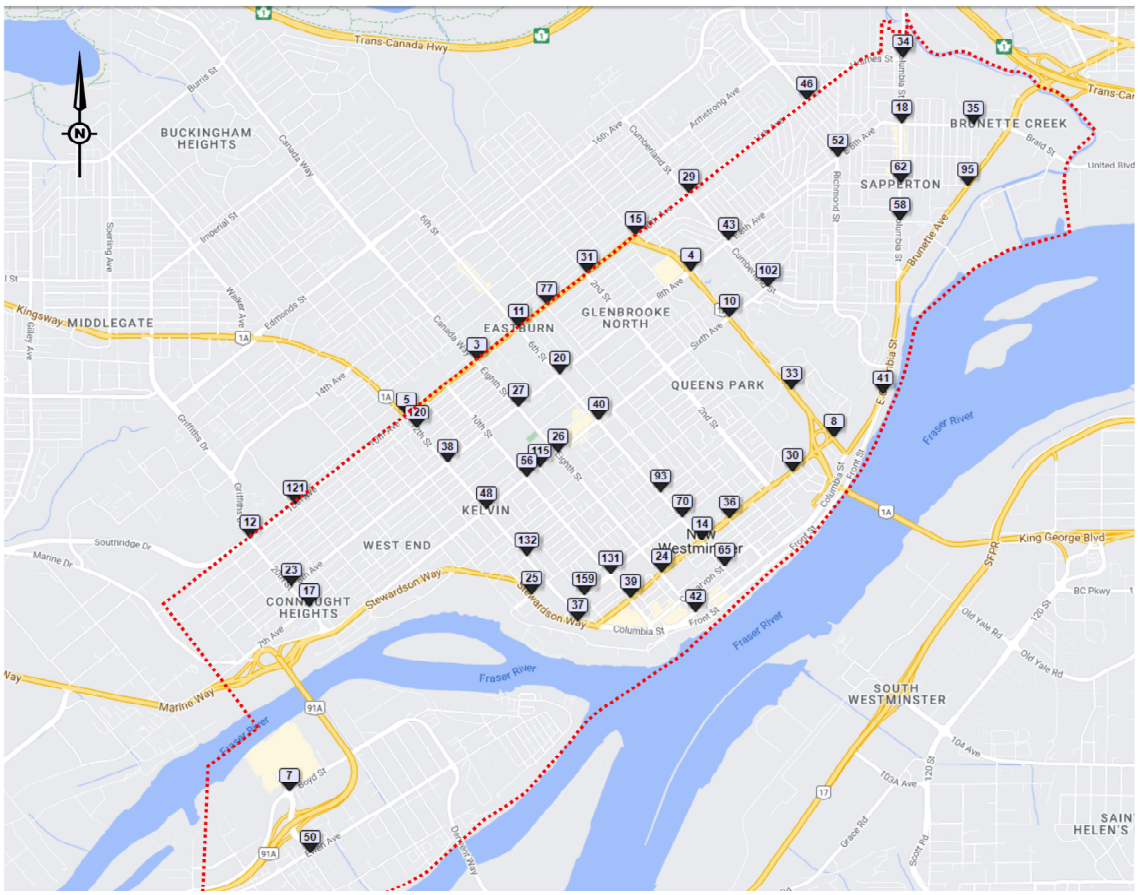


Figure 4.5: Top 51 High Collision Risk Intersections and Total Number of Collisions (2015-2019)

4.6 Comparison with 2016 Study

Based on the initial network screening process, 51 high collision intersections were selected. Compared to the 50 high collision risk locations found in the 2016 Study, similarities and differences are summarized in **Table 4.3** and **Figure 4.6**, and it was summarized as:

- 28 of them are new locations that were not included in the 2016 Study
- 23 of them are common high collision risk intersections for both studies
- 5 intersections in 2016 Study are not considered in this study

Table 4.3: High Collision Risk Intersections Comparison between 2016 and 2022 Studies

ID	INTERSECTION	INTERSECTION TYPE	SELECTED YEARS	ID	INTERSECTION	INTERSECTION TYPE	SELECTED YEARS
3	TENTH AVE & CANADA WAY & EIGHT ST	Full Traffic Signal	Selected In both 2022 and 2016 Studies	39	ROYAL AVE & TENTH ST	Full Traffic Signal	Selected In 2022 Study
4	MCBRIDE BLVD and 8TH AVE / E 8TH AVE	Full Traffic Signal	Selected In both 2022 and 2016 Studies	46	SIXTH AVE & SIXTH ST	Full Traffic Signal	Selected In both 2022 and 2016 Studies
5	KINGSWAY & TENTH AVE	Full Traffic Signal	Selected In both 2022 and 2016 Studies	40	TENTH AVE & CARIBOO RD & E TENTH AVE & SURREY ST	Full Traffic Signal	Selected In both 2022 and 2016 Studies
7	BOYD ST & HOWES ST & TURNING LANE	Full Traffic Signal	Selected In both 2022 and 2016 Studies	41	E COLUMBIA ST & FRONT ST	Full Traffic Signal	Selected In 2022 Study
8	E ROYAL AVE & MCBRIDE BLVD & ROYAL AVE	Full Traffic Signal	Selected In 2022 Study	42	COLUMBIA ST & EIGHTH ST	Full Traffic Signal	Selected In 2022 Study
10	E SIXTH AVE & MCBRIDE BLVD & SIXTH AVE	Full Traffic Signal	Selected In both 2022 and 2016 Studies	48	SIXTH AVE & TWELFTH ST	Full Traffic Signal	Selected In both 2022 and 2016 Studies
11	TENTH AVE & SIXTH ST	Full Traffic Signal	Selected In both 2022 and 2016 Studies	52	E EIGHTH AVE & RICHMOND ST	Full Traffic Signal	Selected In 2022 Study
12	TENTH AVE & GRIFFITHS DR & SOUTHRIDGE DR & TWENTIETH ST	Full Traffic Signal	Selected In 2022 Study	56	SIXTH AVE & TENTH ST	Full Traffic Signal	Selected In 2022 Study
14	SIXTH ST & ROYAL AVE	Full Traffic Signal	Selected In both 2022 and 2016 Studies	50	EWEN AVE & HOWES ST	Full Traffic Signal	Selected In 2022 Study
15	MCBRIDE BLVD & TENTH AVE	Full Traffic Signal	Selected In both 2022 and 2016 Studies	58	E COLUMBIA ST & KEARY ST	Full Traffic Signal	Selected In 2022 Study
18	BRAID ST & EAST COLUMBIA ST	Full Traffic Signal	Selected In both 2022 and 2016 Studies	62	E COLUMBIA ST & SHERBROOKE ST	Full Traffic Signal	Selected In 2022 Study
17	TWENTIETH ST & SEVENTH AVE	Pedestrian Signal	Selected In both 2022 and 2016 Studies	65	CARNARVON ST & SIXTH ST	Full Traffic Signal	Selected In 2022 Study
20	EIGHTH AVE & SIXTH ST	Full Traffic Signal	Selected In 2022 Study	70	QUEENS AVE & SIXTH ST	Stop-controlled	Selected In 2022 Study
26	SIXTH AVE & EIGHTH ST	Full Traffic Signal	Selected In 2022 Study	77	TENTH AVE & FOURTH ST	Stop-controlled	Selected In 2022 Study
24	EIGHTH ST & ROYAL AVE	Full Traffic Signal	Selected In 2022 Study	102	CUMBERLAND ST & E SIXTH AVE	Stop-controlled	Selected In 2022 Study
23	EIGHTH AVE & TWENTIETH ST	Full Traffic Signal	Selected In both 2022 and 2016 Studies	93	SIXTH ST & THIRD AVE	Stop-controlled	Selected In 2022 Study
25	QUAYSIDE DR & STEWARDSON WAY & THIRD AVE	Full Traffic Signal	Selected In both 2022 and 2016 Studies	95	BRUNETTE AVE & SHERBROOKE ST	Stop-controlled	Selected In 2022 Study
27	EIGHTH AVE & EIGHTH ST	Full Traffic Signal	Selected In 2022 Study	115	NINTH ST & SIXTH AVE	Stop-controlled	Selected In 2022 Study
29	TENTH AVE & CUMBERLAND ST	Full Traffic Signal	Selected In both 2022 and 2016 Studies	131	QUEENS AVE & TENTH ST	Stop-controlled	Selected In 2022 Study
30	ROYAL AVE & FIRST ST	Full Traffic Signal	Selected In both 2022 and 2016 Studies	120	LONDON ST & TWELFTH ST	Stop-controlled	Selected In 2022 Study
43	CUMBERLAND ST & E EIGHTH AVE	Full Traffic Signal	Selected In both 2022 and 2016 Studies	121	TENTH AVE & EIGHTEENTH ST	Stop-controlled	Selected In 2022 Study
31	TENTH AVE & SECOND ST	Pedestrian Signal	Selected In both 2022 and 2016 Studies	132	FOURTH AVE & TWELFTH ST	Stop-controlled	Selected In 2022 Study
34	EAST COLUMBIA ST & HOLMES ST	Pedestrian Signal	Selected In both 2022 and 2016 Studies	159	ELEVENTH ST & QUEENS AVE	Stop-controlled	Selected In 2022 Study
33	MCBRIDE BLVD & MEMORIAL DR	Pedestrian Signal	Selected In 2022 Study	51	COLUMBIA ST & FOURTH ST	Full Traffic Signal	Selected In 2016 Study
38	EIGHTH AVE & TWELFTH ST	Full Traffic Signal	Selected In both 2022 and 2016 Studies	53	BEGBIE ST & COLUMBIA ST	Full Traffic Signal	Selected In 2016 Study
36	FOURTH ST & ROYAL AVE	Full Traffic Signal	Selected In 2022 Study	44	EAST COLUMBIA ST & CUMBERLAND ST	Stop-controlled	Selected In 2016 Study
35	BRAID ST & ROUSSEAU ST	Full Traffic Signal	Selected In both 2022 and 2016 Studies	72	EIGHTH ST & FIFTH AVE	Stop-controlled	Selected In 2016 Study
37	STEWARDSON WAY & TWELFTH ST	Full Traffic Signal	Selected In both 2022 and 2016 Studies	214	DUBLIN ST & EIGHTH ST	Pedestrian Signal	Selected In 2016 Study

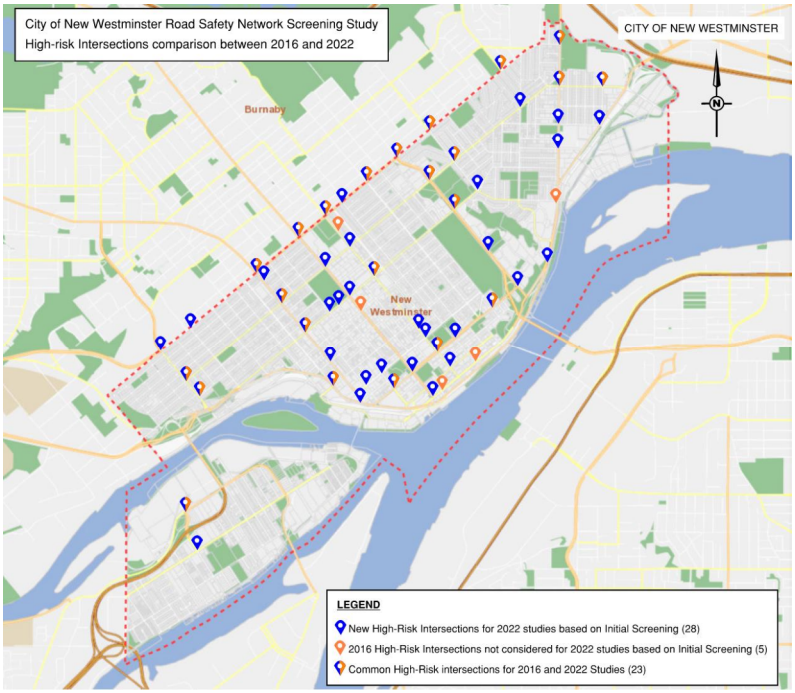


Figure 4.6: High-risk Intersections Comparison between 2016 and 2022 Studies

5.0 Secondary Network Screening

5.1 Identification of Top 25 High-risk Intersections

The total number of intersections selected from initial screening is 51 locations, and then they were further reviewed in secondary screening. Intersections that were identified difficult to provide improvements, were filtered out based on past experience, land availability and site visit.

- 5 intersections, with a total score of three points or above, were selected as top 25. 1 of which is difficult to improve, thus, was not selected for further analysis
- 14 intersections, with a total score of two points or above, were selected as top 25. 4 of which with lower collision rates, recently improved and difficult to improve were not selected for further analysis
- 23 intersections had a total score of one point. 12 of which with lower VRU collision, collision rates and casualty percentages were not selected for further analysis.
- 9 intersections were not selected, as they did not meet any criteria.

The 25 selected high collision risk intersections are illustrated in **Figure 5.1**, and the summary of the selection criteria assessment is provided in **Table 5.1.**

5.2 Fatal Collisions

Although the number of fatal collisions has already been considered in the collision severity index calculations, the occurrence of fatal collisions could have significant impacts on the community. The descriptions of eight fatal collisions reported at the top 25 high collision risk intersections are as follows:

- McBride Boulevard and Eighth Avenue (Site #1) – a pedestrian was hit by a westbound vehicle when jaywalking on McBride Boulevard, around 2:30 PM in November 2016.
- Boyd Street and Howes Street (Site #3) – a skateboarding pedestrian fell onto roadway and was hit by an eastbound truck around 1:00 PM in April 2018.
- Tenth Avenue and Second Street (Site #9) – a right angle collision between eastbound and southbound vehicles around 4:00 AM in December 2019.
- Stewardson Way and Twelfth Street (Site #11) – a left-turn opposing collision between an eastbound left-turn motorcyclist and a westbound vehicle around 8:45 AM in May 2015.
- Stewardson Way and Twelfth Street (Site #11) – a rear-end collision with 3 eastbound vehicles involved around 15:30 PM in June 2018.
- Columbia Street and Keary Street (Site #17) – a crossing pedestrian was hit by a southbound semi-truck around 6:15 AM in January 2016.
- Tenth Avenue and Fourth Street (Site #21) – a left-turn opposing collision between an eastbound vehicle and a westbound left-turn vehicle around 8:15AM in June 2018.
- Brunette Avenue and Sherbrooke Street (Site #23) – a cyclist fell from the bike and was hit by a northbound truck around 8:15 AM in June 2018.

Table 5.1: Selection Criteria Assessment for Top 25 High Collision Risk Intersections

Location Information			5-Year Total Number of Collisions	5-Year VRU Collisions	Secondary Screening Decision Criteria				Selection Rationale
Site No	Intersection	Traffic Control			Observed Collision Rate > Critical Collision Rate	5-Year VRU Collisions ≥ 3	Intersection CSI ≥ City-Wide CSI (≥4.77)	Total Points	
1	EIGHT AVE & MCBRIDE BLVD	Full Traffic Signal	455	7	✓	✓	×	2	Selected (Reported High VRU Collision)
2	TENTH AVE & TWELFTH ST	Full Traffic Signal	308	4	✓	✓	✓	3	Selected (High Total Score for Signalized Intersection)
3	BOYD ST & HOWES ST	Full Traffic Signal	267	9	✓	✓	✓	3	Selected (High Total Score for Signalized Intersection)
4	TENTH AVE & SIXTH ST	Full Traffic Signal	213	4	✓	✓	✓	3	Selected (High Total Score for Signalized Intersection)
5	ROYAL AVE & SIXTH ST	Full Traffic Signal	200	2	✓	×	×	1	Selected (Observed Collision Rate is more than the Critical Collision Rate)
6	SEVENTH AVE & TWENTIETH ST	Full Traffic Signal	174	5	✓	✓	×	2	Selected (Reported High VRU Collision)
7	EIGHTH AVE & SIXTH ST	Full Traffic Signal	141	3	×	✓	✓	2	Selected (Reported High VRU Collision)
8	EIGHTH AVE & TWENTIETH ST	Full Traffic Signal	123	4	✓	✓	✓	3	Selected (High Total Score for Signalized Intersection)
9	TENTH AVE & SECOND ST	Pedestrian Signal	100	0	✓	×	✓	2	Selected (High Total Score for Unsignalized Intersection)
10	BRAID ST & ROUSSEAU ST	Full Traffic Signal	85	2	×	×	✓	1	Selected (Intersection CSI is more than Citywide CSI)
11	STEWARDSON WAY & TWELFTH ST	Full Traffic Signal	79	2	×	×	✓	1	Selected (Reported Fatal Collision)
12	EIGHTH AVE & TWELFTH ST	Full Traffic Signal	90	2	×	×	✓	1	Selected (Intersection CSI is more than Citywide CSI)
13	ROYAL AVE & TENTH ST	Full Traffic Signal	79	4	×	✓	✓	2	Selected (Reported High VRU Collision)
14	SIXTH AVE & SIXTH ST	Full Traffic Signal	73	6	×	✓	×	1	Selected (Reported High VRU Collision)
15	SIXTH AVE & TWELFTH ST	Full Traffic Signal	67	4	×	✓	✓	2	Selected (Reported High VRU Collision)
16	EWEN AVE & HOWES ST	Full Traffic Signal	59	6	×	✓	×	1	Selected (Reported High VRU Collision)
17	COLUMBIA ST & KEARY ST	Full Traffic Signal	46	4	×	✓	✓	2	Selected (Reported High VRU Collision)
18	COLUMBIA ST & SHERBROOKE ST	Full Traffic Signal	42	5	×	✓	×	1	Selected (Reported High VRU Collision)
19	CARNARVON ST & SIXTH ST	Full Traffic Signal	38	5	×	✓	✓	2	Selected (Reported High VRU Collision)
20	QUEENS AVE & SIXTH ST	RRFB	36	2	✓	×	✓	2	Selected (High Total Score for Unsignalized Intersection)
21	TENTH AVE & FOURTH ST	Stop-controlled	32	0	×	×	✓	1	Selected (Reported Fatal Collision)
22	THIRD AVE & SIXTH ST	Stop-controlled	23	4	×	✓	✓	2	Selected (High Total Score for Unsignalized Intersection)
23	BRUNETTE AVE & SHERBROOKE ST	Stop-controlled	22	2	×	×	✓	1	Selected (Reported Fatal Collision)
24	SIXTH AVE & CUMBERLAND ST	Stop-controlled	24	3	×	×	✓	1	Selected (CSI > City's Average for Unsignalized Intersection)
25	LONDON ST & TWELFTH ST	RRFB	15	2	×	×	✓	1	Selected (CSI > City's Average for Unsignalized Intersection)

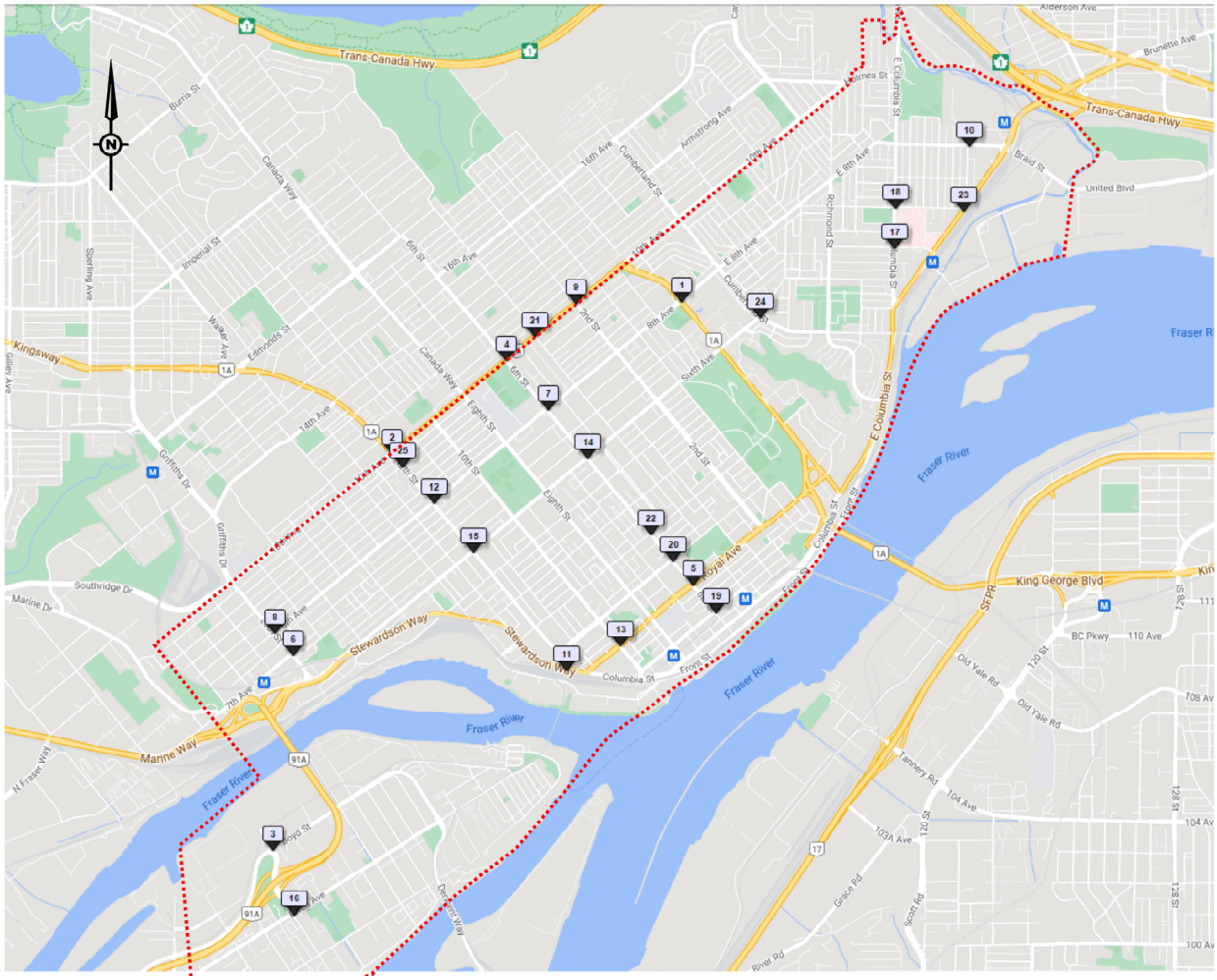


Figure 5.1: Top 25 High Collision Risk Intersections and Site Number

5.3 Field Review

Field reviews of the top 25 high-risk intersections were conducted in mid-June of 2022, where photographs, videos, and site observation notes were taken by three road safety engineers (**Borg Chan, P.Eng., PTOE, RSP, FITE; Sai Shoben Madurai Sekar, EIT and Kyle Li, EIT**). All 25 selected intersections were examined by a drive-through/walk-through for all intersection approaches, providing safety reviewers with motorists and other road users perspectives of potential traffic safety issues.

During the walk-through field reviews, potential safety issues were identified for all road users, using the *Transportation Association of Canada* (TAC) *Site Visit Sample Observation Report* from the *TAC Road Safety Review Guide*. The TAC Report has a list of questions, including both physical and operational checklists, to be completed during and after the field reviews to identify the existing and potential safety issues.



Field Review on June 14, 2022
(Boyd Street & Howes Street)



Field Review on June 16, 2022
(Columbia Street & Keary Street)

5.4 Common Safety Issues/Trends for Top 25 Intersections

The identified issues (operational, geometric, signal, vulnerable users, and others) for each of the 25 intersections, were summarized in a table which can be found in **Appendix C.** It was noted that the most common safety issues/trends from the 25 intersections include:

Operational:
- High through volume(s) and queue(s) – *16 intersections*
- On-street parking close to intersection – *12 intersections*
- Considerable lane changing/weaving – *11 intersections*
- Significant heavy vehicle volume(s) – *8 intersections*
- High left-turn volume(s) and queues(s) – *8 intersections*

Geometric:
- Steep gradient on approach(es) – *16 intersections*
- Wide lane(s) – *12 intersections*

Signal:
- Poor traffic signal head(s) visibility – *7 intersections*

Vulnerable Road User:
- Substantial pedestrian crossing volume(s) – *13 intersections*
- Inadequate cyclist facilities – *9 intersections*

Others:
- Inadequate street lighting – *10 intersections*

Meanwhile, the top intersections (shown in **Figure 5.2**) with the highest number of identified issues were:

- Tenth Avenue and Twelfth Street – 16
- Boyd Street and Howe Street – 14
- McBride Boulevard and Eighth Avenue – 12
- Tenth Avenue and Sixth Street – 12
- Tenth Avenue and Second Street – 12
- Eighth Avenue and Twentieth Street – 11
- Royal Avenue and Sixth Street – 10
- Braid Street and Rousseau Street – 10
- Eighth Avenue and Twelfth Street – 9
- Sixth Avenue and Twelfth Street – 9
- Columbia Street and Keary Street – 9

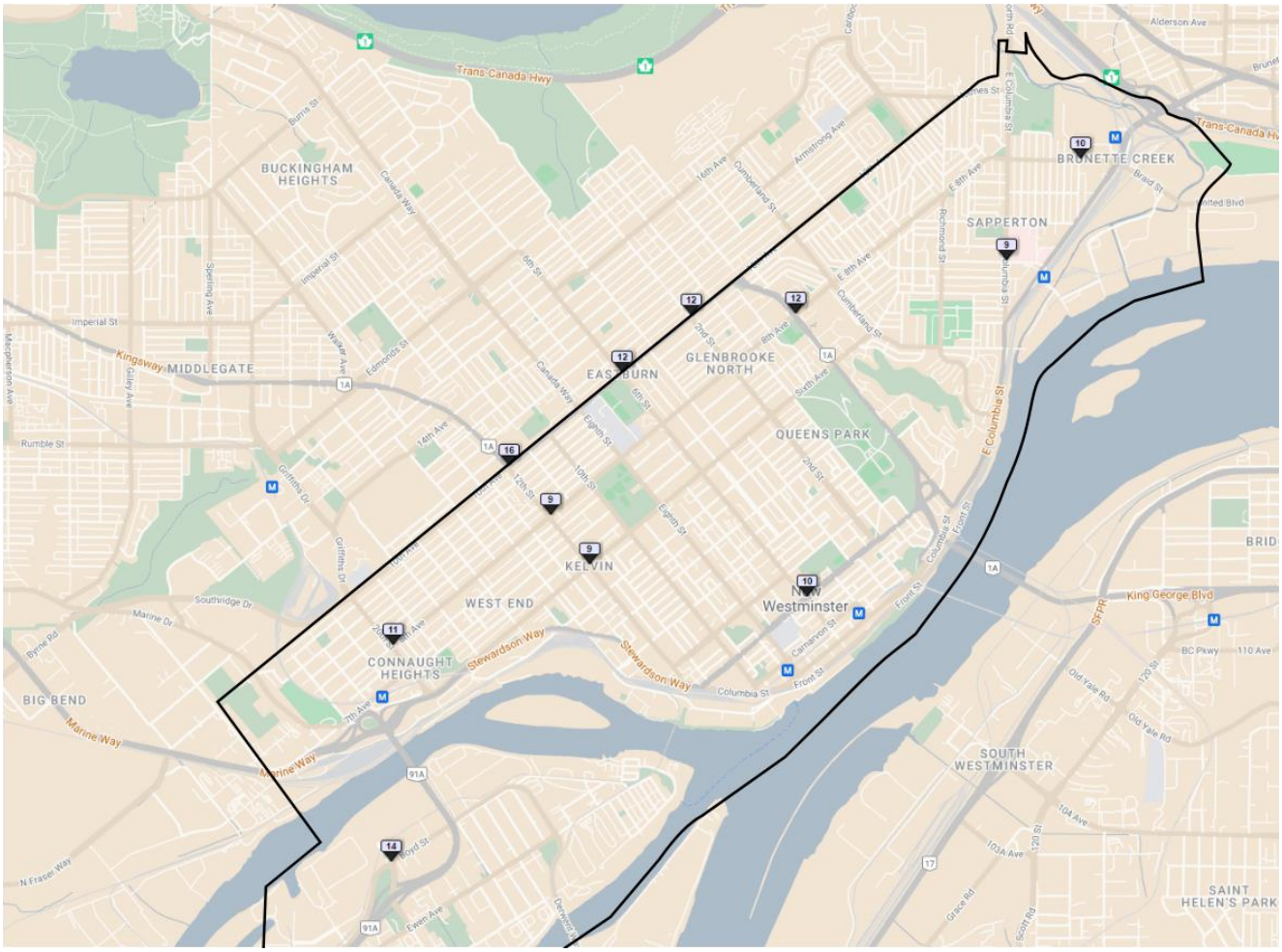


Figure 5.2: Locations with High Number of Identified Issues

6.0 Road Safety Implementation Plan

6.1 City-wide Countermeasures

Based on the results of the common safety issues/trends in Phase 2, the top 10 identified common safety issues/trends were further analyzed to develop potential City-wide countermeasures. These City-wide countermeasures were categorized into phased approaches as follows:

- Short-term (less than 2 years)
- Medium-term (2 to 5 years)
- Long-term (over 5 years)

The City-wide countermeasures for each identified common safety issue/trend were summarized in a table, along with a brief description, sample photos, affected collision types, and number of selected locations with the identified issue. The summary table of each City-wide countermeasure can be found in **Appendix D**.

6.2 Intersection Safety Countermeasures

The collision data analysis results and field review observations were summarized into a two-pages Intersection Safety Review Report that can be found in **Appendix E**. The following information is included in each sheet:

Intersection Information:

- Site Number – based on the annual collision frequency ranking
- Approach Leg – number of legs
- Traffic Control Type – e.g., signalized - P/P (protected/permissive) LT (left-turn) in all directions
- Road Class (N-S) & (E-W) – obtained from the City's GIS Map
- Surrounding Land Use – e.g., residential, commercial, institution, etc.
- Daily Traffic Volume (2017) – based on 2017 (mid-year) ADT volume provided by the City
- Existing Lane Configurations and Recent Improvements – Aerial photos with bicycle facilities, lane configurations and recent improvements

Collision Statistics (2015-2019):

- Collision Frequency (per year) and Total Number of Collisions (5-year)
- Collision Severity Index and Casualty Percentage
- Observed and Critical Collision Rates
- Collision with Pedestrians and Cyclists
- Collision Distribution by Year and Severity
- Highest Percentage of Total Collisions by Month, Average Weekday / Weekend, and Highest Percentage Time Period
- Top Three Collision Types with the Percentage of Total Collisions (based on 2017-2019 ICBC claims data)
- Overrepresentation of Casualty/ VRU collisions and collision type (based on 2017-2019 ICBC claims data); Chi-Square test was performed to identify the difference between each parameter (casualty %, VRU collisions, or collision type) at a single intersection and the average value obtained from all intersections.

Field Review Observations (June 2022):

- Operational – observed and expected traffic operations
- Geometric – such as intersection layout, lane configuration, and nearby driveways
- Signal (traffic control) – traffic signal characteristics, such as phasing, movement restrictions, and advance warning flasher

- Vulnerable Road User – activities, infrastructure, and conflicts with vehicles
- Other – such as missing road sign, presence of red-light/speed cameras, and on-street parking provision

Site Observation Photos:

- Site Photos – selected two field review photos indicating relevant site observation or identified issues

Potential Improvements:

- Collision Trends / Identified Issue – correctable high collision types such as rear-end collisions and sideswipe collisions. As well as issues identified from site observation such as lack of cycling facilities and inadequate street lighting
- Potential Countermeasure – improvements to address specific issue, which are categorized into short-, medium-, and long-term phases

6.3 Further Considerations

With the suggested city-wide and site-specific countermeasures, the City of New Westminster could be able to take actions to prioritize implementing the recommended safety improvements based on the City's Capital Program and available funding.

For future potential safety study after this project, although it is not in the study scope, ISL would welcome the opportunity to support the next stage of Road Safety Plan with the followings:

- Collision Saving Identification
- Conceptual Design
- Cost Estimate Analysis
- Safety Cost-Benefit Analysis

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